ENERGY TRANSITION PARTNERSHIP

Powering Prosperity and Enabling Sustainability in South East Asia

The Southeast Asian Energy Transition Partnership (ETP) is a multi-donor platform that brings together government donors, philanthropies and Southeast Asian governments to accelerate the energy transition in Southeast Asia.

Procurement For Services

Grid Modernization and Detailed Design and Supervision Services for for Upgrading Java-Bali Control Center

Indonesia
April 2021

Procurement for Services

I. Background

Southeast Asia's impressive economic growth has created enormous opportunities and challenges. People in the region have benefitted from raised income and substantial poverty reduction, but they have also been exposed to increasingly higher levels of air pollution and hazardous emissions mainly due to the use of fossil fuels. In fact, the remarkable GDP growth in the last couple of decades has been largely fueled by fossil energy sources, leading Southeast Asian countries to lead the global growth rate for CO_2 emissions per capita.

Energy demand is forecasted to grow by an average of 5% per year until 2035 across the region, which provides an opportunity to transition the economy to clean energy resources. The alternative is business as usual (BAU), fossil fuel-based power generation, which will undeniably lead to higher levels of carbon emissions, a consequent worsening of the climate emergency, health, well-being, and productivity of people in the region.

The next few years will be a critical window for reducing carbon emissions and delivering on the Paris Agreement. The latest Intergovernmental Panel on Climate Change (IPCC) report emphasizes that the GHG emissions need to reduce by half by 2030 if global warming is to be limited to safe levels by 2050 and Southeast Asia is critical to the success of the international community to achieve this objective.

An energy transition driven by renewable energy (RE), energy efficiency (EE) and sustainable infrastructures would allow countries in the Southeast Asian region sustain their economic growth, while ensuring environmental sustainability and energy security. Renewable energy sources have become very competitive and together with energy efficiency, they provide new opportunities for investment, growth and jobs while leading to environmental sustainability and safer climate.

The ETP is a unique new platform that brings together government donors, philanthropies and Southeast Asian (SEA) governments to fund (1) support an improved delivery environment to accelerate the energy transition in Southeast Asia, (2) improve coordination between other relevant initiatives in the region, including capital investments and technical assistance, and (3) promote communication and knowledge sharing among stakeholders in the region on energy transition. The Partnership is set up for an initial period of five years from 2020 to 2025 and works initially with Indonesia, the Philippines and Viet Nam, with a potential to expand to other Southeast Asian countries.

ETP's strategic objective to accelerate energy transition in Southeast Asia is predicated on the region's rapid growth and large populations that drive energy demand, which is expected to double by 2035. To abate damage to the human and natural capital of the region and to the world through greenhouse gas (GHG) emissions and the consequences of climate warming, there is a tremendous opportunity to supply this demand with renewable energy and to forge rapid energy transition. With the initial countries of intervention, Indonesia, the Philippines and Viet Nam, having committed to energy transition through

their climate commitments, they are implementing significant change through policies, regulations and programs to extend renewable energy and energy efficiency. ETP's theory of change rests on four pillars of

1. Strengthening the renewable energy (RE) and energy efficiency policies (EE) enabling environment by enhancing the institutional planning and implementing capacities and improving RE and EE policies, regulations and Laws;

2. Increasing public and private investments flow in EE/RE by supporting improvement of policies, regulations and laws encouraging investments such as fiscal and financial policies and increasing availability of project finance, de-risking instruments and bankable projects.

3. Increasing the amount of RE integrated in smarter grids by providing technical knowledge and expertise for grid planning and operation and by increasing availability of investments for grid upgrades.

4. Strengthening human capital, knowledge and public awareness by fostering RE/EE knowledge that is accessible to relevant stakeholders and to the public supporting the development of a strong local workforce to enact the energy transition

To make a significant difference, ETP has assessed barriers to energy transition in Indonesia. Among these, the capacity of the transmission and distribution grid network, dispatching technology, control technology for optimizing and integrating renewable energy into consumption is a critical impediment. Grid network is a prerequisite for feeding electricity to the consumption. PT Perusahaan Listrik Negara (PLN) is an Indonesian government-owned corporation responsible for electricity generation, transmission and distribution in Indonesia. PLN generates the majority of the country's electrical power, 70% concentrated on the Java-Bali grid of the total electricity production capacity of 53,920 megawatt (MW) and electricity production of 245.52 terawatt hours (TWh, 2019) servicing 69.6 million consumers.

