

TRANSNET PROPERTY

ANNEXURE 1 -

TECHNICAL SPECIFICATION FOR THE NATIONAL SMART METERING SYSTEM

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TABLE OF ABBREVIATIONS

AC	Alternating Current
DC	Direct Current
DAQ	Data Acquisition
SPC	Spare Parts Catalogue
TP	Transnet Property
RFP	Request for Proposal
IEC	International Electro-Technical Commission
I	Current
V	Voltage
f	Frequency
P	True Power (W)
Q	Reactive Power (VAR)
S	Apparent Power (VA)
PF	Power Factor
APN	Access Point Name
GSM	General System for Mobile Communications
GPRS	General Packet Radio Services
IoT	Internet of Things
IP	Internet Protocol
ISO	International Standard Organisation
SABS	South African Bureau of Standards
SANS	South African National Standards
NSM	National Smart Metering
NRS	National Regulatory Services
SIM	Subscriber Identification Module
SAP	System Analysis Program Development
MSISDN	Mobile Station International Subscriber Directory Number
OTA	Over The Air
ENS	Energy and Sustainability
EPC	Energy Performance Certificates

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1. INTRODUCTION

Transnet Property (TP) manages a large portfolio of commercial and residential properties across South Africa. The majority of these properties occupied by tenants are not metered for electricity and water consumption. TP owns a portion of the properties in the portfolio and manages the rest on behalf of Transnet Freight Rail (TFR) and is therefore responsible for settling the consumption bills with the Utilities Suppliers across the portfolio. The utility bills received from the Utility Suppliers are typically sourced from bulk meters for each account, owned by the Utility Suppliers, that feeds multiple buildings with various tenants in the precinct.

As such, this specification document describes Transnet Property's requirements for the supply, design, development, delivery, installation, testing and commissioning of the **National Smart Metering System (NSMS)** to provide, consolidate and analyse Utilities consumption data, both electricity and water, using Smart Meters on a national central National Smart Metering System.

2. TRANSNET PROPERTY SMART METERING SYSTEM

2.1. National Smart Metering System Overview

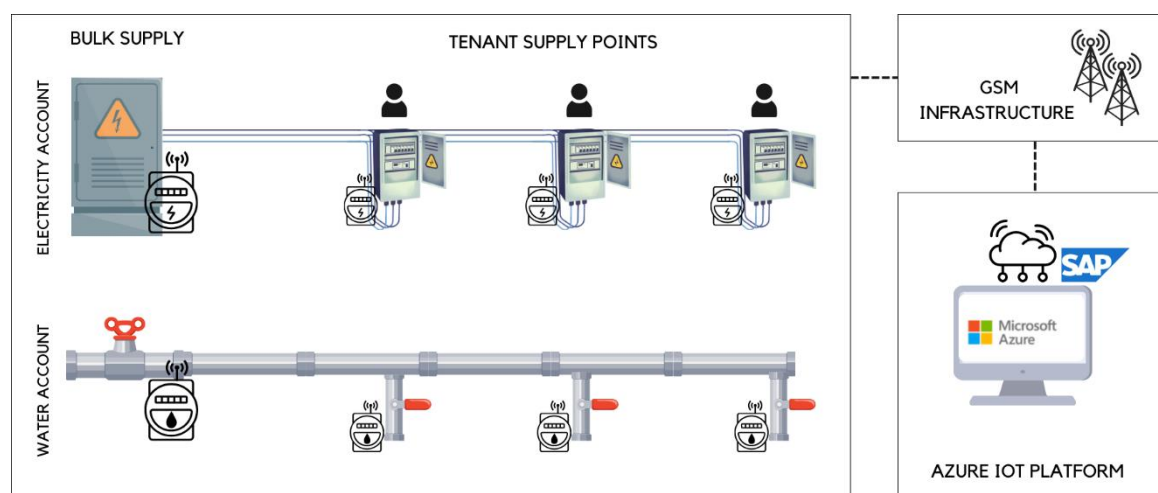


Figure 1: National Smart Metering System High Level Overview

Bulk Supply: Bulk points of utilities (water and electricity) supply are fed by various suppliers like Eskom, municipalities and water boards. These points of supply are typically marked by the supplier's utility meters where the electricity/water account is monitored for consumption and billed on a monthly invoice basis. Smart meters shall be installed adjacent to supplier's meters for each account included in the tender works. These internally owned bulk meters shall perform check metering for billing dispute resolutions with suppliers.

Tenant Supply Points: Various tenants are connected to the bulk points of supply who contribute to the consumption charges reflected on the monthly bulk account monthly invoices. All tenants connected to accounts included in the tender works shall be metered at their point of individual supply. Submetering of tenants enables monitoring and accurate invoicing of tenant consumption.

Wireless Communications: The supply of M2M SIM cards will be facilitated by Transnet Property via the business cellular network provider for the completion of metering installation works. Site

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assessments included in the installation works involve measurement of network connectivity strength. The network connectivity must be at a minimum threshold of -90dBm at the physical locations of the smart devices to be recommended as the recommended network. Major networks to be verified for use at points of installation include, but may not be limited to, Vodacom and MTN. Availability statistics for the network sites covering physical locations of the smart devices should be provided as part of evidence of network coverage pending the completion of site assessments for all metering points in each phase of execution. This enables possible reworking of roaming requirements for the operations of the SIM cards. Tender works include the collaboration of the successful bidder with the business's cellular network provider to enable GSM communication between all installed meters and the Azure IoT Platform. This includes but is not limited to configuration of SIM cards and APN setup.

Azure IoT Platform: Microsoft Azure is the official cloud platform for Transnet. The cloud environment is regulated by a Transnet Cloud Standard and various relevant ICT policies and standards. All design and development activities will be performed and executed on the Transnet cloud platform. Microsoft Azure best practices and guidelines must be used in the software development works. Transnet ICT personnel will guide the software team to align development with applicable policies and standards. The software architecture designed for the system must include minimum elements of devices, provisioning and ingestion of data, data processing and storage, management and business integration of the solution. Final approval for implementation of the software is provided by *Group ICT Architecture Review Council*.

