Loan-SRI: Green Power Development and Energy Efficiency Improvement Investment Program – Tranche 1 – The Pre-Feasibility Study and the Detail Feasibility Study for a Pumped Storage Hydropower Project

Terms of Reference for Consultants

A. Introduction

1. The Ceylon Electricity Board (CEB), hereinafter referred to as the Client, is a body corporate established in Sri Lanka by Ceylon Electricity Board Act, No. 17 of 1969 as amended by Act Nos. 31 of 1969, 29 of 1979, 32 of 1988 and by the Sri Lanka Electricity Act, no. 20 of 2009 and having its Head Office at, No. 50, Sir Chittampalam A. Gardiner Mawatha, in Colombo 00200. CEB is under a statutory duty to develop and maintain an efficient, coordinated and economical system of Electricity Supply for the entire country.

2. Sri Lankan power sector is governed by the Sri Lanka Electricity Act, No. 20 of 2009 as amended by Sri Lanka Electricity (Amendment) Act, No. 31 of 2013. CEB holds the Transmission License (in addition to Generation License and four Distribution Licenses) and is the single buyer of electricity generated by generation licensees and the System Operator in respect of the Transmission system. As at 2020, total installed generation capacity of the Sri Lankan system was 4,265 MW. This includes 900 MW of coal power (3x300MW), 1,268 MW of oil based thermal power plants (Auto Diesel, Furnace Oil, and Naphtha) and 2,097 MW from renewable energy (RE). The composition of RE is 1,383 MW from storage hydro, 410 MW from mini hydro, 179 MW from wind, 50 MW from biomass and 75 MW from solar power. In addition to this, solar rooftop systems operating as micro power producers contributed with a capacity of 347MW. Out of the total annual electricity generation of the national grid, 36% is met using the RE resources, 37% by coal and 27% by thermal oil.

3. The peak demand has grown at a rate of 4.0% during the last 5 years. The recorded maximum demand of the country was 2,717 MW in 2020. Figure 7-1 shows the country's daily load curve recorded on the day of annual peak for previous eight years.

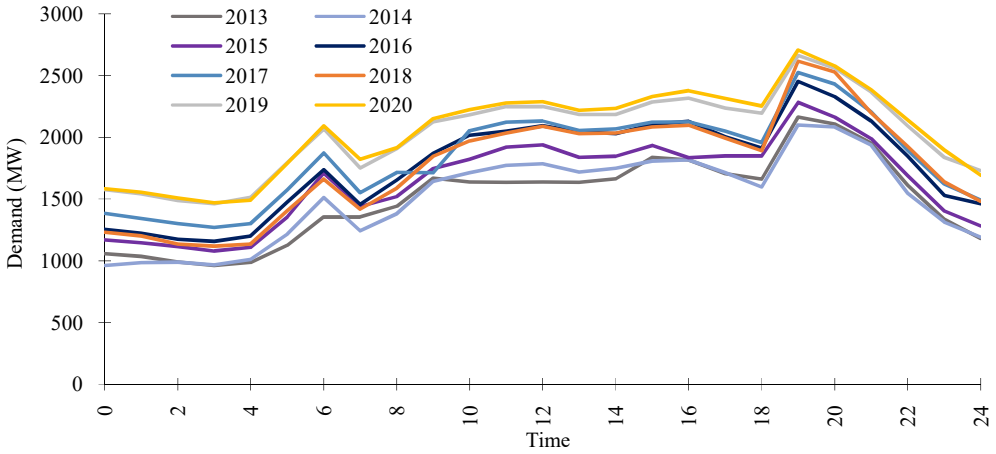

Figure 7-1: Change in Daily Load curve over Last Eight Years

4. Electricity demand has been growing at a rate of 5.5% per annum during last 5 years. Annual electricity demand (sales) is approximately 14,286 GWh in 2020 and net electricity generation was 15,714 GWh (9.08% loss). The overall annual demand for electricity is expected to increase by an average of 5%-6%, and future electricity generation expansion programs are expected to meet this demand in growth. Additional statistics pertaining to power sector can be downloaded from the CEB website www.ceb.lk (https://www.ceb.lk/publication-media/annual-reports/en).

5. The latest "General Policy Guidelines on the Electricity Industry" as issued in April 2019 as per section 05 of Sri Lanka Electricity Act requires the sector to "*Progress with the vision to achieve 50% of electricity generated in 2030 from Renewable sources*".

B. Background and Objective

6. The Least Cost Long Term Generation Expansion Plan (LCLTGEP)[1] prepared by CEB for the period 2018-2037 has identified three 200MW Pumped Storage power plants to the Sri Lankan power system starting from 2025. However, the latest LCLTGEP prepared for the period 2022-2041 had revised the starting year of the first plant to 2029.

