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FOREWORD

Recommendations for corrections, additions or deletions should be addressed to the:

Technology Services General Manager

City Power Johannesburg (Pty) Ltd

P O Box 38766

Booysens

2016

INTRODUCTION

When any electrical system fails to meet its purpose, it is time to investigate the problem, find the cause, and initiate corrective action. The purpose of the electrical distribution system is to support proper operation of the loads. When a load does not operate properly, the quality of the electric power in the system should be suspected as one possible cause. Whether it is used for troubleshooting purposes or to obtain baseline data, measuring/analysing electrical system parameters is called power quality analysis.

Measuring and monitoring quality of supply to the customer is a mandatory licence requirement for City Power Johannesburg. The NRS 048 provides the minimum requirement to be monitored which is a voltage waveform quality (voltage unbalance, voltage regulation, harmonics, and fluctuation) and voltage events like (voltage dips, voltage swells, voltage interruptions and voltage harmonics). Due to changes in the Electrical environment having instruments which measures the minimum requirements is no longer sufficient. Therefore City Power Johannesburg required a specific instrument or a recorder and a meter that can measure other parameters such as energy, power, current and flicker.

Furthermore, the large number of different types of metering billing meters being utilized at present, range from mechanical to electronic, cause problems such as errors in meter readings and also increased maintenance. It has therefore become necessary to standardise and rationalise on electronic three phase bulk or intake meters and associated components which will improve the accuracy of meter readings and again giving the quality of supply information as required by NRS 047 and NRS 048. Covering both quality of supply and billing requirements This implies that this instrument will have the capability of satisfying NRS 048 quality of supply requirements and also to be able to give the billing file as required by metering department

1 SCOPE

This specification details City Power's requirements for Quality of Supply (QoS) and check metering measuring instruments. The QoS and check metering instruments shall be installed in substations and City Power Key Customers. All the instruments, communication and data storage shall comply with NRS and SANS/IEC requirements.

This specified instrument will cover also three phase bulk or intake meters, QoS and the electronic three phase demand and energy meters and spares for all the meters specified in this specification

2 NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this specification. All standards and specifications are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the possibility of using the most recent editions of the standards listed below

SANS/IEC 61000-1-1: *Electromagnetic compatibility (EMC) Part 1: General Section 1: Application and interpretation of fundamental definitions and terms.*

SANS/IEC 61000-4-15: *Electromagnetic compatibility (EMC) - Part 4-15: Testing and measurement techniques – Flicker-meter - Functional and design specifications*

SANSIEC 61000-4-7: *Electromagnetic compatibility (EMC) Part 4-7: Testing and measurement techniques — General guide on harmonics and inter-harmonics measurements and instrumentation, for power supply systems and equipment connected thereto.*

SANS/IEC 61000-4-11: *Electromagnetic compatibility (EMC) Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests*

SANS/IEC 61000-4-29: *Electromagnetic compatibility (EMC) Part 4-29: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests*

SANS/IEC 61000-6-1: *Electromagnetic compatibility (EMC) Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments*

SANS/IEC 61000-6-2: *Electromagnetic compatibility (EMC) Part 6-2: Generic standards — Immunity for industrial environments*

SANS/IEC 61010-1: *Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements.*

SANS/IEC 61010-2-032: *Safety requirements for electrical equipment for measurement, control and laboratory use Part 2-032: Particular requirements for handheld and hand-manipulated current sensors for electrical test and measurement*

SANS/IEC 61000-4-30 : *Electromagnetic compatibility (EMC) Part 4-30: Testing and measurement techniques — Power quality measurement methods.*

SANS/IEC 61000-2-2: *Electromagnetic compatibility (EMC) Part 2-2: Environment — Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems.*

SANS/IEC 61000-2-12: *Electromagnetic compatibility (EMC) Part 2-12: Environment — Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems.*

SANS/IEC 61000-2-4: *Electromagnetic compatibility (EMC) Part 2-4: Environment — Compatibility levels in industrial plants for low-frequency conducted disturbances.*

