United Nations Office for Project Services

This call for proposal will contribute to the objectives of ETP to develop and expand smart grids in Indonesia by assisting PLN in carrying its plan to modernize its energy control technological structure 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.

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RFP SECTION III SCHEDULE I TERMS OF REFERENCE

TERMS OF REFERENCE (ToR)

CONSULTING DEVELOPMENT PLANNING, CONSTRUCTION SUPERVISION AND COMMISSIONING SERVICES FOR THE PLN MAIN AND DISASTER RECOVERY CONTROL CENTERS

Rev 1.5 - June 2021

III.1 BACKGROUND

Perusahaan Listrik Negara PLN is the most important electricity provider in Indonesia, a country that represents the largest electrical energy demand in the ASEAN countries with a participation over 36% of the total energy consumption representing 66% more usage than the second largest electrical energy consumer country in the region (Thailand).

The country percentage of electrification in 95.75% representing a substantial increase from 2015 figure that was 86.2%.

The total peak demand for the year was of 41.670 MW and the total reported electrical energy generation represented 269 TWh, being the total billed energy 245.5TWh. The above represents 9.6 % losses (technical and non-technical). The total number of customers served were 75.7 million.

Indonesia generates a significant share of the global greenhouse gas emissions, with 1.5% of the world's totals (ranked 12th in the world and 3rd in Asia, after China 20.1% and South Korea 1.9%). These figures serve as evidence of the relevance that an active engagement from the Country as whole, and PLN specifically, have in developing and displacing fossil energy sources by renewable zero emission sources to mitigate and achieve the Paris agreement goals.

PLN (Persero) UIP2B JAMALI (Main Unit Load Management Center Java Madura Bali) currently uses a Spectrum Power system from Siemens for its SCADA/EMS needs. This system has been running since 2005 and underwent an update from version 4.4 to version 4.6 in 2008. Considering the recent years expansion of PLN electrical system, the current SCADA/EMS Master Station system accrues many limitations and cannot keep up with the operational demands and the needs for additional automation of Java-Bali load management required supporting future business developments.

III.2 JUSTIFICATION OF CONSULTANCY

III.2.1 Existing SCADA/EMS Master Station end of life in 2021

Spectrum Power version 4.6 is based on the SPARC hardware architecture and can only run on the Solaris 10 operating system. The Solaris 10 operating system has no support from Oracle to run on current market available hardware. Siemens, as the application developer, has stopped working in Spectrum Power 4.6. and has changed the product development effort to Spectrum Power 7, which runs on the Linux operating system with x86-based open hardware. Significant changes in hardware and software architecture mean that there is no upgrade option for the SCADA system used by UIP2B JAMALI. Termination of support from hardware manufacturers and application manufacturers causes UIP2B to maintain the performance of the SCADA/EMS Master Station using existing devices and spare parts inventory.

III.2.2 Supporting the growth of the Java-Bali electrical power system

The development and expansion plan, targeting 35,000 MW for the Java-Bali power system, requires additional data, updating of existing applications and adding new applications that have a direct impact on the capacity, capability and speed of H/W and S/W of the Master Station SCADA/EMS. For example, the contingency analysis application will require many enhancements to support the planned network changes.

The addition of transmission installations and substations controlled by the SCADA/EMS system must also consider an increase in the amount of data, communication lines and additional points and equipment modelled by the EMS applications.

III.2.3 Anticipate the entry of Renewable Energy generators, Storage Systems, HVDC devices

Government policy for RUEN proclaims that by 2025, 23% of the total national electricity energy will be produced from Renewable Energy (RE) generators. New proposals and 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 EMS applications that properly model the IRE. To support the power system frequency and voltage stability, the construction of energy storage systems and interconnections with HVDC are an alternative feasible solution. In the existing SCADA/EMS Spectrum Power version 4.6 there are no provisions for the modelling of renewable energy, storage systems and HVDC.

III.2.4 Anticipation of Changes in Regulation and Transaction Model

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 - IPPs, transmission, distribution, customers, government) while at the same time fulfilling the load regulation objectives regarding security, reliability and economy.

The SCADA/EMS System 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 mean of an Enterprise Service Bus (ESB) architecture, allowing for a high level of integration between different applications.

III.2.5 Standards Compliance

Current SCADA/EMS system do not fully comply with the Common Information Model CIM, Cyber Security Standards (NERC CIP, ERNCIP, IEC 62443) and data openness to interact with external business systems.

III.2.6 Efficiency and Effectiveness of System Operation

The PLN organization has changed to a vertically integrated regional structure. Java-Bali is now incorporated to the Java, Madura and Bali Regional Business Directorate.

Currently, the Java-Bali load supply is carried out in a distributed manner, where the Java-Bali electric power control system is managed from 6 Control Centers (6 SCADA/EMS Master Stations). One of them, identified as UIPB JAMALI/JCC, is responsible for the 500kV network, and performs energy management and generation control functions while the rest (5), called UP2B, monitor and control regional 150kV systems, from where switching and regional power plant supervision is executed. These control centers are mutually integrated with a multi-site database.

UIPB JAMALI is located in Cinere, Depok while the UP2B are in Cawang, Cigereleng, Ungaran, Waru and Kapal. This control center arrangement results in telecommunication links for both, SCADA and voice, being spread across each control center creating many connecting points for communication from one CC to the substation.

Organizational changes and service issues create an opportunity to review the efficiency and effectiveness of the Java-Bali system operation.

III.2.7 Supporting the Industrial Revolution 4.0

Because of the existing Control Center arrangement, the Java-Bali load supply requires many dispatchers to carry out basic network operations (MW flow monitoring, generator start-stop, etc.). In the future, the operation of the Java-Bali system must enable the dispatchers to perform broader safety analysis and reliability/stability monitoring, while at the same time maintaining the quality and economy of the electricity product.

III.2.8 Anticipation of Disruptive Technology

The availability of new and advanced technologies and tools, applied to the field of power systems monitoring and management, offers many new functions that are recognizably superior, especially in fields such as applied artificial intelligence and data analytics. The main purpose of these technologies is to assist system operators in improving its situational awareness, in carrying out accurate system conditions analysis, load predictions, effectively using operations validation functions and receiving recommendation steps for a more stable and increased reliability system condition.

III.2.9 Supporting the Millennial Way

Information from SCADA/EMS in the future must be able to provide accurate and reliable data and system control. The choice to build the best SCADA/EMS Master Station must also be supported by various other infrastructures, Remote Terminal Units, SAS systems, telecommunications and control center facilities that follow and comply with world-class standards. For this reason, system planning and design should be carried out thoroughly, being The Millennial Way (easy access, reliable data, transparency, challenging, fresh, vibrant). In addition, SCADA is the main source of data blasts, namely the disruption of information systems of customers who are directly affected by an occurring disturbance and/or outage.

III.3 OBJECTIVES

This consultancy will provide PLN (Persero) UIP2B JAMALI (Main Unit Load Management Center Java Madura Bali) with the necessary multi-disciplinary analysis and specifications for the planning, construction supervision, integration and commissioning of the Main SCADA/EMS Control Center (MCC) and Disaster Recovery Control Center (DRC).

The main objectives of the service to be provided are:

(i) Evaluation and selection of the optimal technologies to execute the project.

(ii) Propose the best systems and solutions for the project.

(iii) Preparation of engineering documents.

(iv) Supervise of the engineering works.

(v) Supervise the Construction and commissioning.

(vi) Training.

(vii) Preparation of the Vendors Terms of Reference (ToR) and Budget Calculation (Budget Estimation Plan and Engineering Estimation Cost).

III.4 IMMEDIATE OBJECTIVES - SCOPE OF WORK

The scope of work in this technical assistance includes:

Contract Phase 1

a) Project planning (tasks 1 - 5 below)

b) Development of the architectural design and the basic and detailed engineering for the Main Control Center (MCC) and Disaster Recovery Center (DRC) buildings, including environmental impact assessment. (tasks 6 and 8 below)

c) Development of the basic engineering and technical specifications of the SCADA/EMS system for the MCC and DRC. (task 7 below)

d) Organisational and operational planning (tasks 9 - 11)

e) Technical support to tender process (tasks 12 - 15)

Contract Phase 2

f) Training for Managers, SCADA/EMS engineers and System Operators

g) Supervision of the Buildings Construction.

h) Supervision of the SCADA/EMS implementation.

The Consultant will be responsible for the above scope, which will result in 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. The new two buildings shall allow an occupancy estimated in 100 people with an average density of 25 sq.m/p. and a referencial space distribution indicated in Table 1.

	MCC BUILDING			DRC BUILDING		
	Qty	Area sq. m per Unit	Area (sq.m)	Qty	Area sq. m per Unit	Area (sq.m)
Occupancy	**100**			**100**		
Private Offices	8	18	144	8	18	144
Workgroup Areas	2	460	920	2	460	920
Conference/Meeting Room (Small)	2	40	80	1	40	40
Conference/Meeting Room (Large)	1	80	80	1	80	80
Control Room	1	500	500	1	500	500
Market Room	1	50	50	1	50	50
SCADA/Telco Room	1	50	50	1	50	50
Pantry	3	40	120	3	40	120
Utility Room	3	40	120	3	40	120
Praying Room	1	40	40	1	40	40
Toilets (with shower)	2	15	30	2	15	30
Toilets (ladies and gentlemen)	8	20	160	6	20	120
Data Center	1	60	60	1	60	60
Communication Rooms	4	20	80	4	20	80
DTS Training Room	1	60	60	1	40	40
UPS and Battery	1	20	20	1	20	20
Genset and ATS	1	30	30	1	30	30
			2,544			2,444

Table 1 Estimated Construction Areas for MCC and DRC buildings

The Scope of Work has been divided into Tasks to facilitate its analysis and development of expected products.