The current grid control system for the Java-Bali has reached end of life, and will no longer be supported by the vendor (Siemens) beyond 2021. Further delay in its replacement will compromise system availability and network security. PLN also seeks to support Indonesia's commitment to reduce the environmental impact of electricity provision and implement significant additional renewable energy in the energy mix increasing its current share from 12% to 23% by 2025.

Thus, a conventional replacement of the grid control systems in line with the existing system would not allow for adequate or safe expansion of renewable electricity generation and the supporting transmission system due to insufficient data management processing capabilities and controls. Operating the power system with increasing and flexible participation of renewables requires new features and functionalities that currently are not available in the existing SCADA system and cannot be incorporated modularly.

The required replacement presents the opportunity to modernize the Java-Bali grid control system in support of extensive renewable electricity expansion. Indonesia ratified its commitment to the Paris Agreement through law No. 16/2016. As part of the mitigation action, Indonesia will increase its renewable energy development in accordance with National Energy Policy and Planning (RUEN). PLN follows the Indonesian Energy Supply Business Plan (RUPTL) defining a 10-year electricity development plan for all its operating areas. The RUPTL includes demand forecasts, expansion plans, electricity production forecasts and fuel requirements among others to determine projects to be developed by PLN and independent power producer (IPPs) investors.

In view of this, PLN will need to modernize its energy control technological structure based on a modern SCADA Energy Management System (EMS) to supervise, monitor, operate and plan its current and future electrical system considering the expected growth in demand and in generation, mostly based on intermittent renewable energies. The detailed design will include a multi-disciplinary analysis required for the planning, design, supervision, integration and commissioning of the main SCADA EMS Control Center (MCC) and Disaster Recovery Control Center (DRC), for both new buildings need to be designed and engineered.

This call for proposal will contribute to the objectives of ETP to develop expand smart grids in Indonesia and will:

- Enable PLN to implement its plan to change the primary energy mix via an energy transition that will displace coal and other fossil fuel based generation with clean energy from renewable resources.

- Support Indonesia with its commitments under the Paris agreement, renewables participation in the electric generation energy mix must increase from 12% to 23% by 2025. Demand is expected to reach 35,000 MW, which will be satisfied mostly with generation expansions based on renewable energy.

II. Description of Scope of Work

1. Rationale

Indonesia is the world's 4th most populous country with 267 million people. Its economy is growing rapidly and is forecast to return a growth of 6% in 2022, as the pandemic related slowdown recedes.[1] This implies significant growth in electricity demand, estimated at around 5% per annum. It also generates a significant share of 1.5% of the global greenhouse gas (GHG) emissions, some 40% of which stems from the energy sector. Rapid action to reduce curtailment of the current renewable energy and integration of the planned additional renewable energy supply is critical in arresting the GHG emissions.

Despite the impressive economic growth overtime, Indonesia's renewable energy resources account for only 12% (2020) of our total primary energy production supply (TEPS) capacity, well

[1] IMF Article IV, 2020.
https://www.imf.org/en/Publications/CR/Issues/2021/03/01/Indonesia-2020-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-50131

short of the national energy policy target of 23% of capacity by 2025. In Indonesia, the energy sector is regulated and controlled by the State through a set of State-owned power enterprises (SOEs). Perusahaan Listrik Negara (Persero) (PLN) is Indonesia's national power utility that serves over 75.7 million customers, making PLN one of the largest electric utilities in the world by number of customers.[2] PLN is the sole buyer, transmitter and distributor in electricity in Indonesia. The power supply comes from a mix of its own generation, totaling 45,381 MW, and purchases from independent power producers (IPPs), totaling 17,327 MW.

Government policy for RUEN provides that by 2025, 23% of the total national electricity energy will be produced from Renewable Energy (RE) generators. New projects in the near future will add Intermittent Renewable Energy (IRE) such as the Windpark Power Plant (PLTB) in Cirebon (84MW); PLTB Sukabumi (100MW); PLTB Tuban (66MW); PLTB Tegal (67.5MW); and PLTB Lebak (100MW), Solar Power Plant (PLTS) in Cirata (100MWp); PLTS Bekasi (50 MWp); PLTS Subang (50MWp); PLTS Pemalang (50MWp); and PLTS Pasuruan (50MWp).

