West Africa Power Pool (WAPP)

Terms of Reference
for
Recruitment of Panels of Experts for Dams & Hydropower Projects

Système d'Echanges d'Energie Electrique Ouest Africain (EEEOA)

Termes de référence pour le recrutement de panels d'experts pour les projets de barrages et d'aménagements hydro-électriques

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1. Presentation of WAPP

The West African Power Pool (WAPP) Organization was established by the highest decision making body of ECOWAS, the Authority of Heads of State and Government of Member States, as a mechanism and institutional framework for integrating the national power systems of ECOWAS member countries and help meet the energy needs of the ECOWAS citizenry by providing least cost reliable and sustainable electricity supply for economic development. The Implementation Strategy of WAPP is based on realizing complementary and mutually reinforcing infrastructure sub-programs that encompass various regional generation and transmission projects, which when implemented, would result in a fully integrated grid in West Africa. The WAPP Infrastructure Programme is derived from the ECOWAS Master Plan for the Generation and Transmission of Electrical Energy that was developed in 1999, revised in 2005, and its updated version was approved for implementation by the Authority of the ECOWAS Heads of State and Government in February 2012.

The outcomes of the approved Master Plan involve the development of, among others, about 16,000 km of transmission lines, 7,092 MW of Hydropower, and 800 MW of Renewable Energy projects for the period 2012 to 2025. The implementation of these projects shall not only result in a complete integration of all the national power systems of ECOWAS Member States thereby promoting trade, but shall also significantly augment the quantity, quality and access to low cost clean energy resources, which in turn shall support poverty reduction and improve the economic well-being of the ECOWAS citizenry.

It is therefore evident that the successful attainment of a fully functional power pool in West Africa that would permit the trading of electricity and the efficient delivery of power from energy-rich countries to energy-deficient countries is contingent on the timely preparation and realization of the key projects that would interconnect the national utilities of the Member States of ECOWAS. As such, the WAPP Secretariat has placed great emphasis on proficient project development, management and delivery with particular prominence on the timely preparation and implementation of projects.

2. WAPP Integration and Technical Assistance Project – Parent Project & Additional Financing

In support to the WAPP Secretariat's program to establish an interconnected and coordinated network for fourteen countries in West Africa, the World Bank, Under the Component 2 of the Côte d'Ivoire–Liberia–Sierra Leone–Guinea (CLSG) Interconnection Project, provided an IDA grant in May 2012 (Parent project) in order to mobilize Technical Assistance aiming at (i) enhanced WAPP integration, (ii) synchronization of WAPP transmission networks and (iii) capacity building of the WAPP. The World Bank also provided in December 2017 an additional IDA grant to the Parent Project to scale up the impact of the WAPP Integration and Technical Assistance Project and among other, finance preparatory studies for possible hydropower development in Liberia to produce cost-effective electricity that could be exported using the CLSG transmission line and to

provide technical assistance to the CLSG countries as needed to support efficient energy trade through the CLSG interconnection.

Component 2A of this WAPP Integration and Technical Assistance Project (*Supply Alternatives Studies & Project Preparation Support*) aims at ensuring that generation capacity will be developed along the CLSG line in a timely and least cost manner. Given that the primary energy resource in the sub-region is hydropower, WAPP Secretariat's efforts are focused on developing, in the mid- to long- term horizon, a number of regional hydro plants identified as Priority Hydropower Projects ("Projects") in the approved Master Plan. When fully operational, these Projects shall contribute up to 30% of the energy mix under the base scenario.

At this point, hydropower projects funded by the World Bank under the WAPP Integration and Technical Assistance Project (Parent Project and Additional Financing) include pre-investment studies for Amaria hydropower plants in Guinea and activities in Liberia to support pre-investment studies for the optimization of existing hydro generation at Mount Coffee on the St.Paul River, including the possible development of upstream storage capacity (Via reservoir) and further hydropower capacity.

Each Project shall be prepared in accordance with highest international standards. To this effect, the WAPP Secretariat will put in place two Panels of Experts (PoEs) as follows to review all aspects of the proposed Projects and ensure that the quality of pre-investment studies promote sustainable development of available hydropower resources.

- A Dam Safety Technical Panel
- An Environmental and Social Panel.

These ToRs aim at recruiting Experts who will be contributing to the Panels. For coordination and team building purposes, the present ToRs are integrated. Common sections and section specific to each Expert will be considered as ToRs for each of the Experts. Nevertheless, in mirror, no claim or disputes will be accepted by Experts quoting the ToRs of another Expert as a reason for challenging tasks appointed to his duty.

3. Objective of the Panels of Experts - PoEs

The primary objectives of the Panels are to:

- provide an independent and high level engineering evaluation of Projects as it relates to dam safety;
- advise the Client on all aspects of the Projects relevant to the environmental assessment of the Projects.

The Panel of Experts shall undertake comprehensive review of the Projects. At this stage, the following Projects (and associated studies prepared by Consultants) are envisaged to be submitted to the PoEs:

Future hydropower development on the St. Paul River in Liberia

- Optimization Study;
- Feasibility Study of the priority project (FS);
- Environmental and Social Impact Assessment (ESIA) of the priority project.

Projet d'aménagement hydroélectrique d'Amaria in Guinée (to be confirmed)

- L'Étude de faisabilité et de l'Avant-projet Détaillé (APD) ;
- L'Étude d'Impacts Environnemental et Social (EIES).

Any other hydropower projects in West Africa *(Nota: mobilization by the WAPP of the Experts for any other projects than those mentioned above will be subject to WB's approval)*

Members of the PoEs will be requested to make evaluation and recommendations with the overall purpose of achieving adequacy, efficiency, safety and cost effectiveness of the Projects as well as sustainability (including mitigation or compensation of negative impacts).

Related to the above activities/reporting by the Consultants, the Panels shall review and provide comprehensive opinions/recommendations, inter alia, on the soundness of the engineering studies and design, including design memoranda and calculations, field investigations, models (hydraulic and structural), technical and economic selection of Projects and optimization of their components, and construction methods of the Project as well as all safeguard aspects.

4. Organization and Membership of the Panels

WAPP SG will establish two Panels of Experts: (i) a Technical Dam Safety Panel and (ii) a Socio-Environmental Panel. WAPP SG will contract directly the members of the Panels on an individual basis. Conflict of interests shall be avoided; Consultants maintaining a close working relationship with any Experts on the Panel will not be allowed to submit a Proposal to carry out part of or the entire pre-investment studies..

The Panels will consist, as necessary, of members with the following expertise and experience in hydropower projects:

Dam Safety Technical Panel

- Hydropower Dam Specialist (with expertise in Civil engineering);
- Geologist with geotechnical expertise;
- Hydrologist;
- Hydraulic engineer;
- Electromechanical Specialist;

Environmental and Social Panel

- Environmental Specialist;
- Social Specialist;

- Health and Safety Specialist.

The constitution of Panels may change over the project cycle, but it is highly desirable that a strong continuity of knowledge of the project problems and progress be maintained.