III.4.1 General Criteria for engineering and supervision of construction

The design of a building for a SCADA/EMS Control Center requires, in addition to a regular office building project, specific expertise from the designer, that should clearly understand the type of 24/7 activity done in a Control Room, control room design, console ergonomics, visual distance to video-projection systems, location and types of equipment that will be hosted as mission critical hardware, security specific requirements, communication requirements, uninterruptible power and backup generation, flexibility needs for cabling, operator's rest areas, and the general and restricted areas for operators' cafeteria, among others. It is expected for the Consultant to demonstrate the accrued experience in this type of building design.

Consultant must consider the following general criteria:

a) Design Requirements and Intensity

- Ensuring that the building will be used according to its function.
- Ensuring the safety of users, communities and the environment.

- Ensuring inclusive design for all building users, including disabled access and welfare facilities, and cultural and gender considerations.

b) Architectural and Environmental Requirements

The Consultant must use best practice standards for the environmental performance of buildings through design, specification, construction and operation.

Key requirements:

- Ensuring the creation of a spatial layout that can provide balance and harmony of buildings to their environment.
- Guarantee that buildings are properly constructed and utilized, and will not cause negative impacts on the environment.
- A passive design approach should be adopted to maximise internal comfort and minimise demand on energy use for the building in operation

c) Building Structure Requirements:

The design must ensure that the building is capable of transferring the expected loads in its lifetime safely to the ground. Design of various structural components like slabs, beams, walls, columns and footing should ensure safety.

Key requirements:

- Guarantee the creation of buildings that can support the loads that arise from natural and human behaviour.
- Ensure human safety from possible accidents or injuries caused by structural, electrical, mechanical or architectural failures.
- Ensure the protection of humans from loss or damage to objects caused by structural behaviour.
- Ensure the protection of other properties from physical damage caused by structural failure.

d) Fire and Natural Hazard Resilience Requirements

The Consultant's design must rely in the following principles:

- Structure should not ignite easily.
- The building performance during an earthquake event should be in agreed with UNOPS and PLN
- Building should be resistance to flooding
- Building orientation should be such that the spread of fire is slow.
- There should be means of easy access to quickly vacate the building in case of fire or natural disaster. Possible natural disasters include floods, earthquakes, volcanos, tsunamis, cyclones and avalanches.

To achieve these principles, the Consultant's design should guarantee the realization of buildings that are constructed in such a way that they are structurally stable during fires and natural disasters.

Key requirements:

- Allow enough time for residents to evacuate safely.
- Allow time for firefighters to enter the location to put out the fire or rescue people trapped in case of natural disaster.
- There is a sufficient water supply available in order to extinguish a fire.
- Avoid damage to other properties.

e) Electrical Installation, Lightning Protection

The Consultant's design must provide a safe, energy-efficient system that meets PLN needs and complies with Indonesian and world accepted codes. Life safety and preservation of property are two of the most important factors in the design of the electrical system.

Lightning protection design must consider the tropical climate of Indonesia. Lightning protection must be approached from a system's point of view. All parts of the system must be complete for the overall protection scheme to be effective. The following building elements should be covered: Structural protection against direct lightning strike, protection of antenna structures - towers and masts, earthing and bonding, surge protection for power distribution, surge protection for RF cables, surge protection for telephone/data cabling.

Key requirements:

- Guarantee that the electrical installations are safe enough for users and its maintenance.
- Protection for the building, service equipment, SCADA/EMS equipment and people should include measures against direct lightning strikes and indirect lighting strikes (due to transient over voltages when a direct lighting hits a building or any of its services, caused by resistive, inductive and capacitive coupling).
- Separated ducting for data and power supply installations

f) Communication Requirements

- Separate rooms should be designed for the general telephone/internet communications (wired LAN, fiber optics, IP telephones, WIFI cabling, communication between MCC, DRC and distribution control center, substations, power plants etc.), the SCADA-EMS main hardware, the telecommunication equipment serving the SCADA and the CCTV & access control and surveillance equipment. An acceptable design for the SCADA-EMS server's room should consider the use of double doors, 1800 mm wide and 2300 mm high, 42u racks should easily be installed.
- It is anticipated that the design should account for enough distribution closets in each floor. All rooms must be located away from any source of water damage. No water carrying pipes must be permitted to run through or within the ceiling space or floor of rooms, except pipes associated with any required fire protection system. No showers, toilets, or similar wet rooms/areas shall be adjacent to or above these rooms.
- Consultants are to design the communication rooms according the SCADA-EMS specifications, considering a typical configuration of rack mounted servers, external disc storage systems, telecommunication equipment, and front-end equipment including terminal servers, structured cabling cabinets, and any other equipment that is considered in his technical specifications. Racks should have factory installed PDUs. Minimum clearance between racks and other equipment should be considered.

Key requirements:

- Ensuring the availability of adequate communication facilities to support the implementation of activities in buildings according to their functions.

g) Ventilation and air conditioning requirements

The Consultant should design the ventilation and air conditioning needed for the office space considering the tropical climate prevailing in Indonesia, with temperatures ranging from 23 to 31 Celsius. Special attention shall be paid to the design of the air conditioning of the control room and the communication rooms dedicated to host SCADA/EMS equipment. For both, redundant systems with electrical power connected to a preferential electrical service panel should be considered in the design. Passive design techniques should be adopted to reduce energy demand.

Key requirements:

- Ensuring the fulfillment of sufficient air needs, both natural and artificial, to support activities in buildings according to their functions.
- Server's room shall have precision air conditioning and humidity control with positive pressure to avoid dust, debris and unconditioned air.
- Maintain the proper operating temperature for the equipment.
- Lighting Requirements.
- Ensuring the fulfillment of adequate lighting needs, both natural and artificial, to support activities in buildings according to their functions.
- Follow Green Building components

h) Building Security

The Consultants should assess and design the required physical protection of each of the buildings in the scope, taking into account the potential threats to the premises and its occupants. The highest possible degree of security applied to Mission Critical Activities should be considered in the design and specified accordingly. Special attention should be paid to the control room, communications rooms, and all service areas supporting the SCADA/EMS.

Key requirements:

- Control Center Building security designed with Mission Critical areas requirements with CCTV and entry access restrictions for the building, as well as barriers to each Control Center and/or SCADA/EMS related area.
- Personal trackers and messaging.
- Emergency and general voice alert and evacuation system.
- Security windows, rated for explosions and hurricane-force winds protection, with no vision from the outside (for the control room and adjacent critical areas).
- Four (4) security areas: (i) Public access, (ii) Work areas, (iii) Restricted work areas, (iv) Security area (control center and data room).

i) Building Project Documents

The final project for both buildings should be completed and centered on the final purpose of each facility, that is the MCC and DRC, both with Control Rooms and SCADA/EMS equipment working in parallel with on-line swapping capabilities. All temporary constructions, list of materials, list of services, contractor's services and supplies, and work permits with full legal compliance will be part of the Consultant's building design and later inspection work.

The project should enable potential contractors to bid the complete execution of the building until handed over to PLN in due time, and on the agreed bid price.

Key requirements:

- Enable competitive tenders.

- Deliver a document plan for the cost requirements of the construction and inspection of the Main Control Center (MCC) and Disaster Recovery Center (DRC) buildings.

III.4.2 Task 1: Scope and Planning

This preparatory activity is necessary in order for the consulting firm to present and arrange its working team; once it understands the scope, resources, and possible threats or weaknesses concerning the project.

The following activities shall be conducted:

a) Kickoff meeting (introductory conference call)

- Presentation of team: members, roles and responsibilities
- Review of scope and planned work
- Identification of issues that might affect the project
- Discussion about methodology
- Coordination of first visit to PLN to meet with management and stakeholders

b) Information review

- Detailed data
- Site visit

c) Deliverables review

Deliverables of Task 1: The Consultant shall prepare a report describing all work performed, and including all reports, deliverables, and findings of the task.

III.4.3 Task 2: Technology Review

The consulting firm shall present a technological review of similar projects carried out during the last five years that represent the state of the art in Energy Control Centers.

a) Similar projects profiles of technologies

b) Identification of suppliers with contact data

c) Market score reports of suppliers

Deliverables of Task 2: The Consultant shall prepare a report describing all work performed, and including all reports, deliverables, and findings of the task.

III.4.4 Task 3: Key Sector Trends

Analyse technological trends, global development of renewable and non-renewable energies, demand growth, regulatory framework and its impact on Energy Control Centers, considering the following aspects:

d) Global sector trends analysis

- Distributed generation
- Utilities-scale renewable generation
- On-grid storage
- Demand response
- Electric vehicles
- Grid-connected micro grid
- Transmission and Distribution integration

e) National sector trends

- Increase generation of renewable sources

- Market regulation changes
- Key sector electrification including HVDC connection between islands.

f) Regulatory trends analysis

g) Comparative analysis

h) Impact on the Control Center

Deliverables of Task 3: The Consultant shall prepare a report describing all work performed, and including all reports, deliverables, and findings of the task including the analysis results and impact assessment.

III.4.5 Task 4: Organizational Context and System Inventory

The Consultant shall get familiar with PLN's organization and main processes, in order to better understand the main needs, in terms of infrastructure and functions of the Control Centers. This shall include the following aspects:

a) PLN mission, values strategies

b) Organizational structure

c) Business processes

d) Procurement procedures

e) PLN business and technical systems lists and its integration to the Control Center

Deliverables of Task 4: The Consultant shall prepare a report describing all work performed, and including all reports, deliverables, and findings of the task 4.

III.4.6 Task 5: Strategic Vision

The Consultant shall arrange on-site sessions with PLN to present and discuss:

a) Strategic Vision of the New Control Center

b) General Implementation Roadmap

c) Long Term maintenance and replacement strategy

Deliverables of Task 5: The Consultant shall prepare a report describing all work performed, and including all reports (draft and final survey report, documentation for building and advanced master station), deliverables, and findings of the task 5.

