

ASSAM POWER GENERATION CORPORATION LTD. (APGCL)

REQUEST EOI FOR PROJECT MANAGEMENT CONSULTANT

The Assam Power Generation Corporation Ltd. (Executing Agency – EA) is desirous of engaging a reputable and experienced firm ("the PM Consultant") for the project implementation of a 120MW Hydro Power project in the state of Assam in India. The Consultant must have capability in the design and operations of storage hydropower plants and in the project/contract management and construction supervision. The PM Consultant will also coordinate and supervise construction packages during the construction period, and assist EA to operate the plan in the most efficient way. In particular, the PM Consultant will be responsible for supporting the EA in project administration, design and engineering services, contracting, management control, procurement and expediting of equipment, materials control, inspection of equipment prior to delivery, shipment, transportation, control of schedule and quality, pre-commissioning and completion, performance guarantee testing, inventorying spare-parts, training of owner's/plant sub-system operating and maintenance personnel, all financial, human resources and administrative management of the project both during construction and operation phase under the company's board.

The PM Consultant should be a hydropower developer/electric utility/any other consulting and engineering firms having adequate international experience in detailed design, selection, monitoring, supervisions and co-ordination of contractor(s), operation and maintenance of hydropower project.

The consultant will be appointed for a period as mentioned here :• 1 year of pre-construction stage, •4 years of construction stage and •1 year of operation stage. On successful completion of two years of operation, the contract may be further renewed.

Expected date of commencement of the assignment is January 2017

Estimated Budget for the Project Management Consultants service is approx. USD 12.00 million

The detail advertisement for submission of Expression of Interest (EOI) will be available in the following Websites during the month of June 2016

- www.cms.adb.org
- www.apgcl.org

The detailed terms of reference are as placed below:

TERMS OF REFERENCE FOR THE PROJECT MANAGEMENT CONSULTANT

1. Background

The proposed Lower Kopili Hydroelectric Project (LKHEP) is the second stage development of Kopili River Catchment Area in the east of Karbi Anglong district of Assam, near Longku. The first stage which is upstream of the proposed LKHEP, consists of (3 x 25 MW) Kandong HEP and (4 x 50 MW) Kopili HEP schemes. Both the projects are operated and maintained by North East Electric Power Corporation (NEEPCO).

The scheme has been contemplated to run at full potential in monsoon season and operate as a peaking station in non-monsoon season. The installed capacity of the project has been adopted as 120 MW comprising of the Main Power house with 2 units of 55 MW each and an Auxiliary Power house with an installed capacity of 10 MW located at the dam toe.

Lahmeyer International India (LII) Pvt Ltd, Gurgaon was engaged for preparation of the Detailed Project Report ("DPR"). The DPR of LKHEP was submitted to the Central Electricity Authority for techno-economic clearance, and the clearance was received in August 2015.

Environment Impact Assessment (EIA) and Social Impact Assessment (SIA) studies for the project were conducted by WAPCOS Ltd, Gurgaon as consultant to APGCL. The EIA Report (revised) submission is expected during March-April 2016 and the final environmental clearance is expected in the first part of July 2016.

The salient features of the Lower Kopili HEP are presented in the Annexure A

APGCL (the Executing Agency – EA) is desirous of engaging a reputed and experienced firm as the Project Management Consultant ("the PM Consultant") for supervision of construction of LKHEP and its initial operations. The PM Consultant should have the capability to design and operate storage hydropower plants, and in project management, contract management and construction supervision. The PM Consultant will also coordinate and supervise all contract packages during the construction period, and assist APGCL to operate the power plant in the most efficient way.

The PM Consultant will be appointed for a period as mentioned below:

- 1 year for pre-construction stage,
- 4 years during the construction stage and
- 1 year of operation stage

2. Objectives of the Assignment

The PM Consultant will be responsible for supporting the APGCL in project administration, design and engineering services, environmental and social safeguards implementation, contracting, management control, procurement and expediting of equipment, material control, inspection of equipment prior to delivery, shipment, transportation, control of schedule and quality, pre-commissioning and completion, performance guarantee testing, inventorying spare-parts, training of owner's/plant sub-system operating and maintenance personnel, all financial, human resources and administrative management of the project during construction and operation phases.

The PM Consultant should be a hydropower developer/electric utility or other consulting and engineering firm with adequate international experience in detailed design, equipment selection, project monitoring, supervision and co-ordination of contractor(s), and in operation and maintenance of hydropower plants.

Specific experience in the areas of:

- (i) Hydropower development with storage reservoirs,
- (ii) Inflow forecasting and operational scheduling of cascade hydropower plants,
- (iii) Dam safety,
- (iv) Effective sediment management,
- (v) Asset management in hydropower plants,
- (vi) Implementation of social and environmental safeguards for hydropower projects in accordance with internationally accepted guidelines and practices (such as those of ADB, and other international financial institutions), and
- (vii) Training and skill transfer programs for staff recruited locally in hydropower projects outside the bidder's country will be advantageous.

The tentative construction packages will be the following:

Package 1: General Infrastructure for the main power plant and the auxiliary power plant. (Access roads, accommodation, power supply);

Package 2: Major Civil works. (Dam, and for the main power plant, water conveyance systems, hydro-mechanical works, power plants and switchyard); and

Package 3: Electro-mechanical works in the main power plant. (Turbine, generator, switchyard, controls, etc.).

Package 4: All works directly associated with the auxiliary power plant

The PM Consultant shall assist APGCL to coordinate various activities so as to achieve effective project implementation within the stipulated time and budget.

The PM Consultant shall also prepare operating procedures to ensure effective operation of the plant and equipment. This should include activities for condition monitoring program (for example, turbine runner non-destructive testing), a functional testing program, routine preventative maintenance activities and prepare asset management plans for the power plant covering electro-mechanical as well as hydro-mechanical plant. The information presented in this plan will be used by APGCL for their future planning of plant outages and budgeting.

3. Detailed Scope of Work

The services for the PM Consultant are divided into 2 phases:

Phase A: Project Preparation

Phase B: Project Implementation

The services for Phase B can be split in 3 sub-phases:

- (i) Review of the detailed design, Supervision of construction and erection, and contract management
- (ii) Commissioning up to Project Acceptance Certificate (PAC) and Commercial Operation Date (COD).
- (iii) Operation after COD up to Final Acceptance Certificate (FAC).

Consultancy services of Phase A are deemed to be fulfilled with the evaluation of bids from potential EPC contractors. Based on the construction costs of the given proposals, APGCL will decide on whether to proceed with the project or not.

In case of a positive decision by APGCL to proceed with the project, the next phase (Phase B: Project Implementation) will be assigned to the PM Consultant.

The APGCL has the right, based on unsatisfactory performance, to end the contract with the PM Consultant after Phase A.

In both cases, the PM Consultant does not have any right to claim for compensation.

However, the PM Consultant is required to submit an offer for both Phase A and B.

3.1 Scope of Work – Phase A

Phase A covers the services required in the procurement of EPC contractors to implement the LKHEP. Phase A of PM Consultant's work will commence as soon as the letter of award is issued by APGCL, with a joint kick-off meeting in Guwahati. The main tasks of Phase A will include but will not be limited to:

- (i) Review of existing studies and documents.
- (ii) Risk assessment
- (iii) Optimization and finalization of the design (according to FIDIC red/pink book for the basic design).
- (iv) Design an environmental and social management system with project-specific environmental and social management plans.
- (v) Coordinate design finalization
- (vi) Cost calculations
- (vii) Define quality measures, sustainable standards and milestones for EPC contractors.
- (viii) Conduct the tender engineering and prepare tender documents to select EPC contractors.
- (ix) Conduct together with APGCL the tendering process and evaluation process to select EPC Contractors, and assist and guide APGCL through negotiations with the selected bidders.
- (x) In consultation with APGCL and ADB, prepare contract documents for EPC Contractors, and assist and guide APGCL through the contract finalization.
- (xi) Reporting and documentation.