The Panels may request WAPP SG the assistance on a temporary basis of other experts in other areas when in the Panel's opinion it is advisable to do so in, inter alia, sedimentation, seismology, hydraulic model testing, structural model testing, grouting, concreting, rock mechanics, and additional studies and field investigations. When doing so, the Panels shall recommend qualified experts who could perform such evaluations on short notice. These experts can then be appointed by the WAPP SG as Panel members for the required period of time in accordance with Projects' requirements.

The WAPP SG in coordination with the permanent members of the Panels shall appoint a Chairman of each Panel and shall appoint a senior staff member of WAPP SG/PIPES as Project Coordinator to plan, coordinate, and support the activities of the Panels and to assist them and their members in all arrangements.

The Chairmen will coordinate the communications of the Panels, chair its meetings, ensure the membership's objectivity, and provide balance in its reviews and recommendations. WAPP senior staff will facilitate access to information and documents to the Chairmen who will themselves be responsible for dissemination and management of information with other Experts.

5. Schedule, meetings and cost-efficiency

The schedule of the activities will be coordinated by WAPP Project Coordinator in conjunction with the Consultants and the Panels.

The Panels shall meet as frequently as deemed necessary by WAPP Project Coordinator during the preparation of the work/reports of each Phase of work of the Consultants to assess the status of the work and to present recommendations. The meetings will normally take place at projects' site, and shall be attended by the relevant members of the Panel as identified by the authorized representatives of the WAPP SG/PIPES. The Panels shall agree with the WAPP SG/PIPES or its Consultants as to the adequate scheduling of meetings. Physical or virtual meetings should be held when important decisions regarding key aspects of the Project must be made and, at minimum, on a regular basis expected to be twice a year. In addition, meetings will take place preferentially, for instance, at the time that draft reports become available for each Phase of the Consultants' work. The schedule of the meetings should be arranged well in advance, taking into account the program of work on the Project. The duration of physical meetings are expected to take around one week including travel.

On a selective basis, the services of the individual members of the Panels should be used as necessary or desirable during intervals between meetings, with copies of their comments being sent to the other members of the Panels and the WAPP SG/PIPES.

The WAPP SG/PIPES shall inform with the necessary anticipation the financing institution (The World Bank) of the dates of each meeting to allow the institution to participate as observer in these meetings.

The Panels shall provide these services on a cost-efficient basis, respecting the nature of the high level profile of the Panels and the structure of their remuneration, tailored to short time high level advices. Except for emergency and ad-hoc desk expertise, work plan and mobilization will be in principle agreed on a rolling 6-month period between the WAPP Projects Coordinator and Chairmen of the Panels.

6. Supporting Services

The WAPP SG/PIPES shall make available its authorized personnel and that of the Consultants of the Project for discussions with the Panel of Experts at per request of the Chairman of each Panel, and they shall be present during the meetings with the Panel or at least provide written responses to preparatory requests and questions. The WAPP SG/PIPES and Consultants shall provide the necessary documentation such as background information, relevant data, engineering design reports (criteria and calculations), laboratory tests, and minutes of consultation meetings, related to the Project. The Project Coordinator and Team Leaders of the Consultants shall coordinate the collecting and assembly of such information.

The WAPP SG/PIPES shall provide clerical, drafting and documentation reproduction services during the meetings and for the preparation of the Panel's reports. The WAPP SG / PIPES shall take necessary actions to allow prompt travel clearances of the members of the Panels or specialists requested by the Panels, and shall provide full safe physical access to the Project area and sites.

Members of the Panels will be requested to have their own computers and will be responsible to store all communication and documents on their own device, while ensuring confidentiality and security of these data. Request for receiving again past reports or information should remain exceptional.

7. Scope of Work of the Panels

7.1 Phases and Subjects

The Panels shall, inter alia, review, comment, provide suggestions or recommendations as it deems prudent, or as requested by the WAPP SG/PIPES or its Consultant on any subject it considers vital to the successful completion of the engineering, construction, and operation and maintenance of the Projects. The Scope of Work is not considered complete, and it cannot substitute for the expertise of the members of the Panels, and during the course of their assignment, it may be modified as required.

The subjects apply as applicable to the study/reports related to WAPP hydropower Projects. The level of detail of the subjects shall be adjusted according the phases of projects' development i.e. from preliminary studies to detailed design (and specific construction studies when required), without performing any remedial designs, but identifying potential lacking and giving general recommendations for potential solutions and approaches for corrective measures.

The subjects, some of which may overlap, will include inter alia reviews and comments as discussed below.

7.2 Dam Safety Technical Panel

Detailed comments on major aspects of the Panels' work are given below. As per the profiles of Panels', the WAPP will search Experts that will complement each other in order to cover, as much as possible, hereunder topics. When not possible, complementary experts might be mobilized.

7.2.1 Hydrology, Hydraulics and Sediments

Review (i) the extent and sufficiency of the basic hydrology data available and the method used to develop adequate stream flow records that take into account state-of-the-art practices for climate change considerations; (ii) the criteria and methods by which the data were used to estimate flows available for the Project, Design Flood and flows to be diverted during project construction, the proposed elevations of the cofferdams, and the need to use other methods to improve accuracy of results, evaluate the risk factors associated with diversion during construction, and (iii)the criteria and method of routing the maximum inflow through the reservoir to obtain the required spillway capacity.

Review formulation and adequacy of powerplant characteristics and operation rules used in the simulation studies for estimating and comparing power and energy of the Projects, including the integration of environmental and social limitations.

Review the adequacy of the methods and criteria adopted to identify the best scenario for the optimal development of available hydropower potential, and for the technico-economic optimization of each component of the hydropower schemes and plants characteristics.

Review criteria and method of calculating outlet discharge capacity as well as the method used to compute wave heights, wave run-up, and freeboard to establish top of dam elevation, the need for and desirability of using emergency spillways or other methods of minimizing damage if the computed spillway capacity is exceeded, and the extent and sufficiency of impending disaster or danger warning systems and procedures.

Review the hydraulic design of the spillways and energy dissipation facilities, diversion works during construction and their closure upon completion of project construction, water conveyance systems (approach channel, intake, penstocks, head race tunnel, surge chamber, and tail race, etc.), and hydraulic equipment (gates, valves, etc.). Review conditions of proposed initial reservoir filling.

Provide comments on the terms of reference and reports for hydraulic models including selection of testing laboratory, models testing, and reports. Attend the model testing as required.

Review the criteria and methodology used for estimating the sediment load that will enter the reservoir, analysis of sedimentation in the reservoir, and measures to ameliorate the impact of sedimentation on the reservoir.

7.2.2 Engineering Geology and Geotechnical Engineering

Review the quality and sufficiency of the engineering geology study reports, program for and reports from field investigations, in-situ testing (number, location and direction of adits, borings, trenches, etc.) and laboratory tests reports and interpretation thereof, location of cracks and faults, to establish foundation levels and determine the soundness of foundation/abutments, foundation

permeability, the type and probable scope of grouting and the need for grouting tests, and the basis for the design of the drainage system.

