

REPUBLIC OF RWANDA

Ministry of Infrastructure

**ENERGY WATER AND SANITATION
AUTHORITY (EWSA)**



**Electricity Access Rollout Programme
(EARP)**

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**PROJECT BRIEF FOR RUKARARA – KILINDA 110 KV
TRANSMISSION LINE AND CONSTRUCTION OF SUB-
STATIONS**

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LIST OF ACRONYMS

ARAP	Abbreviated Resettlement Action Plan
EMF	Electromagnetic Fields
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
IAPs	Interested and Affected Parties
IDA	International Development Association
LV	Low Voltage
MV	Medium Voltage
MININFRA	Ministry of Infrastructure
FORENWA	National Fund of the Environment in Rwanda
NDF	Nordic Development Fund
PPE	Personal Protective Equipment
PCBs	Polychlorinated biphenyls
PAPs	Project Affected Parties
PCU	Project Coordination Unit
RPF	Resettlement Policy Framework
RoW	Right Of Way
REMA	Rwanda Environment Management Authority
EARP	Electricity Access Roll-Out Program
MINIFOM	Ministry of Mines and Forests
MINELA	Ministry of Environment and Lands
KCC	Kigali City Council
EWSA	Energy, Water and Sanitation Authority

0. BACKGROUND

The Government of Rwanda, in its effort to sustain economic growth, has increased and stabilised the power production since the severe power shortages in 2004. However, infrastructure bottlenecks in the urban areas and limited access in the rural areas have emerged as a significant constraint. One of three major strategic objectives of the Economic Development and Poverty Reduction Strategy (EDPRS 2008-2012) is to expand access while also improving the quality and lowering the cost of economic infrastructure – especially transport, power, and communications. The Government of Rwanda (GoR) also exercises a strong leadership role in donor coordination and has begun to work with donors on a clearer division of labour by identifying areas of individual donor comparative advantage.

In connection with the mentioned strategy, the Government of Rwanda through Energy, Water and Sanitation Authority (EWSA) is embarked on a country-wide **Electricity Access Program** to realize the primary EDPRS target for the electricity sector of tripling access by 2012 to about 16 percent of households and at least 50 percent of identified public institutions in health, education and local administration. This will require about 160'000+ with new grid connections, and will also include efforts to reach rural consumers and service providers currently off the national grid.

In this regard, EWSA has established a new Electricity Access Scale-up Roll-out Program (EARP) as a part of its corporate structure. The program will be implemented within the framework of a Sector Wide approach (SWAp) to encompass all donors active in the sector under one common sector investment program. The overall investment envelope for the first SWAp time (2009-2013) is estimated at \$378 million, for the program period covered by the Prospectus that has been endorsed by all the Partners and key sector institutions in Rwanda, including EWSA.

The prospectus outlines the overarching spatial least cost rollout plan and priority connection targets through the medium term, the rollout strategy and the financing policy platform for the EARP. Additionally, the EARP implementation will be subject to a monitoring, evaluation and results framework as well as the oversight and accountability process of regular reviews as agreed

with the energy sector working group (SWG), chaired by Ministry of infrastructure (MININFRA) on advice from the partners.

A number of development partners so far committed to support the program including World Bank IDA, World Bank GEF/ESMAP CEIF, African Development Bank, BADEA, OFID, Saudi Funds, Netherlands, Japan, and others.

It is in this regard that Rwandan government through its cooperation with AfDB applied for grant to undertake the construction of Rukarara Kilinda 110Kv transmission lines which will cover about 36 kms.

I. DESCRIPTION OF THE PROJECT

I.1. INTRODUCTION

This is a rural electrification project which is in the context of the effort of the Ministry of Infrastructure to meet the national Economic Development and Poverty Reduction Strategy (EDPRS) target to increase access to electricity on a national scale, and to supply reliable and affordable energy to Rwandan householders. This lack of electricity in some parts of rural areas caused concentration of economic activities in urban areas, causing a lot people to shift from nearby centres for green pasture.

The electricity access roll-out program aims at increasing connections, boost economic activities all over the country, direct and indirect creation of jobs and raise off-firm jobs. The ongoing EARP will enable energy sector stakeholders to connect at least 16% of the population or 350,000 customers to the grid by 2012. It is in this regard therefore that remote areas have been identified to benefit this grant.

Currently, the Rwandan transmission system is composed of 370 km 110 kV and 70 kV lines linking the southern substation Mururu II to Gikondo as well as the 70 kV line from Jabana to Rwinkavu. The transmission system has also eleven 110kV substations, and four 70kV substations that supply all Country.

According to the high energy demand The Rwandan transmission system require also the construction of new generation units and the Hydropower plants are more appropriate regarding to the profitability and the environmental protection. It is in this regard that a hydropower plant at **RUJARARA** has been constructed in order to be able to increase the production capacity and to assure also some spinning reserve to reinforce the stability of the Rwandan network. To allow the evacuation of the energy produced from the power plant, it is required to build a step-up substation at Rukarara and an 110kV transmission line from Rukarara to Kilinda Substation.

I.2. OBJECTIVES OF THE PROJECT

The purpose and objectives of this project are as follow:

- Reducing poverty through increase of electricity access rate by direct or indirect job creation
- Reduce CO₂ emissions from kerosene by providing clean electric energy
- Uplift living standards in the targeted areas as investors have been limited by having no electricity guarantee
- To reduce the use of charcoal which result in deforestation and end up causing soil erosion
- To create foundation for other infrastructure like ICT infrastructure and other investments that require electricity.

I.3. PROJECT ACTIVITIES

The Project components shall consist of the construction of substations and a new 110kV overhead 36 km transmission line between RUKARARA and KILINDA.

The Works will consist of:

- Construction of MV and pole mounted transformer substations in along the transmission line in the project area
- Transportation of line building materials from Kigali to the Contractor's warehouse on site
- Storage and management of the materials in the warehouse
- Line and topographic surveys, profile calculations and calculation of structures and detailed plans for pole and cables
- Providing as built drawings of the lines.
- Arrangement of system shut-downs and outage notifications
- Testing and commissioning
- Inventory of damaged items in transit

I.4. TECHNICAL DESCRIPTION

The transmission line between Rukarara Power plant and Kilinda substation must be build in this project, to allow the energy flow to the existing 110kV network. As mentioned previously, currently the energy produced by this Power plant is evacuated to the network using a 30kV what is not is not favorable to assure the efficient operation. The line will be 36Km long and the conductor of ACSR 240/40mm² will be used to foresee the probability increase of the production capacity in the Region. The final technical details will be done during the technical study phase, but the cost is given in the estimated bill of price basing on the known cost per Km of 110kV Transmission line.

The RUKARARA substation will be constructed near the newly constructed hydro power plant to allow the step-up of 30kV voltage to 110kV voltage. This substation will be equipped with one step-up transformer of 10MVA and the outgoing will be assured by an 110kV overhead line from RUKARARA to be connected at KILINDA Substation. This line is 36km long and will be included within this project. Currently the Power plant is feeding the grid using a 30kV line with many disturbances. The aim of the construction of this line and substation is to allow the interconnection of RUKARARA Power plant (that will produce 9MW) to the existing 110kV grid.

The 110 kV Outdoor Switchyard will be of the open air type with one 110kV Transformer bay as well as one 110kV Line bay to evacuate the energy to national grid. The Transformer bay will be equipped with the following equipments:

- One (1) power transformer 110/30kV, 10MVA YN0d11
- One (1) busbar disconnector, outdoor, 3-pole, rotary type, 1.250 A, manually gang-operated and motor drive
- Three (3) 110kV current transformers, outdoor, 100-200/1/1/1 A
- One (1) circuit-breaker, 3-pole, 1.250A, 31,5 kA rated short time withstand current (3s), with motor drive 110 V DC
- Three (3) lightning arresters, outdoor, 110 kV, 20 kA discharge current, with discharge counters,
- Post insulators, outdoor,

- Feeder Adaptation unit for all low voltage cable (command, control and protection)

The 110 kV outdoor switchyard is indicated on the single line diagram.

The Power transformer to be used is 110/30kV 10MVA and YN0d11 as vector group to allow the step-up from 30kV to 110kV. The vector group will assure the galvanic separation between the network and the Power Plant.

The 110kV Line bay will be equipped with the following equipments:

One (1) busbar disconnector, outdoor, 3-pole, rotary type, 145kV, 1.250 A, manually gang-operated and motor drive;

Three (3) 110kV current transformers, outdoor, 200-400/1/1/1 A;

One (1) circuit-breaker, Single pole, 145kV, 3150A, 31,5 kA rated short time withstand current (3s), with motor drive 110 V DC;

Three (3) lightning arresters, outdoor, 110 kV, 20 kA discharge current, with discharge counters;

One (1) line disconnector with earthing switch, outdoor, 3-pole, rotary type, 145kV, 1.250 A, manually gang-operated and motor drive;

Three (3) Voltage inductive transformer $\frac{110kV}{\sqrt{3}} / \frac{100V}{\sqrt{3}} / \frac{100V}{3}$

Feeder Adaptation unit for all low voltage cable (command, control and protection)

The 110 kV outdoor switchyard is indicated on the single line diagram.

The MV switchboard shall be of the Gas Insulated GIS type, SF6 insulated, metal-enclosed and metal-clad, with vacuum circuit-breakers.