The above tasks are further elaborated below

3.1.1 Review of existing studies and documents

Before commencing the front end design services, the existing data and documents have to be thoroughly reviewed and analysed. The activities to be undertaken by the PM Consultant shall include but will not be limited to:

- (i) Review and be familiar with the final updated and approved version of the DPR for LKHEP undertaken by Lahmeyer International (India), the EIA and SIA report prepared by WAPCOS Ltd, Gurgaon, supplemental environmental and social assessments, and all other relevant reports or background reports and data.
- (ii) Review and be familiar with reports on additional geotechnical, hydrological and topographical studies.

- (iii) Review and be familiar with all approval certificates/documents and statutory requirements required for the commencement of construction activities.
- (iv) Check the proposed access road options and quarries.
- (v) General check on assumptions and design features.
- (vi) Identification of weak points, missing or insufficient data.
- (vii) Identification and scope of additional studies and investigations, if required.
- (viii) Develop a Communication Management Strategy that describes the means and frequency of communication with parties both internal and external to the project.

3.1.2 **Comprehensive Risk Assessment**

- (i) Conduct a risk analyses and advise APGCL on potential risks during the design, construction, commissioning and operational phases of the project;
- (ii) Develop a Risk Management Strategy that describes the specific risk management techniques and standards to be applied, and the responsibilities for achieving an effective risk management procedure;
- (iii) Prepare a report on strengths and weaknesses of the project with detailed suggestion and guidance to APGCL, of optimisation and sustainability for the next project phases;
- (iv) The PM Consultant has to take into account a worst case scenario for different risks and show the impact and how to deal with it, reduce or eliminate it.

3.1.3 **Basic Design and Specifications**

Based on the design review conducted in the DPR, the risk analyses and possible new aspects/options a basic design and value engineering has to be done. Geological, geo-technical conditions and seismicity in selection of type of structures and foundation of the various project components have to be taken into account. Interfaces have to be considered and optimised. A Design Intent Memorandum should be prepared.

Additional flow measurements from the newly-installed gauging station upstream of the Lower Kopili Reservoir have to be considered in estimating the energy output and layout of the project.

Specifications for the design, construction and operation of the LKHEP shall be defined and prepared.

This basic design will be the source for the tender documents. It has to be sufficient and clear that a potential EPC Contractor is able to submit a proposal. All findings and design will be submitted in a basic design report.

The major aspects of the design work would be, but not limited to, the following:

Civil Engineering and Works

- Basic design and optimisation of the LKHEP design and components, based on the available and additional studies, investigations and peer reviews;
- Study on alternative layouts for waterways (surface penstock instead underground pressure shaft) with respect to geotechnical information and review reports;
- Undertake basic structural calculations, geotechnical calculations and stability analysis with respect to the given boundary conditions (seismic, geotechnical, topographical, etc.), load cases and operating conditions;
- Define provisions for installations and technical equipment;
- Define safe sediment flushing operational release requirements from the reservoir;
- Define and prepare the scope for hydraulic model studies of the dam spillway, reservoir flushing and power intake;
- Define architectural features;
- Define location and concept of the civil works components;
- Define access roads and infrastructure requirements;
- Select appropriate alignments for permanent and temporary access roads for the entire project;
- Define location for workshop sites and works camp;
- Define procedure for operation during flood events;
- Define specifications for materials and construction procedures (e.g. concrete works, steels works, etc.);

- Define specifications for community development measures and mitigation measures related to all approvals.

Electrical Equipment – Main and Auxiliary Power Plants

- High and low voltage layout;
- Switchyard;
- Auxiliary power supply;
- Generator equipment;
- Transformers;
- Protection systems;
- SCADA;
- Auxiliary electrical equipment (power house and intake; tapping possibilities for the villages);
- Communication system;
- HVAC system;
- Switchgear, HV equipment (breakers, disconnectors, etc.), busbar arrangement, Interface to civil works;
- Earthing;
- General aspect of installation and operation;

Mechanical and Hydraulic Steel Elements - Main and Auxiliary Power Houses and Spillway Gates

- Turbine;
- Turbine governor;
- Valves;
- Gates, stop-log system;
- Auxiliary mechanical equipment;
- Trash racks and rack cleaner (if proposed);
- Penstock and penstock manifold;
- Interface to civil works;
- General aspects of installation and operation.

Balance of Plant - Main and Auxiliary Power Houses

- Auxiliary transformers;
- Black start and isolated grid system (based on the turbines);
- Low voltage switchgear;
- Ancillary systems;
- Hydraulic aggregates and system;
- Fire fighting system;
- Cooling water system;
- Pumping systems;
- Compressors;
- Cranes with attendant facilities.

Drawings

The Consultant will provide sufficient drawings to show all the LKHEP components and their dimensions in an appropriate scale, to establish the magnitude and the characteristics of the works, to enable the EPC contractors to fully understand the project. These drawings shall include:

- General arrangement and layout drawings of LKHEP and the structures;
- All relevant geological and geotechnical maps and sections;
- Sufficient cross sections of the intake, power house and channels;

- Longitudinal sections of all waterways;
- Details if required for a better understanding;
- Hydraulic schemes;
- Diagrams for electrical systems;
- Control and communication layout;
- Alignments of permanent and temporary access roads and bridges.

Environmental and Social Management Plan (ESMP)

The PM Consultant shall establish an Environmental and Social Management Plan (ESMP) and perform the necessary monitoring.

For the requirements of the Resettlement Action Plan (RAP) and ESMP, the PM Consultant has to cover follow issues:

- (i) Establish, in cooperation with APGCL, an environmental and social management system with project specific ESMP including contributions to a Catchment Management Plan, considering the provisions set in the EIA and SIA reports and the conditions set in the Ministry of Environment and Forestry and Climate Change (MOEF&CC) approvals , as well as additional requirements of ADB;
- (ii) Update the environmental and social baselines: Baseline information will be required upstream of the reservoir and downstream of the tailrace and for the Kopili River ecosystem. This will require the review of existing documentation, including EIA and SIA reports for the LKHEP. Undertake field studies as necessary to fill identified gaps, and to confirm and update monitoring indicators. Indicators to be monitored should be well articulated with clear frequency and resources for monitoring;
- (iii) Providing necessary information to the Resettlement Action Plan. The PM Consultant requires to support the update of the figures for land acquisition, types and numbers of project affected people etc., under consideration of the final project layout;
- (iv) Ensure that management plans prepared by the contractors are compliant with the ESMP and oversee their implementation;
- (v) Preparation of monthly reports on compliance on all environmental and social/community aspects including grievances (Environmental and Social Performance Reports, covering APGCLs Environmental and Social Management as well as the implementation of construction contractor's ESMP);
- (vi) APGCL environmental management staff shall be continuously involved in environmental and social impact management tasks in order to build up further capacity on environmental and social impact management and monitoring.

Cost Calculations

Based on the findings, design and risk assessment, the PM Consultant will provide a cost calculation for the project and the necessary construction, infrastructure and compensation measures.

The cost shall be split as follows (separately for Main and Auxiliary Power Plants):

- (i) Civil works;
- (ii) Infrastructure;
- (iii) Electrical works;
- (iv) Mechanical equipment;
- (v) Hydro mechanical Equipment;
- (vi) Balance of Plant;
- (vii) Switchyard;
- (viii) Compensation payments as of RAP study;
- (ix) Community development initiatives;
- (x) Land purchases;
- (xi) O & M costs.

All other additional project costs such as taxes, local taxes, duties and levies, insurances, etc. have to be considered as well.

The investment and running costs will be used as the basis for establishment of expenditure cash flow schedules.