SANS/IEC *61000-2-8: Electromagnetic compatibility (EMC) - Part 2-8: Environment - Voltage dips and short interruptions on public electric power supply systems with statistical measurement results*

SANS/IEC 61000-3-7*: Electromagnetic compatibility (EMC) - Part 3-7: Limits - Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems*

SANS/IEC 60364-5-53: *Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control*

SANS/IEC 60721-3-1: *Classification of environmental conditions - Part 3 Classification of groups of environmental parameters and their severities - Section 1: Storage*

SANS/IEC 60721-3-2: *Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transportation*

SANS 60721-3-3: *Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations*

SANS/IEC 60870-5-104: *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

SANSIEC 61850-1: *Communication networks and systems for power utility automation Part 1: Introduction and overview.*

SANS/IEC 1816: *Electricity supply – quality of supply: Power quality monitoring instruments specification.*

NRS 048-2: Part 2: *Voltage characteristics, compatibility levels, limits and assessment methods*

SANS/IEC 60068-2-63: E*nvironmental testing part 2: Testing methods test e.g.: impact, spring hammer*

SANS/IEC 60068-2-6: *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed

The following standards should be used in relation to the Bulk Intake and Check metering component of the Quality of supply statistics and check metering instrument with billing capabilities CP_TSSPEC_003:

SANS/IEC 62051: *Electricity metering – Glossary of terms*.

SANS/IEC 474:2018 Electricity Metering – Standard requirements
SANS/IEC 62052-11: *Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment.*

SANS/IEC 62053-11: *Electricity metering equipment (a.c.) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2).*

SANS/IEC 62053-21, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2).*

SANS/IEC 62053-22, *Electricity metering equipment (a.c.) – Particular requirements – Part 22: Static meters for active energy (classes 0,2 S and 0,5 S).*

SANS/IEC 62053-23, *Electricity metering equipment (a.c.) – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3).*

SANS/IEC 61968-9: *Application integration at electricity utilities system interfaces for distribution management – Part9 Interfaces for meter reading control*

SANS/IEC 1524-1: *Electricity payment systems Part 1: Payment meters*

SANS/IEC 62055-31*: Electricity metering — Payment systems Part 31: Particular requirements — Static payment meters for active energy (classes 1 and 2)*

SANS/IEC 62055-41*: Electricity metering – Payment systems – Part 41: Standard transfer specification (STS) – Application layer protocol for one-way token carrier systems*

SANS/IEC 1799, *Watt-hour meters – AC electronic meters for active energy.*

SANS/IEC 9001: *Quality Systems – Model For Quality Assurance In Design/Development, Production, Installation And Servicing.*

SANS 60529: *Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides.*

SANS/IEC 62056-21: *Electricity metering — Data exchange for meter reading, tariff and load control Part 21: Direct local data exchange*

SANS/IEC 61036:*Alternating-current static watt-hour meters for active energy (Classes 1 and 2).*

NRS 057:2009: *Code of practice for electricity metering*

NRS 009: *Electricity Sales Systems*.

NRS 071, *automated meter reading for large power users.*

3 DEFINITIONS AND ABBREVIATIONS

Definitions used in this document shall reference to those used at the normative reference documents, Including the below specific general power engineering abbreviations related the Specification for Quality of supply statistics and check metering instrument with billing capabilities

AC	:	Alternating Current
CT	:	Current Transformer
GSM	:	Global System for Mobile communications
Hz	:	Hertz (frequency)
IEC	:	International Electromechanical Commission
ISO	:	International Standards Organisation
kVA	:	Kilovolt-ampere
kVAh	:	Kilovolt-ampere-hour
kVAr	:	Reactive kilovolt-ampere
kVArh	:	Reactive Kilovolt-ampere-hour
kW	:	Kilowatt
kWh	:	Kilowatt-hour
LED	:	Light Emitting Diode

PC : Personal Computer
SABS : South African Bureau of Standards
VA : Volt-ampere
VAh : Volt-ampere-hour
VAr : Reactive volt-ampere
VArh : Reactive volt-ampere-hour
VT : Voltage Transformer
W : Watt
Wh : Watt-hour
ROM : Read Only Memory
EEPROM : Electrically Erasable Programmable ROM

