

**Environmental and Social Management Plan (ESMP)
For the Rehabilitation/Reinforcement of
Sagamu (Ogun State), Awka (Anambra State),
Yandev (Benue State) and Gasau (Zamfara State)
132/33kV Transmission Sub-Stations
By**



DRAFT FINAL REPORT

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ABBREVIATIONS

AC	Alternating Current
ACMs	Asbestos Containing Materials
ASRs	Air Sensitive Receivers
ASTs	Above-ground Storage Tanks
BPE	Bureau of Public Enterprise
CHS	Community Health & Safety
Co	Cobalt
dBa	decibel
DC	Direct current
EDC	Electricity Distribution Company
EER	Environmental Evaluation Report
EIB	European Investment Bank
EMS	Environmental Management System
ENS	European Standards
ESA	Environmental Site Assessment
ESMP	Environmental and Social Management Plan
FGN	Federal Government of Nigeria
FME _{env}	Federal Ministry of Environment
GRM	Grievance and redress Mechanism
GWP	Global Warming Potential
HWMP	Hazardous Waste Management Plan
ICNIRP	International Commission of Non-ionizing Radiation Protection
IDA	International Development Association
IFC	International Finance Corporation
KV	Kilovolts
mg/kg	Milligram per kilogram
mm	Millimeter
m/s	Meter per seconds
NEGIP	Nigerian Electricity and Gas Improvement Project
NESREA	National Environmental Standard & Regulatory Enforcement Agency
NNPC	Nigerian National Petroleum Corporation
NO ₃	Nitrate
NO _x	Nitrogen Oxide
OHS	Occupational Health & Safety
PCBs	Polychlorinated Biphenyls
PHCN	Power Holding Company of Nigeria
PMU	Project Management Unit
PPE	Personal protective equipment
PVC	Poly Vinyl Chloride
TCN	Transmission Company of Nigeria
THC	Total Hydrocarbon Content
TOR	Terms of Reference

USTs	Underground Storage Tanks
SME _{env}	State Ministry of Environment
SOPs	Standard Operational Procedure
SO _x	Sulfur Oxide
SPM	Suspended Particulate Matter
V/m	Volt per meter
WAA	Waste Accumulation Area
WHO	World Health Organization
µg/m ³	Microgram per meter cube
%	Percentage

A. EXECUTIVE SUMMARY

A.1. Background

Nigeria Electricity and Gas Improvement Project (NEGIP) is undertaking efforts to improve electricity quality and reliability, in response to growing demand for electricity. The growing population, the increasing demand on power and pressure on existing facilities, especially old ones, are common problems that usually face the power sector, in addition to the financial problems that are related to lack of sufficient financing for maintaining, rehabilitation and replacement of equipment. In light of TCN efforts to improve electricity reliability and meet the growing demand, the International Development Association (IDA) has agreed to fund the rehabilitation/reinforcement of several transmission substations.

This consolidated report presents the Environmental and Social Management Plan (ESMP) for the Rehabilitation/Reinforcement of the four (4) proposed 132/33kV Transmission Sub-Stations located in Sagamu (Ogun State), Awka (Anambra State), Yandev (Benue State) and Gasau (Zamfara State).

The project being site specific based on their similar layout, equipment, management (TCN), purpose, functionality and life span of each station. These factors indicate that the Transmission Substations have related generic operations, therefore necessitating a consolidated report.

This ESMP has been prepared based on an overall environmental and social assessment, which includes (i) the general baseline at project areas (ii) Evaluation of potential environmental and social impacts of different project components and subcomponents and (iii) Assessment of environmental practices in different ongoing and completed projects. This standardized ESMP specifies mitigation measures to respond to the anticipated and potential project impacts.

ESMP Objectives

This ESMP aims to address the environmental and social impacts that may arise from the rehabilitation/reinforcement work (transportation, storage, handling, upgrade and commissioning) at the respective Transmission Substations. This shall be achieved through Environmental Assessment of the Site and the surrounding area through auditing of the existing facility and establishing the potential environmental and social impacts of different project components and subcomponents impacts during construction and operation phases.

It shall also proffer measures to be adopted to mitigate negative, and enhance positive, impacts; and to achieve an overall improved management of environmental and social challenges and opportunities. A framework shall be put in place to ensure compliance of the rehabilitation process with pertinent national regulations and World Bank safeguard policy (Whenever there is a discrepancy between national and international requirements, the more stringent ones will be considered)

A.2. ESMP Methodology

The ESMP focused on identifying the environmental and social issues. The ESMP included collecting data from previous reports and studies for obtaining background data about environmental and socio-economic characteristics of the project area. In addition a team of multidiscipline experts audited the existing substation.

The literature review included both reports provided by the client as well as web based resources, which helped in assessing:

- The environmental and socio-economic characteristics of the project area
- Project background and proposed interventions
- The legal, institutional and organizational framework and background of the electricity sector and the historical background
- The Nigerian legislations and the World Bank safeguard policies related the project
- Environmental and social standards and guidelines for related environmental and social issues

In addition to a literature review, structured site visits were undertaken to collect primary data in order to get stakeholders perceptions about some issues, especially social issues, such as:

- The current environmental situation on site and surrounding the project area as well as the natural condition of the project area
- The current energy sources and their impacts on the livelihoods
- The short and long term impacts predicted from the project,
- Ideas for maximizing the positive benefits especially on people's livelihoods and the economic development of the project,
- The social power dynamics and the different interests of different stakeholders,

A.3. Legal Framework

National Regulations

The Nigerian environmental legal and administrative framework has taken major strides towards protecting environmental resources and institutionalizing their Sustainable management. The Nigerian Environment Law is comprehensive, covering the main issues relevant to environmental protection and law enforcement. Among the objectives of the FMEnv are:

- Protecting the environment from all sorts and types of pollution
- Protecting public health and social welfare
- Incorporating environmental resources protection in all social and economic development plans and promote sustainable development to protect the rights of future generations;
- Conserving ecologically sensitive areas, protecting biodiversity, and rehabilitating environmentally damaged areas;
- Setting inter-ministerial cooperation regulations and standards in various environmental protection areas and jurisdictions;

- Promoting environmental information collection and publication, public awareness, education and training.

The Nigerian Environmental Laws addresses various environmental issues including:

- Management and protection of various resources. Issues covered are related to land environment, air environment, water resources and aquatic environment, natural, archeological, and historical heritage protection.
- Environmental and Social Impact Assessment (ESIA) and auditing, permitting of development projects, monitoring of environmental resources and their parameters.
- Penalties to be applied in case of violation of any article presented under the law.
- Other issues addressed by the legislation include emergency preparedness, public participation, research training and public education.

Federal Laws of the Federal Ministry of Environment (FMEnv)

The applicable laws are:

- The Environmental Impact Assessment Act CAP LFN E12 2004
- National Environmental Protection (Effluent Limitations) Regulations (S.I.8) of 1991
- National Environmental Protection (Pollution Abatement in Industries Producing Waste) Regulation (S.I.9) of 1991
- Federal Ministry of Environment (FMEnv) National Guidelines for Environmental Audit in Nigeria 1999.
- FMEnv Procedural Guidelines (1995)
- FMEnv Guidelines and Standards for Environmental Pollution and Control in Nigeria (Act Cap 131 LFN)
- The National Environmental Protection Management of Solid and Hazardous Wastes Regulations (S.I.15, 1991)
- Land Use Act of 1978
- Public Health Law – CAP 103 of the Laws of Eastern Nigeria (1963)
- The Endangered Species (Control of International and Traffic Act, No. 11 of 1985)
- National Environmental Standards and Regulation Enforcement Agency (NESREA) Act 25 of 2007

International Standards

The proposed project will be financed by the International Development Agency IDA and might seek finance from other financing institutions. Therefore, in addition to the national regulations, the project should comply with typical or common international requirements. World Bank (and IFC) Environmental and Social requirements typically cover those of most other financing institutions.

World Bank Operational Policies

OPs applicability to the proposed project is discussed in the following table:

Triggered OPs according to World Bank

1. Environmental Assessment (OP/BP 4.01)
Triggered (Yes/NO): Yes
Justifications: The proposed project requires an environmental assessment to establish an ESMP for the rehabilitation project during construction, operation and decommissioning of the proposed Substations.
2. Natural Habitats (OP/BP 4.04)
Triggered (Yes/NO): No
Justifications: N/A
3. Forests (OP/BP 4.36)
Triggered (Yes/NO): No
Justifications: N/A
4. Physical Cultural Resources (OP/BP 4.11)
Triggered (Yes/NO): No
Justifications: The ESMP for the proposed project identifies no sites of cultural or religious significance to local communities.
5. Indigenous Peoples (OP/BP 4.10)
Triggered (Yes/NO): No
Justifications: N/A
6. Involuntary Resettlement(OP/BP 4.12)
Triggered (Yes/NO): No
Justifications: The rehabilitation project will take place within the substation surrounding fence
7. Safety of Dams (OP/BP 4.37)
Triggered (Yes/NO): No
Justifications: N/A
8. Projects on International Waterways (OP/BP 7.50)
Triggered (Yes/NO): No
Justifications: N/A
9. Projects in Disputed Areas (OP/BP 7.60)
Triggered (Yes/NO): No
Justifications: N/A

The guidelines will be sourced aiming at fulfilling the requirements of World Bank, and EIB regarding the triggered safeguard policy (Environmental Assessment (OP/BP 4.01) and in addition to:

- IFC EHS General guideline
- IFC EHS Guideline for Electric Power Transmission And Distribution

These Guidelines contain the performance levels and measures that are normally acceptable to World Bank and are generally considered to be achievable in new facilities at reasonable costs by existing technology. Also the General EHS Guidelines cover four areas of international good practice, these are:

- Environmental;
- Occupational Health & Safety (OHS);
- Community Health & Safety (CHS); and
- Construction and Decommissioning.

The proposed Project is assessed in accordance with the IFC guidelines, performance standards and their related guidance notes, and manuals related to environmental, social, health and safety issues.

When host country regulations differ from the levels and measures presented in the World Bank operation policies, projects will be required to achieve whichever is more stringent. This also applies if there is a differences between Federal and State standards. The sterner standard must be followed.

A.4. Project Description and Scope

The four (4) proposed sites are existing 132/33 KV Transmission Substations commissioned over thirty (30) years ago with the quality of electricity supply deteriorated over the years due to low capacity of infrastructure occasioned by attendant load demand of an ever increasing population and/or development. The existing equipment are over-stretched, obsolete and/or damaged as a result of over loading, poor maintenance and system faults/failures.

The scope of the project work in the Transmission substations shall include the following:

- Upgrade and/or installation of power transformers (replacement of lower to higher capacity)
- Replacement of obsolete isolators, circuit breakers (CBs), current Transformers (CTs) etc.
- Provision of spares of accessories for use during emergencies

Rehabilitation / Reinforcement Scope

The phases of the Rehabilitation / Reinforcement work entails sequence of activities. The Planned activities are:

- ✓ Site preparation and earth works
- ✓ Rehabilitation of the substation (concrete works); foundations, control rooms, etc.
- ✓ Upgrade of power transformers to high capacity

- ✓ Supply and installation of accessories and electrical components (high capacity transformers, HV and MV equipment, Control and Protection panels, substation automation, Plc equipment and accessories, AC/DC station supply, galvanized steel structures, overhead connections, earthing system, accessories and ancillary materials, MV and LV cables and spare parts)
- ✓ Installation of safety measures, alarm system, and other auxiliary works
- ✓ Landscape, fencing, etc.

A.5 Description of the Environmental and Social Baseline

Location of Transmission Substations

- Sagamu with 68.03 square kilometres land area is located within latitude 6°50' and 7°00' N and longitude 3°45' and 4°00' E and is the third largest settlement in Ogun state after Abeokuta and Ijebu Ode. Sagamu is a part of the Yoruba cultural region of south-western Nigeria.
- Awka is situated in Awka South, Anambra, Nigeria with geographical coordinates is 6° 10' 0" North, 7° 4' 0" East and its original name (with diacritics) is Awka Nise. The area lies below 300 metres above sea in a valley on the plains of the Mamu River and located in the Eastern region of Nigeria.
- The transmission substation is located along the yandev to Dangote Cement road in Yandev a community in Gboko town. Gboko local government area which has a land area of 4,493 sq. Km located between Latitudes 07° 08' 16" and 07° 31' 58", and Longitudes 08° 37' 46" and 09° 10' 31" . It is located at an elevation of 315 meters above sea level. The Transmission Substation is situated approximately 500 metres from Dangote Cement Plc formerly Benue Cement Company (BCC).The area is located within a sub- humid tropical region of the middle belt of Nigeria.
- The transmission substation is located in Samaru community along Zaria – Sokoto road in Gusau. Gusau is a city and Local Government Area located in north-western Nigeria. It is the capital of Zamfara State. The LGA has an area of 3,364 km².

The Environmental Baseline survey findings are summarized as:

- Climate and Meteorology
The climate of Sagamu (Ogun), Yandev (Benue) and Awka (Anambra) are characterized by high annual temperature, high rainfall, high evapotranspiration and high relative humidity which makes it to be classified as humid tropical region whereas Gasau (Zamfara) lies in a dry and warm tropical region with high temperature.
- Air Emissions and Ambient Air Quality

The general air quality of the four (4) transmission substation areas were relatively good and devoid of obnoxious gases, however high concentration of pollutant gases (e.g. CO) was recorded on the perimeter of the sites as a result of vehicular movement and other anthropogenic activities along the boundary wall of the transmission substations.

- Noise
Several measurements were conducted within the facility and the closest community and all measurements were in compliance with the pertinent national regulations
- Soil Characteristics
Soil were sampled and analyzed at different locations within the substations. Soil sample at the transformer areas were found to be contaminated heavily with transformer oil and trace concentrations of PCB.
- Vegetation and Wildlife
No information was obtained on the occurrence of rare or protected plant or animal species or on the biodiversity conservation situation in the area in general
- Land use
The predominant use of the Substation area is residential at Sagamu (Ogun), Awka (Anambra) and Gasau (Zamfara) while Yandev (Benue) commercial area.
- Geology
Sedimentary rocks
- Social
Overall, the participants of the consultations were supportive of the Rehabilitation/Reinforcement project

Summary of Audit Findings are:

- Building Materials
No Asbestos containing materials were observed at Sagamu (Ogun), Yandev (Benue) and Gasau (Zamfara) whereas the security gate house roofing sheets at Awka (Anambra) Transmission substation are of Asbestos containing materials.
- Water Supply, Effluents and Storm water Drainage
The Storm drains observed are unable to contain the quantity of rain that falls during heavy down pour. Effluents from the station building conveniences are channeled into a soak away pit
- Waste Production and Disposal
Scrapped materials such as breakers, cables, electric poles were found littered within the transmission substation. No segregation of hazardous waste is performed.
- Hazardous Materials
Old manufactured power transformers like the ones in four (4) transmission substations are a major legacy source of PCBs.

Soil analysis in the transformer area indicated that soil is contaminated with PCBs although at low concentrations within WHO tolerable limit. However the recommended measures shall be implemented.

- Occupational Health and Safety/Personal Protective Equipment (PPE)/First Aid
No safety signs exist anywhere within the station and outside the station warning people of danger equipment and zones
Transmission Staff Capacity needs improvement
Inadequate PPEs and First Aid kit
- Fire and Emergency Precautions
Fire extinguisher canisters were available but all were expired and not calibrated.
- Housekeeping
Generally poor
- Site Security
Lights are inadequate at night for proper visibility and needs to be improved upon.

The standard operation procedures provided in Appendix A of this report that the facility shall implement to comply with national and international pertinent regulations and standards are:

- Polychlorinated biphenyls PCBs in the Old Transformers
- Hazardous Substances
- Soil Contamination
- Solid Wastes
- Non-Hazardous and Scrap Wastes
- Implementation of Health and Safety Procedures
 - Fire Prevention and Suppression
- General Electrical Safety
 - Electrical Grounding
 - Electrical Panel
 - Electrical Safety Guidelines
 - Electrical Emergency Response
- Personal Protective Equipment (PPE)
- Housekeeping

A.6 Potential Environmental and Social Impacts and Recommended Mitigation Measures for the Proposed Rehabilitation Project

Assessed Significance of the expected negative Impacts during Construction Phase are

1. Impacts due to handling of construction waste
2. Construction air emissions

3. Construction noise
4. Impacts on Fauna and Flora
5. Health and Safety
6. Socioeconomic (Impacts on traffic)

Assessed Significance of Expected negative Impacts during Operation Phase are

1. Risk of Waste generated
2. Exposure to EMFs
3. Risk of soil and groundwater contamination
4. Impacts due to noise emissions
5. Human Health and Safety

A.7 Implementation Plan

The implementation plan will be executed on the site by all responsible parties and a monthly report shall be submitted through the management structure of the project for management review and close-out function.

Environmental and Social Monitoring Plan Matrix during Construction Phase

1. Management of the Project
 - The Proponent should appoint a project HSE Officer while the Contractor should appoint his/her HSE officer;
 - Demarcate clearly (e.g. using fencing) all areas to be developed before construction commences
 - The contractor to comply with the conditions of the ESMP for the project;
 - Maintain records of environmental incidents and avail a copy of these records to relevant lead agencies on request throughout the construction phase;
 - Identify and confirm suitable sites for the construction camps, if any, and storage areas for materials;
 - Store construction equipment in construction camps. Ensure oil changes take place on an impermeable surface such as reinforced concrete slab;
 - Train site staff on the following areas of environmental management;
 - a) Environmental awareness training for construction staff, concerning the prevention of accidental spillage of hazardous chemicals and oil; pollution of water resources (groundwater), air pollution and litter control;
 - b) Project Manager shall ensure that the training and capabilities of the Contractor's site staff are adequate to carry out the designated tasks;
 - d) No operator shall be permitted to operate critical items of mechanical equipment without having been trained by the Contractor and certified competent by the Project Manager;

e) Staff should be educated as to the need to refrain from indiscriminate waste disposal and/or pollution of local soil and water resources and receive the necessary safety training.

2. Effects of construction waste

- Identify disposal sites for construction waste approved by the local authority
- Identify a Waste Accumulation Area (WAA) within the construction site for temporary storage of construction waste , including a secured area for the interim accumulation of hazardous wastes
- Adequate transportation and disposal of construction waste
- Allocate and prepare areas for temporary storage of scrap
- Keeping tidiness and cleanliness of the WAA
- Inspection of the existing Septic tank for evacuation

3. Excavation

- Identify the excavation depth and width according to the drawing design
- Clear safety signs and boundary for the excavation sites
- Safety and clear area around the excavation site including the safety helmets and boots compulsory for workers

4. Construction air emissions

- Store construction materials in pre-identified storage areas.
- Cover friable materials during storage.
- Regulation of speed to a suitable speed (30 km/h) for all vehicles entering the site.
- Implement preventive maintenance program for vehicles and equipment working on site and promptly repair v visible exhaust fume.
- Using locally available materials whenever possible thus limiting the travel distance. Reducing the distance and number of trips will result in an overall reduction in in gaseous and carbon emissions.

5. Construction noise

- Provide ear muffs to construction workers usually located near noisy machines
- Organize working hours so that noise exposure to workers will be minimized
- Coordinate and Inform inhabitants/employees at the nearby sensitive receptors about the peak time and hours for construction activities

6. Human health and safety

- Restrict application to the health and safety procedures
- The contractor should make health and safety facilities available in the project site

- Contracts should be signed with the health facilities close to the construction site
 - Drivers should have a certified and valid license

 - All mechanical equipment should be checked prior to use
 - Appropriately tag all mechanical equipment that are locked or out of service
 - Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers
 - Safety belts should be provided to workers working at height and should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident.
 - A guard should be assigned to keep community people out of the construction site
7. Socioeconomic impacts
- Job opportunities to be provided to the community workers
 - Integration of community leaders during the employment procedures
 - Prevent storage of construction materials, equipment and machineries on traffic lanes
 - Continues stakeholders consultation
 - Moving heavy vehicles during the night
 - Capacity building of the drivers about safety utilization should be assured

Environmental and Social Monitoring Plan Matrix during Construction Phase

1. Disposal of waste during construction
 - Quantities of scrap item by type (inventory)
 - Segregated waste weight
 - Types of hazardous wastes recorded

2. Excavation impacts
 - Areas of excavations and trenching Safety areas around the excavation

3. Safety of mechanical equipment
 - Performance of the equipment and the visible damage
 - Total number of injured workers

4. Human health and safety
 - Total received grievances related to health and safety
 - Total number of attendance to the orientation sessions about health and safety

5. Socioeconomic impacts (job opportunities)
 - Number of jobs provided to the community people
 - Total number of complaints raised by workers
 - Storage sites areas

Environmental and Social Management Plan Matrix during Operation Phase

1. Risk of Waste generated
 - Implement Standard operation procedures for Solid waste management Appendix A
 - Allocate and prepare areas for temporary storage of scrap
 - Keeping tidiness and cleanliness of the utility store
 - Controlling the hazardous and special waste (to sell or to recycle)
 - Controlling disposal of non-sold hazardous
 - Implement waste minimization measures
2. Risk of soil and groundwater contamination
 - Care should be taken during transformer oil changing, which should be over an impermeable layer of soil
 - Adequate collection and disposal of contaminated soil
 - Inspection of the existing Septic tank for evacuation
3. Noise emissions during operation
 - Provide ear muffs to construction workers usually located near noisy machines
 - Organize working hours so that noise exposure to workers will be minimized
4. Risks of Electrocution and Fires
 - Maintain standard safety procedures for substations
5. Human health and safety
 - Restrict application to the health and safety procedures
 - Health and safety facilities should be available to all workers within the substation

 - Expired Fire Extinguishers shall be recalibrated and maintained by producers
 - Contracts should be signed with the health facilities close to the construction site
 - Drivers should have a certified and valid license

 - All mechanical equipment should be checked prior to use
 - Appropriately tag all mechanical equipment that are locked or out of service

- Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers
- Safety belts should be provided to workers working at height and should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident.
- A guard should be assigned to keep community people out of the construction site

6. Socioeconomic impacts

- Job opportunities to be provided to the community workers
- Integration of community leaders during the employment procedures

Environmental and Social Monitoring Plan Matrix during Operation Phase

1. Disposal of hazardous waste and scrap
 - Quantities of waste items by type
2. Risk of soil and groundwater contamination
 - Volume of contaminated soil
 - Presence of PCBs
 - Groundwater quality
3. Exposure to EMF
 - EMF (mG)
4. Risks of Electrocutation and Fires
 - Total number of injured workers
 - Total number of injured community people
 - Total received grievances related to health and safety
 - Total number of attendance to the orientation sessions about health and safety

Conclusion

The ESMP study and the Environmental Audit concluded, after analyzing the activities of the project through the various stages of construction and operation and the existing potential various environmental consequences, that the project has many positive effects on the social and economic level in terms of providing job opportunities especially during the construction phase and support the national economy, and improve the conditions of the existing substation.

As for the negative environmental impacts at the construction phase and operational phases, an environmental management and monitoring plan has been designed to limit and control any the environmental and social impacts caused by the project. The impacts during construction are limited and short-term and can be minimized through applying the recommended mitigation measures and Standard operation procedures

The assessment indicates that the establishment of the proposed project will not have a severe negative impact on the existing environmental, social, health and safe conditions of the local people. This is achievable when the mitigation, monitoring, and institutional measures are undertaken during the implementation and maintenance of the intervention work in order to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

CHAPTER ONE INTRODUCTION

1.1 Background

Nigeria Electricity and Gas Improvement Project (NEGIP) is undertaking efforts to improve electricity quality and reliability, in response to growing demand for electricity. The growing population, the increasing demand on power and pressure on existing facilities, especially old ones, are common problems that usually face the power sector, in addition to the financial problems that are related to lack of sufficient financing for maintaining, rehabilitation and replacement of equipment. In light of TCN efforts to improve electricity reliability and meet the growing demand, the International Development Association (IDA) has agreed to fund the rehabilitation/reinforcement of several transmission substations.

Project Locations

The substations are located at Nibo, Awka, Anambra State; Yandev, Benue State; Sagamu, Ogun State and Gasau, Zamfara State. The following satellite map shows the location of the four (4) substations within this assignment scope.

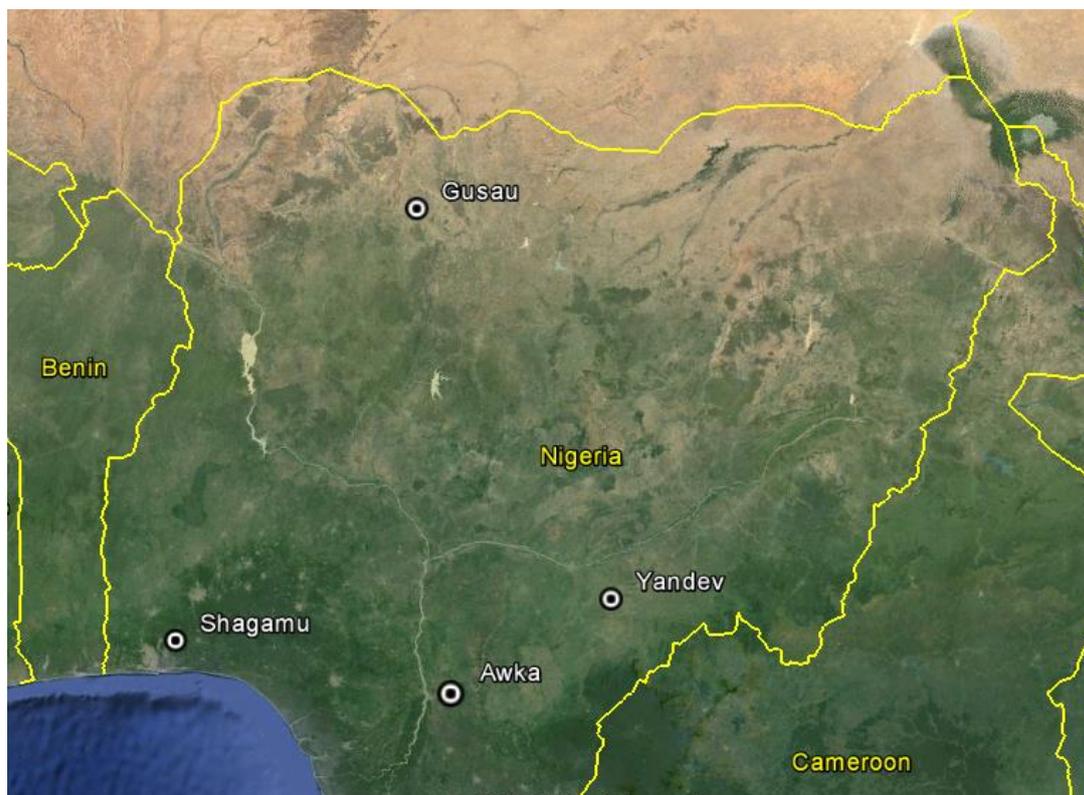


Figure 2.1: Satellite image the location of the substations (denoted with white circle)

The consolidated report presents the Environmental and Social Management Plan (ESMP) for the Rehabilitation/Reinforcement of the four (4) proposed 132/33kV Transmission Sub-Stations located in Sagamu (Ogun State), Awka (Anambra State), Yandev (Benue State) and Gasau (Zamfara State).

The project being site specific based on their similar layout, equipment, management (TCN), purpose, functionality and life span of each station. These factors indicate that the Transmission Substations have related generic operations, therefore necessitating a consolidated report.

Transmission substations are associated with common environmental issues; most are related to the use of coolant oil containing Polychlorinated Biphenyl (PCB) and the management of Asbestos Containing Materials (ACMs) in old building materials.

EcoConServ was contracted by TCN-PMU to audit and prepare an Environmental and Social Management Plan ESMP of each of the four substations for use during the implementation of the above mentioned project.

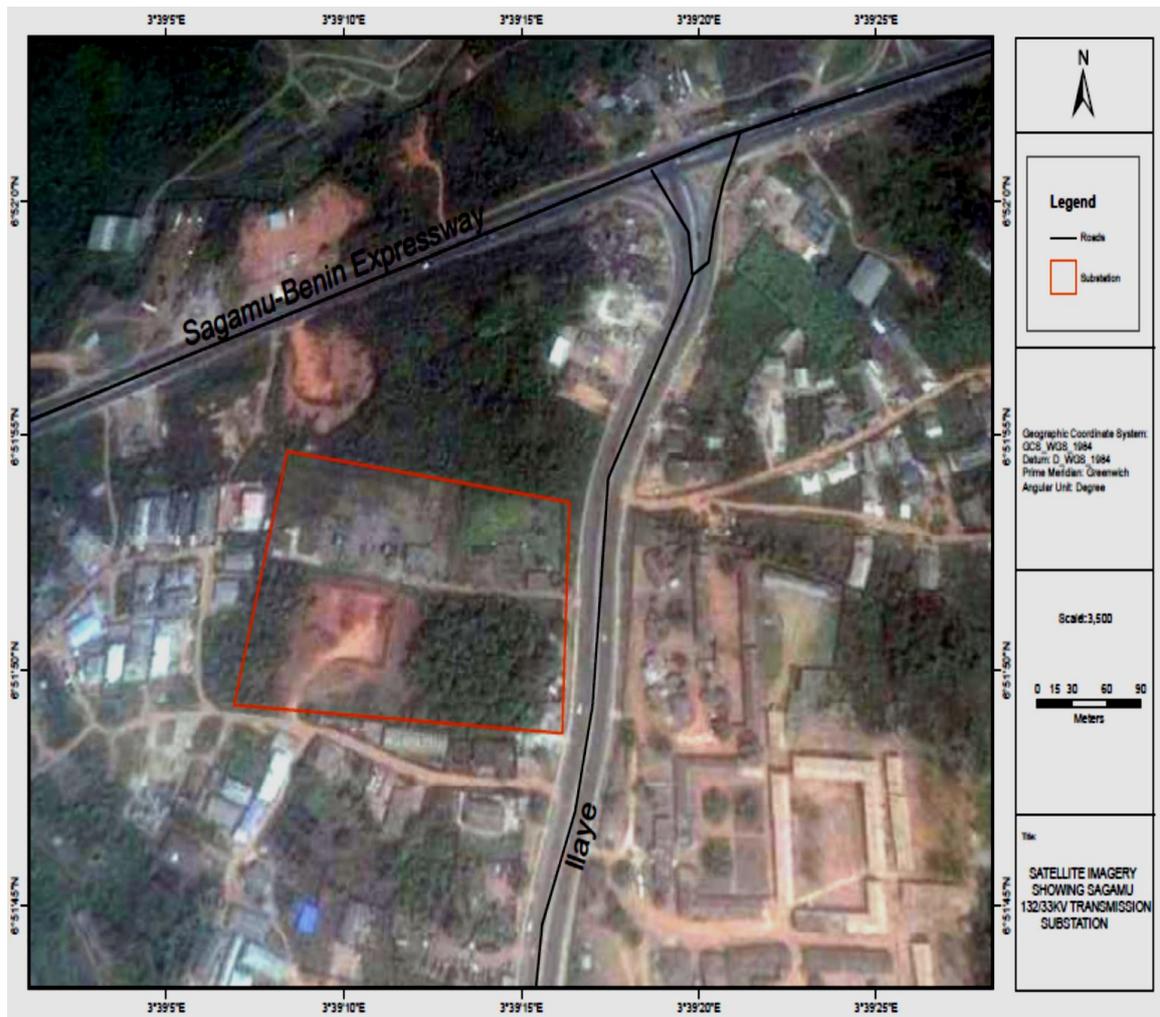


Figure 1.2: Satellite image for Sagamu substation



Figure 1.3: Satellite image for Awka (Nibo) substation



Figure 1.4: Satellite image for Yandev substation



Figure 1.5: Satellite image for Gasau substation

1.2 ESMP Objective

The main aim of the ESMP is to ensure that the project complies with applicable national environmental and social legal requirements and World Bank’s environmental and social safeguards, as applicable. Further, the ESMP aims at identifying environmental and socio economic benefits of the project as well as identifying any potential adverse environmental and socio economic impacts. To mitigate the adverse impacts and enhance project benefits the ESMP describes measures that will be taken to prevent, minimize, mitigate and or compensate for adverse environmental and social impacts. The ESMP is specifically providing the following:

- Assessment of the baseline environmental and social situation of the Site and the surrounding area (including auditing the existing facility)
- Assessment of the potential environmental and social impacts of different project components and subcomponents impacts during construction and operation phases

- Proposing measures that may be adopted to mitigate negative, and enhance positive, impacts; and to achieve an overall improved management of environmental and social challenges and opportunities.
- Ensuring compliance of the rehabilitation process with pertinent national regulations and World Bank safeguard policy (Whenever there is a discrepancy between national and international requirements, the more stringent ones will be considered)

The Environmental and Social Management Plan (ESMP) provides a logical framework within which identified negative environmental and socio-economic impacts can be mitigated and monitored. In addition, the ESMP assigns responsibilities of actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done. This document comprises environmental and social management plan (ESMP) for the proposed rehabilitation/reinforcement project. The ESMP covers information on the management and/or mitigation measures that will be taken into consideration to address impacts in respect of the project life cycle.

Mitigation measures proposed in the ESMP are designed to bring the project into full compliance with pertinent national laws and regulations as well as World Bank safeguard operational policies, and IFC Environmental Health and Safety guidelines. These Guidelines cover the following elements:

- Environment
- Occupational Health and Safety
- Community Health and Safety (Corporate social Responsibility)

World Bank Operational policies are designed to ensure that World Bank-financed projects are environmentally and socially sound and sustainable, and that potential negative environmental impacts are avoided wherever possible, and/or mitigated.

1.3 Approach

The Consultant - to the extent possible – identified and compiled the readily available technical data and information concerning the project elements and the project areas. In addition, field visits and investigations, including interviews and discussions, have been conducted to allow preparing the ESMP with the least uncertainties.

Baseline surveys were performed in order to assess the existing conditions at the project sites. In preparing the Environmental and Social Impact Assessment, the Consultant considered the following standards, regulations, and laws to ensure full compliance:

- The World Bank Safeguard Policies and Environmental Health and Safety Guidelines.
- Nigerian Environmental Impact Assessment Decree No. 86 of 1992
- The regulations, guidelines and standards of the Federal Ministry of Power as it concerns high voltage power transmission in Nigeria.

- The regulations, guidelines and standards of the Federal Ministry of Environment concerning power generation and transmission activities in Nigeria.
- The regulations, guidelines and standards of the Anambra, Benue, Ogun and Zamfara States Ministries of Environment on environmental protection.
- All International Conventions/Treaties on Environmental Protection to which Nigeria is party.
- The Corporate and Operational Policies of the Transmission Company of Nigeria.
- Electricity Law related to the right of way and the public electricity connections
- The World Bank safeguards Operational Policy OP 4.01 on Environmental Impact Assessment.
- IFC Environmental and , Health and Safety guidelines

1.4 Impact Evaluation Methodology

The environmental and social impact assessment will be carried out at different levels to reach accurate results about the project impacts, the most advantageous project alternatives and the suitable mitigation measures to minimize negative impacts and maximize positive impacts. This Chapter will distinguish between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts during construction and operation phases indicating their importance level and their probability of occurrence. This chapter will also identify impacts which are unavoidable or irreversible. Cumulative effects shall be also addressed taking into account other projects or actions planned in the study area. This shall include the social – economic impact assessment.

Each potential positive and negative impact resulting directly or indirectly from the project will be categorized based on **Magnitude** and **Sensitivity of the receptor**.

1.4.1 Magnitude of Impact

The impact resulting from the project will first be categorized as a positive or negative impact; the latter will be further analyzed and its magnitude assessed as: Negligible, Low, Medium, or High. Various considerations come into play as the experts assess the impacts, the main parameters are:

- Duration - As the time duration of the impact increases, it is weighed more heavily. Special consideration is given to impacts that go beyond the project's anticipated life-expectancy.
- Time – The time of which an impact commences or occurs can be vital to construction and maintenance operations.
- Spatial – The area impacted is to be considered, as some impacts may extend beyond the project's boundaries or interfere with land regulations, etc.
- Probability – The chance of an impact occurring and its frequency is to be assessed
- Reversibility - The possibility and extent to which an impact can be intervened or mitigated for a factor to return to the Baseline environment
- Compliance – National and international standards and regulations may dictate an impact's maximum allowable consequence.

After an analysis of the various parameters, an impact's magnitude is categorized as follows:

- Negligible – No anticipated change to the baseline environment
- Low – Minor anticipated change to the baseline environment
- Medium – Moderate anticipated change to the baseline environment
- High – Significant anticipated change to the baseline environment

Medium and High impacts usually cause a major temporary variance to the baseline conditions or a long-term ongoing modification.

1.4.2 Sensitivity of the Receptor

Sensitivity of the receptor is based on the relationship between the respective project and present baseline environment (the receptor). It is assessed based on vulnerability of the receptor, including the surrounding population and environment. As the effect of an impact is more readily absorbed and easily mitigated it is less sensitive; on the other hand, as an impact is more challenging to mitigate and cannot be absorbed by the population and environment it becomes more sensitive and requires an extensive management plan.

The sensitivity of the receptor is assessed as:

- Low- Existing capacity to absorb/mitigate impact
- Medium – Limited capacity to absorb/mitigate impact
- High – No capacity to absorb/mitigate impact

1.4.3 Impact Evaluation

The virtual resultant of the **magnitude of the impact** and **sensitivity of the receptor** for each impact is evaluated to generate the impact’s significance and overall assessment. The following chart illustrates how the two factors are coupled:

		Magnitude of Impact			
		Negligible	Low	Medium	High
Sensitivity	Low	Level 1	Level 1	Level 1	Level 2
	Medium	Level 1	Level 2	Level 2	Level 3
	High	Level 2	Level 3	Level 3	Level 4

Where:

- Level 1 – Nominal impact to the baseline environment (requires no mitigation or management plan)
- Level 2 – Minimal impact to the baseline environment.
- Level 3 – Medium impact to the baseline environment.
- Level 4 – Significant impact to the baseline environment

Radial direction represents the sensitivity of the receptor (low-medium-high)

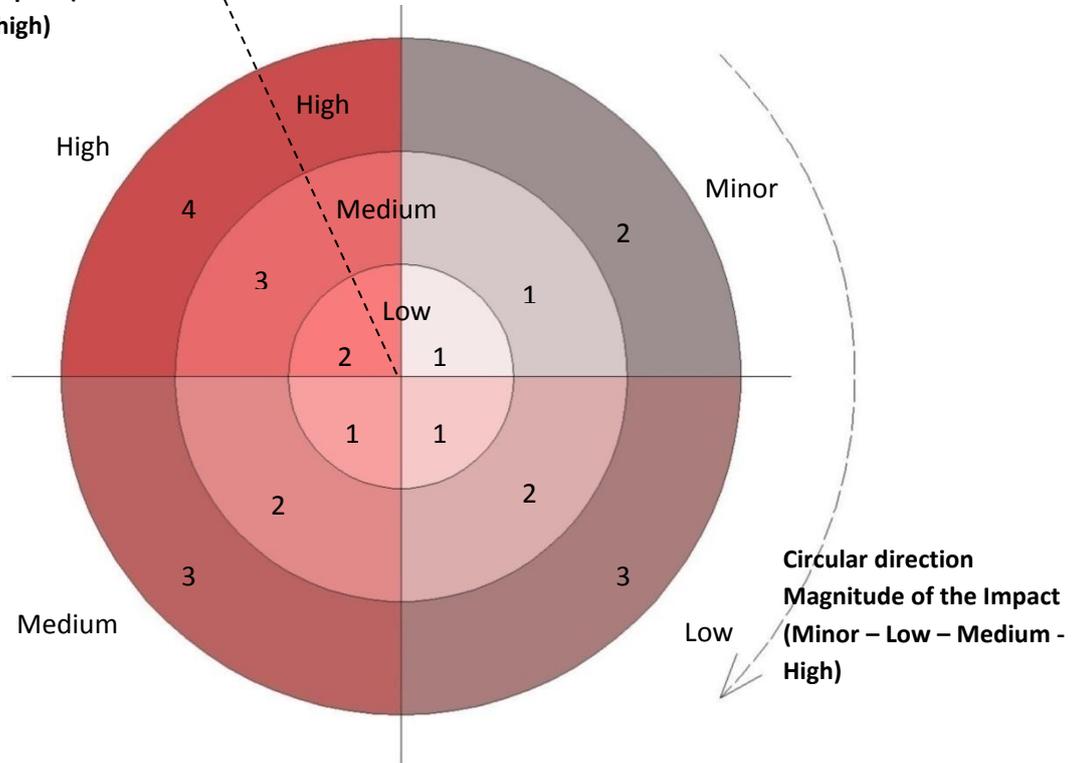


Figure 1.6: Impact evaluation methodology

2 CHAPTER TWO ENVIRONMENTAL LEGISLATIVE AND REGULATORY FRAMEWORK

This Section describes the policy, legal and administrative framework of the proposed Project. It lists the national laws and international requirements to the Project. International finance organizations require that the projects they finance comply with the country's national standards as well as International environmental and social policies. In addition to Nigerian legislations, the Project should address World Bank operational policy regarding environmental and social issues as it covers the requirements of many of the financing institutions.