The 30 kV switchgears will be of the indoor type with rated busbar current 1.250A, short circuit capacity 25kA, rated feeder current 1.250A, composed of the following cubicles:

- **One (1) incoming feeder for transformer 110/30 kV**
- **One (1) incoming line feeder BUTARE**

- **One (1) outgoing line feeder Power Plant**
- **One (1) outgoing line feeder Spare**
- **One (1) Auxiliary transformer feeder**

30 kV indoor arrangement with a single busbar system with the following data:

- Rated Current Busbar 1250 A
- Rated Short Circuit Withstand Current common for all equipment 25 kA (3 sec)
- Nine voltage transformers $\frac{30kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{3}$

The Transformer Feeder Incoming will be as follow:

- One (1) three pole three position switch 1.250 A
- one (1) three pole circuit breaker 1.250 A, 25kA
- three (3) current transformers 200-400/1/1/1 A
- cable compartment for plug-in SF6/ cable sealing ends for six single core cables
- low voltage compartment with the CPU of the control and protection equipment as specified in this document
- three (3) voltage transformers $\frac{30kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{3}$

The Line Feeder BUTARE will be as follow:

- One (1) three pole three position switch 1.250 A
- one (1) three pole circuit breaker 1.250 A, 25kA
- three (3) current transformers 200-400/1/1 A
- cable compartment for plug-in SF6/ cable sealing ends for three single core cables
- low voltage compartment with the CPU of control and protection equipment as specified
- three (3) voltage transformers $\frac{30kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{3}$

The Line Feeder POWER PLANT will be as follow:

- One (1) three pole three position switch 630 A
- one (1) three pole circuit breaker 630 A, 25kA

- three (3) current transformers 100-200/1/1 A
- cable compartment for plug-in SF6/ cable sealing ends for three single core cables
- low voltage compartment with the CPU of control and protection equipment as specified

The Line Feeder AUXILIARY TRANSFORMER will be as follow:

- One (1) three pole three position switch 630 A
- one (1) three pole circuit breaker 630 A, 25kA
- three (3) current transformers 100-200/1/1 A
- cable compartment for plug-in SF6/ cable sealing ends for three single core cables
- low voltage compartment with the CPU of control and protection equipment as specified

The Line Feeder Spare will be as follow:

- One (1) three pole three position switch 630 A
- one (1) three pole circuit breaker 630 A, 25kA
- three (3) current transformers 100-200/1/1 A
- cable compartment for plug-in SF6/ cable sealing ends for three single core cables
- low voltage compartment with control and protection equipment as specified

The 30 kV switchgear room shall be adapted such as to have space for at least 2 additional feeders.

Control, Supervision and Protection

One (1) combined control and protection panel for 110 kV bay and 30kV switchgear, complete with:

- One (1) Differential line for 110kV line bay;
- One (1) micro-processor Bay Control Unit (BCU) for 110kV line bay as per specification in this document;
- One (1) micro-processor Bay Control Unit (BCU) for 110kV Transformer bay as per specification in this document;
- Key-lockable selector switch for control positions LOCAL-OFF-REMOTE (may be included in BCU);

- Five (5) micro-processor Bay Control Unit (BCU) as per specification in this document. (the protection functions are included within this BCU,s);
- One (1) Differential Transformer;
- Set of material such as panel, wiring, terminals, etc;

The Power transformer tap-changer will be controlled by an Automatic Voltage regulator equipped with the following equipment:

- One automatic numerical controlled voltage regulator
- One numerical controlled parallel operation control unit, if not included in the voltage regulator
- Control selector switch (positions: AUTO-MANUAL-REMOTE)
- Tap-change control switch for 2 push-buttons for operation of the tap changer for RAISE/LOWER
- One digital tap position indicator
- Temperature indicator with selector switch to select oil temperature and winding temperatures primary and secondary.
- Alarm unit
- Set of indication and operation lamps
- Set of material such as panel wiring, terminal etc.
- One (1) Digital Voltage indicator 110kV
- One (1) Digital Voltage indicator 30kV

The voltage regulator must be equipped with a communication interface using IEC 103 protocol

All equipments necessary to integrate the substation in the existing SCADA system must be supplied within this project. The list of the equipments is as follows:

- RTU whit serial
- Communication Equipment.
- Splice box

Foundations for switchgear and gantries shall be designed and installed on the basis of the technical data sheets and the results of the soil investigation.

Transformer foundations and firewalls shall be designed according to the actual requirements and size of the transformers. The oil-collecting pit for each transformer shall have a capacity for 120 % oil of one transformer. A water/oil evacuating system using a pump shall be installed for the oil/rain water collecting pit.

Setting and Erection

The route will be pegged on the centre-line by means of steel pins positioned every kilometre, or such smaller distance as may be required to provide intervisibility between intermediate points. Each turning point will be pegged and referenced by providing four additional steel pins, giving a means of relocating should the turning point marker be displaced or removed. Each turning point position and reference system will be recorded on a field distance. The fourth peg will be placed in any convenient location and recorded.

The error in longitudinal measurement will not exceed 0,05% between 'kilometre' pegs and the accumulated error over line route sections between turning points will not exceed 0,1%. The error in angular measure will not exceed 0,5 minutes and the error in setting out a bearing will not exceed 5 minutes of arc. Where the sections between turning points are long and the route traverses country with few reference points, a correction not exceeding 2 degrees to the route direction may be permitted.

At overhead line or telephone crossings where the line being surveyed crosses between two poles or structures, the conductor height will be assumed to be an imaginary straight line connecting the uppermost attachment point on the two poles or structures and not the actual height of any conductors at the crossing point.

Field sketches of all power and communication line crossings will be made at the time of setting out, show the general disposition of conductors, insulators and earth wire. The pole height to the upper attachment will be measured accurately from the elevation datum. The inspection of the pegged route will be undertaken at least three days before excavations begin.

Site Preparation

The pruning or complete removal of trees where necessary along the routes of overhead lines will be undertaken. Where trees are to be removed, the relevant trees will be completely uprooted by means of a monkey winch or other approved methods, and stack them in a position approved by EWSA. All holes caused by such uprooting will be filled to leave the site clean and tidy. Where the branches of trees are to be pruned, such pruning will be neatly carried out in an effective and workmanlike fashion.

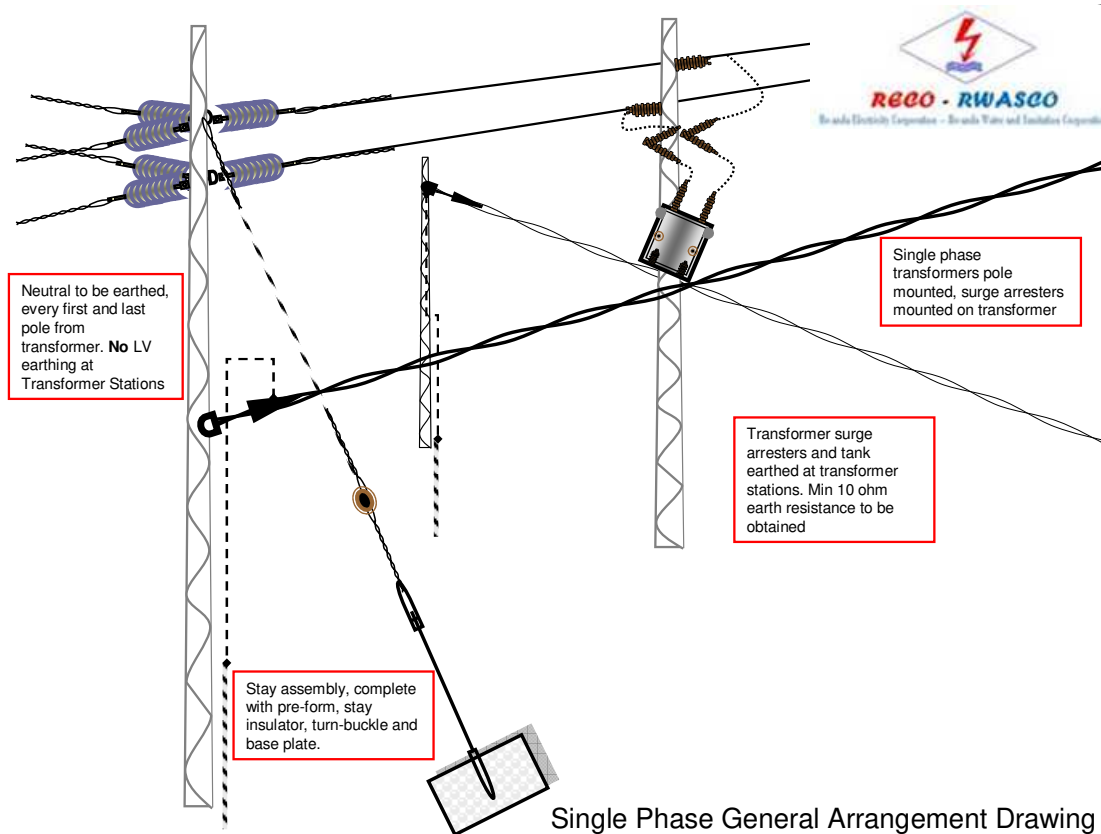
The removal of trees, except shrubs, with trunks within 5m from the nearest conductor along the routes of all lines will be allowed. The pruning of all tree branches, along the routes of all lines, in such a way that no branch will project through a vertical plane parallel to and 3m from the nearest conductor, on the understanding that such branches of which the highest points are below 6m above ground level need not be pruned unless it is within 3m from any pole. An area with a radius of 3m will be treated with weed killer at each pole or leg of structure.

Protection of natural vegetation

Any destruction, damage or removal of natural trees and vegetation, except where instructed or given permission to do so in cases where it is unavoidable. No trucks or plants will be allowed to run over areas not specifically set aside for this purpose. Trees protected by the Government of Rwanda will under no circumstances be uprooted or damaged in any way except with the consent of EWSA.

Construction

Prior to commence work on any property, EWSA will make sure that way leaves are in order and give the occupier of such property adequate notice of the commencement of the work.