Review the adequacy of design parameters, permeability, optimum water content, slope stability, and any other parameters demanded by the design.

For embankment type dams, the adequacy of core materials, filter materials, rockfill or riprap, and their necessary placement. The adequacy of proposed methods of acceptability of the materials and conditions for their placement, provisions for drainage and other details of embankment construction.

Review the studies and investigations related to the hydrogeology of the Projects' area, reservoir area, and sites for the Projects' structures (intake, penstocks, dam, power house and underground works) to assure water tightness or measures needed to obtain it or necessary limitations on the maximum reservoir level.

Review the design criteria and methodology of surface and underground excavations, including selection of stable slopes; appropriate shape, size and orientation of surface and underground excavations; of the design of temporary structure supports and tunnel lining, of dam instrumentation, of the program for collecting, evaluating and maintaining data.

7.2.3 Seismology

Review the identification of sources/location of seismic activity, the assignment of earthquake magnitude to each source, the criteria and methodology for derivation of parameters for maximum and credible design earthquakes, the seismic design criteria, safety allowances and methods used to withstand them.

7.2.4 River Development and General Layout

Review the adequacy, with respect to sustainable development, of the overall river development and each project arrangement/layout including dam heights and reservoir capacities. This review shall consider:

- the acceptability of the location of the major project components with regard to the intake, dam, bottom outlets, spillway and energy dissipating facilities, penstocks, diversion works, headpond, water conveyance systems, surge chamber, powerhouse, tailrace, etc.,
- the effect of the proposed layout on future developments,
- the most suitable methods and sequences of project construction and operation and maintenance of the Project.

7.2.5 River Diversion

Review the adequacy and soundness of the general design concept of the diversion and closure schemes, including capacity of the diversion works (intake, tunnel, gates and other appurtenances), location, size and type of cofferdams, adequacy and suitability of the foundations, water tightness measures under the cofferdams, the necessary dewatering methods, equipment and systems, and the impact of the proposed design on the most suitable methods and sequences of project construction.

7.2.6 Type of Dam, Appurtenances and Project Layout

Review the selections of the type (arch, concrete gravity, roller compacted concrete, embankment, etc.), axis, and characteristics of the dam and whether these selections are justified

compared to alternative options. Confirm the adequacy of dam design with respect to state-of-the-art practices.

Review stability analysis and results, factors of safety for normal, extreme and unusual loadings including seismic loading criteria for the dam (arch, concrete gravity, embankment, etc.) spillway structures and outlet works, slopes, underground works, etc.

Review the adequacy of dam safety assurance program within the national, other national and international standards and best practices, including World Bank OP 4.37 on Dam Safety. If necessary, the Panels should request the WAPP SG /Project and the Engineering Consultant to perform additional studies before it can arrive at their conclusions and recommendations.

Provide comments on the terms of reference and reports for structural models including selection of testing laboratory, models testing, and reports. Attend the model testing as required.

Review the selection and design of water conveyance structures such as intake type, penstocks, tunnels as affected by the geology and overall geotechnical parameters, and the impact of the proposed design on the most suitable methods and sequences of project construction including inspection during construction, and operation and maintenance of the Project.

Review of powerhouse arrangement, spillway type and suitability of the energy dissipation structure, the selection of type and number of gates and valves and hoisting equipment, the technical/economical size of water conveyance structures, the need, extent and type and adequacy of tunnel linings, and the effect of the proposed layout/design on the most suitable methods and sequences of project construction including inspection during construction, and operation and maintenance of the Project.

7.2.7 Drainage Systems and Grouting

Review the adequacy and suitability of drainage systems used in the design of the dam and its foundations, under and around the spillway and in the underground and open-cut excavations, and the need for drainage galleries in the abutments and in the dam foundations and abutments.

Review the need, type and extent of the grout curtain under the dam and its abutments, the requirements for consolidation grouting of the foundations of the various concrete structures, around tunnels and other types of underground openings, the need for special drainage, grouting, or other measures within the reservoir and construction areas to eliminate or minimize slides and water leakage.

7.2.8 Soil/Rock Support Measures

Review the adequacy and selection of proper type of supports measures in underground and open-cut excavations.

7.2.9 Concrete

Review the adequacy of source of water, cement, sand and coarse aggregates, and the adequacy of testing the various materials and combinations of them to assure minimum costs and absence of harmful reactivity among the ingredients, the need for and method pre-cooling/cooling and other special treatment to assure sound concrete, the suitability and the adequacy of instructions and specifications for placement and finishing, the need for special ingredients/cementing

materials, or special design features to resist cavitation or erosion, and adequacy of water stops and drainage systems.

7.2.10 Instrumentation and Controls

Review the adequacy of the instrumentation plan, especially of those instruments or monuments which would be useful in forecasting serious damage or failure of the structures, the adequacy of proposed instrumentation in the dam and its foundations/abutments, open-cut slopes and underground structures such as chambers and caverns, the adequacy of mechanism to control opening and closing of major gates and valves and surge chamber to limit pressure.

7.2.11 Mechanical and Electrical Equipment

Review the technical and economic design and characteristics of major equipment (turbines, generators, transformers, switchyard, gates, hoists, cranes etc.), and the design criteria following state-of-the-art.

7.2.12 Construction Schedule

Review the overall adequacy of the construction schedule, accesses to the sites of the various project components, the sequence of river diversion, time allocated for the construction of the various project components, installation and testing of major equipment, machinery and facilities, and reservoir filling, and the overlapping of major activities within the same contract or among various contracts as the case may be, and the time allocated to each major activity.

7.2.13 Operation and Maintenance and Safety Programs

Review the adequacy of the proposed preliminary operation and maintenance plan and establishment of project operations procedures.

Review the procedures for handling project records, including as-built drawings, operation records, inspection records, instrumentation data and other information associated with the long term safety of the dam, water conveyance structures and equipment, and appurtenances.

7.3 Environmental and Social Safeguards

Review and evaluate the preliminary environmental and social impact assessment in the screenings conducted in accordance with country requirements and the operational policies of the World Bank. This includes a preliminary stakeholder assessment, inventory of impacts, review of land-related issues, and social impact.

7.3.1 Social Impact

Specifically, the review of the social impact should consider the following elements:

- Project-Affected People (PAP) and key stakeholders upstream and downstream the dam;
- Existing communication channels between government and local population and the communication strategy and mechanisms;

- Mapping and profiling of the general population of the immediate basin area;
- Land acquisition requirements and the scale of displacement;
- Census and socioeconomic survey;
- Impact of river flow regimes on communities;
- Impact of population influx during and after construction;
- Capacity of governmental and non-governmental services that are locally available with particular reference to disease control;
- Job loss and job creation, including indirect economic activities;
- Availability and cost of alternative land to be provided to PAP;
- Vulnerable population;
- Impact of any resettlement on neighboring villages;
- Integration of the infrastructural development of the area into the construction requirements for the Project;
- Minimization of short-term impact during construction to be addressed in future construction contracts;
- Other social and cultural impact, including issues related to cultural property.

