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Executive Summary

This document provides an overview of Eskom's requirements for a commercial enquiry for the development and supply of a power system control and monitoring system that includes the Energy Management System (EMS), Operator Training Simulator (OTS), Wide Area Monitoring System (WAMS), Generation Dispatch System (GDS), Rear and Front Projection System for Eskom Transmission.

The document provides an overview of the envisaged solutions; identifies the strategic objectives to be fulfilled by the solution; the procurement approach; and acts as an index and supplement to the detailed technical specifications, 240-170000483 "*Transmission Power System Control and Monitoring Specification*".

This document sets the context in which *Tenderers* should approach this enquiry and defines the technical evaluation criteria that will be used in this enquiry.

1. Introduction

This document outlines the project requirements for the Transmission Power System Control and Monitoring System (TPSCM) to facilitate accurate and efficient responses to the commercial enquiry.

2. Supporting clauses

2.1 Scope

This document provides information relating to a commercial enquiry for the design, development, testing, development of user documentation, training, supply, delivery, installation, and commissioning of an integrated TPSCM system.

The scope includes the EMS, OTS, GDS, WAMS, Rear and Front projection system and the required hardware specification. The scope excludes the scouring of the hardware

2.1.1 Purpose

This document aims to clearly define and contextualise the design philosophy, the scope, the project phases and timelines, the required standards, tender gatekeepers, tender returnables and scoring criteria for the TPSCM enquiry.

2.1.2 Applicability

This document shall apply to all TPSCM solution *Tenderers*.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs. All national and international documents referenced shall be obtained directly from the source.

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems.
- [2] 240-170000483 Transmission Power System Control and Monitoring Specification
- [3] 240-95401790 Reference Project Life Cycle Model Standard

2.2.2 Informative

- [4] Transmission Development Plan <https://www.eskom.co.za/eskom-divisions/tx/transmission-lines/transmission-development-plans/>

2.3 Definitions

2.3.1 General

None

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
AGC	Automatic Generation Control
AS	Acceptance Schedule
COVID-19	Coronavirus disease 2019
CV	Curriculum Vitae
DDS	Detailed Design Specification
DGW	Data Gateway
DMS	Distribution Management System
DS	Deviation Schedule
EMS	Energy Management System
FAT	Factory Acceptance Test
GDS	Generation Dispatch System
GE	General Electric
GPS	Global Positioning System
ICCP	Inter-Control Center Communications Protocol
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IPS	Interconnected Power System
ISO	International Organization for Standardization
IT	Information Technology
MSAP	Multi-Service Access Platform
NCC	National Control Centre
NERC	North American Electric Reliability Corporation
NIST	National Institute of Standards and Technology
OEM	Original Equipment Manufacturer
OS	Option Schedule
OT	Operational Technology
OTS	Operator Training Simulator
PCC	Primary Control Centre
PMU	Phasor Measurement Unit
PO	Pricing of Options
PS	Pricing Schedule
PS5	PS5 schedule
Q	Questionnaire

Abbreviation	Description
RCC	Regional Control Centres
RFP	Request For Proposal
RS	Requirement Schedule
RTAC	Real-Time Automation Controller
RTE	Remote Terminal Equipment
RTU	Remote Terminal Unit
SAPP	Southern African Power Pool
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SCC	Secondary Control Centre
SEL	Schweitzer Engineering Laboratories
SOC	System Operating Control
SPDC	Substation class Phasor Data Concentrators
STABNAC	Standby National Control
TEMSE	Transmission Energy Management System Evolution
TPSCM system	Transmission Power System Control and Monitoring
VAT	Value Added Tax
VPN	Virtual Private Network
WAMS	Wide Area Monitoring System
ZAR	South African rand

2.5 Roles and responsibilities

The *Tenderer* shall use this document and all those listed in 3 *Documentation for enquiry* in responding to the TPSCM enquiry.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Not applicable.

3. Enquiry Documentation

This section provides a complete index of all Eskom standards and supporting documents that are applicable to this enquiry.

Table 1: TPSCM System Enquiry Documentation

Number	Document number and Title
Overview Document	
[1]	240-170000482 Overview of requirements for the Transmission Power System Control and Monitoring System
TPSCM Specification	
[2]	240-170000483 Transmission Power System Control and Monitoring Specification
Standards	
[3]	240-55410927: Cyber Security Standard for Operational Technology
[4]	32-373: Information Security - IT/OT Remote Access Standard
[5]	SD-OT/0010001: Security Division Position Paper – Cloud Computing
[6]	240-61478980 Eskom Slave device IEC 60870-5-101 Implementation Standard
[7]	240-61478967 Eskom Master device IEC 60870-5-101 Implementation Standard
[8]	240-160474571 Measurement and recording of Eskom frequency
[9]	240-72942279: EMS and DMS Master Station Computer Disaster Recovery Standard
[10]	240-91479924 Cyber Security Configuration Guidelines of Networking Equipment for Operational Technology
[11]	240-82331576: Inter Control Centre Communications Protocol Standard
National and International documents	
[12]	Tier III Data Centre as per Tier Levels https://uptimeinstitute.com/tiers
[13]	IEEE C37.118.2 IEEE Standard for Synchrophasor Data Transfer for Power Systems
[14]	IEEE C37.118 2005 IEEE Standard for Synchrophasor Data Transfer for Power Systems
[15]	IEC 60870-5-101 Transmission protocols –Companion standard for basic telecontrol tasks
[16]	IEC 60870-5-104 Transmission Protocols - Network access for IEC 60870-5-101 using standard transport profiles
[17]	IEC 60870-6 Inter-Control Center Communications Protocol
[18]	The South African Grid Code -The Information Exchange Code
[19]	Grid Connection Code for Battery Energy Storage Facilities (BESF) connected to the electricity Transmission System (TS) or the Distribution System (DS) in South Africa

The *Tenderer* shall source the latest version of national and international documents referenced in 240-170000483: *Transmission Power System Control and Monitoring Specification* and 240-170000482 *Overview of requirements for the Transmission Power System Control and Monitoring System*. Documents and plans, which are annually reviewed, shall be current at the time of tender submission.

4. Strategic objectives

4.1 Ensure smooth transition and continuity of operations

The implementation and commissioning of the TPSCM shall consider the continuity of operations, namely, the operating and control of the Interconnected Power System (IPS), to ensure a smooth transition from the currently installed Transmission Energy Management System Evolution (TEMSE) to the TPSCM solution. The TPSCM design and/or architecture as well as the deployment procedures must cater for parallel operation.

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During the parallel operation of the two systems, TEMSE and the TPSCM, a single master copy of the Eskom data and displays shall be maintained. Conversion procedures shall automate the transfer the data and displays from the master copy of the data.

External interfaces to the TPSCM must incorporate a smooth switch over for the existing interfaces, such as telecommunication circuits, access to data on the corporate network, for example historians, the Generation Dispatch System and the Situational Awareness.

The operator workstations shall allow for simultaneous access to the graphical user interface of both the systems, TEMSE and the TPSCM system, during the parallel operation.

4.2 Ensure a sustainable TPSCM solution

Maintenance agreements shall be aligned to support the TPSCM, hardware and software, throughout the life cycle of the TPSCM solution. The TPSCM architecture shall support a mid-cycle, after seven (7) years, hardware replacement. The continuity of operations shall be maintained during the hardware replacement and/or upgrade of firmware. The TPSCM solution shall be robust and expandable to cater for additional communication circuits and an extension to the rear-projection system. The TPSCM databases shall be sized to allow for the modelling of new generation sources, such as provided through Independent Power Producers (IPPs).

Upgrading the TPSCM software shall be managed to ensure the versions to be deployed are compatible with the installed hardware and the solution remains stable. An upgrade of hardware shall also not be restricted due to available software versions. The TPSCM solution shall be perceived by the operators to be user friendly and easy to support and maintain by the support engineers. The support engineers shall continuously aspire to improve the quality of the TPSCM solution and the maintenance thereof. This includes enhancing and adding maintenance and logging tools to the TPSCM solution. Audits shall be a mechanism used as part of the maintenance phase to ensure a sustainable solution.

4.3 Deploy least cost feasible solution

The TPSCM solution shall conform to the applicable international standards and standards adopted by the *Employer*. The *Employer* has embraced the use of open-source technologies. The deployment of open-source technologies assists the *Employer* in implementing least cost feasible solutions with the available skills.

Where available the TPSCM shall make use of the *Employer's* national agreements and contracts for hardware, licenses, and support agreements. The hardware shall be sourced locally to maximise on support agreements.

4.4 Support changing landscape

The IPS is a changing landscape with regards to new generation resources being connected to a transforming transmission grid. The TPSCM shall support the deployment of new software and tools to support the operating and control of these resources.

4.4.1 Generation

The migration of the installed TPSCM solution shall enhance the functionality available to support new generation resources to be introduced over the life cycle of the TPSCM. The availability and integration of new software shall be evaluated annually as part of the maintenance agreement.

4.4.2 Transmission

The TPSCM solution shall enable the seamless integration and commissioning of new network models and applications to support renewable energy sources from IPPs and other embedded generation resources.

The model of the transmission power network shall be consistent throughout the TPSCM solution. The system shall be sized to meet the data and modelling requirements to meet the *Transmission Development Plan* and micro grids introduced into the power system.

4.5 Responsive to utility legal separation

The TPSCM solution shall be flexible and neutral to allow and support any functional separation and governance changes within the *Employer*. The management and adherence to policies and standards shall be controlled from within the TPSCM solution.

4.6 Ensure robust cyber security compliance

The TPSCM solution shall conform to international cyber security requirements, specifically the requirements from the Cybersecurity Framework from the National Institute of Standards and Technology (NIST) and the North American Electric Reliability Corporation (NERC) requirements on critical infrastructure protection supplemented by the *ISO/IEC 27002 - Information technology – Security techniques – Code of practice for information security controls*.

Local standards to comply with include *240-55410927: Cyber Security Standard for Operational Technology* of the *Employer*. The updating of local and international cyber security standards shall not reduce the compliance of the solution.

Cyber security requirements for Operation Technologies shall be the focus during the design, installation and maintenance of the TPSCM solution.

4.7 Deploy field proven products

The TPSCM system shall comprise tried and tested field proven products requiring minimal customisation. Customisation shall be limited to functionality required for the secure operating and control of the IPS and to avoid operating errors.

The *Employer's* customs shall be generalised to be included in the standard product.

4.8 Ensure availability of skills and knowledge

First line support will be the responsibility of the *Employer*. The *Employer* will deploy third (3rd) party tools to assist and enable the management of the integrity of *Employer's* data and the TPSCM solution. Deployment of the TPSCM solution will be executed by the *Employer* with the assistance of the *Contractor*. The *Contractor* shall provide the procedures required to enable the *Employer* to do the deployment. Training shall be available from the *Contractor* to facilitate the skills and knowledge transfer required for the installation, commissioning and maintenance of the TPSCM solution.

5. Project strategy

5.1 Hardware procurement

To secure an optimum hardware procurement strategy, the following criteria will be considered during the evaluation for this enquiry:

- the local maintenance and support for the TPSCM hardware from the permanent local office of the hardware OEM;
- the end-of-support and end-of-life classification for the hardware from the hardware OEM;
- standardisation of the equipment throughout the TPSCM solution;
- conformance to the cyber security principles for operational technology;
- the availability of the hardware and spares from the permanent local office; and
- the recommendation from the hardware OEM on the *Tenderer's* hardware proposal for the configuration and architecture of the TPSCM hardware solution.

The procurement of the hardware, network and cabling will be through a second enquiry based on the information obtained from this successful tender for the specification and requirements for the TPSCM system software.

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5.2 Scope ratification

The response from the *Tenderer* to the 240-170000483: *Transmission Power System Control and Monitoring Specification* is the input into the scope ratification phase and forms the baseline for the potential contract placement for the rest of the phases. The *Employer* shall use the responses to the Requirement Schedule to determine the potential allocation of one or more contracts for the supply of the TPSCM solution. The *Employer* shall select from the Option Schedule to conclude on the scope of the TPSCM solution for contract placement. The *Tenderer's* submission, including supporting documents, shall define the functional specification and system design report for the TPSCM solution. The project programme shall include the complete scope of the *Tenderer's* offering. The project programme shall remain feasible regardless of the options selected from the Option Schedule. No revised pricing or adjustments to the project programme shall be the result of tender clarifications during the scope ratification.

