

**GUIDE FOR CONTENT OF A FEASIBILITY STUDY REPORT FOR BIOMASS PROJECTS**

**2014-11-21**

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# PART – I: EXECUTIVE SUMMARY

1. Project Background
2. Project Area
3. Topographical Studies
4. Fuel Supply
5. Design Optimisation
6. Project Optimisation
7. Project Description and Basic Design
8. Operation and Maintenance Requirements
9. Power Evacuation
10. Geo-technical Studies
11. Environmental and Social Impacts and Mitigation
12. Financial and Economic Analyses
13. Construction Planning, Schedule and Costs
14. Project Evaluation & Risk Analysis
15. Conclusion and Recommendations.

The developer must also input the values for the following contents of the salient features of the proposed project as shown in the table below;

|  |
| --- |
| **UNIT/DETAIL** |
| Project Name |  | |
| Location (Village, County Sub county, district , region) |  | |
| Developer (Physical address and contact details including telephone contacts) |  | |
| Position/ project layout including GPS coordinates in accordance to the Ugandan datum and coordinate system (local Uganda datum– ARC1960):   * Power house * Fuel storage * Switch yard * Interconnection arrangement /delivery point |  | |
| Purpose, objective and scope of the project |  | |
|  | | |
| **Data for the Plant** | | |
| Plant for only Power Generation |  | Yes or No |
| Plant for Heat and Power Generation |  | Yes or No |
| Use of Heat for |  | |
| **Fuel** | | |
| Type of Fuel |  | |
| Source of Fuel Supply to Plant |  | Tons/year |
| Means of Fuel Transportation from source to Plant |  | |
| Site storage details |  | |
| **Burning or Gasification** | | |
| Combustion of Biomass |  | Yes or No |
| Anaerobic Digestion of Biomass |  | Yes or No |
| Thermal Gasification of Biomass |  | Yes or No |
| **Power Facilities** | | |
| Power House type |  | |
| Type of Digester |  | |
| Type of Boiler |  | |
| Power Generation Technology |  | |
| Type of Turbine |  | |
| Installed capacity |  | MWe |
| Conversion Factor (From raw material to kWh |  |  |
| **Distribution / Transmission Facilities** | | |
| Transformer type |  | |
| Transformer rating |  | |
| Distribution / Transmission line type |  | |
| Line Voltage |  | kV |
| Line Length |  | km |
| Line capacity |  | MVA |
| Proposed conductor size |  | mm2 |
| Technical Loss factor along the line |  | Percentage and MW |
| **Total Power Production** | | |
| Total Efficient Capacity |  | MW |
| Average Generation during the year |  | MW |
| Mean Annual Power Production during Peak Periods |  | GWh |
| Mean Annual Power Production during Shoulder Periods |  | GWh |
| Mean Annual Power Production during Off-Peak Periods |  | GWh |
| Mean Annual Total Power Production |  | GWh |
| Capacity Factor |  | % |
| Plant Factor  *(The ratio of the average power load of the plant to its rated capacity)* |  | % |
| Coefficient of Utilisation Efficiency |  | % |
| **Power Production delivered to the Grid** | | |
| Total Efficient Capacity |  | MW |
| Mean Annual Power Production during Peak Periods |  | GWh |
| Mean Annual Power Production during Shoulder Periods |  | GWh |
| Mean Annual Power Production during Off-Peak Periods |  | GWh |
| Mean Annual Total Power Production |  | GWh |
| **Power Production for Own Use** | | |
| Total Efficient Capacity |  | MW |
| Mean Annual Power Production during Peak Periods |  | GWh |
| Mean Annual Power Production during Shoulder Periods |  | GWh |
| Mean Annual Power Production during Off-Peak Periods |  | GWh |
| Mean Annual Total Power Production |  | GWh |
| Average Generation for own use |  | MW |
| **Total Heat Production** | | |
| Total Annual Heat Production |  | GWh |
| **Economics and Financials** | | |
| Investment Costs (CAPEX) based on detailed underlying assumptions |  | 1,000 USD |
| Annual Operational costs (OPEX) based on detailed underlying assumptions |  | 1,000 USD/year |
| Annual Revenue from Operation |  | 1,000 USD/year |
| Net Present Value (NPV) |  | 1,000 USD |
| Internal Rate of Return (IRR) |  | % |
| Pay-Back Period (PBP) |  | Years |
| **Environmental and Social Indicators** | | | |
| Distance to nearest residential zone |  | m | |
| Distance to nearest protected area |  | km (or “inside”) | |
| Access roads through protected areas |  | km total | |
| Number of biomass suppliers |  | Number | |
| Own land for biomass production |  | ha | |
| Land area with agreements in place for biomass production |  | ha | |
| Labour requirement for construction |  | Average number | |
| Personnel requirement for operations |  | Number of persons | |
| Land acquisition required |  | m2 | |
| Required resettlement |  | Number of persons | |
| Compensation for land access/use |  | Number of persons | |

