West Africa Power Pool (WAPP)

Terms of Reference for the
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

27 August 2018

List of Abbreviations and Acronyms

CLSG	Côte d'Ivoire-Liberia-Sierra Leone-Ghana (Interconnection Project)
DS	Dam Safety
EHSG	Environmental Health and Safety Guidelines
ESIA	Environmental and Social Impact Assessment
ESF	Environmental and Social Framework
GRM	Grievance Redress Mechanism
GBV	Gender Based Violence
IDA	International Development Agency
OPs	Operation Procedures
PAPs	Project Affected Populations
PCN	Project Concept Note
PoE	Panel of Experts
RAP	Resettlement Action Plan
SEP	Stakeholders Engagement Plan
TORs	Terms of Reference
WAPP (SG)	West African Power Pool (Secretariat General)
WBG	World Bank Group

Table of Contents

1. Presentation of the Organization and Objectives

1.1 Organization in Brief

The West African Power Pool (WAPP) – "the 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.

1.2 Objectives

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 2011, and is currently being updated. The new version shall be approved for implementation by the Authority of the ECOWAS Heads of State and Government in the first quarter of 2019.

The outcomes of the 2011 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. WB Technical Assistance

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 2011 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) are essentially focused on 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.

Associated studies / reports prepared by Consultants which are envisaged to be submitted to the PoEs are the following (see Appendix 1 for general overview of the project):

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, including an estimate of the number of potential PAPs (Project Affected Populations);
- Resettlement Action Plans (RAPs), Local Development Plans and Livelihood Restoration Plans.

Any other hydropower projects in West Africa under this grant may also be added at a later date, with mobilization of the Experts by the WAPP subject to WB's approval.

3. WB Operational Policy for Safety of Dams and E&S Policies

The World Bank Operational Manual, through its Operational Policy OP 4.37 - Safety of Dams, requires that "*when the Bank finances a project that includes the construction of a new dam,* […] *the dam be designed and its construction supervised by experienced and competent professionals. It also requires that the borrower adopt and implement certain dam safety measures for the design, bid tendering, construction, operation, and maintenance of the dam and associated works*".

For large dams, the Bank requires "*(a) reviews by an independent panel of experts throughout investigation, design, and construction of the dam and the start of operations*".

Other International Financing Institutions and Donors make reference to this OP and/or to its principles.

"The independent review panel consists of three or more experts, appointed by the borrower and acceptable to the Bank, with expertise in the various technical fields relevant to the dam safety aspects of the particular dam. The primary purpose of the panel is to review and advise the borrower on matters relative to dam safety and other critical aspects of the dam, its appurtenant structures, the catchment area, the area surrounding the reservoir, and downstream areas. However, the borrower normally extends the panel's composition and terms of reference beyond dam safety to cover such areas as project formulation; technical design; construction procedures; and associated works such as power facilities, river diversion during construction, ship lifts, and fish ladders."

Several Operational Policies apply to E&S Panel activities. Among them special mention deserves WBG Operational Policy 4.12 on Involuntary Resettlement:

"Involuntary resettlement may cause severe long-term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out. For these reasons, the overall objectives of the Bank's policy on involuntary resettlement are the following:
(a) Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
(b) Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
(c) Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by
(a) the involuntary taking of land resulting in
(i) relocation or loss of shelter;
(ii) loss of assets or access to assets; or
(iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or
(b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons."

For projects other than the one in Appendix 1 and with Project Concept Note (PCN) on Oct 1, 2018 or after, the World Bank's Environmental and Social Framework (ESF) replaces the OPs.

To this effect, the Organization will put in place two Panels of Experts (PoEs) as follows to provide comprehensive review all aspects of the project already identified (and other hydropower projects to be facilitated or supported by WAPP and by the WB under this grant), including the TORs for the proposed studies, and ensure that the quality of pre-investment studies promote sustainable development of available hydropower resources.

- a Dam Safety Technical Panel;

- a Socio-Environmental Panel.

These TORs form the basis under which Experts who will be contributing to the Panels will be recruited. 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.

4. Objectives of the Panels of Experts

The primary objectives of the two Panels are respectively,

for the Dam Safety Technical Panel:

- To provide an independent and high-level engineering evaluation of Projects as it relates to dam safety;

and for the Social-Environmental Panel:

- To advise the Client on all aspects of the Project(s) relevant to Environmental and Social issues.

Members of the PoEs will be requested to provide advisory services and make evaluation and recommendations with the overall purpose of achieving adequacy, efficiency, safety and cost effectiveness of the Project(s) as well as sustainability (including mitigation or compensation of negative environmental, social and health and safety 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 basic data, design memoranda and calculations, field investigations, models (hydraulic and structural), technical and economic selection of Projects and optimization of their components, and construction methods and procedures, as well as all safeguard aspects, including TORs and Reports for the Environmental and

Social Impact Assessments (ESIAs) of the Projects, TORs and Reports for the Resettlement Action Plans (RAPs),Livelihood Restoration Plans for PAPs, Local Development Plans, environmental flows, need for an artificial flood, water resources management options and impacts of Climate Change on water availability, dam height as related to the number of potential PAPs, etc.