7.3.2 Environmental Impact

Review of the EIA including the identification of the base-line situation, expected impacts of the project, and the mitigation and monitoring plans developed for the Environmental Management Plan (EMP). [1]

The review should take into account the whole range of reservoir and river basin management issues, including water flow-through, including but not limited to:

- ecological effects of the flooding and construction activities, including risks to habitats and topographical impacts that would induce landslides or flooding;
- effect on the hydrology and on the water quality of the river/reservoir;
- impact of the changed river flow regime, including impact due to river impounding upstream of the dam, and river left dry downstream of the dam;
- determination of the ecological flow between the dam and the tailrace discharge;
- effect of river animal and aquatic lives and potential for maintaining them;
- likelihood of reservoir stratification;
- foliage and vegetation in area to be flooded and removal requirements before flooding;
- impact on local drinking water supply systems;
- sedimentation of the reservoir;
- land use and soil types, including the potential for reservoir landslides and soil erosion;
- biomass flooding potential;
- possible loss of cultural property (including archaeological and historical sites), including a site survey and provision for chance finds;
- potential impact from short-term or long-term migration to the project area or such induced activities as logging;
- potential for incidence of water borne and water related diseases;
- impact on fisheries and other sources of local income.

[1] The EIA will be prepared in accordance with the guidelines and policies of the World Bank.

7.3.3 Resettlement Action Plan (RAP)

Review the Resettlement Action Plan (RAP) that describes policies and procedures that will be applied during the entire life for the investment projects on matters of the acquisition of private land, displacement of households, and impact on household incomes.[2] The Panel will also review the minutes of consultation meetings to ensure sufficient information dissemination to the project affected people.

7.3.4 Health and Safety Issues

Review all aspects of the project related to health and safety of workers and populations, on construction site, around the dam, and in the affected communities.

To do so, the Panel will need to take ownership of all health and safety issues of the ESIA and confirm the relevance of the proposed measures, and their compliance within the applicable regulatory framework. Similarly, the Panel will analyze the relevance and compliance of the ESMP for the health and safety aspects, including the monitoring and surveillance plans.

7.4 Tradeoffs

Elements of the project design may represent an optimum solution from an engineering and/or economic point of view while being suboptimal from an environmental and/or social point of view. The Panels shall assist the Consultants in clarifying to the Client the tradeoffs between these aspects of the various project elements/decisions.

8. Qualifications for recruitment of Experts

8.1 Shared/ Common requirements

All Experts will be requested to have at least an Engineering Degree or Master Level (MSc.) and be fluent in English and French.

All experts should master Microsoft Office Suite (Word, Excel, Outlook etc.) (format requested for reviews).

Each Expert will have to demonstrate international experience in at least 5 hydropower projects as key technical staff and/or expert in the fields relevant to the Position advertised.

Experts must demonstrate capability to work effectively in a team and have strong communication skills (verbally and in writing).

Dam Safety Technical Panel

[2] The RAP will be prepared in accordance with World Bank OP/BP 4.12. Additional information is provided in the referenced TOR.

8.2 Hydropower Dam specialist (with expertise in Civil engineering)

The Expert required is expected to have at least 20 years of professional experience in the development and implementation of hydropower dam projects and cascade developments, with previous field work experience in Sub-Saharan Africa, and proven track record of project optimization with due consideration to environmental and social issues

Expertise shall cover all aspects of civil engineering, including field investigations, design of dam and water conveyance structures, modeling, and construction planning,

The Expert shall have recognized competences in dam safety and be familiar with WB Operational and Bank Policies (OP/BP) as they relate to dam safety. Working knowledge of the Electricity Sector and dam safety regulations in Sub-Saharan Africa would also be a significant advantage.

Hands-on experience in construction supervision, operation and maintenance of hydropower plants and dam monitoring would be looked at favorably.

8.3 Geologist with geotechnical expertise

The Expert is expected to have at least 20 years of professional experience in the design and construction of large dams with working knowledge of conditions prevailing in Sub-Saharan Region.

Expertise shall cover all aspects of geology and geotechnical engineering, from reconnaissance studies to construction, including field investigations, laboratory testing, design of dams, foundations and underground structures, construction planning, and dam monitoring.

Hands on experience with dam monitoring instrumentation would be looked at favorably.

8.4 Hydrologist

The Expert required is expected to have at least 20 years of professional experience in hydrology related to hydropower projects and cascade developments, with proven track record in dealing with climate change adjustments and previous work experience in Sub-Saharan Region.

Expertise shall cover data collection (including field measurements), modeling, establishment of flow records and water levels, flood studies, sedimentation, reservoir filling.

The Expert shall have working knowledge of World Bank dam safety policies and local regulations in Sub-Saharan Africa.

Experience in reservoir operation, generation estimates and cascade development will be a significant advantage.

Competences in generation planning, valuation of power, load-supply balance and reliability analysis an asset.

8.5 Hydraulic Engineer

The Expert required is expected to have at least 20 years of professional experience in the design of mechanical equipments related to hydropower dam projects.

Expertise shall cover all design aspects of turbines, penstocks, gates, valves, and auxiliary mechanical systems, and their integration in the layout.

Experience in project evaluation, reservoir operation, generation estimates, and reliability analysis would be considered positively.

Previous field work experience in Sub-Saharan Africa an asset.

8.6 Electro-mechanical Specialist

The Expert required is expected to have at least 20 years of professional experience in the design of electric-mechanical equipments for hydropower dam projects and interconnection to the grid.

Expertise shall cover all design aspects of generators, transformers, control and protection, instrumentation, switchyard, gates, hoists, cranes, and their integration in the hydropower scheme and the grid.

The Expert shall have working knowledge of power grids, operation structures and regulations in ECOWAS region.

Hands on experience in operation and maintenance of hydropower plants and dam monitoring would be looked at favorably.

Knowledge of World Bank dam safety policies a significant advantage.

Competences in generation planning, valuation of power, load-supply balance and reliability analysis an asset.

Environmental and Social Panel

8.7 Environmental specialist

The Expert is expected to have a minimum of 15 years of international experience in the assessment of environmental impacts and implementation of environmental management plans for sensitive and controversial hydroelectric dam projects.

Specific qualifications required include:

- Experience in Africa on 2-3 similar projects

- Hands on experience in environmental management of hydro dams

- Working knowledge of WB policies, rules and guidelines as well as local and international regulatory standards on environmental issues.

8.8 Social Specialist

The Expert is expected to have min 15 years of international experience in assessment, implementation and monitoring of sensitive and controversial projects with institutional, socioeconomic and cultural issues.

Qualifications required include

- Experience in Africa on 2-3 similar projects

- Hands on experience in compensation and relocation of population affected by similar projects

- Working knowledge of WB policies, rules and guidelines as well as local and international standards for relocating people.