3.1.4 **Implementation Schedule**

The PM Consultant will submit a comprehensive schedule for the next steps to realise the LKHEP, and indicate the major milestones and work tasks of the project.

Parts of the implementation schedule are also the different construction works and installations, and also including temporary works and river diversion.

3.1.5 **Quality Assurance**

The PM Consultant has to define the standards, measures and methods for quality assurance during design, construction, installation and operation phase, for a reliable and sustainable hydroelectric project, as follows:

- (i) Define quality measures and standards for the services and installed equipment of EPC contactors;
- (ii) Define codes and general standards applied, for design, construction and equipment;
- (iii) Define schedule, quantities and type of testing procedures – define testing and commissioning procedures and standards;
- (iv) Define working conditions and requirements to be in line with the safety and socio-ecological requirements of the RAP, EIA, SIA, and project affected persons;
- (v) Develop a Quality Management Strategy (QMS) that defines the quality techniques and standards to be applied, and the various responsibilities for achieving the required levels during the project.

3.1.6 **Tender Process**

The Tender process shall be executed in two stages:

1. Prequalification and
2. Tender phase.

Prequalification

The PM Consultant shall:

- (i) Establish the prequalification procedure in accordance with ADB's guidelines and regulations;
- (ii) Prepare the prequalification documents including the evaluation criteria;
- (iii) Prepare the general procurement notice and the invitation for prequalification, to be advertised by APGCL;
- (iv) During the preparation of applications for prequalification, support APGCL in responding to requests for clarifications raised by the applicants;
- (v) Carry out evaluation of the applications together with APGCL and prepare a detailed evaluation report;
- (vi) Maintain contact with ADB during evaluation procedure;
- (vii) Prepare information on the results of the evaluation to be sent to the applicants.

Tender Phase

The PM Consultant shall prepare comprehensive and consistent tender documents with the aim of achieving the most economical tender prices and equitable sharing of risks between the parties to the contract.

The tender/contract package of documents for the EPC Contractors shall be structured as follows:

- Part I: Instruction to EPC Tenderers
- Part II: General Conditions of Contract
- Part III: Special Conditions
- Part IV: Performance Specifications

Part V: EPC Tender Drawings

Part VI: Forms and Schedules

Part VII: Supplementary Information.

Within these documents, at least the following general items have to be defined and settled:

- Liability;
- Payment Terms;
- Price Adjustment;
- Warranty;
- Guarantee;
- Penalties;
- Insurance;
- Force Majeure;
- Applicable Law, Settlement of Disputes.

The tender services shall include:

- (i) Ensuring that the EPC contractor tender documents respect the terms and guidelines for procurement of the project financing institutions and international standards such as the FIDIC books;
- (ii) Conducting an international tender process (2 envelopes) and one or two lots;
- (iii) Supporting APGCL with responses to questions / requests for clarifications raised during the tender process;
- (iv) Together with APGCL, conducting the evaluation process of the EPC Contractor, assessment of the technical and financial proposals from the prequalified bidders.

Contracting

This task includes the following services of the PM Consultant:

- (i) Drafting the EPC Contract;
- (ii) Participation in the award process and negotiations;
- (iii) Recommendation and assistance in contract finalization;
- (iv) Assistance and guidance during financial negotiations until financial closure;
- (v) Participate in negotiations and assist in contract finalisation etc. with the second best evaluated bidder provided that negotiations with the best evaluated bidder have not been successful.

3.1.7 Reports and Documentation

The reports and documents to be prepared by the PM Consultant during Phase A need to be submitted to APGCL, first as a draft and after review, in a final version. These reports shall be:

- (i) Communication Management Strategy;
- (ii) Review Report;
- (iii) Risk Assessment Report;
- (iv) Basic Design and Specification Report together with the Drawings;
- (v) Environmental and Social Management Plan;
- (vi) Prequalification Documents;
- (vii) Report on Prequalification Evaluation;
- (viii) Tender Documents together with the Tender Drawings;
- (ix) Consultant Cost Estimate and Implementation Schedule;
- (x) Any Addenda issued during the course of tendering;
- (xi) Evaluation Report of technical proposals;
- (xii) Evaluation Report of financial proposals;

- (xiii) Summary of Evaluations and Recommendations for Award;
- (xiv) Drafting of EPC contracts;
- (xv) Documentation of contractual negotiations.

The reports shall be submitted according to the following timetable, but not necessarily limited to these:

Reports	Delivery in months after commencement
Communication Management Strategy	0.5
Review Report	1.5
Risk Assessment Report including the Risk Management Strategy	1.5
Basic Design and specification Report together with the Drawings	3.5
Environmental and Social Management Plan	4.0
Cost estimate and Implementation Schedule	4.0
Quality Assurance Report including the Quality Management Strategy	4.0
Prequalification documents	1.0
Reports on Prequalification Evaluation	2.5
Tender Documents together with tender Drawings	5.0
Evaluation Report on Technical proposals	To be agreed on the basis the tendering schedule
Evaluation Report on Financial Proposals	To be agreed on the basis the tendering schedule
Summary of Evaluation and Recommendations for Award	To be agreed on the basis the tendering schedule
EPC Contracts	To be agreed on the basis the tendering schedule
Documentation of contractual negotiations	To be agreed on the basis the tendering schedule

All the above reports shall be simultaneously submitted in draft to APGCL in two (2) hard copies and by e-mail to APGCL and ADB. APGCL shall review and comment on the submitted reports by email within two weeks from the date of receipt. The PM Consultant shall be expected to incorporate these comments within two weeks. The final reports have to be resubmitted in 2 hard copies and by e-mail.

3.2 Scope of Work – Phase B

Phase B covers the services of supervision of the EPC contractors to realise the LKHEP. It will be divided in three sub-phases:

1. Design, Construction and Erection
2. Commissioning up to PAC and COD
3. Operation after COD up to Final Acceptance Certificate (FAC)

The PM Consultant shall act as an implementation engineer on taking over responsibility for all engineering/design activities for the entire implementation phase until Commissioning, PAC, COD and FAC. The PM Consultant shall review, supervise and follow up the design, implementation schedule and prepare the required documents and certificates. The main tasks are shall be, but not limited to, the following:

- (i) Review and comment on all submitted designs, documents, implementation plans and reports submitted by EPC contractors;
- (ii) Advice APGCL on design changes, quality measures, implementation plans, etc;
- (iii) Continuous project control and monitoring, ensure adherence to all the contractual obligations of the EPC;
- (iv) Examine invoices submitted by contractor on the basis of the supply and works contract;
- (v) Coordination of the interface between the RAP implementation and construction works;
- (vi) Monitor the implementation of all aspects of the contractor's Environmental and Social Management Plans;

- (vii) Implement APGCL's E&S Plans by regular monitoring; conduct training of APGCL's staff in the monitoring of these plans;
- (viii) Ensure international safety standards;
- (ix) During commissioning and operation phase advise, supervise and provide approvals for general test procedures developed by the EPCs,
- (x) Taking action and following up the process to achieve the COD (Commercial Operation Date), PAC (Project Acceptance Certificate) and FAC (Final Acceptance Certificate);
- (xi) Approve as-built drawings, documentation and O&M manuals;
- (xii) Support APGCL during the defects liability period, on request;
- (xiii) Organise contract closure activities;
- (xiv) Advise and guide APGCL regarding the provisions of the Power Purchase Agreement and Grid Code

3.2.1 **Activities during the Design, Construction and Erection Phase**

- A. Make proposals for appropriate indicators to measure the impact of the project on target groups to determine how far the project has successfully contributed to the overall programme objectives. The general indicators that should be considered, but not limited to, are:
- a. Annual energy output, split between off-peak and peak periods;
 - b. Energy cost saving (compared with alternative fossil power plants);
 - c. Reduction of pollutants and CO₂ emissions (compared with the alternative with fossil power plants);
 - d. Economic internal rate of return of the project;
 - e. Technical availability of the power plant;
 - f. Complete fulfilment of relevant social and environmental safeguards.

