

**GUIDE FOR CONTENT OF A FEASIBILITY STUDY REPORT FOR HYDROPOWER PROJECTS OF CAPACITY LESS THAN 20 MW**

**2014-11-21**

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**PART – I: EXECUTIVE SUMMARY**

1. Project Background
2. Project Area
3. Topographical Studies
4. Hydrological and sedimentation studies
5. Geo-technical Studies
6. Environmental and Social Impacts and Mitigation
7. Project Layout
8. Optimization
9. Description of Project
10. Financial and Economic Analyses
11. Construction Planning, Schedule and Costs
12. Project Evaluation & Risk Analysis
13. 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/s ( 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):* Intake
* Forebay
* Surge Tank
* Power house
* Switch Yard
* Interconnection arrangement /delivery point
 |  |
| Purpose, objective and scope of the project |  |
|  |
| **Hydrological Features at the Weir site** |
| Catchment Area |  | km2 |
| Mean Annual Flow |  | m3/s |
| Normal Average Flow – Wet season |  | m3/s |
| Normal Average Flow – Dry season |  | m3/s |
| Design Flow |  | m3/s |
| Flow (1,000y flood event) |  | m3/s |
| Flow (100y flood event) |  | m3/s |
| **Reservoir** |
| Reservoir |  | Yes or No |
| Normal Water Level (NWL) |  | mAD |
| Minimum Operating Level |  | mAD |
| Surface area at NWL |  | m2 |
| Live Storage Volume |  | m3 |
| Dead Storage Volume |  | m3 |
| Water retention time |  | No. of days |
| Length of river impounded  |  | km  |
| Number of downstream tributaries |  | No. |
| Useful reservoir life |  | years |
| **Present Use of Water** |
| Water used for irrigation |  | m3/s |
| Water used for drinking purposes |  | m3/s |
| Water used for other settlement/industry purposes ( please specify activities) |  | m3/s |
| **Dam/Weir** |
| Weir Construction |  |
| Type |  |
| Slope |  | m/m |
| Crest elevation |  | m |
| Crest length |  | m |
| Maximum height |  | m |
| Volume |  | m3 |
| **Diversion facilities ( please specify)** |
| Length |  | m |
| Diameter/cross-section |  | m |
| Diversion flow |  | m3/s |
| **Spill way** |
| Type |  |
| Crest Elevation |  | m |
| Maximum flood level |  | mAD |
| Width |  | m |
| Discharge |  | m3/s |
| **Water Conveyance system** |
| Length |  | m |
| Discharge |  | m3/s |
| **Fore-bay/Surge tank**  |
| Design water level |  | mAD |
| Static water level |  | mAD |
| **Penstock** |
| Penstock construction |  |
| Total length |  | m |
| Horizontal length |  | m |
| Diameter |  | m |
| **Power facilities** |
| Power House type |  |
| Type of turbine |  |
| Gross head surge bay-power house |  | m |
| Design discharge |  | m3/s |
| Length of tailrace channel |  | m |
| Installed capacity |  | MW |
| **Distribution / Transmission facilities** |
| Transformer type |  |
| Transformer rating |  |
| Transmission line type |  |
| Line voltage |  | kV |
| Line length |  | km |
| Line capacity  |  | MVA |
| Proposed conductor size |  | mm2 |
| Proposed conductor material |  |  |
| Technical Loss factor along the line |  | Percentage  |
| **Power Production** |
| Total Efficient Capacity |  | MW |
| Average generation during wet season |  | MW |
| Average generation during dry season |  | 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)* |  | % |
| Average Generation for own use |  | MW  |
| Annual Power Production for own use |  | 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 |
| Labour requirement for construction  |  | Average number |
| Labour camp accommodation needed |  | Number of persons |
| Personnel requirement for operations |  | Number of persons |
| Environmental Flow  |  | m3/s |
| Fish species diversity |  | No. of fish species |
| Land acquisition required |  | m2 |
| Required resettlement |  | Number of persons |
| Compensation for land access/use |  | Number of persons |
| Cultural heritage sites within project affected area |  | Number of sites |

**ATTACHMENTS**

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

**PART II- MAIN REPORT**

1. **INTRODUCTION**
	1. Authorization & Background
		1. National (Uganda) EIA Certificate for EIA implementer
		2. Feasibility Study Certificate for Feasibility Study implementer
	2. Project Objective
	3. Feasibility Study Objective
	4. Structure of the Feasibility Study
2. **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
3. *Intake/Weir/Dam*
4. *Forebay*
5. *Surge Tank*
6. *Power House*
	1. Physical & Salient features of the project site

*(rivers, escarpments, aqueducts, etc.)*

* 1. Load profile and electricity demand
	2. Demographic and Socio-economic parameters
	3. Interaction with other hydropower plants on the river system

*(existing, planned, under construction)*

* 1. Interaction with other administrative areas supplied from the catchment area
1. **TOPOGRAPHICAL SURVEYS**
	1. [[2]](#footnote-2)Topographical survey of the entire project area
		1. Introduction
		2. Topographical Description/Maps

*Project layout superimposed on the maps from the Ministry of lands in Uganda using the GPS coordinated in the Ugandan Datum ARC 1960.*

* + 1. Strip survey of access road, water conveyance systems
		2. Estimation of inundated land area (if any)
	1. Field work survey and topographic measurements

*For dam and reservoir sites*

* + 1. Introduction
		2. Topographical maps of the dam and reservoir sites
		3. Indication of the location of the dam and reservoir sites
	1. Bathymetric survey
	2. Survey of additional recommended areas
1. **[[3]](#footnote-3)HYDROLOGICAL AND SEDIMENTATION STUDIES**
	1. Hydrological Studies
		1. Catchment characteristics
		2. Rainfall, climate and precipitation data analysis

*(Min. twelve months duration)*

* + 1. Reference hydrology and stream flow data i.e.