7. Ceylon Electricity Board (CEB), with the technical assistance from JICA, carried out a study titled “Development Planning on Optimal Power Generation for Peak Power Demand in Sri Lanka” in 2015, where the requirement of developing pumped storage hydropower plants to Sri Lankan system was identified for the first time.

8. Such Pump Storage Hydropower Plants (PSHPs) are to be used as a grid level energy storage option and as a frequency controlling option. PSHPs are also expected to balance out the intermittent renewable generation that are to be added to Sri Lankan power system in large capacities in the future and to "firm out" the output of such non-firm technologies. PSHPs are expected to increase the demand during low demand hours in the daily load curve by carrying out pumping back operations and generate stored energy during peak periods. They are also expected to operate during periods where there is a very high proportion of generation from non-dispatchable renewable technologies such as Solar PV and Wind to assist the supply demand balance. PSHPs are also expected to add mechanical inertia to the system to improve frequency stability of the system. The PSHPs are expected to have controlling capability both during pump back and generating modes.

9. The JICA assisted “Development Planning on Optimal Power Generation for Peak Power Demand in Sri Lanka” study referred above was completed in 2015 and the same, after considering many candidate locations, had identified a site at Aranayaka in the Maha-Oya basin (identified as Maha3 site in this study), hereinafter referred to as the Maha-Oya site as the most suitable site to locate a pumped storage hydropower project in Sri Lanka. However, subsequently, another new site at a location called Wewathenna on the upstream of the existing Victoria hydropower reservoir, hereinafter referred to as Wewathenna-Victoria site, was identified through preliminary level assessment during the "Electricity Sector Master Plan Study" by JICA in 2018 and the study had identified the same as a lower cost option than the site at Aranayake. Under the latter proposal, it was proposed to use an existing natural reservoir at Wewathenna as the upstream reservoir and a part of the existing Victoria hydropower reservoir as the downstream reservoir.

10. The proposed locations of Maha-Oya and Wewathenna-Victoria sites are given below. Photographs of the Wewathenna and part of Victoria reservoir are also given.

[1] A two year rolling plan prepared by CEB for a 20 year period ahead.

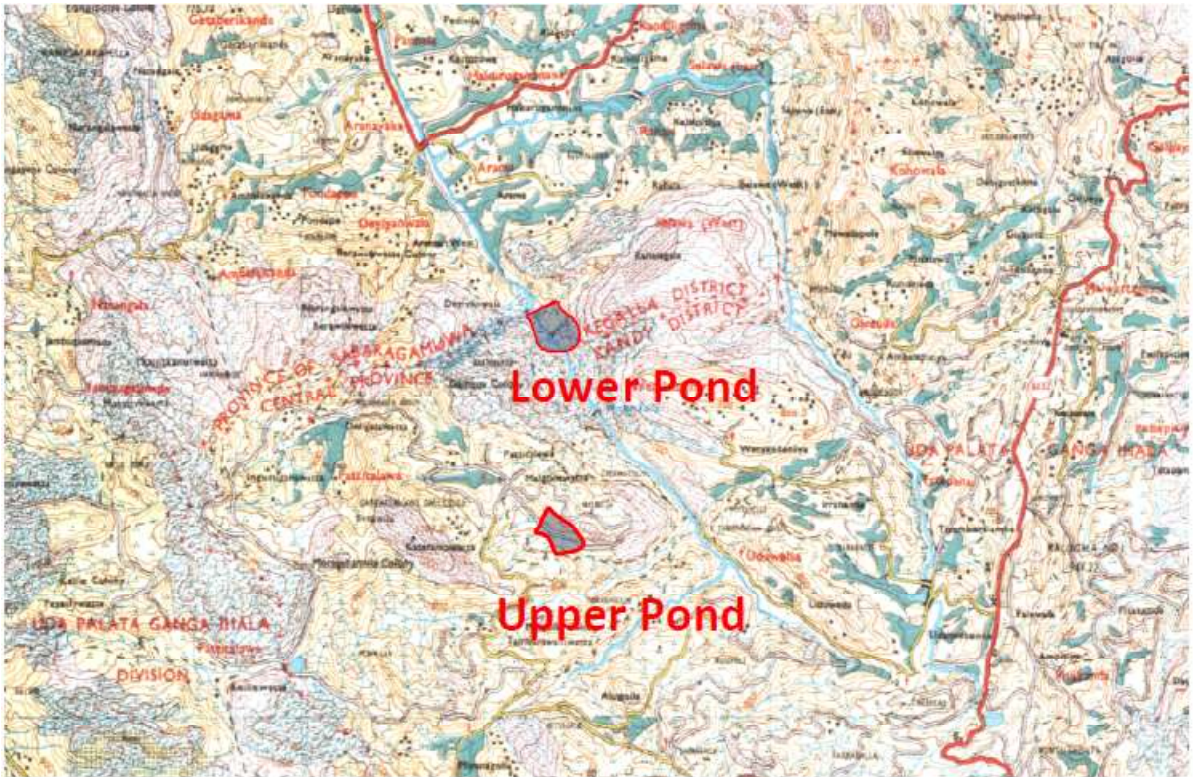

Figure 7-2: Upper and Lower Pond Locations of Maha-Oya Site

Figure 7-3: Upper and Lower Pond Locations of Wewathenna-Victoria Site

Figure 7-4: Photograph of Wewathenna Reservoir (Upper Pond)

Figure 7-5: Photograph of a Part of Victoria Reservoir (Lower Pond)

11. The primary objectives of the project are:

Phase 1:

(i) To supplement the current study done on the proposed pumped storage project at Wewathenna-Victoria site and develop it to a pre-feasibility level study.