III.4.7 Task 6: Site and Building Design

The Consultant must carry out the engineering project for two new buildings that will house the new Energy Control Centers and related offices, named the MCC and the DRC. Some of the current constructions date back to 1982, which means that the engineering project must analyze the feasibility of the demolition of existing buildings in the locations to be evaluated. The construction project must consider that current PLN operations cannot be disrupted.

In addition, the consulting firm should provide proofs of experience in the design and construction inspection of office building qualified for mission critical activities housing

manned control centers, computer server rooms, and network and telecommunication

equipment. The building design and construction should account for reliable water and electricity supplies. The electricity supply should consider uninterruptible electrical power (redundant UPS), preferential power sources (backup generation), and commutable utility power sources, such as redundant feeders with ATO). References of ECO Building detailing efficient energy resources, water usage, waste reduction practices, indoor air quality, toxics substances reduction and sustainability are expected from the consultant. If unable to present matching experiences, projects with similarities can be accepted if a descriptive scope is provided.

a) List of similar building design and/or construction supervision tasks.

b) Operator Control room designs and layouts (including operator console ergonomics).

III.4.7.1 Design of the MCC and DRC buildings

a) Site Assessment and Preparation of the Design Brief

b) Assessment of Proposed Locations

Visit the locations for MCC and DRC, and come to be familiarized with all aspects of the project, site investigation and data collection, to accurately assess the current state. The assessment shall take into consideration the preliminary information provided by PLN, while at the same time meeting the stakeholders' expectations.

The sites to be assessed should guarantee easy access by road, availability of public services (fresh water, wastewater disposal, electricity and communications), security (police and fire station), and show low crime rate statistics. Particular attention should be paid to assessment of local communications access as it relates to technical needs of the project (i.e. internet, landline, and cellphone).

c) Preliminary engineering surveys, investigations and mapping

Conduct soil boring tests, seismic analysis, surveys, and investigations of the site, including boundaries of the properties, elevations, contours, locations, and other pertinent data on existing buildings and potential improvements, and maximize existing utilities. The data gathered will be used to inform design parameters, architectural, structural and otherwise.

d) Design Brief & Concept

Prepare a Design Brief Report outlining the design objectives, scope, and requirements, including but limited to the following:

- Objectives
- Scope
- Spatial requirements - Describe the general idea with regard to the planned buildings in consideration of the proposed use of the space. The control room should accommodate the operators, supervisors and SCADA/TELCO support staff of the actual main and regional centers. The Architect should consider among others the following spaces:
    - Control Room with video wall.
    - Console ergonomics and focal distances to the video wall.

- Multiple meeting rooms.

  - Service areas: restroom, locker, pantry and praying room.
  - Situation Room (in a different level with complete view of control room).
  - Support Offices.
  - Cafeteria for cooked food provisioning.
  - Service elevator with security access.
  - Security check-in.
  - Data Center.
  - Auxiliary Services (workshop, storage room).MCC & DRC videoconferencing equipment.
- Existing and Site Information
- Design Criteria
  - Civil / Structural
  - Services (MEP, Fire, others)
  - Gender
  - Gender and accessibility
  - Environmental
  - Health and safety
  - Resilience, Durability & Maintenance
  - Quality management
- Codes and standards applicable among others:
  - Indonesia National Building Code (SNI).
  - National Guidelines on Green Buildings.
  - Indonesia Seismic Design Code.
  - SCADA/EMS IEEE/IEC, NERC, ERNCIP Standards.
  - ANSI/TIA-942 Rated-4 standard.
  - Indonesia Building Permits Requirements (IMB).
  - UNOPS Design Planning Manual for Buildings
  - PLN Standards (SPLN Document)

e) Outline Design

Prepare outline design package including but not limited to the following:

- Undertake Design Studies, Engineering Analysis and Cost Exercises in alignment with the Design Brief and Concepts
- Drawings (site, plan, and elevations) to illustrate proposed design solutions and to demonstrate spatial and engineering coordination
- Carry out initial calculations to demonstrate the outline design solution works
- Develop outline costs, and specifications
- Ornament.

f) Detailed Design

Generate building layouts to enable the creation of ergonomic, effective, efficient and reliable system operation activities.

To fulfill this objective, complete Planning and Design drawings include but are not limited to:

- General Conditions: predevelopment, utilities, lay-down yard, dumpster, mobilization, clean up, etc.
- Architectural: building, reception, offices, storage, rest rooms, lighting, finishing details, furniture, parking lot.

- Operations Control Room, SCADA/EMS Engineering and DTS Room.

- DTS room in the same building, but separated from the engineering offices and control room areas, with independent access.
- DTS room suitable to be used as production system backup, in case of emergency.
- Control room furniture design for operator consoles considering activity ergonomics.
- Data Center (Tier 4)
- Structural calculations.
- Construction details.
- Electrical and power installations, including self-generation, UPS, grounding and lightning protection.
- Utility supply arrangement (i.e. main and alternate feeder with ATO).
- Mechanical installations: plumbing, elevators, air-conditioning systems.
- Structured cabling and networking.
- Control access and security.
- Fire detection, alarm and extinction system.
- Sound installation.
- Perspective views - Create the perspective view of MCC and DRC buildings from interior and exterior, showing the Control Room, Data Center, Situational room, Office Areas, Meeting rooms, Communication and Test laboratory, General areas and auxiliary services areas (workshop, spare parts storage room).

The design deliverables will be reviewed by the UNOPS project team and comments and recommendations must be addressed by the Designer.

The final design package will be reviewed by UNOPS IPMG Design Review Unit for alignment with the Design Brief and compliance with codes and standards. All comments must be addressed by the Designer.

III.4.7.2 Construction Schedule

The consulting firm must prepare a building construction schedule to ensure that the project completion is achieved on time and on budget, minimizing downtimes.

III.4.7.3 Costs estimation

Prepare the project costs forecast, avoiding deficiencies on initial estimates or overruns.

Deliverables of Task 6: The Consultant shall prepare the following deliverables for task 6.

a) Design Brief & Concepts

b) Outline Design Package

c) Detailed Design Package (100% complete), including the Construction Schedule, and Cost Estimate in the form of an itemised BOQ (draft and final design Control Center building)

UNOPS will review the deliverables submitted at these three stages to ensure appropriateness, quality, and compliance, and will make comments and recommendations for the design to be accommodated by the Consulting Firm in the design package.

III.4.8 Task 7: SCADA/EMS Functional Design and Analysis

Elaborate the hardware/software platform and SCADA/EMS functions specifications of a two-site Advanced Control Center to support PLN's power system operation.

The SCADA/EMS will have the following components:

a) Main Control Center SCADA/EMS

b) Disaster Recovery Control Center SCADA/EMS

c) DTS System

d) QAS System

III.4.8.1 Assessment

a) Current SCADA/EMS Capacity

b) Communications System for RTU and ICCP including Substations and Power Plants

c) Communications availability between MCC and DRC

d) Existing voice communications

e) Existing SCADA/EMS intangible assets such as SCADA and network model databases, existing displays (one-line, overview, tabular), historical data (online and archived)

f) Existing qualified control center engineers and technicians

III.4.8.2 General Requirements

The Consultant must consider the following basic requirements:

a) Platform

- Virtualized architecture
- Hardware does not depend on just one manufacturer
- Supports open and common operating systems (IoT oriented)
- Main application servers based on Linux Enterprise grade, with x86/x64 architecture and commercial support.
- Local Cloud server as storage platform
- Local Cloud server as for non-real time operation activities like DTS or study tool

b) Distributed Architecture

c) Availability

- Equipment and critical functions redundancy

d) Availability (2N + 1 redundancy, considering MCC and DRC) > 99.999%. Security

- Use of cybersecurity zones
- System hardening
- Role based authentication

- NERC CIP Cybersecurity standard compliance

e) Databases

- Database expansion at least to 20% per year.
- Flexible database and topology-oriented display editing
- Low downtime during engineering changes

f) Database and displays conversion

- Methodology suggested
- Vendor and PLN participation
- Overview and one-line display conversion oriented to Operation Situation Awareness best practices
- Display and naming conventions style guide

g) Programming Tools and Interfaces

- Supports standard programming languages such as C/C++, C#, VB+, SQL+, Java, Python, Perl and HTML5, among others.
- Open interfaces with ODBC, JDBC, System API
- SOA Interfaces with Enterprise Applications

III.4.8.3 RTU Communication Front-Ends

The Consultant must consider the following basic requirements:

a) Installed on dedicated servers in a DMZ.

b) Support of RTU protocols HNZ, MODBUS, DNP3.0, IEC 60870-5-104 and IEC 60870-5-101.

c) For the serial port protocols, the Front-Ends must handle serial-to-ethernet encapsulation.

d) Support for DNP3.0 and IEC 60870-5-104 in Slave mode.

e) Support for future communication between substations and control center using IEC-61850.

f) Support for communication between PDC and control center using PMU-C37.118 master protocol.

g) Listen mode and log RTU communication capability

h) Front-Ends directly synchronized from GPS based NTP server and must support the protocol specific time delay measurand and clock synchronization commands for non-local synchronized RTU's

i) Implement secure communications between RTU and SCADA (TLS, blockchain, etc.).

III.4.8.4 Other data interfaces

The Consultant must consider the following basic requirements:

a) Integrated function to import/export data from/to external systems using CSV, XML or any other file format with preprocessing support.

b) Real-time and Historical database interfaces with ODBC, API's and SOA interface.

c) Specific existing PLN BMS systems.