5. Phases of the Design Works and PoEs Review Works

5.1 Phases

The phases of the design works are the main drivers to identify the PoEs review works for each stage. They are classified here as it follows:

- Pre-Feasibility Study (PFS) (and River Basin Preliminary/Reconnaissance Study);
- Feasibility Study (FS);
- Detailed Design (DD);
- Construction Supervision (CS) (and Initial Commissioning);
- Operation & Maintenance (O&M).

Tasks in the TORs are divided per here above phases. Depending on actual progress on different projects, tasks and phases will (or will not) be triggered as part of the scope of work for the panels as defined hereunder and in the Appendix. From one phase to another, the Panel should also review complementary data and modifications from previous stages.

The Scope of Work is defined in detail but it cannot substitute the expertise of the members of the Panels, and during the course of their assignment, it may be modified as required. The Panels shall indeed, inter alia, review, comment, provide suggestions or recommendations as it deems prudent, or as requested by the Organization or its Consultant on any subject it considers vital to the safe and successful completion of the optimization, design, engineering, construction, and operation and maintenance of the Projects.

The Panels shall not perform any remedial designs but identifying potential lacking and giving general recommendations for potential solutions and approaches for corrective measures.

5.2 Comprehensive Options Assessment and 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 PoEs shall review Consultants' work covering all engineering, economic, environmental, and social aspects with their pros and cons for options selection (dam type, height, power generation capacity, etc.). The Panels shall assist the Consultants in

clarifying to the Client the tradeoffs between these aspects of the various project elements/decisions.

6. Scope of Work per Phase of Dam Safety Technical Panel (DS Panel)

6.1 Pre-Feasibility Study

6.1.1 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 water usages and state-of-the-art practices for climate change preliminary considerations;

(ii) the criteria and methods used to analyze flow regime and estimate flows available for the Project, design flood and flows to be diverted during project construction, the proposed reservoir operating levels, and the need to use other methods to improve accuracy of results, and to evaluate the risk factors associated with diversion during construction; and

(iii) the criteria and method of routing the maximum flows 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.

6.1.2 Engineering Geology and Geotechnical Engineering

Review the interpretation of the Geological Maps (regional geological formation, faults/lineaments, etc.) and first surface geological considerations. Review of the consultant TORs for geotechnical investigation including dam sites, associated facilities, quarries/borrow areas, reservoir areas, etc.

6.1.3 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 most suitable methods and sequences of project construction and operation and maintenance of the projects
- the effect of the proposed layout on future developments
- the preliminary acceptability of the layout and conceptual design including the access roads, and 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 type of dam.

Review of topographic survey, land use and Downstream Hazard Assessment (houses, infrastructure, etc.) for reviewing the required design criteria.

6.1.4 Power Evacuation and Transmission Lines

Review (i) the extent and sufficiency of the basic market data available; (ii) the criteria and methods for evacuating the energy generated by the project; and (iii) the preliminary acceptability of the layout and conceptual design for the transmission lines.

6.2 Feasibility Study

6.2.1 Hydrology, Hydraulics and Sediments

Review updates and complementary analyses added to prefeasibility stages including review of (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 water usages and state-of-the-art practices for climate change considerations; (ii) the criteria and methods used to analyze flow regime and 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 and of hydraulic downstream conditions that could impact safety of populations and/or assets. Review related mitigation structural and non-structural measures. Early warning system of flow releases will also be reviewed.

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.

6.2.2 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.

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

For embankment structures, review of the adequacy of core materials, filter materials, rockfill or riprap, and their necessary placement. The adequacy of proposed methods for acceptance of the materials and conditions for their placement, provisions for drainage and other details of embankment construction will be also reviewed.

For concrete structures, quality and sufficiency of concrete aggregates, pozzolans, etc.

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.

Seismic hazard assessment (probabilistic and deterministic seismic hazard approach) - Review the identification of sources/location of seismic activity, active faults/lineaments, 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.

Review the reservoir rim condition (slope stability, possible land slide area, water tightness, etc.)

6.2.3 River Development and General Layout/ size and layout optimization (dam site, power facility layout, optimal installed capacity, etc.)

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 effect of the proposed layout on future developments
- the most suitable methods and sequences of project construction and operation and maintenance of the projects
- potential risks that could affect the scheme or part of the scheme
- the acceptability of the layout and conceptual design including the access roads, and 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.

6.2.4 Power Evacuation and Transmission Lines

Review (i) the reliability of the market data available and market analysis; (ii) the criteria and methods for evacuating the energy generated by the project; (iii) adequacy of the network studies.

Review the adequacy of the transmission system of each project arrangement/layout. This review shall consider:

- the effect of the proposed interconnection on future developments,
- the acceptability of the transmission line routing;
- stability and safety design aspects of towers.