5.3 Multiple contracts

The *Employer* accepts that the optimal TPSCM solution could result in the placement of multiple contracts, such as for the hardware, rear projection system, front projection system and the TPSCM software solutions. The technical evaluation shall consider the partial submission on merit for that component of TPSCM solution. The *Employer* reserves the right to place one or more contracts for the delivery of the TPSCM solution.

The tender for the TPSCM solution will be evaluated for the optimal solution for each offering while limiting the risk of integration. This tender consists of two (2) parts with the potential independent contract award for *Part A: TPSCM System Software* and *Part B: Rear Project and Front Projection System*. A second enquiry using the information from *Part A: TPSCM System Software*, to determine the requirements for the hardware and networking, will be used for the hardware tender to follow. The hardware contract should be concluded prior to *Phase 4 – Delivery, Installation, Testing and Commissioning*, of the *Software Project Programme*.

Part A: TPSCM System Software

Part A will consist of a main tender and an optional alternative tender. The evaluation of the alternative tender is dependent on an acceptable responsive main tender.

- The **main tender** for the operating and control with generation optimisation integration will consist of:

Offering 1a: Operating and Control with generation optimisation integration; and

Offering 2: Wide Area Monitoring System.

- The **alternative tender** for the operating and control with a replacement Generation Dispatch System will consist of:

Offering 1b: Operating and Control with a replacement Generation Dispatch System; and

Offering 2: Wide Area Monitoring System.

Part B: Rear Projection and Front Projection System

The tender for the rear projection and front projection system will be evaluated regardless of the outcome of *Part A: TPSCM System Software*.

The tender shall consist of the *Offering 3: Rear Projection and Front Projection System*.

Part C: Hardware, cabling and networking

Part C: Hardware cabling and networking will follow from a second enquiry after the successful contract award for *Part A: TPSCM System Software*. The scope includes the procurement and installation of hardware for the TPSCM system, with the permanent local representatives of the hardware OEM, based on the proposed architecture and equipment list from the supplier of *Part A: TPSCM System Software*. The scope of the procurement of the hardware shall include all cabling / networking between the equipment rooms and control centres.

The award of one or more contracts for *Part A: TPSCM System Software* and *Part B: Rear Projection and Front Projection System* will be based on the *Tenderer's* response to 240-170000483: *Transmission Power System Control and Monitoring Specification*. The scope of work for the contracts will be finalised as part of option selection during the *Employer's* scope ratification phase. A single contract will be placed for either the main offering for *Part A: TPSCM System Software* or the alternative offering for *Part A: TPSCM System Software*. The alternative tender will only be considered on condition of a responsive main offering for *Part A: TPSCM System Software*.

The award of a contract for *Part B: Rear Projection and Front Projection System* will be evaluated independently from that of the offering for *Part A: TPSCM System Software*.

A contract for hardware offering will be concluded after the verification process with the permanent local representatives of the hardware OEM of the proposed architecture and equipment. The procurement for the hardware will be based on a second enquiry following the *Employer's* hardware procurement policies and procedures.

Maintenance and support agreements are required from the *Contractors* for the allocated offering categories but will be concluded separately from this tender.

5.4 Skills transfer

The *Employer* considers on-job-training on a product, at the *Contractor's* premises prior to the Factory Acceptance Testing, as an optimal method of skills transfer and training on new technologies. The skills transfer shall further enhance the *Employer's* ability to actively participate in the delivery, installation, testing and commissioning of the TPSCM solution at the *Employer's* premises during the project and to deliver on the mandate of first-line support thereafter.

5.5 Parallel Operation

There shall be a soak period of at least four (4) months that shall commence once the TPSCM system is the main system. Soak period is when the TPSCM system is running without any defects under normal operating conditions as defined in section 2.2.2. of 240-170000483 *Transmission Power System Control and Monitoring Specification*. During this period there shall be at least two consecutive successful database updates and a successful disaster recovery test.

On completion of the SAT there shall be a soak period by which time a full month's active data is available in the *Historical Information System* and one (1) cycle of performance monitoring and management reports have been published. The defects period for the TPSCM solution shall commence only after *Scenario 2: New system, TPSCM, is the main system* has been reached.

6. Acceptance testing philosophy

The current COVID-19 pandemic has created challenges to the recognised best practice for Factory Acceptance Testing and Site Acceptance Testing. Travel restrictions could limit the availability of staff to be present at the *Contractor's* premises or vice versa locally on site, at the *Employer's* premises, which could result in delays. However, the preference remains for the *Employer* to be present at the *Contractor's* premises for the active execution of the Factory Acceptance Test (FAT) and the physical presence of the Contractor locally on site, at the *Employer's* premises, during the Site Acceptance Testing (SAT).

The successful completion of both the FAT and SAT is non-negotiable for the advancement to successive phases respectively in the Project Programme. Mitigation against the risks of delays due to COVID-19 pandemic shall include a bi-directional Virtual Private Network (VPN) connection for remote execution and support of the acceptance testing. A remote controllable video feed shall be available to the *Employer* on demand to observe the execution of the FAT.

The *Employer* may elect to perform more comprehensive commissioning of substations prior to commencement of the site acceptance testing at the *Employer's* premises. A maximum period of six (6) month period shall then be required during *Phase 4 – Delivery, Installation, Testing and Commissioning* and prior to commencement of *Phase 5 – Site Acceptance Test (SAT)*.

The virtualised environment used at the *Contractor's* premise during FAT shall facilitate the maintenance and support of the TPSCM system under the maintenance and support agreement.

7. Design philosophy

The high-level project scope is the procurement, design, installation and commissioning of an integrated system that includes the provision of an EMS, WAMS, GDS and OTS for the System Operator at the Primary Control Centre (PCC), Simmerpan– National Control Centre (NCC), and Secondary Control Centre (SCC), Duvha – STABNAC / System Operating and Control (SOC), control sites. The secondary control site will also fulfil the role of a Disaster Recovery site.

The single integrated solution shall be delivered with a consolidated Graphical User Interface that is inclusive of Situational Awareness analytics. The power system view of the TPSCM shall be consistent for the production, development and training environments.

The TPSCM system design philosophy shall focus on high availability, high reliability and maintenance simplicity. The design requirement shall span across the two (2) control sites, enabling the transparent switch over of the active site between the two control sites.

The continuous operating and control of the IPS requires the smooth transition from the old TEMSE system to the new TPSCM system through a period of parallel operations of the two (2) systems. This implies the duplication of the telecommunication termination equipment during the transition and parallel operations until the decommissioning of the old TEMSE system.

7.1 Energy Management System (EMS)

Application-level redundancy at both the PCC and SCC sites shall be available. Switching to any of the four (4) EMS application servers, two (2) at the PCC and two (2) at the SCC, as active master for operating and control of the IPS shall be transparent to the control centres.

Standard maintenance and support, such as the deployment of a new database, shall limit the unavailability to a single node / server at a time. The updating / upgrading of software at a single site, either the PCC or SCC, shall not reduce the redundancy and performance requirements of the TPSCM system.

Redundancy from the TPSCM to the RTEs is split between the sites through a single communication circuit from the PCC and the SCC respectively. At the sites the circuits are shared equally between the two (2) equipment rooms with communication relayed to the alternative equipment room using splitter boxes supplied by the Contractor of the TPSCM system as defined under the hardware Pricing of Options (PO). It shall be possible to terminate all communication circuits for the site in a single equipment room.

7.2 Generation Dispatch System (GDS)

The critical requirement for the GDS is to retain the deployed functionality available in the production GDS on the current system, TEMSE. The solution for the GDS shall be open to scrutiny and auditing against the regulatory framework for the local electricity supply industry.

The TPSCM specification describes the two (2) options through which the requirement can be met, namely:

- Generation Dispatch System – Replacement:

The standard GDS from the Tenderer shall provide the functionality defined in the *240-170000483: Transmission Power System Control and Monitoring Specification*.

- Generation Dispatch System – Integration:

The TEMSE GDS in production shall be integrated as part of the TPSCM delivery on the new hardware, scoped and delivered as part the TPSCM system, with the same solver or optimisation solving engine in use. The licenses and infrastructure required for the GDS migration and integration shall be delivered as part of the TPSCM system.

The *Tenderer* shall provide details on available offerings for both options. The evaluation criteria for the preferred option shall include the associated risk and the demand on resources to execute the option.

7.3 Wide Area Monitoring System (WAMS)

The seamless integration of the WAMS with the existing Phasor Measurement Units (PMUs) shall be achieved without the duplication of the telecommunication circuits to the substations. The WAMS implementation shall be a replacement of the current WAMS functionality described in the 240-170000483: *Transmission Power System Control and Monitoring Specification*, with enhanced capabilities.

The functionality available in the WAMS shall enable the TPSCM to meet the current and future requirements of the *Employer* as more renewable generation is added to the grid. The *Employer* will select from the Option Schedule WAMS functionality for deployment as part of the TPSCM solution. A migration strategy shall be considered to include additional WAMS functionality over the life cycle of the TPSCM solution.

The WAMS, through the available analytics and alarms, shall support the Situational Awareness in the control centres.

7.4 Operator Training Simulator (OTS)

The OTS shall mimic the real-time EMS, GDS and WAMS. The Graphical User Interface and Situational Awareness on the OTS operator workstations shall be identical to the operator workstations used for the operating and control of the real-time IPS. A single master database and displays shall be used in the production and simulator environments.

The OTS shall provide a robust and fair training environment for the authorisation of operators. The transition to the new OTS shall not disrupt the training program and all existing training and evaluation scenarios shall be migrated.

The end user client shall be intuitive in providing a single consistent interface to the entire TPSCM. The primary look-and-feel of the end user interface shall be defined by the operating and control functions available from the EMS. The end user client shall be open to enable the integration of third (3rd) party interfaces.

7.5 Historical Information Systems

The historical information from the EMS, GDS and WAMS shall be available in an integrated repository.

7.6 Rear Projection and Front Projection Systems

The projection system deployed shall provide an integrated Graphical User Interface for the EMS, GDS, WAMS and Historical Information System for both the real-time and training environments respectively. All analytics from the Situational Awareness shall be displayable on the projection system.

8. Deployment options

All deployment options shall meet the following requirements of the *Employer*:

- traditional classroom training shall be offered online by the *Tenderer* prior to the first (1st) installation;
- common procedures shall be available for all installations; and
- all installations will be done by the *Employer*.

8.1 Data availability

The migration of a data source to the new TPSCM, during the integration, installation and testing at the local sites of the *Employer*, shall not reduce the power system view or the operating and control availability to the operator. It shall be possible to configure TEMSE or the TPSCM as a data source to the other respectively.

8.2 Remote installations

The installation and configuration of the workstations at the RCCs shall be planned to limit the requirement for travelling. The configuration of the remote workstations shall ensure that after the installation, at the RCCs, the workstations shall be available to both TEMSE and the TPSCM for the operating and control of the IPS.

8.3 Site deployment sequence

There are two (2) sites requiring the deployment of the application servers for the TPSCM, namely the PCC and the SCC. It is the *Employer's* preference that the first installation shall be the dual redundant configuration at the PCC.

It shall be possible to commence the application functionality acceptance testing on completion of the installation at the first (1st) site, if and only if a single master configuration can completely demonstrate the functionality. All redundancy, configuration, data consistency, performance and availability testing shall require the full TPSCM installation, at both the PCC and the SCC.

Application functionality acceptance testing shall be repeated, if required, to prove replication throughout the TPSCM system.

8.4 Alternative deployment sequences

Proposed alternative deployment sequences shall mitigate the following requirements of the *Employer*:

- the upskilling of the *Employer's* staff through on job training / experience shall occur at the location closest to the employee's normal place of work;
- the installation and commissioning of the TPSCM shall not negatively impact the work required on TEMSE; and
- the continuous operation without interruption of TEMSE shall remain the focus until the primary control and operating is switched over to the TPSCM.

8.5 Deployment standards

Any modification to standard deployment procedures or scripts shall be delivered as part of *Phase 2 – Detailed Design Specification (DDS)*.

8.6 Hosting

Hosting of the TPSCM system at *Contractor's* premise for testing, upgrade and patch verification shall be available during the project and the fifteen (15) year maintenance phase of the TPSCM.

9. Project risks

9.1 Project dependencies

The TPSCM system is the main component of the delivery of the TPSCM project. The other components include (1) the installation of the telecommunication infrastructure at the PCC and SCC and (2) the provision of a data and energy centre at the SCC. The installation and commissioning of the telecommunication equipment will be done in parallel with the hardware installation.

