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|  | <p align="center">Specification</p> | <p align="center">Technology</p> |
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Title: **Technical Specification for GPS Time Synchronising Unit**

Unique Identifier: **474-283**

Alternative Reference Number: **N/A**

Area of Applicability: **Engineering: Transmission and Distribution**

Documentation Type: **Specification**

Revision: **1**

Total Pages: **23**

Next Review Date: **June 2015**

Disclosure Classification: **CONTROLLED DISCLOSURE**

APPROVED FOR AUTHORISATION
 TECHNOLOGY ENGINEERING
DOCUMENT CENTRE ☎ X4962

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|---|---|---|

Approved by (SCOT SC Chairperson)



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Date: 28/02/2013

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1. INTRODUCTION

This document describes the *Purchaser's* (Eskom Holdings SOC Limited) requirements in respect of the GPS time synchronising units to be used at various Transmission and Distribution substations.

2. SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

The purpose of this document is to provide the *Purchaser's* requirements for the GPS time synchronising unit. The invitation calls for supply, development if necessary, and possible installation at two test sites only with the intention to establish a national contract for the supply of the GPS time synchronising units and Training of *Purchaser's* personnel. The two pilot sites are in the Gauteng Province.

2.1.2 Applicability

This specification document shall apply throughout the *Purchaser's* substations for new GPS time synchronising unit installations.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

The following referenced documents provide the necessary detail to supplement this specification document, and should be read in conjunction with this document. In cases of conflict however, this specification takes precedence.

The following standards contain provisions that, through reference in the text, constitute requirements of this specification document. At the time of publication the revisions indicated were valid. All standards are subject to review and parties entering into purchasing agreement, based on this document, are encouraged to investigate the possibility of applying the most recent revisions of the standards listed below. Information on currently valid national and international standards may be obtained from the Information Centre at Megawatt Park at cost only.

| Standard | Title |
|---------------------------|---|
| IEC 60870-2-1 | Telecontrol equipment and systems Part 2-1: Operating conditions - Section 1: Power supply and electromagnetic compatibility |
| IEC 60870-2-2 | Telecontrol equipment and systems Part 2-2: Operating conditions - Section 2: Environmental conditions (climatic, mechanical and other non-electrical influences) |
| IEC61000-4-3 | Electromagnetic compatibility (EMC) Part 4-3: Testing and Measurement Techniques, Radiated, radio –frequency electromagnetic field immunity test |
| IEC61000-4-5 | Electromagnetic Compatibility (EMC) Part 4-5: Testing and Measurement Techniques – Surge Immunity Test |
| IEC TS 61000-6-5 | Electromagnetic Compatibility (EMC) Part 6-5: Generic Standards. Immunity for power station and substation environments |
| IEC61850-3 | Communication Networks and Systems in Substations Part 3: General Requirements |
| IEEE1588 Version 2 Latest | IEEE Precision Time Protocol |

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| Standard | Title |
|-----------------------|--|
| IEEE 1613:2009 | IEEE Standard for environmental and testing requirements for communications networking devices installed in electric power substations |
| IEEE Std C37.238-2011 | IEEE Standard Profile for Use of IEEE 1588 Precision Time Protocol in Power System Applications |
| ISO 9001:2008 | Quality Management Systems |
| SCSSCAAP9: Latest | Corrosion protection specification for new indoor and outdoor distribution equipment manufactured from steel |
| TESGL0020 | Transmission Secondary Plant Technology Development |

2.2.2 Informative

Not Applicable.

2.3 DEFINITIONS

| Term | Definition |
|-----------------------|--|
| Defects Date | Starts on the hand over date and lasts 52 weeks from that date. |
| DST | Daylight Saving Time is when the time on local clocks is advanced forward by one hour at the beginning of the defined period of DST, and returned back by one hour at the end of DST. |
| GPS | Global Positioning System. |
| Local Time | This is the same as LST but in periods of DST one hour has to be added to the local clock, so that local time is ahead of standard time by an hour. |
| LST | Lunar Standard Time. The earth is divided into standard time zones and there is local standard time for each time zone. |
| Out-of-band-Rejection | Ability of the device to pass most frequencies unaltered, but attenuating those out of range to very low levels with reference to the pass band. |
| Receiver Sensitivity | Defines the minimum strength a receiver can receive and still be able to provide time and position within a specified accuracy. If the signal strength is below the sensitivity level, the information will be recovered at the less than specified quality. |
| UTC | Coordinated Universal Time is the worldwide standard for time and date. |