6.2.5 Type of Dam, Appurtenances and Project Layout

Review the selections of the type (arch, conventional concrete gravity, roller compacted concrete, CFRD, center-core rockfill, etc.), axis, and characteristics of the dam (and other hydraulic infrastructure such as saddle dams, weirs, canals…) and whether these selections are justified compared to alternative options.

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.)

Only for special case, 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 powerhouse arrangement, spillway types 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.

6.2.6 Construction Planning

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

6.2.7 Mechanical and Electrical Equipment

Review the technical and economic design and characteristics of major hydro-mechanical and electromechanical equipment (gates, hoists, cranes, turbines, generators, transformers, switchyard, SCADA etc.) and the design criteria comparing to state-of-the-art practices. Review cavitation risks at various hydraulic structures.

6.3 Detailed Design

6.3.1 Hydrology, Hydraulics and Sediments

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 and of hydraulic downstream conditions that could impact safety of populations and/or assets.

Provide comments on the test results/analysis reports for hydraulic models including selection of testing laboratory, models testing, and reports. Attend the model testing as required. Review cavitation risks at various hydraulic structures.

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.

Review data, criteria and methodology adopted with respect to reservoir exploitation (including warning systems), dambreak analysis and inundation maps used as inputs in the preliminary Operation & Maintenance plan and the Emergency preparedness plan.

6.3.2 Engineering Geology and Geotechnical Engineering

Review the quality and sufficiency of the engineering geology study reports, program for & 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 structures, review 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.

For concrete structures, concrete aggregates, pozzolans, etc. (quality and quantity).

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

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.

6.3.3 (River Development and) General Layout

Review adequacy of access roads under normal and adverse conditions and assess related risks.

6.3.4 Power Evacuation and Transmission Lines

Review (i) the reliability of the energy market data available and market analysis; (ii) the criteria and methods for evacuating the energy generated by the project; (iii) adequacy of the network studies.

Review the detailed technical design and characteristics of the control and protection equipment for the substation, transformers and transmission line.

Review the adequacy of the transmission system of each project arrangement/layout. This review shall consider:
- the effect of the proposed interconnection on future developments,
- the acceptability of the transmission line routing;
- detailed design criteria for transmission lines and towers,

6.3.5 Dam, Appurtenances and Project Layout

Review the axis, height, 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 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 until satisfactory and/or acceptable conclusions and recommendations.

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

Review the selection and design of water conveyance structures such as intakes, 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.

6.3.6 Construction Planning

Review the overall adequacy of the construction schedule, accesses to the various sites, 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 and the time allocated to each major activity.

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.

6.3.7 Mechanical and Electrical Equipment

Review the detailed technical design and characteristics of major equipment (turbines, generators, transformers, switchyard, gates/valves for spillway, intake, etc., hoists, cranes, SCADA etc.) and the design criteria following state-of-the-art.

6.3.8 (Dam) Stability Analysis and Design Criteria

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

Review the design criteria including hydrological and seismic safety level as well as geotechnical engineering aspects with due consideration to risks/hazard of particular dams. If required, dynamic analysis under seismic loads based on seismic hazard assessment results.

6.3.9 Foundation Treatment / 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.

Possibly review cut-off /diaphragm walls for seepage control and densification (stone column, etc.) for anti-liquefaction.

6.3.10 Soil/Rock Support Measures

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

Review tunneling works for penstock, reservoir rim slope stabilization if required.

6.3.11 Instrumentation Plan

Review the detailed Instrumentation Plan for the installation of instruments to monitor and record dam behavior and the related hydro-meteorological, geotechnical, hydrogeological, structural, and seismic factors.

Special care shall be devoted to 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.

6.3.12 Operation and Maintenance Plan (Preliminary)

Review the adequacy of the proposed preliminary operation and maintenance plan covering organizational structure, staffing, technical expertise, and training required; equipment and facilities needed to operate and maintain the dam; O&M procedures; and arrangements for funding O&M, including long-term maintenance and safety inspections.

6.3.13 Emergency Preparedness Plan (Framework)

Review the adequacy of the proposed framework Emergency Preparedness Plan. The plan specifies the roles of responsible parties when dam failure is considered imminent, or when expected operational flow release threatens downstream life, property, or economic operations that depend on river flow levels. It includes the following items: clear statements on the responsibility for dam operations decision making and for the related emergency communications; maps outlining inundation levels for various emergency conditions; flood warning system characteristics; and procedures for evacuating threatened areas and mobilizing emergency forces and equipment.

6.4 Construction Supervision

During construction, the DS Panel might be consulted for reviewing some specific construction drawings and studies as well as methods for supervision, especially those that can affect safety. It is reminded here that the role of the panel is advisory to the Owner. They will therefore not overtake any responsibilities as distributed in construction contracts.

6.4.1 Hydrology, Hydraulics and Sediments

Review and inspect the implementation at site of the choices and measures defined at design stage. Review flood protection measures implemented during construction (temporary dikes, early warning, design criteria for demobilization during flood periods, etc.)