When host country regulations differ from the levels and measures presented in the World Bank operation policies, projects will be required to achieve whichever is more stringent. This also applies if there is a differences between Federal and State standards. The sterner standard must be followed.

2.1 National Legal Framework

The national environmental regulatory framework applicable to Electrical Energy Transmission projects includes the following laws and decrees

2.1.1 National Environmental Law

The Nigerian environmental legal and administrative framework has taken major strides towards protecting environmental resources and institutionalizing their Sustainable management. The Nigerian Environment Law is comprehensive, covering the main issues relevant to environmental protection and law enforcement. Among the objectives of the FME_{env} are:

- Protecting the environment from all sorts and types of pollution
- Protecting public health and social welfare
- Incorporating environmental resources protection in all social and economic development plans and promotes sustainable development to protect the rights of future generations;
- Conserving ecologically sensitive areas, protecting biodiversity, and rehabilitating environmentally damaged areas;
- Setting inter-ministerial cooperation regulations and standards various environmental protection areas and jurisdictions;
- Promoting environmental information collection and publication, public awareness, education and training.

The Nigerian Environmental Laws addresses various environmental issues including:

- Management and protection of various resources. Issues covered are related to land environment, air environment, water resources and aquatic environment, natural, archeological, and historical heritage protection.

- Environmental and Social Impact Assessment (ESIA) and auditing, permitting of development projects, monitoring of environmental resources and their parameters.
- Penalties to be applied in case of violation of any article presented under the law.
- Other issues addressed by the legislation include emergency preparedness, public participation, research training and public education.

2.1.1 Federal Laws of the Federal Ministry of Environment (FMEnv)

The applicable laws are:

- The Environmental Impact Assessment Act CAP LFN E12 2004
- National Environmental Protection (Effluent Limitations) Regulations (S.I.8) of 1991
- National Environmental Protection (Pollution Abatement in Industries Producing Waste) Regulation (S.I.9) of 1991
- Federal Ministry of Environment (FMEnv) National Guidelines for Environmental Audit in Nigeria 1999.
- FMEnv Procedural Guidelines (1995)
- FMEnv Guidelines and Standards for Environmental Pollution and Control in Nigeria (Act Cap 131 LFN)
- The National Environmental Protection Management of Solid and Hazardous Wastes Regulations (S.I.15, 1991)
- Land Use Act of 1978
- Public Health Law – CAP 103 of the Laws of Eastern Nigeria (1963)
- The Endangered Species (Control of International and Traffic Act, No. 11 of 1985)
- National Environmental Standards and Regulation Enforcement Agency (NESREA) Act 25 of 2007

2.1.2 State Regulations

- State Noise (Control) Edict
- State Environmental Protection Agency Edit

2.2 International Standards

The proposed project will be financed by the International Development Agency IDA and might seek finance from other financing institutions. Therefore, in addition to the national regulations, the project should comply with typical or common international requirements. World Bank (and IFC) Environmental and Social requirements typically cover those of most other financing institutions.

2.2.1 World Bank Operational Policies

OPs applicability to the proposed project is discussed in the following table:

Table 2.1: Triggered OPs according to World Bank

Safeguard Policy	Triggered (Yes/NO)	Justifications
Environmental Assessment (OP/BP 4.01)	Yes (Sagamu, Awka, Yandev & Gasau)	The proposed project requires full environmental and social impact assessment, as the rehabilitation process during construction, operation and decommissioning of the proposed The proposed project requires full environmental and social impact assessment, as the rehabilitation process during construction, operation and decommissioning of the proposed Substations station will have positive and negative environmental impacts. A comprehensive analysis of the negative impacts and mitigation measures is described in the following chapters.
Natural Habitats (OP/BP 4.04)	No (Sagamu, Awka, Yandev & Gasau)	N/A
Forests (OP/BP 4.36)	No (Sagamu, Awka, Yandev & Gasau)	N/A
Physical Cultural Resources (OP/BP 4.11)	No (Sagamu, Awka, Yandev & Gasau)	The ESMP for the proposed project identifies no sites of cultural or religious significance to local communities.
Indigenous Peoples (OP/BP 4.10)	No (Sagamu, Awka, Yandev & Gasau)	N/A
Involuntary Resettlement (OP/BP 4.12)	No (Sagamu, Awka ,Yandev & Gasau)	The rehabilitation project will take place within the boundaries of the 132/33kV Transmission Sub-Stations at Sagamu (Ogun State), Awka (Anambra State), Yandev (Benue State) and Gasau (Zamfara State)
Safety of Dams (OP/BP 4.37)	No (Sagamu, Awka, Yandev & Gasau)	N/A
Projects on International Waterways (OP/BP 7.50)	No (Sagamu, Awka, Yandev & Gasau)	N/A
Projects in Disputed Areas (OP/BP 7.60)	No (Sagamu, Awka, Yandev & Gasau)	N/A

The guidelines will be sourced aiming at fulfilling the requirements of World Bank, and EIB regarding the triggered safeguard policy of Environmental Assessment (OP/BP 4.01) for the 132/33kV Transmission Sub-Stations located in Sagamu (Ogun State), Awka (Anambra State), Yandev (Benue State) and Gasau (Zamfara State) These is in addition to:

- IFC EHS General guideline
- IFC EHS Guideline for Electric Power Transmission And Distribution

These Guidelines contain the performance levels and measures that are normally acceptable to World Bank and are generally considered to be achievable in new facilities at reasonable costs by existing technology. Also the General EHS Guidelines cover four areas of international good practice, these are:

- Environmental;
- Occupational Health & Safety (OHS);
- Community Health & Safety (CHS); and
- Construction and Decommissioning.

The proposed Project is assessed in accordance with the IFC guidelines, performance standards and their related guidance notes, and manuals related to environmental, social, health and safety issues.

The IFC EHS Guidelines for Transmission and Distribution defines the environmental issues specific to operation of Power Transmission projects as terrestrial habitat alteration, aquatic habitat alteration, electric and magnetic field, and hazardous materials. Air emissions, wastewater discharges, and solid wastes related to construction and decommissioning activities are evaluated in accordance with the IFC EHS General Guidelines.

The Guidelines also address the occupational and community health and safety hazards during the construction, operation, and decommissioning of Power Transmission projects. The occupational health and safety hazards may include physical hazards such as working at heights, working with live power, and exposure to chemicals. According to the guidelines the major community health and safety hazards are aircraft safety, electrocution, and electromagnetic interference.

As stated in IFC general EHS guideline, when host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. Therefore the following tables are presenting IFC threshold for pertinent impacts

Table 1.2: maximum permissible limit for noise intensity in the different areas according to World Bank requirements

Requirements of WB			
Noise	Receptor	One hour LAeq(dBA)	
		Day time 7 a.m. to 10 p.m.	Night time 10 p.m.to 7 a.m.
	Residential	55	45
Industrial	70	70	

Table 2.3: Standards and Limits for Noise Levels in the Work Environment

Requirements of WB			
Noise	Location /activity	Equivalent level LAeq,8h	Maximum LAmax,fast
	Heavy Industry (no demand for oral communication)	75 dB(A)	110 dB(A)
	Light industry (decreasing demand for oral communication)	50-65 dB(A)	110 dB(A)
	Open offices, control rooms, service counters or similar	45-50 dB(A)	N/A
	Individual offices (no disturbing noise)	40-45 dB(A)	N/A
	Hospitals	30-35 dB(A)	40 dB(A)

Table 2.4: standards for ambient air and air Quality

Issue	Requirements of WB $\mu\text{g}/\text{m}^3$				
Air Quality	Ambient air parameters	Ambient air pollutants threshold According to WHO			
	Exposure period	1 hr	8 hr	24 hr	1 year
	Carbon monoxide CO $\mu\text{g}/\text{m}^3$	N/A	N/A	N/A	N/A
	Sulfur dioxide SO ₂ $\mu\text{g}/\text{m}^3$	N/A	N/A	125	N/A
	Nitrogen oxides NO _x $\mu\text{g}/\text{m}^3$	200	N/A	N/A	40
	Particulates PM ₁₀ $\mu\text{g}/\text{m}^3$	N/A	N/A	150	70
	Particulates PM _{2.5} $\mu\text{g}/\text{m}^3$	N/A	N/A	N/A	N/A
	TSP $\mu\text{g}/\text{m}^3$	N/A	N/A	230	80
Ozone	N/A	160	100	N/A	

3 CHAPTER THREE PROJECT DESCRIPTION

3.1 Introduction

The Nigeria Electricity and Gas Improvement Project (NEGIP) are undertaking efforts to improve electricity quality and reliability, in response to growing demand for electricity. The International Development Association (IDA) has agreed to fund the rehabilitation/reinforcement of several transmission substations. This is aimed at boosting economic activities through availability of reliable energy to power homes and business activities.

The main function of the substations is to improve the availability of quality power supply to the environs. Substation typically does the following:

- Reduces voltage using transformers that step transmission voltages (in the tens or hundreds of thousands of volts range) down to distribution voltages
- Stabilizes voltage going into distribution lines via voltage regulators, to prevent under- and over-voltage conditions.
- It often has circuit breakers and switches so that the substation can be disconnected from the transmission grid or separate distribution lines can be disconnected from the substation when necessary.

The objectives of the rehabilitation are mainly:

- Improve the voltage level and system stability
- Improve socio-economic circumstances by providing a readily available electricity supply;
- Increase revenue base for Transmission Company of Nigeria (TCN) and identify requirements for responsible public engagement
- Create job opportunities within the localities.

3.2 Project Scope

The four (4) proposed sites are existing 132/33 KV Transmission Substations commissioned over thirty (30) years ago with the quality of electricity supply deteriorated over the years due to low capacity of infrastructure occasioned by attendant load demand of an ever increasing population and/or development. The existing equipment are over-stretched, obsolete and/or damaged as a result of over loading, poor maintenance and system faults/failures.

The scope of the project work in the Transmission substations shall include the following:

- Upgrade and/or installation of power transformers (replacement of lower to higher capacity).
- Replacement of obsolete isolators, circuit breakers (CBs), current Transformers (CTs) etc
- Provision of spares of accessories for use during emergencies

3.2 Scope of Rehabilitation / Reinforcement

3.2.1 Sagamu (Ogun State) 132/33 KV Transmission substation

- The scope of rehabilitation process covers the installation and commissioning of 1 X 60MVA Transformer with all associated equipment (132kV and 33kV) Earthing transformer, circuit breakers, isolating switches, surge arresters, VT's, earth switches, post and string insulators, structures, overhead conductors.
- Conversion of 33kV indoor circuit breakers to outdoor, Construction of Perimeter wall fence and Re-gravelling of 132 and 33KV Switch yards.

3.2.2 Akwa (Anambra State) 132/33 KV Transmission substation

- installation and commissioning of 2 X 60MVA Transformer with all associated equipment (132kV and 33kV) Earthing transformer, circuit breakers, isolating switches, surge arresters, VT's, earth switches, post and string insulators, structures, overhead conductors.
- Asphalt access Road with Drainages on both sides and
- It includes all works, services and supply of new equipment, adaptation of all equipment and whatever that may be necessary to be done to deliver the new station as specified with control/protection equipment, associated cabling and civil works.
- Drilling of borehole

3.2.3 Yandev (Benue State) 132/33 KV Transmission substation

- The scope of rehabilitation covers delivery, installation and commissioning of 1 X 60 MVA Transformer with all associated equipment (132kV and 33kV) Earthing transformer, circuit breakers, isolating switches, surge arresters, VT's, earth switches, post and string insulators, structures, overhead conductors and extension of 132kV Busbar .

- Renovation of Perimeter wall fence , staff quarters and Gate house,

3.2.4 Gasau (Zamfara State) 132/33 KV Transmission substation

- The scope of rehabilitation process covers the installation and commissioning of 1 X 60MVA Transformer with all associated equipment (132kV and 33kV) Earthing transformer, circuit breakers, isolating switches, surge arresters, VT's, earth switches, post and string insulators, structures, overhead conductors.
- Construct perimeter fence
- Drill borehole
- Resolve legal issues on Land dispute

CHAPTER FOUR
SAGAMU 132/33 KV TRANSMISSION SUBSTATION
ENVIRONMENTAL AND SOCIAL BASELINE

4.1: Introduction

The substation was commissioned in the late 1960s and has been functional for over 35 years. The transmission substation receives power from 132 KV from Ikorodu station via Cement and Ibadan via Ayede station. Sagamu transmission substation also transmits 132 KV to Ijebu Ode transmission substation. The system is a double – bus scheme. The incoming power is 132 KV and transferred to main bus through isolator-circuit breaker-isolator combination. The power from main bus is fed into Two (2) power transformers (2 Elta 60 MVA) which steps the voltage down to 33KV. The power is then fed into a 33KV bus from which different loads then transferred to distribution system through Eight (8) feeders (T1 power transformer feeds Sagamu, Real, Babcock University, Cephass, Ikene) and (T2 power transformer feeds Metafric, NNPC Ogijo, Remo) to meet the requirements of the end consumers at their suitable voltage.

The Substation is situated in Sagamu, Ogun State along Sagamu-Ijebu-ode express way, about 63km from Lagos. Most of the equipment in the substation were all installed and commissioned in 1978.

132kV Switchyard: The station has 2 x 30MVA transformers with a Double bus bar configuration and two incoming 132kV lines.

33 kV Switchyard: There are six (6No.) 33kV indoor outgoing feeders which are over loaded.

Control Building: The control Panels of the equipment for the substation are housed in a building that consists of control room, battery room, communication room, Supervisor’s office, toilet, bath and a store with no space for the installation for additional equipment. The protection/control panels in the control room are very old with obsolete electromechanical relays. There are 110 V and 48 V battery banks with chargers in the control room which are in good condition.

Table 3.1: Transformers within Sagamu 132/33 KV transmission substation

S/N	Description	Type	Year of Manufacturing
1.	Elta 60MVA 132/33KV (T1)	Power	1979
2.	Elta 60MVA 132/33KV(T2)	Power	1979
3.	60 MVA 132/33 (Unconnected)	Power	New

4.2: Environmental Baseline

4.2.1: Project Location

Sagamu with 68.03 square km land area is located within latitude 6°50' and 7°00' N and longitude 3°45' and 4°00' E and is the third largest settlement in Ogun state after Abeokuta and Ijebu Ode. Sagamu is the part of the Yoruba cultural region of south-western Nigeria. Sagamu stands on a low-lying gently undulating terrain with altitude ranging between 30 and 61 m above sea level. Sagamu is a city and the headquarters of the Local Government Area of the same name in south-western Nigeria located in Ogun State near the Ibu River. The Sagamu region is underlain by major deposits of limestone, which is used in the city's major industry, the production of cement. The transmission station owned by the Federal Government of Nigeria (FGN) is managed by Transmission Company of Nigeria (TCN) receives 132/33kv from Ikorodu station via Cement and Ibadan via Ayede station. Sagamu transmission substation also transmits 132/33kv to Ijebu Ode transmission substation.



Plate 10: Substation Extension work in progress



Plate 11: 33kv outdoor switch yard to be relocated

4.2.2: Climate and Meteorology

The area is characterized by high annual temperature, high rainfall, high evapotranspiration and high relative humidity which makes it to be classified as humid tropical region. The climate of Sagamu and Ogun State in general follows a tropical pattern with the raining season starting about March and ending in November, followed by dry season. The rainy season lasts from March/April to October/ November and the dry season which lasts for the rest of the year, October/November till March/April.

The mean annual rainfall varies from 1280 mm in the southern parts of the State to 1050 mm in the northern areas. The average monthly temperature ranges from 23°C in July to 32°C in February. The Central part of the state where Sagamu is located falls in the rain forest belt. The temperature is relatively high during the dry season with the mean around 30°C. The harmattan, brought in the north-easterly winds from December February, has ameliorating effects on the dry sea son high temperatures. Low temperatures an experienced during the rains, especially between July and August when the temperatures could be a low as 24°C. The distribution of rainfall varies from about 1000 mm in the western part to about 2000 mm the eastern part. This area falls within the zone characterized by uni-modal rainfall which peaks in August.

Meteorological variables like ambient air temperature, relative humidity, atmospheric pressure, wind speed and direction were collated from the field. Meteorological data from literature reviews within the axis of the proposed project were used to augment the obtained data.

Table 4.1: Meteorological results

Location	AQ1	AQ2	AQ3	AQ4	AQ5
	Control room area	Transformer area	Extension area	Gate area	Community
	NO6° 51'50.6" EOO3° 39' 13.5"	NO6° 51'49.2" EOO3° 39' 16.3"	NO6° 51'51.9" EOO3° 39' 16.5"	NO6° 51'49.5" EOO3° 39' 12.0"	NO6° 51'49.9" EOO3° 39' 13.3"
Temperature, °C	30.0	31.5	31.1	31.5	31.8
Wind Direction	S	SE	SE	SE	SE
Atm. Pressure, mbar	1042	1042	1042	1041	1041
Wind Speed, m/s	2.50	2.80	3.40	3.90	3.10
Rel. Humidity (%)	77.0	68.0	70.0	69	58

Source: Field work 2015

The relative humidity during field measurements was between 58% and 77%. Analysis of the long term yearly data (1990-2010) shows that the range of relative humidity for Ogun state was 68% to 91%. (Source: Ogun Osun River Basin Development Authority). The wind speed and direction analysis determines the speed of pollutants movement in the air and in what direction at a particular time and place. The diurnal wind speed values obtained during field work was between 2.50 to 3.90 m/s.



Plate 12: Oke-mabinu Ilaye dual carriage way in Sagamu



Plate 13: Sampling at the substation entrance gate with a disturbed forest at background

4.2.3: Air Emissions and Ambient Air Quality

The states of the ambient air in a given environment often depend on a combination of meteorological conditions and cumulative local emission sources. Polluted air contains undesirable materials which may damage human health, vegetation, infrastructure, and/or the global environment. Air Sensitive Receivers (ASRs) identified within the site was residential house at close proximity to the transmission substation. The general air quality of the transmission substation area was relatively good and devoid of obnoxious gases, however high concentration of pollutant gases (e.g. CO) was recorded on the perimeter of the site as a result of vehicular movement and other anthropogenic activities along the two roads bordering the transmission substation (Sagamu – Ore Highway and the Highway – Sagamu township road).

Table 4.2: Air Quality parameters and Results

Location	AQ1	AQ2	AQ3	AQ4	AQ5	WHO Limits (24 hours)	FME _{env} Limit (µg/m ³)
	Control room area	Transformer area	Extension area	Gate area	Community		
	NO6° 51'50.6" EOO3° 39' 13.5"	NO6° 51'49.2" EOO3° 39' 16.3"	NO6° 51'51.9" EOO3° 39' 16.5"	NO6° 51'49.5" EOO3° 39' 12.0"	NO6° 51'49.9" EOO3° 39' 13.3"		
CO, µg/m ³	<1.0	<1.0	1.0	8.0	5.0	NA	11.4
C _x H _y , µg/m ³	<0.01	<0.01	0.01	<0.01	<0.01	NA	160
NO _x , µg/m ³	<0.01	<0.01	<0.01	0.60	0.40	200	75.0 - 112
SO _x , µg/m ³	<0.01	<0.01	<0.01	1.40	1.00	20	260
SPM, µg/m ³	25.0	10.0	150.0	210.0	75.0	50	250

Source: Field work 2015

The Nitrogen Oxides (NO_x) of interest are nitric oxide (NO₂) and nitrous oxide (NO). The concentration of NO_x measured ranged between <0.01 µg/m³ to 0.60 µg/m³. Nitrogen oxides are products of high temperature combustion like vehicle engines, power plants domestic fires and industrial combustions.

SO₂ is a more important oxide of sulphur as a primary pollutant, and is formed from the oxidation of sulphur containing fuels. Fossil fuel combustion by electrical utilities and industry is the primary source of sulphur dioxide. A range of chronic and acute health impacts may result from human exposure to sulphur dioxide (SO₂). SO₂ can irritate the respiratory system; in case of short-term high exposure, a reversible effect on lung functioning may occur, according to individual sensitivity (WHO, 1999). The SO₂ concentration of 1.40 µg/m³ and 1.00 µg/m³ was recorded at the entrance gate of the transmission substation and inside the community as a result of anthropogenic activities.

Carbon Monoxide a product of incomplete combustion (oxidation) of fossil fuels or hydrocarbons recorded a high concentration of 8.0 µg/m³ and 5.0 µg/m³ at the entrance gate of the transmission substation and community respectively.

Light particles (Usually dust, fly ash) or other materials found suspended in the atmosphere and carried around by the wind are termed Suspended Particulate Matter (SPM) ranged from $10 \mu\text{g}/\text{m}^3$ – $210 \mu\text{g}/\text{m}^3$.

4.2.4 Noise and Ozone

Prolonged exposure to noise of value higher than regulatory limits can result in temporary loss of hearing (temporary threshold shift) or permanent loss (permanent threshold shift). Noise in the form of buzzing or humming can be heard around transformers or high voltage power lines producing corona. Ozone, a colorless gas with a pungent odor, may also be produced. Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The noise level within the station complied with Federal Ministry of Environment (FMEnv) and World Bank Standards are presented in the following Table.

Table 4.3: Noise level results

Location	AQ1	AQ2	AQ3	AQ4	AQ5	IFC EHS Noise limits	FMEnv Limit dBA
Noise, dBA	Control room area	Transformer area	Extension area	Gate area	Community		
	NO6° 51'50.6" EOO3° 39' 13.5"	NO6° 51'49.2" EOO3° 39' 16.3"	NO6° 51'51.9" EOO3° 39' 16.5"	NO6° 51'49.5" EOO3° 39' 12.0"	NO6° 51'49.9" EOO3° 39' 13.3"		
	55.0	69.3	60.0	73.0	65.0	80	90

Source: Field work 2015

4.2.5: Soil Characteristics

Soils in the Sagamu area of the transmission substation are ferrallitic in nature. Ferrallitic soils are sometimes called lateritic soils. The ferrallitic soils included red-yellow, red, laterite (with a laterite horizon) and ferrallitic-grey in colour. These are soils that form in the humid tropics as the result of chemical weathering and by the accumulation of humus beneath forest vegetation. They typically have low silica content and a high content of aluminum and iron. They soil on the whole are very permeable and retain little water. The following Table present Soil analysis of targeted parameters.

Table 4.4: Soil results

Location	AQ1	AQ2	AQ3	AQ4	AQ5
pH	Control room area	Transformer area	Extension area	Gate area	Community
	NO6° 51'50.6" EOO3° 39' 13.5"	NO6° 51'49.2" EOO3° 39' 16.3"	NO6° 51'51.9" EOO3° 39' 16.5"	NO6° 51'49.5" EOO3° 39' 12.0"	NO6° 51'49.9" EOO3° 39' 13.3"
	5.98	5.85	6.20	6.10	6.60
THC, mg/kg	<0.01	5,450	0.50	<0.01	4.50
PCB, $\mu\text{g}/\text{g}$	<0.01	65.0	<0.01	<0.01	<0.01

Source: Field work 2015



Plate 14: Soil sampling from extension area



Plate 15: sampling contaminated soil for analysis

4.2.6: Vegetation

Sagamu has two main types vegetation, namely, tropical rain forest and guinea savanna. The tropical lowland rain forest is found in the southern and eastern parts of the local government area, where the transmission substation is sited. Guinea and derived savanna are found most of the western and northern of Sagamu. A total of 15 tree/shrub species in 9 families and 13 herbaceous species in 7 families were observed to exist in the proposed transmission substation rehabilitation/reconstruction area. Within these species compositions, nearly all of them were saplings/wilding seedlings of the various tree/shrub species. Based on this, a total of eight species was occasionally occurring in the area indicating that the majority of species that existed were less than 50% in the area. The species that were occasional were *Alchornea cordifolia*, *Anthocheistavogelii*, *Baphianitida*, *Anarcadium occidentale*, *Rauwolfia vomitoria*, *Huracrepitans*, *Magnifera indica* and *Anthonatamachrophylla*. Similarly, a total of 10 food crop species were encountered in the area. Cultivated crops in the area were also taken into consideration as they formed part of the vegetation alongside their socio-economic, nutritional and health importance. Sequel to the assertion above, a total of ten crops typologies were enumerated in the area. In the observed ten crop species *Musa Sapientum*, species was the only one abundant. Similarly, *Musaparadisiaca* was also the only common species in the area. It should be noted that no endangered species that are identified according to the national regulations, were observed within the substation vicinity.

4.2.7: Wildlife

In the study area, a total of fifteen wildlife species were observed to exist. Five species were noticed to be abundant and occasionally occurring in the area. The abundant species, were *Agama agama*, *Agama aculeata*, *Opheodrys vernalis*, *Najanigricollis* and occasionally occurring species are *Accipiter gentilis*, *Milvus migrans*, *Carvus albus*, *Caeliferaspp* and *Thryonomys swinderianus*. Furthermore, other four species were seen to be common in area given as *Hirundinidae*, *Ploceidae*, *Rattus fuscipes* and *Varanus varius*. Nonetheless, *Bitis gabonica* was the only rarely occurring species found in the area. The area is neither classified as an environmental sensitive area, nor being used as a habitat for rare

or endangered species. No information was obtained on the occurrence of rare or protected plant or animal species or on the biodiversity conservation situation in the area in general.

Table 4.6: Wild life composition within Sagamu Transmission substation vicinity

S/N	Common name	Scientific name
1	Hawk	<i>Accipiter gentilis</i>
2	Kite	<i>Milvus migrans</i>
3	Pied crow	<i>Corvus albus</i>
4	Agama lizard	<i>Agama agama</i>
5	Swallow	<i>Hirundinidae</i>
6	Grass hopper sp	<i>Caeliferaspp</i>
7	Ground agama	<i>Agama aculeata</i>
8	Weevil bird	<i>Ploceidae</i>
9	Bush rat	<i>Rattus usciipes</i>
10	Grass cutter	<i>Thryonomys anus</i>
11	Olive green snake	<i>Opheodrys vernalis</i>
12	Spitting cobra	<i>Naja nigricollis</i>
13	Gaboon viper	<i>Bitis gabonica</i>
14	African giant rat	<i>Cricetomys gambianus</i>
15	Monitor lizard	<i>Varanus varius</i>

Source: Field work 2015

4.2.8: Land cover

There are various land cover classes within the study area. There are small businesses, auto mechanics, forests, uncultivated areas and structures in the study area. There are no declared nature reserves or wetlands adjacent or near the proposed location. The land-cover types of the factory area are:

- ✓ Forest I (disturbed) 15 %
- ✓ Forest II (undisturbed) 0 %
- ✓ water 0 %
- ✓ Built-up/bare soil 85 %



Plate 16 :Excavation treating Substation & towers



Plate 17 :Business along the boundary of Substation

4.2.9: Land use

The land use pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. The rapidly increasing human populations and expanding anthropogenic activities have brought about extensive land use changes throughout the area. General land use types were observed in the site area. The majority of the land use along this section of the road is low density residential/agricultural area. The other types of the land use in the area are scrapped metal gatherers, poultry and a church.

4.2.10: Geology

Geology of Ogun state in which Sagamu - the study area is a part, comprises of sedimentary rocks which underlie approximately three-quarters of the whole surface area of the state stretching from the northwest to the southeast and Basement complex rocks which underlie the remaining one-quarter of the surface of the state (Kehinde-Phillips 1992).

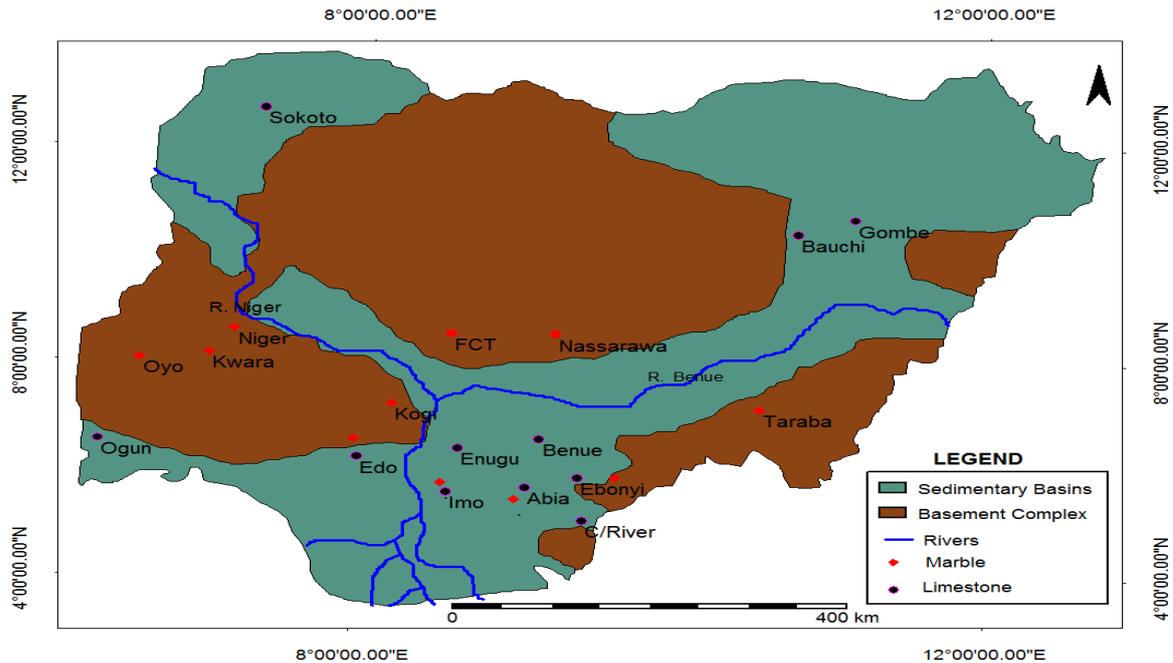


Figure 4.1: Geological map of Nigeria showing limestone and marble occurrences

4.2.11: Social Baseline

The area is peopled by a number of ethnic groups in Nigeria though the Remo dialect of the Yoruba language is the main local language. The Sabo area of Offin, Sagamu, can be branded as different for any typical northern town for language, culture and setting. Occupation of the people is mainly farming. The people of Sagamu Local Government area are predominantly farmers and the majority of people work as kola-nut farmers. The major cash crop is kola-nut. Food crops such as cassava, melon maize and yam are however grown as supplement. Agricultural products of the region include cocoa and kola nuts. Sagamu is the largest kola nut collecting center in Nigeria. The kola nut industry supports several secondary industries such as basket and rope manufacturing, which are used to store the kola nuts.

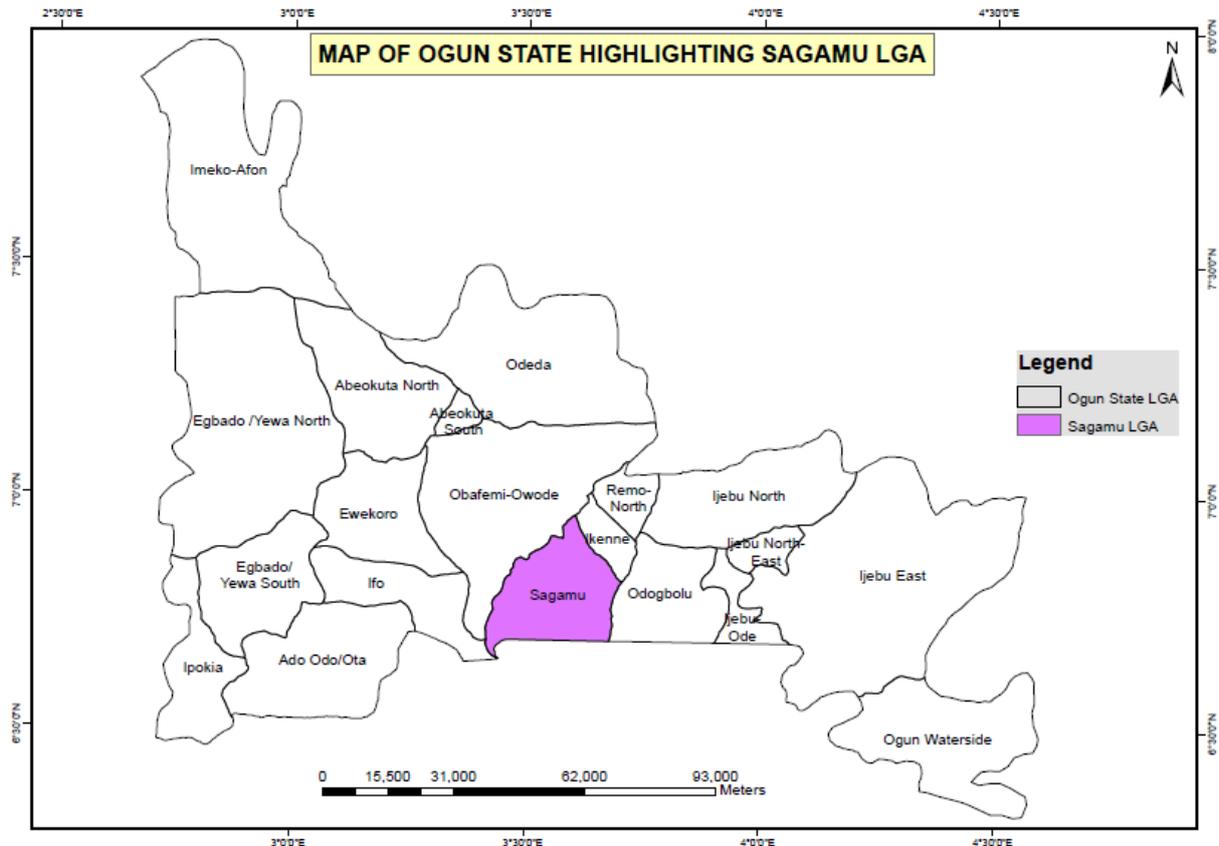


Figure 4.2: Administrative map of Ogun State showing Sagamu LGA.

The population of Sagamu in 1991 was 127,513 and 253,412 in 2006 census (123,801 males and 129,611 females). The two dominant religions in the area are Christianity and Islam. A small proportion of the people still practice traditional religion. Sources of electricity in Sagamu are the national grid owned and operated by the Transmission Company of Nigeria (TCN) and distributed to consumers through the Ibadan Electricity distribution Company (IEDC), private generators, hurricane lamps and wax candles. The major expressway passing through the area from Lagos to the Eastern parts of the Country, namely, the Sagamu-Benin Expressway is the main road connecting Sagamu to other parts of Nigeria. Traffic volumetric survey was conducted to establish typical patterns of variations in the traffic flow along the specified route. The traffic count on the Oke-mabinu Ileaye dual carriage road in front of the transmission substation was conducted for eight (8) hours. The traffic record of 2128 Cars/min buses, 1136 motorcycles/tricycles and 448 trucks moving from North to South of Station site (Sagamu – Benin Expressway into Sagamu township through Oke-mabinu Ileaye dual carriage way). While a traffic count of movement from South to North of site (Sagamu township through Oke-mabinu Ileaye dual carriage way to Sagamu – Benin Expressway) with 2784 Cars/mini buses, 1760 motorcycles/tricycles and 416 trucks.

Agriculture is the main occupation of the people, providing income and employment for a large percentage of the population. The area is blessed with a conducive climate that supports cultivation of a variety of crops such as yam, cassava, maize, rice, plantain, beans, vegetables and citrus fruits such as orange, paw-paw, pineapple and so on. The main cash crops produced in the area are

cocoa, cashew, kola nut, oil palm and palm kernels, rubber and coffee. The physical observation of the site and information gathered from the stakeholders during the consultations revealed that the region had been inhabited since historical times by the natives and there are no official records for any natural (biodiversity, geodiversity, ecosystem types etc.) and cultural (artifacts, monuments, works of arts, landscapes, and ancient buildings) heritages presents in or within the surrounding area of the transmission substation. However the region is rich in folklore, tradition, knowledge, native languages which will not be impacted by the proposed project.



Plate 18: stakeholders consultation



Plate 19: Consultants with head of Community

4.2.12: Stakeholders Consultation

A consultative process is critical in order to inform project beneficiaries and key stakeholders of the project, to receive and include their input in the design and implementation and address concerns. For the Rehabilitation/Reinforcement of 132/33kv Transmission Sub-station meetings with immediate community affected by the substation were organized and conducted. These meeting took place during the period of the Environmental and Social Management Plan (ESMP) field work. The stakeholder consultation was undertaken among people living near the site of the transmission substation in Sagamu (Oke mabinu Ileaye). The aim was to ensure that stakeholder interests were consulted and incorporated in the project development, implementation and operation. Such meetings enable interested and affected parties to contribute their concerns (views and opinions on the proposed Rehabilitation/Reinforcement project). Findings of stakeholder analysis were very important in predicting impacts and development of this ESMP.

The Consultants explained the importance of the Rehabilitation/Reinforcement project and the anticipated positive and negative impacts of the project. Also the benefits form upgrading the existing facilities that will result in benefit of Sagamu and the society. The Rehabilitation/Reinforcement project will contribute to social and environmental development, and raise the reliability of electric networks. Moreover, it will solve many dilemmas related to the electric sector; supplying electricity to the area with high efficiency. It was pointed out that negative impacts are minimal, temporary, and site-specific and can be mitigated.

In the meetings, it has been stressed that substation will act as one of the center points for the transmission system, which as a result will promote the power sector. Sagamu residents especially

Oke-mabinu Ileaye area looked forward for additional benefits that the people can get from the project like being eligible for improved electricity as an incentive for accepting the Rehabilitation/Reinforcement of 132/33kv substation. Matters pertaining to power supply and stability, occupational health and safety and expected health hazards were the major concerns to the local residents.

Concerns Raised In Consultation Meetings

The Project affected population had no serious concerns and all people interviewed supported the Rehabilitation/Reinforcement project. However, few concerns were raised which are presented in the below and minutes of the consultation meeting attached as an appendix. The consulting team and substation supervisor assured the stakeholders responded that all their concerns were important and shall be documented and addressed accordingly.

Concern/Issue	Comments by Stakeholders (Q) /Consulting Team Response (A)	
Employment:	Q.	-The area residents requested to be first considered when employment vacancies arise most especially during the construction phase
	A.	-The contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase
Quality Jobs:	Q.	-The firm should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g. operators
	A.	-The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.
Social Corporate Responsibilities:	Q.	-The locals want the firm (TCN) to take part in their developmental activities. e.g. sinking borehole etc.
	A.	-The firm is a Government social service agency and therefore limited in executing CSR.
Stakeholders Engagement:	Q.	-The residents of the area will need information of impending work that will affect their environment. e.g. traffic, noise etc.
	A.	The stakeholders consultation and engagement will be continues through the life span of the project.

4.3: Findings of Auditing Sagamu Substation

This subsection presents the findings of the conducted audit of the substation and provides the recommended short medium and long term standard operation procedures SOPs to bring the existing substation into compliance with applicable national and international standards. The following sections provide the anticipated impacts assessment, management and monitoring plans for the proposed rehabilitation project.

4.3.1: Building Materials

The predominant material used in construction of the Transmission station control room is concrete. The fencing is of wire mesh which is only around the electrical installation area and not the entire owned boundary of the transmission substation. Asbestos Containing Materials (ACM) were not observed during the Site Visit.

Recommendation: No Asbestos containing materials were observed therefore no SOPs are recommended in this regard.

4.3.2: Water Supply, Effluents and Storm water Drainage

Groundwater is only source of water supply in the transmission substation. The Sagamu transmission substation has a motorized functional borehole and an open dug well of 24.2 meters water depth. Generally hand-dug well source for potable water supply is under threat from pollution either from human life style manifested by the low level of hygiene practiced. Ogun state government municipal water scheme assisted by the World Bank located about 600 meters away from the transmission substation serves the project community. The quality of the water supply was determined by collection of representative sample and carrying out analysis.



Plate 11: Substation Hand dug well



Plate 12: Motorized borehole

Table 4.7: Water Quality Results

PARAMETER	Open dug well	Borehole	FME _{env}	WHO Limits
pH	7.21	6.84	6.5 – 8.5	6.5 – 8.5
Temperature, °C	27.2	29.1	NA	NA
TDS, mg/l	14.5	18.6	500	1000
Conductivity, µs/cm	27.0	34.0	NA	NA
DO, mg/l	2.40	2.20	7.5	NA
Alkalinity (mg/l)	0.001	<0.0001	NA	10
Hardness (mg/l)	17.0	24.0	200	100
Turbidity (mg/l)	2.83	2.83	1.0	5.0
Salinity as Cl ⁻ (mg/l)	17.75	17.75	250	250
TSS (mg/l)	0.004	0.002	<10	10
Cd (mg/l)	0.26	0.37	0.01	0.003
Pb (mg/l)	0.211	0.205	0.05	0.05
Hg (mg/l)	<0.001	<0.001	0.001	<0.001
Fe (mg/l)	0.725	1.09	1.0	0.3
Cr (mg/l)	0.08	0.056	0.05	0.05
Zn (mg/l)	2.31	3.24	5.0	3.0

Source: Field work 2015

The station building conveniences and waste water are channeled into a soak away pit. This soak-a-way pit system is an underground soil treatment system, which receives partially treated sewage from the septic tank. Storm water drainage system designed to drain rain water from the facility do not exist within the station only around the perimeter fence. Cable trenches function as drainage systems for evacuating water from the station. The Storm drains observed are unable to contain the quantity of rain that falls during heavy down pour.