Front end development requires analytical custom applications with dashboards for

- Utilities Management
 - Utilities services are managed by a Regional Utilities Manager in each of the five regions. Regional Utilities Managers have a team of administrators and technicians who perform tasks under their supervision. The Regional Utilities Managers are led by a National Utilities Manager and their respective Regional Heads. Access to the Utilities Management Dashboard must be provided in accordance with RBAC rules according to the teams operational and reporting requirements.
 - Utilities Management must be provided with views and data that streamlines the operational processes and assists with ease of reporting. Categorisation of meters, their association with the asset being monitored and their functionalities within the accounting and business as a whole must be captured within the system and editable for operational changes.
 - The major processes to be digitised are **Accounts Payable** and **Accounts Receivable**.
 - Accounts Payable activities include check metering of newly installed bulk metering data against monthly invoices received to be verified for accurate billing received from the Utilities supplier. Verified billing must be sent to the TP SAP system where payments are made by the finance department. Dispute arising from such events must be tracked on the system for resolution.
 - Accounts Receivable are created for tenants who have lease agreements with TP. Meters installed at the supply points for tenants are then submetered for monthly billing of their consumption as part of the lease agreement. Billing items for invoicing tenants must be sent to the TP SAP system where invoices are generated by the finance department. Dispute arising from tenants must be tracked on the system for resolution.

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- Monthly reconsolidation of total tenant invoicing at the Accounts Receivable with the charges accumulated on the bulk account in the respective Account Payable shall also be available as a software feature to assist with the management of expense recoveries within the TP operational processes.
- Water demand management devices included for tenant water submetering must be afforded two-way communication during normal operations for supply management.
- Energy and Sustainability
 - The Energy and Sustainability dashboard is required for Regional Energy Managers managed by National Energy Manager, National Sustainability Manager, Civil specialists and Data Analysts.
 - All parameters required for Energy Management and Sustainability Management activities must be visualised and downloadable for analysis.

3. RESPONSE TO TECHNICAL SPECIFICATION

- The Respondent must adhere to all requirements outlined in this document. Failure to adhere to these requirements may result in the disqualification of the Respondent's submission, subject to the discretion of the adjudication panel.
- Transnet reserves the right to disqualify any Respondent should its submission not adhere to all the requirements specified in this document.

4. SMART METERING INFRASTRUCTURE TECHNICAL SPECIFICATION

4.1. Smart Energy Meters

Various methods exist for the installation of the metering solution. The proposed system layout for smart metering infrastructure to be installed on Transnet Property's 3-phase networks or grids. This smart metering solution shall comprise of the actual **smart energy meter** and, *where necessary*, the instrument transformers, i.e., the **current transformers** (CTs) and **voltage transformers** (VTs).

The smart metering hardware shall be equipped with wireless and direct communication modules and must be programmed with software that can allow for third party access. The acquired data measured through the current and voltage sensors shall be transmissible to the National Smart Metering System via the end-to-end connectivity solution.

The smart meters shall be interconnected to the CTs and VTs installed on the respective phases to facilitate the measuring of AC and DC transients. Where direct measurements could be taken by the meter, the CTs and VTs may be omitted.

A similar solution architecture is required for the 1-phase systems but will be without the CTs and VTs. Every other functionality must be provided for these smart meters.

The proposed smart metering infrastructure shall be deployed to measure the substations, minisubs, facilities, buildings, and the key systems, processes, components, and subcomponents at voltage applications as given on the table below. It is of importance to note the maximum current and voltage limits of the points of delivery/supply and the corresponding smart meter specified for installation. Each site of installation requires assessment to evaluate and accurately specify the application category meter required.

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Table 1: Smart Energy Meter Application Categories

Application	Description	Typical Maximum Current and Voltage Levels
1*	3-phase MV applications up to 11kV	- Vmax = 11 kV (RMS) [33 kV occurs once in KZN] - Imax = 800 A (RMS) (most common cases)
2**	3-phase 400V system	- Vmax = 400 V (RMS) - Imax > 100 A (RMS)
3	1-phase system	- Vmax = 230 V (RMS) - Imax = ± 63 A (RMS) (most common cases)

* Use for pricing of bulk meters

** Use for pricing of submeters

TECHNICAL REQUIREMENTS FOR THE SMART ENERGY METERING HARDWARE

- This technical specification is applicable for all the application categories of smart energy meters required as listed in Table 1. The site of installation for bulk Metering, submeters and building (EPC application) metering infrastructure must be categorised into the applications during the site assessments prior to hardware design for the metering installations. All requirements apply to Bulk Metering, Submetering and Building Smart Meters.
- The respondent shall provide supporting documentation that can demonstrate their expertise to fulfil these functional requirements.

Table 2: Technical Requirements for Smart Energy Meters

#	Technical Requirements
R1.	General Requirements
R1.1.	The meter must have a clearly visible, indelibly, and distinctly marked name plate containing the following information: - Manufacturer's name - Meter type - Number of phases and number of wires - Meter serial number - year of manufacture - Rated voltage of the system - Basic current and maximum current - Reference frequency in hertz - Meter constant in imp/kWh - Meter Constant in imp/kVARh - Class index of the meter - Reference Standards
R1.2.	The meter must be backlit and powered with auxiliary control power
R1.3.	The meter must be protected by a password for the setup menu, alarms and reset menus
R1.4.	The meter must be equipped with internal anti-tamper security feature to ensure the integrity of the measurements with detection of tampering triggering an alert/alarm transmitted from the meter.
R1.5.	All setup parameters required by the meter shall be stored in non-volatile memory and retained in the event of a control power interruption

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R1.6.	The meter must have a real-time clock with battery back-up with at least 1 year ride-through time without external power
R1.7.	The meter must be capable of being applied without modification at nominal frequencies of 50 or 60Hz
R1.8.	The meter must have a minimum usable lifespan of 15 years, or the Responder can stipulate such information
R2.	Measurement Requirements
R2.1.	The intervals for measurement, Logging and Transmission of data must be configurable.
R2.2.	Parameters to be measured or monitored and transmitted at 15 minutes intervals with interval time stamp
R2.2.1.	Current – per phase and True RMS, Voltage – per phase and True RMS, Power Factor, Frequency, Phasor angles. Four Quadrant (import/ export): - Apparent Power (kVA) - Active Power (kW) - Reactive Power (kVAR) - Apparent Energy (kVAh) - Active Energy (kWh) - Reactive Energy (kVARh)
R2.2.2.	Power Quality Indication: - Total Harmonic Distortion (THD) - Harmonics (up to the 31st) - Unbalance
R3.	Display Requirements
R3.1.1.	The meter's Data Display Auto Scroll shall include: - Date and Time - Cumulative Active Energy kWh - Cumulative Apparent Energy kVAh - Instantaneous Phase Voltage - Instantaneous Phase Current - Instantaneous Load kW and kVA - Instantaneous Power Factor, and - Frequency displayed for 5 seconds each.
R3.1.2.	Data Display Scroll with Push Button: All Parameters mentioned under Auto-Scroll mode should be displayed and additionally: - Meter Serial Number - Current Month Maximum Demand - GSM Signal Strength
R4.	Accuracy Requirements
R4.1.	For meters with CT ratio x/5A: - Active energy: Class 0.5S - Reactive energy: Class 1 - Current: +/-0.3% - Voltage: +/-0.3% - Active/apparent power: +/-0.5%