The equipment rooms at the primary control site (PCC) are prepared and available for the installation of the TPSCM. However, there is a risk that, due to the unavailability of the data and energy centre at the SCC the deployment at the two sites will not be synchronised. Thus, the project schedule shall consider a delay between the first installation at the PCC and the second installation at the SCC.

9.2 Telecommunication migration

The Employer is in the process of migrating the telecommunication infrastructure to the Multi-Service Access Platform (MSAP). The planned completion date is the end of 2022. Thus, the TPSCM shall consider using the current TEMSE as a data source until such time that the MSAP migration is complete.

9.3 COVID-19 pandemic

The TPSCM project shall accommodate ad-hoc restrictions due to the impact of the COVID-19 pandemic. Any potential restrictions shall be communicated timeously to all parties for action within the project schedule. Proposals to deal with a restriction shall be documented for acceptance prior to implementation.

Working from home shall conform to all the *Employer's* cyber security policies and remote access standards. The TPSCM architecture shall include the infrastructure to enable the concurrent access for at least ten (10) of the *Employer's* engineers. It shall be possible to execute remote Factory Acceptance Testing securely from the *Employer's* site or from the employees' homes if the *Employer* has restricted employees to work from home.

Succession planning from the *Tenderer's* side shall be stated to ensure continuity.

9.4 Supply chain problems

The specification of hardware and equipment shall consider potential problems in the hardware and equipment supply chain. The TPSCM architecture shall consider the local availability of the hardware and equipment. Limited availability of the hardware and equipment shall not increase the number of different hardware models required.

9.5 Data and energy centre

The current data and energy centre at the SCC is not suitable for the installation of the TPSCM. The risk is being mitigated to provide a data centre with requirements specified in Tier III Server Rooms and Data Centres as per UptimeInstitute definition (<https://uptimeinstitute.com/tiers>).

10. Project timeframe and phases

An indicative timeline shall be aligned to the proposed six (6) phases of the Project Programme. (Refer to the phases defined below.) The first five (5) phases of the Project Programme shall adhere to the Engineering Process for Operational Technology.

The project plan shall allow for the migration of all the Employer's IPS data, operating data, displays and operator entered data for use during system integration and commissioning. Migration tools which shall be used during the contract phase prior to commercial operation shall ensure that the operational data in the production system TEMSE and the TPSCM stay identical. All acceptance testing shall be performed with the latest operating data and displays from the Employer.

The continuation to the next phase shall only commence upon the completion of the preceding phase and the sign-off of all deliverables. The interdependencies between the project deliverables and timeframes for the potential multiple contracts are defined in the project programmes. Three (3) project programmes are provided. The Software Project Programme is applicable to Offering 1a: Operating and Control; Offering 1b: Generation Optimisation and Offering 2: Wide Area Monitoring System. Two (2) additional project programmes are provided for Offering 4: Hardware and Cabling and Offering 3: Rear Projection and Front Projection System related requirements.

The start of *Phase 5 – Site Acceptance Test (SAT)* shall be aligned for all the project programmes.

10.1 Software Project Programme

The six (6) phases of the Project Programme are:

Phase 1 – Scope Ratification

The purpose of the phase shall be to verify and align the solution against the *Employer* specification and to conclude on the scope as per the schedules. In the process the current technology and solutions will be reviewed with the option to augment the scope in the specification. This will provide the *Employer* with the opportunity to mitigate the risk associated with potential non-delivery against the requirements and scope adjustment prior to contract placement. A schedule of compliance against the *Employer's* specification shall be produced.

The deliverable for this phase shall be the following:

- An accepted Specification for a potential contract placement.

This is an internal *Employer* process and forms part of the RFP evaluation.

Phase 2 – Detailed Design Specification (DDS)

The primary deliverable for this phase shall be the updated Detailed Design Specification for both hardware and software components of the system with special reference to cyber security requirements. This phase shall be used to agree upon a migration plan while ensuring the continuous operation of the installed system. A High Availability Configuration design shall detail the architecture and configuration of the TPSCM to meet performance criteria. The Network Design document shall provide the detail on the five (5) security levels and port configuration of the TPSCM. The Factory Acceptance Test (FAT) and Site Acceptance Test (SAT) documents shall be mapped to the specification to ensure all user requirements are met. The *Employer* shall individually approve all documents prior to the commencement of Phase 3.

The deliverables for this phase shall be:

- the Detailed Design Specification for both hardware and software components;
- the Network Design document for cyber security;
- a cyber security compliance declaration for source code;
- the System Continuity and Disaster Recovery manual for all components;
- the High Availability Configuration design for all the servers and/or functionality;
- the Factory Acceptance Test document; and
- the Site Acceptance Test document.

Phase 3 – Development, System Integration and Factory Acceptance Test (FAT)

Phase 3 shall commence on completion of Phase 2. Procedures to migrate the *Employer's* databases, displays and all operator entered data shall be verified. These procedures shall be valid even during commercial operation when the new system is in parallel operation with the old system. The pre-Factory Acceptance Test shall be performed by the *Contractor* and verified by the *Employer* to determine the accuracy of the Factory Acceptance Test documents. An option shall exist to perform the Factory Acceptance Test on the system installed on the pre-production environment. Test procedures shall also include other systems / applications which use the TPSCM system data. The FAT shall include the full TPSCM data flow.

The deliverables for this phase shall be:

- database, display and operator entered data migration procedures and scripts;
- a signed-off pre-Factory Acceptance Test report; and
- a signed-off Factory Acceptance Test report.

Phase 4 – Delivery, Installation, Testing and Commissioning

Phase 4 shall commence on completion of Phase 3. This phase shall follow the agreed upon cut-over plan. This phase is dependent on the procurement of hardware by the *Employer* after consultation and agreement with the *Contractor* of the TPSCM system. The phase consists of the delivery of the software, documentation and manuals to site for installation of the system by the *Employer* under the supervision of the *Contractor*. The sourcing of the hardware shall be a separate contract as per the policies of the *Employer*. Thereafter, the TPSCM system shall be commissioned in accordance with operating constraints of the IPS. The TPSCM system is required to operate in parallel with the existing TEMSE and WAMS systems prior to the commencement of Phase 5.

The deliverables for this phase shall be:

- system documentation in triplicate hardcopy and electronic format;
- the Implementation Report to be approved by the *Employer*; and
- a commissioned system.

The critical predecessor for this phase shall be:

- the delivery and installation of all equipment including cabling / networking and the signed off as-built diagrams thereof.

Phase 5 – Site Acceptance Test (SAT)

The commencement of this phase shall be at least two (2) weeks after the successful completion of Phase 4. This phase shall consist of performing tests according to the Site Acceptance Testing procedure and verification of database, display and operator entered data migration. The testing and verification of the TPSCM system shall cater for at least two (2) database updates and commissioning thereof. The SAT shall be on the integrated TPSCM solution using real-time data. A soak period of at least six (6) weeks shall be included where no fail-overs, database updates, no human intervention or software intervention occurs. This phase should be a maximum of 6 months. Advanced Power Network Applications shall require a freeze period of 3 months for changes where Supervisory Control and Data Acquisition (SCADA) and WAMS are fully operational with validated database and displays. Advanced Power Network Applications SAT shall not be done during any other tests. The SAT shall have the following order of execution for the offerings:

- First the accepted offering for *Package 1: System Operating and Control System with Generation Optimisation* which is either
 - Offering 1a: Operating and Control, or
 - Offering 1b: Generation Optimisation;
- Thereafter, it will be the Offering 2: Wide Area Monitoring System.

The SAT general order for the applications of *Offering 1a: Operating and Control* and *Offering 1b: Generation Optimisation* are:

- SCADA, Automatic Generation Control (AGC), GDS and Data Gateway (DGW);
- Advanced Power Network Applications;
- OTS; and
- Situational Awareness.

Other activities during this phase are:

- operating system audit and tuning of parameters;
- software application audit, evaluation and changing of vendor parameters that are accessible to users as well as non-volatile parameters; and
- an audit of all application's logs and health statuses.

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The deliverables for this phase shall be:

- signed-off Site Acceptance Testing reports indicating accepted completion of Site Acceptance Testing;
- source code for all software delivered;
- compliance audit against *240-55410927 Cyber Security Standard for Operational Technology* and cyber security section in the detailed design; and
- a handover certificate.

Phase 6 – Commercial operation

This phase shall consist of the parallel operation of old and new systems in the following order:

- Scenario 1: Old system, TEMSE is the main system
- Scenario 2: New system, TPSCM, is the main system

Thereafter the old system shall be decommissioned after completion of the *Employer's* evaluation of the stability of the TPSCM solution at the PCC and SCC.

10.2 Hardware Project Programme

The Hardware Project Programme shall commence after the submission of the acceptance of the Detailed Design Specification for both hardware and software components from the Software Project Programme. The start of for the Hardware Project Programme could be preceded with an enquiry based on the hardware requirements defined during the Software Project Programme. The applicable phases for the Hardware Project Programme are:

Phase 1 – Detailed Design Specification (DDS)

The primary deliverable for this phase shall be the updated Detailed Design Specification from the hardware OEM for the hardware of the system. A High Availability Configuration design shall detail the architecture and configuration of the TPSCM to meet performance criteria. The Network Design document shall provide the detail on the five (5) security levels and firewall configuration of the TPSCM. The SAT documents shall be mapped to the specification to ensure all user requirements are met. The *Employer* shall individually approve all documents prior to the commencement of Phase 2.

The deliverables for this phase shall be:

- the updated Detailed Design Specification for the hardware components;
- the updated Network Design document for cyber security;
- the High Availability Configuration hardware architecture; and
- the Site Acceptance Test document.

Phase 2 – Delivery, Installation, Testing and Commissioning

Phase 2 shall commence on completion of Phase 1. This phase consists of the procurement of hardware by the *Employer* after consultation and agreement with the *Contractor* of the TPSCM system and the delivery of the hardware, documentation and manuals to site for installation. The hardware shall be commissioned prior to start of *Phase 4 – Delivery, Installation, Testing and Commissioning* of the Software Project Programme.

The deliverables for this phase shall be:

- system documentation in triplicate hardcopy and electronic format;
- the Implementation Report to be approved by the Employer; and
- the commissioned hardware.

Phase 3 – Site Acceptance Test (SAT)

This phase shall commence after the approval of the Implementation Report. This phase shall consist of performing tests according to the Site Acceptance Testing procedure. Other activities during this phase are:

- an audit of all server logs and health statuses; and
- successful soak period of six (6) weeks.

The deliverables for this phase shall be:

- a signed-off Site Acceptance Testing report indicating accepted completion of Site Acceptance Testing;
- compliance audit report against 240-55410927 Cyber Security Standard for Operational Technology and cyber security section in the detailed design; and
- a handover certificate.

A successor to this phase shall be:

- the start of Phase 4 – Delivery, Installation, Testing and Commissioning of the Software Project Programme.

10.3 Rear Projection and Front Projection Project Programme

The Rear Projection and Front Projection Project Programme shall commence after the *Phase 1 – Scope Ratification* of the Software Project Programme. The applicable phases are:

Phase 1 – Detailed Design Specification (DDS)

The primary deliverable for this phase shall be the Detailed Design Specification for the rear projection system and the front projection system. A High Availability Configuration design shall detail the architecture of the rear projection system to meet the performance and availability criteria. The SAT documents shall be mapped to the specification to ensure all user requirements are met. The *Employer* shall individually approve all documents prior to the commencement of Phase 2.

The deliverables for this phase shall be:

- the Detailed Design Specification for the rear projection system and front projection system;
- the High Availability Configuration architecture for the rear projection system; and
- the Site Acceptance Test document.

Phase 2 – Delivery, Installation, Testing and Commissioning

Phase 2 shall commence on completion of Phase 1. This phase consists of the delivery, installation, testing and commissioning of the equipment, documentation and manuals on site. The equipment shall be commissioned prior to start of *Phase 5 – Site Acceptance Test (SAT)* of the Software Project Programme.

The deliverables for this phase shall be:

- system documentation in triplicate hardcopy and electronic format;
- the Implementation Report to be approved by the Employer; and
- the commissioned hardware.

Phase 3 – Site Acceptance Test (SAT)

This phase shall commence after the approval of the Implementation Report. This phase shall consist of performing tests according to the Site Acceptance Testing procedure. Other activities during this phase are:

- an audit of all rear projection system server logs and health statuses; and

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- successful soak period of six (6) weeks.

The deliverables for this phase shall be:

- a signed-off Site Acceptance Testing report indicating accepted completion of Site Acceptance Testing;
- compliance audit against *240-55410927 Cyber Security Standard for Operational Technology* and cyber security section in the detailed design; and
- a handover certificate.