# ATTACHMENTS

1. Location Map
2. Project Area map
3. Drawing Showing General Arrangement of Project
4. Provisional Bill of Quantities

# PART II- MAIN REPORT

# INTRODUCTION

* 1. Authorization & Background
     1. National (Uganda) EIA Certificate for EIA implementer
     2. Feasibility Study Certificate for Feasibility Study implementer
     3. Type of business for Applicant/s
  2. Project Objective
     1. Project Description
     2. Plant Capacity

*Power capacity and yearly production*

* + 1. Minimum operation
    2. Fuel supply

*Type of fuel*

*Fuel mix, if different types of Biomass are used the mixture should be indicated e.g. Cotton stalk 40% rice husk 60%*

*Supply per day and per year*

* + 1. Finance and economic criteria
  1. Feasibility Study Objective
  2. Structure of the Feasibility Study

# DESCRIPTION OF PROJECT AREA

* 1. Project location with coordinates and relevant site maps.
     1. General (Village, sub county, county and district)
     2. [[1]](#footnote-1)Road Accessibility to the main civil structures:
  2. Physical & Salient features of the project site
  3. Water supply

*Process water and cooling water*

* 1. Load profile and electricity demand
  2. Demographic and Socio-economic parameters

# TOPOGRAPHICAL SURVEYS

* 1. Topographical survey of the project site
     1. Introduction
     2. Topographical Description and Maps
     3. Strip survey of access road
  2. Bathymetric survey, if applicable

# Fuel Supply

*Alternative fuels including their availability, including the various sources, sustainability, number of collection points, distance from the plant, means of transportation to the plant and the characteristics of them should be studiedand documented in the report.*

* 1. Availability of Fuel

*Type/s of fuel*

*Fuel available within the plant area (e.g. wood waste, bagasse, rice husk)*

*Fuel from external suppliers*

*Number of collection points and their distance from the plant*

*Fuel requirements*

* 1. Fuel Supply
     1. Fuel Supplier/s
     2. Volumes of Fuel available with their respective sustainability
     3. Sustainability of Fuel Supply

*Continuity of fuel supply (sustainability indicating each source/ owner)*

*If applicable sustainable forestry, e.g. replantation of trees*

* + 1. Cost of Fuel
    2. Transportation, handling and storage
    3. Management of Ashes
    4. Alternative Use of the Fuel
  1. Fuel Design Specification
     1. Characteristics / Specifications
     2. Operational Experience
     3. Laboratory analyses

*Incl. ash analysis*

* + 1. Calculations of energy potential
    2. Emissions and their respective mitigation to comply with NEMA standards
    3. Recommendations

# Design OPTIMISATION

*Alternative technical solutions should be studied*

* 1. Overall System

*Only power generation or heat and power (Co-generation)*

*Alternatives with burning of Biomass or generation of Biogas*

* 1. Alternative with burning of biomass
     1. Fuel reception, storage and preparation
     2. Boiler