2.4 CLASSIFICATION

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

2.5 ABBREVIATIONS

| Abbreviation | Description |
|--------------|----------------------------|
| BNC | Bayonet Neil-Concelman |
| CD | Compact Disc |
| DC | Direct Current |
| DCLS | Direct Current Level Shift |

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| Abbreviation | Description |
|--------------|---|
| DST | Daylight Saving Time |
| EMC | Electromagnetic Compatibility |
| EMI | Electromagnetic Immunity |
| FAT | Factory Acceptance Testing |
| GPS | Global Positioning System |
| IEC | International Electrotechnical Commission |
| IED | Intelligent Electronic Device |
| IEEE | Institute of Electrical and Electronics Engineers |
| IRIG-B | Inter-Range Instrument Group |
| LST | Local Standard Time |
| NTP | Network Time Protocol |
| PPHH | Pulse Per Half Hour |
| PPM | Pulse Per Minute |
| PPS | Pulse Per Second |
| PTP | Precision Time Protocol |
| SAT | Site Acceptance Testing |
| SCADA | Supervisory Control and Data Acquisition |
| SSH | Secure Shell |
| TTL | Transistor-Transistor Logic |
| UTC | Coordinated Universal Time |

2.6 ROLES AND RESPONSIBILITIES

Not Applicable.

2.7 PROCESS FOR MONITORING

Not Applicable.

2.8 RELATED/SUPPORTING DOCUMENTS

Not Applicable.

3. PROJECT PROGRAMME

The project shall be executed according to a defined project schedule made up of six phases. These phases are governed by the procedures defined under the “System Synthesis” and “Implementation” in TESGL0020 – Transmission Secondary Plant Technology Development.

The *Purchaser* reserves the right to eliminate one or more of the phases, prior to commencing each phase. The *Supplier* is required to provide a detailed work breakdown and the associated costs for the activities in each phase.

3.1 PHASE 1 - FUNCTIONAL DESIGN SPECIFICATION (FDS)

This phase consists of the production of a Functional Design Specification comprising a Functional Specification document. The intention of this phase is to finalise all requirements to form the baseline for the following phases.

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The deliverables for this phase included the following:

- A Functional Specification
- Updated Project Programme

3.2 PHASE 2 - DETAILED DESIGN SPECIFICATION (DDS)

This phase consists of the production of a Detailed Design Specification for the time synchronising unit and specifies the procedures for testing.

The format of the test descriptions shall be as follows:

- Test Name
- Test Objectives
- Test Description
- Test Procedure with description on all test equipment / simulators to be used
- Expected Test Results

The deliverables for this phase shall be:

- Detailed Design Specification (If applicable)
- FAT Procedure document
- SAT Procedure document

The above deliverables shall be individually approved by the *Purchaser* prior to the commencement of Phase 3.

3.3 PHASE 3 - DEVELOPMENT, SYSTEM INTEGRATION AND FACTORY ACCEPTANCE TEST (FAT)

Phase 3 shall commence on completion of Phase 2.

This phase consists of the procurement of two time synchronisation units, training of the *Purchaser's* personnel, which is to be followed by formal testing of the time synchronisation unit at the *Supplier's* premises, in the presence of the *Purchaser's* personnel.

The deliverable for this phase shall be:

- A signed-off FAT report indicating accepted completion of FAT.

3.4 PHASE 4 - DELIVERY, INSTALLATION, TESTING AND COMMISSIONING

Phase 4 shall commence on completion of Phase 3.

This phase comprises the delivery of two time synchronisation units to site, installation, documentation and manuals, in conjunction with the *Purchaser's* personnel and training. Thereafter, the system shall be commissioned in accordance with operating constraints of the power system.

The deliverables for this phase shall be:

- Equipment delivery and installation for two substations only
- System documentation in triplicate hardcopy and digital format
- Implementation Report; to be approved by the *Purchaser*
- Commissioned GPS time synchronising unit

3.5 PHASE 5 - SITE ACCEPTANCE TEST (SAT)

The commencement of this phase shall be on completion of Phase 4. This phase consists of conducting tests according to the SAT procedure document.

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The deliverables for this phase shall be:

- A signed-off SAT report indicating accepted completion of SAT.
- A hand-over Certificate.

3.6 PHASE 6 - ESTABLISHMENT OF SUPPLY CONTRACT

On successful completion and approval of the FAT and SAT on the prototype, by the *Purchaser*, the final phase of this project shall commence.

