



Technical Assistance Report

Project Number: 51122-001
Transaction Technical Assistance (TRTA)
December 2017

Democratic Socialist Republic of Sri Lanka: Preparing Power System Reliability Strengthening Project

This report is being disclosed to the public in accordance with ADB's Public Communications Policy 2011.

Asian Development Bank

CURRENCY EQUIVALENTS

(as of 16 November 2017)

Currency unit	–	Sri Lanka rupee/s (SLR/SLRs)
SLR1.00	=	\$0.006501
\$1.00	=	SLRs153.80

ABBREVIATIONS

ADB	–	Asian Development Bank
CEB	–	Ceylon Electricity Board
kV	–	kilovolt
LECO	–	Lanka Electricity Company (Private) Ltd.
MPRE	–	Ministry of Power and Renewable Energy
PSSE	–	Power System Simulator for Engineering
SLR	–	Sri Lankan rupees
TASF	–	Technical Assistance Special Fund
TRTA	–	transaction technical assistance

NOTE

In this report, "\$" refers to United States dollars.

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TRANSACTION TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data		Project Number: 51122-001	
Project Name	Power System Reliability Strengthening Project	Department /Division	SARD/SAEN
Nature of Activity	Project Preparation	Executing Agency	Ceylon Electricity Board, Lanka Electricity Company (Private) Ltd.
Modality	Regular		
Country	Sri Lanka		
2. Sector		Subsector(s)	
✓ Energy		Electricity transmission and distribution	
			ADB Financing (\$ million)
			1.50
		Total	1.50
3. Strategic Agenda		Subcomponents	
Inclusive economic growth (IEG) Environmentally sustainable growth (ESG)	Pillar 1: Economic opportunities, including jobs, created and expanded Natural resources conservation	Climate Change Information	
		Climate Change impact on the Project	Low
4. Drivers of Change		Components	
Governance and capacity development (GCD) Knowledge solutions (KNS)	Institutional development Application and use of new knowledge solutions in key operational areas	Gender Equity and Mainstreaming	
		Some gender elements (SGE)	✓
5. Poverty and SDG Targeting		Location Impact	
Geographic Targeting	No	Nation-wide	High
Household Targeting	No		
SDG Targeting	Yes		
SDG Goals	SDG7		
6. Risk Categorization			
7. Safeguard Categorization Safeguard Policy Statement does not apply			
8. Financing			
Modality and Sources		Amount (\$ million)	
ADB		1.50	
Transaction technical assistance: Technical Assistance Special Fund		1.50	
Cofinancing		0.00	
None		0.00	
Counterpart		0.00	
None		0.00	
Total		1.50	

I. THE ENSUING PROJECT

1. Sri Lanka's energy sector performance has achieved a national electrification ratio of 99.3% (2016) of the households up from 29% in 1990.¹ However, the demand for electricity continues to grow with increasing economic growth and improving living standards of the population. While trying to meet this increasing demand the sector continues to struggle because of the high cost of electricity emanating from poor generation mix and inadequate level of reliability. This is partly due to underinvestment in the transmission network, medium voltage network, and protection system resulting from high government debt-to-GDP ratio over the years and the poor financial status of Ceylon Electricity Board (CEB)—the state-owned public utility whose operations have been constrained by non-implementation of full cost recovery tariff and receivables.

2. In 2015–2016, Sri Lanka suffered three country-wide blackouts within the span of 7 months. All these blackouts were attributed to poor operation of the protection system, lack of operational flexibility and bottlenecks in the transmission system. Economic loss from the three blackouts was estimated at monetarized value at the unit of \$/kWh un-served activity. Indirect social impacts, such as increase in crime rates, were also reported.

3. Strengthening the transmission system, improving the 33/11 kilovolt (kV) medium voltage network, and upgrading the protection system are needed to ensure reliable operation of the power system. These interventions will also help increase absorption of intermittent wind and solar power which in turn will contribute to achieving government targets for clean energy development. Similarly, these will improve the quality of power supply in rural areas, where currently the quality is low.

4. The project is consistent with the national sector investment program that is based on the National Energy Policy and Strategies of Sri Lanka² and Vision 2025.³ The project is also in line with Asian Development Bank's (ADB's) country partnership strategy for Sri Lanka where the energy sector is expected to focus on, among others, expanding nontraditional renewable energy using wind and solar, and improving reliability of power supply.⁴ The project is also strongly linked to recently approved ADB programs supporting investments in removing bottlenecks in power transmission and strengthening distribution system, and expanding access to clean electricity and promote renewable energy development.

5. Lessons from previous projects will be considered and incorporated into the project design and implementation arrangements. Specifically, the project will integrate renewable energy, and improve implementation arrangements by strengthening CEB and Lanka Electricity Company (Private) Ltd. (LECO)⁵ capacity in complex project supervision and safeguard monitoring.