(ii) Carryout a comparison of Wewathenna-Victoria and Maha-Oya sites taking in to consideration all relevant aspects and recommend the best site out of the two to locate the Pumped Storage Hydropower project.

(iii) To submit the Report on the Pre-feasibility at Wewathenna-Victoria site and the comparison of the two sites to the CEB for its consideration within the stipulated time period

Phase 2: To undertake a detailed feasibility study on the site out of the two sites as decided by the CEB

C. Implementation Arrangement

12. The Ceylon Electricity Board is currently seeking to engage the services of an experienced and reputed Consulting firm that will provide consultancy services to conduct the Pre-Feasibility and the Detailed Feasibility Studies for a Pumped Storage Hydropower Project in Sri Lanka. The detailed scope of work for the Pre-feasibility and the Feasibilities Study is set forth below.

13. The Consultant will be selected in accordance with ADB Procurement Policy (2017, as amended from time to time) and its associated Staff Instructions (SI) through Quality- and Cost-Based Selection (QCBS) method where the proposed approach and methodology, and personnel aspects of the proposal (Technical proposal) will be assigned a weighing of 80%, while cost (Financial proposal) is assigned a weighing of 20%, using the full technical proposal (FTP).

D. Scope of Work

14. The scope of services for Phase 1 includes:

14.1 Perform a pre-feasibility study including all field investigations, surveys, cost estimations, financial/economic analysis and other necessary studies to determine the technical, environmental and economic viability of the proposed pumped storage project at Wewathenna-Victoria site.

14.2 Carryout a comparison of all relevant factors of Wewathenna-Victoria and Maha-Oya sites for pumped storage hydropower projects (PSHPs) and recommend the best site for a PSHP.

15. During Phase 2, the Consultant is expected to perform a detailed feasibility study for the selected site under Phase 1. This should include detailed investigations/surveys of the project area, feasibility level design with basic specifications of main components and structures, cost estimation for all main components, estimates of capital costs and operating costs, development of overall implementation schedules and any other details to implement the project.

16. Consultant should review/study the previous and ongoing studies related to this assignment. (Previous studies related to pump storage power projects, transmission and generation planning studies, renewable energy integration studies, etc.).

E. Expected Outputs for Phase 1

17. The Consultant is expected to deliver (but not limited) the following, related to pre-feasibility study on Wewathenna-Victoria site and comparison between Wewathenna-Victoria and Maha-Oya sites.

17.1 Surveys, Tests and Studies

a. Topographical survey and Preparation of Maps

The necessary Topographical surveys shall be carried out and following maps have to be provided with sufficient details;

I. 1 :10,000 topographic maps of the project area
II. 1 :5,000 topographic maps of the project area
III. 1: 1,000 topographic maps of the main areas of the project

b. Geological, Geotechnical and Material studies

The results should be presented with the standard classifications and analysis including:

- Geological mapping based on field investigations, interpretation of existing air-photos and GPS aerial views and field reconnaissance. (scale 1:10,000)
- Identification of major fracture zones surrounding the project site and analysis on geotechnical characteristics of lineaments
- Definition of foundation conditions and material properties to be utilized in the designs
- Assessment of seismic risk (Seismic Prospecting) for the project for possible ground motions, both the far and near field structures.
- Slope stability and possibility of landslides of project site and surroundings

Test drilling shall be carried out at following sites for major structures in order to identify geological conditions. Drill core loggings and permeability tests including the Lugeon maps should be prepared.

Dam Sites	50m X 08 holes

Including Standard Penetration Test (SPT), Water Pressure tests and Laboratory tests on materials

Range of Geophysical prospecting is as follows:

Seismic prospecting	5 km
Electrical resistivity	5 km

c. Hydrological Studies

Work to be carried out, in connection with the project catchment hydrology data, is as follows:

- Obtain and evaluate the rainfall and stream flow data of the project area and study on the water resource availability for the project considering the other potential water usages.