4 ENVIROMENTAL CONDITIONS REQUIREMENTS

4.1 Operating conditions

4.1.1 **Operating environment for fixed indoor use**

Environmental Parameters	**Storage and Transport**	**Indoor Operations**
Ambient temperature: limit range of operation	-40°C to + 70°C	-25°C to + 55°C
Ambient temperature: rated range of operation		-10°C to + 45
Relative humidity: 24 h average	from 5% to 95%	from 5% to 95%
Solar radiations		700 W/m²
Altitude		≤ 1800 m
Pollution degree		2 acc to SANS/IEC 61010
Overvoltage category (related to the mains supply)		Overvoltage category III
Measurement category (related to the measurement inputs)		Measurement category III or IV

Table 1: Environmental levels

4.1.2 **Safety requirements**
Safety tests shall be conducted according to SANS/IEC 61010.

Overvoltage categories specified in SANS/IEC 61010-1 as well as Measurement categories specified in SANS/IEC 61010-2-30 shall apply.

4.1.3 **EMC Emission**
CISPR 22 class A requirements shall apply.

4.1.4 **EMC Immunity**
Immunity tests shall be conducted according to SANS/IEC 61000-6-5. Taking into account the "Measurement" performance criteria. Devices shall comply with G environment.

EMC Immunity Parameters	**Indoor Operations**
Continuous phenomena: SANS/IEC 61000-6-5	(i) PQ instrument is operational, and (ii) PQ instrument continues to provide accurate steady-state measurements, both during and after the time when continuous EMC phenomena are applied in accordance with SANS/IEC61000-4-30 , Class A
Transient phenomena with high occurrence or **transient phenomena with low occurrence**: SANS/IEC 61000-6-5	(i) PQ instrument is operational, and (ii) PQ instrument continues to provide accurate steady-state measurements, both during and after the time when continuous EMC phenomena are applied in accordance with SANS/IEC61000-4-30, Class A (but not necessarily during the time when they are applied).

Table 2: EMC Immunity

4.1.5 **Climatic Requirements**

Climatic test, fully operation	**Standard and level**	**Test requirement**	**Temperature limits**
Cold	SANS/IEC 60068-2-1 Test Ad	96 hours	-25°C
Dry Heat	SANS/IEC 60068-2-2 Test Bd	96 hours	+55°C
Damp Heat	SANS/IEC 60068-2-78 Test Cab	93% RH, 4 days	+40°C
Temperature changes with a specified variation speed	SANS/IEC 60068-2-14 Test Nb	0°C to maximum temperature, 1°C / min, t1 = 2 hours, 5 cycles	+55°C

Table 3: Climatic test fully operation

Climatic test, de-energised	**Standard and level**	**Test requirement**	**Temperature limits**
Cold	SANS/IEC 60068-2-1 Test Ab	96 hours	-40°C
Dry Heat	SANS/IEC 60068-2-2 Test Bd	96 hours	+70°C
Temperature changes with a specified variation speed	SANS/IEC 60068-2-14 Test Nb	-40°C to maximum temperature, 3°C / min, t1 = 2 hours, 5 cycles	+70°C

Table 4: Climatic test de-energised

4.1.6 **Mechanical Requirements**

All parts that are subject to corrosion under normal working conditions shall be protected effectively. Under normal working conditions, the protective coating shall not be damaged due to exposure to air nor by ordinary handling.