6. **ADB Value Addition.** The project will involve a careful analysis of the existing power protection systems and implement appropriate solutions to ensure optimum reliability of supply

¹ Ceylon Electricity Board. 2017. *Statistical Digest 2016*. Colombo.

² Government of Sri Lanka. 2008. *National Energy Policy and Strategies of Sri Lanka*. Colombo.

³ Government of Sri Lanka. 2017. *Vision 2025: A Country Enriched*. Colombo.

⁴ ADB. 2017. *Country Partnership Strategy: Sri Lanka, 2018–2022—Transition to Upper Middle-Income Country Status*. Manila.

⁵ Ceylon Electricity Board (CEB) is a state-owned corporation established on 1 November 1969 under the Ceylon Electricity Board Act No. 17 of 1969. CEB is engaged in power generation, transmission, distribution and supply of electricity. Lanka Electricity Company (Private) Ltd. (LECO) is a private limited liability company incorporated in 1983 for the purpose of electricity distribution in Sri Lanka under the Companies Act No. 17 of 1982 and Companies Act No. 7 of 2007. CEB and the Ministry of Finance are the major shareholders of LECO, among other shareholders, mainly state entities.

under critical contingencies. By consolidating experiences from ongoing and past ADB projects, the project will enhance the capacity of CEB and LECO to plan, design, implement, manage, monitor, and operate ADB-financed projects, and improve safeguards implementation of power projects. Latest and advanced technologies (such as the Wide Area Monitoring System, low-loss conductors for transmission and energy efficient transformers for distribution) will be incorporated into the design of the transmission system and medium voltage distribution system to minimize system losses and increase reliability.

II. THE TECHNICAL ASSISTANCE

A. Justification

7. The objectives of the transaction technical assistance (TRTA) are (i) to undertake study on power supply reliability and protection development; and (ii) to conduct technical, economic, financial, safeguards and governance due diligence, prepare project cost estimates, procurement plan and implementation schedule. The TRTA is included in the 2017 program and listed in the country operations business plan for Sri Lanka 2018–2020.⁶

B. Outputs and Activities

8. **Output 1: Study on power supply reliability conducted.** The study will be prepared by consultants engaged under the TRTA and address the following issues:

- (i) verify the transmission system model used in the Power System Simulator for Engineering (PSSE) software;
- (ii) verify the dynamic parameters used in the generator/governor/exciter models of PSSE by testing the existing hydro and thermal machines;
- (iii) evaluate the sequence impedance parameters of all components of the existing network, including transmission lines, transformers and others;
- (iv) carry out stability studies (transient and voltage) for sequence of events in the power system, assess system reactive power requirements for various system conditions (steady state and transient) for the next 10 years, and review critical fault clearing times at grid substations;
- (v) carry out studies on the impact of transmission network due to the operation of Electrical Multiple Units (EMUs, traction loads) in railway electrification.
- (vi) review present operational philosophy giving due consideration to spinning reserve policy, required operational changes to existing power plants, and requirement of flexibility of power plants' operation;
- (vii) review in detail present protection philosophy and settings;
- (viii) build Ceylon Electricity Board's (CEB) capacity in transmission planning, protection and system control for carrying out such studies in future; and
- (ix) recommend investments for improving power system protection and reliability.

9. **Output 2: Project preparatory due diligence completed.** The consultants engaged under the TRTA will conduct technical, economic, financial, safeguards and governance due diligence, prepare project cost estimates, procurement plan and implementation schedule.

⁶ ADB. 2017. *Country Operations Business Plan: Sri Lanka, 2018–2020*. Manila. The TRTA will be posted in the business opportunities section of ADB's website in December 2017.

C. Cost and Financing

10. The TRTA is estimated to cost \$1,500,000 to be financed on a grant basis by ADB's Technical Assistance Special Fund (TASF-VI). The key expenditure items are listed in Annexure 1. The government will provide counterpart support in the form of counterpart staff and other in-kind contributions.

D. Implementation Arrangements

11. ADB will administer the TRTA and will be responsible for selection, supervision and evaluation of consultants, and procurement of goods under the TRTA.

12. ADB will be the executing agency. The CEB and LECO will be the implementing agencies for the TRTA. CEB and LECO have experience and capacity in implementing externally funded projects and TAs, including those financed by ADB and other development partners. The TRTA will be implemented over a 12-month period commencing March 2018 and finishing in February 2019. Table 1 provides a summary of the implementation arrangements.

Table 1: Implementation Arrangements

Aspects	Arrangements		
Indicative implementation period	March 2018–February 2019		
Executing agency	Asian Development Bank		
Implementing agencies	Ceylon Electricity Board and Lanka Electricity Company (Private) Ltd.		
Consultants	To be selected and engaged by Asian Development Bank		
	Quality- and cost-based selection	58 person-months	\$1,320,000
	Individuals	8 person months	\$150,000
Procurement	To be procured by consultants		
	Shopping	3 contracts	\$30,000
Advance contracting and retroactive financing	Advance contracting will be undertaken for this TRTA		
Disbursement	The TRTA resources will be disbursed following ADB's <i>Technical Assistance Disbursement Handbook</i> (2010, as amended from time to time).		
Asset turnover or disposal arrangement upon TRTA completion	Upon completion of the technical assistance all procured equipment will be handed over to the implementing agency		

TRTA = transaction technical assistance.