The successor to this phase shall be:

- the start of Phase 5 – Site Acceptance Test (SAT) of the Software Project Programme.

Phase 4 – Commercial operation

This phase shall consist of the parallel operation of old and new systems in the following order:

- Scenario 1: Old system, TEMSE is the main system
- Scenario 2: New system, TPSCM, is the main system

The rear projection system shall project the output from both TEMSE and the TPSCM in parallel regardless of the which system is the main system. Thereafter the old system shall be decommissioned after completion of the *Employer's* evaluation of the stability of the TPSCM solution at the PCC and SCC.

11. Tender returnables (Technical)

The Tenderer's submission can consist of either Part A or Part B or both:

Part A: TPSCM System Software

Part A will consist of a main tender and an optional alternative tender. The evaluation of the alternative tender is dependent on an acceptable responsive main tender.

The **main tender**, the operating and control with generation optimisation integration offering, includes the Requirement Schedule plus *Sub-category 1: Operating and Control*, *Sub-category 2: Generation Optimisation Integration* and *Sub-category 4: Wide Area Monitoring* in the Option Schedule. The *Part A: TPSCM System Software* main tender consists of:

- Offering 1a: Operating and control with generation optimisation integration; and
- Offering 2: Wide Area Monitoring System.

The **alternative tender**, the Generation Dispatch System replacement, includes the Requirement Schedule plus *Sub-category 1: Operating and Control*, *Sub-category 3: Generation Optimisation Replacement* and *Sub-category 4: Wide Area Monitoring* in the Option Schedule. A Generation Dispatch System replacement alternative tender, as detailed in *Sub-category 3: Generation Optimisation Replacement*, can only be submitted in addition to *Part A: TPSCM System Software* main tender. The alternative tender will consist of:

- Offering 1b: Operating and Control with a replacement Generation Dispatch System; and
- Offering 2: Wide Area Monitoring System.

The hardware specification and costing, pertaining to the equipment required in support of the respective main and alternative (if applicable) tender defined above in *Part A: TPSCM System Software*, shall be provided.

Part B: Rear Projection and Front Projection System

The tender for the rear projection and front projection system will be evaluated regardless of the outcome of *Part A: TPSCM System Software*. The rear projection and front projection as a main offering shall include the project philosophy and engineering requirements defined in the Requirement Schedule and the requirements from *Sub-category 5: Rear Projection and Front Projection System*. The tender shall consist of:

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- Offering 3: Rear Projection and Front Projection System.

A *Tenderer* shall submit one or more main tenders to be considered responsive.

For all critical system functionality, *Employer* may require that the *Tenderer* confirm that they will comply prior to the offer to being accepted by *Employer*.

The technical tender returnables shall include the following:

Acceptance Schedule (AS)

The Acceptance Schedule includes the acceptance of the gatekeepers to the project and the completion thereof is mandatory. A declaration of compliance to the technical gatekeepers in 14.1 is mandatory.

Requirement Schedule (RS)

The *Tenderer* shall complete the Requirement Schedule in the documents provided and indicate detailed reference and page number / paragraph number where supporting information can be found within the tender returnables. The level of inclusion, as defined in section 2.8 of *240-170000483 Transmission Power System Control and Monitoring Specification* within the standard product, shall be indicated.

An electronic hyperlink shall be available from the electronic schedule to the specified location in the reference document. All technical documents submitted shall be provided in an electronic format and be searchable.

Option Schedule (OS)

It is mandatory to respond to all the Optional Schedules if the functional requirement is included in the offering. The Option Schedule provides various alternative implementations for the TPSCM solution. The *Employer* reserves the right to include or exclude any proposal defined within the Option Schedule.

Deviation Schedule (DS)

The *Tenderer* shall submit a formal document listing the document number and title and any deviations to the document's requirements, indicating specific section and/or clause numbers. A separate Deviation Schedule shall be compiled for each of the *Employer's* documents. The *Tenderer* shall be deemed to have claimed compliance to all clauses for which no deviations are indicated. The *Tenderer* shall indicate how the non-conformance shall be mitigated.

Questionnaire (Q)

Tenderers shall respond to questions and statements listed in the *Annexures A-D* of the *240-170000482: Overview of requirements for the Transmission Power System Control and Monitoring System*. The questionnaire requests information on the product roadmap, training offered, industry experience, skills, support and protocol interoperability.

Table 2 summarises the responses required from *Tenderers* relating to the documents for this enquiry. The symbol "X" in Table 2 indicates that a specific returnable is mandatory for the corresponding report, standard or specification. All technical documents submitted shall be provided in an electronic format and be searchable. Failure to submit any of the indicated returnables may result in a tender being excluded from the evaluation.

Table 2: List of returnables for Eskom standards/specifications

Number	Document number and Title	DS	RS	OS	AS	Q
Overview Document						
[1]	240-170000482 Overview of requirements for the Transmission Power System Control and Monitoring System	x			x	x
TPSCM Specification						
[2]	240-170000483 Transmission Power System Control and Monitoring Specification	x	x	x		
Standards						
[3]	240-55410927: Cyber Security Standard for Operational Technology	x				
[4]	32-373: Information Security - IT/OT Remote Access Standard	x				
[5]	SD-OT/0010001: Security Division Position Paper – Cloud Computing	x				
[6]	240-61478980 Eskom Slave device IEC 60870-5-101 Implementation Standard	x				
[7]	240-61478967 Eskom Master device IEC 60870-5-101 Implementation Standard	x				
[8]	240-160474571 Measurement and recording of Eskom frequency	x				
[9]	240-72942279: EMS and DMS Master Station Computer Disaster Recovery Standard	x				
[10]	240-91479924 Cyber Security Configuration Guidelines of Networking Equipment for Operational Technology	x				
[11]	240-82331576: Inter Control Centre Communications Protocol Standard	x				
National and International documents						
[12]	Tier III Data Centre as per Tier Levels https://uptimeinstitute.com/tiers	x				
[13]	IEEE C37.118.2 IEEE Standard for Synchrophasor Data Transfer for Power Systems	x				
[14]	IEEE C37.118 2005 IEEE Standard for Synchrophasor Data Transfer for Power Systems	x				
[15]	IEC 60870-5-101 Transmission protocols –Companion standard for basic telecontrol tasks	x				
[16]	IEC 60870-5-104 Transmission Protocols - Network access for IEC 60870-5-101 using standard transport profiles	x				
[17]	IEC 60870-6 Inter-Control Center Communications Protocol	x				
[18]	The South African Grid Code -The Information Exchange Code	x				
[19]	Grid Connection Code for Battery Energy Storage Facilities (BESF) connected to the electricity Transmission System (TS) or the Distribution System (DS) in South Africa	x				

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12. Price schedules and projected quantities

Provide costing while using the following breakdown as a guide. Clearly indicate any volume discounts and other relevant information. Costs shall be provided in ZAR, excluding VAT for the local portion. The foreign portion shall be indicated in the foreign currency, as per the *PS5 schedule*.

Projected quantities can be found in *240-170000483 Transmission Power System Control and Monitoring Specification*. Hardware price shall not be included in the evaluation.

12.1 Pricing Returnables

The pricing tender returnables shall include the pricing for the standard requirements, defined in the Requirement Schedule, and the optional offerings, defined in the Option Schedule.

12.1.1 Pricing Schedule (PS)

All components defined in the Requirement Schedule shall be priced individually. The *Employer* shall aggregate it as per requirement, where needed. The pricing shall be provided for all requirements as detailed in the *240-170000483 Transmission Power system Control and Monitoring Specification* and *240-170000482 Overview of requirements for the Transmission Power System Control and Monitoring System*.

Pricing schedule items shall be mapped and apportioned to the appropriate phases and milestone payments. The pricing of the hosting of FAT at the *Contractor's* premises shall be included in the individual software components.

A maximum of forty percent (40%) of the cost of the component shall be allocated to Phases 2 to 4.

Table 3: Outline for Part A pricing required for Standard Requirements (PS)

		Phase 1 – Scope Ratification	Phase 2 – Detailed Design Specification (DDS)	Phase 3 – Development, System Integration and Factory Acceptance Test (FAT)	Phase 4 – Delivery, Installation, Testing and Commissioning	Phase 5 – Site Acceptance Test (SAT)	Phase 6 – Commercial operation	Post Project Phase – Maintenance
[1]	Software Components							
[1.1]	Situational Awareness		x	x	x	x		
[1.2]	SCADA/ EMS		x	x	x	x		
[1.3]	Historical Information Systems		x	x	x	x		
[1.4]	OTS		x	x	x	x		
[1.5]	WAMS		x	x	x	x		
[1.6]	Analysers and Testers		x	x	x	x		
[1.7]	Cyber security		x	x	x	x		
[1.8]	Data Gateway		x	x	x	x		

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[1.9]	Data and Display Modelling		x	x	x	x		
[2]	Engineering							
[2.1]	Display and data migration		x	x	x			
[2.2]	System engineering and integration		x	x	x	x		
[2.3]	Commissioning and testing of ten (10) stations					x	x	
[3]	Licensing							
[3.1]	Component licensing			x	x			x
[4]	Documentation							
[4.1]	Design		x					
[4.2]	Integration			x	x	x		
[4.3]	Maintenance						x	x
[5]	Date and Time							
[5.1]	Global Positioning System (GPS)		x	x	x	x		
[6]	Hardware							
[6.1]	Analysers and Testers		x	x	x			

12.1.2 Pricing of Options (PO)

It is mandatory to respond to all optional schedules if the functional requirement is included in the offering. The Pricing of Options provides the costing for the various alternatives requested by the Employer. The Employer reserves the right to select the required options as proposed in the Option Schedule and priced in the Pricing of Options schedule.

The pricing of the licensing options shall be aligned to the component licensing defined in the PS.

All training listed in section 3.2.1.6 of the 240-170000483 Transmission Power System Control and Monitoring Specification shall be priced separately to ensure that the skills are available to commence each phase. The Tenderer is to indicate the duration and the maximum number of trainees per module.

All training from Phase 1-6 shall be required for the pricing of options. In addition, training for Post Project Phase - Maintenance will be selected as required by the Employer.

The Employer has a staff compliment of approximately thirty (30) maintenance and support engineers and hundred and ten (110) operators and controllers. For each of the categories of training, such as data and display engineering (10), data acquisition (5), network applications (5), generation optimisation (5) and WAMS (5) the approximate number of employees are indicated in brackets.

Tenderers shall recommend a spare keeping policy and shall provide a list of spares critical to ensure the continuous operation of the TPSCM as per section 3.2.1.6 of the 240-170000483 Transmission Power System Control and Monitoring Specification. Costing for the spares shall be provided in accordance with the Pricing of Options (PO) schedule.

Pricing of options schedule items shall be mapped and apportioned to the appropriate phases and milestone payments. All hardware shall be available prior to Phase 4 – Delivery, Installation, Testing and Commissioning. The maintenance agreement shall be considered in the Post Project Phase – Maintenance. The front and rear projection system shall be available any time prior to Phase 5 – Site Acceptance Test (SAT).

All other items shall be apportioned from Phase 2 to 5.