6.4.2 Engineering Geology and Geotechnical Engineering

Review and inspect the implementation at site of the choices and measures defined at design stage. Review compliance of complementary geotechnical analyses with design criteria used at design stages.

6.4.3 (River Development and) General Layout

None unless necessary.

6.4.4 Power Evacuation and Transmission Lines

Review and inspect implementation on site and review compliance with choices and measures defined during design stages.

6.4.5 Type of Dam, Appurtenances and Project Layout

Review and inspect implementation on site and review compliance with choices and measures defined at design stages.

6.4.6 Construction Planning

Review the overall adequacy of planning forecasts and assess progress of the construction schedule including for accesses to the various sites, 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, and the time allocated to each major activity.

Respecting the unique responsibility of Contractor, proposing suggestion on the adequacy and soundness of the implementation 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 methods and sequences of construction.

6.4.7 Mechanical and Electrical Equipment

Review and inspect implementation on site versus choices and measures defined at design stages.

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

6.4.8 (Dam) Stability Analysis and Design Criteria

Review and inspect conditions and implementation on site versus assumptions, choices and measures defined at design stages.

6.4.9 Drainage Systems and Grouting

Review the adequacy and inspect the implementation at site of drainage systems used for the dam and its foundations, under and around the spillway and in the underground and open-cut excavations, as well as drainage galleries in the abutments and in the dam foundations and abutments.

Review the adequacy and inspect the implementation at site 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.

6.4.10 Soil/Rock Support Measures

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

6.4.11 Instrumentation Plan

Review the adequacy and inspect the implementation at site of the detailed Instrumentation Plan including installation of instruments to monitor and record dam behavior and the related hydrometeorological, geotechnical, hydrogeological, structural, and seismic factors. Review the staffing and training program for perennial employees who will be locally in charge of dam safety.

Special care shall be devoted to review the adequacy and inspect the implementation at site of those instruments or monuments which will 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.

6.4.12 Operation and Maintenance Plan (Final)

Review the adequacy of the proposed operation and maintenance plan covering organizational structure, staffing, technical expertise, and training required; equipment and facilities needed to operate and maintain the dam; review O&M procedures, including long-term maintenance and safety inspections, staff capacity (especially those in charge of dam safety) and arrangements for funding O&M.

6.4.13 Emergency Preparedness Plan (Final)

Review the adequacy of the proposed final Emergency Preparedness Plan. The plan specifies the roles of responsible parties when dam failure is considered imminent, or when expected operational flow release threatens downstream life, property, or economic operations that depend on river flow levels. It includes the following items: clear statements on the responsibility for dam operations decision making and for the related emergency communications; maps outlining inundation levels for various emergency conditions; flood

warning system characteristics; and procedures for evacuating threatened areas and mobilizing emergency forces and equipment.

6.4.14 Quality Assurance

Review and inspect the adequacy of source of water, cement, sand and coarse aggregates. review the methodologies for 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. Review the suitability and the adequacy of instructions and specifications for concrete 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. Also, core, filter, shell, riprap materials for embankment structures regarding materials tests, compaction, etc., and required in-situ and laboratory tests.

6.5 Operation & Maintenance (O&M)

At O&M stage, the Dam Safety Technical Panel will be requested to assess the soundness of the data processed at design stages versus new/on-the-ground information collected (new time series…). On this basis the Panel will assess the adequacy of the choices and measures defined at design stages and potentially recommend updates of studies and/or mitigation/preventive measures. The Panel will also review the availability, accessibility and clearness of the relevant documentation.

6.5.1 Hydrology, Hydraulics and Sediments

Cf. introduction of section 6.5.

6.5.2 Engineering Geology and Geotechnical Engineering

Cf. introduction of section 6.5.

6.5.3 (River Development and) General Layout

None, unless necessary for specific reasons.

6.5.4 Power Evacuation and Transmission Lines

Cf. introduction of section 6.5. Asses also the current status of the assets, with special care to equipment whose failure may jeopardize the security of the hydropower project.

6.5.5 Type of Dam, Appurtenances and Project Layout

None, unless necessary for specific reasons.

6.5.6 River Diversion

None.

6.5.7 Mechanical and Electrical Equipment

Asses the current status of the assets, with special care to equipment whose failure may jeopardize dam safety or the security of staff.

6.5.8 (Dam) Stability Analysis and Design Criteria

Cf. introduction of section 6.5.

6.5.9 Drainage Systems and Grouting

Cf. introduction of section 6.5.

6.5.10 Soil/Rock Support Measures

Cf. introduction of section 6.5.

6.5.11 Construction Schedule

Not applicable.

6.5.12 Instrumentation Plan

Cf. introduction of section 6.5. Assess the current status of the assets with special care to equipment (including monitoring equipment) whose failure may jeopardize the safety of the infrastructure.

Asses the reliability of data collection, processing and interpretation since first reading of the instrumentation, and the availability, accessibility, clearness and security storage of the relevant data base.