Source: Asian Development Bank estimates.

13. **Consulting services.** Two separate consulting firms will be selected for (i) undertaking study on power supply reliability and protection development (Part A), and (ii) conducting project preparatory due diligence (Part B). The TRTA will require total of 58 person-months of consulting services (34 international and 24 national) in the areas of (i) Part A: power system modeling and analysis, power system protection, and power system operation with intermittent renewable (wind and solar) integration, transmission and generation planning and operation, and (ii) Part B: power system engineering, transmission and distribution, economics, financial analysis, environmental and social safeguards, procurement and others.

14. Procurement (including consulting services) to be financed by ADB will follow ADB's Procurement Policy and Regulations (2017, as amended from time to time). The two consulting

firms and consultants will be engaged by ADB through quality and cost-based selection (with quality to cost ratio of 90:10), using a simplified technical proposal. The TRTA-financed equipment will be procured by the consultants. The disbursements under the TRTA will be made under ADB's *Technical Assistance Disbursement Handbook* (May 2010, as amended from time to time). Terms of reference for consulting services are in Annexure 2.

III. THE PRESIDENT'S DECISION

15. The President, acting under the authority delegated by the Board, has approved the provision of technical assistance not exceeding the equivalent of \$1,500,000 on a grant basis for the Sri Lanka Power System Reliability Strengthening Project , and hereby reports this action to the Board.

Takehiko Nakao
President

COST ESTIMATES AND FINANCING PLAN
(\$'000)

Item	Amount
Asian Development Bank ^a	
1. Consultants	
a. Remuneration and per diem	
i. International consultants	775.2
ii. National consultants	184.8
b. Out-of-pocket expenditures	
i. International and local travel	240.0
ii. Reports and communications	20.0
iii. Miscellaneous administration and support costs	10.0
2. Surveys ^b	110.0
3. Equipment ^c	30.0
4. Training, seminars, and conferences ^d	60.0
5. Representative for contract negotiations	10.0
6. Contingencies	60.0
Total	1,500.0

Note: The total transaction assistance (TRTA) is estimated to cost \$1,650,000, of which, \$1,500,000 contributions from the ADB's Technical Assistance Special Fund (TASF-VI) are presented in the table above. The government will provide counterpart support in the form of counterpart staff and other in-kind contributions. The value of government contribution is estimated to account for 10% of the total TRTA cost.

Source: Asian Development Bank estimates.

^a Financed by the Asian Development Bank's Technical Assistance Special Fund (TASF-VI)

^b Costs for survey enumerators, field transportation, rental of venue, audio-visuals, printing and stationary etc.

^c Includes photocopier, projector, screen, fan, office table, whiteboard, desktop computer and other office related items. Equipment purchased under the transaction technical assistance will be turned over to the executing agency at the end of the technical assistance.

^d Costs for capacity development workshops, event materials etc.

TERMS OF REFERENCE FOR CONSULTANTS

1. Two separate consulting firms will be selected for (i) undertaking study on power supply reliability and protection development (Part A), and (ii) conducting project preparatory due diligence (Part B) and two individual international consultants to enhance safeguards implementation. The transaction technical assistance (TRTA) will require total of 66 person-months of consulting services (34 person months international and 24 person months national under two firms, and 8 person months individuals for safeguards) in the areas of (i) Part A: power system modeling and analysis, power system protection, and power system operation with intermittent renewable (wind and solar) integration, transmission and generation planning and operation, (ii) Part B: power system engineering, transmission and distribution, economics, financial analysis, environmental and social safeguards, procurement and others

Part A: Study on Power Supply Reliability and Protection Development

2. **Transmission System Planning Specialist/Team Leader (international; 4 person-months):** The specialist should preferably have a master's degree in electrical engineering and at least 15 years of experience in the energy sector including in transmission system planning. He/she should have extensive experience in the power system analysis with intermittent renewable (wind and solar) integration, transmission planning and system operation, developing standard and specifications, and relevant cost estimation. The consultant should also have extensive experience in power system analysis using the Power System Simulator for Engineering (PSSE) network analysis software. The consultant will also manage a consulting team and ensure quality outputs. The tasks of the consultant will include but will not be limited to the following:

- (i) Be responsible for the overall quality and implementation of the TRTA assignment, providing the required support for the executing agency/implementing agencies (the EA/IAs) and reporting to Asian Development Bank's (ADB's) project officer. As team leader, coordinate with other team members to develop a detailed work plan and implementation schedule, work with the EA/IAs to oversee the consulting team, and compile, edit, and ensure the quality of reports to be issued under the TA;
- (ii) Review and validate existing transmission system model data;
- (iii) Review and validate existing transmission system models;
- (iv) Carry out load flow studies covering a planning period of up to 2028. The study should cover different generation and transmission options including India-Sri Lanka High Voltage Direct Current (HVDC) connection and operation of EMUs (traction loads) in 132kV network;
- (v) Report of system upgrades necessary for each option including bottlenecks in transmission network;
- (vi) Develop high level cost aspects of different options;
- (vii) Carry out transient and voltage stability studies over the next 5 years;
- (viii) Streamlined reactive power and voltage control plan for the next 5 years; and
- (ix) Build the capacities of CEB engineers.

3. **Power system operation expert (international; 3 person-months):** The specialist should preferably have a master's degree in electrical engineering with at least 15 years in a utility system operation and system operation planning environment. The consultant should have an extensive experience on generator scheduling for daily dispatch utilizing available generators,

contingency planning, power system's supervisory control and data acquisition (SCADA) and Energy Management System. Knowledge on the use of dispatch software like Stochastic Dual Dynamic Programming (SDDP) and short-term model for daily dispatch, NCP is an added advantage. The tasks of the consultant will include but will not be limited to the following:

- (i) Review current practices on active power management (frequency control) and reactive power management (voltage control);
- (ii) Review the planning methodology with regard to n-1 criteria, credible n-2 criteria and present active and reactive power reserve policy (5% spinning reserve policy);
- (iii) Review the CEB system control center policies and procedures;
- (iv) Make recommendations for improvements based on international best practices that are applicable to CEB's system;
- (v) Working closely with the power system planning expert and the power protection expert make recommendation on any special protection schemes and synchro phasor measurement location, if required;
- (vi) Review the contingency plan after major transmission failure and suggest international best practice;
- (vii) Review the asset management and CEB's Operation and Maintenance branch current practices and suggest international best practice;
- (viii) Review parameters and values in the Grid Code considering the Sri Lankan network arrangements;
- (ix) Develop a methodology for power system stabilization using present communication technology; and
- (x) Advise on the renewable energy desk at the dispatch center.

4. Power system protection analysis and protection development expert (international; 3 person-months): The specialist should preferably have a master's degree in electrical engineering with at least 15 years of hands-on experience in power system engineering with main focus on protection and control. Further, the expert should preferably have followings experience: (a) engineering experience with generation, transmission and distribution systems and in-depth knowledge with protective relay theory and applications; (b) familiarity with microprocessor-based relays from major relay vendors (such as SEL, GE, ABB, Alstom, Siemens, etc.); (c) expertise with relay setting calculations for lines, transformers, buses, feeders, etc.; (d) experience with protection and control system design and relay panel design; (e) expertise with power system modeling using steady state and transient simulation software such as PSS/E and/or DigSilent, ASPEN Oneliner, CAPE, PSCAD, RSCAD, etc.; (f) expertise with fault analysis to identify the root cause of mal-operations; (g) experience with test and commissioning of relaying systems; and (h) experience with RTU, PMU, DFR, communication network, etc. The tasks of the consultant will include but will not be limited to the following:

- (i) Carryout a review of the protection philosophy adopted by CEB and propose further improvements if any to be adopted considering the renewable energy integration into the network;
- (ii) Review the protection settings of the transmission lines, transformers, capacitor banks, reactors, static var compensators (SVC) and generators connected to transmission network, which are operated by CEB or independent power producers to determine their correct application and ensure proper coordination;
- (iii) Review the practices adopted by protection engineers for setting calculation and failure analysis based on a comparison with typical best international practice;
- (iv) Review the maintenance practices for the protection system to determine whether the present arrangements are adequate;

- (v) Provide guidance on the application of robust electrical power system protection design and analysis software, which complies with international standards;
- (vi) Provide a comprehensive training for the protection engineers in CEB on setting calculation, failure analysis and maintenance of protection system;
- (vii) Working closely with the power system planning expert and system operation expert review recommendations for special protection schemes and synchro phasor measurement location, if required; and
- (viii) Develop a protection database and protection simulation model of the Sri Lankan high voltage network in an industry standard simulation tool recommended by CEB. Perform simulation to verify the existing protection settings and make recommendations.

5. Power system component model development expert (international; 3 person-months): The specialist should preferably have a master's degree in engineering with at least 15 years of hands-on experience on generator modeling and testing. The expert should also have experience in generator model development and validation and model data extraction. Moreover, the expert should have experience in power system dynamic behavior and related studies. The tasks of the consultant will include but will not be limited to the following:

- (i) Review the current year (or the one specified by CEB) dynamic models and compare simulation results with available field recordings;
- (ii) Identify generators that need to be tested for further refine the model;
- (iii) In collaboration with CEB generation engineers, perform necessary tests and record test results;
- (iv) Perform calculation to extract the generator parameters for dynamic model update;
- (v) Verify accurate model response; and
- (vi) Provide final report and updated system model to CEB.
- (vii) Propose a methodology to update the dynamic model when a power system component is added in the future.