Mechanical robustness, in operation test	**Standard and level**	**Test requirement**
Behaviour to vibrations	SANS/IEC 60068-2-6 Test Fc	Frequency range: 10 Hz to 150 Hz Sweeping frequency range: 58 Hz to 60 Hz 0,075 mm, 2-9 Hz, 20 cycles 0,5 g_n, 9-150 Hz, 20 cycles
Behaviour to shocks	SANS/IEC 60068-2-27 Test Ea	10 gn / 11 ms, 3 pu
Behaviour to earthquakes	SANS/IEC 60068-2-57	1-35 Hz, Zero period acceleration = 1 g_n horizontal, 0,5 g_n vertical
Endurance to vibrations	SANS/IEC 60068-2-6 Test Fc	Frequency range: 5 Hz to 150 Hz Sweeping frequency range: 8 Hz to 9 Hz 7,5mm, 2-9Hz, 20 cycles 2 g_n, 9-150Hz, 20 cycles
Resistance to shocks	SANS/IEC 60068-2-27 Test Ea	15 gn / 11 ms, 3 pulses
Free fall tests	SANS/IEC 60068-	The test shall be conducted with equipment in

	2-31 Test Ec, free fall procedure 1	the transport packaging Free fall 500 mm Number of stresses: 2 each side
Resistance to heat and fire	SANS/IEC 60068-2-1/1	The terminal block, terminal cover and meter case shall ensure reasonable safety against spread of fire and shall not ignite by thermal overload of live parts in contact with them.

Table 5: Mechanical requirements

4.2 Degree of Protection by Enclosure (IP code)

IP 52 Protection rating is required to support both indoor and portable installations

The manufacturer shall document equipment Intrusion Protection (IP) according to SANS/IEC 60529.

4.3 Parameters

The method of measurement for class A power quality parameter shall be as specified in SANS/IEC 61000-4-30. This class is used where precise measurements are necessary, for example, for contractual applications that may require resolving disputes, verifying compliance with standards, etc. Any measurements of a parameter carried out with two different instruments complying with the requirements of Class A, when measuring the same signals, will produce matching results within the specified uncertainty for that parameter.

The basic measurement time interval for parameter magnitudes (supply voltage, harmonics, inter-harmonics and unbalance) shall be a 10-cycle time interval for 50 Hz power system. The 10/12-cycle measurement shall be re-synchronised at every UTC (Universal Time Coordinated) of 10-min tick. The 10/12-cycle values are then aggregated over 3 additional intervals: – 150/180-cycle interval (150 cycles for 50 Hz nominal)/ 10-min interval/ 2-hour interval for Plt flicker.

4.4 Measurement aggregation algorithm

4.4.1 Requirements

Aggregations shall be performed using the square root of the arithmetic mean of the squared input values.

NOTE For flicker measurements, the aggregation algorithm is different (SANS/IEC 61000-4-15).

4.4.2 150/180 Cycle aggregation

The data for the 150/180-cycle time interval shall be aggregated without gap from fifteen 10/12-cycle time intervals. The 150/180-cycle time interval is resynchronized upon the UTC 10-min tick. When a 10-min tick occurs, a new 150/180-cycle time interval begins, and the pending 150/180-cycle 365 time interval also continues until it is completed. This may create an overlap between these two 150/180-cycles intervals.

4.4.3 10-min aggregation

The 10-min aggregated value shall be tagged with the absolute time (for example, 01H10.00). The time tag is the time at the conclusion of the 10-min aggregation. The data for the 10-min time interval shall be aggregated from 10/12-cycle time intervals. Each 10-minute interval shall begin on a UTC 10-min tick. The 10-min tick is also used to re-synchronize the 10/12-cycle intervals and the 150/180-cycle intervals. The final 10/12-cycle interval(s) in a 10-min aggregation period will typically overlap in time with the UTC 10-min clock tick. Any overlapping 10/12-cycle interval is included in the aggregation of the previous 10-min interval.

4.4.4 2-hour aggregation

The data for the 2-hour interval shall be aggregated from twelve 10-min intervals. The 2-hour interval shall be gapless and not overlapping.

4.4.5 Time-clock uncertainty

Time clock uncertainty shall be defined relative to Universal Time Coordinated (UTC), which is continuously incrementing and available world-wide.

NOTE: The time clock may move forwards or backwards under certain circumstances, such as daylight savings time, external sychronisation updates, etc. When the clock moves forward in time, the user should be aware that there may be gaps in the data. When the clock moves backwards in time, the user should be aware that data may overlap in time.