This phase of the project shall involve the subsequent supply of time synchronisation units for purchase and may include the delivery, offloading and possible installation of the purchased equipment.

Provision of training, spares, and on-going support for the product may also be included in this phase.

4. FUNCTIONAL REQUIREMENTS

4.1 ENVIRONMENTAL REQUIREMENTS

The GPS time synchronising unit receiver shall:

4.1.1 Operate within a temperature range of -40 °C to 85 °C.

4.1.2 Handle relative humidity of up to 100% outdoors and between 10-95% inside the substation in the specified temperature range.

4.1.3 Be immune to environmental conditions as per IEC61850-3 standard.

4.1.4 Provide error free operation when exposed to EMI stress and electrical surges, as per class 2 requirements of IEEE 1613.

4.1.5 Operate within an altitude range of 0 – 2500m.

4.2 ENCLOSURE PROTECTION

The device shall meet the following enclosure protection:

4.2.1 The IP rating of 68 for indoors and outdoors.

4.2.2 Suitably protected against corrosion as per SCSSCAAP9.

4.3 POWER AND EARTHING REQUIREMENTS

4.3.1 The power supply in voltages supported shall be 48, 110 and 220 volts DC.

4.3.2 The offer shall include an optional dual power supply.

4.3.3 The GPS time synchronising unit shall be equipped with a surge arrester to be fitted between the antenna and the receiver.

4.3.4 The surge arrester shall include the earth stud for bonding to the earth mat.

4.3.5 Wherever the surge arrester is applied, it shall be replaceable and repositionable.

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4.3.6 The *Supplier* shall specify the losses incurred by the surge arrestor.

4.3.7 The surge arrestor shall comply with the IEC 61000-4-5 standard class 4.

4.4 SYSTEM ALARMS

The GPS time synchronising unit shall provide the following alarm functionality:

4.4.1 GPS unhealthy alarm: for internal malfunction.

4.4.2 GPS bad time alarm: when the unit is not locked or not tracking the satellites.

4.4.3 These alarms shall be available for mapping as potential free input contacts to be used with the existing SCADA system.

4.4.4 The alarms shall be available over SNMP version 2c.

4.5 TIMING OUTPUT REQUIREMENTS

The GPS time synchronising unit shall have the following timing output functionality:

4.5.1 A Pulse Per Minute signal (PPM) with adjustable duty cycle.

4.5.2 Pulse Per Second signal (PPS) with adjustable duty cycle.

4.5.3 The PPM and PPS outputs shall be fed via isolated opto-couplers which should be capable of switching 110 and 220 VDC.

4.5.4 The timing accuracy for PPM and PPS signals shall be 1ms from UTC.

4.5.5 A Pulse Per 30 Minute signal (PPHH) with adjustable duty cycle with accuracy of 1ms from UTC. (Preferable)

4.5.6 Standard IRIG-B signals:

4.5.6.1 IRIG-B122

4.5.6.2 IRIG-B002

4.5.7 The accuracy of the IRIG-B timing output shall be no more than 100µs from UTC.

4.5.8 An NTP version 4 Server which provides time synchronisation over a networked environment.

4.5.9 An SNTP version 4 Server which provides time synchronisation over a networked environment.

4.5.10 The GPS time synchronising unit shall output UTC + offset time which is selectable.

4.5.11 The GPS time synchronising unit shall be a Grandmaster Clock supporting IEEE 1588 version 2 precision time protocol, and IEEE Std C37.238-2011 and it shall be clearly stated if it is an add-on or integrated module.

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4.6 GPS RECEIVER AND CLOCK REQUIREMENTS

4.6.1 The primary source of time information to the GPS receiver shall be obtained from the GPS satellites to establish a UTC time base.

4.6.2 The GPS receiver shall have an internal real time clock that will maintain accurate time if the communication to the GPS satellites is lost or is of bad quality.

4.6.3 The *Supplier* shall specify the accuracy of the internal clock of the GPS receiver and preference shall be given to the most accurate internal real time clock.