8.9 Health and Safety Specialist

The Expert is expected to have a proven record of at least 15 years of experience in the assessment, implementation and monitoring of all health and safety aspects for sensitive and controversial projects. This includes health and safety issues for workers and populations, on construction site, and in the affected communities.

Qualification criteria include:

- Experience in Africa on 2-3 similar projects

- Hands on experience in health and safety protection of workers and local population, hygiene on site, including prevention and management of water borne diseases, and implementation of emergency plans.

- Working knowledge of WB policies, rules and guidelines as well as local and international health and safety standards.

9. Reporting / Invoicing

The Panels of Experts shall document the results of each one of (i) their reviews and (ii) of their meetings and of the overall conclusions and recommendations following their meetings at the Project sites. Reviews, minutes and reports shall be prepared in English or French by the Panels, depending on the adequate language related to the Project. In general, the language of submitted reports will apply. Deliverables from overall review and/or site visits should be coordinated by Chairmen who will collect and integrate each individual contribution towards comprehensive deliverables.

Final versions of review and/or reports shall be signed by participating members of the Panels and presented to WAPP Project Coordinator for distribution to WAPP SG /Project and Consultants.

The Panels of Experts shall not perform any remedial designs, but should give general recommendations for potential solutions and approaches for corrective measures. After the WAPP SG /Project and the Consultants have developed a program for modification, the Panels will provide a review of the measures proposed. Each member has the professional duty to alert WAPP Project Coordinator of any events or design features that in nature are likely to generate dam safety issues or to be against state-of-the-art practices or WB Operational and Bank Policies (OP/BP).

After each meeting and after reception of integrated reviews, the WAPP SG /Project shall provide copies of each minute/report to the financing agency (The World Bank or others), including a statement of actions taken on the recommendations of the previous meeting of the Panels. Any reviews provided by the Experts on projects or studies which are not financed by the World Bank will not engage any responsibility of the Bank. Disclaimers (validated by WAPP and WB legal departments will have to be validated before commencing such review / services).

Selected Experts will have to (i) report at least every six-months on activities implemented during the period as well as on time spent (ii) agree with WAPP on the workplan for the coming six-months. These reports and timesheets will be validated by the WAPP Project coordinator before payment. Expenditures such as flights and travel costs will be paid as reimbursable upon

submission of receipts. Food and accommodation for site and country visits will be covered through daily allowance as per WAPP standard daily rates.

Appendix 1: Mount Coffee HPP and St. Paul River

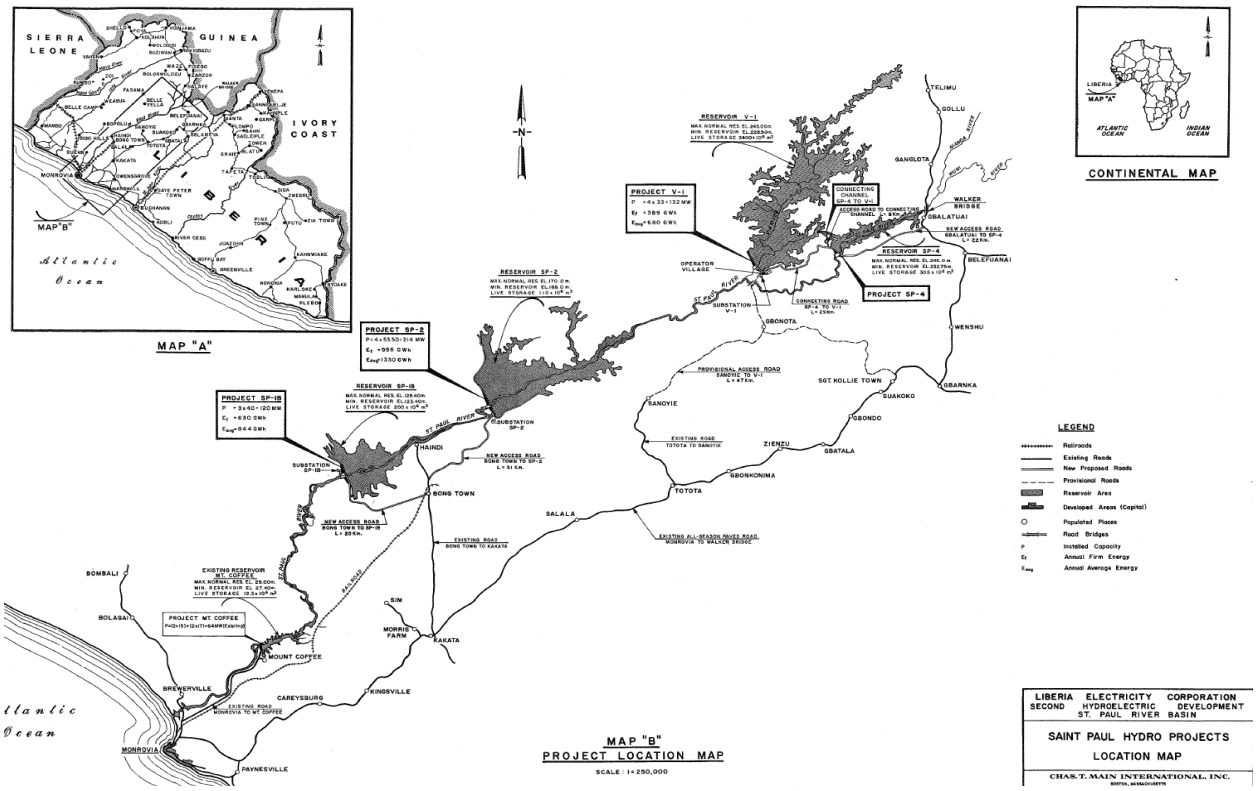
The St. Paul River has a technical hydropower potential of nearly 600 MW. This potential could be exploited by means of one or two upstream regulating reservoirs (Via Reservoir and Diversion Reservoir, also called SP4) and a downstream cascade of three to four HPPs as follows: one plant at the foot of Via Reservoir (around 130 MW), one at St. Paul 2 Dam (214 MW), one at St. Paul 1B Dam (120 MW) and the Mount Coffee HPP. Today only the Mount Coffee HPP exists; it underwent major rehabilitation and is currently operating with an installed capacity of 88 MW. Additional groups could also be added to Mount Coffee HPP as two additional water intakes had been built initially in the dam.

Optimization Study

The first step of the optimization study will be a market study for electricity from the next hydropower project in Liberia. This will include (a) a review of regional and Liberian electricity demand forecasts under different assumptions, including mining projects, and (b) a review of existing and potential generation and transmission projects (including potential imports). This market analysis will explore national needs and export/import opportunities over time (2025, 2035, and 2045) and will assess the needs for base and peak loads as well as ancillary services expected from the future developments. For memory, in the WAPP Master Plan, Liberia is expected to export 1,860 GWh by 2025, with most of this electricity coming from St. Paul River hydropower development.