- Study the impact of the flood
- Study on the water availability of both upper and lower reservoirs, considering the downstream water usage requirements.

d. Calculation of Reservoir Volumes

Storage capacity of upper and lower reservoirs shall be calculated considering the topography of the reservoir beds, sedimentation, erosion, etc.

e. Land use pattern survey

Survey on utilization of the available lands in project area

f. Environmental and social Surveys
- Ecological surveys (on terrestrial and aquatic environment)
- Physical Environment Tests (air, noise, surface and ground water, soil, etc.)
- Social surveys (on social impacts, resettlements, etc)

g. Power System and Interconnection Studies

Power System study is required for analyze options for interconnection arrangement of the proposed PSHP. This should be done in close association with the relevant CEB branches.

17.2 Access Roads, Construction Camps, Quarry Sites and Dumping Sites

Study shall be carried out to see the possibility of obtaining access roads from the existing roads to the reservoirs, power station, switch yards, construction camps, disposal areas, quarry sites, any other project component and all other necessary sites and installations by selecting the most economical alignment.

17.3 Conceptual Level Design

Consultant should identify the locations and parameters of dam, penstocks tunnels, power house, electro-mechanical equipment, hydro mechanical equipment, switch yards, construction camps, disposal areas, quarry sites etc.

Conceptual design and required preliminary costing shall be derived to confirm the optimum project configuration and parameters. This shall be undertaken in considering with the geological and geotechnical studies. This level will provide the conceptual design and project configuration.

17.4 Construction Schedule

Consultant should identify all the steps and activities of the construction of the project. A construction schedule should be prepared accordingly.

17.5 Financial and Economic Feasibility

The Consultant should prepare a cost estimate on all aspects of the proposed development and prepare a cost breakdown on major components and activities.

Financial and economic feasibility of the project shall be done considering all the relevant factors and sensitivity analysis.

17.6 Comparison of Wewathenna-Victoria and Maha-Oya Sites

The Consultant should perform a comparison of both potential sites in Wewathenna-Victoria and Maha-Oya for PSHP development in terms of technical, economic, environmental and social aspects and provide recommendation with justification.

Consultant can carry out any additional surveys, tests and studies for Maha-Oya site, if required for the comparison.

F. Expected Outputs for Phase 2

18. The Consultant is expected to deliver (but not limited) the following, under Phase 2.

18.1 Surveys, Tests and Studies

If the following are already done, those outcomes should be updated with required accuracy for a detailed feasibility study.

a. Topographical survey and Preparation of Maps
The necessary Topographical surveys shall be carried out and following maps have to be provided with sufficient details;
- 1 :10,000 topographic maps of the project area
- 1 :5,000 topographic maps of the project area
- 1:1000 contour maps of the project area (Switchyard, penstock area, reservoir power station area, tunneling area and any other construction etc.)
- 1 :1,000 topographic maps of the project area (including Access Roads, Construction Camps, Quarry Sites, Dumping Sites, etc)

Benchmarks should be established at identified site locations within standard error limits.

b. Geological, Geotechnical and Material studies

Surface Reconnaissance:
Surface reconnaissance will be carried out for dams, head race tunnel and power station site and vicinity and detailed geological route maps prepared.

Test drilling shall be carried out at following locations for major structures in order to identify geological conditions with more details. Drill core loggings and permeability tests including the Lugeon maps should be prepared.

Test drilling locations, with the minimum requirement are as follows:

• Dam Sites	25m	X	06 holes
• Intake	50m	X	01 hole
• Surge Tank	200m	X	01 hole
• Tunnel Trace	100m	X	02 holes
• Power Station	200m	X	01 hole
• Outfall	30m	X	01 hole

In conjunction with test drilling, seismic prospecting will be carried out at sites for major structures to clarify geological conditions.

Range of Geophysical prospecting is as follows:

I. Seismic prospecting 7 km
II. Electrical resistivity prospective 7 km

c. Laboratory and other Tests

The following laboratory tests, among the other should be carried out to identify characteristics of rock, foundation, in situ stress and aggregate materials in the Project area

I. Core compression strength test 32mm bore hole 04 tests
II. Concrete aggregate analysis 2 sites x 5 samples 10 tests

The results of the geological, geotechnical and material studies should be presented with the standard classifications and analysis including

- Geological mapping based on test drilling, field investigations, interpretation of existing air-photos and GPS aerial views and field reconnaissance
- Definition of foundation conditions and material properties to be utilized in the designs
- Assessment of seismic risk (Seismic Prospecting) for the project due to possible ground motions, both the far and near field structures shall be examined for seismic activities and a probable ground motion arrived for design of structures
- Slope stability and possibility of landslides of project site and surroundings

d. Hydrological Studies

- Work to be carried out, under hydrological studies is as follows:

I. Extension of the existing rainfall data base to include additional stations and updating records at the stations included in the previous studies
II. Refinement of the isohyetal map of the project area
III. Extension of the river flow data base to extend the standard period of monthly flows
IV. More detailed examination of the historic flood data in the basin to develop more reliable data for flood events, principally the spillway design flood

- Calculation of Reservoir Volumes

Storage capacity of upper and lower reservoirs shall be calculated considering the topography of the reservoir beds, sedimentation, erosion, etc.