III.4.8.5 Human-Machine Interface HMI

The Consultant must consider the following basic requirements:

a) Linux X86-64 (preferred) or Windows native HMI (no emulators). Windows version shall be 10 or newer IoT oriented.

b) Role Based Access with Area of Responsibility

c) Displays oriented to improve situational awareness, considering highly effective HMI recommendations

d) Baseline predefined displays for al SCADA/EMS functions

e) Network coloring depending on multiple criteria and PLN style guide: voltage level, node, loading, energized, open-end, grounded, tagged, island etc.

f) Historian Playback capability using one-line, summary displays and events displays.

g) Possibility to display operator notes and comments.

III.4.8.6 Display Style Guide and Equipment Naming Nomenclature standards for PLN

The Vendor will be responsible to propose and develop a Display Style Guide that fully exploits the native graphical features of the database graphical editing and picture editing tools. The guide will contain the standards under which all one-line and overview displays will be created during the project and thereafter.

Also, a revised equipment naming convention should be part of these documents, so as to ensure optimal usage of the vendor naming structure, without compromising existing conventions.

The Style Guide and its nomenclature addendum will be proposed and adapted during the display creation workshop, requested as part of the training.

III.4.8.7 Alarms and Events

The alarms and events function to be specified shall have the following features:

a) Ordering and filtering

b) Priority handling

c) Flexible coloring and audible alarming

d) Area of Responsibility handling

e) Smart filtering based on conditions

f) Copy and paste selected alarms

g) Create annotations on any alarm

h) Help on alarm

i) Audit and keep track of Acknowledgement and manual override/restore history.

III.4.8.8 Data Acquisition functions

The Consultant must consider the following requirements:

a) Communication Front-Ends management: current state, recovery and statistics.

b) Listen mode handling.

c) Conversion for linear and non-linear measurands.

d) Static and Dynamic Limits processing.

e) Allow measurands and indications redundant points from up to four (4) different sources.

f) Stale points monitoring.

g) SOE data with 1ms time resolution in a dedicated report.

h) Control processing, tagging and interlocking.

i) Have the displays to record/track/list manual changes on measurements i.e., what, who and when etc.

III.4.8.9 SCADA Load Shedding

The Consultant must consider the following requirements:

a) Shed and restore load from predefined lists of loads.

b) Manually or automatically, rotate the shed loads among other eligible in-service loads.

c) Accounting for times in curtailment and in service of operator interruptible loads.

d) Keep records of load shedding actions.

e) Alarm and warnings based on operator defined elapsed times.

III.4.8.10 Calculations

The Consultant must consider the following requirements:

a) Predefined common calculations of power system such as Apparent Power, Power Factor, Current, Power Integration, time error correction & alarming.

b) Custom calculations with basic, trigonometrical, aggregated and logical, with quality handling.

c) Custom programming with command controls capability

d) All calculation engines should include a development environment, a loop detection with isolation mechanism, and a debugging tool.

III.4.8.11 ICCP Communication

The Consultant must consider the following requirements:

a) Installed on dedicated servers in a DMZ

b) ICCP (Tase.2) must support versions 1996.8 and 2000.8

c) Support multiple links and associations

d) Support at least ICCP blocks 1, 2 and 5 (optionally also block 4 for Information Messages).

e) Support and statistical tools

III.4.8.12 Data Historian

The Consultant must consider the following basic requirements:

a) Installed on dedicated servers

b) At least five (5) years of data retention

c) Should support one (1) second resolution events

d) The following information must be saved:

- Measurands, Indications and Accumulator points values and quality
- Alarms and Events
- Calculated points stored as any other SCADA RTDB point.
- Topology network coloring
- Any Realtime SCADA/EMS database table column

e) Advanced compression algorithms should be available to optimize the storage

f) Integrated easy-to-use client applications for trending and spreadsheet reports

g) The system architecture should consider additional historian server in a DMZ to be accessed from the corporate network

h) Evaluate historian implementation on commercial RDBMS such as Oracle, PostgreSQL and time-series database as OSIsoft PI

i) The Historian solution should support adding context to data and asset hierarchies

j) Vendor provides or supports PLN to develop an automation process to manage Historian tags update for EMS model update.

k) The Historian solution should support PMU data at 30 frames/second

III.4.8.13 Historian Play Back Function

The Consultant must consider the following basic requirements:

a) Play back capabilities for user selected historical information for simultaneous and time synchronized displaying of analog and switches-indication values in one-line displays, overview displays, operator defined trends displays and events/alarms.

b) User selectable start for playback date-time, update frequency and time interval steps (forward-backwards)

c) Differentiated window background to recognize in play back mode.

III.4.8.14 Data Analytics

The Consultant must consider the following basic requirements:

a) Data analytics tool working on top of the underlying Historian database

b) Analysis, Monitoring and Prediction capabilities

c) Use of AI (Artificial Intelligence) / ML (Machine Learning) technologies and algorithms

d) Data visualization, alarming/messaging and custom calculations

III.4.8.15 Weather Monitoring System Interface

The Consultant must consider the following basic requirements:

a) The SCADA must interface the existing weather monitoring system to provide the required data for the Short-Term Load Forecast Tool (STLF)

III.4.8.16 Security

The Consultant must consider the following aspects:

a) Security Zones based Architecture.

b) Centralized authentication for users and services.

c) Role based access.

d) Antivirus and IDS.

e) System Monitoring tool for compliance.

f) System hardening.

III.4.8.17 Time Synchronization and Frequency measurement

All system components must be synchronized using a redundant GPS clock appliance using NTP protocol.

Front-End servers must synchronize their clocks directly from GPS, and be capable of sending the clock synchronization commands to the RTUs with the protocols that support this type of message.

The GPS appliance must include a frequency measuring card, in order to feed the frequency to the SCADA in a database point to be used as a reference source for the AGC function.

The specifications must include NTP based, Date/Time and Frequency 4-inch height displays.

III.4.8.18 Backup and Recovery

The Consultant must consider the following basic requirements:

a) Specify the most appropriate servers and console-backup solution.

b) Request the Vendor to configure the recommended backup plan.

c) Support EMS local failover and site failover within acceptable interruption time.

III.4.8.19 GMS Functions

The Consultant must consider the following Generation Management System (GMS) function capabilities:

a) Automatic Generation Control (AGC)

- ACE filtering (configurable).
- Execution periodicity (4 to 6 secs).
- ACE limits monitoring for Permissive, Time-Out and Suspension Conditions.
- Tunable unit control sub-loops with non-tracking logic, ramp limiting logic.
- Support for raise/lower pulses (configurable short and long) and setpoint control (absolute or incremental).
- Multi-island operation – Island recognition.
- Look-ahead capability for improved regulation control.
- Constant frequency, Constant Interchange and Tie-line bias modes AGC modes.
- Regulating reserves and ramps monitoring for units providing secondary regulation.
- Flexible configuration of regulating participation factors
- Generation Unit Operational Constraints (Conventional, Renewable, BESS) – Fuel, emissions, temperature dependency, units high and low regulation limits.
- System and Plant level constraints – resources to reduce unit's duties.
- BESS management – treated as a generator unit with State of Charge ACE regulation participation factor logic (actual, remaining daily throughput, charging status)
- Renewable Energy Sources curtailment and close loop control (voltage, power factor).
- Combines cycle participation in secondary regulation.
- Frequency regulation quality standards monitoring.
- Regulating unit's performance indexes.

- Generation by technology summaries (end user configurable).
- On line save and retrieval of tuning parameters.
- Flexible interface to Historian to save any calculated AGC variable (intermediate or final) in configurable frequencies and retentions.
- Area net interchange schedules management.

b) Economic Dispatch (ED)

- Fuel cost minimization algorithm (equal lambda, others).
- Capability of using merit-order dispatch (Block dispatch algorithm).
- Comprehensive modelling of Combine Cycles for Economic Dispatch.
- Flexible allocation for regulation control Ancillary Services (bid base allocation, marginal cost).
- Support for Forbidden zones.
- Use of Generating Units penalty factors.
- Support of a separate set of High and Low Economic limits.
- Use of Security limits calculated by external applications such as Optimal Power Flow. These limits will override Economic and Regulating limits if reduced.
- Flexible interface to Historian to save any calculated economic dispatch variable (intermediate or final) in configurable frequencies and retentions.

c) Reserves monitoring

- Support the following reserve types: Operating, Spinning, Ready.
- Consider interruptible loads in reserve calculation.
- Flexibility to configure time dependent reserve types.
- Reserve Up and Down monitoring per reserve type.
- Multi-Island condition reserve monitoring per type.
- Flexible interface to Historian to save any reserve variable in configurable frequencies and retentions.

d) Production Costing and Fuel Consumption

- Current Generation Marginal costs (units providing secondary regulation services, all on line generation units).
- Hourly production Cost Summaries (unit, plant) – current hour – past hour.
- Hourly fuel consumption (unit, plant, fuel type) – current hour – past hour.

e) Forecasting tool for Load and intermittent renewable generation

- Neural network-based forecast engine with training algorithm.
- Load, generation (renewable, intermittent) forecasting with configurable resolution (for input and output) – 5', 15', 30' and 1hr.
- Multivariable neural network load forecasting with no less than 3-layer network.
- Renewable neural network intermittent renewal generation forecast.
- Manually adjustable forecasts and merging tools with similar day patterns for special days, holidays, etc.
- Advance forecasts adjustments using user selectable; Adaptive bias adjustment, Mean percent error adjustment and Dynamic weighting adjustment.
- Automated interface to weather services for meteorological data with extensive validation logic for outlier input data detection.

f) Interface to external production scheduling applications

- Vendor responsible for full integration: To-EMS from externally calculated generation schedules, regulation margin, in-use-fuel, etc.) and From-EMS to external applications to export short term load and intermittent generation forecasts, current state estimator solutions used input to external optimization functions).
- Support for asynchronous update of production schedules per unit for intra-day conditions.