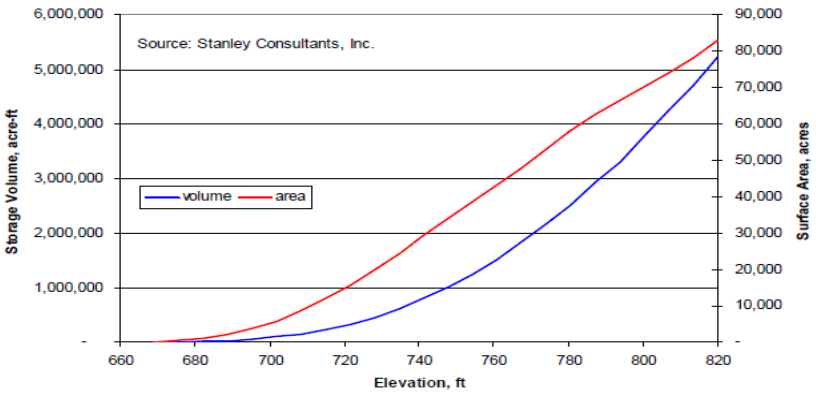
The second step will confirm the location of best sites for hydropower development. Previous studies and national authorities identified St. Paul River as the priority. The TA will confirm this identification, based on comparison with other hydropower sources (St. John and Mano Rivers) and updated socioenvironmental data, especially on forestry and on the population likely to be affected. A LIDAR will be deployed to collect topographic and land use data, as well as to identify households and infrastructure likely to be affected. Hydrological data will be reviewed and revised to integrate climate change dimensions. Geological and seismic data will be collected and analyzed including, where necessary, simple geotechnical investigations such as seismic lines. Prefeasibility studies of different sites and river cascades will be harmonized to facilitate comparison. Sites will be ranked on technical-economic criteria and potential environmental and social impacts.

St. Paul River Hydropower Cascade as Studied in 1982 (by Chas. T. Main International)



The third step will explore the optimal mix among hydro, solar, and existing generation, aiming to reduce cost of electricity and socio-environmental impact including carbon emissions. Use of water storage and hydropower to complement intermittent generation such as solar will be simulated. A balance between storage, power production, and environmental and social impacts will be sought, including fine-tuning of reservoir operating levels (see figure 2.2 for Via Reservoir). A multi-criteria and economic analysis will be implemented including sequencing of projects over time and potential offset of existing HFO plants. As part of the multi-criteria analyses, risk analysis, readiness for implementation, and sensitivity analysis will be conducted. Integration of proposed projects within the national and regional grids as well as needs for transmission lines and/or substations will also be analyzed.

Via Storage Reservoir Elevation versus Volume and Area (by Stanley Consultant 2008)



To support the integrated use and management of water resources on the St. Paul River, the consultant will also review other water uses in the basin as well as the water resources management framework in Liberia. Results of this review will be integrated in the design of the project.

The consultant will also develop a model of the cascade at different time steps (monthly, daily, and hourly) to reflect hydraulic regimes as well as power production over time measured against demand forecasts and daily consumption patterns. Potential for irrigation and other multipurpose uses of the water resource will also be captured. The most promising and balanced development plan of the cascade shall then be presented for decision on the priority project. A workshop presenting the draft outcomes will help develop consensus and collect feedback from key stakeholders.

A preliminary social analysis of the characteristics of the populations likely to be affected by the priority project will be conducted, before full ESIA studies. The analysis will consider among other issues demographics, livelihoods, forestry, and severity of impacts, numbers of affected people and assets, and whether physical resettlement would be necessary.

Feasibility Study of the Priority Project to be Developed

The activity will develop a bankable Feasibility Study for the development of the priority project, including storage and transmission lines to evacuate the power. The bankable FS will facilitate mobilization of financial resources for the project. The FS will be detailed enough to support preparation of tenders. To facilitate a smooth transition to the development stage, the consultant in charge of preparing the FS may be asked to include in his/her bid the cost of the preparation of tenders for contractors.

The FS will follow technical best practices including design criteria, civil engineering and hydraulic studies, electro- and hydro-mechanical studies, electro-technical studies (including transformers and substations), design of the SCADA, control systems, ancillary equipment, and so on. It will also include a Geological Baseline Report (GBR) tier A to be developed on the basis of an informed risk analysis. The GBR will be developed to a level of detail suitable for integration in future tender documents. The scope of work will include geotechnical investigations in key locations and laboratory testing. If solar development is included, the FS will cover aspects related to this technology.

The FS will also include detailed analysis of the integration of the priority project within the CLSG and national transmission systems. Necessary transmission lines (225 and 66 kV) will be studied and simulated on a power system simulator for engineering model. Static and dynamic simulations of the grid will be implemented to define the transmission network and demonstrate the adequacy of the proposed design with regard to performance and stability of HPP integration to the networks.

Finally, detailed construction schedules will be prepared and the critical interfaces among subcomponents defined. To achieve the best outcome of the technical studies, save time, and avoid unnecessary transaction costs, the procurement of the FS consultant will be implemented in parallel with the optimization study. The technical consultants will work closely with the consultant for environmental and social studies (ESIA).

ESIA and other Studies for the Priority Project

Environmental and social safeguard studies and activities will be carried out for the priority project, including (a) review of the environmental and social screening from the optimization study; (b) evaluation of the design of the project including dam, HPP, and transmission lines; and (c) development of the required ESIA, ESMP, RPF, RAP, Labor Influx, and Work Camp Management Plans for associated infrastructure, a comprehensive Analysis of Alternatives and a Cumulative Impact Assessment, which will include the part of the St. Paul River Basin in Guinea. The ESIA consultant will work closely with the technical consultants for the optimization study and FS. The consultant will make recommendations for socio-environmental aspects of the project including confirmation of environmental flows, needs for maintaining the ecological continuum, forestry management, and so on. Existing biodiversity and fish migration patterns will also be reviewed. The assessment will include any transmission lines and other infrastructure required, such as access roads, work camps, and site installations.

This consultancy will also include participatory and communication activities, including public consultation and workshops, based on socio-environmental studies (the ESIA, ESMP, RAP, and so on) to address issues such as future benefit sharing with host communities, citizen engagement and grievance collection mechanisms, labor influx and work camp issues, social conflict prevention, gender equality, and access to electricity in the project area.

These studies and activities will inform the GoL, LEC, and other stakeholders about potential socio-environmental impacts of the project and propose mitigation measures. The studies will be implemented according to World Bank safeguards policies and international best practices and will follow with World Bank emerging guidance on hydropower TAs.

Appendix 2 : Projet d'aménagement hydroélectrique d'Amaria

Système électrique de la Guinée

Le potentiel hydroélectrique total de la Guinée est estimé à une puissance de l'ordre de 6,1 GW, pour une énergie annuelle garantie évaluée à 19 300 GWh. À ce jour, moins de 10% de ce potentiel a été développé. Le taux d'accroissement de la demande d'énergie est estimé entre 7 et 10% par an, hors secteur minier. Le secteur minier est un facteur prédominant dans la croissance de la demande et représente 40% de la demande totale, influençant ainsi considérablement les prévisions.