*Options*

*Combustion process*

*Fuel feeding*

*Air feeding*

*Steam generation*

*Ash handling*

* + 1. Risks for Landslides

*For Power house*

* 1. Alternative with generation of biogas
     1. Fuel reception, storage and preparation

*Silage preparation*

*Storage*

*Water*

* + 1. Digester

*Digester*

*Gas cleaning / Desulphurisation*

*Safety system*

*Residue handling and usage (sludge, fibre, wastewater)*

* + 1. Gas cooling and condensation
    2. Gas storage
  1. Alternative Power Generation Technologies
     1. Steam Turbine

*Steam Turbine Market and Steam Data*

*Design Limitations*

*Proposed Steam Data*

*Configuration and Data for Different Alternatives*

* + 1. Gas Turbine
    2. Combined Cycle
    3. Internal Combustion Engine

*E.g. diesel engine*

* + 1. Other Technologies

*E.g. ORC (Organic Rankine Cycle)*

* 1. Flue Gas Condenser
     1. Description
     2. Evaluation
  2. Design Cases

# PROJECT OPTIMISATION

*Alternative layouts and sizes should be studied and presented*

* 1. Project Layout and Sizing
     1. Description of Possible Alternative Layouts and Sizing for project
     2. Project Sizing

*Parameters used for Optimization*

* + 1. Estimation of Power and Energy Production

1. *Plant capacity*
2. *Plant factor*
3. *Annual energy*
   * 1. Cost Estimates for each alternative
     2. Economic and Financial Analysis
   1. Pre-selection of optimum/ recommended layout and sizing
   2. Presentation of Recommended Project Layout

*Including the Physical integration, accessibility and Scheme Layout and recommendation of Full Supply Level and Installed Capacity*

# PROJECT DESCRIPTION AND BASIC DESIGN

*Basic design for the recommended layout and size for the project*

* 1. Power Generation Scheme
  2. Main System Blocks and Terminal Points
  3. Fuel System
     1. Scope of Supply
     2. Fuel Handling and Treatment
     3. Storage
     4. Comparison of Fuel Handling Principles
     5. Specification of Fuel/s and Fuel Characteristics

*Impact on Boiler or on Biogas Generator (Digester)*

* + 1. Plant Design
  1. Fuel Feed
  2. Boiler or Digester
  3. Handling and Treatment of Residues and Waste

*E.g. ash or digestate*

* 1. Flue Gas Treatment
  2. Turbine System

*Description*

*Make-up Water Supply and specifications*

*Civil Construction and Buildings*

*Scope of Supply*

*Description*

*Equipment Weights*

*Stack Elevation*

* 1. Automation / Control system
  2. Generating Equipment
     1. General principles of equipment design
     2. Plant electrical system details
     3. Electro-mechanical Equipment

*Specifications of electro-mechanical equipment e.g. generators, etc.*

* + 1. Civil Structures
    2. Electrical and Control Equipment
       1. Single Line Diagrams

*Outline of diagrams*

* + - 1. Switchyard equipment

*Transformers*

*Retaining wall*

*Oil spillage*

*Gantry*

*Metering*

* + - 1. Protection systems

*Electrical protection*

*Earthing and lightning protection*

7.10.6 Fire Safety

*Fire detection system*

*Fire fighting systems*

* 1. Bill of Quantities

*A Provisional Bill of Quantities for all main items shall be included in an Attachment.*

*The table shall include quantities and approximate unit prices for the items.*

*The calculated total cost for the plant shall be used in the Financial Model and in the Business Plan*

# Operation and Maintenance requirementS

* 1. Operation requirements
  2. Maintenance requirements

# Distribution / Transmission Line and Connection to the Grid

* 1. General principles of equipment design
  2. Surveying and Line Routing
  3. Power system studies

1. *Voltage level*
2. *Loading in area*
3. *Interconnection point*
4. *Load flow analysis*
5. *Technical solution*
   1. Cost of distribution / transmission line including a deailed cost benefit anaysis
   2. Contacts and agreements with authorities, UETCL and distribution line operator