6.5.13 Operation and Maintenance (Plan and Practices)

Review the current operation and maintenance plan and practices covering organizational structure, staffing, technical expertise, and training required. Review equipment and facilities needed to operate and maintain the dam. Review O&M procedures (including routine and long-term maintenance and safety inspections), staff capacity and arrangements for funding O&M.

6.5.14 Emergency Preparedness Plan (under application)

Review the adequacy and the degree of implementation of the applicable Emergency Preparedness Plan. Review potential needs for updates or complements. Live tests might be required for assessing downstream impacts of extreme events (full start and stop of the plants, flood warning releases…)

6.5.15 Concrete

Cf. introduction of section 6.5. Review monitoring reports.

7. Scope of Work per Phase of Environmental and Social Panel

7.1 Pre-Feasibility Study

7.1.1 Documentation

Review and evaluate the preliminary TORs for the proposed Environmental and Social screening in compliance with (i) the country Environmental and Social requirements, (ii) the triggered operational safeguard policies of the World Bank or the World Bank Environmental and Social Framework, and (iii) the World Bank General Environmental, Health and Safety Guidelines (EHSG) of April 2007, as well as the World Bank Power Electric Transmission and Distribution EHSG, and other applicable EHSGs. This includes a preliminary stakeholder assessment, review of the Stakeholder Engagement Plan (SEP), preliminary inventory of potential socio-environmental impacts and preliminary review of land-related issues.

7.1.2 Social Impacts

The review of the social impacts should consider the following elements at preliminary levels:

- Land acquisition requirements and the scale of displacement;
- Social impacts downstream of the dam;
- Social impacts within, in the vicinity, downstream and upstream project's area;

7.1.3 Environmental Impacts

The review of the Environmental Impacts should consider the following elements at preliminary level:

- environmental impacts within, in the vicinity, downstream and upstream project's area;
- effect on flow regimes and on the water quality of the river/reservoir;

7.2 Feasibility Study

[Note: The preparation of the ESIA should be carried out in parallel with the Feasibility Study and the two Consultants as well as the two Panels should work closely together]

7.2.1 ESIA Documentation

Review and evaluate the TORs for the proposed Environmental and Social Impact Assessment (ESIA) in compliance with the country ESIA requirements and the triggered operational safeguard policies of the World Bank or the ESF, as well as the General Environmental, Health and Safety Guidelines of April 2007 and the World Bank Electric Power Transmission and Distribution EHSG as well as other applicable EHSGs. This includes a stakeholder assessment, SEP, inventory of impacts, review of land-related issues, and social impacts.

7.2.2 Social Impacts

The review of the social impact should consider the following elements:

- The TORs for the proposed Resettlement Action Plan (RAP) in compliance with the country land acquisition requirements and the World Bank OP 4.12 or the ESF
- Land acquisition requirements and the scale of displacement; Social impacts downstream of the dam and need for an Artificial Flood to mitigate these social, as well as environmental impacts
- Determination of the correct height of the dam and the size of the reservoir in relation to expected resettlement;
- Social impacts upstream of the reservoir area and downstream of the dam;
- Review of a minimum two public consultation meetings: (i) the first one on the ESIA TORs to verify that all concerns of affected people are included in the TORs and (ii) the second one concerning the Final Draft ESIA Report. Adequacy of the Stakeholder Engagement Plan (SEP);
- Project-Affected People (PAP) and key stakeholders in upstream, reservoir area 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 in the immediate basin area;
- Census and socioeconomic survey;
- Impact of river flow regimes on communities, including environmental flows and artificial/regulated floods;
- Impact of population influx during and after construction;
- Worker's Camp Management Plan;
- Code of Conduct to be signed by workers prior to start work, including the prohibition of child labor, forced labor, sexual harassment and sex with minors (<18 years);
- Capacity of governmental and non-governmental services that are locally available with particular reference to disease control;
- Jobs' losses and jobs' creation, including indirect economic activities;
- Availability and cost of alternative land to be provided to PAP;
- Vulnerable population;
- Impact of any resettlement on neighboring and host 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;
- Functioning of the Grievance Redress Mechanism (GRM) for workers and communities;
- Other social and cultural impacts, including issues related to cultural property;
- Determination of the adequacy of the preliminary Early Warning System.

Review of the ESIA including the identification of the base-line situation, expected impacts of the project, and the mitigation and monitoring plans developed for the Environmental

and Social Management Plan (ESMP). Adequacy of the ESMP's institutional arrangements and budget.