4.7 INTERFACE REQUIREMENTS

The device shall support the following physical interfaces and all shall be modular and optional:

4.7.1 Phoenix connectors for PPM and PPS outputs.

4.7.2 BNC connectors for IRIG-B002 TTL.

4.7.3 Phoenix connectors for IRIG-B002 RS485.

4.7.4 IRIG-B002 Optical output via LC connectors (Preferable) or ST connector as a second option.

4.7.5 BNC connector for IRIG-B122.

4.7.6 Ethernet ports shall be 100Base-Tx (RJ45) and 100Base-Fx (LC connector Preferable).

4.7.7 The *Supplier* shall state number of ports provided for each timing output and the capability of each timing output to drive loads.

4.8 DISPLAY REQUIREMENTS

4.8.1 The GPS time synchronising unit shall have a backlit digital display and indications on the front panel which show the following:

4.8.1.1 The time of the day (HH:MM:SS)

4.8.1.2 The date (DD/MM/YYYY)

4.8.1.3 The status of the clock

4.8.1.4 The total signal strength

4.8.1.5 The number of satellites locked and synchronised to the receiver clock.

4.8.1.6 GPS synchronised – when the receiver is accurately tracking the GPS time signal.

4.8.1.7 GPS locked – when the unit is locked.

4.8.1.8 GPS bad time – when the unit is not locked or tracking

4.8.2 Each GPS time synchronising unit delivered shall include a 19 inch rack mount option.

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4.9 GPS ANTENNA REQUIREMENTS

4.9.1 The antenna shall be an active antenna.

4.9.2 The active antenna shall be powered from the indoors unit.

4.9.3 The antenna shall be supplied with the installation bracket for mounting the antenna.

4.9.4 The antenna shall operate from a distance of up to 100m from the indoors unit.

4.9.5 The antenna cable shall be screened coaxial cable.

4.9.6 The antenna shall be designed for outdoor use in accordance with the IEC 61000-4-3 EMC standard.

4.9.7 The antenna shall be housed in a shielded enclosure with the IP rating of 68.

4.9.8 The antenna shall be supplied with an optional antenna splitter to feed at least four GPS receivers.

4.10 SECURITY

4.10.1 The GPS time synchronising unit shall be immune to spoofing.

4.11 CONFIGURATION TOOL

4.11.1 The configuration of the unit shall be password protected while the configuration information shall be read only to all users.

4.11.2 The elevation mask angle and cable delay compensation shall be user configurable.

4.11.3 Basic configuration shall be via the front panel of the GPS receiver.

4.11.4 Device shall be configurable via Telnet/SSH (Preferable) or serial connection.

5. GENERAL SPECIFICATION

5.1 SOFTWARE LICENSE

The *Supplier* shall provide an enterprise software license, if any, for all software provided with the GPS time synchronising unit for use by the *Purchaser*.

5.2 DOCUMENTATION

5.2.1 The *Supplier* shall supply a complete set of documentation. Such documentation shall enable *Purchaser's* personnel to perform maintenance on the GPS time synchronising units. The documentation shall include the following:

5.2.1.1 Manuals

5.2.1.2 Connection Drawings to IED's

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5.2.2 Manuals shall include the following:

5.2.2.1 Hardware manuals with all the mechanical, electrical and environmental specifications of the units

5.2.2.2 Engineering manuals – with all the installation and electrical schematics for the complete system

5.2.3 All documents shall be supplied in English Language.

5.2.4 All documents shall be supplied in a digital format on a CD and hard copy format and shall be available on the internet.

5.3 TRAINING

5.3.1 Comprehensive training courses shall be offered to enable the *Purchaser's* personnel to configure, operate and maintain the GPS time synchronising units.

5.3.2 The training cost shall include tuition and documentation.

5.4 SPARES AND MAINTENANCE

5.4.1 The *Supplier* shall specify routine maintenance that is to be performed after Defects Date and specify the maintenance requirements.

5.4.2 The *Supplier* shall indicate the minimum inventory of spares to be kept on site (if relevant).

5.4.3 The *Supplier* shall highlight any equipment where there is a likelihood that spares may become difficult to obtain.

5.5 SYSTEM DURABILITY

5.5.1 The service life of the GPS time synchronising units shall not be less than 10 years.

5.5.2 The *Supplier* shall notify the *Purchaser* in writing of the unit obsolescence as soon as it becomes known to the *Supplier*.

5.6 QUALITY ASSURANCE

5.6.1 Eskom's Quality Assurance requirements as specified in ISO 9001:2008 are applicable.

5.7 TESTING AND APPROVAL

5.7.1 The *Supplier* shall provide a detailed acceptance testing procedure to verify the timing accuracy of the GPS time synchronising unit.