The operation of the IRE will require changes to the operations and dispatch planning model, advance real time system control, accurate and timely weather forecasts and energy management system (EMS) applications that properly model the IRE. To support the power system frequency and voltage stability, construction of energy storage systems (i.e. battery storage systems [BESS] and interconnections with high voltage direct current [HVDC] will be used to mitigate the intermittent behaviour of renewables generation and to store surplus generation used for hours of the day when the energy sources are not available, i.e. during nights for solar). In the existing SCADA/EMS[3] Spectrum Power version 4.6 there are no provisions for the modeling of renewable energy, storage systems and high voltage direct current.

Power market is considered by PLN to be the most appropriate transactional model to economically and efficiently to continue meeting the load-generation balance considering the industry trends and the planned changes in the electricity energy matrix. This model is able to provide transparency of information, an equal playing field for participants in the grid (investors in generation, independent power producers (IPPs), transmission, distribution, customers, and government, while at the same time fulfilling the load regulation objectives regarding security, reliability and economy.

The SCADA/EMS needs to anticipate and have provisions for this new model because the power market system is very dependent on its readiness. Information needs from participants, both from the public and regulators require a SCADA/EMS Master Station that can provide technical and market information by means of an Enterprise Service Bus (ESB) architecture, allowing for a high level of integration between different applications.

ETP grant provides PLN an opportunity to access world-class engineering services for the detailed design and supervision for the upgrade project of the Java-Bali Control Center. It also provides a strong additionality as a result of ETP being a multi-donor fund managed under UNOPS guidelines, which implies that the procurement process will be supported by UNOPS's

[2] PLN Statement of Intent on Sustainable Financing Framework. 2020.

[3] SCADA stands for Supervisory Control And Data Acquisition Energy Management System. A SCADA system is a common process automation system which is used to gather data from sensors and instruments located at remote sites and to transmit and display this data at a central site for control or monitoring purposes.

transparent and competitive processes in which area UNOPS has a decades long experience and a specific business line; and the project can access support and services of the UNOPS' internal Infrastructure Project Management Group, providing for engineering and procurement oversight throughout the process. PLN has pointed out these additional benefits from ETP-PLN partnership particularly as it is aware of the high cost and engineering complexity of both equipment and housing infrastructure for a large control center, which in turn, implies that the utility will be in a decade-long relationship with the chosen vendor.

1. Scope

The government policy for RUEN and its mandatory compliance from PLN will require increasing by 2025 the renewable generation share to 23% of the total system generation. Projects in execution and planned for the expansion of renewables account for 717.5 MW (417.5 wind, 300 solar). To dispatch this intermittent generation, the existing automatic generation control (AGC), production forecasting tool, intra-hour unit commitment tools among others are not available in the current system and should be available by the end of 2022. PLN has recognized that with time the risks of losing the supervision of the whole network increase exponentially so do the cost to maintain the systems.

2. Objectives

The detailed design for the Java-Bali Control Center is the core of the Java-Bali grid, and facilitates the acquisition of a robust modern, reliable and secure supervision and control platform, compliant with international standards and industry best practices, required to operate safely and with high reliability the power grid and enable efficient integration of grid modernization and critical for enabling integration of renewable irregular energy supply to the energy mix and consumption.

The Project will result in detailed engineering designs for two new buildings hosting the Main Control Center (MCC) and Disaster Recovery Center (DRC); the Advanced Control Center system SCADA/EMS and its supporting systems, which will include technical aspects, operational aspects, organizational aspects and other related aspects required to create a more reliable, efficient and economical operation of the Java-Bali electric power system.

3. Scope

The scope of work in this technical assistance includes:

(1) Development of the basic and detailed engineering for the Main Control Center (MCC) and Disaster Recovery Center (DRC) buildings; and

(2) Development of the basic engineering and technical specifications of the SCADA/EMS system for the MCC and DRC.

4. Expected Outcomes

The Project delivers a critical component for modernizing the main Java-Bali grid and enables renewable energy integration into consumptions, concurrently reducing interruptions to the energy service and curtailment of the variable renewable energy. In this vein, the Project will:

- Strengthen PLN's operations by enabling a detailed engineering design that will advance its operations to first-in-class operation in terms of its ability to optimize integration of irregular renewable energy into the grid and consumption.