7.2.3 Environmental Impacts

The review of the Environmental Impacts should consider the following elements:

- (cumulative) environmental impacts upstream of the dam, in the reservoir area and downstream of the dam;
- Effect on the hydrology and on the water quality of the river/reservoir;
- Ecological effects of the flooding and construction activities, including risks to natural and critical natural habitats and topographical impacts that would induce landslides or flooding;
- Impacts of the changed river flow regime, including impact due to river impounding upstream of the dam, and river with reduced flows downstream of the dam;
- Determination of the ecological flow between the dam and the tailrace discharge;
- Determination of the need for an Artificial Flood;
- Effect and impact on river and reservoir aquatic fauna and flora and potential for maintaining them, as well as the impacts on terrestrial fauna and flora (protected areas);
- Likelihood of reservoir stratification and management of the stratification;
- Biomass removal 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;
- Impacts of remaining biomass on water quality;
- 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 and development of shanty towns and prostitution;
- Potential for increased incidence of water borne and water related diseases;
- Impact on fisheries and other sources of local income;
- Analysis of relevance and potential need for fish ladders;
- Risks of invasion of aquatic species, such as water hyacinth and others;
- Determination of the need for a Catchment Management Plan in order to manage sedimentation.

Review of the ESIA including the identification of the base-line situation, expected impacts of the project, and the mitigation and monitoring plans developed for the Environmental and Social Management Plan (ESMP), including adequate institutional arrangements for the ESMP implementation during construction and operation;
Adequacy of the ESMP budget.

7.2.4 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, economic or physical displacement of households, and impact on household incomes and overall livelihood.

The Panel will also review the minutes of consultation meetings to ensure sufficient information dissemination to the project affected people. The composition of the meetings (women, youth, vulnerable groups) will also be reviewed to ensure inclusive consultations have taken place.

Review the Grievance Redress Mechanism (GRM) for PAPs.

7.2.5 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, as well as the safety related to water released from the dam during operation (Alert System including potential regulated warning water releases).

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 environmental monitoring and surveillance plans.

The Health and Safety Plan to be prepared and implemented by the contractors need to be in compliance with OHSAS 18001:2007, NEBOSH or similar standards.

7.3 Detailed Design

At detailed design stage, the E&S Panel will review any additional information or modifications in project's design that could affect any socio-environmental components of the project (as described hereabove at Feasibility Stage). When needed, this will include review of updates or addendums to ESIA, ESMP, RAP…

Moreover, the E&S PoE will review all requirements derived from all E&S activities and reports to be included in the Bidding Documents (and future contracts), including requirements from ESIA, ESMP, RAP, GRM, Labor Influx Management Plan, Emergency Preparedness Plan etc. as well as Health and Safety requirements and Gender Based Violence prevention requirements.

7.4 Construction Supervision

Prior to the start of construction, the E&S Panel will verify that the RAP for the Construction area has been fully implemented and all compensation and assistance has

been provided as agreed to the PAPs. The Panel will also verify that the GRM is functional (log of grievances with details on each case and its outcome, PAPs aware of the GRM). Panel will assess the management of proposed Gender Based Violence (GBV) prevention measures. The E&S Panel will do the same verifications for the area of the reservoir six months before filling the reservoir.

At construction stage, the E&S Panel will (i) assess the soundness of the data processed at design stages versus information newly collected through construction activities and (ii) assess compliance of the implementation of construction activities and mitigation measures with E&S requirements defined in previous stages. On this basis the Panel will assess the adequacy of the choices and measures defined at design stages and potentially recommend updates of specific studies and of targeted mitigation/preventive measures. The Panel will also review the availability, accessibility and clearness of the relevant documentation, including reports prepared by the Owner's Engineer.

7.5 Operation & Maintenance

At O&M stage, the E&S Panel will assess (i) adequacy of the E&S monitoring procedures, staffing and capacity, (ii) E&S monitoring reports and surveys and (iii) compliance of the E&S activities and mitigation measures with requirements defined in previous stages. On this basis the Panel will assess the adequacy of the choices and measures defined in previous stages and potentially recommend updates of specific studies or of targeted mitigation measures. The Panel will also review the availability, accessibility and clearness of the relevant documentation

8. Configuration and Membership of the Panels

8.1 Separated and Independent Panels

Whilst it is crucial to ensure the coordination between them, the two Panels (the Dam Safety Technical Panel and the Environmental & Social Panel) shall be established separately and independently.

8.2 Organization Project Coordinator

The WAPP Secretariat General (SG) will hire the services of the Experts for each Panel.

WAPP SG 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.

8.3 Recruiting and Conflict of Interests

The 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 activities for the projects.

8.4 Composition of the Panels

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

Dam Safety Technical Panel

- Dam Specialist;
- Senior Hydrologist;
- Engineer Geologist with geotechnical expertise;
- Electromechanical Specialist;

Environmental and Social Panel

- Social, Resettlement and Livelihood Restoration Specialist;
- Environmental Specialist;
- Health and Safety Specialist.

8.5 Continuity of Knowledge vs. Evolving Competencies along the Project Cycle

The constitution of Panels may change over the project cycle, but it is highly desirable to have a strong continuity maintained.

The Organization is planning to utilize the same Panels for several projects and for different phases of these projects. They will dedicate special care to the position of Dam Specialist as requested profile may be evolutive. Indeed, apart for the very first tasks where broad skills may be required, requirements for dam safety specialist's expertise / qualification could vary over time. For example, it would not make sense to ask a seasoned RCC specialist to review rockfill dam design and vice versa. A flexible composition of the Panel may be then considered as well as mobilization of ad-hoc expertise.