Prior to carry out erection of the conductors or installation of earth electrodes or counterpoise along or across public roads, telegraph or telephone lines or across power lines, a requisite notice to the appropriate authorities of the date and time to perform the work. Where the local authorities and other public undertakings affected deem it necessary for the protection of the public and the assistance of traffic, to provide flagmen or watchmen or installation of warning lights, etc., the cost of such provision will be borne by the Contractor.

During the progress of the work, the following will be provided: proper fencing, watching and lighting of excavations, dumps of materials, ladders and the like and for the prevention and straying of and damage to livestock until backfilling of excavations and permanent reinstatement of fences, walls, hedges, gates and the like be completed.

All structures will be vertical within a tolerance at the structure top of 0,3% of the overall structure height, before erection of the conductors. Poles will not exhibit either twisting or bowing greater than the approved tolerances which will not exceed 2% of the mast length. After erection of the conductors the vertical tolerance of the structures will not exceed 0,5% of the height and the cross

arm transverse alignment will be square with the line to within half the width measured at the crossarm end. Proper precautions will be taken to ensure that poles are not strained or damaged in any way during erection. Suitable ladders shall be used whenever necessary during erection of the structures. All ladders will be removed when erection work is not in progress. The standard span length will be 50m to 100m and will be the span length on which all standard structure heights, assuming level ground, will be based.

Conductor Spacing and Clearances



The spacing between conductors and the clearances between clamps, jumper loops, and other live metal and structure steelwork under all specified conditions will not be less than the figures given below.

Maximum voltage for which insulation is designed, kV r.m.s. clearance phase to phase	Minimum safety clearance	Minimum clearance in meters				
		Above ground outside townships	Above ground in townships	Above roads in townships proclaimed roads outside townships railways and tramways	To communication lines, other power lines or between power lines and cradles	To buildings, poles and structures not forming part of the power lines
1,1 or less		4,9	5,5	6,1	0,6	3,0
7,2	0,15	5,0	5,5	6,2	0,7	3,0
12	0,20	5,1	5,5	6,3	0,8	3,0
24	0,32	5,2	5,5	6,4	0,9	3,0
36	0,43	5,3	5,5	6,5	1,0	3,0

Stringing

The fullest possible use will be made of the maximum conductor length in order to reduce to a minimum the number of joints. There will be no tension joints in adjacent spans or in sections between tensions structures of less than three spans. There will be no joints in spans crossing roads or in the spans immediately adjacent thereto.

The conductors, joints and clamps will be erected using approved tools and will be erected in such a manner that no bird caging, over-tensioning of individual wires or layers, or other deformation or damage to the conductor will occur. Auxiliary erection clamps or hauling devices will be of approved design and will, under erection conditions, allow no relative movement of strands or

layers of the conductors. Cutting of layers of conductors will be carried out with tools designed not to damage underlying strands.

Jumpers will be cut in the centre and connected with an approved aluminium parallel groove clamp. Bimetallic clamps will be used where the take off is of copper material. Conductor ends will be sealed with an approved red-lead compound. Cropping or shearing of complete conductors will not be permitted.

Conductors will be run under partial tension and erected by means of snatch blocks of approved materials and dimensions, at every intermediate structure and by other approved means so as to reduce to a minimum contact between the conductor and the ground or other obstruction during erection. Under no circumstances may conductors be dragged along the ground. Any necessary special arrangements for running out and sagging the conductors where the route crosses buildings, gardens or other grounds over which erection cannot be carried out in the normal manner will be made. The conductors will be bound to the pin insulators with approved preformed wire ties and grips. Where reel and shackle type insulators are fitted the conductor will be bound to the insulators with approved side ties.

Insulators will be erected so as to avoid damage in any form. Pin insulators will be fully tightened on the pins before setting the insulator groove alignment and will remain tight after erection of the conductors.

The maximum tension in the conductor will not exceed 40% of the breaking tension at temperature $-5,5^{\circ}\text{C}$ and maximum wind load, and simultaneously will not exceed 18% of breaking load at average daily temperature of 35°C without wind except for sections with extra long spans where compliance with the specified maximum working tensions under the assumed maximum loading condition may necessitate a lower figure for the 35°C . C still air tensions.

Suitable dynamometers, sighting rods or other approved apparatus necessary for the proper checking of the work will be provided. Dynamometers will be tested and if necessary re-calibrated if so required by EWSA. The initial tension of the conductor during stringing will be increased by 8%

of the value corresponding to the erection conditions on site to counteract non-elastic stretch of the conductor.

Standard design procedures will be used to determine the sag and tension for a specific transmission line. The following standards are applicable to the proposed conductors under the conditions stated.

Sag in the following conductors under the following conditions.

Safety factor	2,5
Conductor specification	SS 215
Stringing temperature	35°C wind 3.5 m/s
Maximum operating temperature	75°C
Worst Conditions	0,0kg/m ice 35 m/s wind 5°C

II. DESCRIPTION OF THE ENVIRONMENT

II.1. DESCRIPTION OF THE PHYSICAL ENVIRONMENT: METEOROLOGY, HYDROGRAPHY, GEOLOGY, RELIEF AND BIODIVERSITY

This chapter gives background information of the project area as a whole then narrows down to project specific site in terms of its location, administrative set-up, climate, settlement patterns, and the major environment attributes, which will play a crucial role in the identification of impacts and influence the overall direction in the development of the project.

Project Location

The transmission line project route is located in Nyamagabe and Karongi Districts which are located in the Southern and Western Province of the Republic of Rwanda respectively. The Rukarara hydropower which generates the electricity is located about 7 kilometers from Gikongoro town in the District of Nyamagabe district.

Climatic condition

Temperature

The temperatures in the project area vary from 11 to 18 °C degrees centigrade with high values in the east than in the west, with weak variations.

Rainfall

The rainy moderate climate of altitude of the area is characterised by: Dry season of 3 months (June, July and August) and a long rainy season from September to May and is marked by a short dry season around January, the month of April is the most rainy. The rainfall in the area is registered as of more than 1300mm/year decreasing from west to east

Relief

The relief of the project area is dominated by mountains and hills with an average altitude of about 2000m.

Overall Geology

The project area falls within a highly dissected pen plain made up of rounded hills having their peaks at more or less even level. The region shows well developed drainage pattern that belongs to dendritic and trellis types. Metamorphic rocks form the major part of the rock mass and some magmatic rocks are also present here. Major rock types observed in the area are granitic gneiss, quartzite, schists and amphibolites.

Over the project area most of the valley slopes extending from river banks to the top of the ridges are cleared for cultivation of various crops of a seasonal nature. As a result, soil cover is well exposed for observation. A few patches of new forest plantations of eucalyptus and pines can also be seen on the valley slopes.

In general rock exposures are rare on the valley slopes, which are covered with residual soils having a thickness of 0.5 to 1.5m. As observed in the test pits sunk along the canal route, below this residual soil layers hard moderately decomposed to highly decomposed rock could be found. However in some areas residual soil is underlain by thick weak, completely to highly decomposed rock.

Land Uses

Land use in the project area is primarily under cultivation of food crops. The local communities cultivate a variety of food crops under mixed cropping. They include bananas, cassava, passion fruits, avocado, coffee, mango trees, maize, egg plant, tea among others.

Cultivation occurs along the steep slopes predominant in the area without proper soil conservation techniques hence accelerating soil erosion. However, it is worth mentioning that terracing as a measure for soil erosion control is practiced in some parts of the project area. A few of the local communities also keep livestock mainly cows under zero grazing.

Biological Environment

Flora

The project area has no natural flora and is mainly characterised by grown flora. Noticeable flora include trees that are exotic to the project site mainly the eucalyptus trees that have been extensively planted in the hillsides and play a vital role in controlling soil run off that is prevalent in the steep hillside. Other floral species that can be observed in the project area include: grevillea, jacaranda, cyprus and pine,

Also present in the project area and hence can be termed as flora are crops planted by the local communities and make an important component of the vegetation cover. These crops include beans, coffee, bananas, passion fruits, yams, and cassava.

Fauna

The project area has no known significant species of wildlife and avifauna that could be adversely impacted by the project. However, domesticated animals like goats, chicken, pigs and cows are kept by the local communities at a small scale level.

Fisheries

The River Rukarara is not known to have any significant fish species or resources that is worth mentioning in this study report and which could be adversely affected by the dam.

II.2. DESCRIPTION OF THE SOCIO-ECONOMIC ENVIRONMENT

Employment /Economic Trends-Local economy/Occupation/Incomes

Agriculture is practiced as a labour intensive, intercropping system with both cash crops and subsistence crops. Women are responsible for food supply and other household duties whereas men are responsible for cash income including cash crops.

Housing and Infrastructures

Roads

The road access leading to the dam site and along the proposed transmission lines right of way is primarily an all weather murrum road that is loose surfaced narrow in size and prone to erosion owing to the steep nature of the terrain which makes it hardly passable during rainy season.

Housing

Housing is constructed mainly in family compounds. Buildings are either 'temporary' (built with traditional materials), 'semi-permanent' (with traditional walls and corrugated iron roofs) or 'permanent' (with brick or concrete walls). The majority of housing is owner-occupied.

Most of the inhabitants along the river bank and right of way of the transmission lines could be described as small plot peasant farmers that may supplement their income through cash crops and other income generating activities (e.g. trade).

Services

Electricity

There is no electricity supply in the project area and communities rely on kerosene lamps for lighting and wood fuel for cooking.

Water and sanitation

The Rukarara River is one of the sources of water for the communities residing in the proposed project area. There is no piped clean water in the project area. Pit latrines are also the primary source and mechanism for faecal waste disposal.