- Sedimentation Studies

Sedimentation studies should be carried out to assess the sedimentation levels of the reservoirs and to decide on the sedimentation impacts and to plan the control measures.

e. Environmental Studies

- Carryout the environmental surveys and tests in ecological, physical and social environment
- Collection of required based line data for environmental analysis, ecological sensitive areas and other details as required as per the preliminary survey.
- Identify environmental impacts due to the implementation of proposed project with their magnitude and significant of impacts on various environmental elements
- Propose preventive and mitigation measures for those impacts and estimate the cost of these measures.
- Develop appropriate monitoring mechanism to ensure the protection of environment during all stages of project implementation and operation
- The results of these studies are expected to be in a standard level that could be used to prepare the EIA report for the project.

f. Social studies:

The Consultant shall carry out a study on social impact for the people in the proposed project locations, while addressing any impacts to their livelihoods and wellbeing. It is also required to identify and asses cost related to resettlements (if any) and any other social issues due to the project.

g. Power System and Interconnection Studies

Power System and Interconnection study done in the pre-feasibility level to be updated with required simulations and analysis.

The Consultant shall carry out a study on the viability of adoption of adjustable speed drive pump-turbines for the purpose of addressing power system stability and operational requirements. These studies shall include and not limited to frequency controlling, load following capabilities, inertia support, etc. This should be done in close association with the relevant CEB branches.

h. Following Studies to be carried out (if Wewathenna-Victoria site is selected for carrying out the detail feasibility study):

- Consultant should study the impact of the possible vibration/shock wave transmitted along ground and water to Victoria dam due to the tripping of PSHP.

- Consultant should study the possible impacts to the Victoria dam due to blasting and drilling during construction activities related to PSHP.

- Consultant should study the water availability of upper reservoir for PSHP operations, considering the quantity of water releases directly from Wewathenna reservoir for irrigation purposes.

- Consultant should study and recommend all remedial processes to avoid the operation of PSHP on pumping mode for extended periods either due to technical faults or operator errors, causing unintended spilling of upper reservoir. (Eg: water level sensing and tripping mechanism, inclusion of a spillway at the upper pond, etc.)

18.2 Access Roads, Construction Camps, Quarry Sites and Dumping Sites

Conceptual design drawings of access roads shall be prepared. Consultant should identify sites for construction camps at all work sites with estimated workers and suggest suitable alternatives with layouts. Appropriate quarry sites and dumping sites with alternatives shall also be identified with estimated capacities.

18.3 Feasibility Level Design

Feasibility level design with specifications and layouts for the project shall be given including following:

1. All the calculated parameters of the project design details including reservoirs, penstocks, surge chamber, powerhouse, switchyard, control buildings, tunnels, hydro-mechanical equipment, etc. This work shall include optimization of above components and structures.
2. Electro-mechanical parameters of power station equipment: pump-turbines, motor-generators, transformers, switchyard equipment, etc.
3. Layout of the dams, waterways and related structures, penstocks, tunnels
4. Layout of the power station and switchyard
5. Single Line Diagram for the power station and switchyard
6. Parameters of supervisory control & data acquisition and other auxiliary systems
7. Access roads, quarry sites, dumping sites, camps and site facilities

18.4 Implementation Planning and Construction Schedule

A detailed implementation plan with construction schedule should be prepared based on the subdivision of project activities and the associated construction work. This should include estimated quantities of material, manpower and machinery requirement for each subdivision.

18.5 Cost Estimation, Financial and Economic Analysis

An estimate of the costs of the project shall be done and a financial analysis shall be carried out.

a. Cost Estimates
   The Consultant shall estimate the foreign and local costs components associated with all aspects of the proposed development and prepare an estimate of the total cost of the project including a cost breakdown on major components and activities.

b. Financial Analysis
   The Consultant shall establish the requirement of capital investment. Financial analysis should be carried out and determine the financial feasibility of the project. Examine the sensitivity to various financial, environmental and other socio-economic scenarios.

c. Economic Studies
   An economic cost benefit analysis shall be carried out for the project.

   The financial cost estimates shall be converted to economic costs and economic analysis should be carried out with all relevant parameters.

   Sensitivity appraisal shall be required as an integral part of analysis to test the impact of various key parameters such as demand growth, project cost variations, etc.

d. Investment Models
Consultant should study and provide different investment options for the project.