L'Électricité de Guinée (EDG) est la société de service public d'électricité publique, autonome, créée en 2001 et dont le capital est détenu à 100% par l'État guinéen. Elle constitue l'entité principale du sous-secteur de l'électricité en Guinée chargée de l'exploitation des infrastructures de production, de transport, de distribution et de commercialisation d'énergie sur l'ensemble du territoire guinéen.

Le Ministère en charge de l'Énergie assure la planification et la réalisation des infrastructures de production, de transport et de distribution.

La puissance totale installée en Guinée est de 629 MW dont 58,4% hydroélectrique et 41,6% thermique (y compris les locations de puissance). De ce parc de production, outre les installations exploitées par l'EDG, les producteurs indépendants disposent d'une puissance installée estimée à 140 MW découlant des sociétés minières.

Les perspectives de développement de nouvelles sources de production concernent : i) le projet énergie OMVG comprenant 128 MW à Sambagalou, ii) le projet hydroélectrique de Souapiti (450 MW selon la plus récente étude par CWE), iii) la centrale hydroélectrique de Fomi de 90 MW. Des projets clés pour le développement des abondantes réserves minières sont aussi en cours d'élaboration pour répondre dans le futur aux besoins importants en énergie de ces industries estimés à plusieurs centaines de MW.

En décembre 2012, le Gouvernement de la République de Guinée a élaboré une nouvelle Lettre de Politique de Développement du Secteur de l'Énergie (LPDSE-II) qui définit les directives de politique générale en ce qui concerne le développement du secteur de l'énergie sur les quinze années à venir. Ces directives portent, notamment, sur le développement du potentiel hydroélectrique tout en prenant en compte les possibilités d'interconnexion sous-régionale.

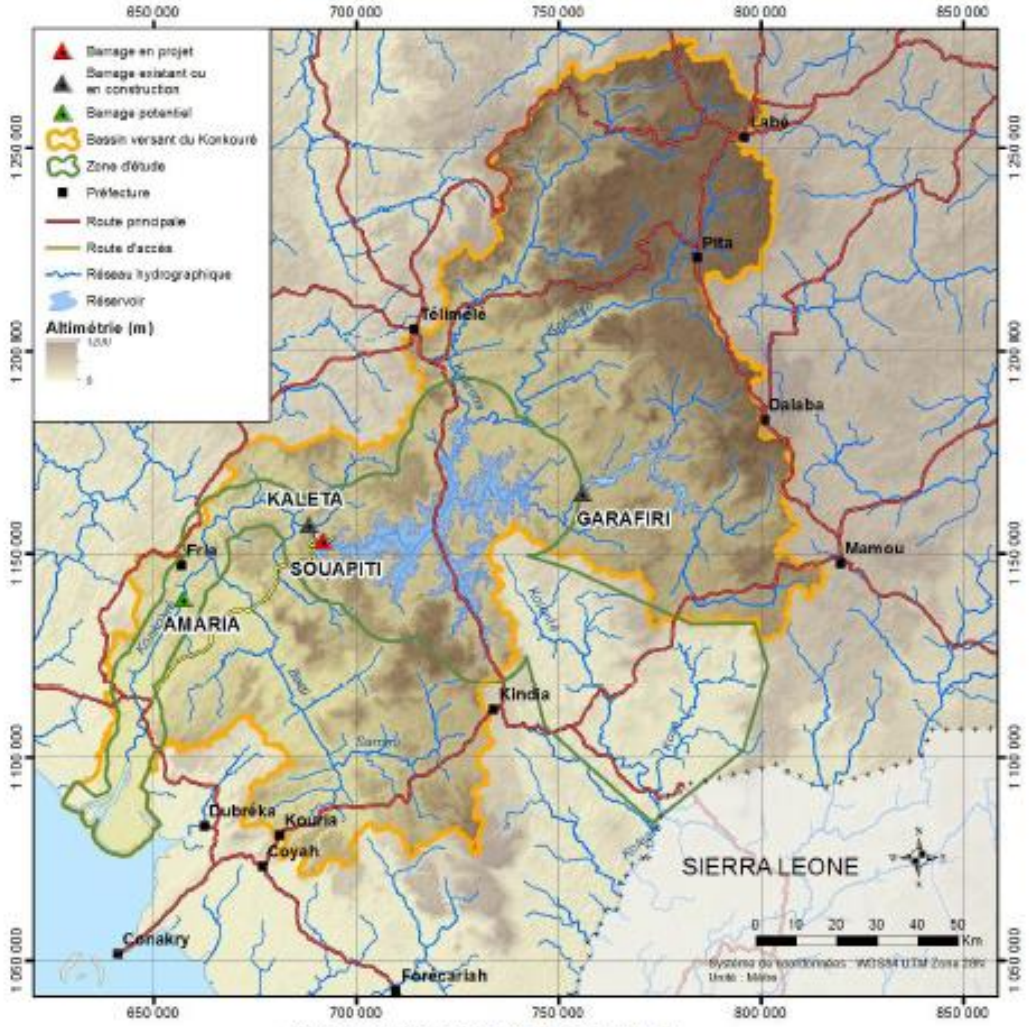
Bassin versant du Konkouré

Plus récemment, le Ministère de l'Énergie et de l'Hydraulique de la République de Guinée a demandé à Tractebel de définir une stratégie optimale de développement du potentiel hydroélectrique à l'échelle du pays. À cet effet, le rapport émis en décembre 2015 souligne l'intérêt régional de poursuivre le développement hydroélectrique du bassin du Konkouré où se trouvent déjà les aménagements de Garafiri, le plus grand réservoir de Guinée, mis en service en 1999, et de Kaléta, un site aménagé et mis en service par la China International Water and Electric Corporation (CWE) en 2015 (voir les figures ci-dessous, extraites de l'Étude d'impact environnemental et social du barrage hydroélectrique de Souapiti). On y recommande aussi de revoir l'inventaire des sites potentiels par bassin versant pour optimiser la production énergétique

globale des projets en tenant compte des influences réciproques des développements à l'échelle du bassin.

Tel qu'illustré ci-dessous, le fleuve Konkouré, qui se trouve entièrement en Guinée, prend sa source dans le Fouta Djallon à proximité de Mamou et coule dans une orientation générale axée vers l'ouest jusqu'au site de Kaléta. Au-delà du site de Kaléta, le Konkouré oriente son cours vers le sud - ouest.