For the purpose of future project evaluation, the PM Consultant shall establish a data base by conducting an appropriate baseline study for the above agreed indicators. The PM Consultant shall also develop a Benefits Review Plan used to define how and when a measurement of the achievement of the project's benefits can be made.

- B. Review and, where appropriate, comment on all designs submitted by the EPC contractors and provide comment and advice to APGCL on potential improvements to the designs.
- C. Review and comment on the project implementation plans prepared by the EPC contractors to effectively implement the project.
- D. Monitor, provide advice, and for key subjects approve:
 - a. Final engineering designs and modifications made by the EPC contractors;
 - b. All tender documents, technical specifications, bid drawings and other documents prepared by the EPC contractor for all major procurements;
 - c. Construction works;
 - d. Establishment of milestone dates and events;
 - e. Quality standards and requirements;
 - f. Site installations and erection, progress monitoring, quality control and testing requirements (workshop and site) as well as commissioning and project acceptance documents (PAC – Project Acceptance Certificate);
 - g. Reporting proposal (substance and frequency);
 - h. Continuous project control and monitoring;
 - i. Claim provision, assessment and defence;
 - j. Compliance with Indian and international site safety and environment standards and regulations.
- E. Review, coordinate and, where appropriate, comment on all documents and reports submitted by EPC contractors.
- F. Establish, update and monitor the following logs/registers throughout project implementation:

- a. Project diary – to record informal issues, required actions or significant events not captured by the other registers or logs;
 - b. Issue register – to capture and maintain information on all issues that are being formally managed;
 - c. Quality Register –to summarize all the quality management activities that are planned or have taken place;
 - d. Risk Register – provides a record of identified risks relating to the project including their status and history.
- G. Provide on the job training to APGCL technical team involved in the project, in all aspects of the project during design, construction, and commissioning.
- H. Monitor and conduct the implementation of all aspects of the Environmental and Social Management Plans, to ensure compliance with relevant requirements. The following specific plans will be included:
- a. Environmental Management and Monitoring Plan
 - b. Pollution prevention plan
 - c. Waste management plan
 - d. Health and safety management plan
 - e. Traffic management plan
 - f. Emergency preparedness and response plans
 - g. Biodiversity monitoring plan
 - h. Social and cultural heritage management and monitoring plan
 - i. Livelihood restoration plan
 - j. Community development plan
 - k. Catchment management plan
- I. Engineering interpretation of the physical models and hydraulic manufacture’s model, if carried out.
- J. Report key issues directly to APGCL and ADB during construction stage including procurement of contracts.
- K. The PM Consultant will:
- a. Examine invoices submitted by EPC Contractors on the basis of the supply and service contracts, to determine whether the services and supplies being invoiced were actually performed;
 - b. Examine that the payment has fallen due and all necessary documents are available as required in the supply and service contracts;
 - c. Examine that the documents to be presented include valid down payment and implementation guarantees in accordance with the specimen required by ADB (validity, guarantee amount), if applicable, insurance policies and transport documents;
 - d. Examine whether the regulations concerning the disbursement procedure that are agreed between the APGCL and ADB – and are passed on to the Consultant – are being adhered to;
 - e. In so far as the above mentioned conditions are met:
 - o certify the copy of the contractor’s invoice
 - o certify the disbursement request to be addressed to ADB or APGCL accordingly;
 - f. Provide Certificates of Milestone Completion;
 - g. Prepare and follow up the cost control schedule;
 - h. Report regularly financial status of the project to APGCL by:
 - Reporting the disbursement result and financial position.
 - Actual cash flow position.
 - Performing detailed variation analysis between estimated/budgeted position vis–a-vis the actual position.
 - Assessing future requirements and payment schedules.
 - Recommending possible measures for reducing expenditure, if any.
 - i. Investigate, inspect and assess requirements from the contractors for the extension of time, additional works, payment for additional works, etc.
 - j. Review claims along with its supporting data, evaluate reports on the claim and assist APGCL in settling the claims or disputes (if any).
 - k. The PM Consultant will keep the relevant documents ready for inspection by APGCL and ADB.

3.2.2 **Activities during commissioning up to PAC and COD**

Advise on and, where necessary and appropriate, represent APGCL and coordinate and provide approvals in relation to activities associated with:

- a. General test procedures developed by EPC contractors;
- b. Compliance with Indian and international site safety and environment standards of ADB(including performance standards of the International Finance Corporation[IFC]);;
- c. Testing of electromechanical plant and equipment (including factory acceptance tests, factory inspection, raw material inspection);
- d. Commissioning of civil structures (if not executed in an earlier state), electromechanical plant and equipment including dry and wet testing as well as initial readings (forces, measurements, etc) during the commissioning period;
- e. Issuing and review of critical spare parts list;
- f. Support on the job training by the EPC Contractors to the involved APGCL's professionals in all aspects of the project during implementation and commissioning;
- g. Filing and where necessary improving as-built drawings, documentation and O&M manuals;
- h. Issuing final punch list for PAC;
- i. Supervision of the rectification of the major punch list items before issuing PAC;
- j. Supervision of the trial run;
- k. Issuing Project Acceptance Certificate (PAC);
- l. For a quarterly Project Review Meeting during the entire implementation phase, the PM Consultant shall prepare and present a formal audio/visual presentation as well as a project review report. The final Project Review Meeting shall take place with the issuance of a COD Certificate;
- m. Engineering interpretation of efficiency or index measurements, if carried out;
- n. Issuing the Commercial Operation Date (COD) Certificate, the signature and issuance of which will designate the beginning of the two years warranty period/defects liability period;
- o. Any other related activities.

3.2.3 **Activities during operation after COD up to FAC**

During the defects liability period, the PM Consultant will advise on and, where necessary and appropriate, represent APGCL and coordinate and provide approvals and recommendations in relation to activities associated with:

- a. Supervision of the rectification of all defects during the warranty period with issuing of clearances for defects rectified as well as a prolongation of warranty for major parts, if applicable;
- b. Overseeing compliance with contractual obligations;
- c. Issuing the Final Acceptance Certificate (FAC) after successful ending of the defects liability period.
- d. Preparation of the final accounts for the construction soon after issuance of the FAC;
- e. Preparation of a project completion report, acceptance of which will signify the end of the PM Consultant's assignment on the consultancy contract;
- f. Organise contract closure activities and contract closure meeting;
- g. Any other related activities;

3.2.4 **Support for APGCL in Operation (Post Commissioning) of the Project**

(a) Plant operation planning in detail

The PM Consultant shall prepare operations and maintenance strategy documents including organization and staffing of operation, long-term and mid-term maintenance schedules, schedule and procedures of regular inspections, sediment flushing schedule and procedures, training program for APGCL staff, recording system on a regular basis, accident reporting system, and submit them to APGCL for review and consent. The consultant shall

also prepare operation and maintenance manuals of the plant for APGCL's staff, detailing schedule of each maintenance activity, and submit it to APGCL. The strategy documents and operation and maintenance manual shall be finalized not later than one month before the commissioning of the project.

(b) Operation and maintenance activities of the plant on regular basis

Based on the operation and maintenance strategy documents and daily instructions by the APGCL's load dispatch centre, the PM Consultant shall assist APGCL in operating the plant on the basis of three shifts. The consultant shall train APGCL's operations staff through a training program as consented in the operation and maintenance strategy documents. The consultant shall gradually transfer their operation and maintenance activities to APGCL's staff in consultation with APGCL, so that the APGCL staff can operate the plant by themselves after the consultancy contract of the PM Consultant expires. The PM Consultant shall prepare an annual maintenance plan with an estimated budget to optimize the cost of maintenance and to achieve long term reliability of operation of the systems and equipment. The maintenance plan shall include the maintenance activities, and the frequency of maintenance. For overhauling works, the PM Consultant shall prepare the overhaul schedule with budget estimates in the long term schedule. The PM Consultant shall assist APGCL in conducting maintenance of the plant in accordance with the annual maintenance plan.