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	- Reactive power: +/-2% - Power factor: +/-0.005 - Frequency: +/-0.05%
R4.2.	For meters with CT ratio x/1A: Active energy: Class 1 Reactive energy: Class 2 Current: +/-0.5% Active/apparent power: +/-1% Power factor: +/-0.005
R4.3.	The meters shall be calibrated and refurbished at calibration intervals specified according to the load within the NRS-057 Standard.
R5.	Electrical and Mechanical Connections
R5.1.	The meter must have removable connectors for voltage inputs, control, power, communications, input, and outputs
R5.2.	Inputs for supply voltage: Screw-type terminals
R5.3.	Measurement inputs for voltage: Screw-type terminals
R5.4.	Measurement inputs for current: Screw-type terminals.
R5.5.	Meter Mounting: Panel Mounted.
R6.	Communication Requirements
R6.1.	Local Communication: RJ45, Optical Port, RS485, MBUS
R6.2.	Remote Communication Modules: Cellular GSM, 4G, 5G and NB-IoT
R6.3.	Communication Protocols: MBUS TCP/IP, Wideband Code Division Multiple Access (WCDMA) (3G) and Long-Term Evolution (4G) with capability of 5G migration; DLMS/COSEM
R7.	Protection Requirements
R7.1.	The IP rating of the supplied meter and accompanying equipment shall be no less than IP40 front panel, IP20 casing.
R8.	Data Access Requirements
R8.1.	The onboard logged data shall be downloadable in a .csv-format as a minimum at 15 minutes intervals.
R8.2.	The measured data shall be transmissible remotely to an National Smart Metering System.
R9.	Environmental and Operational Requirements
R9.1.	Ambient Temperature
R9.1.1.	The maximum external air temperature the equipment will be exposed to due to environmental conditions is 50 degrees Celsius.
R9.1.2.	The minimum external air temperature the equipment will be exposed to due to environmental conditions is negative 10 degrees Celsius.
R9.1.3.	No de-rating of any equipment shall occur when the equipment operates within the above-mentioned temperature ranges.
R9.2.	Operating Temperature
R9.2.1.	The intended application shall be subjected to direct sunlight for prolonged periods of time. Accordingly, the design shall accommodate temperature rises within cubicles to ensure that the components do not exceed their specified temperature ratings and thus do not compromise equipment design life.

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R9.2.2.	The design shall ensure that during operation under any condition, the surface of the supplied equipment shall not exceed 90 degrees Celsius.
R10.	Security Requirements
R10.1.	The meter must be able to provide alerts/alarms for: - Tamper detection - Fault detection
R10.2.	The meter box must be secured with a locking mechanism to protect the meter from unauthorised access.
R11.	Compliance Requirements
R11.1.	The equipment offered shall comply with the latest SANS 474:2009 (NRS 057) and NRS 049-2
R11.2.	The services of a meter calibration laboratory that has been accredited by SANAS to SANS 17025 for AC energy, including on-site calibration must be used to perform calibration of meters.
R12.	Obsolescence Management Requirements
R12.1.	The meter model must be commercially available for the next 8 years as a minimum or the meter model must be selected such that replacement in the event of obsolescence must be easily integrated into the NSM system.

4.2. Smart Water Meters

Various methods exist for the installation of the metering solution. The proposed system layout for smart water metering infrastructure to be installed on Transnet Property's water distribution system. The meters' intended applications are to perform:

- The remote monitoring of cold potable water consumption/flow profiles,
- The remote monitoring of high and/or low consumption/flow profiles,
- Demand management capabilities, and
- The remote monitoring of leakage within a zone.

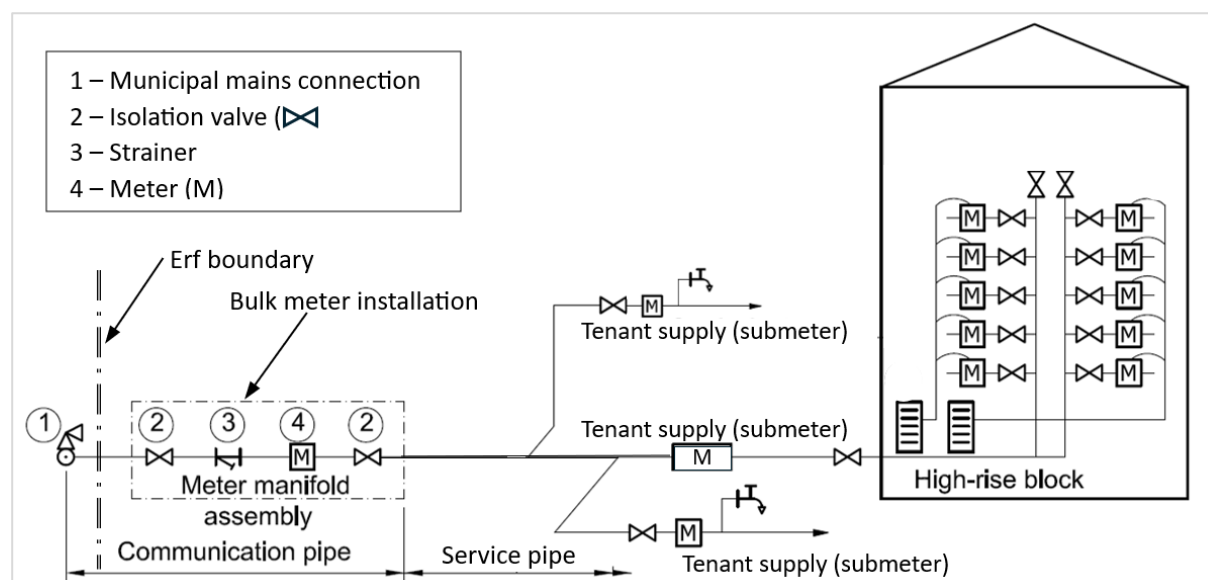


Figure 2: Typical Site Water Smart Meter Installation Layout

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A site assessment by a qualified Plumber/Technical Manager and/or Engineer is required to determine meter sizes for installation at each site that should typically fall into the listed application categories:

Table 3: Water Smart Meter Application Categories

Application	Nominal Bore	Flange Specification	Max. Working Pressure	Body Material
Housing / Commercial	15mm – 32mm ^{##}	SANS 1123 T16 / BS4504 T16	1600 kPa	Cast Iron
Commercial	40mm	SANS 1123 T16 / BS4504 T16	1600 kPa	Cast Iron
Medium Activity Depots / Commercial	80mm	SANS 1123 T16 / BS4504 T16	1600 kPa	Cast Iron
Industrial / Commercial	100mm	SANS 1123 T16 / BS4504 T16	1600 kPa	Cast Iron
High Activity Depots / Industrial	150mm [#]	SANS 1123 T16 / BS4504 T16	1600 kPa	Cast Iron

TECHNICAL REQUIREMENTS FOR THE SMART WATER METERING HARDWARE

- This technical specification is applicable for all the application categories of smart water meters, both bulk and submeters required as listed in Table 3 **except for water demand management devices which are only required for submeters**. Each site of installation must be assessed prior to the design of the installation and categorised into the application required per site.
- The respondent shall supply complete the right most column in response to the requirements of the equipment.
- The water meters can comprise of a holistic IoT integrated metering solution or can be provided as a water meter, data logger, and (for submeters only) water management device packaged together that meet the technical requirements listed below.
- The respondent shall provide supporting documentation that can demonstrate their expertise to fulfil these functional requirements.

Table 4: Technical Requirements for Water Smart Meters

#	Technical Requirements
R1.	General Requirements
R1.1.	The meter is intended to be permanently installed and be selected for long term unattended operation and minimal maintenance.
R1.2.	The water meter shall be installed in a suitable location where it is easily accessible and maintainable.
R1.3.	The meter shall be designed for easy maintenance and repairs without the use of special tools or equipment for dismantling or assembly.
R1.4.	The long-term reliability of the meter whilst operating in harsh environments and the battery life will be considered as very significant factors in the product selection.
R1.5.	The meter/meter solution may comprise of an all-inclusive IoT Water Smart Meter with demand management <u>OR</u> a combination of a water meter, a data logger, and a water management device to meet the minimum capability of: - measuring water flow, consumption, and pressure - data logging and remote transmission of measured parameters - controlling the quantity of water flowing through a water meter.

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R1.6.	The meter must be able to be installed in an above ground and/or underground chamber, which is intermittently flooded or similar.
R1.7.	The meter must use electromagnetic induction for measurements.
R1.8.	The meter must be fitted internally with an integral non-return valve that prevents the meter operating in the reverse direction.
R1.9.	The meter must be battery powered, user replaceable and locally sourced
R1.10.	The meter should be suitable for flow in light loads and from pumped pipes
R1.11.	The meter should be suitable for use with water temperatures up to 50°C and maximum working pressure of 1600 kPa.
R1.12.	The meter must have pulse output.
R1.13.	The meter must be suitable for vertical, horizontal, or inclined installation and have unlimited fitting positions
R1.14.	The meter must have a minimum usable life of 10 years, or the Responder must stipulate usable life.
R1.15.	The meter must be immune to magnetic interference
R1.16.	The meter display must be a 6 digits LCD display
R1.17.	The meter must be PN16 rated with both ends flanged
R1.18.	The meter nameplate shall be clearly and indelibly marked with the following information: - Name or trademark of the manufacturer - Meter serial number where first two digits indicate year of manufacture. - Direction of flow on both sides of the body - Unit of measurement - Meter type and size - Maximum admissible pressure - Pressure loss class - Temperature class - Straight pipe requirement - Metrological approvals and flow values.
R2.	Bulk Meter Installations (Above- and Below- ground Installation)
R2.1.	Site audits/assessment and data from TP representative should be obtained to aid the design and final position of the meter installation layout. All sites' Detailed Design shall be approval by TP prior installation.
R2.2.	Minimum requirements are indicated on the drawing TP/DWG.01 and TP/DWG.02. The designer is responsible and liable for further details and to ensure effective operation and maintenance of the site-specific installation.
R2.3.	The Bulk Water meters shall, where possible, always be installed immediately inside the stand boundary, as indicated on the Figure 5.
R2.4.	The designer remains responsible to ensure that all the guidelines, standard drawings, standards and specifications of the Department of Water and Sanitation and relevant Engineering Compliance Regulations have been met and are complied with in the design.
R2.5.	All material and workmanship must comply with the requirements of the latest relevant SANS standard.
R2.6.	Unless otherwise specified by the designer, class of concrete shall be: - Reinforced class 30/19 - Thrust blocks class 20/19 - Blinding class 15/19 - Floor screed sand: cement = 3:1

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R2.7.	Pre-cast concrete rings and cover slabs to comply with SANS 1294.
R2.8.	Joints between concrete rings and between cover slabs and between rings and floors to be sealed with sealant as approved by the designer.
R2.9.	All joints between the pipe and the chamber wall and between brick wall and concrete floor to be sealed to prevent water leaking into and out of the chamber. Method of sealing to be submitted to Transnet for approval.
R2.10.	Flange drilling to be in accordance with SANS 1123. Designer to specify flange table.
R2.11.	All bolts, washers and nuts to be hot dipped galvanised in accordance with SANS 763.
R2.12.	The designer to specify all pipework and shall to a minimum comply with standards as indicated in the drawing TP/DWG.01 and TP/DWG.02.
R2.13.	Underground steel pipe items to be wrapped as specified by the designer.
R2.14.	Where applicable, concrete supports shall be required underneath valves and pipe work. Such detail shall be indicated by the designer.
R2.15.	Designer shall specify step irons or ladder inside chamber for below ground installations. Such specified step irons/ladder shall be built in.
R2.16.	The Supplier's Design Team shall ensure that accurate as-builts of all infrastructure installed, replaced or relocated during the contract are submitted to Transnet. The submission shall include the position of pipe bends, junction boxes, duct ends, and all other underground infrastructure given by co-ordinates. Where necessary, levels shall also be given.
R2.17.	Road surfaces and paving shall be re-instated upon completion. The method of re-instatement of road surfaces shall be as described in the SANS 1200DM, SANS 1200ME and SANS 1200MH with the paving method of placement as described in the SANS 1200MJ. Re-instatement shall be done to the satisfaction of the Supplier's Designer and TP.
R3.	Measurement Requirements
R3.1.	Parameters to be measured, timestamped, and logged onboard at 15-minute intervals: - Current water flow rate (m³/h) - Water consumption (kl) - Water pressure (kPa)
R3.2.	Onboard memory shall be non-volatile and sufficient to store a minimum of the latest 3-month logged measurements.
R3.3.	Parameters to be timestamped and remotely transmitted at 30-minute intervals: - Current water flow rate (m³/h) - Water consumption (kl) - Water pressure (kPa)
R3.4.	Intervals for measurements, logging and transmission must be configurable.
R4.	Accuracy Requirements
R4.1.	The meter must conform to Class C Accuracy specification.
R5.	Water Management Requirements – Tenant Meters only
R5.1.	The water management valve and body must be waterproof (IP68 submerged), robust, chemical and UV resistant or UV stabilized.
R5.2.	The valve body must be plastic grade glass filled nylon reinforced to a PN10 - PN16 pressure rated
R5.3.	Water delivered via the valve must be at full bore pressure and not on a trickle flow basis and there must be no change in pressure or flow
R5.4.	The volume of water delivered via the valve shall not vary with pressure fluctuations with a flow rate range per municipal ratings
R5.5.	The water management device shall have capabilities to