Part B: Project Preparatory Due Diligence

6. Power System Engineer / Team Leader (international; 6 person-months): The international Power System Engineer / Team Leader (thereafter the Consultant) will be qualified with a degree in engineering or equivalent, with graduate qualifications and at least 15 years of work experience in power systems, preferably in projects with multilateral lending agencies in developing countries. Working experience in the South Asian region would be preferable. The consultant will also manage a consulting team and ensure quality outputs for due diligence conducted for the ensuing project. The tasks of the consultant and team leader will include, but not be limited, to the following:

- (i) Be responsible for the overall quality and implementation of the TRTA assignment, providing the required support for the executing agency/implementing agencies (the EA/IAs) and reporting to Asian Development Bank's (ADB's) project officer. As team leader, coordinate with other team members to develop a detailed work plan and implementation schedule, work with the EA/IAs to oversee the consulting team, and compile, edit, and ensure the quality of reports to be issued under the TA;
- (ii) With input from other consultants, the consultant and team leader will prepare overall sector assessment, finalize relevant detailed project designs, including

- technical specifications, cost estimates and procurement packages in consultation with EA/IAs staff, and also formulate overall procurement plan;
- (iii) Prepare the scope, capital and operating cost estimates, implementation schedule showing anticipated progress of work and expenditures, contracting, and implementation arrangements, and combine and formulate suitable procurement packages for all components;
 - (iv) Coordinate conducting due diligence on transmission, medium voltage and distribution network, examine alternative solutions.
 - (v) Prepare a final project report consisting of information needed for ADB to bring the investment proposal for its Board consideration;
 - (vi) Prepare/update a design and monitoring framework for the ensuing project according to ADB standards, clearly identifying impacts, outcomes, outputs, inputs, and activities and milestones, and set up monitoring indicators for implementation and post evaluation, including collecting necessary baseline data and establishing target indicators for the ensuing project to enable impact evaluation after project completion;
 - (vii) Estimate Green House Gas Reduction, where feasible, for appropriate components of the project in line with best international practice and ADB endorsed methodology;
 - (viii) Review the results of route surveys carried out by EA/IA staff;
 - (ix) Finalize the least-cost design for line routes and the cost estimates for the relevant infrastructure of the ensuing project, taking into account the financing plan available; and
 - (x) Develop an investment plan for the proposed infrastructure in the areas to be covered by the project.

7. **Power System Engineer (national; 4 person-months):** The consultant will be qualified with a degree in engineering, with at least undergraduate qualifications and 7 years of work experience in power systems, preferably in projects with multilateral lending agencies in developing countries. The tasks of the consultant will include, but not be limited, to supporting international Power System Engineer in undertaking his responsibilities.

8. **Medium Voltage Network/Distribution Specialist (international; 3 person-months):** The Medium Voltage Network/Distribution Specialist (thereafter the Consultant) will be qualified with a degree in engineering or equivalent, with graduate qualifications and at least 10 years of work experience in medium voltage network/distribution designs, preferably in projects with multilateral lending agencies in developing countries. Working experience in the South Asian region would be preferable. The tasks of the consultant and team leader will include, but not be limited, to the following:

- (i) Conduct/review the results of route surveys carried out by EA/IA staff;
- (ii) Finalize the least-cost design for line routes and the cost estimates for a relevant component of the ensuing project, taking into account the financing plan available;
- (iii) Conduct load flow studies to optimally sizing the wire and develop an investment plan for construction/upgrading/reinforcing/reconductoring mid-voltage (33 and 11 kV) lines in the project area;
- (iv) Review/propose reactive power management options through installation of 33 kV/11 kV capacitor banks if applicable;
- (v) Prepare a procurement plan for the component, and support the IA in preparing relevant bidding documents; and

- (vi) Prepare a detailed component implementation schedule showing anticipated progress of work and expenditures.

9. **Medium Voltage Network/Distribution Specialist (national; 4 person-months):** The consultant will be qualified with a degree in engineering, with a university bachelor degree with 7 years of experience in medium voltage network/distribution designs, preferably in projects with multilateral lending agencies in developing countries. The tasks of the consultant will include, but not be limited, to supporting international Medium Voltage Network/Distribution Specialist in undertaking his responsibilities.