Plate 13: Substation Soak away pits



Plate 14: Inspecting the oil drain pit

▪ **4.3.3: Waste Production and Disposal**

The management of waste at the transmission substation was identified in detail, and quantities noted of each of the various categories of wastes and their rate of generation over time. Waste management in the transmission substation could be significantly improved. Wastes were not sorted/segregated into the different waste streams but are dumped haphazardly and disposal was by open burning thereby polluting the ambient air and creating an unhealthy environment which promotes diseases/health conditions. Waste collection points are major attraction for insects and rodents which in turn attracted reptiles especially snakes.

Scrapped materials such as breakers, cables, electric poles were found littered within the transmission substation which could lead to accidents, crawling animals like snakes or even rodents could hide under the machines. There is no demarcated place used as scrap area.



Plate 15: unsegregated waste at dump site



Plate 16: Poor housekeeping of scrapped materials

4.3.4: Hazardous Materials

Hazardous materials in this sector include insulating oils / gases (e.g. Polychlorinated Biphenyls [PCB] and sulfur hexafluoride [SF₆], and fuels, in addition to chemicals or products for wood preservation for poles and associated wood construction material. Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. They are typically found in the largest quantities at electrical substations and maintenance shops. Sulfur Hexafluoride (SF₆) is used as a gas insulator for electrical switching equipment especially in the breaker units as an alternative to insulating oils at Sagamu transmission substation. However, the use of SF₆, a greenhouse gas with a significantly higher global warming potential (GWP) than CO₂, should be minimized. In cases the gas is used for applications involving high voltages (>330 KV), equipment with a low leakage- rate (<99 percent) should be used.

Liquid petroleum fuels for equipment such as the diesel generator is stored at transmission substation in an above ground cylindrical metal container with no bound wall underneath in the event of a spill. Prevention and control of hazards associated with spill prevention, emergency response, clean-up, and contaminated soil remediation are not addressed in the station administration.

Polychlorinated Biphenyls (PCB) were widely used as a dielectric fluid to provide electrical insulation, although their use has been largely discontinued due to potential harmful effects on human health and the environment, however traces of PCB were detected in the contaminated soil samples analyzed. Due to their low vapor pressure, PCBs accumulate primarily in the hydrosphere, in the organic fraction of soil, and in organisms.

Old manufactured power transformers like the ones in Sagamu transmission substation (1970) are a major legacy source of PCBs. Even units not originally filled with PCB may be contaminated, since PCB and oil mix freely and any given transformer may have been refilled from hoses or tanks also used with PCBs.

The soil analysis in the transformer area indicated that soil is contaminated with PCBs therefore the recommended measures shall be implemented.

Recommendations are provided in Appendices A

4.3.5: Occupational Health and Safety

These impacts include, among others, exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust and noise; falling objects; work in confined spaces; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Occupational health and safety hazards specific to electric power transmission operation and projects primarily include live power lines, working at height, Electric and magnetic fields (EMF) and exposure to chemicals.

Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines. Although there is no empirical data demonstrating adverse health effects from exposure to typical Electric and magnetic fields (EMF) levels from power transmissions lines and equipment. Electric fields are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and increase in strength as the current increases.

Switch yards is the main source of EMF. The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a non-governmental organization formally recognized by the World Health Organization, has set guidelines exposure limits for public and occupational exposure to EMF for ac systems, as indicated in the following table¹.

¹ Source: ICNIRP (1998): "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

ICNIRP Guidelines for EMF public and occupational exposure

Electric Field (V/m)	Magnetic Field (mG)	Electric Field (V/m)	Magnetic Field (mG)
5,000	1,000	10,000	5,000
4,150	830	8,300	4,150

It should be noted that no safety signs exist anywhere within the station and outside the station warning people of danger equipment and zones. Also, the station is under staffed with only 2 operational staff and 1 supervisor running 24hr shifts instead of the standard number of 6 operators and 1 supervisor on 8 hours shift.

Transmission Company of Nigeria (TCN) safety department handles all matters relating to Health, Safety and Environment from regional and sub-regional administrative offices at Ayede, Ibadan in Oyo state and Osogbo in Osun state respectively. Safety officers from the regional and sub-region pay infrequent visit and consequently making environmental awareness and compliance low at transmission substations. The operators and safety officers are not well trained in Health, Environment and safety.

Recommendations are provided in Appendices A

4.3.6: Personal Protective Equipment (PPE)

Personal protective equipment (PPE) was provided for the staff at the transmission substation, however inadequate in terms of number provided (per-station instead of per-person) frequency of change and type. The non-use of PPE causes and leads to various forms of incidents/accidents ranging from loss of limbs, burnt skin, and blindness from transformers explosions, electrocution and even death in few instances.

It should be noted that no accident monitoring records were obtained during the site visit to Sagamu Transmission substation.

Recommendations are provided in Appendices A

4.3.7; First Aid

First aid as the provision of initial care for an illness or injury is essential and necessary in high risk work areas like a transmission substation. A collection of supplies and equipment (first aid box) for use in giving first aid for minor ailments and primary care is not available in the transmission substation. The operational staff is not trained in any form of first aid.

Recommendations are provided in Appendices A

4.3.8: Fire and Emergency Precautions

Fire extinguisher canisters were available but were expired and not calibrated. Fire and explosion, dangers of fire hazards arise from electrical short circuiting and lightning. There are no smoke detectors, fire alarms, fire hose and hydrants available within the substation. The transmission substation operators have little or no training in firefighting.

Recommendations are provided in Appendices A

4.3.9: Housekeeping

Housekeeping within and outside the Sagamu transmission substation was observed to be generally could be significantly improved. Discarded items, used drums; scrapped panels and furniture were observed kept around the premises of transmission substation. They constitute a health hazard because they have the potentials to cause accidents like falls, cuts, lacerations and serve as breeding grounds for rodent and insects which attract reptiles like snakes.

Recommendations are provided in Appendices A

- **Site Security**

Security lights are inadequate at night for proper visibility and needs to be improved upon. Armed soldiers, Nigerian security and civil Defense corps and members of the Nigerian Legions were observed manning the entrance of the substation. The communities have well defined ways of handling crime and security issues. They adopt the method of mitigating against crime and security issues through the formation of vigilante Groups or community policing.



Plate 17: 60 MVA transformer yet to be connected



Plate 18: Wire mesh fence with over grown vegetation

Recommendations are provided in Appendices A

Kindly refer to Appendix D for Laboratory certified analysis report

CHAPTER FIVE

AWKA (NIBO) 132/33 KV TRANSMISSION SUBSTATION ENVIRONMENTAL AND SOCIAL BASELINE

5.1: Introduction

The Substation is situated in Awka the capital of Anambra State which is about one hour drive from Enugu Airport. The station is also about 45 minutes' drive from Onitsha also in Anambra State. Most of the equipment in the substation was all installed and commissioned in 1976. The switchyard operates a single bus scheme electrical system. The transmission substation receives 132/33kv from Onitsha – Nibo – Orji River line.

The incoming power is 132 KV and transferred to main bus through isolator-circuit breaker-isolator combination. The power from main bus is fed into Two (2) power transformers (2 x 30MVA) which steps the voltage down to 33KV. Nibo transmission substation also transmits 33/11kv to four (4) feeders (Neni, Agulu, TR2 and TR4) to meet the requirements of the end consumers at their suitable voltage. Two distribution transformers (TR2 and TR4) are situated inside the switchyard.

The Substation is situated in Awka the capital of Anambra State which is about one hour drive from Enugu Airport. The station is also about 45 minutes' drive from Onitsha also in Anambra State. Most of the equipment in the substation was all installed and commissioned in 1976.

132kV Switchyard: The 132kV switchyard is a Single bus bar configuration with two incoming 132kV lines. The Substation has 2 x 30MVA, 132/33kV Transformers (T1 & T2). The transformers are in good condition but are overloaded.

33 kV Switchyard: There are four (4No.) 33kV outdoor outgoing feeders which are over loaded.

Control Building: The control/protection Panels of equipment for the substation is to be installed in the existing control room. The existing control building consists of control room, battery room, communication room, Supervisor's office, toilet, bath and a store with no space for the installation for additional equipment, thus requiring renovation and extension. The protection/control panels in the control room are very old with obsolete electromechanical relays that will be converted to Digital substation Control System (DSCS). There are 110V and 48V battery banks with chargers in the control room which are in good condition.

Table 5.1: Transformers within Awka (Nibo) 132/33 KV transmission substation

S/N	Description	Type	Year of Manufacturing
1.	(TR1) ABB 30MVA 132/33KV	Power	1989
2.	(TR3) Powell Trafo 30MVA 132/33KV	Power	1986
3.	(TR2) Elprom Energo 15MVA 33/11KV	Distribution	1999
4.	(TR4) Brush 15MVA 33/11KV	Distribution	2002

5.2: Environmental Baseline

5.2.1: Project Location

Awka is situated in Awka South, Anambra, Nigeria with geographical coordinates is 6° 10' 0" North, 7° 4' 0" East and its original name (with diacritics) is Awka Nise. The area lies below 300 metres above sea in a valley on the plains of the Mamu River. Two ridges or cuestas, both lying in a North-South direction, form the major topographical features of the area. The ridges reach the highest point at Agulu just outside the Capital Territory. About six kilometres east of this, the minor cuesta peaks about 150 metres above sea level at Ifite –Awka. Awka situated within Awka capital territory and sited in a fertile tropical valley but most of the original rain forest has been lost due to clearing for farming and human settlement. The transmission station receives 132/33kv from Onitsha – Awka – Orji River Line. Awka (Nibo) transmission substation also transmits 33/11kv to four (4) feeders (TR2, TR4, Neni and Agulu).



Plate 19: Original designed access road to station yet to be constructed



Plate 200: Power transformer and concrete control room building in background

5.2.2: Climate and Meteorology

Awka is in the tropical rainforest zone of Nigeria and experiences two distinct seasons brought about by the two predominant winds that rule the area: the south-western monsoon winds from the Atlantic Ocean and the north-eastern dry winds from across the Sahara desert. The monsoon

winds from the Atlantic creates seven months of heavy tropical rains, which occur between April and October and are followed by five months of dryness (November - March). The harmattan, also known as Ugulu in Igbo, is a particularly dry and dusty wind which enters Nigeria in late December or in the early part of January and is characterized by a grey haze limiting visibility and blocking the sun's rays. The temperature in Awka is generally 27-30 degrees Celsius between June and December but rises to 32-34 degrees between January and April, with the last few months of the dry season marked by intense heat. The secondary data acquired for this study was monthly rainfall for Awka from 1977 – 2012.

Meteorological variables like ambient air temperature, relative humidity, atmospheric pressure, wind speed and direction were collated from the field. Meteorological data from literature reviews within the axis of the proposed project were used to augment the obtained data.

Table 2.2: Meteorological results

Location	AQ1	AQ2	AQ3
	Transformer area	Gate area	Community
	N06° 12' 34.5" E007° 04' 13.4"	N06° 12'39.2" E007° 04' 16.1"	N06° 12'49.9" E007° 04' 12.3"
Temperature, °C	31.2	30.1	29.9
Wind Direction	SE	S	S
Atm. Pressure, mbar	1034	1034	1040
Wind Speed, m/s	4.60	4.80	2.10
Rel. Humidity (%)	61.0	72.0	78

Source: Field work 2015

The relative humidity during field measurements was between 61% and 78%. Awka has a tropical climate. Analysis of the long term yearly data shows that the average annual temperature is 26.6 °C. The average annual rainfall is 1506 mm. The driest month is December, with 8 mm of rainfall. With an average of 281 mm, the most precipitation falls in September. The warmest month of the year is March, with an average temperature of 28.7 °C. August has the lowest average temperature of the year, with 24.7 °C. The difference in precipitation between the driest month and the wettest month is 273 mm. During the year, the average temperatures vary by 4.0 °C. Diurnal wind speed values obtained during field work was between 2.10 to 4.810 m/s. The wind speed and direction analysis determines the speed of pollutants movement in the air and in what direction at a particular time and place. The secondary source of data was obtained from the Nigeria Meteorological Agency, Amawbia Station (located within Awka capital territory).

5.2.3: Air Emissions and Ambient Air Quality

The state of the ambient air in a given environment often depends on a combination of meteorological conditions and cumulative local emission sources. Polluted air contains undesirable materials which may damage human health, vegetation, infrastructure, and/or the global environment. Air Sensitive Receivers (ASRs) identified within the site was residential house at

close proximity to the transmission substation. The general Air quality of the substation area was relatively good and devoid of obnoxious and pollutant gases, however high concentration of gases was recorded in the community as a result of anthropogenic activities).

Table 5.3: Air Quality parameters and Results

Location	AQ1	AQ2	AQ3	WHO Limits (24 hours)	FME _{env} Limit ($\mu\text{g}/\text{m}^3$)
	Transformer area	Gate area	Community		
	N06° 12' 34.5" E007° 04' 13.4"	N06° 12'39.2" E007° 04' 16.1"	N06° 12'49.9" E007° 04' 12.3"		
CO, $\mu\text{g}/\text{m}^3$	<1.0	<1.0	2.0	NA	11.4
C _x H _y , $\mu\text{g}/\text{m}^3$	25.0	<0.01	5.0	NA	160
NO _x , $\mu\text{g}/\text{m}^3$	<0.01	<0.01	1.25	200	75.0 - 112
SO _x , $\mu\text{g}/\text{m}^3$	<0.01	<0.01	2.50	20	260
SPM, $\mu\text{g}/\text{m}^3$	15.0	50.0	45.0	50	250

Source: Field work 2015

The Nitrogen Oxides of interest are nitric oxide (NO₂) and nitrous oxide (NO). The concentration ranged between <0.01 $\mu\text{g}/\text{m}^3$ to 1.25 $\mu\text{g}/\text{m}^3$. Nitrogen oxides are products of high temperature combustion like vehicle engines, power plants domestic fires and industrial combustions. SO₂ is a more important oxide of sulphur as a primary pollutant, and is formed from the oxidation of sulphur containing fuels. Fossil fuel combustion by electrical utilities and industry is the primary source of sulphur dioxide. A range of chronic and acute health impacts may result from human exposure to sulphur dioxide (SO₂). SO₂ can irritate the respiratory system; in case of short-term high exposure, a reversible effect on lung functioning may occur, according to individual sensitivity (WHO, 1999). The SO₂ concentration of <0.01 $\mu\text{g}/\text{m}^3$ and 2.50 $\mu\text{g}/\text{m}^3$ was recorded at the Gate and community as a result of anthropogenic activities. Carbon Monoxide a product of incomplete combustion (oxidation) of fossil fuels or hydrocarbons recorded a high concentration of <1.0 $\mu\text{g}/\text{m}^3$ and 2.0 $\mu\text{g}/\text{m}^3$ at the Gate and community respectively. Light particles (Usually dust, fly ash) or other materials found suspended in the atmosphere and carried around by the wind are termed Suspended Particulate Matter (SPM). SPM ranged from 15 $\mu\text{g}/\text{m}^3$ – 50 $\mu\text{g}/\text{m}^3$.

5.2.4: Noise and Ozone

Noise in the form of buzzing or humming can be heard around the transformers or high voltage power lines producing corona. Ozone, a colourless gas with a pungent odour, may also be produced. Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The noise level within the station and in the neighbouring community complied with Federal Ministry of Environment (FME_{env}) and WHO Ambient Quality Guidelines. The noise level within the station complied with Federal

Ministry of Environment (FMEnv) and World Bank Standards are presented in the following Table.

Table 5.4: Noise level results

Location	AQ1	AQ2	AQ3	IFC EHS Noise limits	FMEnv Limit dBA
Noise, dBA	Transformer area	Gate area	Community		
	N06 ⁰ 12' 34.5"	N06 ⁰ 12'39.2"	N06 ⁰ 12'49.9"		
	E007 ⁰ 04' 13.4"	E007 ⁰ 04' 16.1"	E007 ⁰ 04' 12.3"		
	69.4.0	64.6	55.0	80	90

Source: Field work 2015

5.2.5: Soil Characteristics

The terrain is undulating although the station was stabilized and is relatively flat. The area is susceptible to soil erosion Gravel was spread within the Awka (Nibo) transmission substation area. Ferralitic soils are sometimes called lateritic soils. These are soils that form in the humid tropics as the result of chemical weathering and by the accumulation of humus beneath forest vegetation. The cuestas and other elevated areas underlain by sandstones and shales of the Ameke Formation and the Nanka Sands are regions of ferralitic soils. The soils are deep, red to reddish brown loamy sands, often referred to as "re-dearth" or acid sands because of low fertility. They are easily eroded into gullies. Ferruginous soil is rich free iron. However, they vary from the deep - red and brown porous soil derived from sandstones and shale to deep porous brown soil, derived sandstone and clay (UN -HABITAT, 2007). The soil sustains forest vegetation but on the low plains further away from the river they maintain good vegetation cover. The following Table presents Soil analysis of targeted parameters.

Table 5.5 Soil results

Location	AQ1	AQ2	AQ3
pH THC, mg/kg PCB, µg/g	Transformer area	Gate area	Community
	N06 ⁰ 12' 34.5"	N06 ⁰ 12'39.2"	N06 ⁰ 12'49.9"
	E007 ⁰ 04' 13.4"	E007 ⁰ 04' 16.1"	E007 ⁰ 04' 12.3"
	5.50	6.45	6.65
	2,125	<0.01	2.50
	4.80	<0.001	<0.001

Source: Field work 2015

5.2.6: Vegetation

The existing vegetation of the area is mainly cultigens (anthropogenic climax). Further, this section was concerned with impacts of the project on vegetation and wildlife species inter-alia. Consequently, a total of 13 tree/shrub species in 10 families and 10 herbaceous species in 4 families were observed to exist in the area. Similarly, a total of 10 food crop species were encountered in the area. The vegetation in the area is controlled by geologic factors of topography, relief and lithology as well as other anthropogenic factors. The vegetation ranges from light rainforest to savannah. The area supports extensive man-made vegetation community which comprises mainly cashew orchard and palm trees, with thick under growth and numerous climbers especially during the rainy seasons. Natural vegetation marginally the tropical rainforest type. Because of the high population density in the state, most of the forests have been cleared for settlement and cultivation. What exists now is secondary regrowth, or a forest savannah mosaic, where the oil palm is predominant, together with selectively preserved economic trees. Relics of the original vegetation may, however, be found in some "juju" shrines or some inaccessible areas.

Crop species composition in the area are Okro (*Abelmoschus esculentus*), Sugar cane (*Saccharumoffi cinarum*), Cocoyam (*Colocasia esculenta*), Yam (*Dioscorea spp*), Banana (*Musa sapientum*), Plantain (*Musa paradisiaca*), Pawpaw (*Carica papaya*), Cassava (*Manihot esculenta*), Pineapple (*Ananas comosus*) and Bitter leaf (*Vernomiaa mygdalina*).

A total of 33 flora species were observed to have high socio-economic and ethno-botanical value to the residents range from food, medicine, forage, timber and snacks. It should be noted that no endangered species that are identified according to the national regulations, were observed within the substation vicinity.

Table 5.6: Socio-economic/Ethno-botanical value of species

s/n	Vegetation species	Ethno-botanical value
1	<i>Dacryodisedulis</i>	Food, resins
2	<i>Elaeisguinensis</i>	Food, oil
3	<i>Pentaclethramacrophylla</i>	Food, oil
4	<i>Termineliacatapa</i>	Food, ornamental
5	<i>Magnifieraiindica</i>	Food, medicinal
6	<i>Numboldialaervis</i>	Boundary, stakes
7	<i>Ficus exasperate</i>	Medicinal
8	<i>Anthonatamacrophylla</i>	Medicinal
9	<i>Cocusnucifera</i>	Food, oil
10	<i>Alstoniaboonie</i>	Timber

s/n	Vegetation species	Ethno-botanical value
11	<i>Heveabraziliensis</i>	Resins, fuel wood, energy
12	<i>Persea America</i>	Food, medicinal
13	<i>Alchorneacordifolia</i>	Medicinal, snack, forage food, forage.
14	<i>Pennisetumpurpureum</i>	Food, Forage
15	<i>Calapogoniummucunoides</i>	Medicinal, erosion control
16	<i>Panicum maximum</i>	Forage
17	<i>Centrosemapubescens</i>	Medicinal, forage
18	<i>Aspilia Africana</i>	Medicinal
19	<i>Tridaxprocumbens</i>	Medicinal
20	<i>Imperata cylindrical</i>	Forage
21	<i>Sidaacuta</i>	Medicinal
22	<i>Panicumlexum</i>	Forage
23	<i>Chromolaenaodorata</i>	Medicinal/forage
24	<i>Colocasiaesculenta</i>	Food
25	<i>Dioscoreaspp</i>	Food
26	<i>Musa sapientum</i>	Food
27	<i>Musa paradisiaca</i>	Food
28	<i>Carica papaya</i>	Food, medicinal
29	<i>Manihotesculenta</i>	Food
30	<i>Ananascomosus</i>	Food
31	<i>Vernoniaamygdalina</i>	Food, medicinal
32	<i>Saccharumofficinarum</i>	Food
33	<i>Abelmoschusesculentus</i>	Food

Source: Field work 2015

5.2.7: Wildlife

In the study area, a total of 12 wildlife species were recorded. Wildlife species were observed to exist in the Awka (Nibo) transmission station area. Within this number, five species were noticed to be abundantly and occasionally occurring in the area. The abundant species were Agama agama and Agama aculeate. The area is neither classified as an environmental sensitive area, nor being used as a habitat for rare or endangered species. No information was obtained on the occurrence of rare or protected plant or animal species or on the biodiversity conservation situation in the area in general.

Wild life composition in the Awka area are Hawk (*Accipiter gentilis*), Kite (*Milvusmigrans*), Pied crow (*Corvusalbuis*), Agama lizard (*Agama agama*), Ground agama (*Agama aculeate*), Bush rat (*Rattussuscipes*), Grass cutter (*Thryonomys anus*), Olive green snake (*Opheodrysvernalis*), Spitting cobra (*Najanigricollis*), Gaboon viper (*Bitisgabonica*), African giant rat (*Cricetomysganbianus*) and Monitor lizard (*Varanus varius*).

5.2.8: Land Cover

There was only one land cover class within the study area. There are no declared nature reserves or wetlands adjacent or near the proposed location. Slightly built up area, auto mechanics, cultivated areas, uncultivated area and structures surrounds the transmission substation. The land-cover types of the factory area:

✓ Forest I (disturbed)	2	%
✓ Forest II (undisturbed)	0	%
✓ water	0	%
✓ Built-up/bare soil	98	%

5.2.9: Land use

The land use pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. The rapidly increasing human populations and expanding anthropogenic activities have brought about extensive land use changes throughout the area. The majority of the land use in area is residential, administrative, commercial and small scale farming.

5.2.10: Geology

The geology of the area exposes two main lithologic formations. They are Imo Shale (Paleocene - Eocene) and Nanka Sandstone (Eocene) a lateral equivalent of Ameki Formation. Imo Shale the older of the two geological formations cover about twenty five (25) percent of the study area. The geology of the Awka area is that of the Imo Shale Group. It is overlain by the Bendel Ameki Group and is underlain by cross-bedded sandstones and upper coal measures of the Nsukka Formation and Ajali Sandstone. This Formation belongs to the sedimentary Anambra Basin sampled soil is a dark brownish red soil with a plastic and gritty feel. Grain fragments are angular. Some metres away from the site are thin to thick strata of highly indurated and ferruginised sandstone.

5.2.11: Socio-economics

There are four major villages that make up the town, they are in order of seniority; Ezeawulu, Umuanum, Ifite and Ezeoye. Awka is a community of cooperative men and women that work jointly for the development of the town. Over the years Awka and Awka settlements have attracted people from other states in Nigeria and has a significant number of immigrants from northern Nigeria, Delta and Enugu states, Cameroon and Ghana now comprising more than 60% of residents in the town. Awka people today as in traditional times are well travelled. In ancient times demand for their skills as blacksmiths had Awka people travelling throughout Nigeria making farming implements, household tools and guns.

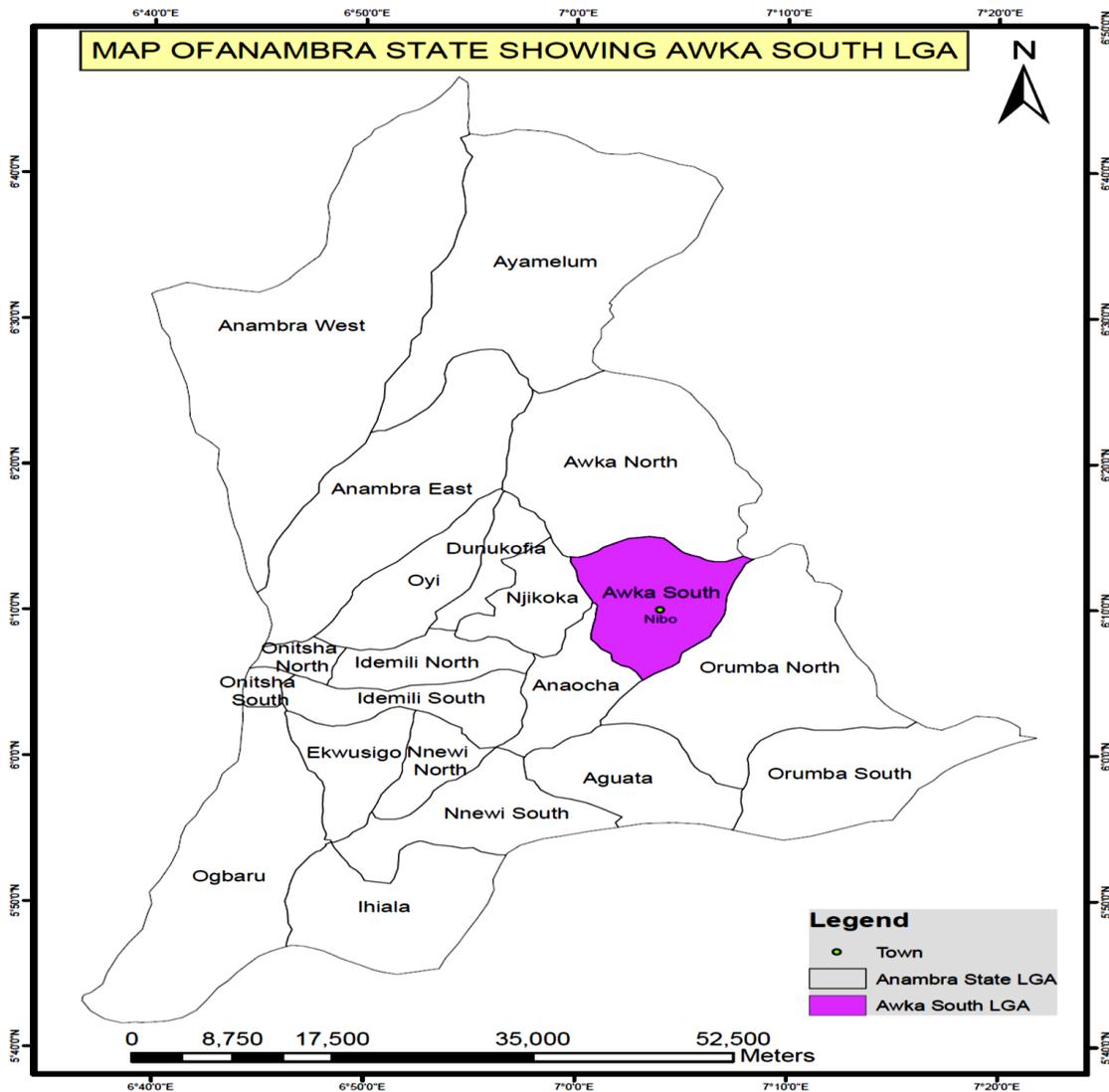


Figure 5.1: Administrative map of Anambra state showing Awka South LGA

Population of Awka south LGA where Awka is situated was 130,664 in 1991 (Male 67,007 and Female 63,657) and 189,049 in 2006 (Male 97,815 and Female 91,234). Christianity is the main religion of Awka people although many also retain belief in their traditional religion which encompasses many similar traditions and values. Awka is a community of cooperative men and women that work jointly for the development of the town. There are four major villages that make up the Awka town, they are in order of seniority; Ezeawulu, Umuanum, Ifite and Ezeoye.

Awka has various traditional festivals which include OnwaAsa (New Yam festival) Onwa, Asato and Awka Day. Awka Day is usually presided over by Ezeike-in-council. It is a very important day usually held on 26 December every year. It is usually a day for recognition of prominent sons and friends of the town who contribute to the development of the town. Okpukpe Eke is one of the famous omitted festival with which the people of Awka is known for besides Ede Mmo. The region has been inhabited since historical times, and there are no official records for any natural and cultural heritages presents in or within the surrounding area of the transmission substation.

The people of Awka are connected to the national grid through the Enugu Electricity distribution Company (EEDC). According to the interviews conducted, power supply is epileptic in nature in the area. Other sources include generators, solar power and the old hurricane lamps.



Plate 21: Consultation with stakeholders at Community town hall



Plate 22: damaged community road used as access to transmission substation

5.2.12: Stakeholders Consultation

A consultative process is critical in order to inform project beneficiaries and key stakeholders of the project, to receive and include their input in the design and implementation and address concerns. For the Rehabilitation/Reinforcement of 132/33kv Transmission Sub-station a meeting with the municipalities affected by the substation was organized. These meetings took place during the period of the ESMP field work when the project was launched, up to today. The stakeholder consultation was undertaken among people living near the site of the substation in Awka. The aim was to ensure that stakeholder interests were consulted and incorporated in the project development, implementation and operation. Such meetings enable interested and affected parties to contribute their concerns (views and opinions on the proposed project). Findings of stakeholder analysis were very important in predicting impacts and development of this ESMP.

The Consultants explained the importance of the project and the positive impacts and the facilities that will result to the benefit of Awka and the society. The project will contribute to social and environmental development, and raise the reliability of electric networks. Moreover, it will solve many dilemmas related to electric sector; supplying electricity to all southwest areas with high efficiency. It was pointed out that negative impacts are minimal, temporary, and site-specific and can be mitigated.

The Project affected population had no serious concerns and all people interviewed supported the Rehabilitation/Reinforcement project. However, few concerns were raised which are presented in the below and minutes of the consultation meeting attached as an appendix. The consulting team and substation supervisor assured the stakeholders responded that all their concerns were important and shall be documented and addressed accordingly.

Concern/Issue	Comments by Stakeholders (Q) /Consulting Team Response (A)
Access Road	<p>Q. -The community access road has been used for operations of the substation which has dilapidated the road. TCN should put to use the original access road to the substation and restore the damaged community access road.</p> <p>A. -The consulting team assured the community that the first part of the rehabilitation/reinforcement is putting to use the original access road to the substation. The damaged community access road will be repaired in a joint effort.</p>
Employment:	<p>Q. -The area residents requested to be first considered when employment vacancies arise most especially during the construction phase</p> <p>A. -The contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase</p>
Quality Jobs:	<p>Q. -The firm should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g operators</p> <p>A. -The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.</p>
Social Corporate Responsibilities:	<p>Q. -The locals want the firm (TCN) to take part in their developmental activities. e.g. sinking borehole etc.</p> <p>A. -The firm is a Government social service agency and therefore limited in executing CSR.</p>
Stakeholders Engagement:	<p>Q. -The residents of the area will need information of impending work that will affect their environment. e.g. traffic, noise etc.</p> <p>A. -The stakeholders consultation and engagement will be continues through the life span of the project.</p>
Electricity Supply	<p>Q. -The community members and neighboring house around the substation are bitter of the low shedding of electricity to the area despite having a substation in the neighborhood.</p> <p>A. -The Electricity flow diagram from generation to distribution was explained to the stakeholders and believing that the distribution company will also upgrade its transformers to enable it improve electricity supply to the area.</p>

**Corporate Social
Responsibility**

- Q.** The substation in time past used to help the community members and neighbors with borehole water since quality water is difficult to access in the area. However the practice has stopped for a while.
- A.** The substation supervisor explained to the gathering how the submersible pump of the borehole went bad and got stuck in the ground



Plate 23: Narrow community road used as access to substation



Plate 24: present access road through residential houses with substation gate at the background

5.3: Findings of Auditing Awka (Nibo) Substation

This subsection presents the findings of the conducted audit of the substation and provides the recommended short medium and long term standard operation procedures SOPs to bring the existing substation into compliance with applicable national and international standards. The following sections provides the anticipated impacts assessment, management and monitoring plans for the proposed rehabilitation project.

5.3.1: Building Materials

The predominant material used for construction of the Transmission station control room is concrete. The fencing around the transmission substation is built with concrete blocks and with good height. The security house is also constructed with concrete block however the roofing material is made of Asbestos. Asbestos have been banned because they have been found to be carcinogenic. The most common diseases associated with chronic exposure to asbestos include: asbestosis and pleural abnormalities (mesothelioma, lung cancer). Asbestosis has been reported primarily in asbestos workers, and appears to require long-term exposure, high concentration for the development of the clinical disease. There is also a long latency period (incubation period of an infectious disease, before symptoms appear) of about 12 to 20 years.

Recommendations

The recommended SOPs to be adopted in the short term are as follows:

- Procurement Department shall to document procurement policy and procedures which should be audited by the HSE Department to prevent procurement of any of ACMs
- The surface area of the asbestos roof is approximately 12 m² and shall be disposed and handled according to the following:
- .ACMs at Awka (Nibo) substation should be collected in suitable double air tight PE bags with adequate thickness to bear the asbestos waste. In order not to cause further disturbance of asbestos waste, and generate further asbestos fibers, the waste removal and soil clean-up should be undertaken by a professional asbestos contractor². The procedures to be followed in such activity normally includes:
 - o Wetting all waste items and underneath soil before any handling
 - o Careful placement wet asbestos waste in suitable container bags
 - o Cutting large items should be avoided unless they couldn't be fitted in the containment. In such cases the cutting tool should be carefully selected to suite cutting wet materials
 - o Parts of the soil should also be placed in containers bag in wet condition for cleaning the area.
 - o The waste area should be isolated and all workers in removing waste and cleaning the site should wear full cloth protection and respiratory protection. All cloth used during clean-up should be disposed in container double container bags as described above.
- Asbestos waste shall be sent transported qualified hazardous waste transportation contractors. :

² If no such contractor is available in Nigeria, international contractors should be employed

- Clear warning signs should be fixed in out of the room
 - Any maintenance practices, such as cleaning nearby shelves or using sharp tool in a nearby fixture, within these buildings should consider the following precautions³:
 - The area of maintenance should be isolated and provided with portable ventilation equipment
 - By all means sawing, sanding and drilling asbestos is prohibited
 - In case accidental disturbance occurred to an asbestos surface the area should be evacuated.
 - Only workers wearing full protective cloth and respiratory protection could enter the area for repairing the damaged part either through encapsulation in plaster or latex paint and adequately wet any asbestos waste which should be collected, along with contaminated cloth, in double thick air-tight plastic bags. In such cases air sampling should be undertaken to ensure that the damage has been effectively repaired.
 - All above measures should be supervised by HSE staff received professional asbestos training
- The generated waste shall be contained in a concrete box and stored in hazardous waste designated area since no sanitary landfill is available in Nigeria.

5.3.2: Water Supply, Effluents and Storm water Drainage

The staff of the transmission station draws water for use from neighboring residence in the area and water is sometimes supplied with commercial water trucks at the instance of the Regional General Manager (GM) at Enugu. Groundwater used to be the source of water supply in the transmission substation however the pump has gone bad a long time ago and is yet to be repaired because the pump is stuck in the hole. Groundwater is thought to be a natural resource that is available to any one that has the means to access it. Comparatively, it is considered to be naturally protected and of better quality than either rain or surface water. The quality of the water in the area was determined by collection of representative sample and analysis carried out. The groundwater in the area is compliant to National and international limits for drinkable water. However one of the critical concerns of the residents of area is the lack of safe and sustainable water supply.

A great percentage of the population depends on self-help in order to make the vital resource of life available through the exploitation of groundwater, surface water bodies and rain water-harvesting. The acute need to provide water seems to have pushed every consideration for quality and acceptable best practices beyond the reasoning of the inhabitants. Families and businesses scrambling to place orders from peripatetic vendors such as water tankers, wheel-cart pushers, bucket, kegs and sachet water hawkers.

³ These procedures are recommended by USEPA



Plate 25: non-functional station borehole



Plate 26: Borehole at Community town hall

Table 5.7: Water Quality Results

PARAMETER	Borehole at TownHall	Borehole in Community	FMEnv	WHO Limits
pH	6.35	6.14	6.5 – 8.5	6.5 – 8.5
Temperature, °C	30.3	33.2	NA	NA
TDS, mg/l	36	40	500	1000
Conductivity, µs/cm	65	78	NA	NA
DO, mg/l	2.42	2.50	7.5	NA
Alkalinity (mg/l)	5.0	7.5	NA	10
Hardness (mg/l)	15	18	200	100
Turbidity (mg/l)	4.98	4.63	1.0	5.0
Salinity as Cl ⁻ (mg/l)	12.0	14.0	250	250
TSS (mg/l)	8.0	8.5	<10	10
Cd (mg/l)	0.33	0.31	0.01	0.003
Pb (mg/l)	<0.001	<0.001	0.05	0.05
Hg (mg/l)	<0.001	<0.001	0.001	<0.001
Fe (mg/l)	1.24	0.89	1.0	0.3
Cr (mg/l)	0.04	0.04	0.05	0.05
Zn (mg/l)	2.15	2.64	5.0	3.0

Source: Field work 2015

Effluents from the station building conveniences are channeled into a soak away pit. This soak-away pit system is an underground soil treatment system, which receives partially treated sewage from the septic tank. Storm water drainage system designed to drain rain water from the facility do not exist within the station only around the perimeter fence. The Storm drains observed are unable to contain the quantity of rain that falls during heavy down pour.

5.3.3: Waste Production and Disposal

The management of waste at the transmission substation was identified in detail, and quantities noted of each of the various categories of wastes and their rate of generation over time. Waste management in the transmission substation could be significantly improved. Wastes are not

sorted/segregated into the different waste streams but are dumped haphazardly and disposal was by open burning thereby polluting the ambient air and creating an unhealthy environment which promotes diseases/health conditions. The Waste collection point is a major attraction for insects and rodents which in turn attracted reptiles especially snakes.



Plate 27: Indiscriminate disposal of waste

5.3.4: Hazardous Materials

Hazardous materials in this sector include insulating oils / gases (e.g. Polychlorinated Biphenyls [PCB] and sulfur hexafluoride [SF₆], and fuels, in addition to chemicals or products for wood preservation for poles and associated wood construction material. Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. They are typically found in the largest quantities at electrical substations and maintenance shops. Sulfur Hexafluoride (SF₆) is used as a gas insulator for electrical switching equipment especially in the breaker units as an alternative to insulating oils at Awka (Nibo) transmission substation. However, the use of SF₆, a greenhouse gas with a significantly higher global warming potential (GWP) than CO₂, should be minimized. In cases the gas is used for applications involving high voltages (>330 KV), equipment with a low leakage- rate (<99 percent) should be used.

Polychlorinated Biphenyls (PCB) were widely used as a dielectric fluid to provide electrical insulation, although their use has been largely discontinued due to potential harmful effects on human health and the environment, however traces of PCB were detected in the contaminated soil samples analyzed. Due to their low vapor pressure, PCBs accumulate primarily in the hydrosphere, in the organic fraction of soil, and in organisms.

Old manufactured power transformers like the ones in Awka (Nibo) transmission substation are a major legacy source of PCBs. Even units not originally filled with PCB may be contaminated, since PCB and oil mix freely and any given transformer may have been refilled from hoses or tanks also used with PCBs.

Table 5.8: PCB Comparison Study between the Two National Inventories

INVENTORY PROJECT	TOTAL WEIGHT OF OIL CONTENT IN TRANSFORMER	WEIGHT OF PCB CONTAINING OIL IN TRANSFORMERS (kg)	PERCENTAGE OF PCB CONTAINING OIL
The partial Baseline National Inventory of PCBs and PCB-containing Equipment in Nigeria (2008)	32,096,552	3,427,764	10.68%
National Baseline Inventory of PCBs and PCB containing Equipment (2014)	10,823,475	1,558,626.75	14.40%

5.3.5: Occupational Health and Safety

These impacts include, among others, exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust and noise; falling objects; work in confined spaces; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Occupational health and safety hazards specific to electric power transmission operation and projects primarily include live power lines, working at height, Electric and magnetic fields (EMF) and exposure to chemicals.

Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines. Although there is no empirical data demonstrating adverse health effects from exposure to typical Electric and magnetic fields (EMF) levels from power transmissions lines and equipment. Electric fields are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and increase in strength as the current increases.

Switch yards are sources of EMF. The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a non-governmental organization formally recognized by the World Health Organization, has set guidelines exposure limits for public and occupational exposure to EMF for ac systems, as indicated in the following table⁴.

⁴ Source: ICNIRP (1998): “Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

Table 5.9: ICNIRP Guidelines for EMF public and occupational exposure

Frequency	Public Exposure		Occupational Exposure	
	Electric Field (V/m)	Magnetic Field (mG)	Electric Field (V/m)	Magnetic Field (mG)
50 Hz	5,000	1,000	10,000	5,000
60 Hz	4,150	830	8,300	4,150

It should be noted that no safety signs exist anywhere within the station and outside the station warning people of danger equipment and zones. The station is under staffed with only 2 operational staff and 1 supervisor running 24hr shifts instead of the standard number of 6 operators and 1 supervisor on 8 hours shift.

Safety department at the sub-region and regional administrative offices at Onitsha and Enugu respectively handle all matters relating to Health, Safety and Environment. Safety officers from the regional and sub-region pay infrequent visit and consequently, making environmental awareness and compliance is very low at transmission substations.

Recommendations are provided in Appendices A

5.3.6: Personal Protective Equipment (PPE)

Personal protective equipment (PPE) was provided for the staff at the transmission substation, however inadequate in terms of number provided (per-station instead of per-person) frequency of change and type. The non-use of PPE causes and leads to various forms of incidents/accidents ranging from loss of limbs, burnt skin, and blindness from transformers explosions, electrocution and even death in few instances.

It should be noted that no accident monitoring records were obtained during the site visit to Awka (Nibo) Transmission substation.

Recommendations are provided in Appendices A

5.3.7: First Aid

First aid as the provision of initial care for an illness or injury is essential and necessary in high risk work areas like a transmission substation. A collection of supplies and equipment (first aid box) for use in giving first aid for minor ailments and primary care is not available in the transmission substation. The operational staff is not trained in any form of first aid.

Recommendations are provided in Appendices A

5.3.8: Fire and Emergency Precautions

Fire extinguisher canisters were available but all were expired and not calibrated. Fire and explosion, dangers of fire hazards arise from electrical short circuiting and lightning. There are no smoke detectors, fire alarms, fire hose and hydrants available within the substation. The transmission substation operators have little or no training in firefighting.

Recommendations are provided in Appendices A

5.3.9: Housekeeping

Housekeeping within and outside the Awka (Nibo) transmission substation was observed to be generally good.



Plate 28: Graveled well-kept premises of substation



Plate 29: Power distribution transformer in substation with signs of leakages

Recommendations are provided in Appendices A

5.3.10: Site Security

Security lights are inadequate at night for proper visibility and needs to be improved upon. A good number of Nigerian Security and Civil Defense Corps (NSCDC) are used to secure the substation. The area is well patrolled by police men because of the Nigerian Police Command headquarters at Amawbia in Awka, which is about One kilometer from the Awka (Nibo) Transmission substation.



Plate 30: concrete boundary fence of substation



Plate 31: Consultants with TCN sub region safety officers (OSR) at the substation

Recommendations are provided in Appendices A

CHAPTER SIX
YANDEV 132/33 KV TRANSMISSION SUBSTATION
ENVIRONMENTAL AND SOCIAL BASELINE

6.1: Introduction

The Substation is situated in Yandev about 2km from Gboko, an hour drive from Makurdi the capital of Benue State. Most of the equipment in the substation was all installed and commissioned in 1978. The switchyard operates a single bus scheme electrical system. The incoming power is 132 KV and transferred to main bus through isolator-circuit breaker-isolator combination. The power from main bus is fed into Three (3) power transformers (40 MVA and 60MVA) which steps the voltage down to 33KV. The power is then fed into a 33KV bus from which different loads then transferred to distribution system through Five (5) feeders (BCC1, BCC2, Makurdi, Wukari, Yandev and Kastina Ala) to meet the requirements of the end consumers at their suitable voltage. A power transformer (Serranti 30 MVA) for decommissioned and dismantled is inappropriately placed within the switchyard.

Table 6.1: Transformers within Yandev 132/33 KV transmission substation

S/N	Description	Type	Year of Manufacturing
1.	Mitsubishi Mobitra 45MVA 132/33KV (T1)	Power	1978
2.	LEEC 60MVA 132/33KV (T2)	Power	2011
3.	Serranti 30MVA 132/33KV (Decommissioned)	Power	1976

6.2: Environmental Baseline

6.2.1: Project Location

The transmission substation is located in Yandev a community in Gboko town, Gboko local government area which has a land area of 4,493 sq. Km located between Latitudes 07° 08' 16" and 07° 31' 58", and Longitudes 08° 37' 46" and 09° 10' 31" is a populated place in Benue State. It is located at an elevation of 315 meters above sea level and its population amounts to 536,068. The area is located within a sub- humid tropical region. Gboko is a fast-growing town in the Benue state of North-central Nigeria. It is the traditional capital of the Tiv tribe and it has the official residence of the Tor-Tiv.

Dangote Cement Plc formerly Benue Cement Company (BCC) is located at Yandev, near Gboko town, in Gboko Local Government Area (LGA) of Benue State in Nigeria’s north-central region.

The central location of the factory is at 7° 24' 42.45"N and 8° 58' 31.28"E, at about 532 feet above mean sea level.



Plate 32: Substation Staff Quarters



Plate 33: Entrance to Transmission Substation

6.2.3: Climate and Meteorology

The climate at Yandev is tropical. The average annual temperature in Gboko is 26.8 °C. Precipitation here averages 1412 mm. The driest month is January, with 3 mm of rain. With an average of 264 mm, the most precipitation falls in September. March is the warmest month of the year. The temperature in March averages 29.4 °C. July has the lowest average temperature of the year with 25.4 °C. There is a difference of 261 mm of precipitation between the driest and wettest months. The average wind speed over the study area is about 1.50 m/s, while the average ambient air temperature is about 30°C (Nigeria Meteorological Agency 2012).

The area experiences two distinct seasons, the wet season and dry season. The rainy season lasts from April to October with annual rainfall in the range of 100-200mm. The dry season begins in November and ends in March. Temperatures fluctuate between 21 – 37 degrees Celsius in the year.

Table 6.2: Meteorological results

Location	AQ1	AQ2	AQ3	AQ4
	Transformer area	Road /Gate area	Station Quarters	Community
	N07° 24' 24.5" E008° 59' 13.8"	NO7° 24'24.7" EOO8° 59' 19.0"	NO7° 24'21.4" EOO8° 59' 16.9"	NO7° 24'49.9" EOO8° 59' 12.3"
Temperature, °C	31.5	30.1	30.7	31.0
Wind Direction	SW	SW	SW	S
Atm. Pressure, mbar	1029	1030	1029	1029
Wind Speed, m/s	4.60	5.20	4.80	3.10
Rel. Humidity (%)	64.1	72.0	68.0	74.3

Source: Field work 2015

As shown in the table above, the temperature ranged from 30.1oC to 31.5oC; winds were fast and ranged from 3.10 to 5.20 m/s and were predominantly southwest in direction. The relative humidity ranged from 64.1 to 74.3%.

6.2.4: Air Emissions and Ambient Air Quality

Polluted air contains undesirable materials which may damage human health, vegetation, infrastructure, and/or the global environment. Air Sensitive Receivers (ASRs) identified within the area was farmlands and communities.

Table 6.3: Air Quality parameters and Results

Location	AQ1	AQ2	AQ3	AQ4	WHO Limits (24 hours)	FME _{env} Limit (µg/m ³)
	Transformer area	Road /Gate area	Station Quarters	Community		
	N07° 24' 24.5" E008° 59' 13.8"	N07° 24'24.7" E008° 59' 19.0"	N07° 24'21.4" E008° 59' 16.9"	N07° 24'49.9" E008° 59' 12.3"		
CO, µg/m ³	<1.0	3.0	<1.0	4.0	NA	11.4
C _x H _y ,µg/m ³	350	<0.01	<0.01	2.45	NA	160
NO _x , µg/m ³	<0.01	2.35	<0.01	1.75	200	75.0 - 112
SO _x , µg/m ³	<0.01	1.80	<0.01	1.25	20	260
SPM,µg/m ³	60.0	70.0	40.0	45	50	250

Source: Field work 2015

The only significant air pollutants observed are suspended particulate matter (which ranged from 40 to 70 µg/m³) and oxides of nitrogen (as nitrogen dioxide, which ranged from <0.01 to 1.75 µg/m³). The concentration of hydrocarbons (transformer oil) and Suspended Particulate Matter (SPM) are considerably high and therefore do not pose any health problems (such as respiratory tract irritation and diseases) particularly for children under five years old and the elderly in the project area. Fortunately low concentration of oxide of sulphur was detected; the presence of sulphur would have led to similar health problems and possibly caused acidic precipitation.

6.2.5: Noise

The measured noise levels ranged from 45 to 72 dB (A). These values are considerably below the FME_{env} and internationally allowed limits of 90 dB (A) and 70 dB (A), respectively for eight and twenty four hours continuous exposure, in all the locations. Noise in the form of buzzing or humming can be heard around the transformers or high voltage power lines producing corona. Ozone, a colourless gas with a pungent odour, may also be produced. Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The noise level within the station complied with Federal Ministry of Environment (FME_{env}) and World Bank Standards are presented in the following Table.

Table 6.4: Noise level results

Location	AQ1	AQ2	AQ3	AQ4	IFC EHS Noise limits	FME _{env} Limit dBA
Noise, dBA	Transformer area	Road /Gate area	Station Quarters	Community		
	N07° 24' 24.5" E008° 59' 13.8"	N07° 24'24.7" E008° 59' 19.0"	N07° 24'21.4" E008° 59' 16.9"	N07° 24'49.9" E008° 59' 12.3"		
	64.6	72	45	65.0	80	90

Source: Field work 2015

6.2.6: Soil Characteristics

The soil is sandy loam and the soil pH value of the area was generally slightly acidic (pH: 5.3 - 6.9). Acidity may be due to high buffering capacity and the leaching of appreciable quantities of exchangeable base - forming Cations (Ca, Mg, K and Na) from the surface layers of the soils.

The soil is the most important factor in agricultural production being the main medium for plant growth. The manipulation or management of this resource base has significant influence on the environment or ecosystems because of its effects on water resource, human settlement, atmospheric quality, water and land pollution, vegetation type and distribution, fishery and wildlife. The following Table presents Soil analysis of targeted parameters.

Table 6.5: Soil results

Location	AQ1	AQ2	AQ3
pH THC, mg/kg PCB, µg/g	Transformer area	Road /Gate area	Station Quarters
	N07° 24' 24.5" E008° 59' 13.8"	N07° 24'24.7" E008° 59' 19.0"	N07° 24'21.4" E008° 59' 16.9"
	5.50	6.45	6.65
	2,125	<0.01	2.50
	4.80	<0.001	<0.001

Source: Field work 2015



Plate 34: polluted soil due to wrong SOP



Plate 35: Polluted soil around transformers

6.2.7: Vegetation

A total of 8 tree/shrub species in 5 families and 11 herbaceous species in 6 families were observed to exist in the area. Similarly, a total of 9 food crop species were encountered in the area. Yandev is located in the southern Guinea Savannah. Persistent clearance of the vegetation has led to the development of regrowth vegetation at various levels of development, but more importantly, parklands with grasses ideal for animal grazing during their early growth. These succulent grasses can be cut with machinery, dried and baled for dry season livestock feeding. The grasses however grow very tall, coarse and tough on maturity. The scattered trees are mainly those of economic value and include locust bean, shear butter, mango, silk cotton, African iron, Isoberlinia, cashew, oil palm, Daniellia Oliveri, gmelina, et cetera. These trees produce valuable fruits, wood and fibre which can be utilized for small scale cottage industries. The farm produce found in commercial quantity include yam (*Discorea alata*), cassava (*Manibot esculenta*), rice (*Oryza sativa*), and fruits trees such as mangoes (*Mangifera indica*), Citrus spp. Such as oranges pear and banana. Important cash crops in the area include Soya beans, rice, peanuts, mango varieties, Citus etc. Other cash crops include palm oil, melon, African pear, chili pepper etc. Food crops include yam, cassava, sweet potato, beans, maize, millet and guinea corn. It should be noted that no endangered species that are identified according to the national regulations, were observed within the substation vicinity.



Plate 36: Bushy vegetation in front of switch yard with the tarred road in the background



Plate 37:Vegetation before the station gate



Plate 38:Vegetation tarred road in front of the substation with Dangote cement factory in the background



Plate 39: Farmland beside the transmission substation

6.2.8: Wildlife

In the study area, a total of 19 wildlife species were recorded. Majority of the Species were not Sighted by the Team but identified by interviewing community hunters within the Study Area. Based on the National Red list, none of the amphibians and reptiles sighted or mentioned is among the endangered and vulnerable species. The major wildlife animals commonly found in the area are Spitting cobra (*Naja nigricollis*) Pied crow (*Corvus albus*), Kite (*Milvus migrans*), Hawk (*Accipiter gentillis*), Royal python (*Python regius*), Boa snake (*Boa constrictor*), Bush rat (*Rattus suscipes*), Agama lizard (*Agama agama*), Monitor lizard (*Vatanus varius*), African giant rat (*Crycetomys gambianus*), Olive green snake (*Ophreodrys vernalis*), Bush fowl (*Francolinus bicalcaratus*), monkey (*Cercopitbeus ascanius*), Hedgehog (*Atelerix albiventris*), squirrel (*Xerus erythropus*), Rabbit (*Poelagus ascanius*) and Grass cutter (*Thyonomys swinderianus*). No information was obtained on the occurrence of rare or protected plant or animal species or on the biodiversity conservation situation in the area in general.

6.2.9: Land cover

There are no declared nature reserves or wetlands adjacent or near the proposed location. Slightly built up area, administrative institutions and structures in the transmission substation. The land-cover types of the factory area are::

✓ Forest I (disturbed)	60	%
✓ Forest II (undisturbed)	0	%
✓ water	0	%
✓ Built-up/bare soil	40	%

6.2.10: Land use

Rapidly increasing human populations and expanding agricultural activities have brought about extensive land use changes. Though human beings have been modifying land to obtain food, shelter and other essentials of life for thousands of years, current rates, extents and intensities of such modifications are far greater than ever in history and continue undocumented. The following mosaic of land uses- built-up, plantation, fallow land/scattered cultivation, high forest, low forest mangrove, river and quarry- were identified. Disturbed forest and bare soil were the most predominant land use.

6.2.11: Geology

The limestone-shale sequence at Yandev belongs to the Albian Asu River Group deposited during the first marine transgressive cycle in the Benue Trough. The Benue Trough is a major geological formation underlying a large part of Nigeria and extending about 1,000 km northeast from the Bright of Benin to Lake Chad. It is part of the broader Central African Rift System. The Benue Trough of Nigeria is an intra cratonic rift system whose development is closely associated with the separation of Africa from South America and the opening of the South Atlantic Ocean during the Early Cretaceous. The Trough consist of a long stretch of sedimentary basin running from about the northern tip of the Niger Delta Basin and terminates under the Chad Basin and sandwiched by the Basement Complex areas in the north and south of River Benue.

6.2.12: Socio-economics

The Tiv are the dominant ethnic group, in Yandev and Gboko. Gboko was also the headquarters of the Tiv Native Authority. Most of the people are farmers while the inhabitants of the riverine areas engage in fishing as their primary or important secondary occupation. The people of the state are famous for their cheerful and hospitable disposition as well as rich cultural heritage. Agriculture forms the backbone of the economy, engaging more than 70 per cent of the working population. This has made the area and Benue State at large the major source of food production in the Nation. It can still be developed because most of the modern techniques are not yet popular to 98% of Nigeria. Mechanization and plantation agriculture/agro-forestry are still at its infancy.

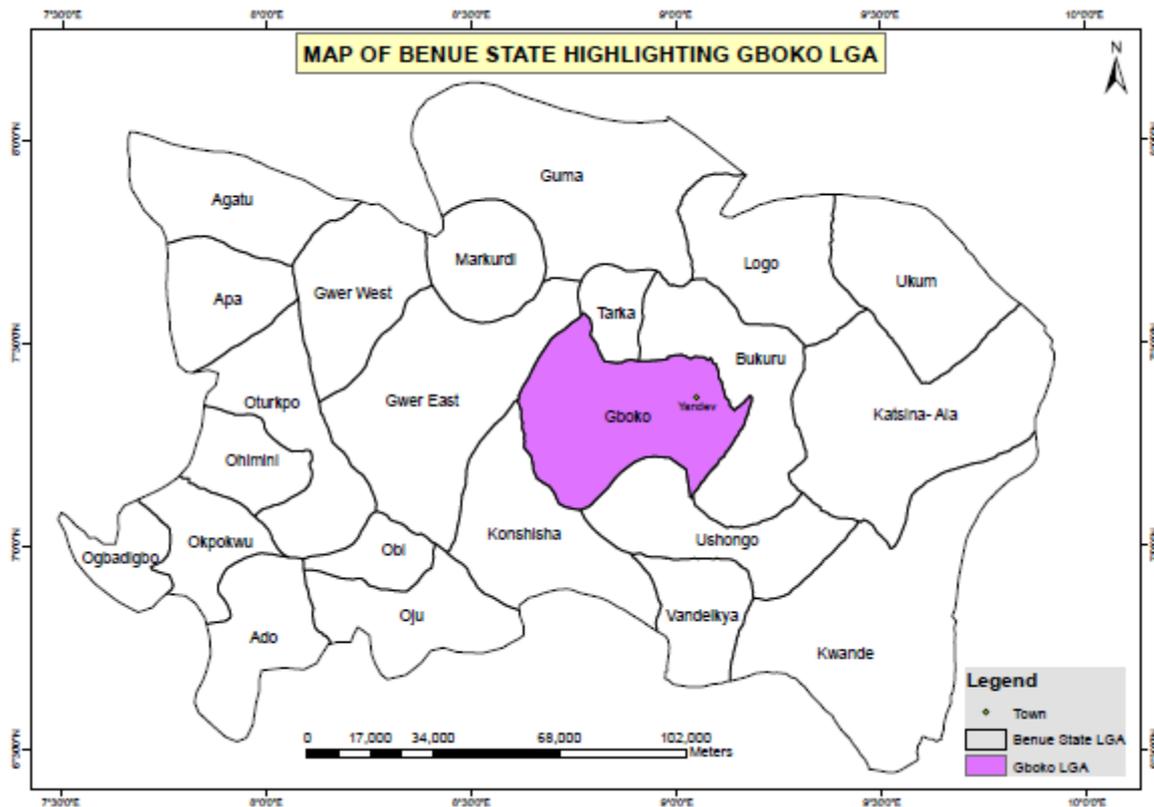


Figure 6.1: Administrative map of Benue state showing Gboko LGA

Population of Gboko LGA where Yandev is situated was 300,044 in 1996 and 358,936 in 2006 (Male 198,320 and Female 160,616). (Source: National population Commission) Christianity is the main religion of Gboko people although many also retain belief in their traditional religion which encompasses many similar traditions and values. Gboko is nicknamed "Gboko-yuhwa" which means "heavy town" owing to the rebellious attitude of its youths. The town is also called "G-Town" by many today. Important annual events in Gboko are the kwagh-hir Festival and Tiv Day celebration. Kwagh-hir is the Tiv traditional theater. It is the festival of storytelling and it usually includes big animal puppets. It is staged at any time of year and on special occasions. The Tiv Day celebration is the day when all Tiv sons and daughters resident in all other parts of the world converge in Gboko to celebrate the cultural heritage of the Tivs and also deliberate on developmental issues affecting the Tiv people. Gboko remains highly underdeveloped in terms of infrastructure, poor road networks and youth unemployment is very high as can be seen among many youths inhabiting the town, who survive mostly on riding commercial motorcycles popularly known as "Okada". In consequence, the rate of Crime in the town remains high as youth unrest soars. The Dangote Cement Plant, once owned by the Benue State Government (formerly called Benue Cement Company) is situated at Gboko. The people of Yandev are connected to the national grid through the Jos Electricity Distribution Company (JEDC). According to the interviews conducted, power supply is epileptic in nature in the area. Other sources include generators, solar power and the old hurricane lamps.



Plate 40: consultations with Tse-Amua community



Plate 41 : consultation with community leader

6.2.13: Stakeholder Consultation

A meeting with the Amua community the immediate settlement of Yandev was organized for the Rehabilitation/Reinforcement of 132/33kv Transmission Sub-station. These meetings took place during the period of the ESMP field work when the project was launched, up to today. The aim was to ensure that stakeholder interests were consulted and incorporated in the project development, implementation and operation. Such meetings enable interested and affected parties to contribute their concerns (views and opinions on the proposed project).

The Consultants explained the importance of the project and the positive impacts and the facilities that will result to the benefit of Yandev and the society. The project will contribute to social and environmental development, and raise the reliability of electric networks. Moreover, it will solve many dilemmas related to electric sector; supplying electricity to all southwest areas with high efficiency. It was pointed out that negative impacts are minimal, temporary, and site-specific and can be mitigated.

In the meetings with community head, it has been stressed that substation will act as one of the center points for the transmission system, which as a result will promote the power sector in the area. The concerns of the people included, employment of the community youths at least in the unskilled category at the substation, regular power supply especially to the host community, Benue Cement Industry, whose establishment in Gboko local government area has created a lot of problems to the host communities(Yandev, Tse-Kucha and Tse-Amua) between 1981 when it was established till date (2012) a lots of cement dust has been emitted into the environment there by affecting the socio- economic activities of the host communities. All the notes and comments have been recorded. Overall, the participants of the consultations were supportive of the project. However, few concerns were raised. Details attached in Appendix C.

Concern/Issue	Comments by Stakeholders (Q) / Consulting Team Response (A)	
Employment:	Q.	-The area residents requested to be first considered when employment vacancies arise most especially during the construction phase
	A.	-The contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase
Quality Jobs:	Q.	-The firm should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g operators
	A.	-The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.
Social Corporate Responsibilities:	Q.	-The locals want the firm (TCN) to take part in their developmental activities. e.g. sinking borehole etc.
	A.	-The firm is a Government social service agency and therefore limited in executing CSR.
Stakeholders Engagement:	Q.	-The residents of the area will need information of impending work that will affect their environment. e.g. traffic, noise etc.
	A.	The stakeholders consultation and engagement will be continues through the life span of the project.

6.3: Findings of Auditing Yandev Substation

This subsection presents the findings of the conducted audit of the substation and provides the recommended short medium and long term standard operation procedures SOPs to bring the existing substation into compliance with applicable national and international standards. The following sections provide the anticipated impacts assessment, management and monitoring plans for the proposed rehabilitation project.

6.3.1: Building Materials

The predominant material used for construction of the Transmission station control room is concrete. The fencing around the switch yard of the transmission substation is built with wire mesh and with good height. The residential quarters and security house are built with concrete blocks; however the roof of the security house is of asbestos material.



Plate 42: Concrete Control room building of the switch yard



Plate 43: Concrete block residential quarters of the substation station

6.3.2: Water Supply, Effluents and Storm water Drainage

Groundwater from an open hand dug well is the source of water supply in the transmission substation. A borehole has never being drilled since the inception of the substation. The water from the hand dug well is moderately hard (120 mg/l). Generally hand-dug well source for potable water supply are under threat from pollution either from human life style manifested by the low level of hygiene practiced in developing nations. The quality of the water in the area was determined by collection of representative sample and analysis carried out.



Plate 44: Stream flowing through a culvert at the approach of the switch yard

Plate 45: Drainage at the back of the switch yard

Table 6.6: Water Quality Results

PARAMETER	Underground storage		FMEnv	WHO Limits
	Hand dug well	Water from community		
pH			6.5 – 8.5	6.5 – 8.5
Temperature, °C	7.79	7.84	NA	NA
TDS, mg/l	31.2	32.0	500	1000
Conductivity, µs/cm	240	200	NA	NA
DO, mg/l	470	420	7.5	NA
Alkalinity (mg/l)	2.30	1.60	NA	10
Hardness (mg/l)	11.88	13.40	200	100
Turbidity (mg/l)	120	65	1.0	5.0
Salinity as Cl ⁻ (mg/l)	2.29	2.85	250	250
TSS (mg/l)	48.0	56.0	<10	10
Cd (mg/l)	4.60	8.50	0.01	0.003
Pb (mg/l)	0.21	0.18	0.05	0.05
Hg (mg/l)	0.10	0.05	0.001	<0.001
Fe (mg/l)	<0.001	<0.001	1.0	0.3
Cr (mg/l)	0.85	1.10	0.05	0.05
Zn (mg/l)	0.12	0.07	5.0	3.0

Source: Field work 2015



Plate 46: Drainage outside the wire mesh perimeter fence of switch yard



Plate 47: Hand dug well serving the switch yard and residential quarters

Effluent from the station building conveniences and wash area are channeled into a soak away pit. This soak-a-way pit system is an underground soil treatment system, which receives partially treated sewage from the septic tank. Storm water drainage system designed to drain rain water from the facility exist on the boundary of substation. Cable trenches also serve as drainage systems for evacuating water from the station.

6.3.4: Waste Production and Disposal

Waste management in the transmission substation could be significantly improved. Wastes were not sorted/segregated into the different waste streams but are dumped haphazardly along the entrance to the substation thereby distorting the aesthetics of the environment. The disposed waste is regularly burnt thereby polluting the ambient air and creating an unhealthy environment which promotes diseases/health conditions. Waste collection points are major attraction for insects and rodents which in turn attracted reptiles especially snakes.

Scraps were found littered in the switch yard of the substations. The scrap area is not cordoned off and this could lead to accidents, crawling animals like snakes or even rodents could hide under the scraps.



Plate 48: Waste disposal point in front of the switch yard

6.3.5: Hazardous Materials

Hazardous materials in this sector include insulating oils / gases (e.g. Polychlorinated Biphenyls [PCB] and sulfur hexafluoride [SF6], and fuels, in addition to chemicals or products for wood preservation for poles and associated wood construction material. Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. They are typically found in the largest quantities at electrical substations and maintenance shops. Sulfur Hexafluoride (SF6) is used as a gas insulator for electrical switching equipment especially in the breaker units as an alternative to insulating oils at Yandev transmission substation. However, the use of SF6, a greenhouse gas with a significantly higher global warming potential (GWP) than CO2, should be minimized. In cases the gas is used for applications involving high voltages (>330 KV), equipment with a low leakage- rate (<99 percent) should be used.

Prevention and control of hazards associated with spill prevention, emergency response, clean-up, and contaminated soil remediation are not addressed in the station administration. Polychlorinated Biphenyls (PCB) were widely used as a dielectric fluid to provide electrical insulation, although their use has been largely discontinued due to potential harmful effects on human health and the environment, however traces of PCB were detected in the contaminated soil samples analyzed. Due to their low vapor pressure, PCBs accumulate primarily in the hydrosphere, in the organic fraction of soil, and in organisms.

Old manufactured power transformers like the ones in Yandev transmission substation are a major legacy source of PCBs. Even units not originally filled with PCB may be contaminated, since PCB and oil mix freely and any given transformer may have been refilled from hoses or tanks also used with PCBs.



Plate 49: Drums of transformer oil wrongly placed on gravel and not concrete floor



Plate 50: Leakage from decommissioned and dismantled transformer

The soil analysis in the transformer area indicated that soil is contaminated with PCBs therefore the recommended measures shall be implemented

6.3.6: Occupational Health and Safety

These impacts include, among others, exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust and noise; falling objects; work in confined spaces; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Occupational health and safety hazards specific to electric power transmission operation and projects primarily include live power lines, working at height, Electric and magnetic fields (EMF) and exposure to chemicals.

Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines. Although there is no empirical data demonstrating adverse health effects from exposure to typical Electric and magnetic fields (EMF) levels from power transmissions lines and equipment. Electric fields are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and increase in strength as the current increases.

Switching yards is sources of EMF. The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a non-governmental organization formally recognized by the World Health Organization, has set guidelines exposure limits for public and occupational exposure to EMF for ac systems, as indicated in the following table⁵.

Table 6.7: ICNIRP Guidelines for EMF public and occupational exposure

Frequency	Public Exposure		Occupational Exposure	
	Electric Field (V/m)	Magnetic Field (mG)	Electric Field (V/m)	Magnetic Field (mG)
50 Hz	5,000	1,000	10,000	5,000
60 Hz	4,150	830	8,300	4,150

It should be noted that no safety signs exist anywhere within the station and outside the station warning people of danger equipment and zones. The station is staffed the standard number of 4 operators and 1 supervisor on 8 hours shift.

Recommendations are provided in Appendices A

⁵ Source: ICNIRP (1998): "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

6.3.7: Personal Protective Equipment (PPE)

Personal protective equipment (PPE) was provided for the staff at the transmission substation, however inadequate in terms of number provided (per-station instead of per-person) frequency of change and type. The non-use of PPE causes and leads to various forms of incidents/accidents ranging from loss of limbs, burnt skin, and blindness from transformers explosions, electrocution and even death in few instances.

PPE were provided and were inadequate in terms of numbers (per-station instead of per-person) and type. It should be noted that no accident monitoring records were not obtained during the site visit to Yandev Transmission substation.

Recommendations are provided in Appendices A

6.3.8: First Aid

First aid as the provision of initial care for an illness or injury is essential and necessary in high risk work areas like a transmission substation. A collection of supplies and equipment (first aid box) for use in giving first aid for minor ailments and primary care is not available in the transmission substation. The operational staff is not trained in any form of first aid.

Recommendations are provided in Appendices A

6.3.9: Fire and Emergency Precautions

Fire extinguisher canisters were available but were all expired and not calibrated. Fire and explosion, dangers of fire hazards arise from electrical short circuiting and lightning. There are no smoke detectors, fire alarms, fire hose and hydrants available within the substation. The transmission substation operators have little or no training in firefighting.

Recommendations are provided in Appendices A

6.3.10: Housekeeping

Housekeeping within and outside the switch yard was observed to be could be significantly improved. Discarded items, used drums; scrapped panels were observed kept in and around the premises of the substation. They constitute a health hazard because they have the potentials to cause accidents like falls and cuts, lacerations. They also serve as breeding grounds for rodent and insects which attract reptiles like snakes.



Plate 51: Scraps by security house of switch yard



Plate 52: Scraps lined up on the fence of switch yard

Recommendations are provided in Appendices A

6.3.11: Site Security

Security lights are inadequate at night for proper visibility and needs to be improved upon. Nigerian Security and Civil Defense Corps (NSCDC) and local guards from communities around were observed guarding the entrance of the substation

Recommendations are provided in Appendices A

Kindly refer to Appendix 3 for Laboratory certified analysis report

CHAPTER SEVEN

GUSAU 132/33 KV TRANSMISSION SUBSTATION ENVIRONMENTAL AND SOCIAL BASELINE

7.1: Introduction

The Substation is situated in Gusau central the capital of Zamfara State which is about two and half hour's drive from Sokoto Airport. Most of the equipment in the substation were all installed and commissioned in 2006.

The 132KV/33KV Gusau transmission sub-station incoming power is received at 132 KV from a 132 kV Kaduna –Zaria- Funtua – Gusau line with a T-off to Talata Mafara 132/33kv substation. The switchyard operates a single bus scheme electrical system. The incoming power is 132 KV and transferred to main bus through isolator-circuit breaker-isolator combination. The power from main bus is fed into Three (3) power transformers (Mobitra 30 MVA and MVA) which steps the voltage down to 33KV. The power is then fed into a 33KV bus from which different loads then transferred to distribution system through six (6) feeders (Kaura Namoda, Sabon Gari (T2A), Industrial Damba (T2B), Power house, Magami, NNPC and Tsafe) to meet the requirements of the end consumers at their suitable voltage. The distribution transformers for Sabon Gari (T2A) and Industrial Damba (T2B) are located inside the transmission substation. The Toshiba 30/40 MVA 132/33KV rating is a refurbished power transformer yet to be connected.

132kV Switchyard: The station has 1 X 60MVA and 1 X 30MVA (Mobile) transformers with a Single bus bar configuration and one incoming 132kV lines from Zaria.

33 kV Switchyard: There are five (5No.) 33kV outdoor outgoing feeders which are over loaded.

Control Building: The control Panels of the equipment for the substation is housed in a building that consists of control room, battery room, communication room, Supervisor's office, toilet, bath and a store with no space for the installation for additional equipment. The protection/control panels in the control room are very old with obsolete electromechanical relays. There are 110V and 50V battery banks with chargers in the control room which are in good condition.

Table 7.1: Transformers within Gasau 132/33 KV transmission substation

S/N	Description	Type	Year of Manufacturing
1.	Mobitra 30MVA 132/33KV (T2)	Power	1987
2.	30/40 MVA (T1A) 132/33KV	Power	1987
3.	Toshiba 30/40 132/33KV (unconnected)	Power	1987
4.	Elprom 7.5MVA 33/11KV	Distribution	1987
5.	Hyundai 7.5 MVA 33/11 KV	Distribution	1979

7.2: Environmental Baseline

7.2.1: Project Location

The transmission substation is located in Samaru community along Zaria – Sokoto road in Gusau. Gusau is a city and Local Government Area located in north-western Nigeria. It is the capital of Zamfara State. The LGA has an area of 3,364 km².



Plate 53 : Gusau substation switch yard



Plate 54: Sokoto – Gusau road terrain

7.2.2: Climate and Meteorology

The climate of Zamfara is warm tropical with temperature rising up to 38 °C (100.4 °F) between March to May. Rainy season starts in late May to September while the cold season known as Harmattan lasts from December to February. Zamfara state enjoys a tropical type of climate, largely controlled by two masses, namely, the Tropical Maritime from the state Atlantic and the Tropical Continental from the Sub Sahara and the Middle East. Temperature: The hottest months in Zamfara state are March and April, that is just before the onset of the first rains. The onset of the rains brings a cooling effect with temperatures dropping air, as below 36oC (90oF). The peak of the rainy season from about July to September except towards the lever, end of November/October when the tropical safe continental air masses from the Sahara predominate.

The temperatures are highest on average in April, at around 30.9 °C. January has the lowest average temperature of the year. It is 22.9 °C.

Rainfall: The mean annual rainfall in the State varies slightly, from the northern to the southern parts of the State. For example, while Gumir records an average of 579mm of rainfall, Talata is Mafara records 798mm, Kaura Namoda 990mm and Moriki 1,020mm. The onset of the rains, on the average, is between mid-March and May, lasting for about six months till the end of October. The least amount of rainfall occurs in January. The average in this month is 0 mm. With an average of 262 mm, the most precipitation falls in August. The variation in the precipitation between the driest and wettest months is 262 mm. During the year, the average temperatures vary by 8.0 °C.

Meteorological variables like air temperature, relative humidity, rainfall, atmospheric pressure, wind speed and direction were collated from the field. Other Meteorological data from literature sources for the stations considered or within the axis of the proposed project were used to augment the available ones.

Table 7.1: Meteorological results

Location	AQ1	AQ2	AQ3
	Transformer area	Gate area	Community
	N012° 09' 11.3"	N012° 09'12.0"	N012° 09'14.5"
	E006° 41' 55.9"	E006° 41' 56.1"	E006° 41' 57.5"
Temperature, °C	32.3	31.5	31.9
Wind Direction	SW	SW	S
Atm. Pressure, mbar	992	993	995
Wind Speed, m/s	4.40	5.70	4.10
Rel. Humidity (%)	41.0	52.0	51.0

Source: Field work 2015

The relative humidity during field measurements was between 41% and 52%. Gusau has a tropical climate. Diurnal wind speed values obtained during field work was between 4.10 to 5.70 m/s. The wind speed and direction analysis determines the speed of pollutants movement in the air and in what direction at a particular time and place. The secondary source of data was obtained from the Nigeria Meteorological Agency.

7.2.3: Air Emissions and Ambient Air Quality

The state of the ambient air in a given environment often depends on a combination of meteorological conditions and cumulative local emission sources. Polluted air contains undesirable materials which may damage human health, vegetation, infrastructure, and/or the global environment. Air Sensitive Receivers (ASRs) identified within the site was residential house at close proximity to the transmission substation. The general Air quality of the substation area was relatively good and devoid of obnoxious and pollutant gases, however high concentration of gases was recorded on the fringes of the site as a result of vehicular movement and other anthropogenic activities along the road.

Table 7.2: Air Quality parameters and Results

Location	AQ1	AQ2	AQ3	WHO Limits (24 hours)	FME _{env} Limit ($\mu\text{g}/\text{m}^3$)
	Transformer area	Gate area	Community		
	N012° 09' 11.3" E006° 41' 55.9"	N012° 09'12.0" E006° 41' 56.1"	N012° 09'14.5" E006° 41' 57.5"		
CO, $\mu\text{g}/\text{m}^3$	<1.0	3.0	5.0	NA	11.4
C _x H _y , $\mu\text{g}/\text{m}^3$	40.0	<0.01	1.0	NA	160
NO _x , $\mu\text{g}/\text{m}^3$	<0.01	<0.01	1.50	200	75.0 - 112
SO _x , $\mu\text{g}/\text{m}^3$	<0.01	<0.01	1.00	20	260
SPM, $\mu\text{g}/\text{m}^3$	10.0	20.0	40.0	50	250

Source: Field work 2015

The Nitrogen Oxides of interest are nitric oxide (NO₂) and nitrous oxide (NO). The concentration ranged between <0.01 $\mu\text{g}/\text{m}^3$ to 1.50 $\mu\text{g}/\text{m}^3$. Nitrogen oxides are products of high temperature combustion like vehicle engines, power plants domestic fires and industrial combustions. SO₂ is a more important oxide of sulphur as a primary pollutant, and is formed from the oxidation of sulphur containing fuels. Fossil fuel combustion by electrical utilities and industry is the primary source of sulphur dioxide. A range of chronic and acute health impacts may result from human exposure to sulphur dioxide (SO₂). SO₂ can irritate the respiratory system; in case of short-term high exposure, a reversible effect on lung functioning may occur, according to individual sensitivity (WHO, 1999). The SO₂ concentration of <0.01 $\mu\text{g}/\text{m}^3$ and 1.00 $\mu\text{g}/\text{m}^3$ was recorded at the Gate and community as a result of anthropogenic activities. Carbon Monoxide a product of incomplete combustion (oxidation) of fossil fuels or hydrocarbons recorded a high concentration of <1.0 $\mu\text{g}/\text{m}^3$ 3.0 $\mu\text{g}/\text{m}^3$ and 5.0 $\mu\text{g}/\text{m}^3$ at the Gate and community respectively. Light particles (Usually dust, fly ash) or other materials found suspended in the atmosphere and carried around by the wind are termed Suspended Particulate matter (SPM). SPM ranged from 10 $\mu\text{g}/\text{m}^3$ – 40 $\mu\text{g}/\text{m}^3$.

7.2.4: Noise

Noise in the form of buzzing or humming can be heard around the transformers or high voltage power lines producing corona. Ozone, a colourless gas with a pungent odour, may also be produced. Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The noise level within the station and in the neighbouring community complied with Federal Ministry of Environment (FME_{env}) and WHO Ambient Quality Guidelines. The noise level within the station complied with Federal Ministry of Environment (FME_{env}) and World Bank Standards are presented in the following Table.

Table 3.3: Noise level results

Location	AQ1	AQ2	AQ3	AQ4	AQ5	IFC EHS Noise limits	FME _{env} Limit dBA
Noise, dBA	Control room area	Transform er area	Extension area	Gate area	Community		
	NO6° 51'50.6" E003° 39' 13.5"	NO6° 51'49.2" E003° 39' 16.3"	NO6° 51'51.9" E003° 39' 16.5"	NO6° 51'49.5" E003° 39' 12.0"	NO6° 51'49.9" E003° 39' 13.3"		
	55.0	69.3	60.0	73.0	65.0	80	90

Source: Field work 2015

7.2.5: Soil Characteristics

Two major soil types ferruginous tropical soils and lithosols dominate Zamfara State. Lithosols, usually associated with ferruginous soils, can be found towards the eastern part of the State, particularly in such areas as Gusau. The soil is not only of low agricultural productivity but are also susceptible to erosion. The following Table presents Soil analysis of targeted parameters.

Table 7.4: Soil results

Location	AQ1	AQ2	AQ3
pH THC, mg/kg PCB, µg/g	Control room area	Transformer area	Extension area
	NO6° 51'50.6" E003° 39' 13.5"	NO6° 51'49.2" E003° 39' 16.3"	NO6° 51'51.9" E003° 39' 16.5"
	5.98	5.85	6.20
	<0.01	5,450	0.50
	<0.01	65.0	<0.01

Source: Field work 2015

7.2.6: Vegetation

A total of 2 tree/shrub species in 2 families and 3 herbaceous species in 3 families were observed to exist in the area. Similarly, a total of 1 food crop specie was encountered in the area. The vegetation of the Gusau area consists of the Northern Guinea Savannah. It is a belt with shorter grasses and less trees in the north. This is occasioned by the local climatic conditions of low rainfall and long dry periods. The Guinea savannah, with its typically short trees and tall grasses, is the most luxuriant of the savannah vegetation belts in Nigeria. It should be noted that no endangered species that are identified according to the national regulations, were observed within the substation vicinity.