5.7.2 The *Supplier* shall provide with this tender the compliance test certificates from independent test authority to:

5.7.2.1 IEEE 1588 version 2

5.7.2.2 IEEE Std C37.238-2011

5.7.2.3 Immunity to substation environment

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6. AUTHORISATION

This document has been seen and accepted by:

| Name | Designation |
|----------------|---|
| R McCurrach | Senior Manager : PTMC Engineering |
| P Groenewald | Metering and DC Technology and Support Manager and Chairperson Telecontrol/ SCADA Study Committee |
| S Papadopoulos | Control and Automation Technology and Support Manager |
| P Kara | Protection Technology and Support Manager |

7. REVISIONS

| Date | Rev. | Compiler | Remarks |
|---------------|------|-----------|--|
| June 2012 | 0 | P Khumalo | New Document |
| July 2012 | 0.1 | P Khumalo | Draft Document for Comments Review |
| November 2012 | 0.2 | P Khumalo | Document updated with Comments |
| November 2012 | 0.3 | P Khumalo | Draft Document for Comments Review (2 nd round) |
| December 2012 | 1 | P Khumalo | Final Document for Authorisation and Publication |

8. DEVELOPMENT TEAM

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

- Dumisani Gojela
- John Enslin
- Kashveer Jagdaw
- Marlini Sukhnandan
- Phetheni Khumalo
- Tertius Hyman
- Willie Van Heerden

9. ACKNOWLEDGEMENTS

Not Applicable.

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ANNEXURE A

SUPPLIER QUESTIONNAIRE

The following questionnaire must be completed and attached to the *Supplier's* GPS time synchronising unit tender proposal. Responses to the questions should state the question number and repeat the question, and can consist simply of references to specific sections in the body of the *Supplier's* proposal, where applicable.

1. Please provide the following information:
 - 1.1. Name of Company.
 - 1.2. Company address
 - 1.3. Date of establishment of Company.

2. Give a brief summary of your GPS Synchronising unit and functionalities available. In the summary clearly state the following:
 - 2.1. Timing outputs provided and accuracy for each timing output
 - 2.2. Functionalities that come standard and optional ones. Also state whether the optional functions are add-on modules or integrated
 - 2.3. Expandability of the unit to cater for future requirements and whether it will be achieved by firmware or hardware upgrade.

3. Outline the Company's management structure.

4. State the Company's staff compliment, in terms of:
 - 4.1. Administrative.
 - 4.2. Design.
 - 4.3. Software.
 - 4.4. Inspection and Quality Assurance.
 - 4.5. Support
 - 4.6. Other.

5. Briefly describe the nature of your resources in the Republic of South Africa e.g. workshop facilities, test equipment, etc.

6. State what experience you have had with Time Synchronising units.

7. *Supplier's* Time synchronisation project experience references.
 - 7.1. State the customer and time synchronisation project that you have done (or that are still in progress) during the past five (5) years.
 - 7.2. Provide customers references of similar GPS Time Synchronisation projects.

8. Briefly describe your methods of ensuring that the GPS Time Synchronising Unit complies to environmental conditions.

9. Briefly describe your methods of demonstrating that the Unit's timing accuracies are within the times specified in this specification document.

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10. State your level of adherence to International Engineering Standards.

11. Maintenance

- 11.1. Describe the maintenance policy for the GPS Time Synchronising unit offered, both during and after the warranty period.
- 11.2. Describe the proposal/recommendations regarding maintenance of the unit offered for the life of the system.
- 11.3. Indicate whether or not the *Supplier* will honour all warranties and guarantees if the *Purchaser's* personnel perform maintenance functions on the GPS Time Synchronising unit?
- 11.4. Indicate whether or not all maintenance or repairs to Time Synchronising Unit will be done locally?
- 11.5. Describe any specialised test equipment required for maintenance that is generally not commercially available.

12. Spares

- 12.1. Describe the recommended spares holdings with respect to the *Purchaser's* geographical locations and GPS Time Synchronising unit availability requirements.
- 12.2. Describe your policy on availability of spare parts and expansion parts for a period of ten years subsequent to the expiry of the supply contract.

13. The *Supplier* should state his willingness to provide training on the Time Synchronising Units at the *Purchaser's* premises wherever feasible and practical.

14. The following additional information is required:

- 14.1. Guaranteed lead times for the manufacture and delivery of GPS Time Synchronising Units.
- 14.2. The quality assurance standards that are adhered to by the *Supplier*
- 14.3. Which nationally or internationally recognised body with which the *Supplier* is registered?