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	a. Allow remote shut-off valves to cut off and restrict supply during excessive use or non-payment. b. Regulate flow allowing for restriction of water flow based on preset thresholds (e.g., per day/hour) and supply only during certain hours to encourage off-peak usage. c. Detect and alert unauthorized or wasteful usage.
R6.	Mechanical Requirements
R6.1.	The meter box shall be of metallic or non-metallic SANS approved, with a lockable but removable lid and be suitable for installation in the footway or lightly trafficked areas
R6.2.	The meter shall be protected against corrosion.
R6.3.	The meter box lids shall be provided with a slot to permit reading of the meter without removing the lid.
R6.4.	There must be sliding couplings for ease of installation and removal.
R7.	Communication Requirements
R7.1.	Local Communication: Pulse, Status, MBUS
R7.2.	Remote Communication Modules: Cellular GSM, 4G, 5G, and NB-IoT
R7.3.	Communication Protocols: MBUS, TCP/IP, DLMS/COSEM Wideband Code Division Multiple Access (WCDMA) (3G) and Long-Term Evolution (4G) with capability of 5G migration; NB-IoT
R8.	Security Requirements
R8.1.	The meter must be able provide alerts/alarms for: - Leak detection - Tamper detection - Fault detection - Low Battery
R8.2.	The water management device valve shall be tamper-resistant, and the valve is to shut automatically upon removal of a sensor, tamper detection or if seal is removed. The valve should be able to shut off at least an hour after any of the tampering takes place.
R8.3.	The meter box must be secured with a locking mechanism to protect the meter from unauthorised access.
R9.	Protection Requirements
R9.1.	Complete meters to be provided and fitted with protective security covers.
R9.2.	The IP rating of the supplied meter and accompanying equipment shall be no less than IP68.
R9.3.	The meter box must have: - fusion welded joints - a tamper proof locking mechanism (cover) - Keyed in fittings to prevent meter turning when removing or working with meter, and - SANS approved
R9.4.	The meter must have a wet dial.
R10.	Data Access Requirements
R10.1.	The logged data must be downloadable in a .csv-format as at 15 minutes intervals.
R10.2.	The measured data shall be transmissible remotely to an National Smart Metering System.
R11.	Environmental and Operational Requirements
R11.1.	Ambient Temperature

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R11.1.1.	The maximum external air temperature the equipment will be exposed to due to environmental conditions is 50 degrees Celsius.
R11.1.2.	The minimum external air temperature the equipment will be exposed to due to environmental conditions is negative 10 degrees Celsius.
R11.1.3.	No de-rating of any equipment shall occur when the equipment operates within the above-mentioned temperature ranges.
R11.2.	Operating Temperature
R11.2.1.	The intended application may be subjected to direct sunlight for prolonged periods of time. Accordingly, the design shall accommodate temperature rises within cubicles to ensure that the components do not exceed their specified temperature ratings and thus do not compromise equipment design life.
R11.2.2.	The design shall ensure that during operation under any condition, the surface of the supplied equipment shall not exceed 90 degrees Celsius.
R12.	Compliance Requirements
R12.1.	The meter must comply with the requirements of SANS 1529-1: 2019, BSS5728/1, ISO 4064/1 and the Legal Metrology Act
R12.2.	ISO 4064: Measurement of water flow in closed fully charged conduits – meters for cold potable water and hot water. Part 1: Specifications Part 2: Installation requirements Part 3: Test methods and Equipment
R12.3.	SANS 241: Water for domestic supplies
R12.4.	SANS 763: Hot-dip (galvanized) zinc coatings
R12.5.	SANS 1217: The production of painted and powder coated steel pipes
R12.6.	SANS 1294: Concrete works
R12.7.	SANS ISO 6509: Corrosion of metals and alloys- determination of dezincification resistance of brass
R13.	Obsolescence Management Requirements
R13.1.	The meter model must be commercially available for the next 8 years as a minimum or the meter model must be selected such that replacement in the event of obsolescence must be easily integrated into the NSM system.

5. SMART METERING SOFTWARE SPECIFICATION

The software development required for the National Smart Metering system shall form an Azure IoT platform on Transnet's own Microsoft Azure cloud platform. The system shall remotely receive data measured by on-site smart metering infrastructure, perform data processing, analysis, and storage, and provide graphical user interfaces for end-users.

The major problem that the works address is performing accurate **recoveries** under the Utilities Management processes due to lack of metering infrastructure and various other root causes of data inconsistency. Recoveries refer to the performance of billing and payments made by tenants compared to their share of consumption on the bulk accounts. Overview of the accounts status quo and the required major feature of the National Smart Metering System is shown below.