(c) Monitoring, controlling and reporting operational performance of the project.

The PM Consultant shall prepare operating procedures to ensure effective operation of the plant and equipment. This should include activities for an effective condition monitoring program (for example, turbine runner non-destructive testing), a functional testing program, and routine preventative maintenance activities.

The PM Consultant shall establish the document management system for reports on operation and maintenance activities. The PM Consultant shall review the daily, weekly, monthly, and annual reports prepared by APGCL's staff at the initial operation stage. The PM Consultant shall establish monitoring and control system of operation and maintenance activities, based on the operation and maintenance strategy documents as agreed with APGCL. The PM Consultant shall periodically review efficiency of the said systems and modify as and when required.

The PM Consultant shall also prepare an effective Asset Management Plan for LKHEP covering the electro-mechanical as well as hydro-mechanical plant. The information presented in this plan will be used by APGCL for their future planning of plant outages and budget requirements.

The PM Consultant shall establish a quality assurance system in accordance with the consented operation and maintenance strategy documents. It is recommended that the PM Consultant should apply for quality assurance system ISO 9001. APGCL and the PM Consultant shall establish operating and control procedures for all departments/units within APGCL, monitor performance of all activities concerned, conduct internal audits, correct or prevent non-conformities, and adopt continual improvement actions.

The PM Consultant shall supervise all works pertaining to the operation of the Lower Kopili Hydropower Plant. The consultant shall supervise all works conducted based on the annual maintenance plan or overhaul schedule as well as ensure adherence to project scheduling.

3.3 Project Assignments

(a) Commencement of the Assignment

The commencement date shall be the date of which the contract comes into force, followed in due course by the kick-off workshop of all parties involved

(b) Duration of the Assignment

The assignment will terminate with the FAC and submission of the Project Completion Report to ensure proper coverage of the defects liability period. The construction period is expected to last 4 years. However this is subject to change depending on the implementation schedule of the selected EPC contractors.

The selected PM Consultant must ensure that a team of specialised and experienced engineers will be on site to supervise all relevant tasks of the construction and implementation. The head of the site team shall be the Resident Engineer who shall be in the country and on site at all times from ground-breaking until the commissioning of the project is completed and the PAC is issued. A suitably qualified member of the PM Consultant's team shall serve as an on-site proxy when the Resident Engineer is off-site.

3.4 Reports and Documentation

All reports and documentations by the EPC contractor have to be reviewed and approved by the PM Consultant. In addition, the PM Consultant prepare and issue reports, documents, approvals and certificates covering the following:

- ✚ Proposed indicators;
- ✚ Baseline Study Report and updates when required until COD;
- ✚ Benefits Review Plan/Model;
- ✚ A Monthly Report, issued one week after the end of each month, covering the project activities undertaken, disbursement schedule with a forecast, quality management activities that have been undertaken, issues and risks that have arisen, been dealt with and are still outstanding, and also the signed minutes of site progress meetings;
 - a. Approve monthly progress reports of the EPC contractors;
 - b. Monthly project review meetings with project review report;
 - c. Approved construction drawings for the works including the structural calculations
 - d. Approved as-built drawings
 - e. Approved documentation on the equipment to be supplied by the EPC Contractors including drawings, schedules, diagrams and O&M descriptions,
 - f. Special Technical Reports - may be required on construction, quality issues, manufacture and installation due to unforeseen conditions or problems;
 - g. Commissioning Reports showing the extent of works involved, the criteria by which its performance is to be judged, the initial baseline force measurements, results obtained from the tests during commissioning, and a list of any minor defects or deficiencies to be rectified during the ensuing Defects Liability Period;
 - h. Certifications;
 - i. Project Completion Report together with the FAC which shall include, but not be limited to:
 - comprehensive description of the project as executed, indicating relevant modifications to the initial tender design;
 - compilation of all problems/issues met and risks that emerged during execution and the solutions implemented;
 - the final implementation schedule compared with initial planning;
 - schedule of major events of importance during the execution of the project;
 - summary of the overall project costs, structured according to the initial confidential cost estimate;
 - proposal for post-project review (who prepares it, when it should be done and who should be involved);
 - summary of follow-on action and recommendations, if applicable.

Reports shall be submitted according to the following timetable, but not necessarily limited to these:

Reports	Delivery in months after commencement of Phase B
Proposed indicators	1.0
Baseline Study Report	1.0
Benefits Review Plan/Model	2.0
Monthly report on activities, issues, and risks	One week after the end of each month
Project Review Report	Monthly
Commissioning Report	After Commissioning but before PAC date
As-built and other documentation together with all the project logs/registers	2 months after COD
Project Completion Report	with FAC Date

Except for the Monthly Reports (which shall be submitted to APGCL by e-mail and in two hard copies), all the above reports shall be submitted to APGCL in two (2) hard copies and by e-mail to APGCL and ADB. APGCL shall

review and comment on the submitted reports by email within two weeks from the date of receipt. The PM Consultant shall be expected to incorporate these comments within two weeks. Finally, the documents have to be resubmitted in 2 hard copies and by email.

4. APGCL's Inputs to the Project

- A. APGCL shall make all necessary arrangements to ensure the project proceeds on schedule.
- B. APGCL will appoint a skilled Project Manager with power to act and a Deputy Project Manager together with a project support team for this project.
- C. During the implementation of the project, APGCL shall provide coordination and liaison with all relevant stakeholders.
- D. APGCL will make available for the duration of the services, all relevant reports, data, and documents in their possession pertinent to the proposed services and necessary for the requested services.
- E. APGCL will provide and make available to the Consultants, free of charge, the following facilities, services, equipment, materials, documents and information as required by the PM Consultants in both Guwahati Main Office and at Lower Kopili Construction Camp for carrying out the assignment:
 - a. Office space: sufficient office space for the PM Consultant team, with national and international telephone lines, electricity and air conditioning/heating, and internet connections;
 - b. Office furniture: desks, office chairs, adequate to accommodate the full complement of international and local consultants, and bookshelves/cabinets, etc;
 - c. Organizational support: assistance in all arrangements for workshops, meetings, and field visits; and access to required data, maps and other relevant information.
 - d. Arrangement with other governmental and provincial agencies, authorities and offices for receiving their cooperation as necessary for the execution of the services.
 - e. Assistance in arranging permits and authorization from government agencies for clearance through customs, obtaining entry and exit visas, residence permits, etc. as necessary for the execution of the services.

5. APGCL's Role in the Project

APGCL shall from time to time carry out impromptu inspection of the project to ensure and verify compliance and also monitor progress.

6. Team Composition & Qualification Requirements for the Key Experts

The Lower Kopili Hydroelectric Project is a large hydropower project in Assam and the management of such a project will require specialized skills and relevant international experience. As such, the international and national experts will have to work in coordination with APGCL personnel for the successful execution of the project. The following table gives an estimate of the international and national experts and person months required for the project.