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ANNEXURE B

SCHEDULE OF REQUIREMENTS

This document provides a schedule of compliance with regard to the robust GPS Time Synchronising units to be provided for the *Purchaser*. It cross-references all the relevant Goods information clauses requiring a response from *Tenderers* and assists *Tenderers* in providing a comprehensive proposal.

Tenderers are requested to complete this Schedule A/B as part of the tender submission data package.

INSTRUCTION TO TENDERERS

When completing the Schedule of Requirements A/B *Tenderers* are requested to take cognisance of the following:

- It is expected of *Tenderer* to state clearly, for each clause that requires a statement of compliance in the Schedule of Requirements A/B, either “Comply” or “Do not comply”.
- If a clause in the Schedule of Requirements A/B requires a statement of compliance and additional information e.g. a description etc., *Tenderers* are requested to state clearly either “Comply – followed by any information deemed appropriate by the *Tenderer*” or “Do not comply – followed by any information deemed appropriate by the *Tenderer*”.
- Supplier response to schedule A&B requirements must provide page and line number where compliance can be found on submitted document for tender evaluation.

| Clause | Description | Schedule A particulars' of Eskom's requirements | Schedule A state compliance | Remarks |
|--------|---|---|-----------------------------|----------------------|
| 1 | INTRODUCTION | Stated for Information only | | No response required |
| 2 | SUPPORTING CLAUSES | Stated for information only | | No response required |
| 2.1 | SCOPE | Stated for information only | | No response required |
| 2.1.1 | Purpose | Stated for information only | | No response required |
| 2.1.2 | Applicability | Stated for information only | | No response required |
| 2.2 | NORMATIVE/INFORMATIVE REFERENCES | Stated for information only | | No response required |

| | | | | |
|------------|---|-----------------------------|--|----------------------|
| 2.2.1 | Normative | Stated for information only | | No response required |
| 2.2.2 | Informative | Stated for information only | | No response required |
| 2.3 | DEFINITIONS | Stated for information only | | No response required |
| 2.4 | CLASSIFICATION | Stated for information only | | No response required |
| 2.5 | ABBREVIATIONS | Stated for information only | | No response required |
| 2.6 | ROLES AND RESPONSIBILITIES | Stated for information only | | No response required |
| 2.7 | PROCESS FOR MONITORING | Stated for information only | | No response required |
| 2.8 | RELATED/SUPPORTING DOCUMENTS | Stated for information only | | No response required |
| 3. | PROJECT PROGRAMME | Stated for information only | | No response required |
| 3.1 | PHASE 1 – FDS | State Compliance | | |
| | Functional Specification Project Programme | | | |
| 3.2 | PHASE 2 - DDS | State Compliance | | |
| | Detailed design specification | | | |
| | FAT procedure SAT procedure | | | |
| 3.3 | PHASE 3 - FAT | State Compliance | | |
| | Signed-off FAT report | | | |
| 3.4 | PHASE 4 – Delivery, Testing and Commissioning | State Compliance | | |
| | Equipment Delivery and Installation | | | |
| | System documentation | | | |
| | Approved Implementation Report Commissioned System | | | |
| 3.5 | PHASE 5 - SAT | State compliance | | |
| | Signed-Off SAT report Handover Certificate | | | |

| | | | | |
|------------|--|-----------------------------|--|----------------------|
| | | | | |
| 4. | FUNCTIONAL REQUIREMENTS | Stated for information only | | No response required |
| 4.1 | ENVIRONMENTAL REQUIREMENTS | Stated for information only | | No response required |
| 4.1.1 | Temperature range of -40 °C to 85 °C | State compliance | | |
| 4.4.2 | Relative humidity of 100% outdoors and between 5-95% indoors | State compliance | | |
| 4.4.3 | Immune to environmental conditions as per IEC61850-3 standard | State compliance | | |
| 4.4.4 | Error free operation as per class 2 requirements of IEEE1613 | State compliance | | |
| 4.4.5 | Altitude range of 0 - 2500m | State compliance | | |
| 4.2 | ENCLOSURE PROTECTION | State for information only | | No response required |
| 4.2.1 | Enclosure protection with IP rating of 68 | State compliance | | |
| 4.2.2 | Protected against corrosion as per SCSSCAAP9. | State compliance | | |
| 4.3 | POWER AND EARTHING REQUIREMENTS | Stated for information only | | No response required |
| 4.3.1 | DC voltage options: 48V, 110V and 220V | State compliance | | |
| 4.3.2 | Optional dual power supply | State compliance | | |
| 4.3.3 | Equipped with surge arrestor | State compliance | | |
| 4.3.4 | Surge arrestor includes earth stud for bonding to earth mat | State compliance | | |
| 4.3.5 | Surge arrestor is replaceable and movable | State compliance | | |
| 4.3.6 | Surge arrestor losses have been specified | State compliance | | |
| 4.3.7 | Surge arrestor complies with class 4 of IEC 61000-4-5 standard | State compliance | | |
| 4.4 | SYSTEM ALARMS | Stated for information only | | No response required |
| 4.4.1 | Provides GPS unhealthy alarm | State compliance | | |
| 4.4.2 | Provides GPS bad time alarm | State compliance | | |
| 4.4.3 | Alarms available for mapping as potential | State compliance | | |