*Sources of data should be indicated*

* + 1. Evaluation of obtained river flow data and gauged data

*(Min. one year duration)*

* + 1. Rating curves
		2. Ecological Flow studies and Flow Duration curve
		3. Water/ Flow Availability
		4. Flood Hydrology studies & design flood estimation

*Hydrological optimization showing clearly the Flood Hydrology studies & design flood estimation and how you arrived at the recommended design flow.*

* + 1. Water quality analysis to determine the corrosive effectiveness
	1. Sedimentation studies
		1. Sources of sedimentation
		2. Analysis of sediment samples , data and sedimentation management plan
		3. Sediment transport
		4. Estimate sediment yield
		5. Daily sediment load
		6. Annual sediment load
		7. Mitigation of sediments
1. **GEO-TECHNICAL STUDIES**
	1. Regional Geology
	2. Site Characterization and Geological Studies for project Area
		1. Geology and geomorphology

*For Reservoir, Water way, Penstock, Power house, Potential Quarry sites*

* + 1. Geological Mapping
		2. Risks for Landslides

*For Reservoir, Water way, Penstock, Power house*

* 1. Geo-technical Field investigations
		1. Exploratory Core drilling program & findings
		2. Depth of Ground Water in Boreholes
		3. Test Pits
		4. Laboratory Testing
		5. [[4]](#footnote-4)Report on the analysis of collected samples
	2. Seismological studies
		1. Seismic studies and hazard analysis
		2. Construction materials survey and testing;
1. *Course aggregate*
2. *Sand*
3. *Impervious material*
	1. Material survey and testing for borrow areas and quarry sites
4. **[[5]](#footnote-5)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, operations and decommissioning*

* + - 1. Protected areas and areas of high biodiversity value outside protected areas
			2. Biodiversity in project area
			3. Pollution prevention, including noise, waste, wastewater
		1. Social Impacts

*During construction, operations and decommissioning*

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

*Including emergency planning, traffic safety, drinking water security*

* + - 1. Land acquisition and resettlement needed, access to land
			2. Cultural heritage impacts
			3. 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
1. **PROJECT OPTIMIZATION**

*Alternative layouts and sizes should be studied and presented*

* 1. Project Layout and Sizing
		1. Description of Possible Alternative Layouts for project
		2. Project Sizing and Estimation of Power and Energy Production for alternatives of plant capacity

*Parameters used for Optimization including Hydrological 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 Analysis
		3. Comparison of Alternative layouts
		4. Recommended Project Layout and Size

*Presentation of Recommended Project Layout including the Physical integration, accessibility and Scheme Layout*

*Selection of optimum size*

*Recommendation of Full Supply Level and Installed Capacity*

1. **PROJECT DESCRIPTION AND BASIC DESIGN**

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

* 1. Design standards
	2. Civil Engineering Design
		1. River diversion
		2. Head works (intake, weir, dam, etc.)
		3. Water Conveyance (headrace canal, penstock and surge tank)
		4. Power House Complex
	3. Generating Equipment
		1. Electro-mechanical Equipment

 *Electro-mechanical equipment e.g. turbines, generators, etc.*

* + 1. Hydraulic Controls and civil Structures
			1. *Gates*
			2. *Valves*
		2. Electrical and control Equipment
			1. Single Line Diagrams

*Outline of diagrams*

* + - 1. Switch yard equipment
1. *Transformers*
2. *Retaining wall*
3. *Oil spillage*
4. *Gantry*
5. *Metering*
	* + 1. Protection systems

*Electrical protection*

*Earthing and lightning protection*

* + 1. 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*

1. **Distribution / Transmission Line and connection to the Grid**
	1. Surveying and Line Routing
	2. Power system studies
2. *Voltage level*
3. *Loading in area*
4. *Interconnection point*
5. *Load flow analysis*
6. *Technical solution*
	1. Cost of distribution / transmission line
	2. Contacts and agreements with authorities, UETCL and distribution line operator
7. **OPERATION AND MAINTENANCE REQUIREMENTS**
	1. Operation Requirements
	2. Maintenance Requirements
8. **FINANCIAL AND ECONOMIC ANALYSIS**
	1. Objective and Criteria
	2. Estimating Methodology & Assumptions
	3. Project Costs and Benefits
		1. CAPEX: Capital Cost
			1. Land Acquisition, Access Road, Camp and Construction Power Facilities
			2. Civil Works
			3. Electrical and Mechanical Equipment
			4. Transformers, Switchyard
			5. Distribution Line(s)
			6. Physical Contingencies
			7. Resettlement and Compensation Cost
			8. Environment Impact Mitigation Costs
			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, water flow)*

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

*(Interest rate, inflation, CAPEX, OPEX, time delays, water flow)*

* 1. Summary and Conclusion
1. **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
1. **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 risk
2. **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. Surveying

The developer should conduct a strip survey of access road alignment with 5m contour interval to produce map in 1:5000 scale, with fixing GPS coordinates for bench marks in an interval of 500 m and at major crossing drainage locations

Surveys to cover additional areas if prefeasibility study has recommended for need of such surveys should be carried out.

	1. The equipment used and the methodology for carrying out the surveys should be properly documented. [↑](#footnote-ref-2)
3. Including, but not limited to description of

i. How the hydrological and sediment studies have been carried out.

ii. Data collection period(s).

Studies have to be based on at least one full year of data collection/measuring and monitoring. [↑](#footnote-ref-3)
4. The sedimentation analysis report should indicate the viability of the soil and rock samples for dam construction [↑](#footnote-ref-4)
5. The ESIA report should be submitted to NEMA for approval. [↑](#footnote-ref-5)