III.4.8.20 EMS Functions (Real Time)

The Consultant must consider the following Energy Management System (EMS) functions capabilities:

a) Real Time Security Applications Pre-State Estimation Activities:

- Analog and Switch Status collection (RTU and PMU).
- Analogs assessment for bad values and updates as pseudo measurements using hourly-day type-season allocation tables containing: Switches position, loads values (MW, MVAR), tap positions, regulating busses scheduled KV values, regulating shunts injections, generation values (MW, MVAR).
- User selectable hourly-day type-season allocation tables for pseudo measurement updates.
- Network model creator (branch and node connectivity).
- Schedules for non-measured electrical equipment values.
- Model integrity validation routines (rule-based checks) – Including inconsistent switch status detection, bus mismatches, open ended equipment, in service equipment with no flows, out of service equipment with flows, unreasonable MVAR/MW value for load, etc.)

b) State Estimator

- Robust algorithm to perform the estimation (least square, orthogonal).
- Anomalous measurands and switch status detection logic.
- Integrated quality performance indexes to assess quality and availability.
- Solve observable and non-observable portions of the network.
- Support multi-island solutions.
- Measurements bias errors detection logic.
- Estimated measurands residuals statistics to calculate bias errors.
- Support no less that two user selectable sets of measurand errors.
- Features to enable/disable the use of individual measurements based on user decision or its status. (exclude manually entered, exclude in telemetry error)
- Have auto save option for SE cases
- Allow to save bus mismatch estimates
- Allow for use of PMU measurements (down-sampled)
- De-weighting/reweighting
- Separate and configurable set of equipment limits
- Capability to identify and create contingencies for the Contingency Analysis.
- Results exported in PSSE-34 (user selectable downward compatibility with PSSE-30) and in CIM16 formats.
- Flexibility in the definition of measurement errors.

- Flexible Critical measurement detection based on redundancy levels.
- Alarming capabilities for selected calculated equipment estimated variables.
- Support for angular difference limit monitoring.
- Support for transfer paths limit monitoring.

c) Contingency Analysis

- Capability of enhancing the operator's security awareness by providing information of the worst event that can happen in the power system with reasonable probabilities of occurrence.
- Flexible and strong raking algorithms for AC solutions.
- Use of a Full AC dispatcher power flow, including both Newton Power Flow and Fast Decoupled Power Flow algorithm options.
- Support for single and multiple contingencies.
- Capability of flexible assignment of contingencies to groups.
- On-lines eligibility of equipment participating in the ranking process.
- Support of 3000+ contingencies and complete a CA run in <2-5 minutes.
- On-line capabilities to define new contingencies and/or modify any of the used parameters.
- Solve multi-island using the State Estimator Results.
- Support of modelling of cascading events.
- Support monitoring of groups of branches, generators and loads.
- Support load transfer capabilities for load dropping contingencies.
- Generation reallocation based on participations factor that can be group into responsive areas.
- Modeling of SPS – Special protection schemes including Systemic protections, special remedial actions schemes.
- Support of external triggers resulting of a real time calculation to initiate a remedial action scheme.
- Support automatic arming/disarming of SPS based on external indications.
- Operator oriented results outputs based on contingencies severities.
- Flexible alarming based on contingency severity.
- Debug tools to analyzed suspicious contingency results.
- Monitor bus angle difference exceedances.
- Report a violation due to loss of loads or generations if the loss quantity exceeds the threshold.

d) Short Circuit Analysis

- Compute short circuit levels in the network at bus and equipment level.
- Simulate balance three phase faults and unbalanced faults (single phase-to-ground, double phase to ground, phase to phase) in busses and lines. Capability to define ground impedance value and location within the line.
- Check short circuit currents or MVA limits in specified breakers and busses.
- Show operator selected short circuits results in substations one-line diagrams and overview displays.
- Capability to display results by system, zone, voltage level or individual bus.
- Store of selected short circuit levels for selected monitored equipment.

e) Reactive Reserve Monitoring

- Flexibility to calculate the reactive reserve per configurable reserve zones.
- Calculate total and per reactive reserve zones lagging and leading reactive reserve for generators, SVC, synchronous condensers, shunt capacitors and

reactors.
- Use of generator capability curves bounds and consider out of service shunts in the reactive reserve calculation.

f) Outage Coordinator Assistant

- Support import of scheduled outages and equipment derations from external applications by means of standard data import format.
- Scheduled outages can be any equipment or breaker
- Support of On-Line schedule updates, additions/deletions
- All scheduled outages are presented to the operator sorted by time for the current shift.
- Advance warning of a scheduled outage start time or end time can be set up by operator
- Will be used to set-up the equipment status in a load-flow study case for a future condition

g) Pre-operational checks – Circuit breaker Validation

- Intended for the operator to perform quick evaluations of the consequences in the system of executing one or more actions.
- A load flow program is to simulate intended actions using the latest valid state estimator solution.
- Pretended actions should also be assessed with a contingency analysis execution.
- By exception reporting is required to present side by side pretended actions and consequences, for the actual network and the worst contingency.
- Operator actions to consider are breaker opening/closing, tap changes, setpoint changes for voltage-controlled equipment, load value changes.

h) Optimal Power Flow (OPF)

- Strong and industry proven OPF algorithm
- Support of multiple optimization objectives while observing power flow and security constraints.
- Security constraint removal objectives can be set to: Remove existing violations by suggesting the minimum deviation from current system conditions or by executing the minimum number of operations.
- OPF controllable equipment to be prioritized in its use for solving the objective function.
- Other optimization objectives to be operator selectable as minimize the current generation cost, minimize active losses, minimize reactive losses or feasible combinations of the previous.
- Operator controllable constraint relaxations should be possible.

i) Contingency Analysis Security Advisory

- Strong and industry proven OPF algorithm to provide security advisory on violated constraints solutions based on controllable equipment actions.
- Use of Contingency Analysis results for the worst contingencies as input.
- Controllable Equipment for Security Advisory OPF is to be Operator Selectable.
- If base case is in violation SA-OPF solution is to alleviate it, else, it advises on actions to solve security violations on the worst contingency.

j) Voltage Stability Assessment

- Based on a continuous load flow program to assess transfer paths corridors loading limits and voltage behavior to collapse based on a selected monitoring bus.
- Uses the last valid State Estimator solution or worst ranked contingencies.
- Several methods to increase load to at busses in one side of the corridor should be available and user selectable.
- Loading limits and alarming are to be operator configurable.
- Adequate modeling capability for RAS/SPS devices
- Able to import node-breaker network model defined in a SE base case

k) Transient stability assessment

l) External Applications using as input a State Estimator solution (real time or study) or a Study Power flow solution.

- EMS should provide exporting capabilities for State Estimator solution (real time or study) or a Study Power flow solution using PSSE-34 or CIM-16 base cases exchange specifications.
- PLN existing licenses for Dynamic Security Assessment and Small Signal Analysis to be used. Supporting hardware should be available in the control room for use of real time support engineers.

III.4.8.21 EMS Functions (Study Mode)

EMS to include a minimum of five (5) study areas where independent off-lines studies can be conducted using operator consoles sharing the network model data base.

Operators will log-into a one the study areas using one monitor while supervising the network in the others. The number of monitors allocated in the study area will be the operator's choice.

Library of DPF and Study State Estimator save cases should allow the storage/retrieval of no less than 1000 cases.

Saved cases will keep topological information to allow the execution of study cases even if network topology has changed. For new equipment, absent in the saved case, all line switches will be in their normal state and other equipment (transformers, generators, loads) connecting switches will be assumed as open.

All study areas to have unlimited access to:

- A copy of the real time data base.
- A previously store State Estimator save case.
- A previously store Operator's Load Flow save case.
- A solution from a study mode State Estimator valid execution from a snap shot extracted from the historical data base.

The following applications will be available in each of the study sessions:

a) Pre-Load Flow Activities

- Analog and Switch Status initialization.
- Network model creator (branch and node connectivity).
- Schedules for generators, regulating busses voltages, tap positions, switches.

b) Dispatcher Power Flow

- Newtown Raphson or Fast decouple algorithm.

- Operator oriented – Reporting by Exception of security deviation and limits violations. (Appearing violations and removed violations lists).
- Solution respects capability curve if MVAR limit option is enabled.
- Selectable slack bus; single slack bus, distributed generation (unit capacity, cost based), distributed with fixed interchange.
- Features to compare two selected load flow executions with deviations reporting using Operator definable case comparison criteria.
- Possibility to save multiple cases in a shared library accessible to all study areas.
- System and Area load escalation based on load distribution factors.
- Capable of importing outages in a future time using the Outage Coordinator Assistant scheduled outages and equipment derations.
- Capable of importing generation schedules in future time from the production plan used by the AGC for the generation scheduling.
- Support of load flow standard functionalities to model and simulate controllable equipment (SVC, LTC, Generation MVAR and voltage control, etc.).

c) Study State Estimator

- Based on the same algorithms use for real time estate estimation.
- Uses Historian data for analog values (RTU or PMU) and switches indications as input to perform the state estimation and create a base case.
- Relies on the capability of the historian to store all analogs and indications in a time resolution near real time.
- Solution reporting similar to real time and displayed in one-line substation diagrams.
- Operator selects time in the past from where to execute Study State Estimation.
- Study State Estimator solution can be passed to DPF is executed in the same study area.
- Results to be stored in a save case file.

d) Study Contingency Analysis

- Same features and algorithm as in real time.
- Contingencies can be selected and applied to a power flow execution for detailed analysis and visualization of results.

e) Study Short Circuit Analysis

- Same features and algorithm as in real time.

f) Study Optimal Power Flow

- Same features and algorithm as in real time.

g) Study Voltage Stability Assessment

- Same features and algorithm as in real time.