The absolute time-clock uncertainty shall not exceed ±20 ms for 50 Hz regardless of the total time interval. When synchronisation by an external signal becomes unavailable, the time tagging tolerance shall be better than ±1 sec per 24-hour period; however, this exception does not eliminate the requirement for compliance with the first part of this paragraph.

4.4.6 **Flagging concept**

The flagging concept is applicable for Class A during measurement of power frequency, voltage magnitude, flicker, supply voltage unbalance, voltage harmonics, voltage inter harmonics, mains signaling and measurement of under deviation and over deviation parameters.

NOTE: Information about other types of flagging, or data marking, may be found in IEC 62586-1 (Draft).

For check metering part of this specification, nothing in this specification shall lessen the obligations of the supplier. The supplier shall be fully responsible for the design and supply of three phase meters; and its satisfactory performance in service. Approval by City Power shall not relieve the supplier of the responsibility for the adequacy of the design.

4.5 General billing meter requirements as per SANS/IEC 61036

The meters shall provide all the functions of measurement, registration and multiphase recording required for the metering of a balanced and unbalanced, single or polyphase feeder, with the exception of the external aerial where required, each meter shall be completely self-contained in a single case containing all the necessary terminations.

The meters shall be able to record:

a) Forward and reverse Watt-hours (Wh).
b) Leading and lagging reactive Volt-ampere-hours (VArh).
c) Volt-amperes (VA).
d) Maximum demand.
e) Load profile of Wh (forward and reverse).
f) Load profile of VArh (leading and lagging).

4.6 Maximum Demand as per SANS/IEC 61036

a) Maximum demand measurement shall be programmable to kW and kVA.
b) The meters shall record the maximum demand in kVA, as well as in kW.
c) Maximum demand measurement shall be programmable to the block interval principle.
d) Integration periods shall be programmable to 15, 30 and 60 minutes.

4.7 Energy as per SANS/IEC 62056-21

a) Actual energy measurement shall be programmable to kWh.
b) Reactive energy measurement shall be programmable to kVAr

4.8 Accuracy as per SANS/IEC 61036

The meters shall be of Class 0.2 accuracy as prescribed by SANS/EC 61036

4.9 Operating conditions with an option for an internal mode as per SANS/IEC 62052-11

The design and construction of the meter shall be suitable for the following conditions:

a) Altitude above sea level: at 1800m
b) Ambient temperature: 35 °C ± 2 °C;
c) Relative humidity: 40 % to 60 %; and
d) Atmospheric pressure: 80 kPa to 106 kPa.
e) Lighting: Severe
f) Operating range: −10 °C to 55 °C
g) Dust: Severe

5 QUALITY OF SUPPLY MEASURED NRS 048 PARAMETERS

5.1 Power frequency

The frequency reading shall be obtained every 10-s. As power frequency may not be exactly 50 Hz within the 10-s time clock interval, the number of cycles may not be an integer number. The fundamental frequency output is the ratio of the number of integral cycles counted during the 10-s time clock interval, divided by the cumulative duration of the integer cycles. When a zero crossing method is used for frequency calculation, then before assessment harmonics and inter-harmonics shall be attenuated to minimize the effects of multiple zero crossings.

The measurement time intervals shall be non-overlapping. Individual cycles that overlap the 10-s time clock are discarded. Each 10-s interval shall begin on an absolute 10-s time clock, with uncertainty as defined in SANS/IEC 61000-4-30. Other techniques that provide equivalent results, such as convolution, are acceptable.

5.1.1 Measurement uncertainty and measuring range

Under the conditions described in SANS/IEC 61000-4-30, the measurement uncertainty shall not exceed ±10 MHz over the measuring ranges 42.5~57.5 Hz / 51~69 Hz.

5.1.2 Measurement evaluation

The frequency measurement shall be made on the reference channel.

NOTE: The manufacturer should specify the behavior of frequency measurement whenever the reference channel loses voltage.

5.1.3 Aggregation

Aggregation is not mandatory.