Table 4: Outline of the pricing sub-categories for the optional offerings

No.	Description	Specification Reference	Sub-Category
[1]	Maintenance Agreement		
[1.1]	Standard	3.1.1; 3.2.1.3.2;	1
[1.2]	WAMS	3.1.1	4
[1.3]	GDS (Replacement)	3.1.1	3
[1.4]	GDS (Integration)	3.1.1	2
[2]	Hardware		
[2.1]	Core	3.2.1.3.1; 3.2.5.1.5;	6
[2.2]	Cyber Security	3.2.1.3.1	6
[2.3]	Workstations and Monitors	3.2.1.3.1	6
[2.4]	Data Acquisition	3.2.1.3.1	6
[2.5]	Generation Dispatch System (Replacement)	3.2.1.3.1; 3.3.5.7;	6
[2.6]	Generation Dispatch System (Integration)	3.2.1.3.1; 3.3.5.7;	6
[2.7]	Electronic Dispatch System (Replacement)	3.2.1.3.1	6
[2.8]	Electronic Dispatch System (Integration)	3.2.1.3.1	6
[2.9]	Control Centre Wide Area Monitoring System	3.3.6.1	6
[3]	Licensing		
[3.1]	Licensing	3.2.1.3.2	1
[4]	Spares		
[4.1]	Spares	3.2.1.5.7	1
[5]	Training		
[5.1]	Training	3.2.1.6	1
[6]	Generation Dispatch System		
[6.1]	Integration	3.3.2.2; 3.3.3.2.5; 3.3.5.1.1; 3.3.5.1.2; 3.3.5.2; 3.3.5.3; 3.3.5.4.1; 3.3.5.4.2; 3.3.5.4.3; 3.3.5.5; 3.3.5.6; 3.3.5.7; 3.3.5.8;	2
[6.2]	Replacement	3.3.3.2.5; 3.3.5.1.1; 3.3.5.1.2; 3.3.5.2; 3.3.5.3; 3.3.5.4.1; 3.3.5.4.2; 3.3.5.4.3; 3.3.5.5; 3.3.5.6; 3.3.5.8;	3
[7]	Electronic Dispatch System		
[7.1]	Integration	3.3.5.9; 3.3.5.9.1; 3.3.5.9.2; 3.3.5.9.3;	2
[7.2]	Replacement	3.3.5.9; 3.3.5.9.1; 3.3.5.9.2; 3.3.5.9.3;	3
[8]	Control Centre Wide Area Monitoring System		
[8.1]	Enhancement	3.3.6.2;	4
[8.2]	Replacement	3.3.6.2; 3.3.6.3; 3.3.6.4.2; 3.3.6.5; 3.3.6.5.1; 3.3.6.5.2; 3.3.6.5.3; 3.3.6.6; 3.3.6.7; 3.3.6.4.3;	4
[8.3]	Power Quality Integration	3.3.6.4.1	4
[8.4]	Situational Awareness	3.3.2.1.1	4

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[9]	Data Gateway		
[9.1]	Generation Dispatch System (Replacement)	3.3.7.2;	3
[9.2]	Generation Dispatch System (Integration)	3.3.7.2;	2
[9.3]	Electronic Dispatch System (Replacement)	3.3.7.2.2;	3
[9.4]	Electronic Dispatch System (Integration)	3.3.7.2.2;	2
[10]	Front Projection System	3.2.1.3.1; 3.2.1.4.8; 3.2.5.1.1;	
[10.1]	SCC Alternative		5
[10.2]	NCC OTS		5
[10.3]	SCC OTS		5
[11]	Rear Projection System	3.2.1.3.1; 3.2.1.4.7;	
[11.1]	NCC		5
[11.2]	SCC		5

The phasing of the pricing for the option shall consider the allocation to the sub-category. The Pricing of Options (PO) for the sub-categories are defined below.

12.1.2.1 TPSCM Software Pricing of Option

The software Pricing of Options (PO) include the *Sub-category 1: Operating and Control; Sub-category 2: Generation Optimisation Integration; Sub-category 3: Generation Optimisation Replacement; and Sub-category 4: Wide Area Monitoring*. All phases defined in the Software Project Programme shall be considered. A maximum of the 40% of the pricing shall be allocated to the phases prior to the start of *Phase 5 – Site Acceptance Test (SAT)*.

12.1.2.1.1 Offering 1a: Operating and Control with generation optimisation integration

The Pricing of Options for *Part A: TPSCM System Software (Main)* include *Offering 1a: Operating and Control with generation optimisation integration and Sub-category 2: Generation Optimisation Integration*.

Table 5: Outline for Offering 1a pricing for the Pricing of Options (PO)

		Phase 1 – Scope Ratification	Phase 2 – Detailed Design Specification (DDS)	Phase 3 – Development, System Integration and Factory Acceptance Test (FAT)	Phase 4 – Delivery, Installation, Testing and Commissioning	Phase 5 – Site Acceptance Test (SAT)	Phase 6 – Commercial operation	Post Project Phase – Maintenance
[1]	Generation Dispatch System							
[1.1]	Integration		x	x	x	x		
[2]	Electronic Dispatch System							
[2.1]	Integration		x	x	x	x		
[3]	Data Gateway							
[3.1]	Generation Dispatch System		x	x	x	x		
[3.2]	Electronic Dispatch System		x	x	x	x		
[4]	Maintenance							
[4.1]	15-year plans (excluding 7-year hardware renewal)							
[4.1.1]	Hardware (Date and Time)							x
[4.1.2]	TPSCM solution software							x
[4.1.2.1]	Standard							x
[4.1.2.2]	GDS (Integration)							x
[4.2]	7-year hardware renewal							
[4.2.1]	Indicate any cost over and above those indicated in the fifteen (15) year plan required for the 7-year hardware renewal.							x
[5]	Licensing							
[5.1]	Component licensing			x	x			x
[6]	Training							
[6.1]	Classroom structured		x			x	x	x
[6.2]	On-the-job training			x	x	x	x	

12.1.2.1.2 Offering 1b: Operating and Control with a replacement Generation Dispatch System

A maximum of the 40% of the pricing shall be allocated to the phases prior to the start of *Phase 5 – Site Accept Test (SAT)*.

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The Pricing of Options for Part A: TPSCM System Software (Alternative), that include Offering 1b: Operating and Control with a replacement Generation Dispatch System include Sub-category 1: Operating and Control and Sub-category 3: Generation Optimisation Replacement.

Table 6: Outline for Offering 1b pricing required for the Pricing of Options (PO)

		Phase 1 – Scope Ratification	Phase 2 – Detailed Design Specification (DDS)	Phase 3 – Development, System Integration and Factory Acceptance Test (FAT)	Phase 4 – Delivery, Installation, Testing and Commissioning	Phase 5 – Site Acceptance Test (SAT)	Phase 6 – Commercial operation	Post Project Phase – Maintenance
[1]	Generation Dispatch System							
[1.1]	Replacement		x	x	x	x		
[2]	Electronic Dispatch System							
[2.1]	Replacement		x	x	x	x		
[3]	Data Gateway							
[3.1]	Generation Dispatch System		x	x	x	x		
[3.2]	Electronic Dispatch System		x	x	x	x		
[4]	Maintenance							
[4.1]	15-year plans (excluding 7-year hardware renewal)							
[4.1.1]	Hardware (Date and Time)							x
[4.1.2]	TPSCM solution software							x
[4.1.2.1]	Standard							x
[4.1.2.2]	GDS (Integration)							x
[4.2]	7-year hardware renewal							
[4.2.1]	Indicate any cost over and above those indicated in the fifteen (15) year plan required for the 7-year hardware renewal.							x
[5]	Licensing							
[5.1]	Component licensing			x	x			x
[6]	Training							
[6.1]	Classroom structured		x			x	x	x
[6.2]	On-the-job training			x	x	x	x	

12.1.2.1.3 Offering 2: Wide Area Monitoring System

The Pricing of Options for *Offering 2: Wide Area Monitoring System* include *Sub-category 4: Wide Area Monitoring*.

Table 7: Outline for Offering 2 pricing required for the Pricing of Options (PO)

		Phase 1 – Scope Ratification	Phase 2 – Detailed Design Specification (DDS)	Phase 3 – Development, System Integration and Factory Acceptance Test (FAT)	Phase 4 – Delivery, Installation, Testing and Commissioning	Phase 5 – Site Acceptance Test (SAT)	Phase 6 – Commercial operation	Post Project Phase – Maintenance
[1]	Control Centre Wide Area Monitoring System (WAMS)							
[1.1]	Enhancement		x	x	x	x		
[1.2]	Replacement		x	x	x	x		
[1.3]	Power Quality Integration		x	x	x	x		
[1.4]	Situational Awareness		x	x	x	x		
[2]	Maintenance							
[2.1]	15-year plans (excluding 7-year hardware renewal)							
[2.1.1]	TPSCM solution software							x
[2.1.1.1]	WAMS							x
[2.2]	7-year hardware renewal							
[2.2.1]	Indicate any cost over and above those indicated in the fifteen (15) year plan required for the 7-year hardware renewal.							x
[3]	Licensing							
[3.1]	Component licensing			x	x			x
[4]	Training							
[4.1]	Classroom structured		x			x	x	x
[4.2]	On-the-job training			x	x	x	x	

12.1.2.2 Hardware Pricing of Option

The hardware Pricing of Options (PO) include the *Sub-category 6: Hardware*. All phases defined in the Hardware Project Programme shall be considered. A maximum of the 80% of the pricing shall be allocated to the phases prior to the start of *Phase 3 – Site Acceptance Test (SAT)*. The recommended hardware from the *Tenderer* shall be evaluated as part of this enquiry but will form the bases for specification for a subsequent second hardware enquiry.

The *Employer* shall consider equivalent hardware as currently specified as representative for the 7-year hardware renewal pricing.

The hardware Pricing of Options (PO) for *Offering 1a: Operating and Control with generation optimisation integration; Offering 1b: Operating and Control with replacement Generation Dispatch System* and *Offering 2: Wide Area Monitoring System* is defined below.

12.1.2.2.1 Offering 1a: Operating and Control with generation optimisation integration

The hardware for *Offering 1a: Operating and Control with generation optimisation integration* includes the hardware for the offered operating and control system and the hardware required for the migrated Generation Dispatch System (GDS).

Table 8: Outline for Offering 1a hardware pricing required for the Pricing of Options (PO)

		Phase 1 – Detailed Design Specification (DDS)	Phase 2 – Delivery, Installation, Testing and Commissioning	Phase 3 – Site Acceptance Test (SAT)	Post Project Phase – Maintenance
[1]	Hardware				
[1.1]	Core	x	x	x	
[1.2]	Cyber Security	x	x	x	
[1.3]	Workstations and Monitors	x	x	x	
[1.4]	Data Acquisition	x	x	x	
[1.5]	Generation Dispatch System (Integration)	x	x	x	
[1.6]	Electronic Dispatch System (Integration)	x	x	x	
[2]	Maintenance				
[2.1]	15-year plans				
[2.1.1]	Hardware				
[2.1.2.1]	Core				x
[2.1.2.2]	Cyber Security				x

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[2.1.2.3]	Workstations and Monitors				x
[2.1.2.4]	GDS (Integration)				x
[2.1.2.5]	EDS (Integration)				x
[3]	Spares				
[3.1]	Recommended spares				x

12.1.2.2.2 Offering 1b: Operating and Control with a replacement Generation Dispatch System

The hardware for *Offering 1b: Operating and Control with a replacement Generation Dispatch System* includes the hardware for the offered operating and control system and the hardware required for the replacement Generation Dispatch System (GDS).

Table 9: Outline for Offering 1b hardware pricing required for the Pricing of Options (PO)

		Phase 1 – Detailed Design Specification (DDS)	Phase 2 – Delivery, Installation, Testing and Commissioning	Phase 3 – Site Acceptance Test (SAT)	Post Project Phase – Maintenance
[1]	Hardware				
[1.1]	Core	x	x	x	
[1.2]	Cyber Security	x	x	x	
[1.3]	Workstations and Monitors	x	x	x	
[1.4]	Data Acquisition	x	x	x	
[1.5]	Generation Dispatch System (Replacement)	x	x	x	
[1.6]	Electronic Dispatch System (Replacement)	x	x	x	
[2]	Maintenance				
[2.1]	15-year plans				
[2.1.1]	Hardware				
[2.1.2.1]	Core				x
[2.1.2.2]	Cyber Security				x
[2.1.2.3]	Workstations and Monitors				x
[2.1.2.4]	GDS (Replacement)				x
[2.1.2.5]	EDS (Replacement)				x
[3]	Spares				
[3.1]	Recommended spares				x

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12.1.2.2.3 Offering 2: Wide Area Monitoring System

The hardware for *Offering 2: Wide Area Monitoring System* includes the hardware for the offered Wide Area Measurement System (WAMS).

Table 10: Outline for Offering 2 hardware pricing required for the Pricing of Options (PO)

		Phase 1 – Detailed Design Specification (DDS)	Phase 2 – Delivery, Installation, Testing and Commissioning	Phase 3 – Site Acceptance Test (SAT)	Post Project Phase – Maintenance
[1]	Hardware				
[1.1]	Control Centre Wide Area Monitoring System	x	x	x	
[2]	Maintenance				
[2.1]	15-year plans				
[2.1.1]	Hardware				
[2.1.2.1]	Control Centre WAMS				x
[3]	Spares				
[3.1]	Recommended spares				x

12.1.2.3 Rear Projection and Front Projection Pricing of Option

The rear project and front projection Pricing of Options (PO) include the *Sub-category 5: Rear Projection and Front Projection*. All phases defined in the Rear Projection and Front Projection Project Programme shall be considered. A maximum of the 80% of the pricing shall be allocated to the phases prior to the start of *Phase 3 – Site Acceptance Test (SAT)*.