	International Experts	Man Months
1	Project Manager – Team Leader	69.0
2	Resident Engineer	57.0
3	Design Engineer	12.0
4	Contract and Procurement Specialist	24.0
5	Hydro-mechanical Engineer	18.0
6	Electromechanical Engineer	18.0
7	Project Scheduler	6.0

	Total International Experts	204.0
	National Experts	
8	Deputy Project Manager/Camp Engineer	69.0
9	Road Engineer	25.0
10	Material and Quality Control Engineer	48.0
11	Dam Engineer	48.0
12	Powerhouse Engineer (Civil)	36.0
13	Tunnel Engineer	36.0
14	Structural Design Engineer	36.0
15	Social and Resettlement Expert	57.0
16	Environment Specialist	48.0
17	Project Scheduler	54.0
18	Mechanical Engineer	36.0
19	Electrical Engineer	36.0
20	Cad Manager	66.0
21	Drafting Officer	66.0
22	IT Manager	66.0
	Total National Experts	727.0
	Total International and National Experts	931.0
	National Support Staff	
	Administrative Officer	69.0
	Accounts Officer	69.0
	Assistant Accounts Officer	69.0
	Office Secretary	69.0
	Drivers	345.0
	Runners and Helpers	345.0
	Total National Support Staff	966.0

The above experts may continue to work during the operational phase, if required. In case the experts are not suitable in the transition from construction phase to operational phase, the firm will have to ensure that any replacement be a person of equivalent or better qualifications as the person being replaced.

The Consultant team will consist of experts from twenty two areas of technical expertise for project management activities from construction to operation and maintenance stages. For key expert positions, in-house staff of the firm will be preferred. Each expert will perform his/her tasks in collaboration with their team members. The terms of references outlining the specific areas of responsibility/job description for each expert are given below. In addition, the experts are expected to perform any other reasonable duty that may not be mentioned in the job description, but is expected to be performed in an assignment of this nature.

Qualifications of key international team members shall be as follows:

Project Manager/Team Leader (“TL”)

The TL will be responsible for managing and coordinating the overall project implementation as well as all reporting activities, and liaison with stakeholders. The TL will have a degree in civil engineering, with at least 15 years of experience in construction, operation and management of large hydropower projects. The TL will have work experience in developing countries, preferably in India and/or neighbouring countries, and will preferably have experience working on ADB or other international development agency projects, preferably as team leader. The TL will spend a minimum 85% of the allocated time in-country.

The TL will mainly do the following:

- (i) Work at the project site to control day-to-day operations of the project and report to APGCL Managing Director (MD) and/or Chief General Manager (Hydro, CGM Hydro).
- (ii) Present to the MD and/or CGM (Hydro) the technical and financial progress and issues.
- (iii) Conduct overall supervision of activities performed by both APGCL staff and the PM Consultant team members at the site.

During construction stage

- (i) Supervise the review of the detailed designs prepared by the EPC Contractors.
- (ii) Supervise preparation of the project implementation schedule and its revisions when required, and finalize it in consultation with APGCL.
- (iii) Supervise the PM Consultant team members’ activities such as review and approval of drawings and design documents, supervision, management and monitoring of construction process, witness and approval of equipment testing and commissioning, supervision of all works of contractors, quality assurance, and supervise EPC Contractors’ activities and enhance coordination among them.
- (iv) Supervise the consultant team members’ support to APGCL in ensuring adherence to final project design, engineering and the schedule.
- (v) Supervise the consultant team members’ support to APGCL in ensuring financial, human resource, information technology, and administrative functions.
- (vi) Supervise the consultant team members’ support to APGCL in implementing all safeguards matters encompassing both social and environmental aspects following the plans and policies prepared during project preparation.
- (vii) Supervise preparation of reports and documents specified in the ToR.

During operation stage

- (i) Supervise preparation of operation and maintenance strategy documents and finalize them in consultation with APGCL.
- (ii) Supervise the preparation of operation procedure/manual for the hydropower plant, as well as the asset management plan for the plant.
- (iii) Supervise the consultant team members’ support to APGCL in conducting operation and maintenance, and supervise the consultant team members’ training activities for APGCL staff.
- (iv) Supervise establishment of a document management system for reports on operation and maintenance activities.
- (v) Supervise establishment of a quality assurance system.
- (vi) Manage the consultant team members’ supervision of works pertaining to operation of the Lower Kopili Hydroelectric Plant.
- (vii) Ensuring adherence to project schedule.

For specific jobs

- (i) Supervise the consultant team members’ assisting APGCL in implementing all safeguards matters encompassing both social and environmental aspects in accordance with the plans and policies prepared during project preparation.
- (ii) Supervise cost-benefit analysis of deviations in construction phase from planned design, etc.
- (iii) Supervise proper recording of events leading to delay in construction and operational activities.
- (iv) Optimize generation bottlenecks such as non-availability of water and sedimentation issues.

- (v) Take care of all safety measures.
- (vi) Ensure adherence to all statutory requirements.
- (vii) Supervise the execution of skills transfer programs for APGCL personnel.
- (viii) Assist in maintaining sound external relations and personnel relations.
- (ix) Prepare reports for submission to donors on key issues during operation.

Resident Engineer (RE)

The RE will be responsible for managing and coordinating the construction of the project implementation as well as all reporting activities, and liaison with stakeholders. The RE will have a degree in civil engineering, with at least 15 years of experience in construction of large hydropower projects. The RE will have work experience in developing countries, preferably in India and/or neighbouring countries, and will preferably have experience working on ADB or other international development agency projects, preferably as resident engineer. The RE will spend a minimum 90% of the allocated time in-country.

The RE will mainly do the following:

During construction stage

- (i) Review bidding documents from the point of view of construction
- (ii) Prepare the project implementation schedule in cooperation with other team members.
- (iii) Support APGCL in planning and preparation of strategy documents of contractors, regarding civil works.
- (iv) Supervise the consultant team's support to APGCL in supervision, management and monitoring of construction process and support APGCL in supervision, management and monitoring of construction process of civil works.
- (v) Supervise the consultant team's support to APGCL in witnessing and approving equipment testing and commissioning.
- (vi) Supervise all civil works and supervise the consultant team's supervision activities.
- (vii) Support APGCL in ensuring adherence to the schedule of civil works.
- (viii) Supervise contractors' activities and enhance the coordination among contractors.
- (ix) Prepare reports and documents specified in ToR.
- (x) Record events leading to delay in construction activities.
- (xi) Take care of all safety measures during construction.
- (xii) Execute skill transfer programs for APGCL personnel during construction stage.
- (xiii) Assist in maintaining sound external relations and personnel relations.
- (xiv) Maintain records documenting decisions made at meetings, progress of project implementation and changes to contract plans.

Design Engineer (DE)

The DE will have a degree in civil engineering, with at least 15 years of experience in design of hydropower projects, particularly related to dam engineering and power house design, including experience in developing countries, preferably in India and/or neighbouring countries. The DE will spend a minimum 70% of the allocated time in-country.

The expert will mainly do the following:

- (i) Review the key design assumptions and key features of detailed and basic design of civil structures prepared by EPC Contractors.
- (ii) Assist Team Leader in preparing the project implementation schedule in cooperation with other team members.
- (iii) Review and approve essential drawings and design documents of civil works produced by EPC Contractors.
- (iv) Support APGCL in ensuring adherence to final project design.
- (v) Prepare reports and documents specified in the ToR.
- (vi) Execute skill transfer programs for APGCL personnel during the construction stage.

- (vii) Maintain records documenting decisions made at meetings, progress of project implementation and changes to contract plans.

Contract & Procurement Specialist (C&PS)

The C&PS will have a degree in engineering preferably with a Masters degree in Contract Law, with at least 15 years of experience in construction of hydropower projects or major civil works, particularly related to contract management and procurement activities, including experience in developing countries, preferably in India and/or neighbouring countries. The C&PS will spend a minimum 90% of the allocated time in country.

The C&PS will mainly do the following:

- (i) Review bidding documents from the contractual point of view.
- (ii) Support EA in running the entire bid management process through selection and negotiation of each contract package from the contractual viewpoint.
- (iii) Supervise all works from the contractual point of view.
- (iv) Prepare reports and documents specified in the ToR.
- (v) Set up the procurement procedure for the project.
- (vi) Record events leading to delays in construction activities.
- (vii) Execute skills transfer programs for APGCL personnel during all stages of the project.
- (viii) Assist in maintaining sound external relations and personnel relations.
- (ix) Maintain records documenting decisions made at meetings, progress of project implementation and changes to contract plans.