8.6 Chairpersons

The permanent members of the Panels shall appoint a Chairperson of each Panel.

The Chairperson will coordinate the communications of the Panels, chair its meetings, ensure the membership's objectivity, and provide balance in its reviews and recommendations.

WAPP SG/ PIPES 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.

8.7 Responsibility of the Panel and Tasks of Each Member

Some Tasks listed in the Scope of Work are allocated to all members while other may be easily and primarily allocated to well identified members.

Nevertheless, under the Chairperson coordination, the Panel's reports are a jointly responsibility of the entire Panel.

8.8 Complementary Experts

As per the profiles of Panels', the Experts will complement each other in order to cover, as much as possible, the range of topics submitted to their expertise. When not possible, complementary experts might be mobilized.

The Panels may request the assistance on a temporary basis of other specialized experts in areas where, in the Panel's opinion, it is advisable to do so. Inter alia, such complementarity could be sought in fields such as generation planning, sedimentation, seismology, hydraulic model testing, structural model testing, grouting, concreting, rock mechanics, climate change impacts on water availability, energy modeling etc. 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.

9. Qualifications for Recruitment of Experts

9.1 Shared/ Common requirements

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

All experts should master Microsoft Office Suite (Word, Excel, Outlook etc.)

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 oral and written communication skills.

Dam Safety Technical Panel

9.2 Dam specialist

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 ideally 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, knowledge of international standards and best practices by ICOLD, etc.

The Expert shall have recognized competences in dam safety and be familiar with WB Operational and Bank Policies (OP/BP) especially on dam safety. Working knowledge in 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 will also be considered favorably.

9.3 Senior Hydrologist

The Expert required is expected to have at least 20 years of professional experience in hydrology related to hydropower and/or dam projects, with proven track record in dealing with climate change adjustments and ideally 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, and reservoir impoundment.

The Expert shall have working knowledge of World Bank dam safety policies and, ideally, of 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 will be also considered as an asset.

9.4 Engineer 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 ideally 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 will be evaluated favorably.

9.5 Electro-mechanical Specialist

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

Expertise shall cover key design aspects of turbine, 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, ideally, regulations in ECOWAS region.

Hands on experience in SCADA, balance of plants, operation & maintenance of hydropower plants and dam monitoring would be evaluated favorably.

Knowledge of World Bank dam safety policies would also be a significant advantage.

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

Environmental & Social Panel

9.6 Social Specialist

The Expert is expected to have at least 20 years of international experience in assessment, preparation and implementation of Resettlement Action Plans 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 safeguard policies (especially OP 4.12 on Involuntary Resettlement), rules and guidelines as well as local and international standards for relocating people.

9.7 Environmental Specialist

The Expert is expected to have at least 20 years of international experience in the assessment of environmental impacts and preparation 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 safeguard policies, rules and guidelines as well as local and international regulatory standards on environmental issues.

9.8 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 sites, 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 safeguard policies, rules and guidelines as well as local and international health and safety standards.
- The Health and Safety Specialist should be OHSAS 18001: 2007, NEBOSH or similarly certified.

10. 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 to assist in formulating scopes of works, at inception stages and at issuance of key deliverables from various Consultants.

The Panels will among others assess the status and quality of work and formulate 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. The Panels shall agree with the WAPP SG 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 is expected to take around one week including travel.

On selective and time bases, the services of the individual members of the Panels will 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.

The WAPP SG shall inform with the necessary anticipation the financing institution 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.

11. Reporting / Invoicing

The Panels of Experts shall document the results of each one of (i) their reviews (ii) meetings and (iii) of the overall conclusions and recommendations following their visits and 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 single, all-in-one reports.

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 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 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) and General Environmental, Health and Safety Guidelines of April 2007, as well as the World Bank Electric Power Transmission and Distribution EHSG.

After each meeting and after reception of integrated reviews, the WAPP SG 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 in accordance with WB standard allowances.

12. Supporting Services

The WAPP SG shall make available its authorized personnel and that of the Consultants of the Project for discussions with the Panel of Experts as per request of the Chairperson of each Panel. They shall be present during the meetings with the Panel or at least provide written responses to preparatory requests and questions. The WAPP SG 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 shall provide clerical, drafting and documentation reproduction services during the meetings and for the preparation of the Panel's reports. The WAPP SG 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.

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 socio-environmental 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. The LIDAR data will need to be shared between the Feasibility Consultants and the ESIA/RAP Consultants. 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.