- Strengthen PLN's operations by advancing its capacity to reduce outages and interruptions to energy services and reduce curtailment and improve efficiency.

- Foster innovative technologies in the main energy grid that, in turn, enable all other grid modernization investments to deliver their value addition and integration of additional renewable energy currently available and under planned and future investments into the grid.

- Enhance operational efficiency and management of the energy control and demand and supply optimization solutions through the use of advanced technology to reduce peak energy consumption thus reducing the need for execution of the coal-fired power generation pipeline and paving way for coal-phase out discussions.

5. Description of Specific Activities

All activities below shall be conducted in close coordination with and based on instructions of PLN and the ETP Secretariat and involve technology review, detailed engineering design services for the SCADA/EMS and the infrastructure housing the SCADA/EMS, analysis of key sector trends, organizational and control system inventory, strategic Vision for the New Control Center, financial planning, preliminary environmental impact assessment, operations reorganization plan, financing plan, implementation plan, evaluation criteria. preparation of tender documents, preparation of budget plan, and assistance in the tender process. All deliverables are subject to review and endorsement of PLN and ETP Secretariat. The terms of reference for the project are in Annex 1, together with timeline, budget estimates, and

- The Grantee is responsible for implementing the activities outlined in the Agreement and is accountable to UNOPS for the use of the funds. UNOPS, as the contributing agency, remains accountable to the Donors.

Minimum requirements/qualifications:

- Expertise in the detailed civil and electrical engineering and design, and experience with design of control center equipment and infrastructure development, grid operations and control strategy, management and communications planning, digital transmission and distribution network design, load dispatch and optimization and integration operations, forecasting and modeling;

- 10 years' experience in energy sector engineering and detailed design; - Demonstrate capacity to work in English is essential. Capacity to engage personnel to work with countries in SEA languages is a strong asset);

- Administrative capacity for financial annual turnover of at least USD 5,000,000.

Other critical considerations:

- Experience in capacity and professional development on energy transition, solar, wind, energy efficiency, energy regulation, grid modernization, transitional energy economics in policy, regulation, investment programming for renewable energy and energy efficiency and smart grids and access to finance will be a strong asset;

- Research and policy analysis expertise in the following sectors will be considered a strong advantage: energy, solar, wind, energy efficiency, grid modernization and smart grids, capacity development in the energy and energy transition domain;

- Expertise in assessing sustainable development impacts and transformational change potential of energy and transitional energy sector policies and programming will be an asset;

- Past performance will be strongly considered when selecting the most suitable proposal. History working with public and private sector clients, in particular in developing countries, particularly in SEA countries, shall be provided, by completing the provided experience history form attached to the proposal.

- An emphasis on gender-inclusive approaches will be considered during the evaluation process. The applicant should demonstrate how it intends to ensure gender equality in implementing this project and also share any information on its own internal approach to gender issues.

6. Evaluation process

In line with UNOPS evaluation principles of fairness, transparency and integrity, an independent Grant Evaluation and Selection Committee will be responsible for the review of proposals and the Grantee selection. The review is based on the criteria outlined in the 'Call for Proposals' (CFP) and includes an assessment of the grant proposal's formal, technical and financial aspects. The review should usually include at least two (2) 'substantially compliant'

proposals and result in the selection of the lowest priced, substantially compliant proposal. Any non-compliant proposal may automatically be eliminated from the evaluation process.