Constraints and Potentialities of the Project Environment

General constraints of the project area zone are as follow:

i) Physical constraints of the Project Area

- A topography strongly marked which favours the collinear development by leaps that make the planning difficult;
- Existence of ravines causing stone falls during the rainy season ;

- Vast rural areas yet to be planned.

ii) Artificial constraints

There are also other constraints created by human activities:

- Construction of residential areas in villages with poor road mapping thus origin of the soil erosion;
- Clearing of trees at high scale mainly for cooking and construction purposes;
- Building without planning;
- The paths are steep and hardly passable during the rainy seasons;
- The roads in general in bad condition.

In spite of the constraints noted above, RUKARARA- KILINDA area has the following potentialities:

The soil fertility: the soil is very fertile and the population live out of farming and produce banana, cassava, sweet potatoes, tea and coffee which represents major assets for the project area.

Services: The lack of electricity availability in the area, make the project more viable and a good opportunity for socio economic development of the project areas.

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

III.1. POLICIES RELEVANT TO THE PROJECT

A. Energy Policy

The national policy goal is to meet the energy challenges and needs of the Rwandan population for economic and social development in an environmentally sound and sustainable manner.

Since 1994, the energy sector as well as the overall economy has gone through structural modifications, where the role of the Government has changed, markets have been liberalised and private sector initiatives encouraged. Hence, the energy policy document has to take into account structural changes in the economy and political transformations at national and international levels.

The national policy objective for the development of the energy sector is to provide an input in the development process by establishing an efficient energy production, procurement, transportation, transmission, distribution, and end-user systems in an environmentally sound manner.

The Energy Policy, therefore, focuses on market mechanisms and means to reach the objective, and achieve an efficient energy sector with a balance between national and commercial interests.

An interactive and participatory process between government, other stakeholders and relevant groups has been necessary as part of the formulation process in order to incorporate views of market actors and energy consumers to address the complex nature of the sector.

Specifically, the energy policy takes into consideration the need to:

(a) Have affordable and reliable energy supplies country wide;

- (b) Reform the market for energy services and establishes an adequate institutional framework, which facilitates investment, expansion of services, efficient pricing mechanisms and other financial incentives;
- (c) Enhance the development and utilisation of indigenous and renewable energy sources and technologies,
- (d) Adequately take into account environmental considerations for all energy activities,
- (e) Increase energy efficiency and conservation in all sectors; and
- (f) Increase energy education and build gender-balanced capacity in energy planning, implementation and monitoring.

Domestic energy demand has grown rapidly due to population growth and the increase in economic activities especially during the last ten years

The vision of the energy sector is to effectively contribute to the growth of the national economy and thereby improve the standard of living for the entire nation in a sustainable and environmentally sound manner. The mission of the energy sector is to create conditions for the provision of safe, reliable, efficient, cost-effective and environmentally appropriate energy services to all sectors on a sustainable basis. By fulfilling its vision and mission, the energy sector will contribute to social economic development, and in the long-term framework, poverty reduction.

The national energy policy objectives are to ensure availability of reliable and affordable energy supplies and their use in a rational and sustainable manner in order to support national development goals. The national energy policy, therefore, aims to establish an efficient energy production, procurement, transportation, transmission, distribution and end-use systems in an environmentally sound and sustainable manner.

Short and medium term priority policy actions

The priority for Rwanda is to implement projects now, to overcome the current electricity crisis, to prevent the next electricity crisis, to tackle proactively the wood crisis, to begin to provide greater access to modern energy and to reduce reliance on petroleum products due to the oil price crisis. Without implementation further capacity building and studies will have no value.

The management and institutional capacity has to continue to progress if these projects are to be delivered effectively and efficiently. This will require further external support and guidance.

Several policy actions will be implemented in order to achieve the broad and specific objectives of this energy policy. Strategic financial interventions required to move forward the policy priority actions are indicated alongside the proposed actions.

Below are the priority policy actions:

- Meet the crisis of blackouts caused by delayed investment and drought
- Provide economic power by developing the use of Lake Kivu methane, and by bringing on line more hydro power.
- Enhance overall electrical infrastructure to meet demand growth and supply quality needs – generation, transmission and major distribution construction and rehabilitation.
- Deliver a programme of rural electrification on the basis of enhanced distribution networks, micro hydro, and solar power.
- Implement a wood and charcoal efficiency and substitution strategy to counter the deforestation crisis.
- Continue steady progress to a viable electricity and gas sector, consistent with meeting social needs.
- Commence utilisation of Kivu gas for other than power generation.

B. Land Policy

Apart from a few scattered land regulations, most of which date back to the colonial period, Rwanda has never had a proper land policy, a situation that enhances the existing duality between the very restrictive written law and the widely practised customary law, giving rise to insecurity, instability and precariousness of land tenure.

The Rwandan Government, therefore, found it compelling and necessary to establish a national land policy that would guarantee a safe and stable form of land tenure, and bring about a rational and planned use of land while ensuring sound land management and an efficient land administration.

The following are the main obstacles that hinder the efficient management of land in Rwanda, necessitating the establishment of a national land policy that would guide the essential land reforms:

- Strong pressure on the already spatially limited land resources by a rapidly growing population;
- Domination of the agricultural sector which lacks any specialization in terms of human resources and equipment, and lack of alternative concrete and realistic options that would reduce the pressure on land resource;
- A land tenure system dominated by customary law which favours land fragmentation, a practice which reduces further the size of the family farms which are already below the threshold of the average surface area that is economically viable;
- A considerable number of landless persons who have to be resettled at all costs;
- Scattered farming plots that are difficult to manage due to the scattered mode of human settlement;
- Lack of a reliable land registration system that would guarantee the security of land tenure;
- Weak and inadequate existing methods of land-use planning and land improvement (outline of land potential, land use and land development; reliable methods of soil and water conservation);
- Disorderly and fraudulent land transactions, necessitating the establishment of regulations that would enable the authorities to give to the land a recognised market value that brings considerable profit to the Government Treasury;
- Unplanned use of marshlands which, in spite of their good agricultural soil, cannot be wholly recovered for agricultural purposes, in view of the following factors:
 - Abundance of water which is necessary as a useful water reservoir;
 - The soil make-up, which does not lend itself easily to the current cultivation methods;
 - The biotic environment and biodiversity which should be protected at all costs;
 - The obvious poor coordination among various institutions which use with land to support their activities;

Currently, the land tenure system in Rwanda operates in a dual legal system: On one hand, there is: the customary law, which governs almost all the rural land and promotes the excessive parcelling out of plots through the successive father-to-son inheritance system. And

on the other, there is the written law, which mostly governs land in urban districts and some rural lands managed by churches and other natural and legal persons. This law confers several land tenure rights to individuals such as land tenancy, long term lease and title deeds (particularly in towns).

On the whole, Rwanda's land tenure system requires comprehensive reforms, from the elaboration of a national land policy to the establishment of a land law and land code, which will guide the judicious use and management of the land resource for the economy to be able to take off in such a way that our country is freed from the grips of poverty.

In the perspective of the harmonious and sustainable development, the overall objective of the national land policy of Rwanda is to establish a land tenure system that guarantees tenure security for all Rwandans and give guidance to the necessary land reforms with a view to good management and rational use of national land resources.

In Rwanda, there are currently two modes of land acquisition, namely acquisition according to customary law or conceptions, and acquisition according to the rules of the written law.

According to custom, land ownership is held by whoever occupies the land first. This rule has always been respected in our society. However, in modern times, land acquisition by occupation has become obsolete since all vacant land belongs to the State. Likewise, the provisions of the decree-law No. 09/76 of 4th March 1976, article 1, stipulate that 'all land not held under the written law and affected or not by customary law or land occupation belongs to the State'.

Customarily, land rights are passed on from father to son through inheritance. Girls are excluded from inheritance of the family land from the father. Concerning inheritance rights of widows, the custom merely gives them the right to use the land that belonged to their deceased husbands.

In its original customary conception, land was owned collectively. Any disposal of land was therefore inconceivable, since such land was considered as family property that belonged to the ancestors, as well as to present and future generations.

With the introduction of the subdivision of land into individual plots due to successive inheritance procedures, each family owner of a plot of land was considered as the real owner of the plot, having the right to dispose of it as it wishes. However, Article 2 of the decree-law No. 09/76 of 4th March 1976 stipulates that nobody may sell off his land rights except with the written authorization of the Minister of Lands upon the recommendation of the Municipal Council where the land is located.

In actual fact, ownership through prescription originates from the written law since traditionally, title deeds were unheard of. Rwandans consider that once a right has been acquired or recognized, even customarily, it is indefeasible. This is why the many existing landless people, not having received any new land, continue to feel cheated and left out because they have no right over the land which they owned customarily over 30 years ago, since the law has fixed the time limit of acquisition by prescription to 10 years.

Tenancy contracts of plots for building purposes for a 3-year period in urban areas. Long lease contracts of land for agricultural purposes for a period of 15 years or more in rural areas. Free assignment contracts in both rural and urban areas to natural or legal persons for social activities with real impact on the welfare of the people. Sale contracts and title deeds for plots that are built in urban areas. This is a system of land tenure by urban residents who first lease plots with the contractual obligation of developing them. The Ministry of Lands delivers the title deeds after confirming that the plots have been developed. Right of access: mode of land acquisition which is common for public institutions.

Apart from the above-mentioned different modes of land acquisition and land ownership, there is the case of the landless people who live in rural areas and who must live from farming. These are mostly the refugees of 1959 who were forced into exile for political reasons and left their land behind. These same refugees have now returned to their country and find themselves landless. They cannot claim back their previously owned land which has been occupied by other Rwandans who remained in the country, because the Arusha Peace Accords fixed the time limit for acquisition by prescription to 10 years.