Hydro-mechanical Engineer (HME)

The HME will have a degree in mechanical engineering, with at least 15 years of experience in implementation of hydropower projects, particularly related to design approvals, workshop inspection, installation, erection and commissioning of hydro-mechanical equipment, including experience in developing countries, preferably in India and/or neighbouring countries. The HME will spend a minimum 80% of the allocated time in-country.

The HME will mainly do the following:

- (i) Review the basic and detailed design of hydro-mechanical equipment such as spillway gates, intake gate, draft gates, and sediment penstock liner.
- (ii) Assist the Team Leader in preparing the project implementation schedule in cooperation with other engineers.
- (iii) Support APGCL in running the entire bid management process for construction works of the hydro-mechanical equipment.
- (iv) Support APGCL in planning and preparation of strategy documents of the contractors, regarding hydro-mechanical equipment.
- (v) Review drawings and design documents of the hydro-mechanical equipment produced by the contractor.
- (vi) Support APGCL in supervision, management and monitoring of construction process regarding hydro-mechanical equipment.
- (vii) Support APGCL in witnessing and approving equipment testing and commissioning of hydro mechanical equipment.
- (viii) Supervise all works of hydro-mechanical equipment.
- (ix) Review the contractor's quality assurance program for hydro-mechanical equipment during design, manufacturing, delivery and construction.
- (x) Support APGCL in ensuring adherence to final project design, engineering and schedule of hydro mechanical equipment.
- (xi) Supervise the contractor's activities and enhance the coordination among contractors.
- (xii) Prepare reports and documents specified in ToR.

During operation stage

- (i) Assist the Team Leader in preparing operation and maintenance strategy documents from the point of view of hydro mechanical engineering.
- (ii) Assist APGCL in conducting operation and maintenance of hydro-mechanical equipment.
- (iii) Establish a document management system for reports on operation and maintenance activities for hydro mechanical equipment.
- (iv) Establish a quality assurance system for hydro-mechanical equipment.
- (v) Supervise works pertaining to operation of the power plant.
- (vi) Ensure adherence to the project schedule.

For specific jobs

- (i) Record events leading to delays in construction and operational activities.
- (ii) Optimize generation bottlenecks such as availability of water and sedimentation issues.
- (iii) Ensure adoption of all safety measures during construction and operation.
- (iv) Execute skill transfer programs for APGCL personnel during both construction and operation stages.
- (v) Assist in maintaining sound external relations and personnel relations.
- (vi) Maintain records documenting decisions made at meetings, progress of project implementation and changes to contract plans regarding hydro-mechanical equipment.

Electromechanical Engineer (EME)

The EME will have a degree in electrical/mechanical engineering, with at least 15 years in implementation of hydropower projects, particularly related to design approvals, workshop inspections, installation, erection and commissioning of electromechanical equipment, including experience in developing countries, preferably in India and/or neighbouring countries. The EME will spend a minimum 80% of the allocated time in-country.

The EME will mainly do the following:

- (i) Review the basic design of electromechanical equipment such as the generator, exciter, switchgear and related equipment.
- (ii) Assist the Team Leader in preparing the project implementation schedule in cooperation with other engineers.
- (iii) Support APGCL in running the entire bid management process for construction works of the electromechanical equipment.
- (iv) Support APGCL in planning and preparation of strategy documents of contractors, regarding electromechanical equipment.
- (v) Review drawings and design documents of the electromechanical equipment produced by the contractor.
- (vi) Support APGCL in supervision, management and monitoring of construction process of electromechanical equipment.
- (vii) Support APGCL in witnessing and approving equipment testing and commissioning of electromechanical equipment.
- (viii) Supervise all works of electromechanical equipment.
- (ix) Review the contractor's quality assurance program of electromechanical equipment during design, manufacturing, delivery and construction.
- (x) Support APGCL in ensuring adherence to final project design, engineering and schedule of electromechanical equipment.
- (xi) Supervise the contractor's activities and enhance the coordination among contractors.
- (xii) Prepare reports and documents specified in the ToR.
- (xiii) Record events leading to delay in construction and operational activities.
- (xiv) Ensure adoption of all safety measures during the construction stage.
- (xv) Execute skill transfer programs for APGCL personnel during both construction and operation stages.
- (xvi) Assist in maintaining sound external relations and personnel relations.
- (xvii) Maintain records documenting decisions made at meetings, progress of project implementation and changes to contract plans regarding electromechanical equipment.

National Experts (Engineer Category 1)

Deputy Project Manager/Camp Engineer, Dam Engineer, Powerhouse Engineer (Civil), Tunnel Engineer, Structural Design Engineer, Mechanical Engineer, Electrical Engineer

National expert engineers (engineer category 1) shall hold a degree in their respective field of study assigned to the individual's job title in the PM Consultant team, and have a minimum of fifteen years of experience in heavy construction industry, of which at least 10 years should be in large hydropower projects.

National Experts (Engineer Category 2)

Road Engineer, Material and Quality Control Engineer

National expert engineers (engineer category 2) shall hold a degree in their respective field of study assigned to the individual's job title in the PM Consultant team, and have a minimum of fifteen years of experience in heavy construction industry. Experience in working with large hydropower projects would be an advantage.

National Experts (Safeguards)

Environmental Specialist (ES)

The ES will be a graduate in environmental science, engineering, or related field with at least 10 years of experience in implementation of large-scale infrastructure projects including large hydropower projects, particularly related to development and implementation of environmental management plans according to ADB and/or other international financial institutions' guidelines.

The ES will mainly do the following:

- i. Review the EIA, SIA, EMP, and other supplemental environmental assessments, and prepare necessary inputs into the ESMP, which includes the following (noted in section 3.2.1 H above):
 - (a) Environmental Management and Monitoring Plan
 - (b) Pollution prevention plan
 - (c) Waste management plan
 - (d) Health and safety management plan
 - (e) Traffic management plan
 - (f) Emergency preparedness and response plans
 - (g) Biodiversity monitoring plan
 - (h) Social and cultural heritage management and monitoring plan
 - (i) Livelihood restoration plan
 - (j) Community development plan
 - (k) Catchment management plan
- ii. Ensure that the ESMP documents clearly delineate respective responsibilities of the APGCL, EPC contractor(s), the PM Consultant team, Government of India agencies, ADB, and any other parties engaged in LKHEP construction and operations (e.g., Independent Advisory Panel).
 - (a) Review and update the monitoring requirements and respective budget line items of the ESMP for confirmation by APGCL and ADB.
 - (b) Provide orientation to the EPC on ESMP requirements including construction equipment (e.g., for emission controls), physical construction specifics (e.g., dust and erosion control, and waste management), and EPC's reporting requirements.
 - (c) Coordinate with the APGCL on-site management team on ESMP implementation and reporting requirements.
 - (d) Conduct routine inspections and prepare monitoring reports as required by the ESMP, including notice of deficiencies and corrective actions taken.
 - (e) Coordinate with the social safeguards expert(s) and other parties (e.g., Independent Advisory Panel and 3rd party monitoring) for ESMP implementation.

Social and Resettlement Expert (SRE)

A graduate in social sciences or in a related field, with at least 10 years of experience in resettlement planning and implementation. Experience in infrastructure projects, particularly, in large-scale hydropower projects, is an added qualification. The SRE is expected to possess a good knowledge of involuntary resettlement and indigenous peoples safeguards policies of ADB and other international financial institutions.