Table 11: Outline for Part B pricing required for the Pricing of Options (PO)

		Phase 1 – Detailed Design Specification (DDS)	Phase 2 – Delivery, Installation, Testing and Commissioning	Phase 3 – Site Acceptance Test (SAT)	Phase 4 – Commercial operation	Post Project Phase – Maintenance
[1]	Front Projection System					
[1.1]	SCC	x	x	x		
[1.2]	NCC OTS	x	x	x		
[1.3]	SCC OTS	x	x	x		
[2]	Rear Projection System					
[2.1]	NCC	x	x	x		
[3]	Engineering					
[3.1]	System engineering and integration		x			
[4]	Maintenance					
[4.1]	15-year plans					
[4.1.1]	Rear Projection System					
[4.1.1.1]	NCC					x
[5]	Spares					
[3.1]	Recommended spares					x
[6]	Licensing					
[6.1]	Component licensing		x			x

12.2 Engineering fees

Engineering fees shall be apportioned to the project phases defined in section 10. *Project timeframe and phases* and detailed in *Table 3: Outline for Part A pricing required for Standard Requirements (PS)* and *Table 11: Outline for Part B pricing required for the Pricing of Options (PO)*.

Each phase of product development shall include as an embedded cost, product-related skills development of *Employer’s* appointed product custodians as reasonably required for the *Employer* to accept sign-off of each phase. The product training shall be of an advanced/expert level and shall cover the products, installation and maintenance. Skills development shall be undertaken as on job training both at the *Contractor’s* premises and at the *Employer’s* local premises.

System engineering and integration (including testing) shall be priced as a total figure based on an hourly rate and including a provisional number of hours. Additional hours using the hourly rate may be negotiated as required by the *Employer*. The same shall apply for Display and data migration; and Commissioning and testing of ten (10) stations.

The *Employer* will not offer payment for the establishment of manufacturing and testing facilities at the *Contractor's* premises or that of a sub-contractor, or for the supply of engineering software that is required for the configuration and management of the solution. These items, where costs are applicable, shall be absorbed into the product prices under software in the Pricing Schedule.

The *Employer* reserves the right to witness the factory acceptance tests at no charge from the *Contractor*.

13. Tender Responsiveness

The submission of a responsive tender shall include one (1) or more of the following parts:

Part A: TPSCM System Software

A responsive tender for *Part A: TPSCM System Software* shall include the recommended hardware for the solution.

Main Tender

- Offering 1a: Operating and Control with generation optimisation integration
(Requirement Schedule – 70% : Optional Schedule – 30%)
- Offering 2: Wide Area Monitoring System;
(Optional Schedule – 100%)

with or without the Alternative Tender of

- Offering 1b: Operating and Control with a replacement Generation Dispatch System
(Requirement Schedule – 50% : Optional Schedule – 50%)
- Offering 2: Wide Area Monitoring System.
(Optional Schedule – 100%)

Part B: Rear Projection and Front Projection System

- Offering 3: Rear Projection and Front Projection.
(Requirement Schedule – 30% : Optional Schedule – 70%)

Compliance to the common requirements between the offerings shall be completed individually for the main tender and alternative tender. The weighting for the technical evaluation between the Requirement Schedule and Optional Schedule is indicated in brackets above. The *Employer* will only select *Offering 1b: Operating and Control with a replacement Generation Dispatch System* from the *Tenderer*, if *Offering 1a: Operating and control with generation optimisation integration* is considered responsive.

14. Tender evaluation (Technical)

This section details the methodology to be employed by the *Employer* in scoring the “Technical” category of the tender evaluation.

The *Tenderer* shall state the scope of the main offering.

Each tender shall pass all technical gatekeeper criteria as listed in *14.1 Gatekeepers*. Tenders not meeting any of the technical gatekeepers shall be immediately excluded from further evaluation and shall be assigned a technical score of 0%.

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Tenders which pass the technical gatekeepers shall be adjudicated on a score out of 100% for the main offering. The weighting is made up of scoring in three (3) categories:

- Requirement Schedule plus Option Schedule (Weight = 70%)
- Project Execution (Weight = 10%)
- Risk and Support (Weight = 20%)

The weighted scoring for the technical evaluation of *Part A: TPSCM System Software* and *Part B: Rear Projection and Front Projection System* is summarised in the following three (3) tables.

Table 12: Weighted Scoring for Part A: TPSCM System Software (Main Tender)

Category	Percentage		
Technical			70%
Offering 1a: Operating and control with generation optimisation integration		80%	
Requirement Schedule:		70%	
Specification	80%		
Hardware	20%		
Option Schedule:		30%	
Sub-category 1: Operating and Control	20%		
Sub-category 2: Generation Optimisation Integration	60%		
Hardware	20%		
Offering 2: Wide Area Monitoring System		20%	
Option Schedule:		100%	
Sub-category 4: Wide Area Monitoring			
Projection Execution			10%
Risk and Support			20%

Table 13: Weighted Scoring for Part A: TPSCM System Software (Alternative Tender)

Category	Percentage		
Technical			70%
Offering 1b: Operating and Control with a replacement Generation Dispatch System		80%	
Requirement Schedule:		60%	
Specification	80%		
Hardware	20%		
Option Schedule:		40%	
Sub-category 1: Operating and Control	20%		
Sub-category 3: Generation Optimisation Replacement	60%		
Hardware	20%		
Offering 2: Wide Area Monitoring System		20%	
Option Schedule:		100%	
Sub-category 4: Wide Area Monitoring			
Projection Execution			10%
Risk and Support			20%

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Table 14: Weighted Scoring for Part B: Rear Projection and Front Projection

Category	Percentage		
Technical			70%
Offering 3: Rear Projection and Front Projection System		100%	
Requirement Schedule:		30%	
Specification	80%		
Hardware	20%		
Option Schedule:		70%	
Sub-category 5: Rear Projection and Front Projection	100%		
Projection Execution			10%
Risk and Support			20%

Cross referencing from the compliance schedules (Requirement Schedule and Option Schedule) to the supporting documents shall provide hyperlinks to the specific section/s within a document for ease of navigation between documents. Alternatively, a description in support of the functionality requested shall be included in the compliance schedules. Please note negative scoring will result if the supporting hyperlinks or descriptions do not refer directly to specific functionality requested in the compliance statements.

The detailed methodologies for scoring in each sub-category in the tenders are provided below.

14.1 Gatekeepers

14.1.1 Field proven solution

The *Tenderer* shall provide references of customers with comparable size and functionality for which product implementation and full replacement, or upgrades have been done. The reference customer should have completed at least one hardware replacement or system upgrade for *Offering 1a: Operating and Control with generation optimisation integration* or *Offering 1b: Operating and Control with a replacement Generation Dispatch System*. At least one reference customer should have been using the system for more than ten (10) years. The *Tenderer* shall provide supporting documentation to confirm that *Offering 2: Wide Area Monitoring System* shall follow the same life cycle management as *Offering 1a: Operating and Control with generation optimisation integration* or *Offering 1b: Operating and Control with a replacement Generation Dispatch System*.

14.1.2 Maintenance and support

A maintenance agreement for the TPSCM system components shall be available from the *Contractor* for the continuous support and upgrade of the solution. The maintenance agreement shall provide an evolutionary roadmap such that no component of the TPSCM solution shall reach a state of end-of-line or unsupported.

The *Employer* shall provide the first (1st) line support. The *Employer* shall deploy and utilise third (3rd) party tools to facilitate this function. The *Tenderer's* concern with the *Employer's* skills and knowledge base for first (1st) line support shall be addressed through suggesting and offering suitable training.

The specification of such an agreement is summarised in *Annex C – Maintenance and Support Requirements*. *Tenderers* shall provide supporting documents to motivate compliance.

14.2 Requirement Schedule

This section shall comprise scoring of the technical schedules for the main engineering, functional and project requirements in the Requirement Schedule. All items will be scored to ensure the completeness of the TPSCM solution. Noncompliance risks and major deviations to scored items shall be addressed under *14.5 Risk and support*.

The Requirement Schedule uses a default value of 1 for each scored item without supporting references. Each item will be assigned a score by the *Employer's* evaluation team based upon the tendered response and cross-checked with the supporting documents provided.

Table 15: Scoring of items in the Requirement Schedule

Criteria	Score
Fully compliant	3
Partially compliant (minor deviation)	1
Non-compliant (major deviation)	-4

All scores for the Requirement Schedule will be tallied and a percentage shall be calculated based on the maximum possible score per sub-category. This will be recorded as the percentage score per sub-category. The scores per sub-category in turn will be weighted to obtain an overall score for the TPSCM solution main offering.

14.2.1 Part A: TPSCM System Software

Part A: TPSCM System Software is the core functionality and design required for the TPSCM solution. It includes the *Employer's* operational and process requirement. The engineering requirements include the design and testing of the solution. The primary cyber security requirements for the TPSCM solution are defined.

The data integrity is managed as part of the System Configuration Management.

The core functionality required for the operating and control of the Interconnected Power System include the Energy Management System (EMS), Operating Training Simulator (OTS), and the associated graphical user interfaces. The data exchange and storage within the TPSCM are defined in the Data Gateway and the Historical Information System.

If the operating and control is offered without an integrated Generation Dispatch, the integration to the migrated to the *Employer's* Generation Dispatch solution shall be offered.

Table 16: Percentage weight of requirement specifications in Part A scoring

No.	Requirement	Weight
1	Engineering Requirements (Design, Process, Testing and Operational)	15%
2	Cyber Security Requirements	15%
3	System Configuration Management	10%
4	Graphical User Interface	10%
5	Energy Management System (EMS)	20%
6	Operating Training Simulator (OTS)	10%
7	Data Gateway	10%
8	Historical Information System	10%
	Total	100 %

14.2.2 Hardware

The *Hardware* includes all the requirements related to the servers, networking equipment and workstations in the TPSCM system software solution. The evaluation of the proposed / recommended hardware shall contribute twenty percent (20%) to the scoring for the Requirement Schedule and eighty percent (80%) shall be allocated to the software requirements. The percentage weight between the operating and control and the Wide Area Monitoring System offerings are eighty percent (80%) and twenty percent (20%), respectively.

The procurement of the hardware will be through a separate contract and will include the cabling /network between the equipment rooms, offices and control centres plus the installation and commissioning with the operating systems, where applicable, of the equipment in the equipment rooms and offices.

14.2.3 Part B: Rear Projection and Front Projection System

Part B: Rear Projection and Front Projection System standard requirements include the non-technology specific and cyber security requirements for the projection systems in the TPSCM solution. The percentage weight for the Requirement Schedule allocation for the rear projection and front projection system is defined for the engineering requirements such as system design and implementation. It also evaluates the solution against the cyber security requirements defined. These requirements will be evaluated specifically against the rear projection and front projection offering.

Table 17: Percentage weight of requirement specifications in Part B scoring

No.	Requirement	Weight
1	Engineering Requirements (Design, Process, Testing and Operational)	70%
2	Cyber Security Requirements	30%
	Total	100 %

14.3 Option schedule

This section shall comprise scoring of the technical schedules for the project requirements in the Option Schedule. All items will be scored to ensure the completeness of the TPSCM solution. Noncompliance risks and major deviations to scored items shall be addressed under *14.5 Risk and support*.

The *Option Schedule* uses a default value of 1 for each scored item without supporting references. Each item will be assigned a score by the *Employer’s* evaluation team based upon the tendered response and cross-checked with the supporting documents provided.

Table 18: Scoring of items in the Option Schedule

Criteria	Score
Fully compliant	3
Partially compliant (minor deviation)	1
Non-compliant integration (major deviation)	-1
Non-compliant replacement (major deviation)	-4

All scores for the Option Schedule will be tallied and a percentage shall be calculated based on the maximum possible score per sub-category. This will be recorded as the percentage score per sub-category. The scores per sub-category in turn will be weighted to obtain an overall score for the TPSCM solution.

The *Employer* reserves the right to select for implementation the best alternative for the sub-category.

The weight allocation within each sub-category for the options are detailed below.

14.3.1 Part A: TPSCM System Software

The sub-categories weights for Part A: TPSCM System Software for the tenders are:

Main Tender

- Offering 1a: Operating and Control with generation optimisation integration
 - Sub-category 1: Operating and Control
 - Sub-category 2: Generation Optimisation Integration

- Hardware evaluation
- Offering 2: Wide Area Monitoring System
 - Sub-category 4: Wide Area Monitoring

Alternative Tender

- Offering 1b: Operating and Control with replacement Generation Dispatch System
 - Sub-category 1: Operating and Control
 - Sub-category 2: Generation Optimisation Replacement
 - Hardware evaluation
- Offering 2: Wide Area Monitoring System
 - Sub-category 4: Wide Area Monitoring

14.3.1.1 Sub-category 1: Operating and Control

The option for a Maintenance Agreement – Standard, see *Table 4: Outline of the pricing sub-categories for the optional offerings above*, shall be included in options for the *Sub-category 1: Operating and Control*. The technical evaluation for the optional Licensing, Spares and Training shall also be included the *Sub-category 1: Operating and Control*.