G. Deliverables, Time Schedule and Payments

Phase 1

Deliverables	Expected outputs from each Deliverable	Time Schedule	Payments as a percentage of Price of Phase 1*(see Note 1)*
Advance Payment*(see Note 2)*		After submitting the Advance Payment guarantee	10%
Inception report	• Detail description of approach, methodology and team composition. • Work plan of individual consultants aligns with the deliverables and their expected outputs. • list of people/stakeholders to be interviewed • sub-contractors (if any)	Within two weeks from the date of commencement	5%
First progress report of the study with satisfactory completion of assigned work	• Topographical survey • Environmental surveys • Geological, Geotechnical& material studies • Hydrological studies • Power system &Interconnection study	End of second month from the date of commencement	12.5%
Second progress report of the study with satisfactory completion of assigned work	• Topographical survey • Environmental surveys • Geological, Geotechnical& material studies • Hydrological studies • Power system & Interconnection study • Access roads, construction c amps, quarry/dumping sites • Conceptual design • Financial and economic analysis	End of forth month from the date of commencement	12.5%
Phase 1 Report (First draft) including all the annexes for CEB comments	Should complete all the studies as per the TOR	End of fifth month from the date of commencement	30%
Issuing the comments by CEB for Phase 1 Report		Within 03weeks from submission of Phase 1 Report (First draft)	---

Deliverables	Expected outputs from each Deliverable	Time Schedule	Payments as a percentage of Price of Phase 1*(see Note 1)*
Re-submission of corrected report as per the comments from CEB		Within 03 weeks from the date of issue of such comments	---
Checking and issuing final comments by CEB (if any)		Within 02 weeks from resubmission of the report	---
Submission of Phase 1 Final Report as per the comments (if any) of CEB		Within 01 week of the Consultant being informed of such comments	30%

Note:

1. Price excluding Non-competitive Components (e.g. provisional sums, contingencies, etc.)
2. An Advance payment of 10% of the Price of phase 1 (excluding Non-competitive Components) will be made on submission of an Advance payment guarantee and it will be recovered from the interim payments as defined in above table.

Phase 2

Deliverables	Expected outputs from each Deliverable	Time Schedule	Payments as a percentage of Price of Phase 2 *(see Note 1)*
Inception report	• Detail description of approach, methodology and team composition. • Work plan of individual consultants aligns with the deliverables and their expected outputs. • list of people/stakeholders to be interviewed • sub-contractors (if any)	Within two weeks from the date of Phase 2 work commencement	10%
First progress report of the study with satisfactory completion of assigned work	• Topographical survey • Environmental surveys • Geological, Geotechnical & material studies • Hydrological studies • Power system &Interconnection study	End of second month from the date of Phase 2 work commencement	15%

Deliverables	Expected outputs from each Deliverable	Time Schedule	Payments as a percentage of Price of Phase 2 *(see Note 1)*
Second progress report of the study with satisfactory completion of assigned work	• Topographical survey • Environmental surveys • Geological, Geotechnical& material studies • Hydrological studies • Power system & Interconnection study • Access roads, construction Camps, quarry/dumping sites	End of forth month from the date of Phase 2 work commencement	15%
Third progress report of the study with satisfactory completion of assigned work	• Topographical survey • Environmental surveys • Geological, Geotechnical& material studies • Hydrological studies • Power system & Interconnection study • Access roads, construction Camps, quarry/dumping sites • Feasibility level design • Construction planning & implementation shed. • Cost estimate, Financial and economic analysis	End of sixth month from the date of Phase 2 work commencement	15%
Phase 2 Report (First draft) including all the annexes for CEB comments	In addition to the above outputs; • Feasibility level design • Construction planning & implementation schedule • Cost estimate, Financial& economic analysis	End of seventh month from the date of Phase 2 work commencement	15%
Issuing the comments by CEB		Within 03 weeks from submission of first draft Report	---
Re-submission of Phase 2 Report incorporating comments from CEB		Within 03 weeks from the date of issue of such comments	---
Checking and issuing final comments by CEB (if any)		Within 2 weeks from resubmission of the report	---
Submission of Final Report incorporating comments (if any) of CEB		Within 01 week of the Consultant being informed of such comments	30%

Note:

1. Price excluding Non-competitive Components (e.g. provisional sums, contingencies, etc.)
2. No advance payment will be made for Phase 2.

H. Reporting Requirements

19. The Consultant shall submit the reports described in the deliverables above to CEB with 10 copies of final report and 04 copies of each in other submissions in English. In addition, softcopies of each report shall be provided in PDF format

I. Team Composition / Qualification & Requirements / Position-based Tasks and Responsibilities

20. Based on the above scope of work, the experts identified by the consulting firm shall have the minimum qualification requirements in undertaking the following tasks:

Key Expert Positions – International

	Position (Duration)	Qualifications and Experience	Tasks / Responsibilities
1.	**Pumped Storage Specialist** **(5 person-months Total)** (Phase 1: *2 person-months*) (Phase 2: *3 person-months*)	• Master's degree or Bachelor's degree (Civil or Mechanical or Electrical Eng.) Academically and professionally qualified in relevant field • At least 15 years project experience on Pumped Storage technology	• Expert will provide pumped storage technology related inputs for this assignment including but not limited to the tasks in Section/s 17.3 and 18.3 of the TOR • Responsible for studying and recommending the appropriate pumped storage technology for the specific site(s) with the possibility of adjustable speed drive considering all other relevant parameters • Provide necessary technology specific inputs for the studies and designs
2.	**Specialist Hydro-Mechanical** **(4 person-months Total)** (Phase 1: *1 person-months*) (Phase 2: *3 person-months*)	• Master's degree or Bachelor's degree (Mechanical Eng. or relevant field) Academically and professionally qualified in relevant field • At least 10 years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.3and 18.3of the TOR • Responsible for all the Hydro-Mechanical related studies, designs and recommendations
3.	**Specialist Electro-Mechanical** **(4 person-months Total)** (Phase 1: *1 person-months*) (Phase 2: *3 person-months*)	• Master's degree or Bachelor's degree (Electrical or Mechanical Eng.) Academically and professionally qualified in relevant field • At least 10 years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.3 and 18.3 of the TOR • Responsible for all the Electro-Mechanical related studies, designs and recommendations

	Position (Duration)	Qualifications and Experience	Tasks / Responsibilities
4.	**Specialist Power Systems** **(3 person-months Total)** (Phase 1: *1 person-months*) (Phase 2: *2 person-months*)	• Master's degree or Bachelor's degree (Electrical Eng.) Academically and professionally qualified in relevant field • At least 10 years project experience on power system planning • Experience on power system planning related to pumped storage hydro power project(s) will be an advantage	• Expert will undertake the tasks including but not limited to Section/s17.1g and 18.1gof the TOR • Responsible for power system and interconnection studies, designs and recommendations

Key Expert Positions – National

	Position (Duration)	Qualifications and Experience	Tasks / Responsibilities
1.	**Project Manager/ Team Leader** **(16 person-months Total)** (Phase 1: *7 person-months*) (Phase 2: *9 person-months*)	• Master's degree or Bachelor's degree (Civil or Mechanical or Electrical Eng.)Academically and professionally qualified in relevant field • At least 15years project experience on Pumped Storage Hydropower Projects or Hydropower Projects	As **Team Leader**, the expert will: • Supervise Consultant team members. • Manage all planned activities within the broad scope of services in TOR and produce the outputs within the given timeframes. As **Project Manager**, the expert will: • Present the output to the Client and any other organization named by the Client • Respond to the clarifications regarding the studies • Coordinate with the Client and all stakeholders
2.	**Expert Geologist** **(6 person-months Total)** (Phase 1: *3 person-months*) (Phase 2: *3 person-months*)	• Master's degree or Bachelor's degree (Geology or relevant field) Academically and professionally qualified in relevant field • At least 10years project experience on Geological investigations	• Expert will undertake the tasks including but not limited to Section/s 17.1 b and 18.1 b & c of the TOR • Responsible for studying and analysis of Geological conditions of geographical area to be studied • Provide expert recommendations on designing foundations and civil structures

	Position (Duration)	Qualifications and Experience	Tasks / Responsibilities
3.	**Specialist Civil Engineering** **(10 person-months Total)** (Phase 1: *4 person-months*) (Phase 2: *6 person-months*)	• (Specify academic field/s of study) • Master's degree or Bachelor's degree (Civil Eng) Academically and professionally qualified in relevant field • At least 10years project experience on Pumped Storage Hydropower Project or Hydropower Project • Work experience on 01 Pumped Storage Hydropower Project will be an advantage	• Expert will undertake the tasks including but not limited to Section/s 17.1a , 17.2, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4,of the TOR • Any other relevant tasks • Responsible for all the Civil Engineering related studies, surveys, designs and recommendations
4.	**Environmental Expert** **(8 person-months Total)** (Phase 1: *2 person-months*) (Phase 2: *6 person-months*)	• Master's degree or Bachelor's degree (in a relevant field) Academically and professionally qualified in relevant field • At least 10 years project experience on environmental studies	• Expert will undertake the tasks including but not limited to Section/s 17.1f and 18.1e,fof the TOR • Responsible for all the environment related studies, surveys and recommendations
5.	**Civil Engineer (Tunnelling and underground works)** **(9person-months Total)** (Phase 1: *3 person-months*) (Phase 2: *6person-months*)	• Master's degree or Bachelor's degree (Civil Eng) Academically and professionally qualified in relevant field • At least 06years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.3 and 18.3 of the TOR • Responsible for the studies and designs related to tunneling and underground works
6.	**Civil Engineer (Other structures and roads)** **(8 person-months Total)** (Phase 1: *3 person-months*) (Phase 2: *5 person-months*)	• Master's degree or Bachelor's degree (Civil Eng) Academically and professionally qualified in relevant field • At least 06years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.2, 17.3 and 18.2, 18.3 of the TOR • Responsible for the studies and designs related to dams, other structures and roads
7.	**Civil Engineer (Cost &Quantities)** **(6 person-months Total)** (Phase 1: *2person-months*) (Phase 2: *4person-months*)	• Master's degree or Bachelor's degree (Civil Eng) Academically and professionally qualified in relevant field • At least 06 years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.5 and 18.5 of the TOR • Responsible for the calculations and recommendations on costs and quantities of the project components
8.	**Civil Engineer (Construction Planning)** **(6 person-months Total)** (Phase 1: *2 person-months*) (Phase 2: *4person-months*)	• Master's degree or Bachelor's degree (Civil Eng) Academically and professionally qualified in relevant field • At least 06years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.4 and 18.4 of the TOR • Responsible for the calculations and recommendations of construction planning