The SRE's key activities include:

- i. Review resettlement and indigenous peoples plans, livelihood restoration plans, and community development plans and work out in detail, their implementation strategies, budgets and timelines. Prepare, if required, additional resettlement and indigenous peoples plans to address social safeguards issues identified during project implementation.
- ii. Ensure that ESMP delineates responsibilities (pertaining to land acquisition, compensation payment, physical relocation and economic rehabilitation of project-affected persons) of APGCL, EPC contractor(s), PM Consultant team, Government of India agencies, ADB, Independent Advisory Panel and any other parties engaged in LKHEP construction and operations.
- iii. Review, update and submit monitoring requirements and budget line items of ESMP for approval of APGCL and ADB.
- iv. Orient EPC on ESMP's guidelines on involuntary resettlement and rehabilitation of the project-affected people and its reporting requirements.
- v. Coordinate with APGCL's on-site management team on ESMP implementation and reporting requirements, including compensation payment and physical relocation of the project-affected persons and communities. .
- vi. Conduct routine inspection and prepare monitoring reports as per ESMP.
- vii. Where necessary, prepare corrective action plans.
- viii. Coordinate with the environmental specialist, Independent Advisory Panel, and 3rd party monitoring group on the implementation of ESMP.

National Experts (Support Services)

Project Scheduler, CAD Manager, Drafting Officer, IT Manager

National experts (support services) shall hold a degree in their respective field of study assigned to the individual's job title in the PM Consultant team, and have a minimum of fifteen years of experience in heavy construction industry. Experience in working with large hydropower projects would be an advantage.

All national experts shall assist the Project Manager, Resident Engineer and Deputy Project Manager, in fulfilling tasks assigned to them.

Annexure A

Project Description

1. The Kopili River originates in the Maghalaya state at an altitude of about 1600 meter above sea level, and flows over a distance of about 300 km through the states of Meghalaya and Assam, and then joins the Brahmaputra River. The Lower Kopili Hydroelectric Project (LKHEP) proposes to build a dam across Kopili River at Longku. The project site is situated in the state of Assam, east of Karbi Anglong and west of Dima Hasao Districts. The Kopili River has two hydroelectric power plants already operational, both upstream of the proposed LKHEP: Kandong HEP (75 MW, served from Khandong reservoir on Kopili River) and Kopili HEP (200 MW, served from Umrong reservoir on the Umrong River). Umrong River is tributary of Kopili River, and receives water from the Umrong River as well as the tail water from the Khandong power plant. Both the existing power plants upstream of the proposed LKHEP are owned and operated by North Eastern Electric Power Corporation Limited (NEEPCO).
2. The proposed LKHEP will receive water from (i) tail race water release from the existing Kopili power plant, (ii) incremental flow from the river catchment area between Khandong dam and the proposed Longku dam, (iii) any reservoir spill from Khandong and Umrong reservoirs. LKHEP is designed to operate as a run-of-river power plant, and proposed to have a total capacity of 120 MW, in two power plants: the main power plant will be rated at 110 MW and the auxiliary power plant will be rated at 10 MW. The main power plant would receive water diverted at the dam in Longku on Kopili River, while the auxiliary power plant is located at the bottom of the dam at Longku, using water released at the bottom of the dam to maintain the minimum river flow downstream of Langku. The main power plant is expected to operate on base load during rainy season, but operate at the evening peak time during the dry season. The auxiliary power plant would operate throughout the day, when water is released from the bottom of the dam to maintain the environmental flow.
3. The main power plant of 110 MW is designed to have an average net head of 108 m. It is estimated to produce 456 GWh of electricity per year under average hydrological conditions. The auxiliary power plant is estimated to have a net head of 47 m, to produce 55 GWh of electricity per year. Accordingly, the two power plants of LKHEP are expected to jointly produce 511 GWh per year, reflecting an annual capacity factor of 48.6%.
4. The dam proposed to be built at Longku will be a concrete gravity dam, of height 70 m and width 345 m. The crest of the dam will 232.5 m above mean sea level (MSL). The dam will create a reservoir at Longku with a spread of 620 ha, with a live storage of 77 million cubic meters. The maximum operating level will be 226 m above MSL, while the maximum water level expected will be 229.6 m above MSL. Water stored in the reservoir will be taken out for power generation through two separate intake structures, one for the main power plant and the other for the auxiliary power plant. The main power plant intake is on the right bank of the reservoir, and would be controlled with 2 vertical gates. The auxiliary power plant intake too has 2 vertical gates.
5. A tunnel will be excavated to deliver the water from the reservoir to the main power plant. Water from the intake to the main power plant enters the tunnel of diameter 6.65 m on the right bank of the Kopili River. The designed discharge capacity is 112.7 cubic meter per second, at a flow velocity of 3.13 m/s. This tunnel will be 3.6 km long at a gradient in the range 1:88 to 1:110. At the end of this low pressure tunnel, water will enter the pressure shaft. The pressure will be circular of 5.2 m diameter, steel lined, with a length of 704 m. The pressure shaft will deliver water to two steel penstocks each of length of about 60 m, which in turn would convey water to the turbines. Water to the auxiliary power plant will be taken directly along a steel-lined circular pressure shaft of diameter 2.7 m and of length 70 m, and delivered to the turbine through three steel penstocks, each about 30 m long.
6. The main power plant and the auxiliary power plant will be surface-type power plants. The main power plant will have two generating units each rated at 55 MW. Turbines will be of Francis type. Each turbine will be mounted on a vertical shaft, with the respective power generator mounted above the turbine. The auxiliary power plant too will have two Francis turbines, but they will be mounted on a horizontal shaft. The rated speed of the main power plant will be 230.8 revolutions per minute (rpm), while the auxiliary power plant will have a rated speed of 750 rpm. Power generated at the main power will be stepped up from its generating voltage of 11 kV to 220 kV. This transformation will be done using six single phase transformers, and there will be one spare transformer. Power

generated at the auxiliary power plant will be stepped up to 33 kV from its generating voltage of 6.6 kV, using two 3-phase transformers.

7. Power generated at the 110 MW main power plant would be transferred to the Lanka Substation located at Shankerdev Nagar, through a new 220 kV double circuit transmission line. This transmission line is estimated to be about 40 km long and would use a new right of way from LKHEP to Lanka. The existing substation at Lanka is presently rated at 132 kV, and this substation will be upgraded and expanded to 220 kV to receive power from the LKHEP. Power received at Lanka from LKHEP will be partly used to serve customers and regions presently served by the Lanka substation. The balance power from LKHEP will be transferred to the upstream network through the Lanka-Misa transmission lines. Power generated at the 10 MW auxiliary power plant will be transferred to Umrangso, along a new double circuit 33 kV line to be built under the project. There is an existing 33 kV substation at Umrangso, where a new bay would have to be built to receive the new line from LKHEP. There will be a 33 kV connection from the auxiliary power plant to the main power plant, to provide auxiliary power and back-up power, to ensure the ability to start the main power plant, in case the Lanka substation is de-energized during a transmission network outage in the Lanka-Misa area.

8. Water released from turbines at the main power plant will be taken along a tail race channel to be built under the project, and discharged to the Kopili River at an elevation of 102 m above MSL. The tail race channel of the auxiliary power plant will release water to the river at an elevation of 168.5 m above MSL.

9. There will be temporary structures built to facilitate construction of the dam at Longku and the tunnel. The Kopili River will be diverted using a coffer dam and a diversion channel, both upstream and downstream. The upstream coffer dam will be 18 m tall and 160 m wide. Its crest will be at 186 m above MSL. There will also be a downstream coffer dam, 13 m tall and 126.3 m wide. The diversion channel will be of cross section 11 m x 11m, and 98.2 m long at upstream, and 59.2 m long at downstream.

10. The construction schedule of LKHEP is expected to be five years from the commencement of work on physical infrastructure required to facilitate construction of the dam and the reservoir. Once completed, the LKHEP will operate to serve the state grid in Assam.