Figure 2-1: Bassin versant du Konkouré avec représentation des ouvrages construits, en cours de construction ou à l'étude

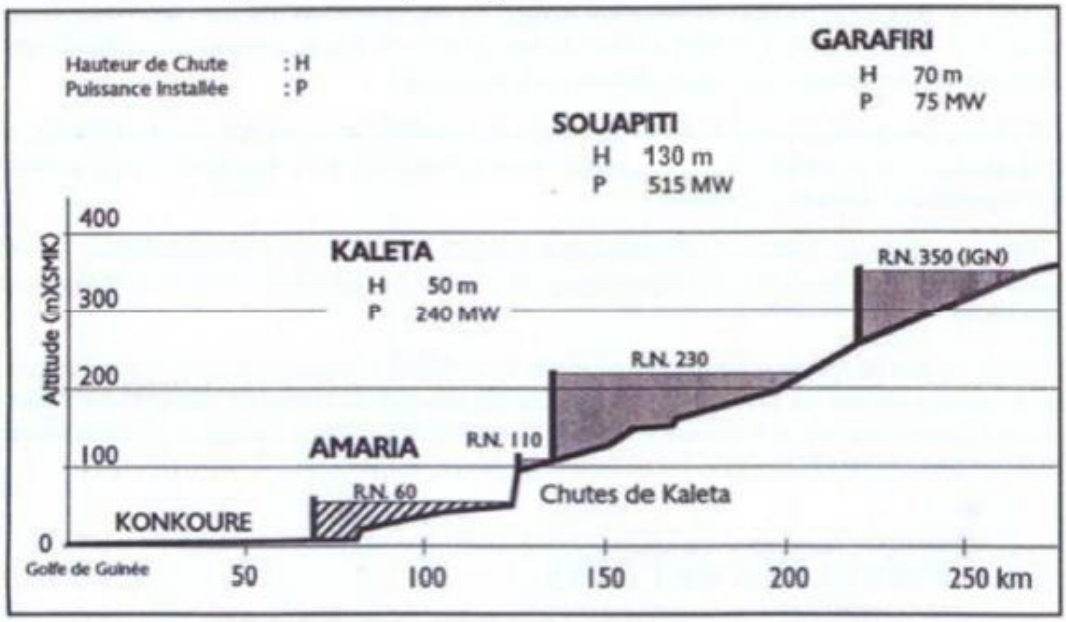


Source : extrait de la carte PL001 en annexe 2

Deux projets retiennent particulièrement l'attention pour répondre à la demande régionale : Souapiti, à l'amont du barrage de Kaleta, où un important réservoir de régularisation est prévu, et Amaria, le site le plus à l'aval sur le Konkouré, qui fait l'objet de ces termes de référence.

La figure illustre un des développements en cascade envisagé par HydroChina en 2011 pour le Konkouré.

Figure 2-2: Coupe longitudinale du fleuve Konkouré



Projet d'aménagement hydroélectrique d'Amaria

Le site d'Amaria se trouve dans la préfecture de Dubréka en Guinée Maritime, à 10 km au Sud de la ville minière de Fria. L'aménagement des ouvrages est prévu juste après la confluence entre le Konkouré et le Badi, à quelques kilomètres en aval du barrage de Kaléta et à quelque 60 km en aval de Souapiti, la principale source de régularisation prévue sur le Konkouré.
Les coordonnées géographiques du site sont X= -13,562222 Y= 10,302778

L'aménagement des ouvrages hydroélectriques d'Amaria visent à exploiter de manière optimale le potentiel hydroélectrique du tronçon le plus à l'aval du fleuve Konkouré. La création d'une retenue à Amaria permettra aussi de contribuer à la régularisation des débits du fleuve Konkouré, ce qui pourrait s'avérer particulièrement intéressant à l'aval de la confluence avec la rivière Badi.
Ainsi, l'aménagement hydroélectrique d'Amaria permettra à la Guinée et aux pays directement bénéficiaires du projet d'interconnexion Côte d'Ivoire, Liberia, Sierra Leone et Guinée (CLSG), aux pays interconnectés par les systèmes électriques de l'Organisation de Mise en Valeur du fleuve Sénégal (OMVS) et de l'Organisation de Mise en Valeur du fleuve Gambie (OMVG) de disposer d'une source de production supplémentaire pour contribuer à la couverture de la demande en énergie électrique au moindre coût. En outre, le projet permettra d'accélérer l'électrification de la Guinée avec la desserte des localités situées dans la zone du projet et celles qui seront traversées par les lignes d'évacuation de l'énergie électrique qui y sera produite.

La seule étude antérieure spécifique au site d'Amaria est l'étude d'Avant-Projet réalisée par la SICAI et dont les rapports datés d'octobre 1975 ont été digitalisés. Les autres études disponibles sont des études générales touchant au bassin versant du Konkouré. Les seules données physiques de base (topographiques, géologiques, géotechniques) du projet disponible à ce jour proviennent des études citées ci-dessus.

Les caractéristiques principales des ouvrages résultant de l'étude d'Avant-Projet réalisée par la SICAI dans les années '70 sont les suivantes :

- Type de barrage : en terre
- Cote de retenue normale (RN) : 100 m
- Capacité totale sous RN : 16 500 hm3
- Module (basé sur 26 ans d'observations) : 603 m3/s
- Puissance installée : 665 MW
- Productibilité moyenne annuelle : 2 450 GWh/an

Ces caractéristiques ont toutefois été revues dans le cadre de l'étude de faisabilité de l'Aménagement du Complexe hydroélectrique de Souapiti/Kaléta réalisée en 1999 par le Groupement Coyne et Bellier et EDF, et reprises par EDF/Artelia/Nodalis dans la plus récente étude du site de Souapiti complétée en février 2016. En effet, Amaria à la cote RN=100m inonderait la route Conakry-Kindia et le chemin de fer Conakry-Fria; de plus, l'étude de SICAI n'a pas pris en compte Garafiri et Kaléta. La cote de la retenue a donc été revue en tenant compte de ces aménagements existants de même que de celui, projeté, de Souapiti, et les dimensionnements de base retenus pour l'aménagement d'Amaria ainsi que les productions énergétiques qui en résultent sont ci-après :

- Cote de RN : 60 SMK[3]
- Niveau Minimum d'Exploitation : 40 SMK
- Niveau de restitution : 13 SMK
- Énergie garantie : 949 GWh/an
- Énergie moyenne : 1243 GWh/an
- Puissance nominale : 285 MW
- Hauteur nominale (brute) : 41 m
- Débit nominal : 835 m3/s
- Débit max sous RN : 728 m3/s

[3]Élévations données dans le "Système Mission Konkouré" adopté par le Groupement Coyne et Bellier/EDF dans l'étude de 1999.

Appendix 3: Project Documents

To be made available to the Panels of Experts:

Mount Coffee HPP and St. Paul River

- Terms of Reference for Optimization Study;
- Terms of Reference for Feasibility Study of the Priority Project to be Developed;
- Terms of Reference for ESIA and other Studies for the Priority Project.

Projet d'aménagement hydroélectrique d'Amaria

- Termes de référence pour l'étude de faisabilité et l'avant-projet détaillé ;
- Termes de référence pour étude d'impacts environnemental et social (EIES).

WB and other

- Selected Aide Memoires from the Bank expert missions;
- Other relevant documents that the Panels may request.