Plate 55: Landscape of the surrounding from the main road

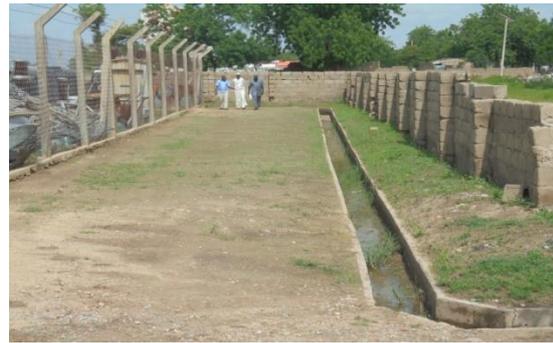


Plate 56: Drainage system around switch yard and concrete block showing one of the areas under dispute

7.2.7: Wildlife

In the immediate study area, a total of 8 wildlife species were recorded. The major wildlife animals commonly found in the area are donkeys (*Equus africanu asinus*) Pied crow (*Corvus albus*), Kite (*Milvus migrans*), Hawk (*Accipiter gentilis*), camel (*Camelus dromedarius*), Agama lizard (*Agama agama*), Monitor lizard (*Vatanus varius*) and African giant rat (*Crycetomys gambianus*). No information was obtained on the occurrence of rare or protected plant or animal species or on the biodiversity conservation situation in the area in general.

7.2.8: Land Cover

There are no declared nature reserves or wetlands adjacent or near the proposed location. Slightly built up area, administrative institutions and structures in the transmission substation. The land-cover types of the factory area are:

✓ Forest I (disturbed)	5	%
✓ Forest II (undisturbed)	0	%
✓ water	0	%
✓ Built-up/bare soil	95	%

7.2.9: Land Use

The land use pattern of the area is an outcome of natural and socio – economic factors and the utilization by people in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressures. Though human beings have been modifying land to obtain food, shelter and other essentials of life for thousands of years, current rates, extents and intensities of such modifications are far greater than ever in history and continue undocumented. This has driven unprecedented changes in ecosystems and environmental processes at local and regional scales. The predominant mosaic of land use of the transmission substation area is- built-up and fallow land/scattered cultivation.

7.2.10: Geology

Geologically, the State characterized by very old igneous and metamorphic rocks, formed during the precambrian-paleozoic era. Two rock types are found in granites and meta sediments. The granites (including undifferentiated granites), gneisses and migmatites are lively resistant to erosion, but when weathered, they result into poor soils. The meta sediments, on the other hand, consist of phyllites, quartzites and meta-conglomerates. Although to meta sediments are also resistant to erosion, weathered, they give rise to more fertile soils account of the fact that the schists are rich in magnesium minerals. In general, the relief of the State bears relationship to its geology.

7.2.11: Socio-economics

Zamfara State is a state in northwestern Nigeria. Its capital is Gusau Zamfara is peopled by Hausa, Fulani and Burmawa peoples. Zamfara is dominated by the Hausa and Fulani and the other ethnic groups in the state include the Kanuri, Nupe and Tivs. Others include the Igbo, Yoruba, Kanuri, Nupe and Tiv. Islam and Christianity are the principal and major religions of the state. Zamfara was the first state in Nigeria to introduce sharia law. English is the official language of the state. Other main languages spoken in Zamfara are Hausa, Fulfulde and Arabic. Population of Gusau LGA where the transmission substation is situated was 259,336 in 1991 and 383,162 in 2006 (Male 199823 and Female 183339). The occupation of the people of the state is primarily farming. They produce both food crops and cash crops. Agriculture is the most important occupation of the people of the state, hence its slogan "farming is our pride".

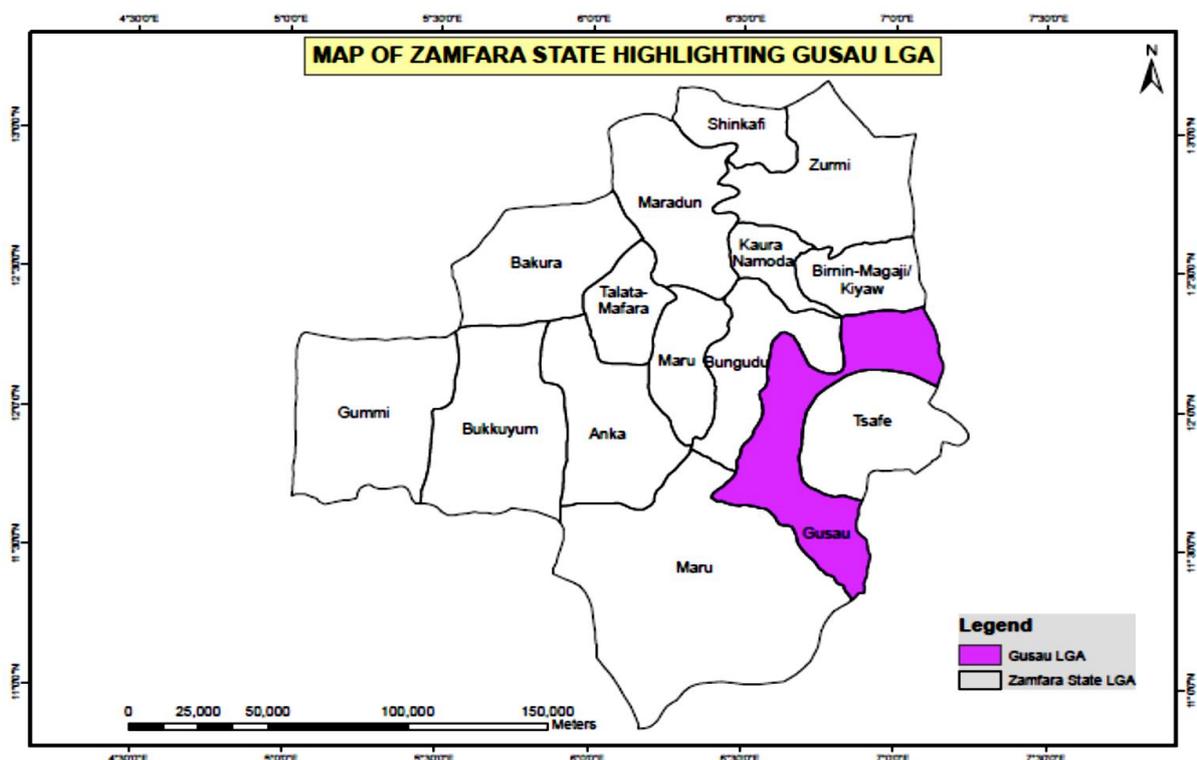


Figure 7.1: Administrative map of Zamfara State showing Gasau LGA

The people of people are connected to the national grid through the Kaduna Electricity distribution Company (KEDC). According to the interviews conducted, power supply is epileptic in nature in the area. Other sources include generators, solar power and the old hurricane lamps..



Plate 57: Consulting team and TCN Gusau staff **Plate 58: Conducting interview in the Station**

The population of Gasau in 1991 was 127,513 and 253,412 in 2006 census (123,801 males and 129,611 females). The two dominant religions in the area are Christianity and Islam. A small proportion of the people still practice traditional religion. Sources of electricity in Gasau are the national grid owned and operated by the Transmission Company of Nigeria (TCN) and distributed to consumers through the Kaduna Electricity distribution Company (KEDC), private generators, hurricane lamps and wax candles.

7.2.12: Stakeholder Consultation

A consultative process is critical in order to inform project beneficiaries and key stakeholders of the project, to receive and include their input in the design and implementation and address concerns. For the Rehabilitation/Reinforcement of 132/33kv Transmission Sub-station a meeting with the municipalities affected by the substation was organized. These meetings took place during the period of the ESMP field work when the project was launched, up to today. The stakeholder consultation was undertaken among people living in Samaru community near the substation in Gusau. The aim was to ensure that stakeholder interests were consulted and incorporated in the project development, implementation and operation. Such meetings enable interested and affected parties to contribute their concerns (views and opinions on the proposed project). Findings of stakeholder analysis were very important in predicting impacts and development of this ESMP.

The Consultants explained the importance of the project and the positive impacts and the facilities that will result to the benefit of Gusau and the society. The project will contribute to social and environmental development, and raise the reliability of electric networks. Moreover, it will solve many dilemmas related to electric sector; supplying electricity to all southwest areas with high efficiency. It was pointed out that negative impacts are minimal, temporary, and site-specific and can be mitigated.

In the meetings with community members, it has been stressed that substation will act as one of the center points for the transmission system, which as a result will promote the power sector. The concerns of the people included, employment of the community youths at least in the unskilled category at the substation and regular power supply especially to the host community.

Other matter of great concern in the area is encroachment into the facility area by people due to lack of fencing. The people residing within the neighborhood had long ago being appropriating some portion of TCN land to themselves. start of the facility around the entrance was sold to a businessman by a woman who claimed she inherited the land from her parents. The Zamfara state governor has intervened and promised to resolve the matter and return the parcel of land to TCN.

All the notes and comments have been recorded. Overall, the participants of the consultations were supportive of the project. However, few concerns were raised. Representatives of the community and other people during the consultation expressed concerns regarding employment of youths, the safety of people and land near power lines. In order to sustain this overwhelming public support, consideration of the public and stakeholder concerns should proceed with project development simultaneously.



Plate 59: Concrete Block fence in front of the switch yard is one of the evidence of encroachment and area under dispute in the court of law



Plate 60: Entrance to substation from main road

Concerns Raised In Consultation Meetings

The Project affected population had no serious concerns and all people interviewed supported the Rehabilitation/Reinforcement project. However, few concerns were raised which are presented in the below and minutes of the consultation meeting attached as an appendix. The consulting team and substation supervisor assured the stakeholders responded that all their concerns were important and shall be documented and addressed accordingly.

Concern/Issue	Comments by Stakeholders (Q) /Consulting Team Response (A)	
Employment:	Q.	-The area residents requested to be first considered when employment vacancies arise most especially during the construction phase
	A.	-The contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase
Quality Jobs:	Q.	-The firm should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g. operators
	A.	-The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.
Social Corporate Responsibilities:	Q.	-The locals want the firm (TCN) to take part in their developmental activities. e.g. sinking borehole etc.
	A.	-The firm is a Government social service agency and therefore limited in executing CSR.
Stakeholders Engagement:	Q.	-The residents of the area will need information of impending work that will affect their environment. e.g. traffic, noise etc.
	A.	The stakeholders consultation and engagement will be continues through the life span of the project.

7.3: Findings of Auditing Gasau Substation

This subsection presents the findings of the conducted audit of the substation and provides the recommended short medium and long term standard operation procedures SOPs to bring the existing substation into compliance with applicable national and international standards. The following sections provides the anticipated impacts assessment, management and monitoring plans for the proposed rehabilitation project.

7.3.1: Building Materials

The predominant material used for construction of the Transmission station control room is concrete. However the decking of the control room is weak and leaks water during any rainfall. This has caused the support beam to weaken and become a potential hazard. The fencing around the switch yard is built with wire mesh and with good height.



Plate 61: Weak beam of the control room



Plate 62: Leaking area of the control room roof

Recommendation: No Asbestos containing materials were observed therefore no SOPs are recommended

7.3.2: Water Supply, Effluents and Storm water Drainage

The station sources for water from the public water system which flows once a while. Whenever the public water supply flows it is stored in an underground storage tank within the substation. The quality of the water in the area was determined by collection of representative sample and analysis carried out. Drainage system at the boundary of the switch yard exist however cable trenches serve as drainage outlets for storm water. Operators do experience water flow into the control room through the cable trench.



Plate 63: Substation Hand dug well



Plate 64: Cable trench

Table 7.5: Water Quality Results

PARAMETER	Underground storage	FME _{env}	WHO Limits
pH	6.86	6.5 – 8.5	6.5 – 8.5
Temperature, °C	30.1	NA	NA
TDS, mg/l	76.8	500	1000
Conductivity, $\mu\text{s/cm}$	140.0	NA	NA
DO, mg/l	1.20	7.5	NA
Alkalinity (mg/l)	9.4	NA	10

Hardness (mg/l)	18.0	200	100
Turbidity (mg/l)	2.91	1.0	5.0
Salinity as Cl ⁻ (mg/l)	25.8	250	250
TSS (mg/l)	6.50	<10	10
Cd (mg/l)	0.04**	0.01	0.003
Pb (mg/l)	0.08**	0.05	0.05
Hg (mg/l)	<0.001	0.001	<0.001
Fe (mg/l)	1.32**	1.0	0.3
Cr (mg/l)	0.05	0.05	0.05
Zn (mg/l)	2.74	5.0	3.0

Source: Field work 2015

Effluent from the station building conveniences and wash area are channeled into a soak away pit. This soak-a-way pit system is an underground soil treatment system, which receives partially treated sewage from the septic tank. Storm water drainage system designed to drain rain water from the facility do not exist within the station only around the perimeter fence. Cable trenches function as drainage systems for evacuating water from the station. The Storm drains observed are unable to contain the quantity of rain that falls during heavy down pour.



Plate 65: Blocked Cable trench with switch yard



Plate 66: Substation land behind the switch yard which is not fenced.

7.3.4: Waste Production and Disposal

The management of waste at the transmission substation was identified in detail, and quantities noted of each of the various categories of wastes and their rate of generation over time. Waste management in the transmission substation is poor. Wastes were not sorted/segregated into the different waste streams but are dumped haphazardly and disposal was by open burning thereby polluting the ambient air and creating an unhealthy environment which promotes diseases/health conditions. Waste collection points are major attraction for insects and rodents which in turn attracted reptiles especially snakes.



Plate 67: Waste deposited in front of substation



Plate 68: Earth drainage in front of substation

7.3.5: Hazardous Materials

Hazardous materials in this sector include insulating oils / gases (e.g. Polychlorinated Biphenyls [PCB] and sulfur hexafluoride [SF₆], and fuels, in addition to chemicals or products for wood preservation for poles and associated wood construction material. Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. They are typically found in the largest quantities at electrical substations and maintenance shops. Sulfur Hexafluoride (SF₆) is used as a gas insulator for electrical switching equipment especially in the breaker units as an alternative to insulating oils at Sagamu transmission substation. However, the use of SF₆, a greenhouse gas with a significantly higher global warming potential (GWP) than CO₂, should be minimized. In cases the gas is used for applications involving high voltages (>330 KV), equipment with a low leakage- rate (<99 percent) should be used.

Prevention and control of hazards associated with spill prevention, emergency response, clean-up, and contaminated soil remediation are not addressed in the station administration. Polychlorinated Biphenyls (PCB) were widely used as a dielectric fluid to provide electrical insulation, although their use has been largely discontinued due to potential harmful effects on human health and the environment, however traces of PCB were detected in the contaminated soil samples analyzed. Due to their low vapor pressure, PCBs accumulate primarily in the hydrosphere, in the organic fraction of soil, and in organisms.

Old manufactured power transformers like the ones in Gasau transmission substation (1970) are a major legacy source of PCBs. Even units not originally filled with PCB may be contaminated, since PCB and oil mix freely and any given transformer may have been refilled from hoses or tanks also used with PCBs.



Plate 69: Polluted transformer space without trough Plate 70: polluted transformer base without a trough

Recommendations:

- The proposed recommendations are included in Appendix A

7.3.6: Occupational Health and Safety

These impacts include, among others, exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust and noise; falling objects; work in confined spaces; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Occupational health and safety hazards specific to electric power transmission operation and projects primarily include live power lines, working at height, Electric and magnetic fields (EMF) and exposure to chemicals.

Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines. Although there is no empirical data demonstrating adverse health effects from exposure to typical Electric and magnetic fields (EMF) levels from power transmissions lines and equipment. Electric fields are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and increase in strength as the current increases.

Switching yards are sources of EMF. The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a non-governmental organization formally recognized by the World Health Organization, has set guidelines exposure limits for public and occupational exposure to EMF for ac systems, as indicated in the following table⁶.

⁶ Source: ICNIRP (1998): “Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

Table 7.6: ICNIRP Guidelines for EMF public and occupational exposure

Frequency	Public Exposure		Occupational Exposure	
	Electric Field (V/m)	Magnetic Field (mG)	Electric Field (V/m)	Magnetic Field (mG)
50 Hz	5,000	1,000	10,000	5,000
60 Hz	4,150	830	8,300	4,150

It should be noted that no safety signs exist anywhere within the station and outside the station warning people of danger equipment and zones. The station is staffed the standard number of 6 operators and 1 supervisor on 8 hours shift.

Recommendations are provided in Appendices A

7.3.7: Personal Protective Equipment (PPE)

Personal protective equipment (PPE) was provided for the staff at the transmission substation, however inadequate in terms of number provided (per-station instead of per-person) frequency of change and type. The non-use of PPE causes and leads to various forms of incidents/accidents ranging from loss of limbs, burnt skin, and blindness from transformers explosions, electrocution and even death in few instances.

It should be noted that no accident monitoring records were not obtained during the site visit to Gasau Transmission substation.

Recommendations are provided in Appendices A

7.3.8: First Aid

First aid as the provision of initial care for an illness or injury is essential and necessary in high risk work areas like a transmission substation. A collection of supplies and equipment (first aid box) for use in giving first aid for minor ailments and primary care is not available in the transmission substation. The operational staff is not trained in any form of first aid.

Recommendations are provided in Appendices A

7.3.9: Fire and Emergency Precautions

Fire extinguisher canisters were available but were all expired and not calibrated. Fire and explosion, dangers of fire hazards arise from electrical short circuiting and lightning. There are no smoke detectors, fire alarms, fire hose and hydrants available within the substation. The transmission substation operators have little or no training in firefighting.

Recommendations are provided in Appendices A

7.3.10: Housekeeping

Housekeeping within and outside the Gasau transmission substation was observed to be generally poor. Discarded items, used drums; scrapped panels and furniture were observed kept around the premises of transmission substation. They constitute a health hazard because they have the potentials to cause accidents like falls, cuts, lacerations and serve as breeding grounds for rodent and insects which attract reptiles like snakes.



Plate 71: Staked materials within switch yard



Plate 72: Poor Housekeeping

Recommendations are provided in Appendices A

7.3.11: Site Security

Security lights are inadequate at night for proper visibility and needs to be improved upon. Armed soldiers, Nigerian security and civil Defense corps six personnel are (6) in total guard the station with two (2) per shift.

Recommendations are provided in Appendices A

CHAPTER EIGHT POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

8.1: Introduction

The assessment of potential impacts has been done through analyzing different project activities and envisaging possible changes to the environment. Each potential impact was qualitatively analyzed to classify its significance to three degrees: major impacts, medium impact and minor impacts. Major impacts are an impact with a reasonable likelihood that is likely to cause violation of applicable standards. Medium impacts are impacts with a reasonable likelihood that are likely to cause violation of applicable standards only in combination with the impact of other sources. Minor impacts are impacts which are not likely to cause violation of applicable standards whether on its own or in combination with other sources. The likelihood of each impact has been qualitatively evaluated to two degrees: highly probable and low probable.

An Environmental and Social Management Plan (ESMP), presented later in the next section, includes mitigation measures that minimize the negative impacts using available technologies and managerial procedures.

Main concerns will be the impacts arising from the construction works during rehabilitation of the existing facility and mainly the impacts from the Electromagnetic Fields (EMF) during operation. The main purpose of this ESMP is to investigate potential impacts of the proposed interventions under the project on both the environment as well as the surrounding community.

For compliance and in accordance with the requirements of Federal Ministry of Environment (FMEnv) and the operational policy and procedures of the World Bank, this study is site specific ESMP for the four (4) transmission substations as to identify potential adverse environmental and social impacts of the project. The objectives of the environmental assessment are to:

- Identify both potential positive and negative impacts of the proposed rehabilitation/reinforcement of the transmission substation during rehabilitation/reinforcement and operation.
- Develop an implementation plan that outlines relevant mitigation measures to minimize and/or mitigate negative effects and impacts and to enhance positive effects and impacts.

The virtual resultant of the **magnitude of the impact** and **sensitivity of the receptor** for each impact is evaluated to generate the impact's significance and overall assessment. The following chart illustrates how the two factors are coupled:

		Magnitude of Impact			
		Negligible	Low	Medium	High
Sensitivity	Low	Level 1	Level 1	Level 1	Level 2
	Medium	Level 1	Level 2	Level 2	Level 3
	High	Level 2	Level 3	Level 3	Level 4

Where:

- Level 1 – Nominal impact to the baseline environment (requires no mitigation or management plan)
- Level 2 – Minimal impact to the baseline environment.
- Level 3 – Medium impact to the baseline environment.
- Level 4 – Significant impact to the baseline environment

8.1.1: Short Term Recommendations

Water Supply, Effluents and Storm water Drainage

The proposed measures in the short term include:

- Take composite samples of discharged wastewater to accurately determine the oil load in the water and other contaminants that are above the law standards. Analysis for PCBs should also be undertaken for the wastewater in the oil drain pit.

The proposed measures in the short term include:

- Install/rehabilitate the existing the compact gravity oil separator unit.
- Enlarge the existing drainage system within the facility
- The separated oil sludge should be handled as hazardous waste. However, frequent analysis should be undertaken for the sludge, and if it contains above 50 ppm PCBs it should be separated and handled as a PCB waste.

Waste production and disposal

The environmental issues associated with non-hazardous solid waste, especially scrap waste, is that it occupies large area of land, limit accessibility for cleaning and housekeeping, accumulates dust, form suitable habitats for insects and snakes, and affect the general appearance and aesthetic considerations. Accordingly it is recommended, as mentioned in the SOPs below, to have certain designated areas for collecting scrap at each location:

The recommended SOPs for scrap management in the short term are:

- Preparing inventory for all scrap and non-hazardous waste in substations. The Managers of the substation shall quantify stored scrap waste in their premises.
- Certain temporary storage areas for scrap should be allocated in each location depending on its generation rate and frequency of collection. The scrap area should be organized so as to allow for cleaning and easy handling of different items

The recommended SOPs for scrap management in the medium term are:

- Record keeping of annual generation rate of each waste items and the amount of waste that is being recycled.
- Investigate possible ways for waste minimization, including making incentives for less waste generation and initiate awareness campaigns.

Building Materials

The recommended SOPs to be adopted in the short term are as follows:

- Procurement Department shall to document procurement policy and procedures which should be audited by the HSE Department to prevent procurement of any of ACMs
- The surface area of the asbestos roof is approximately 12 m² and shall be disposed and handled according to the following:
- .ACMs at Awka (Nibo) substation should be collected in suitable double air tight PE bags with adequate thickness to bear the asbestos waste. In order not to cause further disturbance of asbestos waste, and generate further asbestos fibers, the waste removal and soil clean-up should be undertaken by a professional asbestos contractor⁷. The procedures to be followed in such activity normally includes:
 - o Wetting all waste items and underneath soil before any handling
 - o Careful placement wet asbestos waste in suitable container bags
 - o Cutting large items should be avoided unless they couldn't be fitted in the containment. In such cases the cutting tool should be carefully selected to suite cutting wet materials
 - o Parts of the soil should also be placed in containers bag in wet condition for cleaning the area.
 - o The waste area should be isolated and all workers in removing waste and cleaning the site should wear full cloth protection and respiratory protection. All cloth used during clean-up should be disposed in container double container bags as described above.
- Asbestos waste shall be handled and transported by qualified hazardous waste contractors.
 - o Clear warning signs should be fixed in out of the room
 - o Any maintenance practices, such as cleaning nearby shelves or using sharp tool in a nearby fixture, within these buildings should consider the following precautions⁸:

⁷ If no such contractor is available in Nigeria, international contractors should be employed

⁸ These procedures are recommended by USEPA

- The area of maintenance should be isolated and provided with portable ventilation equipment
 - By all means sawing, sanding and drilling asbestos is prohibited
 - In case accidental disturbance occurred to an asbestos surface the area should be evacuated.
 - Only workers wearing full protective cloth and respiratory protection could enter the area for repairing the damaged part either through encapsulation in plaster or latex paint and adequately wet any asbestos waste which should be collected, along with contaminated cloth, in double thick air-tight plastic bags. In such cases air sampling should be undertaken to ensure that the damage has been effectively repaired.
 - All above measures should be supervised by HSE staff received professional asbestos training
- The generated waste shall be contained in a concrete box and stored in hazardous waste designated area since no engineered sanitary landfill is available in Nigeria.

Hazardous Material

The proposed SOPs in the short term are:

- The solution will be implemented before the commencement of the project. Though the PCB discovered in all the stations were in trace concentrations (<0.01 – 65.0 µg/g) and the soils are heavily contaminated with transformer oil. The contaminated soil is to be excavated to depth of oil pollution, stored transported and disposed by a specialized sub-contractor through thermal treatments which are the most indicated methods for removing PCBs from contaminated soils with Dioxins and Furans removed by scrubbers. Pyrolysis (decomposition by high temperatures) and incineration (combustion of organic substances contained in waste materials) remediation methods ensure with some exceptions, an efficiency of over 99 % in incinerators (high temperature (870 °c– 1500°c) rotary kiln incinerators).

The proposed SOPs for the medium term are:

- Manager of the substation should undertake continuous monitoring of electric performance of the old transformers through appropriate tests, such as dielectric test and power factor test. The declining efficiency of the transformer is an indication for oil degradation and possible development of acidic and corrosive properties, a situation that could cause loss of the integrity of the transformer body and possible subsequent leaks. Therefore transformers with reduced efficiency should be sent as soon as possible to the transformer workshop for proper handling
- Manager of the substation should frequently, say on monthly basis; physically detect the integrity of identified PCB transformers and capacitors. In case of detection of any leak, the transformer/capacitor should be transferred to the workshop for adequate maintenance or sent to scrap storage.

- Any spill from PCB transformers or capacitors should be contained using absorbent material; the contaminated absorbent should be placed in metal drums with clear sign of PCB waste. The clean-up should be undertaken by trained personnel with full PPE, including chemical resistant gloves, boots and overalls. All surfaces exposed to spills should be decontaminated with cloth containing an efficient solvent. Any PCB contaminated waste generated in grid stations or substations should be handled by a specialized contractor.
- All PCB waste (including contaminated cloth, absorbent materials, contaminated soil, contaminated coils, filters and other small contaminated components) should be collected in adequate metal drums with clear signs. Drained PCB oils should also be collected in metal drums with tight lids. Transportation of PCB drums should be in designated hazardous waste vehicle and using documented manifests. Any accidental spill occurred during transportation should be reported immediately reported to HSE Department who should send trained staff to supervise containment of any spill and clean-up of contaminated surfaces according to the above-mentioned procedure.
- A PCB storage area should be prepared at a suitable location. The storage area should be built with adequate roof and walls to prevent rainwater from entering, the store should and have concrete floor lined with imperious liner, and at the edge of the store there should be curbs with sufficient height to contain any leak. The area should be sufficient for storing all PCB equipment and wastes, with sufficient corridors for movement of forklifts and with sufficient ventilation facilities. All waste barrels and equipment should be placed on wood pallets for easy movement by forklifts.
- Inventory records of operating, maintained and stored (for disposal) PCB equipment should be summarized in the annual HSE report as an environmental management indicator.

The proposed SOPs for the long term are:

- The procedure for identifying PCB equipment could be done through making preliminary assumptions about old equipment, and/or through undertaking identification sampling for some suspected equipment. The identification procedure though preliminary assumptions shall follow the following steps:
 - All PCB equipment and PCB contaminated equipment, whether in use or in scrap yards, should have clear marking sign suitable for their identity (PCB or PCB contaminated).
 - In case there are requirement for a more accurate classification of the existing or scrap equipment⁹, sampling and analysis of the oil and the inner surface should be undertaken using a standard sampling procedure, such as USEPA Standards, for oil sample volume and wipe samples. Accurate classification, and marking, of equipment could be undertaken according to analysis results as indicated in the above table

⁹ For reasons such as reducing storage space for PCB waste or for reducing precautions of handling PCB equipment

- It is recommended in the short term to provide international training to some HSE staff about adequate PCB management, so that trained personnel will be focal points for PCBs management in HSE and will disseminate knowledge and awareness among other staff

8.2: Environmental and Social Impacts during Construction

8.2.1: Evaluation and assessment of Construction Waste Impacts

Wastes generated during construction activities at substations will mainly comprise of excavated soil for foundations. The excavated soil will normally be accumulated within the station, and collected after installations are completed. Other types of solid construction wastes would include the following:

- Foundations
- Trimmings of steel.
- Cut-off trees and vegetation
- Metals, wood, cement sacks, sand and gravel, concrete spills, cut off cables, garbage from daily activities of workers.
- Hazardous wastes such as spent oils from the operation and maintenance of machinery.
- Wasted or faulted materials of the towers including conductors and insulators

Impact Significance

The impact of uncontrolled waste dumping to groundwater is considered Medium (level 3) as the receptor (groundwater) is situated at only 24 meters from the source of pollution within the substation. Moreover the impacts during construction are characterized by being short term impacts. Also, the impact on soil is considered Medium (level 2) due to the potential presence of hazardous wastes such as spent oils which could leach into the soil when subjected to rainwater.

From the above, it can be concluded that the impact of solid wastes generation in general, if not properly managed, could be considered of medium significance (level 3) due to the potential presence of hazardous wastes and the possibility of wastes being accumulated which has a negative visual impact.

By implementing the following recommended mitigation measures, the significance of the impact could be reduced to minor.

Proposed Mitigation Measures

- TCN Contactor should communicate with the local authorities for officially assigning location for the disposal of construction waste. Agreement on the disposal sites and the collection means should be reached prior to commencing construction works.
- Adequately equipped trucks should undertake waste transportation. The contractor should make-sure that the trucks are not overloaded and that the waste is adequately contained inside the rear box or covered to prevent dust or particles movements from the truck. The

supervising Consultant should also occasionally inspect that the truck drivers are disposing of the waste at the approved location, and regular checks to the disposal site.

- The on-site waste accumulation area (WAA) in the substation shall be designed to accommodate the expected amounts and different types of wastes. It shall be covered and provided with adequate flooring for possible access of forklifts and small trucks. EHS officer should keep separate areas for each type of waste, keep internal passages inside the WAA for facilitating access and should order for regular cleansing of the area. Records of the admitted waste shall be kept in a register and before the WAA is full.
- Domestic waste generated on site shall be segregated and not mixed with any other type of waste.

Mitigation measures for hazardous waste management:

For the management of HW, A hazardous waste management plan (HWMP) is proposed which will direct actions to be undertaken to ensure environmentally sound management of hazardous wastes. The plan identifies the roles and responsibilities for TCN staff and/or the Contractor's staff, how hazardous wastes can be identified and safely handled, the places where the hazardous wastes could be accumulated and the training requirements for the staff involved. The HWMP and the HWM-SOP shall apply to all hazardous wastes generated at the site managed by TCN and apply to the contractors The following measures shall be applied:

- ***Hazardous waste identification:***

Hazardous wastes which could be generated during the construction of the rehabilitation were identified according to the national and international pertinent regulations. The wastes were checked against five lists (S-list, F-list, K-list, P-list and U-list). The lists cover the different hazardous characteristics of the wastes (i.e. if it is corrosive, flammable, toxic or reactive). As a result, potential hazardous wastes have been identified and classified as follows:

- ✓ Spent Mineral oils (S or special listed wastes);
- ✓ Possible miscellaneous empty chemical containers , depending on the MSDS (S listed wastes);

- ***General Guidelines***

It is totally prohibited to dump or dispose of any hazardous wastes in uncertified sites or use uncertified waste transportation means. All hazardous wastes must be recycled or disposed off-site by a licensed hazardous waste contractor as will be discussed in more details below. Hazardous waste disposal contracts are to be developed and administered by the Hazardous Waste Coordinator.

In general, all types of hazardous wastes cannot be disposed of in the following:

- ✓ trash cans;
- ✓ rainwater drains;

- ✓ by evaporation or dilution;
- ✓ incineration on site and/or through any other onsite treatment process; or

In addition to the above, the following strict prohibitions must be considered:

- ✓ Do not mix different types of hazardous wastes.
- ✓ Do not pour hazardous substances down any type of drain.
- ✓ Do not hose down a spill of hazardous substance.
- ✓ Do not eat or smoke in areas where hazardous materials or hazardous wastes are present.

- ***Specific Hazardous Waste Management guidelines***

For the PVC coated wires/cables:

Wiring is often coated in polyvinyl chloride (PVC) which commonly contains numerous additives, including heavy metal compounds and softeners such as phthalates. Combustion of PVC can produce toxic substances.

- ***Management of the waste accumulation area (WAA)***

The WAA shall be designed to accommodate for a separate fenced and shaded area for the accumulation of hazardous wastes pending collection – this could be a closed container. The hazardous Material Coordinator is responsible for managing this area and ensuring that:

- ✓ The area is secure with limited admission and must be signed with the following: “DANGER - HAZARDOUS WASTE STORAGE AREA”; and “UNAUTHORIZED PERSONNEL KEEP OUT”
- ✓ The area is inspected monthly.
- ✓ Hazardous waste is being registered
- ✓ Hazardous wastes shall be registered in a hazardous waste register containing the following information:
 - Name and address of the establishment/project.
 - Person responsible for maintaining the hazardous waste register
 - The temporal boundaries for the current data
 - Log of hazardous waste held at the storage area including the common name, the characteristics (physical form) and amount (weight/volume) of waste that is being transported off-site.
 - A map indicating the location of accumulation area.
 - MSDSs and waste analyses used to characterize waste streams.
 - Hazardous waste transportation means
 - waste’s destination and disposal methods
 - Waste storage area monthly inspections records and recommendations
 - Records of all spill incidents which required implementation of the Spill Emergency plan or any other corrective actions with regards to hazardous waste handling and storage.
 - Training records

- Manifests and bills of lading for hazardous (and non-hazardous) wastes. These records shall be filed indefinitely in an official file maintained by the Hazardous Materials Coordinator and a duplicate file maintained at the Plant Manager's office.
- ✓ Clear and correct labels are placed on the different storage containers
- ✓ The containers are inspected monthly for leaks or any other form of damage and are kept in good condition.
- ✓ No mixing of different hazardous waste streams is taking place
- ✓ The area is properly shaded from rain and sun heat/light.
- ✓ Must have a water supply
- ✓ Must be accessed from at least two sides for emergency

Hazardous waste can be stored *in drums*, containing small quantities of liquid and solid waste, in order to be easy to handle and to allow proper segregation of incompatible wastes such as reactive substances.

- ***Hazardous Waste Collection and disposal***

Special waste which couldn't be recycled should be disposed of in controlled areas within certified disposal sites. Secured accumulation areas for the collected hazardous wastes (separate or integrated with the WAA) shall be provided on site where necessary with records being kept of the type, amount and date of collection as described above. Transportation of hazardous wastes could be performed quarterly by certified contractors.

- ***Awareness***

Project's stakeholders should be aware of the disposal procedure of hazardous wastes and the possible environmental risks associated with them.

- ***Minimization***

Waste minimization procedures should be adopted during the operation. The supervisor should make sure that the procedures implemented according to the design measures

Monitoring Activities:

- No monitoring activities are required for construction waste as long as the above mitigation measures are implemented
- There should be a form prepared by TCN by the EHS Officer to keep records of quantities, types of scrap received in the store and the location where it has been received from.

Reporting

- ✓ The monthly report of the construction contractor should include how well does the contractor abide to the above measures and any comments noticed by the site supervisor about mismanagement of construction waste during the month.
- ✓ The EHS officer should prepare a monthly report including received scrap items, sold items and disposed items

8.2.2: Management of Excavations

During the rehabilitation of the substation mitigation measures shall be applied

Proposed Mitigation measures:

- All excavations shall be made in accordance with the approved drawings.
- The sides of all excavations, which might expose personnel or facilities to danger resulting from shifting earth shall be protected by providing slope to the appropriate angle of repose or benching in the sides and ends of the excavation or ladders must be used and secured, enough to withstand at least 1 meter above the top of the excavation.
- All excavation deeper than 1.5 meters must have barriers and toe boards around the outside to-prevent persons and material falling into the excavation. Barriers must be of a strength that is capable of withstanding the weight of a person falling against the barrier. Barriers shall be readily visible by day or night.
- All persons in excavation must wear safety helmets and safety boots
- Vehicles and other machineries or construction equipment must not be allowed to come within 2 meters of an excavation unless working in connection with the excavation.

Monitoring Activities

- An inspection must be conducted at the end of the work to ensure that the excavation has been left in a safe manner. Heavy loads shall not be put on the edge of the excavation.
- The observer must conduct monitoring of the safety tools for the workers and the vehicles restrictions along the excavation and trenching sites.

Reporting

- ✓ The observer should report on the monthly basis of the accident or the worker's obedience.

8.2.3: Land Use

The substations extension will be at an owned land by TCN that is fenced. Thus, it is anticipated that limitations and impacts related to the land use of the substation is relatively limited.

Impact significance:

No impact is associated to the land use of the substation; therefore, no mitigation measures will be developed.

8.2.4: Impacts due to air emissions

Excavation, filling, loading, transportation and unloading of soil and raw materials cause suspension of airborne dust that raises the particulate matter concentration on ambient air. These emissions are temporary and its severity depends on the construction activity, meteorological conditions, silt content of the soil and moisture content of the soil.

Another source of air emissions during construction is the exhaust emissions of construction machinery and vehicles visiting and leaving the site. The extent of these emissions depends on the number of machinery working at the site at one time, the type and efficiency of the engines and also the climate conditions.

Impact Significance:

The average distance of residential infrastructure to the substations is approximately 50 meters. Therefore the impact is considered minor. The amount of dust that would be generated is not high due to the soil characteristics. As a result this impact could be also considered Minor (level 2) for the surrounding community line and Medium (Level 2) on the work environment at the substation. Exhaust from vehicles is considered minor (level 2) due to the duration of impact and significance.

Proposed Mitigation measures:

Implement a rehabilitation site management plan including the following measures:

- ✓ Store construction materials in pre-identified storage areas.
- ✓ Cover friable materials during storage.
- ✓ Regulation of speed to a suitable speed (30 km/h) for all vehicles entering the site.
- ✓ Implement preventive maintenance program for vehicles and equipment working on site and promptly repair vehicles with visible exhaust fume.
- ✓ Using locally available materials whenever possible thus limiting the travel distance. Reducing the distance and number of trips will result in an overall reduction in in gaseous and carbon emissions.

Monitoring Activities

- An inspection must be conducted on implementation of the site rehabilitation management plan.

Reporting

The observer should report on the monthly basis of the status of the implemented rehabilitation plan.

8.2.5: Impacts due to noise emissions

Normally construction works include noisy activities related to the operation of construction equipment, possible hammering and drilling works in addition to the noise generated from construction related trucks. The noise impacts could be analyzed in two main aspects: noise impact within the site, and the noise impact on the neighboring receptors. The baseline assessment of noise at Sagamu substation indicated that the hourly equivalent sound levels do not exceed the 8-hr maximum limit value of 75dBA.

During the rehabilitation phase, noise would be generated during day and night at levels exceeding the currently recorded levels during the baseline study. At the vicinity of all identified receptors, the noise intensity should not exceed 55 Decibel during the day (7am-10pm), and 45 Decibel during the night (10pm-7am) according to World Bank operational policy. Monitoring the noise emissions during the construction phase and handling the complaints received from neighboring areas will help to effectively control this impact.

Impact Significance:

Construction noise is not likely to affect neighboring areas because of the distance and the natural barriers between the source (use of machinery) and the receptors. The closest receptor that might be influenced by noise emission during construction in residential areas. The impact of noise emissions is considered medium level 2 at the substation due to the relatively short period of rehabilitation phase.

For noise impact upon workers, within the construction sites, it is possible that construction workers could be exposed to relatively high levels of noise. This could be mitigated through application of the normal precautions normally taken by construction labor. Accordingly, this impact has been classified as a Minor Impact (level 3), which could be further minimized and fully controlled if construction workers used safety gear as recommended in the ESMP.

Proposed Mitigation measures:

- Workers that operate noisy machines and nearby workers should be supplied with earmuffs and should be instructed to put them on when they get into noisy zones. Contractors should be responsible to instruct their workers to abide to this role, and the site supervisor should make sure the Contractor is compliant with this role
- Working hours for workers exposed to noise equipment should be designed so that noise exposure periods do not exceed the safe limits
- Coordinate and Inform inhabitants/employees at the nearby sensitive receptors about the peak time and hours for construction activities.
- Avoid construction activities at night

Monitoring activities:

- No monitoring measures shall be undertaken since the noise emissions are temporary.

Reporting

- The monthly report should include how well does the contractor abide to the above measures and any comments noticed by the site supervisor about high noise levels.
- A monthly report on any observations or complaints about high noise level.