III.4.8.22 DTS Functions

The Consultant must consider the following Dispatcher Training Simulator (DTS) functions aspects:

a) Operators need to be trained in an environment that is almost identical to their daily work situation.

b) DTS should encourage learning and continuous improvements in operational performance.

c) DTS should improve Operators performance by allowing the simulation and analysis of historical situations and to train in future networks expansions before actual commissioning.

d) DTS shall replicate all SCADA-GMS-EMS functions using the same exact tools, applications, displays and even historian capabilities.

e) High-fidelity simulation of power system dynamics and data acquisition. System slow dynamics include generators, automatic tap changers, cold load, load frequency and voltage dependency and a frequency model to create a realistic frequency behavior.

f) Simulation capabilities should enable the accurate modelling of multi-island operation, voltage collapse, black start on island, loss of synchronism, breaker failures, frequency collapse, loss of communications, power flow control, cascading effects and power swings among others.

g) Should include relay modelling of over/under frequency, over/under voltage, synchro check, inverse time overcurrent and distance relays and any other relay that can alter system conditions and behavior based on realistic simulations.

h) Should be able to import RAS/SPS models from CA and simulate them in DTS power flow solutions.

i) DTS specifications should comprise as part of the scope the following:

- Base Case Management Tools, including the features to extract alarms form the historian and convert them into scenarios, fetch snap shots of past situations from historian and using the study state estimator to create a case that resemble an important event in the past.
- Events types and management (immediate, scenario driven).
- Training Scenarios Management (edit tools).
- Scenario library for multiple scenarios storage with save, restore, or delete capabilities.
- Snapshot Control to capture base cases from a running scenario that can be used to restart a simulation or create another scenario. Snapshot tools to periodically or on demand capturing snapshots.
- Session Control capabilities to allow the instructor to initialize a training session from a base case or a snapshot and reinitialize the session after modification.
- Simulation time acceleration up to 4X wall clock time.
- Capability for power flow iteration tracking and unsolved DTS case trouble shooting
- Support both DTS simulation and replay modes and allow for switch between two modes.
- DTS shall be set up for the new EMS testing on extreme system conditions (i.e. islanding and voltage instability) and training for operators and engineers

before EMS is cutover.

III.4.8.23 Quality Assurance System (QAS)

The Consultant must consider a QAS system to perform SCADA testing, patch regression testing, antivirus database definition testing among others. The following aspects also must be considered:

a) Same database structure of production system.

b) Same functions of production control system.

c) Normal and Listen mode capability.

d) Databases changes can be exported and imported in Production System.

III.4.8.24 Training

The Consultant must specify a comprehensive classroom and On-the-Job (OJT) training program to assure a complete knowledge transfer to PLN, designed to allow optimal exploitation and maintenance of all the specified components. Courses and workshops should be distributed in a minimum of 600 hours training program and, in addition, consider 6 continuous weeks for the OJT activities.

The training program must cover at least the following subjects:

a) Database maintenance (SCADA, GMS, EMS) using graphical data engineering tools

b) HMI - Display development tools

c) System security (principles, configuration, maintenance, patch management)

d) System programming (calculation tools, advanced programming tools)

e) Generation Control functions tuning

f) Security Applications tuning

g) Hardware maintenance and diagnostics (time synchronization equipment, networks, servers, etc.)

h) Operator training (SCADA, GMS and EMS functions)

The training must be supplemented with the following workshops and OJT activities:

i) Workshop for display conversion and redesign for optimal exploitation of the system capabilities using a Display Style Guide. (at the beginning of the display and data base conversion activities).

j) Factory OJT for SCADA, GMS and EMS engineers (no less than a 6 weeks' program for minimum 6 engineers to be planned during factory integration).

k) Workshop in Advance Generation Control tools tuning (before cut-over)

l) Workshop in Advance EMS applications tuning (12 weeks after the new system is on line)

m) Workshop for Operator Trainer Simulator's instructor (14 weeks after the new system is on line)

III.4.8.25 Support Service

The Consultant must specify a long-term support contract with the Vendor after the warranty period, with enough supports hours per year.

The non-used support hours should be convertible in refreshing training.

Deliverables of Task 7: The Consultant shall prepare a report describing all work performed, and including all reports (draft and final design Advanced Master Station, documentation) the SCADA/EMS specification document with at least the following requirements sections:

a) General Conditions.

b) Vendor Responsibilities.

c) PLN Responsibilities.

d) System Architecture.

e) Hardware Sizing.

f) Hardware Platform and Spare Parts.

g) Applications Servers.

h) Front-End Servers.

i) Thin-Client Servers.

j) BMS Interfaces.

k) System Consoles.

l) Networking and Electronic Perimeter Security.

m) Data Backup System.

n) Telecommunications for Data and Voice (Telephony, Unified Communication and radio).

o) Video Wall.

p) Furniture.

q) Database Sizing.

r) Functional Requirements.

s) Data Acquisition.

t) SCADA Applications.

u) GMS Applications.

v) EMS Applications.

w) DTS.

x) QAS.

y) SCADA/EMS System Monitoring.

z) Antivirus and IDS.

aa) Time Synchronization.

bb) Performance

Requirements. cc) Availability.

dd) Organization and Execution Plan.

ee) Transfer knowledge oriented Training and OJT

ff) FAT and SAT.

gg) Installation and

Commissioning. hh) Cutover Plan.

ii) Warranty.

jj) Support services.

kk) Cost Estimation.

ll) Integration and Implementation Schedule.

mm) Table of Compliance (ToC).

III.4.9 Task 8: Preliminary Environment Impact Assessment

The Consultant shall conduct a preliminary assessment of the Project's environmental impact and compliance with reference to local requirements. The Consultant shall identify any positive or negative environmental impacts of the Project, and shall discuss the extent to which any negative environmental impacts can be mitigated. The Consultant shall also review any requirements for a full environmental impact assessment in anticipation of the Project moving forward to the implementation stage.

Deliverables of Task 8: The Consultant shall prepare a report describing all work performed, and including all reports, deliverables, and findings of task 9.

III.4.10 Task 9: Operation Reorganization Plan

The Consultant shall revise and propose a reorganization plan, as consequence of the creation of MCC and DRC.

a) Identify the goals in the Operation and Maintenance of the Control Centers' organization.

b) Perform a gaps analysis.

c) Propose a revised organization structure based on:

- Relocation of operators to the new Control Center.
- Distribution of functions throughout the organization.
- Vertical and horizontal authority relationships.
- Communication/decision-making process.
- Internal departmental policies.
- Identification of attributes of department employees.

d) Create the organizational chart.

e) Elaborate job descriptions for new and changed positions.

f) Define skills for new and changed positions.

g) Suggest a communication plan.

Deliverables of Task 9: The Consultant shall prepare a report describing all work performed, and include all reports, deliverables, and findings.

III.4.11 Task 10: Implementation Plan

The Consultant shall develop a project implementation plan, which shall include a detailed description of the various steps required to implement the recommended control center upgrades.

The implementation plan shall include a schedule with specific implementation targets and shall include a timeline that specifies aspects relating to the tender process, platforms, hardware, software, human resources, communication technologies, and regulations.

At a minimum, the implementation plan shall include the following:

a) A procurement strategy which accommodates the requirements for the infrastructure works and for the systems supplier, as well as any other approaches that may be required to suit project objectives.

g) Breakdown of the annual work program into specific work packages.

h) Description and technical specification of each work package

i) Description of implementation services within each work package (including database conversion, data population, tests, documentation, training, etc.).

j) Training of EMS system.

k) Description of the acceptance tests and other verification procedures.

l) Inter-relationship of the work packages.

m) Plan for the implementation of each work package (including whether it should be carried out internally, outsourced, or a combination of the two).

n) Budget for each work package.

o) Data migration plan.

p) Risk management plan.

The Consultant shall also provide a recommendation on the appropriate mix of internal and third-party resources for implementation.

Deliverables of Task 10: The Consultant shall prepare a report describing all work performed, and including all reports, deliverables, and findings.

III.4.12 Task 11: Financing Plan

The Consultant shall review with UNOPS and PLN the financial sources for the Project. The Consultant shall also discuss potential financing options with prospective Vendors. As result, the Consultant shall prepare a financing strategy for the Project that recommends and justifies the optimal financing structure and mechanisms.

Deliverables of Task 11: The Consultant shall prepare a report describing all work performed, and include all reports, deliverables, and findings.

III.4.13 Task 12: Evaluation Criteria

The Consultant should propose the Vendors Evaluation Criteria based on:

a) Technical Solution.

b) Scope compliance (ToC).

c) Vendor ranking and expertise.

d) Quality Assurance System.

e) Delivery dates.

f) Regulatory compliance.

g) Price and financing.

h) Long term support services.

i) Risk assessment.

j) Corporate Social Responsibility.

The tender process may be split into two or more packages to accommodate contracts for the infrastructure works and for the systems supplier. The evaluation criteria should reflect this.

Deliverables of Task 12: The Consultant shall prepare a report describing all work performed, and including all reports (draft and final budget estimation, ToR, documentation for building and control center), deliverables, and findings.

III.4.14 Task 13: Preparation of Tender Documents

The Consultant must prepare the tender package(s) for project implementation. The tender process may be split into two or more packages to accommodate contracts for the infrastructure works and for the systems supplier. The tender packages shall include the following:

a) Detailed scope of work.

b) Technical specifications.

c) Staffing requirements.

d) Implementation schedule.

e) Budget (in detail as PLN standard for procurement).

f) Evaluation criteria.

g) Performance risk assessment.

h) Tender requirements and tendering schedule.

i) PLN's standard contractual requirements.