C. Land Law

This organic law n° 08/2005 of 14/07/2005, determines the use and management of land in Rwanda. It also institutes the principles that are respected on land legal rights accepted on any land in the country as well as all other appendages whether natural or artificial.

Land is part of the public domain of all Rwandans; ancestors, present and future generations. With exceptions of the rights given to people, the state has supreme powers to manage all the national land, and this is done in public interest aimed at sustainable, economic development and social welfare, in accordance with procedures provided for by law. In that regard, it is the state that guarantees the right to own and use the land. The state also has rights to expropriation due to public interest, settlement and general land management through procedures provided by law and prior to appropriate compensation.

This organic law protects equally the rights over the land acquired from custom and the rights acquired from written law. With regard to law, owners of land acquired from custom are all persons who inherited the land from their parents, those who acquired it from competent authorities or those who acquired it through any other means recognized by national custom whether purchase, gift, exchange and sharing.

A land can be categorized urban and rural land (which is confined within boundaries of towns and municipalities established by law), individual land (composed of the land acquired through custom, written law which excludes public land or district, town, municipality and the City of Kigali land, the one acquired from competent authorities, purchased land, gift, exchange and sharing and state land (which makes up the public domain consists of all the land meant to be used by public or land reserved for organs of state services as well as national land reserved for environmental protection; 1° Land containing lakes and rivers as listed by an order of the Minister having water in his or her attributions; 2° Shores of lakes and rivers up to the length determined by an order of the Minister having environment in his or her attributions starting from the furthest line reached by water depending on successive floods. This is not concerned with exceptional floods; 3° Land occupied by springs and wells determined in accordance with an order of the Minister having water in his or her attributions; 4° National land reserved for environmental conservation composed of natural forests, national parks, reserved swamps, public gardens and tourist sites ; 5° State roads and their boundaries which were listed by the

order of the Minister having infrastructure in his or her attributions; 6° Land and buildings the administration reserved for public activities or the land used by public administration organs).

Under this law, registration of land a person owns is obligatory. An employee called the Land Officer who directs the land bureau, shall keep land registers and issues certificates approving ownership of land.

Regarding land issues, he or she holds the power of the public notary and in regard to administration; he or she is supervised by administration of town, municipality or district in which the land he or she is responsible to register is located.

Without prejudice to laws related to human settlement, general land organization and use, the landowner shall enjoy full rights to exploit his or her land in accordance with the existing laws and regulations. However, the laws stipulates that the landowner has no right over minerals and any other wealth underground; they belong to the State but the landowner is allowed before others to enjoy rights of their exploitation upon his or her request and if he or she is capable.

Besides the rights that are enjoyed by the land owners, there some obligations that have to be full filled; unless it is considered to be necessary, the landlord shall not act against other people's rights.

In that regard he or she shall not:

- 1° refuse passage to his or her neighbors leading to their homes when there is not any other way;
- 2° blocking water that is naturally flowing through his or her land from other persons' land above his or hers;
- 3° refuse other people to draw water from a well found on his or her land unless he or she can prove that such a well has been dug or built by him or her.

The law envisages penalties in case of non compliance of the obligations of the land owners. There exist Administrative penalties (requisition of degraded and the unexploited land, forceful confiscation of degraded and unexploited land, repossession of requisitioned land) and penal sanctions (payment of cash as fines).

III.2. ORGANIC LAW ON ENVIRONMENTAL PROTECTION AND MANAGEMENT

The law sets out the general legal framework for environment protection and management in Rwanda. It also constitutes environment as a one of the priority concerns of the Government of Rwanda. Under the fundamental principle on national environmental protection policy develops national strategies, plans and programs, aiming at ensuring the conservation and use of sustainable environmental resources.

The law gives right to every natural or legal person in Rwanda to live in a healthy and balanced environment. They also have the obligation to contribute individually or collectively to safeguard country's natural, historical and socio-cultural heritage.

The framework of the law on the protection and management of natural resources centres on avoiding and reducing the disastrous consequences on environment. It measures result from an environmental evaluation of policies, programs and projects, aimed at preventing the consequences of such activities.

The principle of sustainability of environment and equity among generation emphasizes human beings at the core of sustainable development. They therefore, have a right to a healthy and productive life in harmony with nature. They must so as to equitably meet the needs of the present and future generation.

The protection and management of environment is currently registered in the environmental organic law that has been published in the official Rwanda newspaper in April 8th 2005.

Under the article 65 put, Rwanda Environment Management Authority (REMA) is the institution charged with the responsibility of ensuring environmental protection by demanding for EIA studies to be undertaken before projects are executed.

The present organic law has the following objectives:

- To protect human and natural environment;

- To establish fundamental principles of management and protection of environment against all forms of degradation so as to develop natural resources and to fight all kinds of pollutions and nuisances;
- To improve the living conditions of the population while preserving ecosystems and available resources;
- To ensure sustainable environment and resources as well as rational and sustainable use of resources, taking into account the equality between the present and future generations;
- To guarantee to all Rwandans an economically viable, ecologically rational and socially acceptable development;
- To establish the precaution principle in order to reduce the negative effects on Environment and ensure the rehabilitation of degraded areas.

Chapter IV of the Organic Law Article 67 clearly calls for the need to subject projects to mandatory Environmental Impact Assessment.

Article 3: States that every person has the duty to protect safeguard and promote environment. The States shall protect, conserve and manage the environment.

Article 67: Further specifies that every project shall be subjected to environmental impact assessment prior to its commencement. It shall be the same for programs, plans and policies likely to affect the environment. Specific details of projects referred to in this Article shall be spelt out by the order of the Minister in charge of environment.

Article 68:

The Environmental Impact Assessment (EIA) shall include at least the following:

- A brief description of the project and its variants.
- Analysis of direct and indirect foreseeable consequences on the environment.
- Analysis of the initial state of the environment.
- Measures envisaged reducing, preventing or compensating for the consequences.
- Reasons for the choice.
- A summary of requisitions from clause 1 to 5 of this article;

- A definition of the evaluation and monitoring methods used regularly and environmental indicators before (initial state), during and after implementation of
- the project or, as the case may be, at the final evaluation stage of the project;
- A financial evaluation of measures recommended preventing, reducing or compensating for the negative effects of the project on the environment and measures for regular monitoring and control of relevant environmental indicators.

Article 69:

States that the analysis and approval of environmental impact assessments is done by the Rwanda Environmental Protection Authority or any other person given a written authorisation. The project promoter shall pay a levy which shall be assessed from the amount invested or to be invested, excluding the amount of operating cost. The assessment of this levy shall be fixed by law establishing the National Fund for the Environment. The impact study shall be done at the expense and under the responsibility of the promoter.

The Organic Law also puts in place the National Fund of the Environment in Rwanda (FONERWA). The composition, the working and the assignments of these institutions will be determined by particular laws.

The article 66 of the Organic Law on the environment specifies that it has created, to the level of the Provinces, of the City of Kigali, of the Districts, the Cities, the Sectors and the Cells, Committees responsible for the conservation and the protection of the environment. The composition, the working and the assignments of these committees will be determined by Decree of the prime minister.

Title IV of Article 67 of the Organic Law requires that the execution of Policies, Plans and Projects must be subject to mandatory EIA studies to identify the potential adverse impacts they could have on the environment.

Further to this through the Ministerial Decree, a list of all the project that must be subjected to mandatory EIA has been put in place under article 30 of the Organic Law which stipulates that works of public or private construction as roads, dams etc must be subjected to EIA studies.

Article 69 of the Organic Law further specifies that the EIA studies undertaken must be submitted to REMA for approval and the studies must be undertaken at the proponent's expense.

III.3. ENVIRONMENTAL CLEARANCE PROCEDURES

REMA has now developed the EIA regulations which provide a guideline and requirements for EIA in Rwanda. According to these new regulations Sub Article 1 makes it mandatory for all the projects listed under schedule I to be subjected to a full scale EIA. The Sub Article further states that :

Sub Article 1) No environmental authorization shall be granted by the Authority for any project in Schedule I to these Regulations if no environmental impact assessment has been submitted to the Authority in accordance with the provisions of these Regulations.

Sub Article 2) states that any project listed under Impact Level III of Schedule I to these Regulations shall require a full environmental impact assessment by the preparation of an environmental impact report, unless the Authority refuses permission. The expansion of distribution network in Kigali City that involves construction of substation and electrical lines is in this category and thus must be subjected to full scale EIA.

Public Hearing Process

Article 47: The Authority shall on receipt of the developer's environmental impact report, arrange for a public hearing to take place within twenty (20) working days from the first day of public notification, at which relevant Lead Agencies, local governments, civil societies and concerned members of the public may comment on the environmental impact report and express views on impact of the proposed development. The Authority shall cover all costs incidental to the public hearing.

Article 48: All projects classified under Impact Level III shall be subjected to a public hearing prior to the decision-making process.

III.4. INTERNATIONAL LEGISLATIONS RELEVANT TO THE PROJECT

Rwanda is a signatory to a number of conventions on sustainable development and is a member of various bilateral and multilateral organizations. Some of the relevant development partners in this project are the World Bank and a number of United Nations agencies.

World Bank Environment and Social Safeguards Policy

World Bank Operational Policies (OP) and Bank Procedures (BP) Environmental Assessment - BP4.01 and OP 4.01 (January 1999 all of which require environmental assessment of projects proposed for World Bank financing to help ensure that they are environmentally sound and sustainable.