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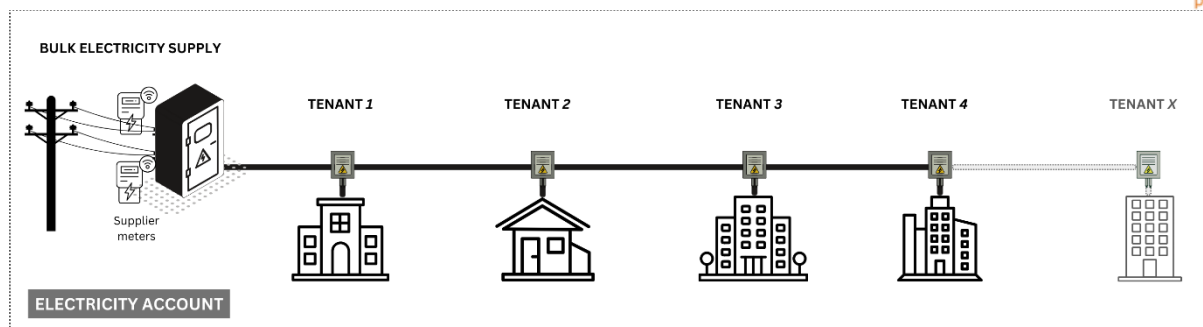


Figure 3: Bulk Electricity Accounts Status Quo

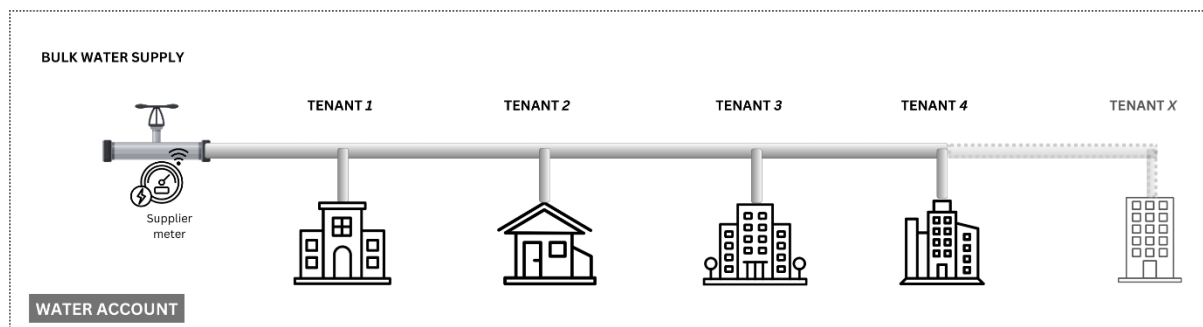


Figure 4: Bulk Water Accounts Status Quo

Internally owned meters are non-existent at many metering points within the tender resulting in new installations being part of the works. Bulk meters shall be installed at the metering point of the account while tenant meters (submeters) shall be installed at the point from which tenants are connected to the electrical reticulation enabling the account. Within the hardware installations and the software development, the account metering shall be structured (high level indication for demonstration purposes only) as per the images below. It is important to note that quantities and layout may slightly vary across the accounts.

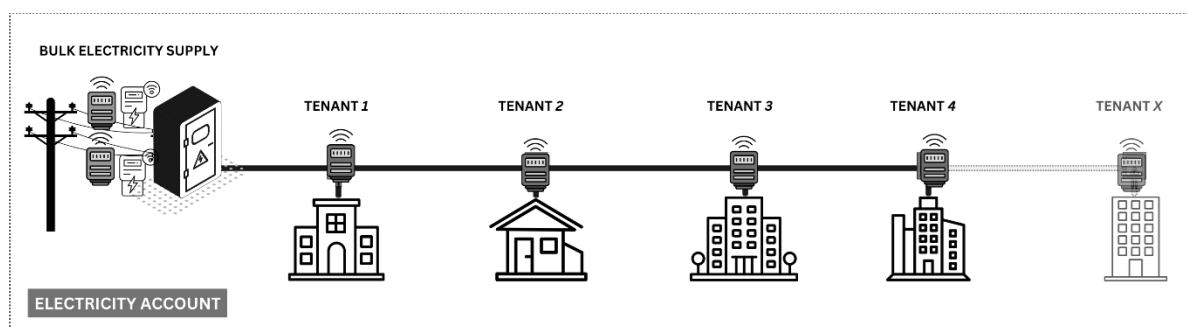


Figure 5: Bulk Electricity Accounts High Level New Metering Demonstration

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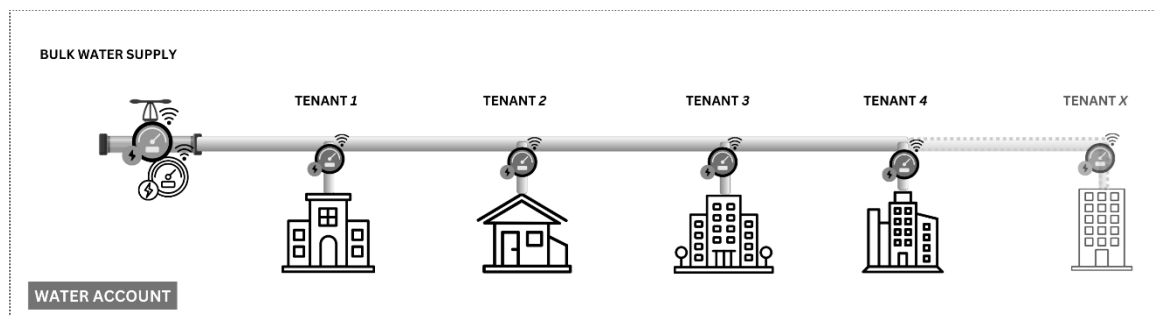


Figure 6: Bulk water Accounts High Level New Metering Demonstration

Meters installed at the bulk point of supply shall perform check metering enabled by internally owned meters installed adjacent to the account meters. This feature assists to enable *Accounts Payable* to be verified for accurate billing and attain data to be used for dispute resolution with Utilities Suppliers on a monthly invoice basis.

Meters installed at tenants' point of consumption/supply shall be categorized as submetering. This feature assists to enable *Accounts Receivable* to encompass accurate billing to tenants where consolidation of bills charged to tenants can be compared to the corresponding Account Payable on a monthly basis. Each tenant has an Account Receivable profile.

Recoveries check the performance of each Account Payable monthly invoice to all applicable tenants' payments made within their Account Receivable. Financial payments made for Accounts Payable and Accounts Receivable for recoveries are tracked within the SAP system, however, Utilities Management activities within the smart metering system must track the consolidation of usage and their associated costs from the metering data.

Account Recoveries = Account Payable: Σ Accounts Receivable

5.1. General

This specification is therefore not prescriptive of any one particular technology, architecture, or implementation paradigm. The successful bidder shall nevertheless demonstrate to the satisfaction of Transnet Property that the underlying software of their solution is fit for purpose: based on robust architecture model and framework using industry standard systems and applications, and compliance to all Transnet Standards and Policies.

There shall be no need for the installation of any software, hardware, or licensing required for front-end users.

Software deployment/ implementation shall be entirely cloud based with a Web based front-end.

The Web Application shall be guaranteed to work with standard versions of Internet browsers, including:

- Microsoft Edge
- Google Chrome
- Mozilla Firefox

There shall be no need for the installation of any browser extensions or "add-ons" such as Adobe Flash or similar.

The database shall have provision for automatically archiving raw data more than five years old, and this archived data shall be accessible if required.