The Consultant shall prepare the Tender Documents including, but not limited to, the following framework:

a) Tender Documents must refer to the provisions/regulations of the Procurement of Goods/Services in effect within PT PLN (Persero).

b) Procurement of goods/services must maximize the use of domestic production referring to the Regulation of the Minister of Industry regarding Guidelines for the Use of Domestic Products for Electricity Infrastructure Development and the provision of price preferences for domestically produced goods / services based on TKDN (Domestic Component Level).

c) In preparing and compiling tender documents as referred to the above, the work will include Preparation of Instruction to Bidder, Bid Data Sheets, Qualification & Evaluation Criteria Bill of Quantity (BOQ), Technical Particular & Guarantee (TPG), Work Plan and technical requirements (RKS), Technical Specifications, Design Drawings and Layout Drawings, Conditions of Contract, Work Plans, Project Schedule and others.

Deliverables of Task 13: The Consultant shall prepare a report describing all work performed, and including all reports (draft and final bidding document and documentation), deliverables, and findings.

III.4.15 Task 14: Preparation of Budget Plan

The Budget Plan (BDG) must be prepared by considering several aspects including the price of equipment on the market, material prices and material indexes on world markets, currency fluctuations, work journals issued by the authorities, inflation, taxes, escalation and so on.

The BDG that is produced must be able to reflect the technical and financial fairness value, and be accounted for professionally and legally, so that it can later be used as a reference in the implementation of the procurement.

In preparing and submitting the BDG, the Consultant is asked to attach the basis/reference/data used in the preparation of the BDG.

Separate BDGs may be required for the works component and the systems supplier component.

Deliverables of Task 14: The Consultant shall prepare a report describing all work performed, and including all reports (draft and final estimated engineering cost document and documentation), deliverables, and findings.

III.4.16 Task 15: Assistance in the Tender Process

Activities carried out by the Consultant in support of the tender process for the works contracts and systems supplier contracts, include but are not limited to:

a) Assisting and accompanying the implementation of explanation meetings, conducting field observations and preparing answers to questions.

b) Prepare addendums for Tender Documents, especially those related to technical changes (if there are any).

c) Assisting in the preparation of estimated price for related Tenders.

d) Assist in the evaluation of technical documents and price bidding documents, including the evaluation of maintenance and support costs.

e) Assist in the contract implementation meeting preparation (Contract Discussion Agreement).

f) Assist in drafting contract documents.

Deliverables of Task 15: The Consultant shall prepare reports describing all work performed, among the expected reports are site visit and pre-bid meeting report, evaluation bidding document report, Statement of Work (SOW) or Contract Discussion Agreement (CDA) report and documentation), deliverables, and findings. PLN will be the leader of the procurement of the works contracts and systems supplier that will not be funded by UNOPS.

III.4.17 Task 16 Training

The consultant shall prepare a general training program for Managers, SCADA/EMS engineers and System Operators that contains the following topics:

a) Introduction to new SCADA/EMS Technologies

b) SCADA/EMS System Overview

c) Communications platforms and protocols

d) Security in SCADA/EMS Systems

e) Situational Awareness Techniques

f) Historian Systems and Analytics

g) Automatic Generation Control and Economic Dispatch

h) Power Load Flow

i) Security Analysis Functions

j) Load Forecasting

k) Renewables Operations

l) Power System Restoration

m) An overarching maintenance strategy and specific maintenance plans

Deliverables of Task 16: The Consultant shall provide a training program covering the specified topics. This training will be remotely. Training and presentation material should be provided electronically and in English.

III.4.18 Task 17 Engineering Supervision

The scope of work of the Consultant is as follows but is not limited to:

a) Assist PLN with the review of Contract conditions between PLN and the Vendors.

b) Carry out site visits with Vendors.

c) Technical Review of Contracts between PT PLN (Persero) and Vendors.

d) Assist PLN with the review of the Vendor's detailed design and perform the technical approval of the engineering documents submitted by the Vendor based on applicable standards, conformity to contract specifications and experience in best practices in control centers migrations.

e) The Consultant will accompany PLN to supervise and control the submission of drawings from the consultant according to a mutually agreed schedule.

f) The Consultant shall prepare a technical recommendation related to changes and non-conformities to contract conditions.

Deliverables of Task 17: The Consultant shall prepare a report describing all work performed, and including all reports (monthly and final document report, documentation), deliverables, and findings.

III.4.19 Task 18 Construction, Installation and Commissioning Supervision

Supervision of the construction and installation activities (done by others) includes, but is not limited to:

a) Evaluate and approve the Vendor work method according to the contract terms.

b) Supervise and check the Vendor work results in accordance with the contract terms.

c) Assessing the effectiveness and efficiency of the Vendors work and suggest necessary efforts to improve work effectiveness and efficiency.

d) Checking, approving the materials, equipment and completeness of the documents submitted by the Consultant.

e) Checking and controlling Vendor compliance with the environmental control program and Occupational Health & Safety (K3).

f) Control the receipt and storage of materials prepared by the Vendor in accordance with the terms of the contract.

g) Checking and administering the progress of the Vendor's work according to the terms of the contract.

h) Witnessing, examining, and approving the results of tests carried out by the Vendor in accordance with the terms of the contract.

i) Checking and implementing the payment for the Vendor work according to the terms of the contract.

j) Evaluating the Contractor's claims and/or recommending the claims of PLN according to the terms of the contract.

k) Assist in the buildings' construction reception.

l) Evaluating the added/reduced work according to the terms of the contract.

m) Follow up the approved training plan.

n) Assist in the implementation of equipment and installation certification.

o) Coordinate the handover of work according to the terms of the contract.

p) Prepare a component list of installed equipment showing the number of parts received.

q) Supervise the Commissioning and Cutover of the SCADA/EMS Main Control Center (MCC) and Disaster Recovery Control Center (DRC).

r) Supervise the integration of DFR and PMU functions into the New Control Center.

s) Supervise the commissioning of interfaces between the Control Center and external systems (BMS, Weather).

t) Supervise the commissioning of communication systems in transmission substations and power plants which includes Unified Communication (UC), VoIP, Hotline and Radio.

u) Supervise the Commissioning of peripherals and supporting equipment for Master Station functions and applications.

v) Supervise the migration of all existing systems to the new system, taking into account the minimum possible downtime (cutover).

w) Verify the system performance as specified and cybersecurity hardening.

x) Review As Built drawing package (prepared by the contractor)

Deliverables of Task 18: The Consultant shall prepare a report describing all work performed, and including all reports (monthly and final document report, documentation), deliverables, and findings.

III.5 DEFINITIONS

Terms of Reference (ToR): is a document describing the objectives, scope of work, detailed tasks and reporting requirements for a specific consulting service assignment.

Consultant: is an individual or consulting firm (as defined below) that provides consulting services.

Consulting firm: means any private or public entity with the capacity to provide consulting services. Such entities include international and national consulting firms, engineering firms, construction firms, management firms, procurement agents, inspection agents, auditors, United Nations (UN) agencies and other multilateral organizations, universities, research institutions, government agencies, civil society organizations (CSO) and nongovernmental organizations (NGOs), when such entities provide consulting services.

Vendor**:** any supplier of goods and services.

Contractor: a person or business that agrees to conduct work for another entity as specified under the terms of a contract.

Service User: PLN Department receiver of services.

III.6 GENERAL CONDITIONS

The Consultant must develop the services to meet the aforementioned objectives in accordance with this Terms of Reference and the UNOPS Consultant Services Contract for Works.

III.7 AVAILABLE DATA

The following information is available for the Consultant to become familiar with the current operational and control center data.

Data is grouped into three categories: Basic Data, Technical Standards and Prevailing Laws.

Basic Data: which comprises PLN internal and public domain documents. These documents will be available for download and consultation in a common shared folder for all participating consultants. If documents are qualified as confidential, the Consultant must not release or use them for purposes different than preparing his technical proposal.

Technical Standards: it will be to the Consultants to review the standards, ensuring the application of the latest releases. The list should not be considered limiting, so the Consultant must follow all applicable standards in each of the technical specialties.

Prevailing Laws: Indonesian Electricity and Building Laws. These will be available in the same folder where the Basic data will be located.

III.7.1 Basic Data

a) Existing SCADA/EMS system data – includes system sizing and station one-line & overview display files.

b) Data of the existing telecommunication system.

c) Operation data and statistics for the Java-Bali System in 2020.

d) Feasibility Study of the Main Control Center & Advanced Master Station SCADA/EMS PT PLN (Persero) UIP2B that was carried out in 2019.

III.7.2 Technical Standards

In addition to the requirements outlined in the technical standards listed below, the design must comply with the UNOPS Design Planning Manual for Buildings. Where there is a conflict, the most onerous requirement applies, unless approved otherwise by UNOPS.

a) SNI 1726: 2019 concerning Earthquake Resistance Planning Procedures for Building and Non-Building Structures.

b) SNI 2397-1991 guidelines for the design of a wind proof simple buildings

c) SNI 1727: 2013 concerning Minimum Load for Designing Buildings and Other Structures.

d) SNI 2847: 2013 concerning Requirements for Structural Concrete for Buildings.

e) ASCE/SEI 7-16 minimum Design Loads and Associated Criteria for Buildings and Other Structures (describes the means for determining dead, live, soil, flood, tsunami, snow, rain, atmospheric ice, earthquake, and wind loads, and their combinations for general structural design)

f) Indonesian Loading Regulations for Buildings (PBI) 1983.

g) Ministry of Public Works Regulation No.26/PRT/M/2008, dated December 30th 2008. Fire protection technical requirements for buildings and the environment.

h) NFPA 75 Standard for the Fire Protection of Information Technology Equipment.

i) NFPA 220 Standard on Types of Building

Construction. j) NPFA 1,10,13,9,14,72,101,5000.

k) ANSI/TIA-942: 2010 Telecommunication Infrastructure Standards for Data Centers.

l) ISO/IEC 24764 Data Center (revised by ISO / IEC 11801).

m) SNI-0225-2011 concerning General Requirements for Electrical Installations (PUIL 2011).

n) ISO 27001 information security management.

o) ISO 27002 information security standard.

p) Applicable IEC and IEEE standards on SCADA/EMS.