The World Bank provides guidance on EIA requirements through the Environmental Assessment Sourcebook (World Bank 1994) which includes sectoral guidelines. The World Bank EIA process is implemented through a set of Operational Policies/Directives whose primary objective is to ensure that Bank operations do not cause adverse impacts and that they “do no harm”. These safeguard policies are grouped into Environment, Rural Development, Social Development and International Law.

The following safeguard policies have been considered in this EIA.

Environment

OP/BP 4.01 Environmental Assessment (January 1999)

Environmental Assessment is one of the 10 safeguard policies of the World Bank. The World Bank Environment and Social Safeguard Policy aims at improving decision making, to ensure that project options under consideration are sound and sustainable, and that potentially affected people have been properly consulted.

The World Bank's environmental assessment policy and recommended processing are described in Operational Policy (OP)/Bank Procedure (BP) 4.01. The World Bank system assigns a project to one of three project categories, as defined below:

Category A: An EIA is normally required because the project may have diverse significant impacts (projects in this category are forestry, large industrial plants, irrigation and drainage,

mineral development (including oil and gas), pipelines (oil, gas, and water), resettlement, rural roads, tourism, urban development, large transmission lines, etc.).

Category B: A limited environmental analysis is appropriate, as the project may have specific environmental impacts. Projects in this category include agro-industries (small scale), aquaculture & marine culture, small industries, mini-hydropower station, public facilities (hospitals, schools, housing complexes, rural electrification, telecommunications, small-scale tourism, rural water supply, etc.

Category C: Environmental analysis is normally unnecessary, as the project is unlikely to have significant environmental impacts. Projects in this category include education, family planning, nutrition, institutional development, technical assistance, etc.

OP/BP 4.04 Natural Habitats (June 2001)

Supports the conservation of natural habitats and the maintenance of ecological functions as a basis for sustainable development. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

Rural Development

OP 4.36 Forests (November 2002)

Aims to reduce deforestation and enhance, through sustainable economic development, the environmental and social contribution of forests. The Bank does not support projects which involve significant conversion or degradation of critical forest areas or related critical natural habitats.

Social Development

OP/BP 4.11 Physical Cultural Resource (July 2006)

Cultural property is defined to include both remains left by previous human inhabitants (e.g. middens, shrines) and unique natural environmental features such as canyons and waterfalls. The Bank does not support projects that will significantly damage non-replicable cultural property and assists only those projects that are sited or designed so as to prevent such damage.

OP 4.10 Indigenous Peoples (July 2005)

Indigenous peoples in particular geographical areas are identified by having: a close attachment to ancestral territories and to the natural resources in these areas; self-identification and identification by others as members of a distinct cultural group; an indigenous language, often different from the national language; presence of customary social and political institutions; and primarily subsistence-oriented production.

The Bank's objective is to ensure that indigenous peoples do not suffer adverse effects from Bank financed projects and that they receive culturally compatible social and economic benefits. Effectively the World Bank requires a project to develop a program for addressing issues based on the informed participation of the indigenous people themselves. Any project that affects indigenous peoples is expected to include components or provisions that incorporate an "Indigenous Peoples Development Plan".

OP/BP 4.12 Involuntary Resettlement (December 2001)

Details involuntary resettlement, emphasizing the severe economic, social and environmental risks, if unmitigated. It ensures that the population displaced by a project receives benefits from it and also covers those with usufruct or customary rights to land or other resources taken for the project. The Operational Policy is specifically inclusive, ensuring that all those affected both directly and indirectly by project developments are compensated as part of the project. Affected population, include those with income derived from informal sector and non-farm activities, and from common property resources. The absence of legal title does not limit rights to compensation.

The World Bank's Policy objectives urge that involuntary resettlement be avoided whenever possible. If unavoidable, displaced persons need to:

- Share in project benefits,
- Participate in planning and implementation of resettlement programs, and
- Be assisted in their efforts to improve their livelihoods or standard of livings or at least to restore them, in real terms, to pre-displacement levels or levels prevailing prior to the beginning of project implementation, whichever is higher.

OP 17.50 Disclosures

This Policy details the Bank's requirements for making operational information available to the public. The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. In addition, timely dissemination of information to local groups affected by the projects and programs supported by the Bank, including nongovernmental organizations, is essential for the effective implementation and sustainability of projects.

Rwanda has ratified the following international conventions and protocols pertaining to the environment and which are of relevance to the Project:

- United Nations Framework Convention on Climate Change, 1992
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal adopted on 22 March 1989
- Bamako Convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, adopted 30 January 1991
- Convention on Biological Diversity, 5 June 1992
- Convention on the Protection of World Cultural and Natural Heritage ratified 1997.
- Convention on the Means of Prohibiting and Preventing the Elicit, Import, Export and Transfer of Ownership of Cultural property ratified 2003.
- Ramsar (wetlands) Convention

IV. PROJECT ALTERNATIVES

This chapter describe and examine the various alternatives available for the sub-project. Alternatives examined during the study included site and route alternatives, on-grid electrification, and finally a No Project alternative was also assessed to determine the impact of this No Project Scenario.

IV.1. ANALYSIS OF ALTERNATIVES

A. Alternative Routes

An analysis of alternative routes was undertaken through mapping and involvement of all the stakeholders in this selection process. At the end of this process, alternative routes were selected among the possible ones, based on the following general sitting criteria (which are related to economic and environmental values):

1. Avoidance of restricted zones ;
2. Distance from zones of landscape value;
3. Distance from mountain edges, preference for valley routings;
4. Distance from residential areas;
5. Route with constant slope;
6. Minimisation of infrastructure crossing (e.g. roads, other power lines, etc.).

B. On-Grid Electrification

Provide on-grid electrification. This is the alternative that is proposed by this sub-project. Through this all target beneficiaries will be provided with electricity from the existing grid system. The project is expected to significantly reduce demand for firewood, as this is the primary source of heating and lighting in these communities. This alternative will contribute positively to improving the lives of the target communities through reduced exposure to smoke, improvement in living conditions, increased communication via use of mobiles and opportunities for seeking alternative livelihood options. Local government institutions will also benefit through reduced time and money spent on sourcing firewood from local communities, as well as increase in accessibility to information through various media sources, internet and

improved communication.

C. No Project Alternative

A No Project alternative would primarily mean that the status quo will be maintained and in a sense the environmental impacts (adverse) will not occur. However the positive benefits will be forgone in terms of providing more access to electricity to the populace of the project area which would have in turn spurred and contributed to economic growth.

IV.2. COMPARISON OF ALTERNATIVES

The second alternative “providing on-grid electrification for the proposed beneficiaries” is the most feasible in light of the easy availability of hydropower in the country, the positive environmental benefits, and most importantly because this is what the local communities prefer. The third alternative of “no-build” is not feasible because electricity is included as a measure of development in a village and therefore is always given high priority in the list of developmental activities for any District Development Plan. It is impossible for the government to overlook this demand especially since the country is a major generator of hydropower energy. While there will be no environmental cost from this alternative, with increasing population it is expected that the demand for fuel wood will increase each year, putting very heavy pressure on the already dwindling forest resource.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The project being a national development agenda in the energy sector has immense benefits that could save the country losses in terms of power rationing and frequent outages. However poor planning of the project could also affect the environment that supports a significant number of Rwandese through the project potential hazards that the project could pose to the public, pollution of water resources and atmospheric resources.

V.1. POSITIVE IMPACTS

Positive impacts of these project are various and diverse in nature. They range from employment opportunities, to wealth creation, industrialization, improvement in service delivery to technology transfer and capacity building.

Socio-economic Benefits

The positive impacts are numerous and wide-ranging. The benefits of the project for domestic supply and use in small-scale businesses and in access to electric power for schools and public services are evident. In the construction phase there will be temporary employment opportunities for local contractors and those who will be employed or supply services and provisions for workers and to contractors. Within the respective project areas there will be opportunities for petty trading and small business service provision along the power line routes.

Significant social benefit will come through employment generation and safer more efficient operation of key services, through provision of electricity access to the villages beyond the substation at Kilinda served by the project. Potential beneficiary enterprises affected by and contributing to regional socio-economic transformation will be small industries and other agricultural processing businesses which need electricity.

The long-term direct positive impact is therefore in access to reliable electricity supplies, which will lead to better provision and easier management of goods and services, and enable new facilities for processing and storage. There will be better availability and supply of safe and

clean water (which needs pumping); data management with computers is made possible and communication facilities like internet can be made available, as also charging for mobile phones; also, electric lighting adds to security at night and enables extended opportunities for work and study.

Electricity would support overall investment in education and strengthen the ongoing effort of capacity building to overcome critical constraints in the implementation of development programmes. Essential to this effort would be power supply to health facilities for the installation of cold storage facilities for the safe transportation and storage of vaccinations and other vital medications.

As a consequence the quality of life and extent of economic opportunity will be changed for the better. Social and environmental costs associated with the use of firewood and others means of lighting will be reduced and there may be a more limited requirement for firewood cutting and collection.

On employment the project expects to employ local casual and skilled labor on-site. This is exclusive of indirectly employed people who will provide support and related services including those trading in foodstuff for the workers on site and construction personnel during the site preparation phase of the project. At this point, the number of women workers or those directly affected by the project who could be employed is unknown but EARP will advise that this group of persons be given priority.

Environmental Benefits

Increased transmission of electricity to the project area and specifically beyond the substation at Kilinda population will ease the pressure on the use of fuel wood that is rampant in the area and in effect would help to conserve the fragile and diminishing forest cover of the country by providing an alternative source of energy.

V.2. ADVERSE IMPACTS DURING DESIGN/PLANNING AND CONSTRUCTION PHASE

Adverse impacts of the proposed transmission network are those unintended effects of the project that have negative impacts to sustainable development and the environment. The following adverse impacts are anticipated to occur during the design/planning and construction phase of the project.