8.2.6: Impacts on Socio-economics (traffic)

The greatest potential for traffic impacts to occur arises during the periods of peak construction activities. Based on observation during the conducted site visit it could be predicted that during peak construction periods, the main road adjacent to the site might be impacted. Since the road is double-lane in each direction and fully divided, it is assessed that the overall additional traffic would have little effect on the level of service due to the relatively small scale of the rehabilitation process.

Impact Significance

The extra traffic caused by construction vehicles is not expected to effectively impact the flow of traffic on the existing roads. The limitations on access to roads during construction are temporary (< 30 minutes). The impact is associated with the time for construction and equipment supply trucks maneuver from the main road into the gate of the substation which is considered a Minor Impact (level 2). Mitigation measures included in the ESMP will effectively control this impact.

Proposed Mitigation measures:

- Traffic detour routes must be prearranged with the Local Government Council.
- Access at entry and exit points to works sites should be controlled and heavy trucks should be assisted by traffic controllers
- Ensure that warning signs are clear and visible at night.
- Limiting the speed within Site.
- Place visually clear instructions in areas close to Construction site

Monitoring activities:

- The contractors under the supervision of TCN to be done whenever needed.

Reporting

- A monthly report on any observations or complaints about traffic and accidents.

8.2.7: Impacts on Fauna and Flora

The proposed sites of the substations has been assessed as no endangered species were identified according to the national regulations. Also, the investigated habitats are not unique and are very

common and widespread in neighboring areas which would provide alternative habitats for the sympatric faunal species to move to these habitats and continue their life cycle.

Impact Significance

Given that the potential impacts of construction are likely to be localized and good site management practices will be implemented, no significant effects are predicted. The impact is considered Minor (level 2).

Proposed Mitigation measures:

- Surround the sites with a secured fence
- Implement a waste management plan and prohibit dumping/uncontrolled disposal of any types of wastes.

Monitoring activities:

- No monitoring activity is required

Reporting

- No reporting is required

8.2.8: Natural disaster risks

An assessment of the risks to the substations due to seismic activity has been based on the gathered baseline information which shows Low seismic activities are clustered on the substation area. Accordingly, it has been concluded that given the engineering measures incorporated into the design of the substations, the potential environmental impacts of a seismic event during the construction of towers are not anticipated to be significant so this impact would be considered a Minor Impact, since possible mitigation measures have been already considered in the technical design.

8.2.9: Human Health and Safety

Potential impacts to workers and public health and safety during construction phase of the rehabilitation of the substations are similar to those associated with any construction project involving earthmoving, use of large equipment, transportation of overweight and oversized materials, and construction and installation of facilities. The practices of the visited substations reflect that the health and safety procedures are not abided by the workers. That might result in injuries and death. Such impacts are distributed into:

- **Occupational health and safety:** the workers are predicted to get affected by accidents that might occur in the construction sites.
- Adverse impacts might result in due to the bites of reptiles (snakes, lizards, etc)

Impact significance

Health and safety for the community surrounding the station does not have a significant impact. Therefore, the impact can be classified as minor. Standard prevention, i.e. clear sign at the entrance and the surrounding the project site and fences around the project area are sufficient to prevent the accident occur for the current staff of the substation. In addition, the medium to major impact is identified for the health and safety of the workers.

The standard protection of the workers reported in national and international standards related to occupational health and safety, especially for the workers that involved in the risk due to the height has to be put into mitigation measures and in the management and monitoring plan to minimize and reduce the significant impact.

Proposed Mitigation Measures:

Community Health and Safety and Occupational Health and Safety

- In accordance with National and IFC EHS general guidelines to occupational health and safety the workers should be oriented about the health and safety procedures.
- All safety procedures reported in the Law should be abided to by the workers and the top management.
- The contractor should assign a health and safety supervisor who ensures the workers are abided to the H&S procedures
- The contractor should make health and safety facilities available in the project site
- Contracts should be registered with the health facilities close to the construction site
- Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers
- Safety belts should be provided to workers working at height and should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident.
 - When operating power tools at height, workers should use a second (backup) safety strap
 - Testing structures for integrity prior to undertaking work
- A guard should be assigned to assure that the community people are not stepping into the project sites. He should pay attention to children and old people.

Safety of Mechanical Equipment

- All mobile mechanical equipment shall be operated by authorized personnel and has a valid license.
- All equipment shall be checked prior to use by qualified personnel.
- Brakes, lights, tire pressures and batteries shall be inspected before using the equipment. Revolving lights must be used for heavy duty vehicles.
- The design capacity of any equipment shall never be exceeded. The equipment shall not be modified to alter its capacity.
- All drivers shall have a valid driving license.

- Equipment that could present a hazard to personnel, if accidentally activated during the performance of installation, repair, alteration, cleaning or inspection, work shall be made inoperative prior to state of work.
- Equipment, which is subject to unexpected external physical movement such as rotating, turning, dropping, sliding etc., mechanical and/or structural constraint, shall be controlled to prevent such movement.
- All equipment, which are locked or taken out of service, because of potentially hazardous condition, shall be appropriately tagged indicating the reason for being taken out of service.

Monitoring activities:

Community Health and Safety and Occupational Health and Safety

- An EHS supervisor should follow the commitment of workers to use the personnel protective equipment PPEs.
- Health and Safety officer should record on a daily bases the activities and accidents occur among the community people.
- The lists of injured workers and community people should be documented and reported to the H&S supervisor on daily bases
- The Grievance log should be monitored, particularly, the cases regarding injuries among the community and the workers
- All workers should attend an orientation session about health and safety procedures

Safety of Mechanical Equipment

- A health and Safety Officer shall be present in case of heavy mobile equipment, which may be hazardous, by its movement. The Officer shall ensure that people are kept away of such mobile equipment.
- The Officer shall appoint a specific place for heavy equipment standby area when it is not been used or taken out of service.
- The Officer shall ensure that heavy equipment are performing efficiently, and tag the equipment which are locked or taken out of service. This information shall be reported on monthly basis

Reporting

Community Health and Safety and Occupational Health and Safety

- Monthly reporting should be prepared by the H&S supervisor and handed to the H&S manager within the PMU
- Orientation session reports should be prepared by the H&S consultant
- A report should be prepared by the H&S manager within the PMU and shared with the funding agencies on quarterly bases. That report should include the following parameters:
 - Total injured workers distributed by their type of work and project site
 - Total injured people among the community people distributed by age category, sex and area

- Total complaints related to H&S procedures. The grievances should be segregated by the type, area and the aggrieved person sex.

Safety of Mechanical Equipment

- Reporting on a monthly basis, the total number and the type of heavy equipment use during the construction phase.
- Reporting on a monthly basis the number of heavy equipment that are locked or taken out of service and the reason of the damages

8.2.10: Socioeconomic impact

Direct impacts would include the creation of new jobs for construction workers and the associated income and taxes generated by the proposed project. Such impact is positive in nature; however, it might be a negative impact in case of not managing employing activities efficiently and wisely. As well as, paying attention to employing some of the community members might put limitation to community disturbance. As stated by the representatives of the electricity companies, it is cheaper for the company to find local workers from each community in order to save the costs of transporting workers from outside. The workers who are needed for such construction works are those with low and medium skills, who represent a high proportion of the residents in the targeted areas.

Impact significance:

Finding job opportunities whether temporary or permanent is the main concern of the local people. Once this is achieved, it will boost the people's sense of ownership towards the project. In the meantime, if the employment process focused on people from outside the project site, it might surge the angry of the community people. Therefore, employment activities should be wisely and transparently handled.

Proposed Mitigation Measures:

- Job opportunities should be primarily provided to the community people adjacent to the substation
- Community leaders should be represented in a Steering Committee. They should be informed about the job opportunities available for the community people
- The community should voice their concerns through an appropriate grievances and redress mechanism
- The workers should be fully aware about their nature and duration of their work

Monitoring Activities:

- Monitoring the lists of workers and their origins
- Site visits to be paid to the surrounding areas in order to investigate the prices of properties pre and post construction

- Review the grievances log in order to verify whether there are any grievance related to economic impacts

Reporting

- Monthly report should be developed by the contractor including the workers employed during the previous month. Information included should be segregated by: 1) type of work, 2) workers, 3) the living area of workers
- Total complaints related to economic impacts. The grievances should be segregated by the type, area and the aggrieved person sex and age.

8.2.11: Potential Positive impacts of the proposed project during construction phase

The project is anticipated to develop various positive impacts during the construction phase.

Job creation and capacity building

- With regards to job creation, the project is expected to result in the creation of job opportunities both directly and indirectly.
- The unskilled and unemployed workers may need to receive trainings prior to the construction activities to be able to work in the project. On the job training activities should be functioning in order to train the community young people who are willing to work in the project.
- Increase access to job readiness through the provision of education and training for both the personnel of the project and the community.
- Providing about job opportunities will definitely reduce the unemployment ratio within the community. The jobs might be taken by newly employed people or the permanent staff working in the contracted companies.

Indirect positive impacts:

- **Upsurge the wealth of rs, suppliers and sales persons:** Flourishing the areas adjacent to the project through purchasing food products, water and construction materials. The supplies might be provided by the local companies in the proximity areas. The construction phase will increase the demand on different consumables such as food and drinks by the workers. This is expected to increase business demand on different service providers especially food sellers.
- **Improved service of electricity:** will help in better operation for electrical appliances and machineries; therefore will allow more working hours inside the existing economic activities in the targeted communities as well as creating new job opportunities.

8.3: Summary of the Impacts during Construction Phase

Table 8.1: Assessed Significance of Expected negative Impacts during Construction

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Impacts due to handling of construction waste	Likely to occur - short term – Highly sensitive receptors include workers. Receptors with medium sensitivity include soil and groundwater.	Medium	Reduce impact significance to minor
Construction air emissions	High likelihood to occur – short term - Highly sensitive receptors including workers. Receptors with low sensitivity include nearby community	Medium	Minimizing impact significance to minor
Construction noise	High likelihood to occur – short term - Highly sensitive receptors including workers and nearby community.	Medium	Minimizing impact significance to minor
Impacts on Fauna and Flora	Negligible likelihood to occur - no sensitive receptor are located within the area of the substation	Minor	No mitigations are required
Health and Safety	Low likelihood of major or medium impacts for workers– high likelihood of minor impact for sensitive recipient	Minor to Medium	Minimizing impact significance
Socioeconomic	Low likelihood of major impacts and temporary	Minor	Minimizing impact significance
Impacts on traffic	Low likelihood of major or medium impacts	Medium	Reduce impact significance to minor

8.4: Environmental and Social Impacts during Operation Phase

8.4.1: Risk of Waste generated

There shall be different types of wastes generated during the operation and maintenance phase of the substations, repair and replacement activities. Among these types the following:

- Domestic waste generated from the operation of including food waste and recyclables.
- Hazardous waste generated form during maintenance activities and Oil substitution.
- Waste cables that will be replaced within the substation. Some of these cables may be covered with PVC insulators, which, if burned, cause harmful emissions including dioxins. Accordingly, waste cables could be of high risk if PVC cables were disposed in open dumps where it could be exposed to open fires.

- Scrap fittings, insulators, cross arms, conductors, and other scrap which are expected to be from inert materials that does not cause high risk in disposal/recycling procedure.

Impact Significance

Non-hazardous wastes which include domestic waste, and scrap associated with relatively low environmental risks. However, certain waste management procedures should be considered in order to avoid situations where scrap occupies large areas of land and causes aesthetic and land-use impacts.

Hazardous waste will be mainly generated from maintenance activities during the operation phase. Therefore it is expected that the amount of generated hazardous waste will not be significant.

The impact is considered of Medium significance (level 2) due to the small amount of hazardous waste generated. The ESMP includes measures for establishing temporary stores (waste accumulation areas) for scrap at the project site and keeping the tidiness and cleanliness of these stores until scrap is sold for recycling or disposed as shall be detailed in the ESMP. In addition scrap, domestic waste and hazardous waste shall be segregated as recommended according to the ESMP. Implementing the measures could reduce the impact to be of a minor significance.

Proposed Mitigation Measures:

- Implement Standard operation procedures for Solid waste management Appendix A
- For non-hazardous wastes (scrap): The site will have a WAA area and a utility store for the operation phase. The store should be of a sufficient area to receive the expected waste quantities and to ensure adequate maneuvering inside the store. The store should be provided with flooring that could bear loads of forklifts and small trucks. The storekeeper/Waste Officer will be assigned to manage the WAA and the utility store. He should keep separate areas for each type of waste, keep internal passages inside the store for facilitating access and should order for regular cleansing of the store. The storekeeper should keep records of the admitted waste in the store, and before the store is full he should advise the operation manager to organize for the waste to be collected.
- If soil got contaminated, this may have hazardous properties or contain hazardous substances, which depend upon the contaminants. In such case, all measures to manage hazardous waste which have been described in details shall be followed.

Monitoring Activities

- There should be a form prepared by TCN by the EHS Officer to keep records of quantities, types of scrap received in the store and the location where it has been received from.

Reporting

- ✓ The EHS supervisors of the substations should prepare a monthly report including received scrap items, sold items and disposed items

8.4.2: Effects of Electromagnetic Fields

At a substation the switch yard is the main source of EMF which is generated during operation. The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a non-governmental organization formally recognized by the World Health Organization, has set guidelines exposure limits for public and occupational exposure to EMF for ac systems, as indicated in the following table¹⁰.

Table 8.2: ICNIRP Guidelines for EMF public and occupational exposure

Frequency	Public Exposure		Occupational Exposure	
	Electric Field (V/m)	Magnetic Field (mG)	Electric Field (V/m)	Magnetic Field (mG)
50 Hz	5,000	1,000	10,000	5,000
60 Hz	4,150	830	8,300	4,150

Up till now there are no statistics showing that electrical workers operating at substations and in principal exposed to both electric and magnetic fields suffer ill health issues compared to other occupations¹¹.

Impact Significance:

At the substation, Design of the substation extension shall take into consideration the perception by human of the field and strive to minimize such effects.

The ICNIRP has set a guideline figure that public exposure to EMF should not exceed 830 mG and occupation exposure should not exceed 4,150 mG, these figures for electric fields are 4.2 and 8.3 kV/m for public and occupational exposure respectively. Thus the impact is considered of Medium significance (Level 3) which will be minimized to Minor Impact if mitigations are applied.

Proposed Mitigation Measures

- Design of the substation extension equipment shall take into consideration the perception by human of the field and strive to minimize such effects.
- Workers shall have awareness sessions in this regard

Monitoring Activities:

- EMF should be measured frequently in different locations especially at the areas
- This monitoring should be undertaken by a specialized expert on quarterly basis.

¹⁰ Source: ICNIRP (1998): “Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

¹¹ W. H. Bailey, D.E. Weil, J. R. Stewart, “HVDC Power Transmission Environmental Issues Review Oak Ridge Laboratory report, 1997

Reporting

- Results of the EMFs monitoring plan should be reported to the head of environmental department of PMU, with the ESMP quarterly progress report.

8.4.3: Risks of soil and groundwater contamination

Soil contamination may result from accidental leakage of transformer oil, oil recovery tank, and spent oil during operation. The design of the substation has to considered placing the transformers on a concrete pit that can accommodate more than 100% of the oil capacity of the transformer in case of a leak, and enclosing the Fuel tank within a secondary concrete wall that is equipped with a leakage detector in order to contain and detected any leakage, no mitigation measured will be required at that case. Soil contamination may arise if spent liquid waste form mechanical room is dumped randomly.

The severity of such impact will depend on the local conditions where the waste is dumped and whether contaminants migration and propagation would be likely to take place in the event of a rainfall.

Impact Significance:

The impact is considered M impact level 2 if design precautions are applied. Application of appropriate mitigation will effectively control the impact and minimize it to the maximum possible extent.

Proposed Mitigation measures:

- Implement Standard operation procedures for Solid waste management Appendix A
- In case a leakage occurred, the soil should be removed and sent for disposal as hazardous waste to a certified hazardous waste landfill as previously mentioned.
- Storm water channels should be designed and installed in the substation and directed to the oil separator to ensure removal any residual of oil before disposal.
- Implement Solid waste management plan

Monitoring activities:

- Amount and management methods of contaminated soil
- Groundwater quality and storm water in the oil separator quarterly
- Visual Inspection of storm water channels.

Reporting

- Reporting of accidental release should be undertaken by the operator, including location and reasons for such incidents.

8.4.4: Impacts due to noise emissions

Noise will mainly emanate from transformers in addition to noise associated with the momentary operation of switching devices. The baseline assessment of noise quality at the substation site indicated that the hourly equivalent sound levels do not exceed the 8-hr maximum limit value of 75 dBA.

The noise impacts could be analyzed in two main aspects: noise impact within the project areas, and the noise impact on the neighboring receptors.

Impact Significance:

Noise emissions from the substation are not likely to affect neighboring areas because of the relatively large distance and the existing natural barriers between the stations. Thus the impact is considered minor level 2.

For noise impact upon workers, workers could be exposed to relatively high levels of noise. This could be mitigated through application of the normal precautions normally taken by operator. Accordingly, this impact has been classified as a Minor Impact (level 2), which could be further minimized and fully controlled if construction workers used safety gear as recommended in the ESMP.

Proposed Mitigation Measures

- Workers that operate at the substation be supplied with earmuffs and should be instructed to put them on when they get into noisy zones. Operator EHS officer should be responsible to instruct their workers to abide to this role.
- Working hours for workers exposed to noise equipment should be designed so that noise exposure periods do not exceed the safe limits

Monitoring activities:

- Measuring noise levels on quarterly to assure that noise levels within the work environment within the substation is complying with legal limits (kindly refer to chapter 2)
- Measuring noise levels 200m away from the substation at the wind direction

Reporting

- A quarterly report on any observations or complaints about high noise level.

8.4.6: Human Health and Safety

Possible impacts to health and safety during operations of the substation include exposures to electromagnetic fields (EMF), electric shock risks accidental injury to workers during operation and maintenance activities In addition, health and safety issues include working at heights, working around energized equipment, working in potential weather extremes, and possible contact with natural hazards and either working at heights or in trenches.

Fire risks could be due to connection of transmission lines entering to the substation to vegetation. Fields having high trees will be removed from the ROW zone of transmission lines. Another factor which could cause fires is overloading of transmission lines, a risk that is also minimized by adequate safety precautions in the design and operation of the system.

Impact significance

Health and safety for the sensitive recipient (community surrounding the project site of transmission lines) does not have a significant impact, as it is described previously that the project site is already localized. Therefore, the impact can be classified as minor.

In addition, the medium to major impact is identified for the health and safety of the workers. The standard protection of the workers, especially for the workers that involved in the risk due to the working at height has to be included into mitigation measures and in the management and monitoring plan to minimize and reduce the significant impact.

Although electrocution accidents and fires could lead to losses in lives and properties, it is believed that the normal design, construction and operation procedures expected to be followed by the operator, in accordance to national regulations will provide sufficient safety precautions so that accidents will be due to unforeseen factors that could not be considered in risk estimation. The impact has been classified as medium impact that could be reduced, following mitigation measures, to minor impact.

In addition, regarding the safety issues, TCN should periodically provide the specific trainings for the operators and the workers who are responsible for the work of operation and maintenance. The training obtains include the civil protection, and firefighting besides the operation and maintenance of its equipment. The map of the emergency plan in case of fire accident is also should be provided.

Health and safety of the workers is considered medium level 3. The standard protection of the workers, particularly, for the workers who get involved in the risk due to the height has to be put into mitigation measures and in the management and monitoring plan to minimize and reduce the significant impact.

Mitigation measures

8.4.7: Human health and Safety

- In accordance with national regulations related to occupational health and safety and IFC EHS guideline for Transmission substation the workers should be oriented about the health and safety procedures.
- All safety procedures reported in the Law should be abided to by the workers and the top management.
- The operator should assign a health and safety supervisor who ensures the workers are abided to the H&S procedures
- The operator should make health and safety facilities available in the project site

- Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers
- Safety belts should be provided to workers working at height and should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident.
 - When operating power tools at height, workers should use a second (backup) safety strap
 - Testing structures for integrity prior to undertaking work
- A guard should be assigned to assure that the community people are not stepping into the project sites. He should pay attention to children and old people.

8.4.8: Management of Electrocution and Fires Risk

- Maintaining standard safety procedures for the substation. TCN PMU will be distributed the safety standard procedures during the operational phase that put in detailed of the safety measurements include:
 - Maintain minimum clearance between ENF generators and the ground according to the standard allowed
 - Provide climbing space to allow linemen to work more safely on the structures while they are energized
- Carry out an awareness raising campaign that should target the different communities where the project will be implemented in order to educate them about the precautions that they should be considering in order to ensure their safety on both community and household or family level.

Monitoring Activities:

- Health and safety supervisor should follow the commitment of workers to use the protective clothes.
- Follow on day to day bases the accidents occur among the workers.
- The lists of injured workers should be documented and reported to the H&S supervisor on daily bases
- The Grievance log should be monitored, particularly, the cases regarding injuries among the workers
- All workers should attend an orientation session about health and safety procedures

Reporting

- Monthly reporting should be prepared by the H&S supervisor and handed to the H&S manager within the PMU
- A quarterly report should be prepared by the H&S manager within the PMU and shared with the funding agencies on quarterly bases. That report should include the following parameters:
 - Total injured workers distributed by their type of work and project site
 - Total injured people among the community people distributed by age category, sex and area

Total complaints related to H&S procedures. The grievances should be segregated by the type, area and the aggrieved person sex.

8.4.9: Socioeconomics

The temporary workers will lose their jobs; consequently, their source of income will be affected. That might result in severe impact on their social status. That might result in severe impact on their social status.

Impact significance

The impact is considered major since the workers will be aware of the nature of their temporary task during the rehabilitation project and the exercises would be put to use during operations.

Mitigation measures:

- Workers should be fully informed about the duration of work.
- Good communication plan
- contracts need to be in place
- former workers should be consider for work during operation

Monitoring activities:

- Condition of service, work scope and other issues will be discussed with the workers during engagement and induction by the Human resources team.

Reporting:

- No reporting is required

Potential Positive impacts of the proposed project

- Direct impacts would include the creation of new jobs for operation and maintenance workers and the associated income and taxes paid to the state. The total number of newly employed personnel can't be defined during this stage.
- Positive impact occurs due to the enhancement of electricity Supply in the country.

8.5: Summary of the Impacts during Operational Phase

Table 8.3: Assessed Significance of Expected negative Impacts during Operation Phase

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Risk of Waste generated	Very Likely to occur - short term – Highly sensitive receptors include soil, groundwater and workers. Receptors with medium sensitivity include nearby projects/settlements.	Medium	Reduces impact significance to minor
Exposure to EMFs	Likely to occur - long term impact	Medium	Reduces impact significance to minor
Risk of soil and groundwater contamination	Likely to occur - short long impact	Medium	Design mitigation measures shall be applied to reduce the impact probability and significance to minor
Impacts due to noise emissions	Likely to occurrence - short term impact	Medium	Minimizing impact significance to minor
Human Health and Safety	Low Likelihood of medium impact for workers and low Likelihood of major impact to the sensitive recipient	Minor to Medium	Reduce impact significance

CHAPTER NINE

Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) aims at defining a mechanism for implementing mitigation measures for the expected negative impacts and to monitor the efficiency of implementing these mitigation measures based on relevant environmental indicators.

The ESMP identifies certain roles and responsibilities for different stakeholders for implementing, supervising and monitoring the environmental and social performance of the project during its life cycle. Also, the ESMP has distinguished between mitigation measures that should be implemented during the construction and operation of the project.

Roles and responsibilities for implementing the ESMP during the construction phase have been proposed based on the institutional set up of TCN.

During the operation phase, the operator at the substation who is appointed by TCN (under environmental safety and health department) will be responsible for monitoring the ESMP. He/She will be responsible for implementing the mitigation measures through periodic reports including auditing and inspections that will be undertaken on random basis.

The section below will detail the Environmental and Social Management Plan during Construction and operational Phases the substation (based on the proposed main responsibility of ESMP mentioned above.

9.1 Introduction

The rehabilitation/reinforcement of transmission substation projects is not likely to result in significant adverse environmental impacts. The land for the rehabilitation/reinforcement or extension of the substation is part of the transmission Substation land expropriated. The landowners of the land had gotten fair and market price compensation for the land over thirty years (30) ago.

The table below lists the potential impacts due to the rehabilitation/reinforcement of transmission substations. The tables also list the required mitigation measures and the actions to be taken in addition to specifying who is responsible for these measures and when to be applied. Most of these impacts are limited geographically and are insignificant adverse environmental impacts. However, if not adequately managed from an environmental perspective, it could, over time, cumulatively impact the people and the environmental resources. When implemented efficiently, the ESMP should ensure that:

- Any environmental issues or concerns are addressed in the design phase and early phases of the project;
- Mitigation measures minimizing environmental impacts are being implemented; and
- Monitoring for compliance and sound environmental performance is continued.

9.2: Institutional Setup

The roles and responsibilities of World Bank (WB), Transmission Company of Nigeria-Project Management Unit (TCN-PMU) Transmission Company of Nigeria (TCN), Electricity Distribution Company (EDC), Federal Ministry of Environment (FMEnv) and State Ministry of Environment (SMEnv) in regard of the implementation and operation of transmission Substation. There will be internal monitoring through the TCN-PMU, which will prepare monitoring reports and make it available to the World Bank.

TCN-PMU is responsible for the preparation and implementation of the Project. For this process, the World Bank provides technical support and advice as appropriate to assist with capacity building. TCN-PMU may draw upon appropriate local technical experience as necessary. TCN-PMU is responsible for the disclosure of the ESMP and the social audit and for liaising with different institutions and stakeholders to ensuring the implementation of the mitigation measure.

TCN is in-charge of operation the substations. TCN will coordinate with the EDC as to make the necessary connections to the substation. EDC is the technical company that is to supply the demand centers with electricity and construction of the distribution lines are to be managed mainly by EDC.

Table 9.1: Summary of Agency Roles and Responsibilities

STAGES	AGENCY	RESPONSIBILITY
Project Preparation	TCN –PMU	- Facilitate and support all relevant project actions
	TCN	- Follow-up on all matters related to complaints
	TCN	- Locally disclose ESMP - Provide direct contact with affected persons - Liaise with appropriate government bodies
Project Implementation	TCN PMU and FMEnv	-Overall supervision - Implement ESMP - Monitoring and Evaluation
	TCN and FMEnv	Assess and process complaints - Undertake community liaison
Project Operation	TCN	-Operate the substation - Sell the electricity to EDC -Supply the consumers with the electricity -Process the public complaints

9.3: Grievance and Redress Mechanism

The project-specific grievance redress mechanism (GRM) will be established to receive, evaluate and facilitate the resolution of Affected People's concerns, complaints and grievances about the social and environmental performance at the level of the subproject. Continued public participation and consultation has been emphasized as a key component of successful project implementation. Complaints are anticipated during the mobilization, construction and operational phase of the project. To settle such issues effectively, an effective and transparent channel for lodging complaints and grievances shall be established. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all stakeholders at no cost and without retribution.

The Grievance Mechanism will be implemented during the entire phases of the project to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied to all complaints from affected parties. The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple means of using this mechanism, including face-to-face meetings, written complaints, telephone conversations should be available. Confidentiality and privacy for complainants should be honored where this is seen as necessary or important.

A grievance redress mechanism and procedures is setup to provide opportunity for project affected persons to settle their complaints and grievances amicably. The established grievances redress procedures and mechanism ensures that project affected persons are provided with the appropriate compensations and that all administrative measures are in line with the law. It also allows project affected persons not to lose time and resources from going through lengthy administrative and legal procedures. Grievances are first preferred to be settled amicably.

The contractor shall work with representatives of project affected persons to have trust and build confidence in the system. The contractor will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome. The procedures to be followed and adopted by the grievance redress should be transparent and simple to understand or uniform process for registering complaints provide project affected persons with free access to the procedures. The response time between activating the procedure and reaching a resolution should be as short as possible. An effective monitoring system will inform project management about the frequency and nature of grievances. The contractor will arrange half yearly meetings where the activities and the outcomes/measures taken according to the Complaints Database are to be monitored and reviewed to ensure the required transparency. In addition to the above, if there are any grievances related to environmental management issues in the project area, the contractor as the first line charge will initiate necessary action and follow-up.

The contractor will redress grievances through creating awareness in communities, education and communication and corporate social responsibility (CSR) e.g employment, sinking of borehole, rehabilitation of roads and infrastructural developments.

In case a dispute is not resolved by the contractor within stipulated time of lodging the complaint, no understanding or amicable solution can be reached or no response is received, then the issue is tabled before TCN-PMU, who will in turn apply its own grievance redress mechanism. If the affected person is still not satisfied with the decision of the PMU, or in the absence of any response within the stipulated time, grievance will be handled by PMU in collaboration with TCN headquarters to address the issue with a higher and standardize grievance redress mechanism. A grievance form will be made available to all stakeholders.

9.4: Emergency Response and Disaster Management Plan

9.4.1 Emergency Response

The initial response to an incident is a critical step in the overall emergency response. Like all other Industries and installations, Power generation facilities must have adequate measures against accidents or incidents to meet the emergency. The purpose of having an Emergency Response Plan (ERP) is to:

- Assist personnel in determining the appropriate response to emergencies.
- Provide personnel with established procedures and guidelines.
- Notify the appropriate Company Emergency Response Team personnel and regulatory/ Govt. agencies.
- Manage public and media relations.
- Notify the next-to-kin of accident victims.
- Promote inter-departmental Communications to ensure a “Companywide” Coordinated emergency response.
- Minimize the effects that disruptive events can have on company operations by reducing recovery times and costs.
- Respond to immediate requirements to safeguard the subtending environment and community.

Generally, the initial response is guided by three priorities Ranked in importance these priorities are:

1. People
2. Property
3. Environment

Emergency Response Procedures will identify who does what and when in the event of an emergency. Responsibility for who is in charge and their coordination of emergency actions shall be identified. Nature of Emergency & Hazardous Situations may be of any or all of the following categories:

- Emergency (Fire, Explosion, Electric shock and Medical emergency)
- Natural Disasters (Flood, Earthquake, Storm and Cloud burst lightning)
- External Factors (Food poisoning/water, poisoning, Sabotage, and War)

9.4.1.1 Steps in Emergency Response

- Step-1
 - Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.
 - Determine potential hazards stemming from local conditions such as inclement weather water bodies etc. and ensure that the initial response team is aware of these conditions.
- Step-2
 - Determine the source/cause of the event resulting to the emergency and prevent further losses.
- Step-3
 - Conduct an assessment of the incident site for any further information on hazards or remedies.
- Step-4
 - Initiate redress procedures.
- Step-5
 - Report the incidence its nature, cause of impact applied redress procedures and any further assistance required etc. to the appropriate company, government and/or land owner.
- Step-6
 - Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property and the environment.

9.4.1.2 Reporting Incidents and Accidents

All accidents and near-miss incidents shall be investigated to determine what caused the problem and what action is required to prevent a recurrence. Employees required to perform investigations shall be trained in accident investigation techniques. The incident/accident investigation should be a fact-finding exercise rather than faultfinding. The investigations will focus on collection of evidence to find out the “root cause” of the incident. The recommendations of the investigation report are implemented in phases.

9.4.1.3 Approaches to Emergency Response

For this project, emergency response systems should be in place to deal with dangerous goods uncontrolled releases of dust and gaseous emission, natural calamities fires burns and injuries. There are to be trained emergency response teams, specific contingency plans and incidence specific equipment packages in place to cope with these types of emergencies. In case of an emergency incident occur, immediate action must be taken to mitigate the impacts. In order to minimize the possibility of injury to the responders and others it is important that emergency responders follow a specific sequence of actions as stepped out in the preceding paragraphs

9.4.2 Disaster Management Plan

In normal operation of the plant, when all environmental protection equipment works according to design specification, then there would be no environmental problems for the present plant. Disaster (to certain degree) may occur if the environmental protection equipment fails to work at normal condition. This situation may arise for any of the following causes

- When plant runs at abnormal situation e.g. if emission level increases than its normal level or if the engines give unwanted noise than normal level
- If liquid waste over flows and pollutes the surroundings

Therefore, appropriate management plan should have to be taken by the project proponent to prevent any unwanted disaster in the plant. In this regard, there should be a provision to stop the production immediately during any process failure as discussed above. The disaster management plan should consist of preventive measures including, among others, the following.

- Formulation and strict implementation of safety codes and measures;
- Periodic inspection of safety relief valves provided with pressure vessels and equipment;
- Preventive maintenance;
- Aware the workers about electric shock
- Declaring the factory a “no smoking zone”
- Mock drills by the firefighting cells/ groups
- Provision and inspection of firefighting equipment and fire hydrant system in all the sections;
- Proper training of the employees about the importance of codes;
- Training the employees and the residents of the surrounding villages about the actions to be taken during an accident, disaster etc.

It is imperative to develop entire facility environment policy and display necessary documentation for ease in accessing information. Some of these documents include:

- Emergency contacts; (Police, Hospitals, Fire service, Road safety etc)
- Emergency response procedures for fires

The facilities operations and monitoring are carried out under the management and help from both the employees and relevant government lead agencies. In order to take care of any hazards the following control should be adopted:

- All safety precautions and provisions covering the general cleanliness of the entire facility down to, ventilation, lighting, sanitary, waste collection, smoke detector, heat detector, sand bucket, water bucket, fire blanket, first aid box provision, adequate fire extinguishers and site security by fencing.

9.5: Monitoring of the ESMP

Environmental and Social monitoring will include visual observations, selection of environmental parameters at specific locations and sampling and regular testing of the relevant parameters. Monitoring will be done at a number of levels. The first level of monitoring of the ESMP will be conducted by the Contractor at work sites during construction/ rehabilitation, under the direction and guidance of the Engineering Consultant who is responsible for reporting the monitoring to the implementing agency. The second level of monitoring of the ESMP will be done where they will verify the results of the Contractor and to audit direct implementation of environmental mitigation measures contained in the ESMP and construction contract clauses for the Project.

To ensure that all the measures are applied and that the contractor is to exactly cope with the requirements of the ESMP, TCN is to appoint an engineer from its side. The engineer is to act the Environmental and Social Officer (ESO) for the project. She/he is to follow up, apply monitoring indicators, and report to ERU coordinator TCN PMU.

An engineer will be appointed by TCN as permanent, not only during the rehabilitation /reinforcement of the transmission substation, but also to follow up the management and monitoring of the mitigation measures also during operation.

During rehabilitation/reinforcement he/she is to have his office at the construction site and to report monthly to TCN the progress of the works and the status of the commitment to the ESMP. During operation he will have his office at TCN and make periodical (weekly) visits to the substation site as to make sure that all measures are coped with.

In addition to the above, the engineer will make sure that all complaints applied to TCN-PMU in regard of the project are recorded and documented, and properly handled and that the mitigation measures are applied. It is recommended to provide the necessary and full support to the ESO and also to consider training him/her on issues related to environmental management complaints handling. It also required updating him/her on the environmental and social requirements and legislations.

The rehabilitation / reinforcement of the transmission substation are undertaken according to the recommendations of the environmental assessment and ESMP in a way that is respectful to the local people, their land and resources. All operations will be managed in a manner that protects the environment, health and safety of employees, customers, contractors and the public.

This ESMP is developed to complete the address the issues identified and provide measures and actions to mitigate / manage potential adverse impacts, or to enhance positive or beneficial impacts based on the following mitigation hierarchy:

- Avoidance;
- Minimization; and

- Compensation/ Offset

The project proponent / owner must allocate financial resources and designate responsible personnel within the organization to implement the management program. A procedure to adjust the ESMP and, to adapt actions and mitigations based on the environmental and social monitoring data must be developed. It is recommended that the contents of the ESMP be integrated

The following tables represent the matrix of management plan as well as monitoring plan during construction phase respectively.