7. UNOPS Grant Support Agreement

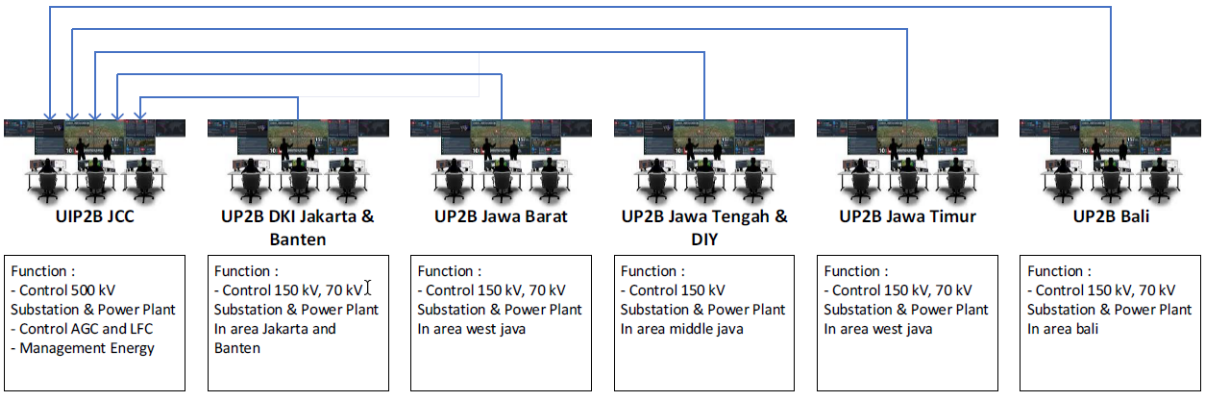
The UNOPS Standard Grant Support Agreement (GSA) (Annex D) containing UNOPS General Conditions (Annex E) is herewith attached The GSA constitutes an integral part of this CFP as it is mandatory to accept this agreement with its conditions before submitting a proposal.

The Java-Bali electrical network serves an area of 134 square kilometers with a population of 155 million, spread over 5 provinces (4 in Java and 1 in Bali) and two special regions. To serve the electricity requirements 4 geographical services areas are defined. All areas are interconnected with an extra-high voltage network of 500 kV integrated by 5,250 Km of transmission lines disposed in a meshed network with several radial lines to supply a peak demand of 26.657 MW[4] and an energy of 269,022.39 GWhr. The total of step-up and step-down transformers in 500kV is 75 representing 36,348 MVA of power conversion capacity.

For regional transmission and sub-transmission, a complex network of 150kV and 70 kV with transmission lines totalizing 18,466 Km is required and a total of 672 power transformers with an aggregated capacity of 63,597 of capacity allow feeding load into distribution voltage levels from where electrical power is delivered to the final consumers.

To monitor and control this geographically scattered and complex equipment layout PLN relies on 6 separate control rooms; one performing as the higher hierarchy control facility which monitors the 500 kV power network and executes the secondary power regulation (Automatic Generation Control (AGC)). The other five perform regional supervision of the power transmission carried out by 150kV and 70kV networks.

The technological infrastructure supporting these control centers is a Sinaut Spectrum V4.4 provided by Siemens that went alive in 2005 that was updated for the last time in 2008 to a V6.4 version. This is a distributed system using a proprietary multi site communication scheme with a centralized database in the main facility (JCC) and one operational/real time database in each of the control rooms. Each system supports standard RTU communications protocols and some proprietary (discontinued) protocols. Also ICCP (inter control center protocol) is available and working as part of the supervisory control and monitoring platform.



The total of data points currently monitored amounts near 190,000, which are periodically collected in 661 Remote Terminal Units, including 18,300 controllable points, 38,000 analog values, 132,000 status points, 250 set point commands, 685 tap position readings and 30 accumulator points conform the population of monitored and controlled points. Besides the SCADA point monitoring

[4] Year 2019

functions the platform has dedicated subsystems for long-term storage of information collected by the SCADA, event recorder, communication controls supervision and alarming subsystems; all interfaced through consoles,[5] where substations one lines and overview displays present to the operator's information relevant for the control of the network.

In addition, the main control room has generation management functions (AGC) and security real time analysis functions (state estimator, bus scheduler, network status processor). For operator's studies a set of parallel study move applications are available being the most important the Dispatcher's load flow. For training purposes an Operator Training Simulator is available.

Until 2016, the existing system served all of PLN supervision and control needs, but hardware technological obsolescence, EOL (End of Live) of all software components, limited availability of spare parts from aftermarket, vendors discontinued support security gaps and non-compliance with NERC CIP policies and the unavailability to increase the data bases to allow the modeling and monitoring of new equipment determined the need for a full replacement of the platform considering into the new design al alternate supervision scheme.

From PLN power systems operation experiences with the existing system, the new conceptual design of the replacement control center facilities is based on one main site (MCC) and a disaster recovery control center (DRC), both located in separated and dedicated buildings with mission critical design that will replace the 6 existing control rooms.

[5] Multi-monitor workstations with special software to enhance the interface between the Operators and the supervised power system.