Permanent Land Loss/Acquisition

In order to construct the substations, create a new transmission network land will definitely have to be acquired for the “mini”substations, creating the new routes and Right of Way (ROW). The EWSA team of surveyors have taken great care to ensure that as little land as possible is acquired by routing the new transmission lines away from settled areas. The land to be acquired is required for the following purposes;

Construction of Access Roads

The construction of access roads can impact the environment through vegetation clearance and compaction of land and a permanent loss of land. Provided temporary access roads are rehabilitated and existing roads/tracks are used for access to minimise the number of new roads required, the impact is not expected to be significant.

Construction of Right of Way (ROW)

Possible interference with or fragmenting of land uses along the ROW. Opening of remote lands to human activities such as settlement, agriculture and vegetation. These effects can be significant if natural areas such as wetlands are affected. The route identified is has been established near the existing non asphalt roads used for domestic transport of goods and people and the cumulative effects from the Project will not be significant.

Construction of Transmission Line Towers

Clearing of vegetation, site compaction and land acquisition has the potential to change land use patterns. However, the area required for each tower and the transmission line is not expected to have a major adverse impact on land use patterns.

Land expected to be Acquired/

Only small land will be permanently lost to the tower bases. The farming of crops will be allowed to continue once tower construction is completed. Disruption to crop production will therefore be experienced for a period of one year only.

A compensation plan, detailed budget and implementation plan will be undertaken and included in the RAP/ARAP Report which addresses both permanent and temporary loss of assets.

Mitigation Measures

Efforts have been made during the identification of the transmission line routes to ensure that the paths are routed in areas with minimal settlements as possible to avoid land acquisition or displacement. In case of land acquisition or displacement as consequence of construction of sub-stations and transmission lines, the PAPs will be compensated as per RAP/ARAP that will be prepared.

Establishing/Pegging Final Alignment of Transmission Line

The first site activities before mobilisation of equipment will be final survey and soil investigations required for final design of line and tower foundations. After determining tower locations, and before commencement of civil works the Contractor will make a terrain reconnaissance which may include rock drilling tests at each tower location. This provides a final opportunity to make minor realignments to the route to avoid any further environmental and social impacts.

Determination of Final Alignment at Survey and design Stages

- Avoid siting transmission line through protected areas, other environmentally sensitive areas or through mature forest stands.
- Avoid cultural and heritage sites.
- Site transmission line towers on high points of land such that conductors can be strung over valleys thereby eliminating the need to remove trees.
- Locate transmission lines along the base of mountain slopes, rather than down the centre of valleys where large birds could come into contact with conductors.
- Locate transmission lines to avoid running through villages and instead run lines behind villages.

- Consult villagers regarding location of valued village resources and locate transmission lines to avoid these features.
- Situate transmission lines not far away from roads, but behind roadside forested areas so as to minimise visual intrusion.
- Minimise the need to construct new access tracks wherever possible.
- Use existing access roads and tracks wherever available.
- Ensure minimum clearance distances between conductors and ground, waterways, road crossings, buildings, communication systems are incorporated into design.

Permanent Minor Loss and Destruction of vegetation cover/crops

The route for the transmission lines are generally agricultural land where the following variety of crops including Avocado trees, Tomato, Orange trees, Mango trees, Grevillea, Pepper, Ficus Trees, Eucalyptus Trees, Euphorbia Trees, Flowers, Cassava, Euphorbia live fences, Maracuja, Cactus tree, Lemon trees, Papaya trees among others are present. These crops and trees will inevitably have to be removed to pave way for the construction of the transmission lines which includes the “cabins”, towers and creating the Right of Way. However, the area required for each tower and ROW for the transmission line is not expected to have a major adverse impact on land use patterns.

Mitigation Measures

This impact is unavoidable and the crops destroyed will be compensated at full market value before any construction works commence. The compensation and resettlement process will be prepared and an ARAP will be prepared for approval by the bank and RDB.

- Limit ROW to 50m width, however, the undergrowth in the ROW should be allowed while only leaving a narrow strip to be completely cleared to allow stringing of the line conductors.
- Strictly define ROW clearing activities in the contract specifications and in the Environmental Management Plan (EMP).
- String conductors under tension to minimise potential damage to remaining ground vegetation.

Disruption in Daily Living and Movement Patterns

It is anticipated that the construction activities will result in some intrusions and disruptions in the daily living and movement patterns of the property owners. Such disruptions are anticipated to be of high significance, but of a short-term nature, and could be caused by the movement of construction vehicles and frequent entries to the properties as a result of the construction activities. This would especially occur in the following cases:

- Where private dwellings and farm worker accommodation are situated near the proposed transmission lines.

Mitigation Measures

The negative social impacts on the living and movement patterns of the property owners during the operation phase of the project are anticipated to be of low significance and of a short duration, as maintenance of the transmission lines would not be undertaken on a daily basis.

Aesthetics and visual related impacts- visual intrusion on the landscape

Construction works especially when construction the cabins and towers are likely to cause visual related impacts mainly by having activities out of touch with the natural environment in some cases. The tower structures are regarded as being the most visually intrusive component of transmission lines. It is anticipated that the construction of the proposed transmission lines will impose a visual impact on the immediate surrounding area. However, it is proposed that the new transmission line be constructed using CRS towers for the majority of the route. These towers are smaller, less steel-intensive, and less visually intrusive.

Mitigation Measures

The frame-like structure of the transmission line tower presents a low degree of view obstruction as a result of it not being a solid structure, and allows for blending with background colour/patterns of most landscapes.

Water Resources

The construction of towers may interfere with the natural drainage systems and modify flow of surface water, and these changes can contribute to soil erosion, flooding, channel modification, downstream scouring and sedimentation in streams and other drainage channels.

- The contractor should aim to keep to areas of lower elevation as far as possible, in order to minimize the visual impacts associated with the proposed transmission lines.

Disruption of Infrastructure and Services

Without the implementation of appropriate management measures, general services (such as underground pipes) could be damaged during the construction period. Any disruption in the services could potentially have a negative impact on local businesses and population.

Mitigation Measures

- The contractor should establish whether there is any infrastructure located near or inside the transmission lines servitude in order to avoid any damage to these during the construction phase.
- Discussions should be held with the relevant parties whose infrastructure could be negatively affected.
- The Local Authorities should be informed of the construction schedules to ensure the minimum disruption of such infrastructure or services.
- Property owners and nearby communities should be informed well in advance of the construction schedule and any changes to this work schedule.
- Heavy vehicles should make use of the existing access roads on private properties as far as possible. In cases where private roads are to be used, this should be negotiated with the property owner before the construction period commences.
- Construction vehicles should keep to the speed limit and should avoid busy roads, as far as possible.
- Construction should preferably not take place during the harvesting season.
- Property owners should be informed when maintenance of the transmission lines will be undertaken on their properties.

Temporary /Limited Fugitive Dust and Noise

Noise resulting from access road and transmission line construction may disturb neighbouring communities and local fauna. This impact will be of a temporary nature only and can be minimised by adopting appropriate mitigation measures including maintaining equipment and vehicles to manufacturers' standards and limiting operating times to daylight hours.

Dust will be an issue during the construction of access roads and clearing of vegetation along the ROW. However, as most construction activities will be undertaken remote from residential areas, the impact is not expected to be major.

Fugitive dust will be localised and may be emitted from construction works e.g., excavations and stock piles of materials including machinery as well as from truck traffic during the construction phase including installation of the towers, construction of access roads and “cabins”. This could cause health related impacts to the communities around and workers in the project site. Dust impacts will be localised and experienced only in the specific areas where the excavation for tower installation and sub-station construction will occur.

Vehicular movement on gravel roads could lead to dust pollution in some areas during dry conditions. This impact would be of a short duration during the construction phase. Dust pollution could also take place during maintenance and inspection of the lines. This impact will be localized and of a short duration, and is anticipated to be of low significance.

Mitigation Measures

- The dirt roads and exposed construction areas should be moisturised during the dry season to prevent or minimise the fugitive dust emissions.
- Proper location of material stockpiles, especially sand and soil downwind from the commercial, residential and other establishments will be required; Frequent wetting of the stockpile and working area; screening of or providing wind breaks for stockpiles;
- Workers in the project site must be equipped with the necessary and required Personal Protective Equipment (PPE) prescribed by the construction industry to mitigate dust impacts
- Routing of the lines should preferably not be in close proximity to residential dwellings.
- The construction schedule should be communicated with potentially affected parties.
- Construction timeframes should be discussed with property owners.
- Dust-suppression techniques should be used along gravel roads, when required.

Wildlife

There are no protected wildlife conservation areas along the alignment so there is likely to be only minor impacts on wildlife during the construction phase as a result of disturbance from

movement of people and machinery and loss of habitat from the establishment of the 50 m ROW along the length of the route. The proposed route passes mainly through a landscape that has already been greatly disturbed by mixed subsistence farming. Wildlife populations have already been severely impacted both in numbers and diversity.

Soil erosion

During the construction phase, activities involving preparation, stripping, grading, soil removal, backfilling, compacting, disposal of surplus and excavation of the earth surface to pave way for the installation of the “substations” and erection of the towers will lead to localized soil erosion and run off when rains are experienced.

The building of foundations for transmission line towers can potentially exacerbate soil erosion. In addition to the loss of productive land due to soil erosion and land acquisition for tower construction, soils can be impacted as a result of disposal of waste materials, and compaction with heavy machinery used for the establishment of towers and the transmission line. This impact is only expected to occur in the areas where excavation works will be carried out either to construct a substation or erect a tower. These impacts can be managed by restricting the use of heavy machinery and vehicles to designated work areas and installing soil protection works in areas sensitive to erosion prior to construction.