5.2 Magnitude of the supply voltage

The measurement shall be the R.M.S. value of the voltage magnitude over a 10-cycle time interval for 50 Hz power system. Every 10/12-cycle interval shall be contiguous, and not overlapping with adjacent 10/12-cycle.

NOTE 1 This specific measurement method is used for quasi-stationary signals, and is not used for the detection and measurement of disturbances: dips, swells, voltage interruptions and transients.

NOTE 2 The R.M.S. value includes, by definition, harmonics, inter-harmonics, mains signalling, etc.

5.2.1 Measurement uncertainty and measuring range

Under the conditions described in SANS/IEC 61000-4-30. , the measurement uncertainty shall not exceed ±0, 1 % of 498 Udin, over the range of 10% ~ 150% of U_{din}.

5.2.2 Measurement evaluation

No requirements.

5.2.3 Aggregation

Aggregation shall be performed according to SANS/IEC 61000-4-30.

5.3 Flicker

Class F1 is recommended, and may be required in the next Edition of this specification.

5.3.1 Measurement uncertainty and measuring range

See SANS/IEC 61000-4-15, the measurement uncertainty required by SANS / IEC 61000-4-15 shall be met over the measuring range of 0,2~10 P_{st}.

5.3.2 Measurement evaluation

The 10-min time interval for P_{st} shall commence on a UTC 10-min tick, and shall be tagged with the absolute time of SANS/IEC 61000-4-30 . Voltage dips, swells, and interruptions shall cause P_{st} and P_{lt} output values (see SANS/IEC 61000-4-15) to be flagged.

5.3.3 Aggregation

Aggregation shall be performed according to SANS 61000-4-15.

5.4 Supply voltage dips and swells

The basic measurement U_{rms} of a voltage dip and swell shall be the $U_{rms(½)}$ on each measurement channe. The cycle duration for $U_{rms(½)}$ depends on the frequency. The frequency might be determined by the last non-flagged power frequency measurement of SANS / IEC 61000-4-30, or by any other method that yields the uncertainty requirements of SANS /IEC 61000-4-30 .

NOTE 1: The $U_{rms(½)}$ value includes, by definition, harmonics, interharmonics, mains signalling voltage, etc.

NOTE 2: It is important to avoid loss of data when dips and swells occur in a rapid sequence (for example, three events in one second, with up to one minute between sequences, may occur when a recloser operates into a sustained fault). If, during a rapid burst, the dip/swell event characteristics cannot be recorded, then a count of events may be useful.

5.4.1 Detection and evaluation of a voltage dip

5.4.1.1 Voltage dip detection

The dip threshold is a percentage of either U_{din} or the sliding voltage reference U_{sr}. The user shall declare the reference voltage in use. On single-phase systems a voltage dip begins when the U_{rms} voltage falls below the dip threshold, and ends when the U_{rms} voltage is equal to or above the dip threshold plus the hysteresis voltage. On polyphase systems a dip begins when the U_{rms} voltage of one or more channels is below the dip threshold and ends when the U_{rms} voltage on all measured channels is equal to or above the dip threshold plus the hysteresis voltage. The dip threshold and the hysteresis voltage are both set by the user according to the use.

NOTE Sliding voltage reference U_{sr} is generally not used in LV systems. See SANS 61000-2-8 for further information and advice.

5.4.1.2 Voltage dip evaluation

A voltage dip is characterized by a pair of data: either residual voltage (U_{res}) or depth, and duration:

– the residual voltage of a voltage dip is the lowest U_{rms} value measured on any channel during the dip;

– the depth is the difference between the reference voltage (either U_{din} or U_{sr}) and the residual voltage. It is generally expressed in percentage of the reference voltage.

NOTE 1: During the dip it may be useful to also record the lowest $U_{rms\,(½)}$ on each channel, in addition to the residual voltage of the dip. The duration spent below the dip threshold on each channel may also be useful.

NOTE 2: If voltage waveforms are recorded before, during, and after a dip, useful information about phase angle changes may be available in the recorded data.