# GEO-TECHNICAL STUDIES

* 1. Regional Geology
  2. Site Characterization and Geological Studies for project Area
     1. Geology and geomorphology for Power house
     2. Geological Mapping
  3. Seismological studies
     1. Seismic studies and hazard analysis
     2. Construction materials survey and testing;

1. *Course aggregate*
2. *Sand*
3. *Impervious material*

# [[2]](#footnote-2)SUMMARY OF ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT (ESIA)

* 1. Introduction
  2. Identification of Project Area of Influence
  3. Policy, Legal and Institutional Framework
  4. Methodology used for Baseline Studies
  5. ESIA Summary
     1. Environmental Impacts

*During construction and operations*

* + - 1. Protected areas and areas of high biodiversity value outside protected areas
      2. Biodiversity in project area
      3. Pollution prevention

Including noise, waste, wastewater and air emissions

* + 1. Social Impacts

*During construction and operations*

* + - 1. Occupational health and safety, and working conditions
      2. Community health and safety

*Including emergency planning, traffic safety*

* + - 1. Land acquisition and resettlement needed, access to land

*Livelihood impacts on people, e.g. on people that traditionally used areas for gather firewood*

* + - 1. Cultural heritage impacts
      2. Indigenous people group impacts
    1. Assessment of significance of environmental and social impacts
    2. Environmental and Social Mitigation Measures to be put in place
    3. Environmental and Social Management Plan for implementation of mitigation measures
  1. Resettlement Action Plan Summary

# FINANCIAL AND ECONOMIC ANALYSIS

* 1. Objective and Criteria
  2. Estimating Methodology & Assumptions
  3. Project Costs and Benefits
     1. CAPEX: Capital Costs including clear underlying assumptions
        1. Land Acquisition, Access Road, Camp and Construction Power Facilities
        2. Civil Works
        3. Electrical and Mechanical Equipment
        4. Transformers and Switchyard
        5. Distribution / Transmission Lines
        6. Physical Contingencies
        7. Resettlement and Compensation Costs
        8. Environment Impact Mitigation Cost
        9. Engineering, Management and Administration Cost
     2. OPEX: Operation and Maintenance Costs
     3. Revenue
        1. Revenue from sale of electricity
        2. Other revenues
  4. Financial Analysis
     1. Methodology
     2. Financing of investments
     3. Parameters and Assumptions
     4. Results
     5. Sensitivity Analysis

*(Interest rate, inflation, CAPEX, OPEX, time delays, fuel supply)*

* 1. Economic Analysis
     1. Methodology
     2. Parameters and Assumptions
     3. Results
     4. Sensitivity Analysis

*(Interest rate, inflation, CAPEX, OPEX, time delays, fuel supply)*

* 1. Summary and Conclusion

# Construction Planning and Project Implementation

* 1. Procurement Planning

*Description of how the construction of the plant will be procured*

* 1. Preliminary Works and Infrastructure
  2. Detailed Project Implementation Schedule Plan / Gantt Chart
  3. Milestones and Risk Assessment of Construction Planning
  4. Project Organisation

# PROJECT RISK ASSESSMENT AND MITIGATION

* 1. Project Appraisal risks
  2. Design and contractual risks
  3. Manufacturing and construction risks
  4. Environmental and social risks
  5. Transmission availability risk
  6. Institutional approval risk
  7. Political and other risk
  8. Financial risks
  9. Fuel supply risks

# CONCLUSIONS AND RECOMMENDATIONS

* 1. Conclusions
  2. Recommendations

# PART –III: ANNEXES & DRAWINGS

**List of Annexes**

**List of Drawings**

1. Alternative routes to the site should be studied and documented both qualitatively and quantitatively clearly indicating how the best option has been arrived at. The developer should attach maps and relevant diagrams showing the various route alternatives as well as provide satisfactory reasons for making the final choice. The GPS coordinates of the alternative routes should be based on the Ugandan Datum ARC 1960 [↑](#footnote-ref-1)
2. The ESIA report should be submitted to NEMA for approval. [↑](#footnote-ref-2)