9.6: Environmental and Social Management Plan Matrix during Construction Phase

Potential Impact	Proposed Mitigation Measures	Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (USD \$)
Management of the Project	<ul style="list-style-type: none"> The Proponent should appoint a project HSE Officer while the Contractor should appoint his/her HSE officer; Demarcate clearly (e.g. using fencing) all areas to be developed before construction commences The contractor to comply with the conditions of the EA for the project; Maintain records of environmental incidents and avail a copy of these records to relevant lead agencies on request throughout the construction phase; Identify and confirm suitable sites for the construction camps, if any, and storage areas for materials; Store construction equipment in construction camps. Ensure oil changes take place on an impermeable surface such as reinforced concrete slab; 	Prior rehabilitation/reinforcement	Construction Contractor	TCN	<ul style="list-style-type: none"> Visual inspection of the site before rehabilitation starts 	<p>Included in the Management Cost for TCN and Contactor</p>
	<ul style="list-style-type: none"> Train site staff on the following areas of environmental management; <ol style="list-style-type: none"> a) Environmental awareness training for construction staff, concerning the prevention of accidental spillage of hazardous chemicals and oil; pollution of water resources (groundwater), air pollution and litter control; b) Project Manager shall ensure that the training and capabilities of the Contractor's site staff are adequate to carry out the designated tasks; d) No operator shall be permitted to operate critical items of mechanical equipment without having been trained by the Contractor and certified competent by the Project Manager; e) Staff should be educated as to the need to refrain from indiscriminate waste disposal and/or pollution of local soil and water resources and receive the necessary safety training. 		Construction Contractor	TCN		

Potential Impact	Proposed Mitigation Measures	Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (USD \$)
Effects of construction waste	<ul style="list-style-type: none"> Identify disposal sites for construction waste approved by the local authority Identify a Waste Accumulation Area (WAA) within the construction site for temporary storage of construction waste, including a secured area for the interim accumulation of hazardous wastes Adequate transportation and disposal of construction waste Allocate and prepare areas for temporary storage of scrap Keeping tidiness and cleanliness of the WAA Inspection of the existing Septic tank for evacuation 	Pre-construction – construction	Construction contractor	TCN	<ul style="list-style-type: none"> Review local authority approvals Site supervision Site supervision and occasional inspection of disposal site Auditing of allocated WAA Auditing of stores 	Management Cost + Transportation of hazardous waste cost (approximately 15 per kilometer (capacity of truck 14 ton+ treatment cost of hazardous waste (500 per kg)
Excavation	<ul style="list-style-type: none"> Identify the excavation depth and width according to the drawing design Clear safety signs and boundary for the excavation sites Safety and clear area around the excavation site including the safety helmets and boots compulsory for workers 	Pre-Construction	Construction Contractor	TCN	<ul style="list-style-type: none"> Site supervision and occasional inspection 	Included in contractor Management Cost
Construction air emissions	<ul style="list-style-type: none"> Store construction materials in pre-identified storage areas. Cover friable materials during storage. Regulation of speed to a suitable speed (30 km/h) for all vehicles entering the site. Implement preventive maintenance program for vehicles and equipment working on site and promptly repair vehicles with visible exhaust fume. Using locally available materials whenever possible thus limiting the travel distance. Reducing the distance and number of trips will result in an overall reduction in in gaseous and carbon emissions. 	Construction	Construction contractor	TCN	<ul style="list-style-type: none"> Site supervision and occasional inspection 	Included in contractor Management Cost
Construction noise	<ul style="list-style-type: none"> Provide ear muffs to construction workers usually located near noisy machines Organize working hours so that noise exposure to workers will be minimized 	Construction	Construction contractor	TCN	<ul style="list-style-type: none"> Site supervision 	Included in contractor Management Cost

Potential Impact	Proposed Mitigation Measures	Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (USD \$)
	<ul style="list-style-type: none"> Coordinate and Inform inhabitants/employees at the nearby sensitive receptors about the peak time and hours for construction activities. 					
Human health and safety	<ul style="list-style-type: none"> Restrict application to the health and safety procedures The contractor should make health and safety facilities available in the project site Contracts should be signed with the health facilities close to the construction site Drivers should have a certified and valid license All mechanical equipment should be checked prior to use Appropriately tag all mechanical equipment that are locked or out of service Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers Safety belts should be provided to workers working at height and should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident. A guard should be assigned to keep community people out of the construction site 	Construction	<p>Construction contractor</p> <p>TCN</p>	TCN-PMU	<ul style="list-style-type: none"> Review of contractor's reports related to health and safety measures as well as the lists of injured workers Capacity building reports and orientation sessions related to health and safety measures 	Included in contractor Management Cost
Socioeconomic impacts	<ul style="list-style-type: none"> Job opportunities to be provided to the community workers Integration of community leaders during the employment procedures 	Construction phase	<p>Construction contractor</p> <p>In cooperation with the community leaders</p>	TCN	<ul style="list-style-type: none"> Reports about the workers employed Complaints raised about employment 	Included in contractor Management Cost (unskilled worker salary)

Potential Impact	Proposed Mitigation Measures	Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (USD \$)
Traffic	<ul style="list-style-type: none"> • Prevent storage of construction materials, equipment and machineries on traffic lanes • Moving heavy vehicles during the night • Capacity building of the drivers about safety utilization should be assured 	Preconstruction and Construction	Construction Contractor	TCN	<ul style="list-style-type: none"> • Site supervision and grievance log related to traffic accidents 	Included in contractor Management Cost

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility	Estimated Cost (USD \$)
Disposal of waste during construction	<ul style="list-style-type: none"> Quantities of scrap item by type (inventory) Segregated waste weight Types of hazardous wastes recorded 	WAA	<ul style="list-style-type: none"> Inspection and recording of admitted items 	<ul style="list-style-type: none"> Quarterly reporting 	TCN	TCN Management Cost
Excavation impacts	<ul style="list-style-type: none"> Areas of excavations and trenching Safety areas around the excavation 	Construction site	<ul style="list-style-type: none"> Inspection and marking of the safety areas for excavation 	<ul style="list-style-type: none"> Upon excavation and trenching 	TCN	TCN Management Cost
Safety of mechanical equipment	<ul style="list-style-type: none"> Performance of the equipment and the visible damage 	Construction site	<ul style="list-style-type: none"> Inspection and recording of the performance 	<ul style="list-style-type: none"> Upon the use of the mechanical and heavy machineries 	Construction contractor	TCN Management Cost
Human health and safety	<ul style="list-style-type: none"> Total number of injured workers Total received grievances related to health and safety Total number of attendance to the orientation sessions about health and safety 	Construction site Desk work	<ul style="list-style-type: none"> Site visits to the construction site H&S monthly reports Reports about stakeholder engagement activities Reports about H&S capacity building activities 	<ul style="list-style-type: none"> Quarterly during the construction phase 	TCN	TCN Management Cost
	Socioeconomic impacts (job opportunities)	<ul style="list-style-type: none"> Number of jobs provided to the community people Total number of complaints raised by workers 	Construction site Desk work	<ul style="list-style-type: none"> Reports about the workers and employment 	<ul style="list-style-type: none"> Quarterly 	TCN Management Cost
Traffic	<ul style="list-style-type: none"> Storage sites areas Complaints related to traffic Total number of complaints raised due to traffic problems 	Construction site Desk work	<ul style="list-style-type: none"> Reports about the capacity building received by drivers Complaints reports 	<ul style="list-style-type: none"> Quarterly 	TCN	TCN Management Cost

9.7: Environmental and Social Management Plan Matrix during Operation Phase

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (USD \$)
Risk of Waste generated	<ul style="list-style-type: none"> • Implement Standard operation procedures for Solid waste management Appendix A • Allocate and prepare areas for temporary storage of scrap • Keeping tidiness and cleanliness of the utility store • Controlling the hazardous and special waste (to sell or to recycle) • Controlling disposal of non-sold hazardous • Implement waste minimization measures in 	Design-construction-operation	TCN	TCN-PMU	<ul style="list-style-type: none"> • Auditing of allocated stores • Auditing of stores • Documentation of the waste management • Documents review and occasional inspection of disposal site • Site supervision 	Management Cost + Transportation of hazardous waste cost approximately 15 per kilometer (capacity of truck 14 ton)
Risk of soil and groundwater contamination	<ul style="list-style-type: none"> • Care should be taken during transformer oil changing, which should be over an impermeable surface • Adequate collection and disposal of contaminated soil • Inspection of the existing Septic tank for evacuation 	Operation	TCN	TCN-PMU	<ul style="list-style-type: none"> • quarterly inspection to substation especially at the transformer location 	Management Cost + Transportation of hazardous waste cost (approximately 15 per kilometer (capacity of truck 14 ton+ treatment cost of hazardous waste (500 per kg)
Noise emissions during operation	<ul style="list-style-type: none"> • Provide ear muffs to construction workers usually located near noisy machines • Organize working hours so that noise exposure to workers will be minimized 	Preconstruction-operation	TCN	TCN-PMU	<ul style="list-style-type: none"> • Site supervision 	25 per person
Risks of Electrocutation and Fires	<ul style="list-style-type: none"> • Maintain standard safety procedures for substations 	Operation	TCN	TCN-PMU	<ul style="list-style-type: none"> • Review of operation reports • Capacity building reports and orientation sessions related to health and safety measures 	TCN Management Cost

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (USD \$)
Human health and safety	<ul style="list-style-type: none"> Restrict application to the health and safety procedures Health and safety facilities should be available to all workers within the substation Expired Fire Extinguishers shall be recalibrated and maintained by producers Contracts should be signed with the health facilities close to the construction site Drivers should have a certified and valid license All mechanical equipment should be checked prior to use Appropriately tag all mechanical equipment that are locked or out of service Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers Safety belts should be provided to workers working at height and should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident. A guard should be assigned to keep community people out of the construction site 	Operation	TCN	TCN-PMU	<ul style="list-style-type: none"> Review of EHS officer reports related to health and safety measures as well as the lists of injured workers Capacity building reports and orientation sessions related to health and safety measures 	Management Cost Plus the following: PPEs per Person : 90 Electric Fire Extinguishers: 1000 First Aid Kit: 40 Special training: 1950 Heights safety belt: 50 per person
Socioeconomic impacts	<ul style="list-style-type: none"> Job opportunities to be provided to the community workers 	Construction	TCN	TCN	<ul style="list-style-type: none"> Reports about the workers employed 	Management Cost Plus the salary for skilled

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (USD \$)
	<ul style="list-style-type: none"> Integration of community leaders during the employment procedures 		In cooperation with the community leaders		<ul style="list-style-type: none"> Complaints raised about employment 	workers according to TCN standards

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility	Estimated Cost (USD \$)
Disposal of hazardous waste and scrap	<ul style="list-style-type: none"> Quantities of waste items by type 	substation utility store	Inspection and recording of admitted items	Quarterly reporting	TCN	Management Cost
	<ul style="list-style-type: none"> Volume of contaminated soil Presence of PCBs Groundwater quality 	Locations of release	Approximate estimation of the volume by measuring surface area and depth Analyzing of soil and groundwater sample using a certified laboratory Excavate soil using specialized su-contractor	Once an accident happens. \ annually	TCN	Management Cost + 200 Sampling cost for 1 soil sample+ 220 sampling cost of groundwater 1000 per excavation, treatment and disposal per kilogram of contaminated soil
Risk of soil and groundwater contamination						
Exposure to EMF	<ul style="list-style-type: none"> EMF (mG) 	Selected locations at the substation	Measurements through EMF meter	Quarterly, or as required	TCN	Management Cost Plus 30 For EMF detector Device
Risks of Electrocution and Fires	<ul style="list-style-type: none"> Total number of injured workers Total number of injured community people Total received grievances related to health and safety Total number of attendance to the orientation sessions about health and safety 	Desk work	H&S monthly reports Reports about H&S capacity building activities	Quarterly during the operation phase	TCN	Management Cost

9.8: Decommissioning / Abandonment

Decommissioning of the subproject will involve dismantling and removing all structures of the substations and lines, dismantling the supporting infrastructure (towers) and all those structures that were associated with this subproject implementation. Some of the impacts of this subproject phase are similar to those that have been discussed during rehabilitation/reinforcement and operational phase. But there are those impacts that are specific to project decommissioning and the proponent will be required to rehabilitate the site to its former status or near what it was before the project was commissioned. TCN will be responsible for preparing the decommissioning plan and will remain responsible for the costs. The design and facilities shall take due recognition of the need to decommission the Transmission Substation and the ancillary facilities at the end of their operational life, the abandonment plan shall take due note of the current national and international legislative requirements. The following shall be considered at the end of the project lifecycle:

- Reasons or needs for facilities decommissioning
- Notification to relevant Regulatory Agencies (FMEnv, NESREA, TCN-PMU etc).
- Establish study and plan the decommissioning/abandonment programme in a manner that meets standard requirement.
- An Environmental Evaluation Report (EER) to determine if the activities carried out at the site have caused any detrimental effects and if any, discuss mitigations and restoration measures.

9.9: Management Structure

The proposed Environmental and health and safety management structure, the related parties' roles and responsibilities during preparation and rehabilitation/reinforcement phase are outlined in the table below:

Table 9.3: Management Structure

Unit	Responsibility for Environment
TCN PMU	<ul style="list-style-type: none"> - Select the environmental consultant. - Receive and supervise the environmental report from the Independent Environmental Consultant (IEC), -reporting to the Financier (World Bank) on a agreed frequency basis - In case of any violations or arising works that submitted by the Environmental consultant, will request contractors to amend and correct the violation. - Receive and supervise the environmental report from the consultant. - Cooperate with TCN-OSR to periodically supervise contractors' activities.
Independent Environmental Consultant	<ul style="list-style-type: none"> - Make reference and prepare site specific plans in accordance with ESMP framework approved - Establish environmental procedure and notify -recommend counter measures if any.
Contractors	<ul style="list-style-type: none"> - After receiving and committing to the environmental procedures and Management Plans, Contractors must fully carry out the measures of the environmental protection as indicated;

Unit	Responsibility for Environment
	<ul style="list-style-type: none">- In case of any violations or arising works that either detected by Environmental consultant or proposed by contractors, they must be reported to PMU and Financier for further actions.- If contractors decided to not follow instruction from PMU construction activities will be halted until necessary actions are taken.

Appendix A

Standard Operation Procedures (SOPs) to improve the current compliance status of the existing substation based on the conducted environmental and Social Audit of Sagamu Substation

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1 Standard Operation Procedures SOPs

The following SOPs are the main recommendation based on the findings of the conducted audit for the current nonconforming issued

1.1 Polychlorinated biphenyls PCBs in the Old Transformers

The proposed SOPs in the short term are:

- The solution will be implemented before the commencement of the project. Though the PCB discovered in all the stations were in trace concentrations ($<0.01 - 65 \mu\text{g/g}$) and the soils are heavily contaminated with transformer oil. The contaminated soil is to be excavated to depth of oil pollution, stored transported and disposed by a specialized sub-contractor through thermal treatments which are the most indicated methods for removing PCBs from contaminated soils with Dioxins and furans captured in scrubbers. Pyrolysis (decomposition by high temperatures) and incineration (combustion of organic substances contained in waste materials) remediation methods ensure with some exceptions, an efficiency of over 99 % in incinerators (high temperature ($870 \text{ }^{\circ}\text{C} - 1500^{\circ}\text{C}$) rotary kiln incinerators).

The proposed SOPs for the medium term are:

- Managers of grid stations and distribution zones, where identified PCB or PCB contaminated equipment exist should undertake continuous monitoring of electric performance of these transformers through appropriate tests, such as dielectric test and power factor test. The declining efficiency of the transformer is an indication for oil degradation and possible development of acidic and corrosive properties, a situation that could cause loss of the integrity of the transformer body and possible subsequent leaks. Therefore transformers with reduced efficiency should be sent as soon as possible to the transformer workshop for proper handling
- Managers of grid stations and distribution zones, where identified transformers exist, should frequently, say on monthly basis; physically detect the integrity of identified PCB transformers and capacitors. In case of detection of any leak, the transformer/capacitor should be transferred to the workshop for adequate maintenance or sent to scrap storage.
- Any spill from transformers or capacitors should be contained using absorbent material; the contaminated absorbent should be placed in metal drums with clear sign of PCB waste. The clean-up should be undertaken by trained personnel with full PPE, including chemical resistant gloves, boots and overalls. All surfaces exposed to spills should be decontaminated with cloth containing an efficient solvent. Any PCB contaminated waste generated in grid stations or substations should be handled by specialized sub contractors.
- Maintenance of large PCB transformers and capacitors should be undertaken at their locations in grid stations.
- All PCB waste (including contaminated cloth, absorbent materials, contaminated soil, contaminated coils, filters and other small contaminated components) should be collected in adequate metal drums with clear signs. Drained PCB oils should also be collected in metal drums with tight lids. Transportation of PCB drums should be in designated hazardous waste vehicle and using documented manifests. Any accidental spill occurred

during transportation should be reported immediately reported to HSE Department who should send trained staff to supervise containment of any spill and clean-up of contaminated surfaces according to the above-mentioned procedure.

- Soil contaminated areas already exists in power stations, substations stations, transformer workshops and scrap yard should be sampled to identify whether it is PCB contamination or not. The sampling shall be undertaken by an environmental consultant based on standards soil sampling procedure. Soil contaminations will be classified to a PCB spill, a PCB contaminated spill or non-PCB spill according to the classification criteria illustrated earlier in the above table.
- A PCB storage area should be prepared at a suitable location. The storage area should be built with adequate roof and walls to prevent rainwater from entering, the store should and have concrete floor lined with imperious liner, and at the edge of the store there should be curbs with sufficient height to contain any leak. The area should be sufficient for storing all PCB equipment and wastes, with sufficient corridors for movement of forklifts and with sufficient ventilation facilities. All waste barrels and equipment should be placed on wood pallets for easy movement by forklifts.
- Inventory records of operating, maintained and stored (for disposal) PCB equipment should be summarized in the annual HSE report as an environmental management indicator. This is being adopted by some international electricity companies as indicated in the following table:

The proposed SOPs for the long term are:

- The procedure for identifying PCB equipment could be done through making preliminary assumptions about old equipment, and conducting laboratory analysis to confirm presence through undertaking identification sampling for some suspected equipment. The identification procedure though preliminary assumptions shall follow the following steps:
 - o Transformers with readable plate tag identifying that manufacturing date is before 1986¹², and transformers without plate or with unreadable plate that have no information about the oil content should be assumed during its operation as a PCB transformer with oil containing PCBs more than 500 ppm.
 - o Transformers with readable plate tag identifying that manufacturing date is before 1986, and there is evidence that it is using or have been retro-filled with mineral oil should be assumed as being PCB contaminated transformer with PCB concentration of more than 50 ppm and less than 500 ppm. Exception for this assumption is that the manufacturer states clearly on the plate tag that the transformer is non-PCB.
 - o Transformers with readable plate tag identifying that manufacturing date is after 1986 and stating clearly that the transformer is non-PCB could be assumed as non-PCB transformer provided the transformer oil has not been refilled with PCB contaminated transformer oil.
 - o All transformers assumed and confirmed through analytical test to be PCB equipment or PCB contaminated equipment should be handled according to sound procedures as mentioned below.
 - o The above procedures should be applied also to capacitors

¹² According to USEPA the ban date of PCB equipment in USA is 2nd of July 1979, however, according to the UNEP document, as mentioned earlier, this ban was gradual and was not worldwide and until 1986 there was still manufacturing of PCB transformers

- All PCB equipment and PCB contaminated equipment, whether in use or in scrap yards, should have clear marking sign suitable for their identity (PCB or PCB contaminated).
- In case there are requirement for a more accurate classification of the existing or scrap equipment¹³, sampling and analysis of the oil and the inner surface should be undertaken using a standard sampling procedure, such as USEPA Standards, for oil sample volume and wipe samples. Accurate classification, and marking, of equipment could be undertaken according to analysis results as indicated in the above table
- It is recommended in the short term to provide international training to some HSE staff about adequate PCB management, so that trained personnel will be focal points for PCBs management in HSE and will disseminate knowledge and awareness among other staff

Table: PCB Comparison Study between the Two National Inventories

INVENTORY PROJECT	TOTAL WEIGHT OF OIL CONTENT IN TRANSFORMER	WEIGHT OF PCB CONTAINING OIL IN TRANSFORMERS (kg)	PERCENTAGE OF PCB CONTAINING OIL
The partial Baseline National Inventory of PCBs and PCB-containing Equipment in Nigeria (2008)	32,096,552	3,427,764	10.68%
National Baseline Inventory of PCBs and PCB containing Equipment (2014)	10,823,475	1,558,626.75	14.40%

-

The proposed SOPs for the long term are:

- Investigate availability and accessibility of adequate facilities for destruction of PCB waste. PCB substances should, in most cases, be incinerated in a high temperature incinerator with certain specifications and emission control measures, other PCB substances or PCB contaminated substances could be disposed in incinerators with less control requirements or in a chemical landfill

¹³ For reasons such as reducing storage space for PCB waste or for reducing precautions of handling PCB equipment

1.2 Hazardous Substances

The proposed SOPs in the short term are:

- Material Safety Data Sheets (MSDS) should be obtained from suppliers of all chemicals and oils. The MSDS should be provided to staff members, handling hazardous substances in grid stations, material store and transformer workshop. Each location handling a certain hazardous substance should have the correspondent MSDS for that substance. All hazardous substance containers should have adequate labeling indicating the substance name, its hazardous property and first aid / containment requirements.
- Records of stored and consumed hazardous substances should be also kept at the level of individual locations in addition to regional level. Accordingly all grid stations, in addition to the transformer workshop, should keep records of the hazardous substances in their premises in addition to any accidental spill and the handling method of empty containers.

The proposed SOPs in the medium term are:

- The oil ASTs in the transformers workshop should be surrounded by containment dykes that should be able to contain 110% of stored oil in case of any leakage. Also storage areas of hazardous substances barrels in grid stations, and transformers workshop, should have hard impervious flooring also surrounded by secondary containment dykes for containing any spill.
- Investigate the feasibility of replacing the mineral transformer oil and cable oil with vegetable or biodegradable oils¹⁴. This could be outsourced to one of the research centers or consultancy firms.

1.3 Soil Contamination

In managing soil contamination issue it is important to start with stopping reasons of spills, then to clean-up contaminated soil. It was clear from the observations of oil stains that the main reasons for spills are:

- During charging oil from or to transformers and cables, by mobile units, it seems that some leaks may have occurred due to un-tight points in the oil piping, such as joints or valves. Maybe some overfilling takes place where extra amount of oil is being pumped above the capacity of the receiving vessel
- Moving transformers may be associated with leaking from weak pipes, joints or damaged gaskets, so when the transformer is full of oil and being moved for maintenance the oil leaks from these points
- Sending transformers to the scrap yard with full oil inside them, which leads to oil leakage during moving the transformer and due to possibly placing it in tilted position at the scrap yard
- Losing the integrity of some oil containers which leads to leakage around their storage areas

¹⁴ This measure has been reported in 2008 annual report of some international electricity companies such as EDF and Energy Australia

- Moving oil barrels without tightly closing their lids or overflowing oil during their loading
- Placing transformer oil containing containers vertically on bare soil.

In order to manage this issue it has been recommended that in the short term there should be thorough investigations for stopping or minimizing further leaks, then clean-up options could be investigated in the medium term.

The proposed SOPs in the short term are:

- Spill control procedures should be adopted in different operations were leaking occurs. Example for the such control procedures relevant to the above-mentioned leaking reasons are:
 - o Equipment used for changing/filling transformers and cable oil should be checked for leaking before application. Any leaking joint or week point should be repaired before starting the operation. Whenever appropriate, control of oil filling should be applied so no overflowing take place
 - o Before moving transformers from substation or grid stations the maintenance staff should search for leaking points or weak seals and gaskets. These weak points should be repaired before moving the transformers
 - o Before sending a transformer to scrap yard oil should be drained out from the transformer and collected at a suitable container to the oil type and status.
 - o Oil barrels should be checked for integrity, once a leak is detected from a certain barrel the oil should be evacuated to another barrel and the damaged barrel sent to scrap yard¹⁵.
 - o Tight lids should be fixed on barrels before moving it.
- Report spillage incidents once occurred to the HSE Department in order to analyze reasoning for such spill and modify spill prevention measures accordingly. The number of spills should be an indicator of GIP in the annual HSE reports

The proposed SOPs in the medium term are:

- Contaminated soil spots that have should be classified in the inventory as fresh spills should be clean-up under supervision of qualified personnel. the contaminated area should be removed by personnel with suitable protective equipment and replaced by clean soil. The removed soil should be handled as hazardous waste, as shall be clarified later in this report. During the clean-up procedure assessment/monitoring of VOCs should be carried out. The process should also include taking samples from groundwater at the spill location and assessment of contaminants migration risks. Demolition of contaminated concrete should be followed by cleanup of the soil underneath. As a second priority the above measures should be applied to older spills.

¹⁵ Decontamination of oil barrels is proposed elsewhere in this report

1.4 Solid Wastes

The Recommended SOPs for hazardous waste management in the short term are:

- Preparing inventory for all hazardous waste in each location. Managers of each location shall quantify stored hazardous waste in their premises and estimate the average rate of hazardous waste generation.
- Removal of accumulated hazardous waste each location and transfer it to qualified disposal facility. Inventory Management Department should arrange for sufficient number of vehicles to transfer the waste from all locations to landfill. A transfer manifest should be prepared by the HSE Department and filled by all staff members involved in handling the waste in all locations. An example for a hazardous waste manifest is presented in (Appendix B).
- The proposed final management of the above waste items, sequenced according to preference, are as follows:
 - o The recycling of batteries component is believed to a better option than land disposal, especially if the recycling contractors are licensed to undertake such work, therefore the it is recommended to continue selling scrap batteries but only to officially licensed contractors
 - o The contaminated cloth, filters, used oils and oil sludge are ideally sent to high temperature incinerator.
- Any deal with contractors to take away hazardous waste should be documented in an official contract and using a suitable waste manifest.
- Communicate with PEPA the above proposed management practices to ensure their approval and ask for their guidance for other possible processes

It is worth noting that no PCB waste should be mixed with other hazardous wastes.

In the medium term the following measures are recommended:

- Temporary storage areas for hazardous waste should be prepared in all locations. The storage areas should be sufficient to safely place and move the waste from and to these storage areas. The recommended preparation for these storage areas are as follows:
 - o The floor of the area should be from suitable concrete (bearing wastes and forklifts loads) coated with impervious material and surrounded by short concrete dykes from 3 sides, except the access side. The floors should have slight slope towards liquid collection drains that ends in a tight water proof collection cesspit¹⁶, the slope direction should be opposite to the access side of the area
 - o The storage area should be covered by a suitable ceiling (such as corrugated metal sheets with sandwich panel) to prevent direct sunrays and rains
 - o Storage of all items mentioned above, except batteries and bulk tanks, shall be in metal barrels. The barrels should be in good condition (no leaks or weak joints) and should have clear labels describing the type of waste and the associated hazards and risks. The barrels shall be placed over suitable wood pallets for easy handlings

¹⁶ In that case the cesspit should be evacuated as needed by tanker truck which shall evacuate the waste in a suitable sewerage system for industrial waste, such as the sewer system of the transformers workshop

- Batteries and bulk tanks could be placed over the concrete flooring, if totally dry, in organized rows
- The area should be provided with adequate fire abatement equipment suitable for the amount of flammable waste

- Frequent transfer, such as on monthly basis, of waste. Transfer should be using manifests proposed above. Suitable trucks should be allocated for this purpose.
- Investigate the market for possible licensed hazardous waste contractors who could be feasibly contracted for taking away items which could be safely recycled.
- Because some waste items may not be adequately disposed or handed over to qualified contractors, it is recommended to investigate the feasibility of establishing a cell for receiving hazardous waste, as a best remaining option, and adequately place it in isolation from the surrounding environment.

1.5 Non Hazardous and Scrap Wastes

The recommended SOPs for scrap management in the short term are:

- Preparing inventory for all scrap and non-hazardous waste in grid stations and the transformer workshop. The Managers of the Grid Stations and the Workshop shall quantify stored scrap waste in their premises.
- Certain temporary storage areas for scrap should be allocated in each location depending on its generation rate and frequency of collection. The scrap area should be organized so as to allow for cleaning and easy handling of different items

The recommended SOPs for scrap management in the medium term are:

- Record keeping of annual generation rate of each waste items and the amount of waste that is being recycled.
- Investigate possible ways for waste minimization, including making incentives for less waste generation and initiate awareness campaigns.

1.6 Implementation of Health and Safety Procedures

The following subsections are describing Health and safety issues applicable to PHCN assets:

1.6.1 Fire Prevention and Suppression

Fire is the most common type of emergency that can arise in the substation and can be a subject of major concern, if appropriate fire safety measures are not followed strictly.

Procedures for minimization of fire risk

1- **General rules:**

Proper housekeeping:

- Clean all corridors and place of works
- Remove all obstructions from all doors

- Proper maintenance of all stairs and escalators
- Daily inspection of the workplace
- Proper organization of the workshop of the transformer (physical separation between different industrial processes)
- Plan of proper waste transportation from different working area
- A safety zone must surround all substations so that no one is allowed to stay close to the station
- Regular inspection and maintenance of all electric boxes

The greatest protection against property loss and injuries from fire is prevention.

- Minimize combustible storage.
- Store waste materials in suitable place / containers.
- Use flammable materials in well-ventilated areas. Use and store flammables away from ignition sources, such as cigarettes.
- Keep equipment in good working order. Have electrical wiring and appliances inspected regularly.
- Ensure that heating units are properly safeguarded.
- Do not hunt for gas leaks using an open flame. Use approved gas indicators.
- Report and repair all gas leaks immediately.
- Conduct hot work in well-ventilated areas.
- Test enclosed or confined spaces for flammable atmospheres.
- Use open flames carefully. Do not use open flames where flammable atmospheres may be present.
- - Inspection and proper insulation of control room
- - All cables have to be covered
- - Fencing of all transformer at the grid stations
- - Proper insulation of electric wires
- - Signs and label of the emergency exit
- - Proper lock out and tag out
- - Good lighting and ventilation at the control room
- - Periodic inspection of manual firefighting cylinder
- - Safety zone around the substations
- All gas cylinder placed in grid stations must be kept away from sun to prevent their explosion or corrosion
- Separate store houses for the different types of goods and chemicals (special store for gas cylinder, for chemicals, for transformers...etc.)
- Reviewing all legislations to comply with the national legislations

2- Establishment of automatic alarming system

Fire equipment - Provision and maintenance

Fire safety equipment must be provided in the factory in such numbers and types so as to fulfill the legal requirements. These includes but not limited to:

- Portable fire extinguishers: Adequate number and suitable type of portable fire extinguishers must be provided in every section of the factory, based on the type of fire risk involved.
- Fire alarm calling points
- Electrically operated fire alarm system (battery backup should be provided).

- One or two fire alarm call-points need to be provided on every floor / section of
- Fire hydrant points of appropriate number (as specified by local law) need to be provided
- Smoke detectors and automatic sprinkler system needs to be provided (if mandatory by provisions of local law)
- Other firefighting equipment (if legally mandatory)
 - o Sand and water buckets
 - o Manila rope
 - o Fire resistant helmets, gloves, boots and clothing

Evacuation drills and fire safety training

Evacuation drills and fire safety training need to be held periodically, following requirements of National Laws. Evacuation drills must be held at least as often as the Labor laws prescribe but will be held at least annually. Objectives of holding periodic evacuation drills are:

- To identify any weaknesses in the evacuation strategy;
- To test the procedure after any recent changes in the factory layout, working practices etc.;
- To familiarize new employees with evacuation procedures;
- To identify weaknesses in emergency procedures and systems.

Fire safety training

Fire safety training needs to be held periodically. It would include and is not restricted to the following content:

- Training on use of fire extinguishers and other related equipment,
- Training on communication during fire emergencies,
- Training on how to aid easy evacuation,
- Training on providing specific first aid during fire emergencies,
- Training on how to read evacuation route plans

Layout, equipment and communication

Following clauses on layout, fire equipment installation standards and fire safety communication need to be followed.

Fire exits

- There must be at least two exits, capable of clearing the work area in a maximum of five (5) minutes.
- An additional exit is required if travel distance is more than 25 meters.
- The width of every exit shall be equivalent to at least the width of the stairs and suitable to evacuate the building in a maximum of five minutes.
- Care needs to be taken to ensure that all exits are kept unobstructed (whether temporary or permanent) at all times.
- One exit will be considered sufficient for rooms where less than 30 people work. In particular, this also applies to floors which can be deemed to only have one room.

Fire exit doors

- Shall open outwards and will not open into aisles and walkways
- Shall have width equivalent to at least the width of the stairs
- Sign must be present
- Easy to open and kept unlocked

- Must not be locked or obstructed under any circumstance when people are inside the building

Fire equipment installation

Fire equipment installation should be in compliance with the requirement of all applicable fire safety laws in terms of numbers, types and locations.

Fire safety signage

All signage and information on fire safety must be made out in the regional language as understood by majority of the workforce. All signage and information provided must be readable from a distance (at least a distance of two meters) and wherever necessary at standard eye-level.

Fire Exit Signs

Fire Exit Signs



(Length equals two times height)

Fire Keep Clear Sign



Fire Door – Keep Shut Signs

To be used where a fire door was built to prevent fire from moving from one room to the other, e.g. entrance door of a chemical storage. Not be confused with fire exit.

Fire Extinguisher / Hose Sign

To be used to indicate the location and purpose of Fire Extinguishers

Fire Extinguisher / Hose Sign



Fire Alarm Sign

To be used to indicate the location of a Fire Alarm button

Fire Alarm Sign



No Smoking Sign

Compulsory in rooms where flammable chemicals are stored or other dangers of fire exist

No Smoking Sign



1.7 Electric Safety

General Electrical Safety

- Only authorized personnel, licensed for electrical work, are permitted to repair, adjust, test or service electrical equipment.
- Follow applicable local and national codes and regulations at all times. Live electrical equipment or electrical component parts must be grounded, isolated or provided with some other means of protection to prevent potential exposure to employees.
- All electrical equipment must be in safe condition before using. Remove defective equipment by maintenance department until it is repaired or replaced.
- Personal portable electrical equipment, such as heaters, etc. must be approved prior to use.
- Do not overload electrical equipment or electrical outlets. Only use approved extension cords and outlets.
- Only use extension cords that are intended for the equipment and conditions associated with the operation. Cords must be grounded and inspected prior to use to assure proper grounding.
- Electrical devices like junction boxes and distribution panels must be closed, undamaged and not be misused for direct connection with machines.
- Wires must be well insulated, replaced if damaged, protected against mechanical damage and damage from heat where necessary.
- Clear warning sign should be erected at high voltage area to avoid any “non-authorized access” and “improper storage inside the high voltage area.”
- Regular maintenance and inspection program should be carried out for all electrical equipment.

Requirements for Safety Performing Electrical Work

- Qualified workers must clearly define any electric or electronic equipment (or system) work and include the work location, a summary of the work to be done, and the equipment (or systems) to be worked on.
- An approved safety document such as a Special Electrical Work Permit (SEWP) for work on energized electrical systems.
- Qualified workers must ensure that protective equipment (such as insulated gloves, mats, shorting hooks, and associated cable, clamps, and resistors) is in good condition and is stored and used properly.
- The hierarchy for hazard controls is:
 1. De-energize the circuit and verify the de-energized condition,
 2. Implement engineered controls,
 3. Implement administrative controls, and
 4. Use personal protective equipment.
- When an electrical hazard exists, qualified workers must positively de-energize exposed circuit parts before beginning work, unless there is a compelling reason to do the work on an energized circuit.

Electrical Grounding

Proper electrical grounding can help prevent electrical injury. Most electrical equipment is grounded with either a three-prong plug or a two-prong plug and insulation. Never remove the grounding plug from any electrical cord! This creates a potentially dangerous situation.

Electrical Panels

Electrical panels or breaker boxes require special safety considerations, including the following:

1. Know where your panel box is located.
2. Do not touch the circuit breakers unless authorized to do so (by Physical Facility.)
3. Ensure that panel box doors are securely attached.
4. Do not block access to panel boxes. There should be at least 30 inches of clear space in front of a panel box.

Electrical Safety Guidelines

Follow these guidelines for general electrical safety:

1. Be familiar with the electrical hazards associated with your work place.
2. Unplug electrical equipment before repairing or servicing it.
3. If a prong breaks off inside an outlet, do **not** attempt to remove it yourself. Call the physical facility for assistance.
4. Ensure that outlets are firmly mounted. Report loose outlets to the Physical Facility.
5. Report all electrical problems, including tripped breakers, broken switches, and flickering lights to the Physical Facility.
6. Do not use an appliance that sparks, smokes, or becomes excessively hot, unless the appliance is specifically designed to exhibit these characteristics.
7. Portable electrical heaters must be placed to avoid causing a trip hazard and must be kept away from combustible material. Never leave a heater unattended. Unplug the heater at the end of the day and when not in use. **Ceramic Heaters are the preferred style of heater.**
8. Keep electrical equipment away from water, unless the appliance is specifically designed for use around water, such as a wet-dry shop vacuum.
9. Be aware of overhead power lines when working with tall equipment (e.g., grain augers, cranes, backhoes, etc.).
10. Follow lockout/tag out procedures, as appropriate.

Electrical Emergency Response

The following instructions provide guidelines for handling three types of electrical emergencies.

1. Electric Shock

- When someone suffers serious electrical shock, he or she may be knocked unconscious. If the victim is still in contact with the electrical current, immediately turn off the electrical power source. If you cannot disconnect the power source - **do not touch** the victim and immediately call emergency department for assistance.
- Current regulations require all cases of electric shock and damage to property from electrical incidents to be reported, so that the cause of the shock/damage can be investigated and corrected.
- Staff working on live electrical equipment needs to be familiar with cardio-pulmonary resuscitation techniques.

2. Protection from Electric Shock

Earthing / Insulation

Class I equipment includes not only insulation of live parts but an earth connection via the flexible cord and power outlet to accessible conductive parts. The accessible parts will not become live if the basic insulation fails. However, the disadvantage of Class I equipment is that an electric shock can still occur if a person forms a connection between live and earthed components.

Class II (double insulated) equipment does not have an earth connection as in Class I equipment but relies on double or reinforced insulation for protection. Introducing an earth on this equipment can be dangerous.

- Residual Current Devices (RCDs)

Residual Current Devices (RCDs) operate by switching off electricity supply when an imbalance is detected between the current flowing between the active and neutral leads. An imbalance will occur when part or all of the current returns via earth rather than the neutral lead. As the detectable imbalance (~30 mA) and switching times are below the levels to result in injury, the RCDs are an effective means of protecting people in most situations but are not to be relied on.

- Low Voltages

Susceptibility to electric shock varies widely between individuals and according to the circumstances and therefore it is not possible to set a safe voltage limit. However, generally low voltage (less than 50 volts) is unlikely to cause injury or electric shock.

IMPORTANT: Do not touch a victim that is still in contact with a power source; you could electrocute yourself. Have someone call for emergency medical assistance immediately.

- Contact with Downed Lines, Live Electrical Equipment, and Other Utilities (e.g., gas, water)

- Identify the location of any energized electrical power circuit that employees (or their tools and equipment) could contact; post signs and advise individuals of the location, hazards, and protective work practices.
- Assume that electrical lines are energized until proven otherwise. Lines and other conductors may become reenergized without warning as utilities are evaluated and restored after a disaster. Ensure that employees are protected from electric shock by de-energizing and grounding circuits they might contact.
- Inspect the work area for downed conductors and do not go near, drive over, or otherwise come in contact with them.
- Downed electrical conductors can energize other objects, including fences, water pipes, bushes, trees, and telephone/CATV/fiber optic cables.
- Unless they are de-energized and visibly grounded, maintain proper distance from overhead electrical power lines (at least 10 feet) and/or provide insulating barriers.
- De-energize circuits and use locks and/or tags to prevent circuits from becoming reenergized accidentally.

- Use ground-fault circuit interrupters on all outlets that are not part of permanent wiring.
- Guard live parts against accidental contact using approved cabinets or other approved enclosures.
- Inspect electrical cords or cables for external defects (such as loose parts, deformed or missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jackets). Do not use damaged cords and cables.
- Use extension cords approved for the intended use (e.g., use heavy duty extension cords on work sites).
- Do not approach any gas leaks; if a gas leak is detected, secure spark-producing devices (e.g., engines, tools, electronic, and communications equipment) and evacuate the area until the leak is secured.
- Contact utility company to assist in locating, marking, and shutting off/purging utility lines that may pose a hazard or may be impacted; ensure that lines have been purged as needed before beginning work.

3. Electrical Fire

If an electrical fire occurs, try to disconnect the electrical power source, if possible. If the fire is small, you are not in immediate danger, and if you have been trained in fighting fires, use any type of fire extinguisher **except water** to extinguish the fire.

IMPORTANT: Do not use water on an electrical fire.

4. Hazards Control:

a- Requirements for Minimizing Electrical Hazards in the Workplace

- Notify the supervisor of any shock hazard or other electrical hazard that is associated with any piece of equipment.
- Do not use the equipment until it has been repaired and checked out.
- Do not reset circuit breakers that are locked and tagged unless the originator removes the lockout.
- When turning or adjusting settings of electrical controls, avoid contact with good conducting grounds, such as wet floors or bare metal pipes.
- Ensure that cord-connected equipment is listed and labeled by a Nationally Recognized Testing Laboratory
- Ensure that connections are secure, are not cracked, have insulation intact, and have appropriate ground prongs.
- Ensure that cords are not spliced and that terminations (for example, strain relief grommets) are in good condition and secure.
- Use extension cords and multiple outlet strips for only short-term usage or in mobile situations.
- Ensure that 3-wire heavy-duty (or higher rated) extension cords are used.
- Ensure that rated capacities are appropriate with actual use and that cords are not brittle or warm to the touch.
- Avoid more than one extension cord in a circuit (daisy chain).
- Protect cords from abrasion and pinching.
- Multiple outlet strips and similar power distribution equipment with built-in surge protection, designed for personal computer installations, may be used for such systems, provided they are not damaged or overloaded.
- Ensure that 30 inches of space is clear in front of breaker panels.

To reduce occupational electrocutions, employers should:

- Develop and implement a comprehensive safety program and, when necessary, revise existing programs to thoroughly address the area of electrical safety in the workplace.
- Ensure compliance with existing EHS regulations
- Provide all workers with adequate training in the identification and control of the hazards associated with electrical energy in their workplace.
- Provide additional specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training should include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/ tag out procedures, first aid including CPR, and proper rescue procedures. Provisions should be made for periodic retraining as necessary.
- Develop and implement procedures to control hazardous electrical energy which include lockout and tag out procedures and ensure that workers follow these procedures.
- Provide those workers who work directly with electrical energy with testing or detection equipment that will ensure their safety during performance of their assigned tasks.
- Ensure Compliance with the National Electrical Code and the National Electrical Safety Code.
- Conduct safety meetings at regular intervals.
- Conduct scheduled and unscheduled safety inspections at worksites.
- Actively encourage all workers to participate in workplace safety.

1.8 Personal Protective Equipment PPE

Personal Protective Equipment (PPE) is the last line of defense against workplace hazards. EHS defines PPE as "equipment for the eyes, face, head, and extremities, protective clothing, respiratory devices, protective shields and barriers." Many EHS regulations state that PPE must meet criteria set by the American National Standards Institute (ANSI). ESHA requires that workers be provided with personal protective equipment (PPE). This equipment must meet EHS requirements and be appropriate for the parts of the body that need protection and the work performed. There are many types of PPE: rubber gloves, insulating shoes and boots, face shields, safety glasses, hard hats, etc. Even if regulations did not exist requiring the use of PPE, there would still be every reason to use this equipment. PPE helps keep you safe. It is the last line of defense between you and the hazard.

1. **Wear safety glasses** with side shields or goggles to avoid eye injury.
2. **Wear proper clothing** that is neither floppy nor too tight. Loose clothing will catch on corners and rough surfaces. Clothing that binds is uncomfortable and distracting.
3. **Contain and secure loose hair** - Wear hair in such a way that it does not interfere with work or safety.
4. **Wear proper foot protection** - Wear shoes or boots that have been approved for electrical work. (Tennis shoes will not protect you from electrical hazards.) If there are non-electrical hazards present (nails on the floor, heavy objects, etc.), use footwear that is approved to protect against these hazards as well.

5. **Wear a hard hat** to protect your head from bumps and falling objects. Hard hats must be worn with the bill forward to protect you properly.
6. **Wear hearing protectors** in noisy areas to prevent hearing loss.
7. **Follow manufacturer's directions** for cleaning and maintaining PPE.
8. **Make an effort** - Search out and use any and all equipment that will protect you from shocks and other injuries.

Key Provisions

Key provisions regarding protective clothing in EHS proposal include the following:

- Employers must assess their workplace to determine if each employee is exposed to hazards from flames or from electric arcs.
- For each employee exposed to hazards from electric arcs, the employer must make a reasonable estimate of the maximum available heat energy to which the employee would be exposed.
- Employers must ensure each employee who is exposed to hazards from electric arcs does not wear clothing that could melt onto his or her skin or that could ignite and continue to burn when exposed to the heat energy estimated.
- Clothing made from the following types of fabrics, either alone or in blends, is prohibited, unless the employer can demonstrate that the fabric has been treated to withstand conditions that may be encountered or that the clothing is worn in such a manner as to eliminate the hazard involved: acetate, nylon, polyester, rayon.

1.9 House keeping

All corridors and working areas must be kept clean and empty all the time. Housekeeping is not just cleanliness. It includes keeping work areas neat and orderly; maintaining halls and floors free of slip and trip hazards; and removing of waste materials (e.g., paper, cardboard) and other fire hazards from work areas. It also requires paying attention to important details such as the layout of the whole workplace, aisle marking, the adequacy of storage facilities, and maintenance. Good housekeeping is also a basic part of accident and fire prevention. Effective housekeeping is an ongoing operation: it is not a hit-and-miss cleanup done occasionally. Periodic "panic" cleanups are costly and ineffective in reducing accidents.

Housekeeping order is "maintained" not "achieved." This means removing the inevitable messes that occur from time to time and not waiting until the end of the shift to reorganize and clean up. Integrating housekeeping into jobs can help ensure this is done.