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| | free input contacts to be used with the existing SCADA system | | | |
| 4.4.4 | Alarms available over SNMP version 2c | State compliance | | |
| 4.5 | TIMING OUTPUT REQUIREMENTS | Stated for information only | | No response required |
| 4.5.1 | PPM with adjustable duty cycle | State compliance | | |
| 4.5.2 | PPS with adjustable duty cycle | State compliance | | |
| 4.5.3 | PPM and PPS outputs are fed via isolated opto-couplers capable of switching 110 and 220 VDC | State compliance | | |
| 4.5.4 | The timing accuracy for PPM and PPS signals is 1ms from UTC | State compliance | | |
| 4.5.5 | PPHH (Preferable) | State compliance | | |
| 4.5.6 | Standard IRIG-B signals | Stated for information only | | No response required |
| 4.5.6.1 | IRIG-B122 | State compliance | | |
| 4.5.6.2 | IRIG-B002 | State compliance | | |
| 4.5.7 | IRIG-B timing output accuracy < 100µs from UTC | State compliance | | |
| 4.5.8 | NTP version 4 Server | State compliance | | |
| 4.5.9 | SNTP version 4 Server | State compliance | | |
| 4.5.10 | UTC + offset time which is selectable | State compliance | | |
| 4.5.11 | The GPS time synchronising supports IEEE 1588 version 2 precision time protocol as a Grandmaster clock | State compliance | | |
| 4.6 | GPS RECEIVER AND CLOCK REQUIEMENTS | Stated for information only | | No response required |
| 4.6.1 | Source of time information is from GPS satellites | State compliance | | |
| 4.6.2 | GPS receiver has internal real time clock | State compliance | | |
| 4.6.3 | The accuracy of the internal real time clock | State the accuracy | | |
| 4.7 | INTERFACE REQUIREMENTS | Stated for information only | | No response required |

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| 4.7.1 | PPM and PPS outputs interfaced with Phoenix connectors | State compliance | | |
| 4.7.2 | BNC connectors for IRIG-B002 TTL | State compliance | | |
| 4.7.3 | Phoenix connectors for IRIG-B002 RS485 | State compliance | | |
| 4.7.4 | IRIG-B002 Optical output via LC connectors | State compliance | | |
| 4.7.5 | BNC connector for IRIG-B122 | State compliance | | |
| 4.7.6 | 100Base-Tx (RJ45) Ethernet ports and 100Base-Fx | State compliance and connector type | | |
| 4.7.7 | State the number of ports for each timing outputs and capability of each output to drive loads | State number of ports and drain/load capabilities of each timing output | | |
| 4.8 | DISPLAY REQUIREMENTS | Stated for information only | | No response required |
| 4.8.1 | Digital display indications | Stated for information only | | No response required |
| 4.8.1.1 | The time of the day (HH:MM:SS) | State compliance | | |
| 4.8.1.2 | The date (DD/MM/YYYY) | State compliance | | |
| 4.8.1.3 | The status of the clock | State compliance | | |
| 4.8.1.4 | The total signal strength | State compliance | | |
| 4.8.1.5 | The number of satellites locked and synchronised to the receiver clock | State compliance | | |
| 4.8.1.6 | GPS synchronised – when the receiver is accurately tracking the GPS time signal | State compliance | | |
| 4.8.1.7 | GPS locked | State compliance | | |
| 4.8.1.8 | GPS bad time – when the unit is not locked or tracking | State compliance | | |
| 4.8.2 | GPS time synchronising unit includes a 19 inch rack mount option | State compliance | | |
| 4.9 | GPS ANTENNA REQUIRMENTS | Stated for information only | | No response required |
| 4.9.1 | Active antenna | State compliance | | |
| 4.9.2 | Active antenna powered from the indoor unit | State compliance | | |