Table 19: Percentage weight of options in Sub-category 1 scoring

No.	Requirement	Weight
1	Maintenance Agreement	65%
2	Licensing	10%
3	Spares	10%
4	Training	5%
5	Graphical User Interface	10%
	Total	100 %

14.3.1.2 Sub-category 2: Generation Optimisation Integration

The integration option associated with the main tender for *Part A: TPSCM System Software*.

Table 20: Percentage weight of options in Sub-category 2 scoring

No.	Requirement	Weight
1	Generation Dispatch System	50%
1.1	Integration	
2	Electronic Dispatch System	20%
2.1	Integration	
3	Data Gateway	20%
3.1	Generation Dispatch System (Weight = 10%)	
3.1.1	Integration	
3.2	Electronic Dispatch System (Weight = 10%)	
3.2.1	Integration	

No.	Requirement	Weight
4	Maintenance Agreement	10%
4.1	Integration	
	Total	100 %

14.3.1.3 Sub-category 3: Generation Optimisation Replacement

The replacement Generation Dispatch System option associated with the alternative tender for *Part A: TPSCM System Software*.

Table 21: Percentage weight of options in Sub-category 3 scoring

No.	Requirement	Weight
1	Generation Dispatch System	50%
1.1	Replacement	
2	Electronic Dispatch System	20%
2.1	Replacement	
3	Data Gateway	20%
3.1	Generation Dispatch System (Weight = 10%)	
3.1.1	Replacement	
3.2	Electronic Dispatch System (Weight = 10%)	
3.2.1	Replacement	
4	Maintenance Agreement	10%
4.1	Replacement	
	Total	100 %

14.3.1.4 Sub-category 4: Wide Area Monitoring

The weight for the components defined for the Wide Area Monitoring System in the options of the *Sub-category 3: Wide Area monitoring* are defined below.

Table 22: Percentage weight of options in Sub-category 3 scoring

No.	Requirement	Weight
1	Enhancement	15%
2	Replacement	60%
3	Power Quality Integration	5%
4	Situational Awareness	20%
	Total	100 %

14.3.2 Hardware

All options defined in *Sub-category 6: Hardware* are aligned to the Pricing Schedule categories. The hardware weighting shall contribute twenty percent (20%) towards the rating for the Option Schedule of the main and alternative tender.

14.3.3 Part B: Rear Projection and Front Projection

14.3.3.1 Sub-category 6: Rear Projection and Front Projection System

The weight allocation for the *Sub-category 5: Rear Projection and Front Projection System* is defined below.

Table 23: Percentage weight of options in Sub-category 5 scoring

No.	Requirement	Weight
1	Rear Projection System	60%
2	Front Projection System	10%
3	Maintenance Agreement	15%
4	Spares	5%
5	Training	5%
6	Licensing	5%
7	Rear Projection System	60%
	Total	100 %

14.4 Project execution

To facilitate the successful project execution the *Employer* shall consider the alignment of the Tenderer with the Eskom Values. The submission of the compliance certificates is required as part of the tender document. The weight allocation for the Project Execution is defined below.

Table 24: Percentage weight for the Project Execution scoring (Part A)

No.	Requirement	Weight
1	Compliance declaration	80%
1.1	Cyber Security Compliance	40%
1.2	Protocol Compliance	15%
1.3	IEC 60870-5-104 (Annex D)	15%
1.4	ICCP / IEC 60870-6-503 (Annex D)	15%
1.5	IEEE C37.118 (Annex D)	15%
2	Eskom Values	20%
	Total	100 %

Table 25: Percentage weight for the Project Execution scoring (Part B)

No.	Requirement	Weight
1	Cyber security Compliance declaration	50%
2	Eskom Values	50%
	Total	100 %

14.4.1 Compliance declaration

The *Tenderer* shall submit the following with this tender:

- 1) A cyber security compliance declaration indicating the special actions and consideration that is in place to prevent the inclusion of backdoors in the source code.

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- 2) The protocol interoperability, defined in Annex D – Protocol interoperability, excludes the special usage of the protocol as stated in the 240-170000483 Transmission Power System Control and Monitoring Specification. Tenderer's shall provide supporting documents to motivate compliance.

14.4.2 Eskom Values

The *Tenderer's* submission shall be compared against the *Employer's* values:

Zero Harm: Eskom will strive to ensure that zero harm befalls its employees, contractors, the public and the natural environment.

Integrity: Honesty of purpose, conduct and discipline in action, and respect for people.

Innovation: Value-adding creativity and results-oriented. Leading through excellence in innovation.

Sinobuntu: We are caring.

Customer Satisfaction: A commitment to meet and strive to exceed the needs of the receivers of products and services.

Excellence: Acknowledged by all for exceptional standards, performance, and professionalism.

14.5 Risk and support

The *Employer* shall consider the risks to the successful project completion, solution integration and ongoing solution support post project by considering the deviation schedule, project risks questionnaire and the system sustainability questionnaire. The weight allocation for Risk and Support is defined below.

Table 26: Percentage weight for Risk and Support scoring

No.	Requirement	Weight
1	Deviation Schedule (DS)	50%
2	Project Requirements Questions (Annex A)	25%
3	System Sustainability Questions (Annex B)	25%
	Total	100 %

The Risk and Support Schedule score shall be as per the as per the table below.

Table 27: Scoring of items under Risk and Support Schedule

Criteria	Score
Low risk	100%
Acceptable risk	80%
High risk	40%
Unacceptably high risk	0%

14.5.1 Deviation Schedule (DS)

A response needs to be provided for each of the standards or documents as outlined in *Table 2: List of returnables for Eskom standards/specifications*. A non-submission of a Deviation Schedule (DS) required as per *Table 2* will negatively impact the scoring for the DS component of the Risk and Support.

The *Tenderer* shall claim a noncompliance to any deviation to clauses and schedules in this tender in the DS. A noncompliance to the Acceptance Schedule (AS) is not permissible.

To assess the risk of non-compliance, supporting clauses and mitigation plans shall be provided with the DS. A single statement of no deviation is considered as a high risk to the project.

Deviation Schedule Scoring – A narrative compiled by the Eskom Technical evaluation team, summarising major non-conformances to the standards/specifications, and excessive or re-occurring minor non-conformances between solutions. This summary shall be used to assign a product risk score as per *Table 27: Scoring of items under Risk and Support Schedule*.

14.5.2 Project Requirements Questionnaire (Annex A)

This following is considered in this section industry experience; local representation; the product roadmap; training and local support.

A score is derived from responses to questions in *Annex A*. Scoring per question shall be assigned as per *Table 27: Scoring of items under Risk and Support Schedule*. A total score shall be compiled per section, then weighted as defined below.

Table 28: Percentage weight for the Project Requirements Questionnaire scoring

No.	Requirement	Weight
1	Product Roadmap	15%
2	Training Offered	15%
3	Skills and Support	15%
4	Industry Experience	40%
5	Engineering Methodology	15%
	Total	100 %

14.5.3 System Sustainability Questionnaire (Annex B)

This following is considered with regards to sustaining the solution post project: local representation; expertise and support; management of configuration and cyber security risks, incidents, and post incident support; and system maintenance and upgrade.

A score is derived from responses to questions in *Annex B*. Scoring per question shall be assigned as per *Table 27: Scoring of items under Risk and Support Schedule*. A total score shall be compiled per section, then weighted as defined below.

Table 29: Percentage weight for the System Sustainability Questionnaire scoring

No.	Requirement	Weight
1	General	20%
2	Configuration Management and Cyber Security	20%
3	Expertise and Support	40%
4	System Maintenance and Upgrade	20%
	Total	100 %

15. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Gav Hurford	Senior Manager National Control
Isabel Fick	General Manager System Operator

16. Revisions

Date	Rev	Compiler	Remarks
April 2022	1	R. Botha	An overview document is required for the TPSCM system solution.

17. Development team

The following people were involved in the development of this document:

- Geoffrey Ive
- Ian Naicker
- Johan Botha
- Karen Adendorff
- Marius Roets
- Mary Mammen
- Rosalette Botha

18. Acknowledgements

Not applicable.

Annex A – Project Requirements

This annexure shall be completed by *Tenderers* and included as part of the tender submission.

Part A Questionnaire

This part of the annexure shall be completed by *Tenderers* for *Part A: TPSCM System Software* and included as part of the tender submission.

1 Product roadmap

- a) Provide the product roadmap/s for the proposed solution, over the next five (5) years.
- b) Describe the product development approach, including customer involvement.

2 Training offered

- a) Provide details on the initial knowledge and skills required by the *Employer* to participate in *Part A - TPSCM System Software* (if tendered) for:
 - Phase 3 – Development, System Integration and Factory Acceptance Test (FAT) of the Software Project Programme; and
 - Creation of the migration procedures and scripts for the *Employer's* data and displays.
- b) Provide a list of specialised training recommended for active participation of the *Employer* in the project and the first-line maintenance and support.

3 Skills and Support

- a) How many employees are employed by the company locally in South Africa?
 - Engineering management
 - Engineering design
 - Technical support
 - Quality
 - Production
 - Installation & commissioning
 - Finance

4 Industry Experience

- a) Give a brief summary of your present range of equipment and services available.
- b) Briefly describe the nature of your resources in the Republic of South Africa e.g. workshop; design; equipment development; testing; and production facilities etc.
- c) Provide information on challenges, additional functionalities, or improvements to Energy Management Systems, Wide Area Monitoring Systems, Generation Dispatch Systems, and Operator Training Simulator (OTS) technology that you have identified as being beneficial or crucial to this tender based on your implementation experience. Align additional responses, where feasible, to the section titles in the 240-170000483: Transmission Power System Control and Monitoring Specification.
- d) State what experience you have had with projects involving the implementation of Energy Management Systems, Wide Area Monitoring Systems, Generation Dispatch Systems, and Operator Training Simulator (OTS).

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- e) Provide comparable sized project experience references:
- State the customer names that you have delivered services to during the past five (5) years.
 - List and describe the number of projects that are currently in progress and/planned to start through 2022 to 2023.
 - Provide customer references indicated above.
 - Provide the original and actual delivery dates of the projects listed above.
 - Where applicable, provide the major reasons for project completion delays, that is where handover was delayed for more than six (6) months from the original schedule.
- f) State your level of adherence to International Engineering Standards.

5 Engineering Methodology

The project shall be executed according to a defined project schedule made up of six (6) phases, which are governed by the procedures defined 240-95401790 *Reference Project Life Cycle Model Standard*. Tenderer to indicate compliance or non-compliance.

Part B Questionnaire

This part of the annexure shall be completed by *Tenderers* for *Part B: Rear Projection and Front Projection* and included as part of the tender submission.

1 Product roadmap

- a) Provide the product roadmap/s for the proposed solution, over the next five (5) years.
- b) Describe the product development approach, including customer involvement.

2 Training offered

- a) Provide details on the initial knowledge and skills required by the *Employer* to participate in *Part B: Rear Projection and Front Projection* for:
- *Phase 2 – Delivery, Installation, Testing and Commissioning* of the Rear Projection and Front Projection Project Programme.
- b) Provide a list of specialised training recommended for active participation of the *Employer* in the project and the first-line maintenance and support.

3 Skills and Support

- a) How many employees are employed by the company locally in South Africa?
- Engineering management
 - Engineering design
 - Technical support
 - Quality
 - Production
 - Installation & commissioning
 - Finance

4 Industry Experience

- a) Give a brief summary of your present range of equipment and services available.
- b) Briefly describe the nature of your resources in the Republic of South Africa e.g. workshop; design; equipment development; testing; and production facilities etc.
- c) Provide comparable sized project experience references:
 - State the customer names that you have delivered services to during the past five (5) years.
 - List and describe the number of projects that are currently in progress and/planned to start through 2022 to 2023.
 - Provide customer references indicated above.
 - Provide the original and actual delivery dates of the projects listed above.
 - Where applicable, provide the major reasons for project completion delays, that is where handover was delayed for more than six (6) months from the original schedule.
- d) State your level of adherence to International Engineering Standards.