10. **Power Economist (international; 3 person-months):** The international Power Economist (thereafter the Consultant) will be qualified with a degree in economics, finance or equivalent, with graduate qualifications and at least 10 years of work experience in power economics and economic analysis, preferably in projects with multilateral lending agencies in developing countries. Working experience in the South Asian region would be preferable. He/she will conduct economic due diligence and economic analysis for the project. The tasks of the consultant and team leader will include, but not be limited, to the following:

- (i) Provide the economic rationale for the project including an analysis of alternatives;
- (ii) In accordance with ADB's *Guidelines for the Economic Analysis of Projects*, undertake economic analysis of the proposed investments and assess their economic viability
- (iii) Estimate the economic capital and operating costs, and carry out least-cost, viability, and beneficiary analysis of the proposed investments, including sensitivity analysis;
- (iv) Conduct economic benefit-cost analysis to confirm the overall viability of the proposed investments in terms of economic internal rates of return;
- (v) In consultation with a social development specialist, incorporate poverty reduction impacts in accordance with ADS's *Handbook on Integrating Poverty Impact Assessment in the Economic Analysis of Projects*;
- (vi) Assess various stakeholders' willingness to pay and ability to pay for expected various services under the proposed project;
- (vii) Estimate the poverty reduction impact ratio (PIR) according to ADB's relevant guidelines and requirements;
- (viii) Assess economic and sustainability issues and carry out distribution, sensitivity and risk analyses;
- (ix) Evaluate the proposed project's direct and indirect environmental impacts, and carry out economic analysis of these impacts in terms of net present value and internal rates of return in accordance with ADS's *Handbook on Economic Evaluation of Environmental Impacts*; and
- (x) Specify indicators to monitor benefits from the ensuing loan, establish procedures and provide cost estimates for benefit monitoring and evaluation in terms of the ADB's *Guidelines for Benefit Monitoring and Evaluation (1992)*.

11. **Power Economist (national; 4 person-months):** The consultant will be qualified with a degree in economics or finance, with a university bachelor degree and at least 7 years of experience in power economics and economic analysis, preferably in projects with multilateral lending agencies in developing countries. The tasks of the consultant will include, but not be limited, to supporting international Power Economist in undertaking his responsibilities.

12. Financial Specialist (international; 3 person-months) The international Finance Specialist (thereafter the Consultant) will be qualified with a degree in finance, economics or equivalent, with graduate qualifications and at least 10 years of work experience in financial analysis of projects, preferably in projects with multilateral lending agencies in developing countries. CA/CPA is required. Working experience in the South Asian region would be preferable. He/she will conduct financial due diligence and financial analysis for the project. The tasks of the consultant and team leader will include, but not be limited, to the following:

- (i) In accordance with ADB's Guidelines for *the Financial Analysis and Management of Projects* (2005), *the Financial Management Assessment Questionnaire* (2005), and *the Financial Due Diligence Methodology Note* (2009), will undertake financial analysis of the proposed project and assess the financial performance and the financial management capabilities of the executing/implementing agencies;
- (ii) Prepare project cost tables and a financing plan for the investment components, including proposed ADB lending and appropriate counterpart funds for local currency and expenditures;
- (iii) Carry out a financial analysis of the proposed investment components by building a financial forecasting model that will create future year projections comprising CEB and LECO income statements, balance sheets, cash-flow statements and key financial ratios. The model should include 3-year historic data and projections for at least 10 years. Key risks should be identified and sensitivity modeled. Actions that will be needed to ensure project sustainability, typically agreement to required future tariff levels and financial ratios, should be identified as potential "assurances and/or covenants". Measures to improve CEB's and LECO's financial position would be recommended;
- (iv) Carry out a financial evaluation of the proposed investment components over the construction and operating periods by calculating the financial internal rate of return and comparing it with a weighted average cost of capital in accordance with the ADB's Guidelines;
- (v) Identify risks to project's revenues and costs, conduct relevant sensitivity analysis, and identify potential risk mitigation strategies and approaches;
- (vi) Undertake a financial management assessment of the proposed executing/implementing agencies, including a review of corporate planning and budgetary control, financial management accounting and reporting, internal control and audit systems, and data processing, to identify any financial issues that could affect program implementation and/or sustainable operations of program investments and suggest mitigation strategies. Measures will be proposed to improve IAs' financial performance, operating systems, and overall efficiency levels as part of its financial management assessment;
- (vii) Study the proposed investment project's financial impact on the executing/implementing agencies and options for sharing the financial burden, recommend measures for improving their financial performance, suggest appropriate financial covenants to monitor the program's financial performance, and recommend ways to improve their corporate governance in light of ADB's policy on governance; and
- (viii) Design the project's fund flow and disbursement mechanism, and where applicable, review lending and on-lending arrangements in consultation with the executing/implementing agencies and the government on the financing terms.

13. Financial Specialist (national; 4 person-months): The consultant will be qualified with a degree in economics or finance, with a university bachelor degree and at least 7 years of

experience in power economics, finance or financial analysis, preferably in projects with multilateral lending agencies in developing countries CA/CPA is required. The tasks of the consultant will include, but not be limited, to supporting international Financial Specialist in undertaking his responsibilities.