	Position (Duration)	Qualifications and Experience	Tasks / Responsibilities
9.	**Hydro-Mechanical Engineer** **(6 person-months Total)** (Phase 1: *2person-months*) (Phase 2: *4person-months*)	• Master's degree or Bachelor's degree (Mechanical Eng) Academically and professionally qualified in relevant field • At least 06years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.3 and 18.3 of the TOR • Responsible for the calculations and designs of hydro-mechanical components
10.	**Electro-Mechanical Engineer** **(6 person-months Total)** (Phase 1: *2person-months*) (Phase 2: *4person-months*)	• Master's degree or Bachelor's degree (Mechanical or Electrical Eng) Academically and professionally qualified in relevant field • At least 06years project experience on Pumped Storage Hydropower Project(s) or Hydropower Project(s)	• Expert will undertake the tasks including but not limited to Section/s 17.3 and 18.3 of the TOR • Responsible for the calculations and designs of electro-mechanical components
11.	**Hydrologist** **(9 person-months Total)** (Phase 1: *4 person-months*) (Phase 2: *5person-months*)	• Master's degree or Bachelor's degree (in a relevant field) Academically and professionally qualified in relevant field • At least 06years project experience on hydrological studies	• Expert will undertake the tasks including but not limited to Section/s 17.1c&dand 18.1d of the TOR • Responsible for the hydrological studies and designs
12.	**Economist** **(5 person-months Total)** (Phase 1: *2 person-months*) (Phase 2: *3 person-months*)	• Master's degree or Bachelor's degree (Economics or relevant field) Academically and professionally qualified in relevant field • At least 06years work experience on financial and economic analysis of power projects	• Expert will undertake the tasks including but not limited to Section(s) 17.5 and 18.5 of the TOR • Responsible for the financial and economic feasibility studies of the project
13.	**Geotechnical Engineer** **(9 person-months Total)** (Phase 1: *3 person-months*) (Phase 2: *6 person-months*)	• Master's degree or Bachelor's degree (Geotechnical or civil Eng) Academically and professionally qualified in relevant field • At least 06years experience on geotechnical engineering	• Expert will undertake the tasks including but not limited to Section/s 17.1b,17.3, 18.1b&c and 18.3 of the TOR • Responsible for the geotechnical studies and designs
14.	**Ecologist** **(8 person-months Total)** (Phase 1: *2 person-months*) (Phase 2: *6 person-months*)	• Master's degree or Bachelor's degree (in a relevant field) Academically and professionally qualified in relevant field • At least 06 years project experience on ecological Studies	• Expert will undertake the tasks including but not limited to Section/s 17.1f and 18.1eof the TOR • Responsible for the surveys, studies and recommendations of ecological studies

	Position (Duration)	Qualifications and Experience	Tasks / Responsibilities
15.	**Sociologist** **(6 person-months Total)** (Phase 1: *2 person-months*) (Phase 2: *4 person-months*)	• Master's degree or Bachelor's degree (in Sociology or relevant field) Academically and professionally qualified in relevant field • At least 06 years project experience on social studies	• Expert will undertake the tasks including but not limited to Section/s 17.1f and 18.1f of the TOR • Responsible for the surveys, studies and recommendations of sociological studies

Note: Selected consultant should utilize the experts at least for the above indicative time periods and records should be provided to the client

J. Information and Facilities Provided by CEB

21. CEB shall facilitate the smooth implementation of the consultancy as follows:

I. Provide information from relevant studies to the assignment:

	Related Site	Document Description
1	Wewathenna -Victoria site	Chapter 15 of the Electricity Sector Master Plan Study report (2018) on preliminary level study of Pumped Storage Hydropower Project at Wewathenna-Victoria site
2	Maha-Oya site	Relevant parts of the study report 'Development Planning on Optimal Power Generation for Peak Demand in Sri Lanka' (2015) on pre-feasibility level study of Maha-Oya (Maha3) site

Note: Copies of the above documents can be obtained from the DGM (Transmission & Generation Planning) of CEB by a written request. Contact details are given in the EOI advertisement.

II. Assist in obtaining permission from the relevant authorities and organizations to access particular sites and locations necessary to perform the studies.

III. Contribute to joint study for power transmission and interconnection.

Note: CEB shall not provide any other facilities/services except above mentioned.