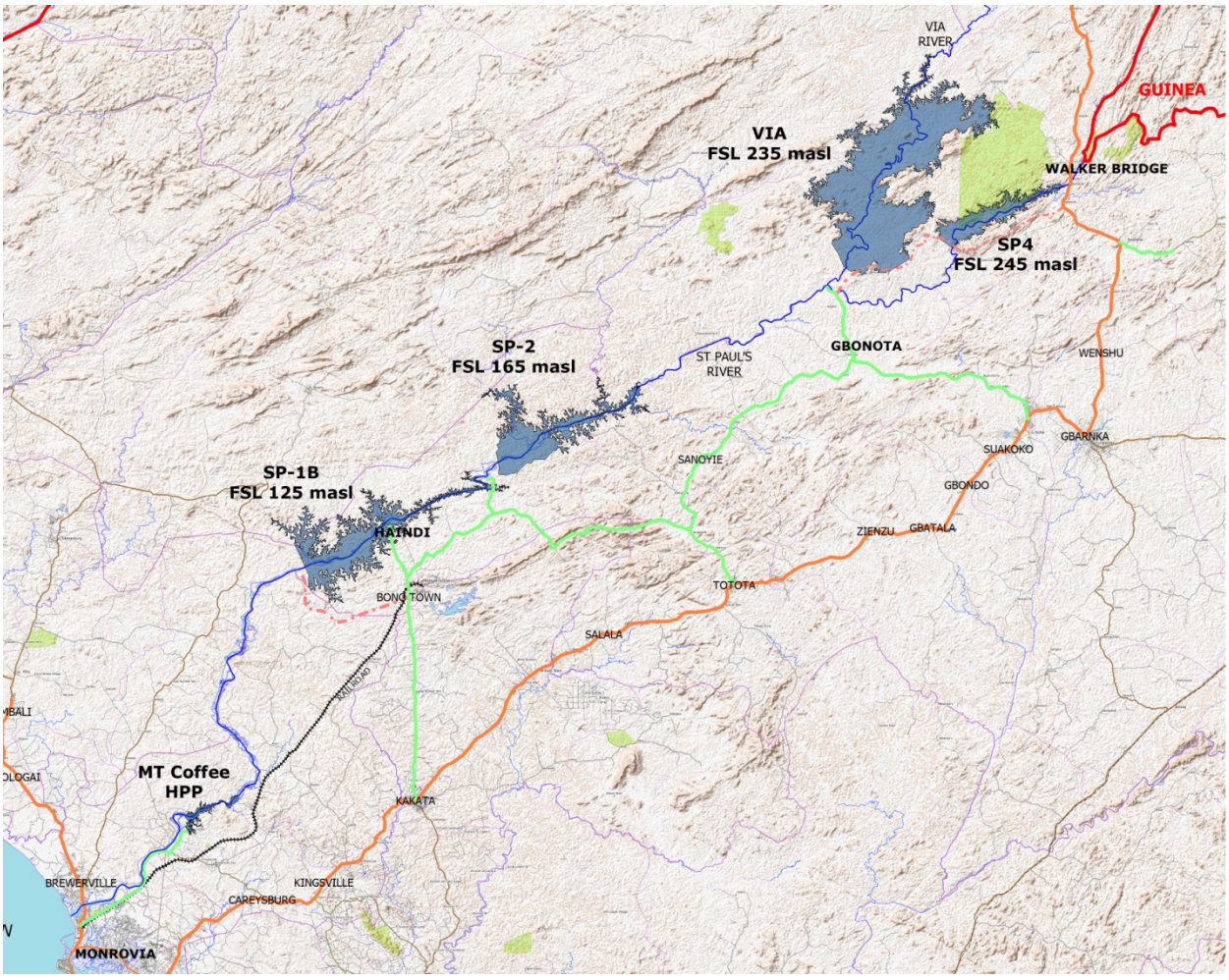

Figure 1 St. Paul River Hydropower Cascade as Studied by Chas. T. Main Int'l in 1982, and updated by Hydrotec in 2018 using LiDAR

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.

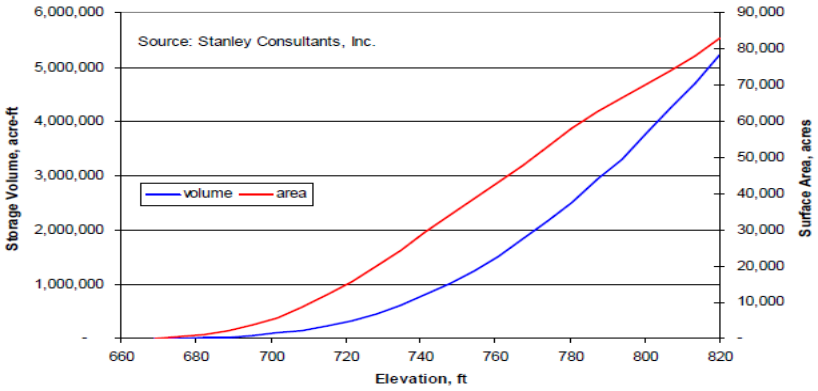

Figure 2 Via Storage Reservoir Elevation versus Volume and Area (by Stanley Consultant 2008)

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 and RAP 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 (ESIA) 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 height, reservoir size, water conveyance structures, HPP, substation, transmission lines, quarries and access roads; 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, artificial floods, needs for maintaining the ecological continuum, forestry management, watershed 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.

Project Documents

To be made available to the Panels of Experts:

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

WB and other

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