14. Environmental Specialist (international; 3 person-months): The international Environmental Specialist (hereafter the Consultant) will be qualified with at least a bachelor degree in environmental science/engineering or equivalent and at least 10 years of experience in carrying environmental studies for projects, Initial Environment Examination (IEE) and Environment Impact Assessment (EIA) preparation, including for power sector projects. The consultant shall have experience in preparing EIAs and IEEs of projects financed by international financial institutions, specifically ADB and the World Bank. Working experience in the South Asian region would be preferable. Familiarity and knowledge about Sri Lanka's environmental framework and approval requirements related to environmental clearances for power sector investment projects would be an asset. The tasks of the consultant and team leader will include, but not be limited, to the following:

- (i) Review of institutional capacity of the proposed executing and implementing agencies to prepare and implement EIA and IEE reports for the project and required Environmental Management Plans to determine mitigation measures in the design, construction, and maintenance phases of the project and national regulatory requirements in accordance with the ADB's *Safeguard Policy Statement (2009)*;
- (ii) Review laws, regulations and policies of Sri Lanka on environment;
- (iii) Prepare Rapid Environmental Assessment Checklist and determine environmental category for each component;
- (iv) Prepare project descriptions and a summary of environmental issues identified for each component to support the determination of the project environmental categorization;
- (v) Prepare EIAs or IEE depending on the project categorization (environmental category A or B) assigned by ADB in accordance with the ADB's *Safeguard Policy Statement (2009)* for the project;
- (vi) Organize and coordinate required environmental surveys and specialist baseline condition surveys;
- (vii) Document and organize public consultations, including local stakeholders, at least once in representative project sites. If any environment Category-A components are identified, carry out two public consultations (once during the early stages of an EIA field work, and once when the draft EIA report is available and before loan appraisal by ADB); and
- (viii) Prepare Environmental Management and Monitoring Plan (EMP and MP) for the project. The EMP shall include a cost estimate plan for implementation of the proposed mitigation measures.

15. Environmental Specialist (national; 4 person-months): The consultant will be qualified with a degree in environmental science/engineering or equivalent, with at least a bachelor degree in environmental science/engineering or equivalent and 7 years of experience in carrying environmental studies for projects, IEE and EIA preparation, including for power sector projects. The consultant shall have experience in preparing EIAs and IEEs of projects financed by international financial institutions, specifically ADB and the World Bank. The tasks of the consultant will include, but not be limited, to supporting international Environmental Specialist in undertaking his responsibilities.

16. **Social Development Specialist (international; 3 person-months):** The international Social Development Specialist (thereafter the Consultant) will be qualified with at least a bachelor degree in social development or related fields and at least 10 years of experience in conducting social and poverty analysis and preparing Resettlement Plans (RPs) of projects, including for power sector projects, financed by international financial institutions, specifically ADB and/or the World Bank. Working experience in the South Asian region would be preferable. In accordance with all relevant policies, in particular with the relevant laws and policies of Sri Lanka and ADB's *Safeguard Policy Statement (2009)*, the tasks of the Consultant will include, but not be limited to, the following:

- (i) Review the national legal policies on land acquisition and involuntary resettlement to verify adequacy and consistency with the ADB's *Safeguard Policy Statement (2009)* and if gaps are found, recommend measures to bridge the gap. Analyze and confirm the following aspects (at national and local levels) that will apply to land acquisition and resettlement in the project area: (a) laws and regulations, including local practices; (b) budgetary processes (tentative agreement from concerned authorities on provision of outlays necessary for land acquisition and resettlement); and (c) relevant administrative arrangements and requirements;
- (ii) Review of institutional capacity of the proposed executing and implementing agencies to implement RP and recommend strategies and actions to enhance the institutional capacity;
- (iii) If the project involves resettlement, prepare a RP with full stakeholder participation including participation of the executing and implementing agencies. RP should be implementable in the Sri Lankan context and still meet ADB policy requirements;
- (iv) Determine the replacement costs of all categories of losses; and prepare an indicative budget for land acquisition and resettlement costs with specific sourcing and approval process;
- (v) Organize and coordinate required baseline condition surveys;
- (vi) Develop communication material (presentations, leaflets, etc) to be used during the project implementation for dissemination of resettlement information, AP entitlements, project impacts etc;
- (vii) Assess the need for an Indigenous Peoples Development Plan (IPDP) and carry out any further indigenous people-targeted surveys, as necessary;
- (viii) Prepare a socioeconomic analysis, including a poverty profile and characteristics and determinants of primary project beneficiaries in the target areas of the proposed investment components based on a review of existing studies, data, and development plans. The analysis will include a review of poverty by gender and ethnic minority and propose specific actions to benefit vulnerable indigenous peoples and minorities;
- (ix) Analyze access to electricity, affordability, consumption levels, and consumer satisfaction across socioeconomic groups in target project areas, assess the determinants and elasticity of the demand for power by different socioeconomic groups, categorize areas where electrification would have the largest growth and poverty reduction impacts given the underlying potential of those areas, and assess the implications on employment generation for poor;
- (x) In consultation with a power economist and a financial analyst to be engaged for other due diligence activities, define groups that would benefit from the proposed investment components, prepare an estimate of the distribution of the project's financial and economic benefits, and summarize the likely net benefits for each group in accordance with ADB's *Handbook for Integrating Poverty Impact in*