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The metering data acquired and stored by the successful bidder is the property of Transnet Property and the successful bidder shall accept full responsibility for the safekeeping, integrity of this data and the uninterrupted provision of these services. The successful bidder shall provide a detailed procedure of how the disaster recovery and backups will be operated and maintained.

5.2. Authentication and Security

- 5.1.7. The National Smart Metering System must make use of a Device Manager to perform onboarding of smart meters into the system.
- 5.1.8. The Device Manager shall provide access control, encryption, and authentication, to prevent data breaches and unauthorized access.
- 5.2.1. The Device Manager must only allow authenticated smart meters to connect to and communicate with the National Smart Metering System.
- 5.2.2. The Device Manager must uniquely identify Smart Meters connecting to and communicating with the National Smart Metering System.
- 5.2.3. The Device Manager must enable configuration beyond the initial provisioning phase including updates to firmware, networking, access permissions, or other properties.
- 5.2.4. The Device Manager must provide OTA updates enable authorised personnel to push updates and patches to Smart Meters automatically.
- 5.2.6. The Device Manager must perform smart meter grouping according to function and location. The main smart meter function groups, viz. water or electricity and bulk meter or submeter.
- 5.2.7.

5.3. Databases and Relationship Management

- 5.3.1. The National Smart Metering System must maintain a database of installed smart meters with their unique SIM card ID, Serial code/number, and details e.g., property GPS coordinates and physical address, existing water pipe size, function, etc.
- 5.3.2. The National Smart Metering System must maintain an editable database of Utilities Suppliers and their Tariff Structures.
- 5.3.3. Bulk meters must be linked to the corresponding Account Payable.
- 5.3.4. The National Smart Metering System must maintain an editable database of Accounts Payable that correspond to the bulk smart meters at their point of supply from which Utilities Suppliers bill the Employer for consumption. The Utility account details include, but are not limited to:
 - 5.3.5. - Utilities Supplier,
 - 5.3.6. - Utilities Account number,
 - Applicable tariff structure and their billable line items,
- 5.3.7. Submeters must be linked with the applicable tenants Account Receivable.
- 5.3.8. The National Smart Metering System must maintain a database of basic lease agreement parameters, e.g. contract no, tenant name, lease duration, that correspond to the tenants submeters
 - Submeters within Accounts Receivable must also be linked with the applicable Account Payable to enable the tracking of recoveries.
 - The National Smart Metering System must maintain a database of Finance Cost Centres and their corresponding Accounts Payable and Accounts Receivable to enable SAP cashflow processing.

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5.4. Data Processing and Visualisation

The National Smart Metering System must ingest data from authenticated Smart Meters as listed in Table 2 and Table 4.

The National Smart Metering System must provide live views and historical views of data over a selected period for each utility, thus, day(s), week(s), month(s), year(s) with calendar plot via profile graphs, tables, etc.

5.4.1. The National Smart Metering System must process, store, and visualise site details such as the site name, meter type, meter GPS coordinates, logged channels (i.e. flow profiles, consumption, down and -upstream pressure, etc), attachments, etc.

5.4.2. The National Smart Metering System must process, store, and visualise ingested data to provide consumption, expenditure and carbon emissions that is both visualised on the National Smart Metering System and downloadable for reporting purposes.

5.4.3. The National Smart Metering System must provide the end-user groups with the customised user interfaces:

- Utilities Management
- Energy and Sustainability Management

5.4.4. The user interfaces shall be intuitive and easy to use.

5.4.5. The National Smart Metering System must provide the capability for end-users to perform remote downloading and exporting of raw data from the smart meters over a selected period for each utility, thus, day(s), week(s), month(s), year(s) with calendar plot.

5.4.6. The National Smart Metering System must provide the capability to enforce demand limits, i.e. control the flow rate of water at the meter installation point via the water management device on tenant submeters.

5.4.7. The National Smart Metering System must provide the capability to verify consumption billing of Account Payable Invoices received from Utilities Suppliers.

5.4.8. The National Smart Metering System Utilities Management application must be integrated with the SAP system to enable transfer of data for payments and billing.

5.4.9. Utilities management personnel must have the capability of loading Accounts Payable monthly invoices onto the National Smart Metering System by:

- importing Microsoft excel files detailing itemised billing, and/or
- automated generation of tariff structure line items where cost associated can be inputted to the user interface.

5.4.10. Utilities management personnel must have the capability of manually adding irregular billed items not typically included in the tariff structure, e.g., interest, deposits.

5.4.11. Each billed item on the invoices must be verified via back-end calculations where discrepancies must be flagged for dispute with the Utilities Suppliers.

5.4.12. In the event of a dispute, average payment of the invoice must be calculated to be sent to the finance department to keep the account status in good health during the process.

5.4.13. Disputes with Utilities Suppliers must be logged and tracked on the National Smart Metering System.

5.4.14. The National Smart Metering System must allow verified bills to be sent to the TP SAP system.

The National Smart Metering System must provide the capability to bill tenants with their consumption costs over a selected period for each utility, thus, day(s), week(s), month(s), year(s) using the consumption data recorded by the submeters.

The National Smart Metering System must allow tenant monthly Account Receivable cost to be sent to TP's SAP system.

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The National Smart Metering System must provide the capability to reconsolidate Accounts Receivable billing upon receipt of the linked Account Payable invoice for the selected period.

The National Smart Metering System must provide Utilities Management with the capability to send verified Account Payable invoices to the SAP system where payments can be actioned.

- 5.4.19. Utilities Management must also be provided with the capability to record payments made for each Account Payable on the National Smart Metering System for reporting purposes.
- 5.4.20. The National Smart Metering System must provide Utilities Management with the capability to send tenant Accounts Receivable billing to the SAP system where invoices can be generated by the finance department.
- 5.4.21. Utilities Managers must also be provided with the capability to record payments received from each tenant/lease on the National Smart Metering System for reporting purposes.
- 5.4.22. Account Payable invoice verification, payments made, and Accounts Receivable invoices generated, and payments received from tenants must be historically downloadable into reports using Excel and PDFs.
- 5.4.23. The National Smart Metering System must indicate and send notifications via a mobile application, cell phone numbers and email addresses in the event of alerts/alarms received by Smart Meters:
- 5.4.24.
 - Tamper detection
 - Fault detection
 - Leakage detection (Water Smart Meters only)
 - Low Battery (Water Smart Meters only)
- 5.4.25. The National Smart Metering System shall have an integrated alert/alarm management system that is able to diagnose, store and report on communication and other metering problems.
- 5.4.26. The National Smart Metering System must log events performed via the user interfaces including, but not limited to:
 - Smart Meter Alert/Alarm notifications
 - The Accounts Payable process
 - The Accounts Receivable process
- 5.4.27. Any and all access to the National Smart Metering System must be controlled using authenticated login credentials.
- 5.4.28. Customised access to the National Smart Metering System User Interfaces shall be provided using the end-user's login credentials according to their user group and area jurisdiction (national or regional).
- 5.4.29. National and regional management users shall be provided with management control of the personnel profiles linked to a manager user's profile.