5 Engineering Methodology

The project shall be executed according to a defined project schedule made up of six (6) phases, which are governed by the procedures defined 240-95401790 *Reference Project Life Cycle Model Standard*. Tenderer to indicate compliance or non-compliance.

Annex B – System Sustainability Questionnaire

Part A Questionnaire

This part of the annexure shall be completed by *Tenderers* for *Part A: TPSCM System Software* and included as part of the tender submission.

1 General

- a) *Tenderer's* shall have a permanent local representative in the Republic of South Africa with a minimum ten (10) year presence in the country. *Tenderer* to indicate compliance or non-compliance.
- b) Provide examples of projects both local and international, indicating the year and customer name in which integration of a Generation Dispatch System (GDS) comparative to this tender was achieved.
- c) Provide examples of projects both local and international, indicating the year and customer name in which integration of a Wide Area Monitoring System (WAMS) comparative to this tender were achieved.
- d) Local representatives shall be used for third (3rd) party products in the TPSCM solution where a permanent local office exists in the Republic of South Africa. Where a permanent local office exists for third (3rd) party products, the *Employer* reserves the right to enter into direct agreements with the third (3rd) party, thus limiting sub-contracting. *Tenderer* to indicate compliance or non-compliance.

2 Configuration management and cyber security

- a) The *Tenderer* shall provide details on how cyber security risks are addressed and managed. The *Tenderer* shall provide information on their responsibility to prevent a cyber security incident and post-event support.
- b) The *Tenderer* shall indicate how change management applies to modifications and bug fixes during the project.
- c) The *Tenderer* shall indicate the requirements to have secure ICCP implemented.

3 Expertise and support

- a) Provide the following profile details for all senior technical staff that will be involved in the development and support of any contract resulting from this enquiry. Curriculum Vitae (CVs) of these staff members shall be submitted as part of the enquiry. Abridged (maximum 5-page) CVs are preferred:
 - Name (Please note that identification, such as passport, will be required for access control to the Employer's premisses, on contract placement.)
 - Field(s) of expertise as per the sub-categories defined for the technical evaluation.
 - Area(s) of speciality such as design, configuration, tuning, resting and commissioning.
 - Years experience in above categories (total)
 - Years experience in above categories (with *Tenderer's* South African office)
 - Highest qualification
 - Professional registration.
- b) Provide a summary of the *Tenderer's* history in Southern Africa, providing specific details with regards to contracts of this nature and size.
- c) Provide examples of similar contracts in scope and size in the world market and specifically in Southern Africa.

-
- d) Describe relevant testing facilities in the Republic of South Africa that the Tenderer plans to utilise for this project.
- e) Describe the activities which may be undertaken by the permanent local office.

4 System maintenance and upgrade

- a) Identify all maintenance tasks which will be required to be undertaken on the system on a scheduled basis, as well as indicating the intervals of such maintenance.
- b) Identify all sub-systems or components of the system for which replacement prior to the mid-cycle hardware replacement is recommended. The recommendation should be justified with supporting documentation.
- c) Provide an overview of system testing and validation functions provided to enable the Employer to perform sub-system or component upgrades.
- d) Provide details on any testing aids which are envisaged to be used during the Factory Acceptance Testing or Site Acceptance Testing.

Part B Questionnaire

This part of the annexure shall be completed by *Tenderers* for *Part B: Rear Projection and Front Projection System* and included as part of the tender submission.

1 General

- a) *Tenderer's* shall have a permanent local representative in the Republic of South Africa with a minimum five (5) year presence for supply and support of the front projection and rear projection systems. Advanced-level support for shall be available from the South African office on all tendered products for the duration of the contract and a post-project maintenance and support agreement. *Tenderer* to indicate compliance or non-compliance.
- b) Local representatives shall be used for third (3rd) party products in the TPSCM solution where a permanent local office exists in the Republic of South Africa. Where a permanent local office exists for third (3rd) party products, the *Employer* reserves the right to enter into direct agreements with the third (3rd) party, thus limiting sub-contracting. *Tenderer* to indicate compliance or non-compliance.

2 Configuration management and cyber security

- a) The *Tenderer* shall provide detail how cyber security risks are addressed and managed. The *Tenderer* shall provide information on their responsibility to prevent a cyber security incident and post-event support.
- b) The *Tenderer* shall indicate how change management applies to modifications and bug fixes during the project.

3 Expertise and support

- a) Provide the following profile details for all senior technical staff that will be involved in the development and support of any contract resulting from this enquiry. Curriculum Vitae (CVs) of these staff members shall be submitted as part of the enquiry. Abridged (maximum 5-page) CVs are preferred:
- Name (Please note that identification, such as passport, will be required for access control to the Employer's premisses, on contract placement.)
 - Field(s) of expertise as per the sub-categories defined for the technical evaluation.
 - Area(s) of speciality such as design, configuration, tuning, resting and commissioning.
 - Years experience in above categories (total)

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- Years experience in above categories (with *Tenderer's* South African office)
 - Highest qualification
 - Professional registration.
- b) Provide a summary of the Tenderer's history in Southern Africa, providing specific details with regards to contracts of this nature and size.
- c) Provide examples of similar contracts in scope and size in the world market and specifically in Southern Africa.
- d) Describe relevant testing facilities in the Republic of South Africa that the Tenderer plans to utilise for this project.
- e) Describe the activities which may be undertaken by the permanent local office.

4 System maintenance and upgrade

- a) Identify all maintenance tasks which will be required to be undertaken on the system on a scheduled basis, as well as indicating the intervals of such maintenance.
- b) Provide detail on any testing aids which are envisaged to be used during the maintenance.

Annex C – Maintenance and support requirements

This annexure shall be completed by *Tenderers* and included as part of the tender submission.

Part A: TPSCM System Software Requirements

This part of the annexure shall be completed by *Tenderers* for *Part A: TPSCM System Software* and included as part of the tender submission.

Tenderer to indicate compliance or non-compliance to the following.

- a) Tenderer's shall offer 24x7 remote support to the TPSCM solution after project completion.
- b) On demand on-site support, on the Employer's premises, shall also be available.
- c) The TPSCM software maintenance and support agreement shall be available to the deliverables defined in the Requirement Schedule and those for the Sub-category 1: Operating and Control; Sub-category 4: Wide Area Monitoring; and either Sub-category 2: Generation Optimisation Integration or Sub-category 3: Generation Optimisation Replacement.
- d) The agreement shall be structured to cater for selection of either a replacement or integration option of Sub-category 2: Generation Optimisation Integration and Sub-category 3: Generation Optimisation Replacement.
- e) An initial five (5) year maintenance and support agreement shall be available after the end of the defects period.
- f) The upgrade of the TPSCM software shall be aligned to the product road map and shall be reviewed annually.
- g) The Employer shall have access to the Contractor's user community for:
 - software and documentation updates and new releases (including patches);
 - product interest groups;
 - support centre web sites and portals;
 - monthly technical newsletters; and
 - user group conferences.
- h) The Contractor's call centre shall provide the following support:
 - hotline 7/24/365 for critical issues;
 - remote diagnostic;
 - response time of less than three (3) hours; and
 - target resolution for restoring the lost functionality of less than eight (8) hours.
- i) *Management reporting and incident responses shall include:*
 - technical support via e-mail;
 - monthly support reports; and
 - incident reports.
- j) The source code for the TPSCM system shall be managed to ensure there is no regression during *upgrades and deployment of patches.*
- k) *Annual audit shall be scheduled to verify the integrity of the TPSCM solution. Ad hoc cyber security audits shall be required.*
- l) *In addition to the above system support, a consultancy service packaged as number of hours for technical assistance per annum shall be included. Hours not consumed under the previous contract will be rolled over to the new contract.*

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- m) An escrow account for the duration of the contract (verification process excluded) with a quarterly upload shall be provided.

Part B: Rear Projection and Front Projection System Requirements

This part of the annexure shall be completed by *Tenderers* for *Part B: Rear Projection and Front Projection* and included as part of the tender submission.

- a) *Tenderer* to indicate compliance or non-compliance to the following.
- b) On demand on-site support, on the *Employer's* premises, shall be available.
- c) The agreement shall provide breakdown and maintenance support for the rear projection system delivered under the *Sub-category 5: Rear Projection and Front Projection*.
- d) An initial five (5) year maintenance and support agreement shall be available after the end of the warranty / defects period.
- e) The agreement shall cover all repairs and labour for repairs carried out on-site, at the *Employer's* premises, or taken off site if unable to repair the equipment on-site.
- f) Critical spares shall be maintained on-site, at the *Employer's* premises, to ensure the maximum uptime.
- g) Telephonic support and call-out in case of a system failure shall be available 7/24/365.
- h) Module replacements and upgrades shall not reduce the integrity of the solution.
- i) Initial response time shall be less than three (3) hours and the target resolution time for restoring the lost functionality of rear projection system shall be less than eight (8) hours.

Annex D – Protocol interoperability

This part of the annexure shall be completed by *Tenderers* for *Part A: TPSCM System Software* and included as part of the tender submission. This annexure provides the list of evidence required to support confirmation of interoperability of the standard protocol implementation to be submitted with the tender.

1 IEC 60870-5-101 and IEC 60870-5-104

Gateways

The *Supplier* solution shall comply to *IEC 60870-5-101* and the *Employer's* IEC60870-5-101 implementation standards, namely the 240-61478980 *Eskom Slave device IEC 60870-5-101 Implementation Standard* and the 240-61478967 *Eskom Master device IEC 60870-5-101 Implementation Standard*.

Existing *Employer* gateways include:

- 1) Talus RTU version E5021B
- 2) GE D400 versions 5.5 and 2.75
- 3) Siemen SICAM PAS Gateway version 8.17
- 4) SEL 3555 RTAC Gateway version R139

The TPSCM solution shall support the interoperability with all the *Employer* gateway models and associated versions as listed above.

The *Supplier* shall state compliance and provide supporting evidence in the form of an implementation document containing all relevant information on their implementation, clearly defining what services and functions contained in the subset are not supported.

The *Supplier* shall conduct a FAT to ensure interoperability / capability between the IEC 60870-5-101(Master) on the TPSCM and IEC 60870-5-101 (Slave) protocol implementation on the *Employer* gateways.

The *Supplier* shall conduct an IEC 60870-5-104 FAT to ensure interoperability between the TPSCM and the *Employer* gateways excluding the Talus RTU.

IEC 60870-5-104 implementation for the WAMS

IEC 60870-5-104 protocol implementation shall be tested against the *Employer's* existing WAMS and the *Employer* gateways to ensure interoperability/ compatibility. FAT

2 ICCP / IEC 60870-6-503

The TPSCM solution shall comply to the *ICCP /IEC 60870-6-503 standard* and the 240-82331576: *Inter Control Centre Communications Protocol Standard*. Existing control systems where ICCP protocol is implemented include:

- 1) ABB Network Manager – Distribution implementation
- 2) GE PowerOn System – Distribution implementation
- 3) GE PowerOn System (latest version) - International implementation

The TPSCM solution shall support the interoperability with all the existing *Employer* control systems listed above.

The *Supplier* shall state compliance and provide supporting evidence in the form of an implementation document containing all relevant information on their implementation, clearly defining what services and functions contained in the subset are not supported.

The ICCP protocol implementation shall be tested during FAT and SAT to ensure interoperability/ compatibility. Interoperability tests during FAT shall include ICCP conformance blocks testing; encrypted ICCP used for controls; and engineering values and status indication tests at application layer. During SAT, ICCP tests shall be conducted with distribution regional control sites and Southern African Power Pool (SAPP) control centre.

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3 IEEE C37.118

The TPSCM solution shall support the interoperability with the *Employer's* existing WAMS components and associated versions as listed below. The existing WAMS system components are:

- 1) SPDC –Advantech UNO3084-D23E hardware
 - Phasorpoint ver. 2.2 or later (must be backward compatible)
 - IEEE C37.118 compliant
- 2) PMU –Micom Alstom P847 B/C PMU hardware
 - Compliant with level 1 performance requirements of IEEE C37.118

The *Supplier* shall state compliance and provide supporting evidence in the form of an implementation document containing all relevant information on their implementation, clearly defining what services and functions contained in the subset are not supported.

The *IEEE C37.118 IEEE Standard for Synchrophasor Data Transfer for Power Systems implementation* shall be tested against the *Employer's* existing WAMS to ensure interoperability/ compatibility. The TPSCM solution shall be backward compatible up to the *IEEE C37.118 2005 IEEE Standard for Synchrophasor Data Transfer for Power Systems*.