All wastes in the working area must be carried and transported to the scrap area. A good housekeeping program identifies and assigns responsibilities for clean up during the shift; day-to-day cleanup; waste disposal; removal of unused materials; and inspection to ensure cleanup is complete.

Aisles and Stairways

Aisles should be wide enough to accommodate people and vehicles comfortably and safely. Aisle space allows for the movement of people, products and materials. Warning signs and mirrors can improve sight-lines in blind corners. Arranging aisles properly encourages people to use them so that they do not take shortcuts through hazardous areas. Keeping aisles and stairways clear is

important. They should not be used for temporary "overflow" or "bottleneck" storage. Stairways and aisles also require adequate lighting.

Spill Control

The best way to control spills is to stop them before they happen. Regularly cleaning and maintaining machines and equipment is one way. Another is to use drip pans and guards where possible spills might occur. When spills do occur, it is important to clean them up immediately. Absorbent materials are useful for wiping up greasy, oily or other liquid spills. Used absorbents must be disposed of properly and safely.

Arrangements for Securing the Health and Safety of Workers

- An inventory of all substances hazardous to health kept on site will be maintained, with appropriate hazard information.
- Competent persons will be appointed to carry out risk assessments of the exposure to substances hazardous to health and advice on their control.
- All operations which involve, or may involve, exposure to substances hazardous to health will be assessed and appropriate control measures will be taken if elimination or substitution of the substance is not possible.
- Engineering controls will be properly maintained and monitored by planned preventive maintenance and annual performance monitoring to ensure continued effectiveness.
- All employees and others who may work in the affected areas will be informed of the purpose and safe operation of all engineering controls.
- Personal protective equipment (PPE) will only be used as a last resort, or as a back-up measure during testing or modification of other controls.
- The type and use of PPE will be carefully assessed and maintained according to manufacturers' instructions. If possible, the number of different types will be minimised to prevent mistakes in servicing or replacement.
- All employees will be provided with understandable information and appropriate training on the nature of the hazardous substances they work with. Employees will be informed about any monitoring and health surveillance results.
- All changes to control measures and changes of PPE will be properly assessed and no new substances will be introduced into the workplace without prior assessment..

Appendix B
HAZARDOUS WASTE MANIFEST

- Example of a Hazardous Waste Manifest

Generator Information:	
Station:	Staff member in-charge:
Waste Description: (waste oil, scrap batteries, waste cloth, waste filters, sludge, contaminated containers, contaminated soil, ... other – please specify)	
Container Type:	Number of Containers for the Consignment:
Gross Weight (with container):	Net Weight:
Accidental Spillage Measures:	First Aid Measures: Inhalation: Skin: Eyes: Ingestion:
Station Staff signature:	Date and time
Transportation Information:	
Driver Name:	Metal Plates:
Vehicle Model:	Number of Containers for the Consignment:
Method of loading/unloading:	Destination and route:
Any accidental release or spill (please provide detailed description):	
Driver signature:	Date and time
Receipt Acknowledgement: (All above data should be reviewed by PHCN Staff member)	
Staff member in-charge:	Date and time of Delivery:
Waste Inspection in the site – Please mention any comments about above description of generation or transportation	
Method of loading/unloading:	Location of storage:
Method and location of disposal	
Staff signature:	Date and time

Appendix C
Stakeholder Consultation

Appendix C.1: Sagamu (Ogun State) 132/33 KV Transmission Substation

Date	06 August , 2015
Time	10am to 1.00pm
Venue	Business Premises by the Substation Perimeter Fence
Language of Communication	English and Yoruba
Stakeholders	Sagamu Substation staff, community leaders, consultants, Business owners, CBO and NGOs.
	The meeting started at about 11 AM with opening prayer said by the Substation Supervisor who opened the floor by highlighting the agenda. He thanked the participants for being present despite short notice. He further introduced all the consulting team and their different roles in the project.
The Project	The Government of Nigeria rehabilitating/reinforcing transmission substation which is financed by the Nigeria Electricity and Gas Improvement Project (NEGIP) of the International Development Association (IDA) to improve electricity quality and reliability, in response to growing demand for electricity. The growing population, the increasing demand on power and pressure on existing facilities, especially old ones, are common problems that usually face the power sector, in addition to the financial problems.
Need for the Public Consultations	Information dissemination and consultation with stakeholders, especially the project Affected Person (PAPs) reduces the potential for conflicts, minimizes the risk of project delays, and enables the project to properly carter as a comprehensive development programme for the needs and priorities of the PAPs. This provides an opportunity to all the stakeholders in the proposed site to raise issues and concerns pertaining to the project, and allow the identification of alternatives and recommendations. Specific objectives of the public information campaign and public consultation included sharing information about the proposed project, its components and its activities, with affected people, obtain information about the needs of the affected people, and their reactions to the Proposed activities; ensure transparency in all activities related to land acquisition and ask local residents especially the Interested and Affected Parties about the problem anticipated with the project and how these can be overcome.
Stakeholder's concerns and Consulting team response	<p>The community leader narrated the history of how the land was sold by the indigenes to the Federal Government and the signing of documents in Lagos which was then the seat of Government. The community leader asked all the questions un-behalf of the stakeholders present whereas the team leader responded for the consulting team.</p> <p>Q: The area residents requested to be first considered when employment vacancies arise most especially during the construction phase</p> <p>A: The Project contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase</p> <p>Q: TCN should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g operators.</p> <p>A: The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.</p> <p>Q: The locals want the firm (TCN) to take part in their developmental activities. e.g sinking borehole etc</p> <p>A: The firm is a Government social service agency and therefore limited in executing CSR.</p>

	<p>Q: The residents of the area will need information of impending work that will affect their environment. e.g traffic, noise etc</p> <p>A: The stakeholder’s consultation and engagement will be continues through the life span of the project.</p> <p>Q: The residents of the area needed assurance that the would be the first beneficiary of improved power when the project had been completed</p> <p>A: The Electricity flow diagram of power generation to Transmission and unto distribution. The supply of light to their homes is from the distribution companies and has nothing to do with the substation however the quantity of bulk electricity supply to the distribution sector will be grossly improved.</p>
Addresses	<ul style="list-style-type: none"> - The Substation supervisor assured the all stakeholders of proper collaboration with relevant agencies of government (Road safety, Police etc) and the community to achieve the objective of the proposed project. He assured that the consultations will be continues through-out the life span of the project and substation. - The thanked all the participants saying that this kind of consultation is continuous and he is happy that everyone recognized the fact we are all part of the project.
Closing	<ul style="list-style-type: none"> - Attendance sheets were passed round for stakeholders to sign. The meeting came to a close with prayer by the community member

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR THE REHABILITATION/REINFORCEMENT OF 132/33KV
TRANSMISSION SUB-STATION AT SAGAMU OGUN STATE
DATE: AUGUST 16, 2015

S/N	NAME	ORGANISATION/AGENCY/COMMUNITY	CONTACT NO	SIGNATURE
1	ENGR. O. O. AD	TCL, SAGAMU T.S.	08121635648	[Signature]
2	Adeyemi wale	EcoConServ	08037203989	[Signature]
3	Bayo. Dashe L.D	ISD Slegamu T.S	08035373037	[Signature]
4	Adekunle A.A	Okeunshin/Ilaje	08037217612	[Signature]
5	Motajun/Euzaboth	Okeunshin/Ilaje	01023633564	[Signature]
6	Musa	Oyeuwa / Security	08166204259	[Signature]
7	Astermbi Oluwaseun	Nigerian Security and Civil Defense Corps	08165054458	[Signature]
8	Bakare	Staff Sagamu	08051832387	[Signature]
9	Muhammad	Staff Sagamu	08181986526	[Signature]
10	Elizabeth Ajisegbe	Member Community	0703205448	[Signature]
11	Tinire Sami	Member Community	08038539408	[Signature]
12	MRS Famulusi	Member Community	08164138843	[Signature]
13	MR Chikwudi	✓	07084313650	[Signature]
14	MR Adedun	✓	09033884608	[Signature]
15	MR Yusuf	✓	0707820702	[Signature]
16	Mrs Mrs. Hamba	Mrs. Crystal Idigbe Ltd	✓	[Signature]
17	Mrs Shams	EcoConServ / Environmental Specialist	+2 01008193873	[Signature]
18	Fakhr Abdul Khalek	EcoConServ - Environmental Consultant	+2 01061804901	[Signature]
19	Mrs Shide Aina	Member Community	—	[Signature]

Attendance list 1: Sagamu Consultation

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR THE REHABILITATION/REINFORCEMENT OF 132/33KV
TRANSMISSION SUB-STATION AT SAGAMU OGUN STATE
DATE: AUGUST 6, 2015

S/N	NAME	ORGANISATION/AGENCY/COMMUNITY	CONTACT NO	SIGNATURE
1	Segun Adigun	MetaSpec Consult	08033966848	
2	Y. Ralph Odeh	MetaSpec Community	08034506530	
3	Michael Odeh	Ecoconserve Esigbi Nigbie	0808455320	
4	Seun Adigun	Community Member	0803146658	
5	Kunle Adeniji	" "	08056309820	
6	Euba Oluwaseun	META SPEC CONSULT	08116405689	
7	Miracle Samuel	MetaSpec Consult	08052347111	
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Attendance list 2: Sagamu Consultation

Appendix C.2: Awka (Anambra State) 132/33 KV Transmission Substation

Date	10 August, 2015
Time	11.40 am to 12.30pm
Venue	Nibo Town Hall
Language of Communication	English and Igbo
Stakeholders	Awka (Nibo) Substation staff, community leaders, consultants, neighbours, CBO and NGOs.
	The meeting started at about 11.40am with opening prayer said by TCN staff (TCN Owerri sub region). The Socio-economic consultant opened the floor by highlighting the agenda. He thanked the participants for being present. He further introduced all the consulting team and their different roles in the project.
The Project	The Government of Nigeria rehabilitating/reinforcing transmission substation which is financed by the Nigeria Electricity and Gas Improvement Project (NEGIP) of the International Development Association (IDA) to improve electricity quality and reliability, in response to growing demand for electricity. The growing population, the increasing demand on power and pressure on existing facilities, especially old ones, are common problems that usually face the power sector, in addition to the financial problems.
Need for the Public Consultations	Information dissemination and consultation with stakeholders, especially the project Affected Person (PAPs) reduces the potential for conflicts, minimizes the risk of project delays, and enables the project to properly cater as a comprehensive development programme for the needs and priorities of the PAPs. This provides an opportunity to all the stakeholders in the proposed site to raise issues and concerns pertaining to the project, and allow the identification of alternatives and recommendations. Specific objectives of the public information campaign and public consultation included sharing information about the proposed project, its components and its activities, with affected people, obtain information about the needs of the affected people, and their reactions to the Proposed activities; ensure transparency in all activities related to land acquisition and ask local residents especially the Interested and Affected Parties about the problem anticipated with the project and how these can be overcome.
Stakeholder's concerns and Consulting team response	<p>The community leader explained the cordial relationship between the community and the substation. He pointed out how the neighbouring house had been assisted with borehole water for domestic use by the substation management. However he conveyed the displeasure of the community with the substation for abandoning the original access road to the substation and using the community access road which is now in a deplorable state. The community leader asked all the questions un-behalf of the stakeholders present whereas team leader responded for the consulting team.</p> <p>Q: The community access road has been used for operations of the substation which has dilapidated the road. TCN should put to use the original access road to the substation and restore the damaged community access road.</p> <p>A: The consulting team assured the community that the first part of the rehabilitation/reinforcement is putting to use the original access road to the substation. The damaged community access road will be repaired in a joint effort.</p>

	<p>Q: The substation in time past used to help the community members and neighbours with borehole water since quality water is difficult to access in the area. However the practice has stopped for a while.</p> <p>A: The substation supervisor explained to the gathering how the submersible pump of the borehole went bad and got stuck in the ground</p> <p>Q: The area residents requested to be first considered when employment vacancies arise most especially during the construction phase</p> <p>A: The Project contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase</p> <p>Q: TCN should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g operators.</p> <p>A: The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.</p> <p>Q: The locals want the firm (TCN) to take part in their developmental activities. e.g sinking borehole etc</p> <p>A: The firm is a Government social service agency and therefore limited in executing CSR.</p> <p>Q: The residents of the area will need information of impending work that will affect their environment. e.g traffic, noise etc</p> <p>A: The stakeholder's consultation and engagement will be continues through the life span of the project.</p> <p>Q: The residents of the area needed assurance that the would be the first beneficiary of improved power when the project had been completed</p> <p>A: The Electricity flow diagram of power generation to Transmission and unto distribution. The supply of light to their homes is from the distribution companies and has nothing to do with the substation however the quantity of bulk electricity supply to the distribution sector will be grossly improved.</p>
Addresses	<ul style="list-style-type: none"> - Engineer of TCN OSR assured the all stakeholders of proper collaboration with relevant agencies of government (Road safety, Police etc) and the community to achieve the objective of the proposed project. He assured that the consultations will be continues through-out the life span of the project and substation. - The SIA consultant thanked all the participants saying that this kind of consultation is continuous and he is happy that everyone recognized the fact we are all part of the project.
Closing	<ul style="list-style-type: none"> - Attendance sheets were passed round for stakeholders to sign. The meeting came to a close with prayer one of the consulting team

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR THE REHABILITATION/REINFORCEMENT OF 132/33KV TRANSMISSION SUB-STATION AT (NIBO) AKWA ANAMBRA STATE
DATE: AUGUST 6-10, 2015

S/N	NAME	ORGANISATION/AGENCY/COMMUNITY	CONTACT NO	SIGNATURE
1	Ofani J.O	TEN DSR	08163964001	[Signature]
2	Chude O.S	TEN OSR	07035917718	[Signature]
3	Ndika Amobi T	TEN System control	08035922252	[Signature]
4	Dr Chis Anjan	Eco-Conserv	0806765 1579	[Signature]
5	Dr Raphael Ojiy	Ecocouncil	08034506570	[Signature]
6	Anola Samuel	Eco-Con serve	0805234711	[Signature]
7	Ebani Okwara	Eco Runners	08116405665	[Signature]
8	Egwanam Chigozie	NSCDC Anambra State Command	08067107707	[Signature]
9	Obambodo Chinyere	NSCDC Anambra State Command	07064722152	[Signature]
10	Samuel Okwara	NIBO Anambra State	08069061427	[Signature]
11	Felix Humphreys	NIBO Anambra state	07088530657	[Signature]
12	Godwin	NIBO Anambra State	08139167993	[Signature]
13	Emmanuel Sitoh	NIBO Anambra State	08236125648	[Signature]
14	Okaka-Araekwe C.	NSCDC Anambra State Command	08068124909	[Signature]
15	Nwankpa Okachi	NSCDC Anambra State Command	08065961411	[Signature]
15	Mbonu Jane C.	NSCDC Anambra State Command	08022625885	[Signature]
17	Okala Rosehine	NSCDC Anambra State Command	08069205409	[Signature]
18	Agu Nkinnika	NSCDC Anambra State Command	08033749954	[Signature]
19	Grace Nwabur	Cleaner Anambra State	08076061782	[Signature]

Figure 3: Attendance list 1: Awka consultation

Appendix C.3: Yandev (Benue State) 132/33 KV Transmission Substation

Date	11 August , 2015
Time	2pm to 3pm
Venue	Tse- Amua Community Leaders House
Language of Communication	English
Stakeholders	Yandev Substation staff, TCN work Station staff Makurdi, community leaders, consultants and Dangote Cement HSE Manager.
	The meeting started at about 11 AM with opening prayer said by the Substation Supervisor who opened the floor by highlighting the agenda. He thanked the participants for being present despite short notice. He further introduced all the consulting team and their different roles in the project.
The Project	The Government of Nigeria rehabilitating/reinforcing transmission substation which is financed by the Nigeria Electricity and Gas Improvement Project (NEGIP) of the International Development Association (IDA) to improve electricity quality and reliability, in response to growing demand for electricity. The growing population, the increasing demand on power and pressure on existing facilities, especially old ones, are common problems that usually face the power sector, in addition to the financial problems.
Need for the Public Consultations	Information dissemination and consultation with stakeholders, especially the project Affected Person (PAPs) reduces the potential for conflicts, minimizes the risk of project delays, and enables the project to properly carter as a comprehensive development programme for the needs and priorities of the PAPs. This provides an opportunity to all the stakeholders in the proposed site to raise issues and concerns pertaining to the project, and allow the identification of alternatives and recommendations. Specific objectives of the public information campaign and public consultation included sharing information about the proposed project, its components and its activities, with affected people, obtain information about the needs of the affected people, and their reactions to the Proposed activities; ensure transparency in all activities related to land acquisition and ask local residents especially the Interested and Affected Parties about the problem anticipated with the project and how these can be overcome.
Stakeholder's concerns and Consulting team response	<p>The community leader asked all the questions un-behalf of the stakeholders present whereas the Team leader responded for the consulting team.</p> <p>Q: The area residents requested to be first considered when employment vacancies arise most especially during the construction phase</p> <p>A: The Project contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase</p> <p>Q: TCN should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g operators.</p> <p>A: The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.</p> <p>Q: The locals want the firm (TCN) to take part in their developmental activities. e.g sinking borehole etc</p> <p>A: The firm is a Government social service agency and therefore limited in executing CSR.</p> <p>Q: The residents of the area will need information of impending work that will affect their environment. e.g traffic, noise etc</p>

	<p>A: The stakeholder’s consultation and engagement will be continues through the life span of the project.</p> <p>Q: The residents of the area needed assurance that the would be the first beneficiary of improved power when the project had been completed</p> <p>A: The Electricity flow diagram of power generation to Transmission and unto distribution. The supply of light to their homes is from the distribution companies and has nothing to do with the substation however the quantity of bulk electricity supply to the distribution sector will be grossly improved.</p>
Addresses	<ul style="list-style-type: none"> - The Substation supervisor assured the all stakeholders of proper collaboration with relevant agencies of government (Road safety, Police etc) and the community to achieve the objective of the proposed project. He assured that the consultations will be continues through-out the life span of the project and substation. - The consultants thanked all the participants saying that this kind of consultation is continuous and he is happy that everyone recognized the fact we are all part of the project.
Closing	<ul style="list-style-type: none"> - Attendance sheets were passed round for stakeholders to sign. The meeting came to a close with prayer by a community member

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR THE REHABILITATION/REINFORCEMENT OF 132/33KV
TRANSMISSION SUB-STATION AT YANDEV BENUESTATE
DATE: AUGUST 11-12, 2015

S/N	NAME	ORGANISATION/AGENCY/COMMUNITY	CONTACT NO	SIGNATURE
1	Engr. Okonkwo I	TCN	080 33363645	
2	Abiola Samuel	Ecoconserve	08052347111	
3	Dr. Chis A.	Ecoconserve	08064651535	
4	A.O. Okunure	TCN Yandev	08063507189	
5	Nwagwu-Nwize P O	TCN Apin	08037433153	
6	Umeh Kenneth	TCN Apin	08037404637	
7	Oscar Gabriel	TCN Yandev	07058932345	
8	CHRA Libani	TCN APIN SUB REGION	08038505252	
9	Chief Joseph	Community head Amua	07033402713	
10	John Jir	DEP. GBOKO	09053822218	
11	R. SAMANAN	DANGOTE CEMENT PLC - GBOKO	09053823201	
12	Dr. R.A. Offiong	Eco Conserve	08034566730	
13	EUBA Okonkwo	Eco Conserve	0816405669	
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Figure 4 Attendance list 1: Yandev (Benue) Consultation

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR THE REHABILITATION/REINFORCEMENT OF 132/33KV
TRANSMISSION SUB-STATION AT YANDEV BENUESTATE
DATE: AUGUST 11-12, 2015

S/N	NAME	ORGANISATION/AGENCY/COMMUNITY	CONTACT NO	SIGNATURE
1	DSKI Godwin	TCA	08067493184	[Signature]
2	AKOPY LIMMOR	V	08085550241	[Signature]
3	DEVE MIA	V	09058585086	[Signature]
4	INGHORA ABOT	V	09036870709	[Signature]
5	UCHIR ABADI	TCA	08051485640	[Signature]
6	TERWASE	D.V	08130031936	[Signature]
7	FCHD TERNA	N.S.C.D.C	08160460439	[Signature]
8	Abachan g-w	N.S.C.D.C	08030544202	[Signature]
9	Ntoya Torgin	TCA		[Signature]
10	Alhan Godwin	N.S.C.D.C	08170583772	[Signature]
11	Adigwe Wale	EcoConServ TCA-Amu/NB	08037003787	[Signature]
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Figure 5 Attendance list 2: Yandev (Benue) Consultation

Appendix C.4: Gasau (Zamfara State) 132/33 KV Transmission Substation

Date	14 August , 2015
Time	2pm to 2.45pm
Venue	Gasau Transmission Substation
Language of Communication	English and Hausa
Stakeholders	Gasau Substation staff, community leaders, consultants, Business owners, CBO and NGOs.
	The meeting started at about 2 pm. The Substation Supervisor opened the floor by highlighting the agenda. He thanked the participants for being present despite short notice. He further introduced all the consulting team and their different roles in the project.
The Project	The Government of Nigeria rehabilitating/reinforcing transmission substation which is financed by the Nigeria Electricity and Gas Improvement Project (NEGIP) of the International Development Association (IDA) to improve electricity quality and reliability, in response to growing demand for electricity. The growing population, the increasing demand on power and pressure on existing facilities, especially old ones, are common problems that usually face the power sector, in addition to the financial problems.
Need for the Public Consultations	Information dissemination and consultation with stakeholders, especially the project Affected Person (PAPs) reduces the potential for conflicts, minimizes the risk of project delays, and enables the project to properly carter as a comprehensive development programme for the needs and priorities of the PAPs. This provides an opportunity to all the stakeholders in the proposed site to raise issues and concerns pertaining to the project, and allow the identification of alternatives and recommendations. Specific objectives of the public information campaign and public consultation included sharing information about the proposed project, its components and its activities, with affected people, obtain information about the needs of the affected people, and their reactions to the Proposed activities; ensure transparency in all activities related to land acquisition and ask local residents especially the Interested and Affected Parties about the problem anticipated with the project and how these can be overcome.
Stakeholder's concerns and Consulting team response	<p>The community leader asked all the questions un-behalf of the stakeholders present whereas consultants responded for the consulting team.</p> <p>Q: The area residents requested to be first considered when employment vacancies arise most especially during the construction phase</p> <p>A: The Project contractor shall be instructed to consider eligible area residents when employment vacancies arise during the construction phase</p> <p>Q: TCN should consider the locals for quality jobs that require skills and training and not just as laborers and watchmen. e.g operators.</p> <p>A: The quality jobs that require skills and training like operators are under the civil service commission with employment centrally by the Federal Government of Nigeria and not the responsibility of the firm or the substation.</p> <p>Q: The locals want the firm (TCN) to take part in their developmental activities. e.g sinking borehole etc</p> <p>A: The firm is a Government social service agency and therefore limited in executing CSR.</p> <p>Q: The residents of the area will need information of impending work that will affect their environment. e.g traffic, noise etc</p>

	<p>A: The stakeholder’s consultation and engagement will be continues through the life span of the project.</p> <p>Q: The residents of the area needed assurance that the would be the first beneficiary of improved power when the project had been completed</p> <p>A: The Electricity flow diagram of power generation to Transmission and unto distribution. The supply of light to their homes is from the distribution companies and has nothing to do with the substation however the quantity of bulk electricity supply to the distribution sector will be grossly improved.</p>
Addresses	<ul style="list-style-type: none"> - The Substation supervisor assured the all stakeholders of proper collaboration with relevant agencies of government (Road safety, Police etc) and the community to achieve the objective of the proposed project. He assured that the consultations will be continues through-out the life span of the project and substation. - The consultant (one of the consultants) thanked all the participants saying that this kind of consultation is continuous and he is happy that everyone recognized the fact we are all part of the project.
Closing	<ul style="list-style-type: none"> - Attendance sheets were passed round for stakeholders to sign. The meeting came to a close with prayer by the community member

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR THE REHABILITATION/REINFORCEMENT OF 132/33KV TRANSMISSION SUB-STATION AT ~~WARRIOR~~ ^{Gasau} ~~REPUBLIC~~ ^{SAMUELA} STATE
DATE: AUGUST 13-14, 2015

S/N	NAME	ORGANISATION/AGENCY/COMMUNITY	CONTACT NO	SIGNATURE
1	Abdymir wal	EcoCon Serv (C.N. Firm) / Mombasa	08057203989	<i>[Signature]</i>
2	A. Abdulbasit	Gasau TS.	08051641988	<i>[Signature]</i>
3	Seni Alhassan	Gasau T/S	07035604445	<i>[Signature]</i>
4	S. BATURE	✓	08036007014	<i>[Signature]</i>
5	Engo. M.H. Alhena	✓	08065525647	<i>[Signature]</i>
6	M. A. SILEGARI	✓	08033220897	<i>[Signature]</i>
7	Sami Shehu	✓	07026376271	<i>[Signature]</i>
8	ALY ULLIYASU	✓	08106965806	<i>[Signature]</i>
9	Bello Mohamed	✓	07084638084	<i>[Signature]</i>
10	Samba Lamin	✓	08031830241	<i>[Signature]</i>
11	Abraham Bulmond	Gasau T/S	08069722491	<i>[Signature]</i>
12	Amily ABU	Gasau T/S	08067577520	<i>[Signature]</i>
13	SALAH O. SMAR	Gasau T/S	08020892682	<i>[Signature]</i>
14	Amuly Mohamed	✓	07063024254	<i>[Signature]</i>
15	Usman Haissan	Ma' Angwa Samaru / Gasau	—	<i>[Signature]</i>
16	Alayu Shehu	Samaru Community	07064032411	<i>[Signature]</i>
17	Bello Sami	" "	—	<i>[Signature]</i>
18	Dr. Chis Anyon	Eco Conserve	08064651599	<i>[Signature]</i>
19	Rabi Mohamed	Community	—	<i>[Signature]</i>

Figure 6 Attendance list 1: Gasau Consultation

Appendix D
Certified Laboratory analysis



FEDERAL MINISTRY OF ENVIRONMENT
Environment House

Independence Way South, Central Business District, Abuja - FCT.
Tel: 09-2911 337 . www.environment.gov.ng, ea-environment.org

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMEEnv/EA/LTS/29/vol.1/36

13th July 2012

The Honourable Commissioner,
Akwa Ibom State Ministry of Science and Technology,
No. 84 Obio Imo Street,
Uyo,
Akwa Ibom State.

ACCREDITATION OF ENVIRONMENTAL LABORATORY

Please refer to your letter reference No. MST/S/31/Vol1/114 dated 15th May, 2012 on the above subject.

2. I am directed to inform you that following the successful completion of the laboratory inspection exercise, the accreditation of your Environmental Laboratory has been **approved**.
3. Your certificate will soon be ready and it is valid for a period of five (5) years.
4. Thank you for your cooperation.

K. B. Odusanya
For: Honourable Minister.

MINISTRY OF PETROLEUM RESOURCES

DEPARTMENT OF PETROLEUM RESOURCES

7 KOFO ABAYOMI STREET, VICTORIA ISLAND, LAGOS

P.M.B. No: 12650

Telephone: 01-279000

Website: www.dprmigeria.com



Ref. No: DPR/LAB/7318/Vol.12/11

Date: 13th December, 2012

The Managing Director
Ministry of Science & Technology Research & Development Laboratory
84 Obio Imo Street
Uyo
Akwa Ibom State

Dear Sir,

Accreditation of Your Laboratory for Environmental Quality Monitoring

Following the inspection and assessment of your laboratory by an officer of this Department on 23rd of September 2012, it was observed that your laboratory has adequate equipment and facilities for the services described above.

2. Consequently, DPR hereby grants your facility an accreditation status. This accreditation would afford you the opportunity to render services to the oil and gas industry in the area of *Environmental Quality Monitoring*.

3. This accreditation is subject to periodic review as may be determined by the Director of Petroleum Resources. Please note that this accreditation is not a permit, therefore you are advised to fulfill all necessary obligations and obtain a permit from the Department for the operation of your facility.

Yours faithfully,

Uto Ihekweumere

For: Director of Petroleum Resources

FEDERAL MINISTRY OF ENVIRONMENT

ACCREDITATION TO OPERATE AS ENVIRONMENTAL CONSULTANT



A registration number is assigned to this document. The registration number is: **002220**
 The registration number is valid until: **31/03/2010**

The Government of Canada, through the Department of the Environment, is pleased to announce the results of the accreditation process for Environmental Consultant pursuant to the Registration and Accreditation of Environmental Consultants Act (R.A.E.C.). The accreditation process is a voluntary process that allows Environmental Consultants to demonstrate their competence and reliability to the public and to the Government of Canada.

1. Name of the Applicant: **ECOSERV CONSULTANTS INC.**

2. Location of the Applicant: **1000 BOULEVARD DE LA GUERRE, SUITE 100, OTTAWA, ONTARIO K1P 6K7**

3. Date of Issuance: **17/03/2009**

4. Validity Period: **17/03/2009 to 31/03/2010**

5. Issued by: **THE REGISTRAR OF ENVIRONMENTAL CONSULTANTS**

6. Signature: **[Signature]**

7. Title: **REGISTRAR OF ENVIRONMENTAL CONSULTANTS**

8. Name of the Registrar: **THE REGISTRAR OF ENVIRONMENTAL CONSULTANTS**

9. Name of the Minister: **THE MINISTER OF THE ENVIRONMENT**

10. Name of the Secretary: **THE SECRETARY OF THE ENVIRONMENT**

11. Name of the Deputy Secretary: **THE DEPUTY SECRETARY OF THE ENVIRONMENT**

12. Name of the Assistant Secretary: **THE ASSISTANT SECRETARY OF THE ENVIRONMENT**

13. Name of the Director: **THE DIRECTOR OF ENVIRONMENTAL CONSULTANTS**

14. Name of the Deputy Director: **THE DEPUTY DIRECTOR OF ENVIRONMENTAL CONSULTANTS**

15. Name of the Assistant Director: **THE ASSISTANT DIRECTOR OF ENVIRONMENTAL CONSULTANTS**

16. Name of the Registrar: **THE REGISTRAR OF ENVIRONMENTAL CONSULTANTS**

17. Name of the Registrar: **THE REGISTRAR OF ENVIRONMENTAL CONSULTANTS**

18. Name of the Registrar: **THE REGISTRAR OF ENVIRONMENTAL CONSULTANTS**

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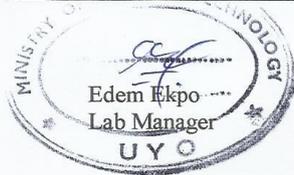
Ministry of Science and Technology
No. 84 Obio Imo Street,
Uyo, Akwa Ibom State

SAMPLE IDENTIFICATION INFORMATION

Client Name .	Metaspec Consult	Sample code	ESMP/SAG/S//9/15
Name of sampler	Metaspec	Location / Field of Sample	Sagamu
Date Sampled	05/08/15	Sampling Point	various
Sample Description	Soil/Ground Water	Sampling Condition	Atmospheric
Sampling Procedure	Standard	Preservation Method used by Sampler	Ice
Estimated Quantity of Sample	1 kg each sample	Type of Sample Container	Plastic bag
Date Received in Lab	05/09/15	No of samples	Five(5)
Preservation Method for Storage	Refrigeration	Date Assigned	07/09/15
Date Analyzed	07/09/15 – 18/09/15	Other Remarks	
Date Reported	21/09/15		

SAGAMU SOIL RESULTS (Sampling Date = 5th August 2015)

	AQ1 Control room area	AQ2 Transforme r area	AQ3 Extension area	AQ4 Gate area	AQ5 Community
pH	5.98	5.85	6.20	6.10	6.60
THC, mg/kg	<0.01	5,450	0.50	<0.01	4.50
PCB, µg/g	<0.01	65.0	<0.01	<0.01	<0.01



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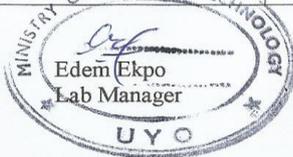
Ministry of Science and Technology
No. 84 Obio Imo Street,
Uyo, Akwa Ibom State

SAMPLE IDENTIFICATION INFORMATION

Client Name .	Metaspec Consult	Sample code	ESMP/SAG/GW/9/15
Name of sampler	Metaspec	Location / Field of Sample	Sagamu
Date Sampled	05/08/15	Sampling Point	various
Sample Description	Soil/Ground Water	Sampling Condition	Atmospheric
Sampling Procedure	Standard	Preservation Method used by Sampler	Ice/Acid
Estimated Quantity of Sample	1 Litre/ sample	Type of Sample Container	Plastic bottles, Amber /glass bottles
Date Received in Lab	05/09/15	No of samples	Two (2)
Preservation Method for Storage	Refrigeration	Date Assigned	07/09/15
Date Analyzed	07/09/15 – 18/09/15	Other Remarks	
Date Reported	21/09/15		

GROUNDWATER QUALITY RESULT

PARAMETER	Open dug well	Borehole
pH	7.21	6.84
Temperature, °C	27.2	29.1
TDS, mg/l	14.5	18.6
Conductivity, µs/cm	27.0	34.0
DO, mg/l	2.40	2.20
Alkalinity (mg/l)	0.001	<0.0001
Hardness (mg/l)	17.0	24.0
Turbidity (mg/l)	2.83	2.83
Salinity as Cl ⁻ (mg/l)	17.75	17.75
TSS (mg/l)	0.004	0.002
Cd (mg/l)	0.26	0.37
Pb (mg/l)	0.211	0.205
Hg (mg/l)	<0.001	<0.001
Fe (mg/l)	0.725	1.09
Cr (mg/l)	0.08	0.056
Zn (mg/l)	2.31	3.24
PCB (µg/l)	<0.001	<0.001



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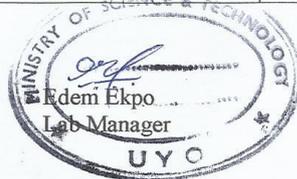
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No. 84 Obio Imo Street,
Uyo, Akwa Ibom State

SAMPLE IDENTIFICATION INFORMATION

Client Name .	Metaspec Consult	Sample code	ESMP/NIBO/GW/9/15
Name of sampler	Metaspec	Location / Field of Sample	Nibo
Date Sampled	10/08/15	Sampling Point	various
Sample Description	Ground water	Sampling Condition	Atmospheric
Sampling Procedure	Standard	Preservation Method used by Sampler	Ice/Acid
Estimated Quantity of Sample	1 Litre/sample	Type of Sample Container	plastic bottles, amber and glass bottles
Date Received in Lab	05/09/15	No of samples	Two (2)
Preservation Method for Storage	Refrigeration	Date Assigned	07/09/15
Date Analyzed	07/09/15 – 18/09/15	Other Remarks	
Date Reported	21/09/15		

GROUNDWATER

PARAMETER	Borehole at TownHall	Borehole in Community
pH	6.35	6.14
Temperature, °C	30.3	33.2
TDS, mg/l	36	40
Conductivity, µs/cm	65	78
DO, mg/l	2.42	2.50
Alkalinity (mg/l)	5.0	7.5
Hardness (mg/l)	15	18
Turbidity (mg/l)	4.98	4.63
Salinity as Cl ⁻ (mg/l)	12.0	14.0
TSS (mg/l)	8.0	8.5
Cd (mg/l)	0.33	0.31
Pb (mg/l)	<0.001	<0.001
Hg (mg/l)	<0.001	<0.001
Fe (mg/l)	1.24	0.89
Cr (mg/l)	0.04	0.04
Zn (mg/l)	2.15	2.64



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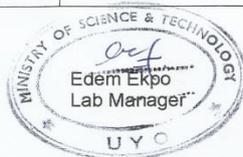
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SAMPLE IDENTIFICATION INFORMATION

Client Name	Metaspec Consult	Sample code	ESMP/YAN/S/9/15
Name of sampler	Metaspec	Location / Field of Sample	Yandev
Date Sampled	13/08/15	Sampling Point	various
Sample Description	Soil	Sampling Condition	Atmospheric
Sampling Procedure	Standard	Preservation Method used by Sampler	Ice
Estimated Quantity of Sample	1 Litre/sample	Type of Sample Container	Plastic bag/ plastic bottles
Date Received in Lab	05/09/15	No of samples	Two (2)
Preservation Method for Storage	Refrigeration	Date Assigned	07/09/15
Date Analyzed	07/09/15 – 18/09/15	Other Remarks	
Date Reported	21/09/15		

YANDEV SOIL RESULT(Sampling Date = 13th August 2015)

	AQ1 Transformer area	AQ2 Road /Gate area	AQ3 Station Quarters	AQ4 Community
pH	5.50	6.45	6.65	
THC, mg/kg	2,125	<0.01	2.50	
PCB, µg/g	4.80	<0.001	<0.001	



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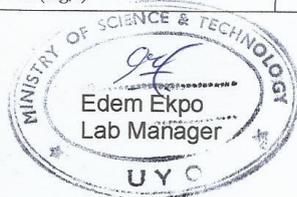
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SAMPLE IDENTIFICATION INFORMATION

Client Name .	Metaspec Consult	Sample code	ESMP/YAN/SW/9/15
Name of sampler	Metaspec	Location / Field of Sample	Yandev
Date Sampled	13/08/15	Sampling Point	various
Sample Description	Surface Water	Sampling Condition	Atmospheric
Sampling Procedure	Standard	Preservation Method used by Sampler	Ice/Acid
Estimated Quantity of Sample	1 Litre/sample	Type of Sample Container	Plastic bag/ plastic bottles/ amber bottles
Date Received in Lab	05/09/15	No of samples	Two (2)
Preservation Method for Storage	Refrigeration	Date Assigned	07/09/15
Date Analyzed	07/09/15 – 18/09/15	Other Remarks	
Date Reported	21/09/15		

GROUNDWATER

PARAMETER	Hand dug well	Water from community
pH	7.79	7.84
Temperature, °C	31.2	32.0
TDS, mg/l	240	200
Conductivity, µs/cm	470	420
DO, mg/l	2.30	1.60
Alkalinity (mg/l)	11.88	13.40
Hardness (mg/l)	120	65
Turbidity (mg/l)	2.29	2.85
Salinity as Cl ⁻ (mg/l)	48.0	56.0
TSS (mg/l)	4.60	8.50
Cd (mg/l)	0.21	0.18
Pb (mg/l)	0.10	0.05
Hg (mg/l)	<0.001	<0.001
Fe (mg/l)	0.85	1.10
Cr (mg/l)	0.12	0.07
Zn (mg/l)	2.48	3.06



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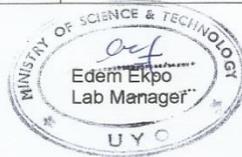
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Name of sampler	Metaspec	Location / Field of Sample	Yandev
Date Sampled	13/08/15	Sampling Point	various
Sample Description	Soil	Sampling Condition	Atmospheric
Sampling Procedure	Standard	Preservation Method used by Sampler	Ice
Estimated Quantity of Sample	1 Litre/sample	Type of Sample Container	Plastic bag/ plastic bottles
Date Received in Lab	05/09/15	No of samples	Two (2)
Preservation Method for Storage	Refrigeration	Date Assigned	07/09/15
Date Analyzed	07/09/15 – 18/09/15	Other Remarks	
Date Reported	21/09/15		

YANDEV SOIL RESULT (Sampling Date = 13th August 2015)

	AQ1 Transformer area	AQ2 Road /Gate area	AQ3 Station Quarters	AQ4 Community
pH	5.50	6.45	6.65	
THC, mg/kg	2,125	<0.01	2.50	
PCB, µg/g	4.80	<0.001	<0.001	



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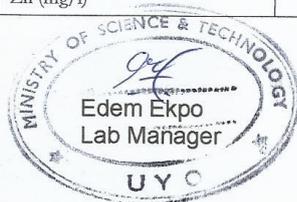
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Sample Description	Surface Water	Sampling Condition	Atmospheric
Sampling Procedure	Standard	Preservation Method used by Sampler	Ice/Acid
Estimated Quantity of Sample	1 Litre/sample	Type of Sample Container	Plastic bag/ plastic bottles/ amber bottles
Date Received in Lab	05/09/15	No of samples	Two (2)
Preservation Method for Storage	Refrigeration	Date Assigned	07/09/15
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Date Reported	21/09/15		

GROUNDWATER

PARAMETER	Hand dug well	Water from community
pH	7.79	7.84
Temperature, °C	31.2	32.0
TDS, mg/l	240	200
Conductivity, µs/cm	470	420
DO, mg/l	2.30	1.60
Alkalinity (mg/l)	11.88	13.40
Hardness (mg/l)	120	65
Turbidity (mg/l)	2.29	2.85
Salinity as Cl (mg/l)	48.0	56.0
TSS (mg/l)	4.60	8.50
Cd (mg/l)	0.21	0.18
Pb (mg/l)	0.10	0.05
Hg (mg/l)	<0.001	<0.001
Fe (mg/l)	0.85	1.10
Cr (mg/l)	0.12	0.07
Zn (mg/l)	2.48	3.06



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