Mitigation Measures

- To prevent soil erosion during site preparation, disturbed soils should be compacted immediately.
- Windblown erosion is to be prevented by soil compaction and wetting the ground to prevent rising of soil particles.
- The final site grade in the cabins should include an adequate drainage channel that should facilitate drainage and avoid flooding and pooling. A site drainage plan should be developed to protect against erosion. Protecting stockpiles through the use of silt fencing and reduced slope angles should be used to minimize soil erosion during construction.
- Design and construct transmission line towers with staggered legs so as to eliminate the need to excavate a level pad into slopes on which to construct towers.

- Clear only a narrow path to facilitate pulling the nylon rope between towers to string conductors.

Accidents/Hazards

As a result of the operation of equipment and machinery during construction, there is a likelihood of accidents occurring especially to the workers.

Mitigation Measures

- All workers need to be provided with the recognised and appropriate Personal Protective Equipment while at the construction site including gloves, dust masks, boots, goggles, and overalls among others.
- Only competent workers and staff should be allowed to operate any machinery and equipment to reduce the incidents of accidents.
- During the construction the project site should be completely sealed off and warning signs erected informing the general public to keep off the construction site when construction is in progress.
- Personal protection gear must be provided and its use made compulsory to all.

Storage and Management of solid waste

Solid waste materials during the construction include paper wrapping, scrap metal, excavated soils, polythene, plastic and metal will cause pollution and littering of the immediate and localized environment.

Mitigation Measures

- The contractor should engage a refuse handling company to remove the wastes from the site to the recommended dumping site.
- Warning signs against littering and dumping within the construction site should be erected by the contractor.
- Excavated top soil should be used as backfill by the contractor

V.3. ADVERSE IMPACTS DURING OPERATION AND MAINTENANCE PHASE

The following adverse impacts are anticipated to occur during the operation and maintenance phase of the project.

Two universal concerns about transmission lines projects are (1) disposal of polychlorinated biphenyls (PCBs) once used in electrical equipment, and (2) possible health impacts of electromagnetic fields (EMF) associated with power transmission lines.

Polychlorinated biphenyls (PCBs) Impacts

PCBs used to be widely used as insulators in electrical equipment, including transformers, capacitors, switches, voltage regulators etc. They are of concern because they are powerful toxins, even at low concentrations, and they persist and bio-accumulate in the environment creating adverse health impacts and adverse ecological changes. Intentional PCB production was ended in most countries by 1980 and most transformers and capacitors built after 1980 do not contain PCBs. The major exception to this is transformers and other PCB applications produced since 1980 in the former Soviet Union.

The Basel Convention on Persistent Organic Pollutants lists PCBs as one of 12 target persistent organic pollutants requiring particular attention. This is also reflected in the WB EA Sourcebook update dealing with “Privatisation and Environmental Assessment: Issues and Approaches” (March 1994). This states that the WB considers the use of PCB containing transformers a “red flag”.

This is not an issue with new transformers, as they will not contain PCBs.

Health Effects of Electromagnetic Fields (EMF) Impacts

Electric and magnetic fields (EMF) are invisible lines of force that surround any electrical device. Power transmission lines, electrical wiring, and electrical equipment all produce EMF. There are many other sources of EMF as well. Electric fields are produced by voltage and increase in strength as the voltage increases. The electric field strength is measured in units of volts per metre (V/m). Magnetic fields result from the flow of current through wires or electrical devices and increase in strength as the current increases. Magnetic fields are measured in units of gauss (G) or tesla (T). Most electrical equipment has to be turned on, i.e., current must

be flowing, for a magnetic field to be produced. Electric fields are often present even when the equipment is switched off, as long as it remains connected to the source of electric power. In summary, voltage produces an electric field and current produces a magnetic field. The US National Institute of Environmental Health Services and the National Institutes of Health has prepared a comprehensive report on electric and magnetic fields associated with the use of electric power which is available on the World Wide Web at: <http://www.niehs.nih.gov/emfrapid>.

Electric fields are shielded or weakened by materials that conduct electricity—even materials that conduct poorly, including trees, buildings, and human skin. Magnetic fields, however, pass through most materials and are therefore more difficult to shield. However, both electric fields and magnetic fields decrease rapidly as the distance from the source increases. As a precautionary measure, EWSA has adopted internationally accepted standard ROW width of 50m along their high voltage transmission lines. All habitation and structures are excluded from the ROW to ensure safety of people and animals from EMFs as well as from direct electric shocks and “flashover”.

With respect to substations, in general, the strongest EMF around the outside of a substation comes from the power lines entering and leaving the substation. The strength of the EMF from equipment within the substations, such as transformers, reactors, and capacitor banks, decreases rapidly with increasing distance. Beyond the substation fence or wall, the EMF produced by the substation equipment is typically indistinguishable from background levels (<http://www.niehs.nih.gov/emfrapid>)

Based on a recent in-depth review of extensive scientific literature (World Health Organisation’s International EMF Project), the WHO has concluded that “despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health” (<http://www.who.int/peh-emf/WhatIsEMF/en.html>). The low levels referred to by the WHO are levels expected to be found outside the 50m ROW proposed for the Project. It is concluded therefore that provided the proposed 50m ROW is enforced along the proposed transmission line route, there will not be any adverse health effects to people along the route.

Accidents at the work place from operating of machineries and equipment by workers

The potential for accidents and hazards occurring in the “substation” during the operation of the equipment is a likely adverse impact that could lead to loss of life or injury to the workers.

Public Safety

Placement of low slung lines or lines near human activity (e.g. roads, buildings) increases the risk for electrocutions. Also, towers and transmission lines can disrupt airplane flight paths and endanger low-flying aircraft.

Mitigation Measures

- All workers entering the construction site must be equipped with PPE including goggles, factory boots, overalls, gloves, dust masks, among others. The PPE should be those that meeting the international standards of PPE.
- Personal protection gear will be provided and its use made compulsory to all. The entire workforce of the plant should be trained in the use of protective gear, handling of chemical products and acid storage cells, electric safety equipment, procedures for entering enclosed areas, fire protection and prevention, emergency response and care procedures.
- Training given to the employees should be backed by regular on- site training in safety measures.
- Machines and Equipments must be operated only by qualified staff and a site supervisor should be on site at all times to ensure adherence.
- The contractor must develop workers' Health and Safety Manual for which all the workers should be conversant with for response in case of accidents.
- At tower positions where occasional flooding may cause damage to towers or foundations, protective embankments shall be erected or alternative measures shall be proposed by the Contractor.

Maintaining Access Roads

The maintenance of access roads can impact the environment through vegetation clearance and compaction of land and a permanent loss of land. Provided temporary access roads are rehabilitated and existing roads/tracks are used for access to minimise the number of new roads required, the impact is not expected to be significant.

Mitigation Measures

- Use existing access roads and tracks wherever available.

- Decommission and rehabilitate excess temporary access tracks as soon as they are no longer required.
- Where access is required across agricultural lands use temporary access paths during the dry season involving placement of geo-textile over aggregates where necessary.
- Minimise the need for access tracks whenever possible.
- Construction to proceed in the dry season if possible to minimise soil erosion and mass wasting and to limit loss of crops (which are not grown in the dry season); where construction is required in the rainy season, potentially unstable slopes to be avoided.

Fire risk

The risk of fire outbreaks during bad weather e.g. storms, winds etc cannot be overruled especially when the towers crash or if electrical faults occur in the “mini” substations. Also failure to maintain the ROW could cause the overgrowth of nearby trees that could end up crashing on the lines during poor weather and hence cause fire outbreaks of black outs.

Mitigation Measures

- A robust fire prevention program and fire suppression system should be developed by the contractor for use in each cabin.
- All of the cabins site must contain fire fighting equipments of recommended standards and in key strategic points. This should include at least, Carbon dioxide systems, Detection/alarm systems and portable fire extinguishers among others.
- A fire evacuation plan must be posted in various points of the cabins including procedures to take when a fire is reported.
- EWSA should continuously ensure that the ROW is kept clear by regular trimming of trees and maintenance.

Bird Strikes/Collusions

Transmission networks are known to be a potential source of bird strikes that get entangled to the lines causing their injury or even instant death. This is especially more significant when large flock of birds migrate from one point to another and usually get struck by these transmission lines.

Mitigation Measure

Once established, the transmission line may cause increased risk of collision of birds in flight, however this risk is expected to be minimal since the route does not pass through any known migratory bird routes.

Aesthetics and visual related impacts- visual intrusion on the landscape

Construction works especially when constructing the mini substations are likely to cause visual related impacts mainly by having activities out of touch with the natural environment in some cases. The tower structures are regarded as being the most visually intrusive component of transmission lines. It is anticipated that the construction of the proposed transmission line will impose a visual impact on the immediate surrounding area.

Mitigation Measures

However, it is proposed that the new transmission line be constructed using towers that are smaller, less steel-intensive, and less visually intrusive for the majority of the route.

V.4. PROJECT DECOMMISSIONING

Decommissioning of the project will involve dismantling and removing all the structures from mini substation sites, dismantling the supporting infrastructure (towers) and all those structures that were associated with this project implementation. Some of the impacts of this project phase are similar to those that have been discussed during construction and operational phase.

Some of the impacts of this project phase are similar to those that have been discussed during construction and operational phase.

But there are those impacts that are specific to project decommissioning after the project life is over. After the project decommissioning, the proponent will be required to rehabilitate the site to its former status or near what it was before the project was commissioned. EWSA will be responsible for preparing the decommissioning plan because it is the proponent and as specified by the Organic Law, the project proponent remains responsible for this. As per the regulations of REMA the proponent will bear the costs for decommissioning and site rehabilitation.

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