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| 4.9.3 | Antenna supplied with installation bracket | State compliance | | |
| 4.9.4 | The antenna operates from a distance of up to 50m from the main unit | State compliance | | |
| 4.9.5 | The antenna cable is screened coaxial cable | State compliance | | |
| 4.9.6 | The antenna is designed for outdoor use and shall comply with the IEC 61000-4-3 EMC standard | State compliance | | |
| 4.9.7 | The antenna is housed in a shielded enclosure with the IP rating of 68 | State compliance | | |
| 4.9.8 | The antenna is supplied with an optional antenna splitter to feed at least four GPS receivers | State compliance | | |
| 4.10 | SECURITY | Stated for information only | | No response required |
| 4.10.1 | Immune to spoofing | State compliance | | |
| 4.11 | CONFIGURATION TOOL | Stated for information only | | No response required |
| 4.11.1 | The configuration is password protected | State compliance | | |
| 4.11.2 | User configurable elevation mask angle and cable delay compensation | State compliance | | |
| 4.11.3 | Basic configuration via the front panel of the GPS receiver | State compliance | | |
| 4.11.4 | Device configurable via Telnet/SSH (Preferable) or serial connection | State compliance and state the configuration options provided | | |
| 5 | GENERAL SPECIFICATION | Stated for information only | | No response required |
| 5.1 | SOFTWARE LICENSE | Stated compliance | | |
| | Provide a software license, for all software provided | | | |
| 5.2 | DOCUMENTATION | Stated for information only | | No response required |
| 5.2.1 | Document set to be provided | Stated for information only | | No response required |
| 5.2.1.1 | Manuals | State compliance | | |
| 5.2.1.2 | Connection Drawings to IED's | State compliance | | |

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| 5.2.2 | Manual set to be provided | Stated for information only | | No response required |
| 5.2.2.1 | Hardware manuals with all the mechanical, electrical and environmental specifications of the units | State compliance | | |
| 5.2.2.2 | Engineering manuals with all the installation and electrical schematics for the complete system | State compliance | | |
| 5.2.3 | All documents supplied in English Language | State compliance | | |
| 5.2.4 | All documents supplied in a digital format on a CD and hard copy format and available on the internet | State compliance | | |
| 5.3 | TRAINING | Stated for information only | | No response required |
| 5.3.1 | Comprehensive training courses for <i>Purchaser's</i> personnel to configure, operate and maintain the GPS time synchronising units | State compliance | | |
| 5.3.2 | The training cost includes tuition and documentation | State compliance | | |
| 5.4. | SPARES AND MAINTENANCE | Stated for information only | | No response required |
| 5.4.1 | Routine maintenance and maintenance requirements specified | State compliance | | |
| 5.4.2 | Minimum inventory of spares to be kept on site specified | State compliance | | |
| 5.4.3 | Highlight any equipment where there is a likelihood that spares may become difficult to obtain | State compliance | | |
| 5.5 | SYSTEM DURABILITY | Stated for information only | | No response required |
| 5.5.1 | Service life if 10 years or more | State compliance | | |
| 5.5.2 | Notification of obsolescence in writing | State compliance | | |
| 5.6 | QUALITY ASSURANCE | Stated for information only | | No response required |
| 5.6.1 | Meets Quality Assurance requirements as specified in ISO 9001:2008 | State compliance | | |

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| 5.7.1 | Detailed testing procedure to verify the timing accuracy of the GPS time synchronising unit provided | State compliance | | |
| 5.7.2 | Compliance Certificates | Stated for information only | | No response required |
| 5.7.2.1 | IEEE 1588 version 2 | State compliance | | |
| 5.7.2.2 | IEEE Std C37.238-2011 | State compliance | | |
| 5.7.2.3 | Immunity to substation environment | State compliance | | |
| 6 | AUTHORISATION | Stated for information only | | No response required |
| 7 | REVISIONS | Stated for information only | | No response required |
| 8 | DEVELOPMENT TEAM | Stated for information only | | No response required |
| 9 | ACKNOWLEDGEMENTS | Stated for information only | | No response required |

Signature: _____

Print Name: _____

Company: _____

Date: _____