III.7.3 Prevailing Laws that must be used

a) MEMR PERMEN No.20 of 2020 concerning the Rules for the Java-Madura-Bali Electric Power System.

q) EPMEN PU No. 45/PRT/M/2007 concerning Technical Guidelines for the Construction of State Buildings.

III.8 DELIVERABLES AND REPORTING

The Consultant will carry out their own quality control review process, including a technical and editorial review of all deliverables and documents submitted to UNOPS, in order to ensure readability, accuracy and consistency. The Consultant must submit a plan for reporting and quality assurance for the project.

All deliverables and documents will be sent in draft form to UNOPS for review and comments prior to finalization. The deliverables specified in these Terms of Reference will serve to keep the Beneficiary informed about the Consultant's work in the TA, and to ensure that the Consultant's work is performed satisfactorily, in accordance with the applicable provisions of the Contract and the terms and conditions and its annexes. All deliverables should be in English language and submitted electronically.

The output produced by the Consultant based on these Terms of Reference will be further regulated in a letter of agreement, which should at least include for each Contract 1 and 2:

a) Inception report.

b) Weekly meetings.

c) Task reports and deliverables.

d) Monthly progress reports with accumulative progress and obstacles encountered.

e) Final report.

All reports, findings and presentations should be in English and submitted to UNOPS electronically. Technical related reports will be submitted electronically to UNOPS with copy to PLN.

III.9 WORK PLAN AND SCHEDULE

The estimated time frame for completion of work is the following:

a) Task 1: Scope and Planning to be completed within 1 month of the signed agreement and in advance of the other tasks

b) Task 2, 3, 4 and 5: Technology Review, Key Sector Trends, Organisational Context, and Strategic Vision to be completed within 1.5 months of the signed agreement and in advance of tasks 6 and 7

c) Task 6: MCC and DRC Building Planning Consulting Services are carried out for 6 months from the completion of tasks 1 to 5. A further breakdown of deliverables for the design is outlined here:

- Design Brief & Concepts - Deliverable within 1.5 month on task 6 (allow 2 weeks UNOPS/PLN review)
- Outline Design Package - Deliverable within 3 months (allow 2 weeks UNOPS/PLN review)

- Detailed Design Package - Draft deliverable within month 5 of task 6, final deliverable at the end of this task. (Plus 4-6 weeks for UNOPS Design Review)

d) Task 8: Environmental Impact assessment should be carried out in parallel and coordination with Task 6 as the design will inform the EIA and vice versa.

e) Task 7: Advanced Master SCADA/EMS Planning Consulting Services are carried out for 6 months after the completion of tasks 1-5.

f) Task 9, 10, 11, 12, 13, 14: Operational, Implementation, Financial and Budget Plans, and the preparation of the tender documents and evaluation criteria should be developed within 7 months of the signed agreement

g) Task 15: The tender process will take place during months 6 to 9 after the signed agreement.

h) Task 16: Training is carried out within 5 month from the completion of the tender process.

i) Task 17: Engineering supervision work and construction supervision of MCC and DRC Data Center Buildings are carried out (20 months) after signing the contract for construction services providers for MCC and DRC Data Center Buildings.

j) Task 18: Engineering supervision and construction supervision work for Advanced Master SCADA/EMS is carried out for 16 months) after the signing of the Advanced Master SCADA/EMS Vendor contract.

III.10 LOCATION OF ACTIVITIES

The location of the Main Control Center (MCC) building is in Gandul, Depok. Meanwhile, the location of the Disaster Recovery Center (DRC) is in Ketintang, Surabaya. The location for the implementation of activities as well as the need for service personnel of the Consultant will be further regulated through an agreement between PLN and the Consultant.

The site surveys and supervision related activities must be carried out on site (MCC and DRC locations); assessments,design and assistance in the tender process can be partially developed remotely with a minimum of local work of 30%. The local activities allocation will be defined during the Statement of Work.

III.11 QUALIFICATIONS AND EXPERTISE

To carry out the activities specified in this ToR, the experts must have a background and experience in a similar field. The Project Team must at least consist of a core group of professionals, and shall involve expert consultants who have significant international experience in the construction of Control Center buildings and SCADA/EMS, and can bring international best practice into the project

For administrative and technical evaluation needs, the Consultant must submit the following documents:

a) Firm background information.

q) Experience in Control Center or related Consulting Services, accompanied by supporting documents.

r) The Consultant shall submit a list of experts who become a team by submitting Curriculum Vitae, work experience related to the requested work, and project name, following UNOPS Format in Returnable Bidding Form.

s) The proposed team should have senior area leaders with demonstrable experience in the following specializations:

- Project Management.
- Architectural Design.
- Civil Engineering.
- Mechanical Engineering.
- Electrical Engineering
- Public Health Engineering
- SCADA/EMS Engineering.
- Communications.
- Data Center Engineering.
- Human Resources.

t) Attach a certificate of user satisfaction and submit a reference for control center planning consulting work for at least five (5) locations.

III.12 SOURCE OF FUNDING

Phase 1 comprises tasks 1 to 15 (inclusive) - planning, design, and tender support. Funding for consulting services for phase 1 comes from the UNOPS Southeast Asia Energy Transition Partnership ETP Budget.

Phase 2 comprises tasks 16 to 18 (inclusive) - training and supervision services during the works. Funding for consulting services for phase 2 will be confirmed in due course. (If financed by State Electricity Company PLN (Persero) Budget, the payment will be in Indonesia Rupiah).

SCHEDULE OF PAYMENTS

Contract Phase 1

- Payment of 10% to be paid after contract signing.
- Payment of 10% to be paid after delivering the Tasks 1 to 5
- Payment of 40% to be paid in 3 payments according the progress of Task 6
- Payment of 5 % to be paid after delivering the Task 8
- Payment of 20% % to be paid after delivering the Task 7
- Payment of 10% to be paid after delivering the Task 9-Task15
- Payment of 5% to be paid after the Final Report for Contract 1

Contract Phase 2

- Payment of 20% to be paid according to the man/hour usage for the Task 16
- Payment of 35% to be paid according to

the man/hour usage for the Task 17
- Payment of 35% to be paid according to the man/hour usage for the Task 18
- Payment of 10% to be paid after the final Report.

III.13 HEALTH AND SAFETY

a) All partners are required to comply with the safety and health regulations within PT PLN (Persero) and UNOPS.

b) Due to the COVID-19 pandemic. All partners must consider the provisions and directives issued by the Indonesian Health Agencies.

c) All partners are required to have and implement standard operating procedures (SOPs) and work instructions.

d) All SOP/IK and workplaces/locations must go through a process of hazard identification and risk control first. The Hazard Identification and Risk Control Table or abbreviated as HIRAC (Hazard Identification Risk Assessment Control) is used as a contract attachment.

e) In accordance with the HIRAC results, if the job and/or workplace is found to have a high, very high, fatal potential hazard and so on, it is mandatory to fill in a Job Safety Analyst (JSA) and a Working Permit (work permit).

f) Provide Personal Protective Equipment (PPE) completely and properly.

g) Work equipment and protective equipment must be complete and appropriate.

h) Technical personnel must hold a training/competency certificate.

i) For work and high-risk work areas, it is mandatory to use a buddy system (not allowed to work or enter the work area alone).

j) Required to apply BPJS or insurance.

k) Must use a lock out and tag out system in high-risk jobs.

l) In the event of a work accident (failure of the occupational safety and health management system), the goods and services providers are fully responsible and all losses are borne by the work partner.

m) If the implementation presented in this document is not fulfilled, UNOPS and PLN will evaluate and decide unilaterally on the ongoing goods and services procurement agreement.

n) If the work partner does not carry out work accident prevention activities or education & training certification, the work partner will be given the first written warning sanction.

o) If after being given the first written warning sanction, an evidence is still found that the work partner has not carried out any work accident prevention activities or education & training certification, the work partner will be given a second written warning sanction.

p) If after the issuance of the first and second written warning sanctions, an evidence is still found that the work partner has not carried out any work accident prevention activities or education & training certification, PT PLN (Persero) has

the right to unilaterally terminate the ongoing goods and services agreement contract and enter the partner on the Black List of companies.

III.14 GLOSSARY

ACE Area Control Error
AGC Automatic Generation
Control AI Artificial Intelligence
BDG Budget Plan
BESS Battery Energy Storage System
BPJS Badan Penyelenggara Jaminan Sosial (Indonesia Social Insurance Administration Organization)
DMZ Demilitarized Zone
DPF Dispatcher Power
Flow
DRC Disaster Recovery Center
DTS Dispatcher Training
Simulator ED Economic Dispatch
EMS Energy Management
System ESB Enterprise Service Bus
GPS Global Positioning System
HIRAC Hazard Identification Risk Assessment
Control HMI Human-Machine Interface
IMB Indonesia Building Permits Requirements (Izin Mendirikan
Bangunan) IoT Internet of Things
IRE Intermittent Renewable
Energy JSA Job Safety Analyst
LFC Load Frequency
Control LTC Load Tap Changer
MCC Main Control Center
ML Machine Learning
OJT On-the-Job
Training OPF Optimal Power
flow
PDC Phasor Data Concentrator
PMU Phasor Measurement Unit
QAS Quality Assurance System
RE Renewable Energy
RTDB Real Time Database
RUEN National Energy Business
Plan SCA Short Circuit Analysis

SCADA Supervisory Control and Data Acquisition

SE State Estimator

SOA Service Oriented Applications
SOP Standard Operating
Procedures SVC Static Var
Compensator
TA Technical Assistance
UIP2B Main Unit Load Management Center
UNOPS United Nations Office for Project Services
WAMS Wide Area Monitoring Systems