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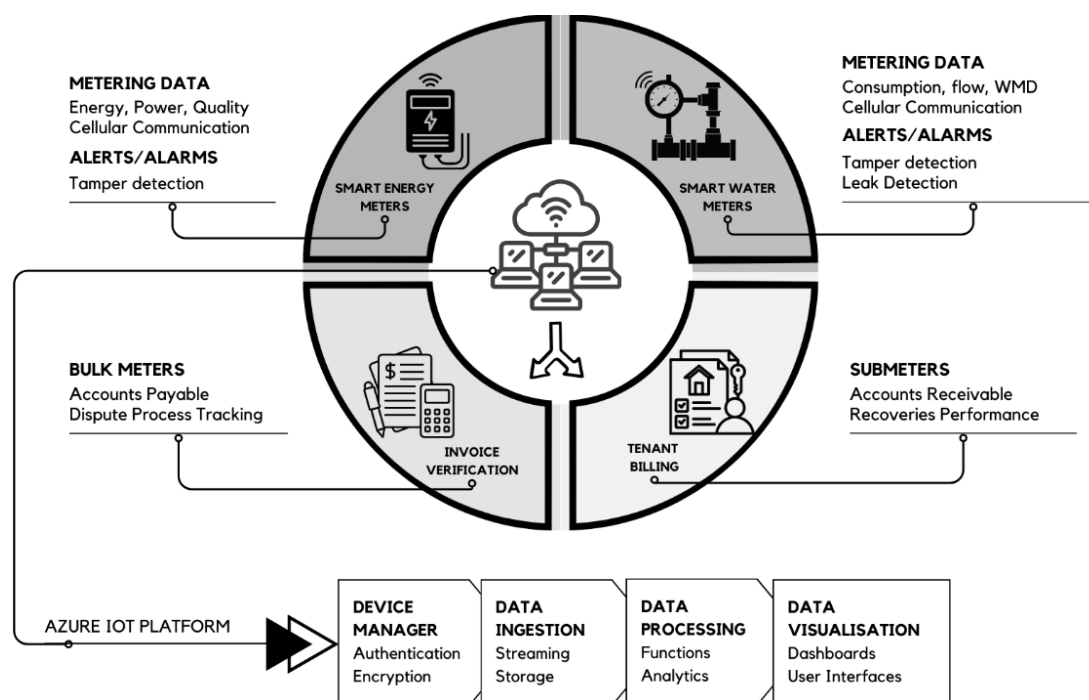


Figure 7: National Smart Metering System Feature Overview

6. ALTERNATIVES OFFERED

In addition to offers which comply with the requirements set forth in this Specification, Respondents may also offer alternative solutions that they consider might be advantageous and/or acceptable to Transnet Property.

Existing software modules developed by the Respondents may be proposed for integration into the solution in order to save on development time and activities. However, the Intellectual Property for the module will therefore be transferred to Transnet Property to ensure that ownership and system continuity are preserved.

The respondent may also offer additions to the scope, either being requested or of their own accord. The final decision to include these alternatives/additions will rest with Transnet Property.

7. APPLICABLE STANDARDS

The respondent shall acknowledge and be aware that the following standards and best practices are to be adhered for goods to be delivered. The respondent must also provide a list of standards that they have adhered to, other than those mentioned in this specification document, to which their products are compliant.

7.1. National Standards/Regulations

- SANS 10142-1 (Latest): The wiring of premises Part 1: Low-voltage installations
- NRS 048-2 (Latest): Electricity supply – Quality of Supply Part 2: Voltage characteristics, compatibility levels, limits, and assessment methods.

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- NRS 049-2 - Advanced Metering Infrastructure Requirement for Smart Metering System
- NRS 071 – Automated Meter Reading for Large Power Users
- NRS 057 – Code of Practice for Electricity Metering

7.2. IEC Standards

- IEC 62053-22:2021: Electricity metering equipment. Particular requirements Static meters for AC active energy.
- IEC 62053-23:2020: Electricity Metering Equipment - Particular Requirements - Part 23: Static Meters for Reactive Energy.
- IEC 62586-1:2017: Power quality measurement in power supply systems - Part 1: Power quality instruments (PQI)t
- IEC 61000-4-7:2009: Testing and measurement techniques – General guide on harmonics and inter-harmonics measurements and instrumentation, for power supply systems and equipment connected thereto.
- IEC 61000-4-23:2016: Testing and measurement techniques - Test methods for protective devices for HEMP and other radiated disturbances.
- IEC 61000-4-30:2021: Testing and measurement techniques - Power quality measurement methods.
- EN50160: Voltage characteristics of electricity supplied by public distribution systems.
- EN61326-1: Electrical equipment for measurement, control, and laboratory use - EMC requirement - General requirements.
- EN60068 2-6: Environmental Testing - Part 2: Tests - Test Fc: Vibration (Sinusoidal).

7.3. ICT Policies and Standards

- Transnet ICT Cloud Standard and all other applicable documents will be provided to the successful bidder

8. PROPOSED PROJECT TIMELINES

8.1. Delivery

- The proposed timeline for a completed delivery and installation for the first phase of the required smart metering infrastructure to Transnet Property is described in the Technical Evaluation Criteria.
- The hardware and software aspects of the project are required to be done in parallel with each other.
- Delivery of all items quoted on shall be to various locations across all sites the five regions of Transnet Property. The priority list will be shared with the appointed supplier.
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8.2. Documentation

- The manufacturing and calibration certificates of all equipment shall be provided upon delivery of the equipment to Transnet Property.
- All technical datasheets shall be provided upon delivery of the equipment to Transnet Property.

8.3. Warranty

- All equipment shall be supplied with a 24-month warranty from the time of installation, testing and commissioning.

8.4. Clarification

- Should any void or uncertainty exist within any clause throughout this specification the supplier is at liberty to contact Transnet Property through the correct channels and request subsequent clarification.

8.5. Evaluation Criteria

- It is required that the supplier respond to the evaluation criteria accompanying this specification.

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