Economic Analysis for Projects. Given the available dataset, assess the direct, indirect, and distributional impacts of the project under different growth scenarios with and without the project, summarize the distributional impacts in a matrix, calculate the poverty impact ratio, and carry out appropriate risk and sensitivity analyses with respect to the poverty impact ratio;

- (xi) In consultation with environment specialists, develop a Grievance Redress Mechanism (GRM), which can be implemented within the local laws & regulation. The GRM will provide the analysis of local context and practicability of the implementation specifically with respect to transmission lines;
- (xii) Prepare a gender needs analysis to identify specific energy needs and preferences of poor and vulnerable women in project areas, design activities/indicators/targets responding to these energy needs to ensure gender beneficial impacts, and develop participatory gender-inclusive strategies to maximize women's participation in program design, development and implementation. Design a gender inclusive productive energy use program to maximize community economic development benefits as feasible.
- (xiii) Assess and recommend ways to improve gender equity, prepare a Gender Action Plan (GAP), as needed;
- (xiv) Review land acquisition and relocation plans of the project that involve resettlement, and assess their conformity in accordance with ADB and other MDBs' guidelines.
- (xv) Incorporate all mitigation measures into the cost estimates of the proposed components; and
- (xvi) Conduct information disclosure and public consultation. Prepare the TOR for the NGO/consultant who will be in charge of the implementation of the RPs, IPDP and GAP, if necessary.

17. **Social Development Specialist (national; 4 person-months):** The consultant will be qualified with a degree in social development or related fields, with at least a bachelor degree and 7 years of experience in conducting social and poverty analysis and preparing RPs of projects, including for power sector projects. The tasks of the consultant will include, but not be limited, to supporting international Social Development Specialist in undertaking his responsibilities.

18. **Biodiversity Specialist (international; 5 person-months individual):** The consultant will be qualified with a Masters or PhD in Wildlife (preferably birds) Conservation or Ecosystem Management or related discipline with specific experience in providing technical advice and support for power projects impacting on migrating birds, critical habitats and threatened species. It is essential to have working knowledge of ADB's Safeguard Policy Statement (SPS) 2009, familiarity with similar safeguard policies, and able to bring in and/or incorporate relevant international best practices to the projects. He/She should have a minimum of 15 years of applied experience in bird watching and modeling, habitat management, biodiversity conservation-related activities involving protected areas including experience working with government conservation authorities, NGOs, and project developers. The tasks of the Consultant will include, but not be limited to, the following:

- (i) Develop the inception report and work plan;
- (ii) Review all relevant national and provincial legal frameworks and guidelines on biodiversity conservation, management and planning of protected areas;
- (iii) Review the EIA Reports and Biodiversity Management Plan(BMP) for critical habitats;

- (iv) Undertake bird watching at each selected vantage point and conduct additional surveys, if necessary;
- (v) Analyze the collected data and conduct bird collision risk modelling, if necessary;
- (vi) Updated BMP to include additional bird monitoring results;
- (vii) Provide inputs for Radar System to development proper interface for bird detection and curtailment;
- (viii) Facilitate consultations among government agencies responsible for protected area management, relevant community organizations, NGOs, affected persons, and other key stakeholders' representatives;
- (ix) Respond to and incorporate comments from Department of Wildlife Conservation, ADB and key stakeholders' representative.

19. Communication Specialist (international; 3 person-months individual): The consultant will be qualified with a Masters in communication, journalism, social sciences, public affairs, political science, or international relations or related field. He/She should have a minimum of 8 years experience in designing and managing development communication programs and public communication programs, preferably for development projects. Experience in handling communication programs of energy projects is an advantage. The assignment is to prepare a Communication Strategy to guide stakeholder communication and engagement during implementation of the project. The tasks of the Consultant will include, but not be limited to, the following:

- (i) Conducting a Communication-Based Assessment (CBA) and stakeholder analysis to identify stakeholders, their information preferences and needs, and other communications contexts, risks or needs associated with the project;
- (ii) Creating a Communication Strategy to guide communication activities and engagement with key stakeholders during implementation;
- (iii) Designing an internal operations process to assist the EA(s) in the timely registration, processing and response to complaints or concerns registered by stakeholders through the projects formal grievance mechanisms
- (iv) Assessing the capacity of the EAs/IAs to deliver the communication strategy, identify capacity building needs, if any; and assist them in establishing communications systems and mechanisms for delivery of the communication strategy; and
- (v) Producing communication materials as needed to support the EAs' stakeholder engagement initiatives.