The start time of a dip shall be time stamped with the time of the start of the U_{rms} of the channel that initiated the event and the end time of the dip shall be the time stamped with the time of the end of the U_{rms} that ended the event, as defined by the threshold plus the hysteresis. The duration of a voltage dip is the time difference between the start time and the end time of the voltage dip.

NOTE 1: For polyphase measurements, the dip duration may start on one channel and terminate on a different channel.

NOTE 2: Voltage dip envelopes are not necessarily rectangular. As a consequence, for a given voltage dip, the measured duration is dependent on the selected dip threshold value. The shape of the envelope may be assessed using several dip thresholds set within the range of voltage dip and voltage interruption thresholds.

NOTE 3: Typically, the hysteresis is equal to 2 % of U_{din}.

NOTE 4: Dip thresholds are typically in the range 85 % to 90 % of the fixed voltage reference for troubleshooting or statistical applications.

NOTE 5: Residual voltage is often useful to end-users, and may be preferred because it is referenced to zero volts. In contrast, depth is often useful to electric suppliers, especially on HV systems or in cases when a sliding reference voltage is used.

NOTE 6 Phase shift may occur during voltage dips.

NOTE 7 When a threshold is crossed, a time stamp may be recorded.

5.4.2 Detection and evaluation of a voltage swell

5.4.2.1 Voltage swell detection

The swell threshold is a percentage of either U_{din} or the sliding reference voltage U_{sr}. The user shall declare the reference voltage in use.

– On single-phase systems a swell begins when the U_{rms} voltage rises above the swell threshold, and ends when the U_{rms} voltage is equal to or below the swell threshold minus the hysteresis voltage.

– On polyphase systems a swell begins when the U_{rms} voltage of one or more channels is above the swell threshold and ends when the U_{rms} voltage on all measured channels is equal to or below the swell threshold minus the hysteresis voltage. The swell threshold and the hysteresis voltage are both set by the user according to the use.

5.4.2.2 Voltage swell evaluation

A voltage swell is characterized by a pair of data: maximum swell voltage magnitude and duration.

– the maximum swell magnitude voltage is the largest U_{rms} value measured on any channel during the swell;

– The start time of a swell shall be time stamped with the time of the start of the U_{rms} of the channel that initiated the event and the end time of the swell shall be the time stamped with the time of the end of the U_{rms} that ended the event, as defined by the threshold minus the hysteresis.

– the duration of a voltage swell is the time difference between the beginning and the end of the swell.

NOTE 1: For polyphase measurements, the swell duration measurement may start on one channel and terminate on a different channel.

NOTE 2: Voltage swell envelope may not be rectangular. As a consequence, for a given swell, the measured duration is dependent on the swell threshold value.

NOTE 3 Typically, the hysteresis is equal to 2 % of U_{din}.

NOTE 4 Typically, the swell threshold is greater than 110 % of U_{din}.

NOTE 5: Phase shift may also occur during voltage swells.

NOTE 6: When a threshold is crossed, a time stamp may be recorded.

5.4.3 Calculation of a sliding reference voltage

The sliding reference voltage implementation is optional, not mandatory. If a sliding reference is chosen for voltage dip or swell detection, this shall be calculated using a first-order filter with a 1-min time constant.

This filter is given by

$$U_{sr(n)} = 0{,}9967 \times U_{sr(n-1)} + 0{,}0033 \times U_{(10/12)rms}$$

Where:

$U_{sr(n)}$ is the present value of the sliding reference voltage;
$U_{sr(n-1)}$ is the previous value of the sliding reference voltage; and
$U_{(10/12)rms}$ is the most recent 10/12-cycle r.m.s. value.

When the measurement is started, the initial value of the sliding reference voltage is set to the declared input voltage. The sliding reference voltage is updated every 10/12-cycles. If a 10/12-cycle value is flagged, the sliding reference voltage is not updated and the previous value is used.

5.4.4 Measurement uncertainty and measuring range

The measurement uncertainty shall not exceed ±0,2 % of Udin.

5.4.4.1 Duration measurement uncertainty

The uncertainty of a dip or swell duration is equal to the dip or swell commencement uncertainty (half a cycle) plus the dip or swell conclusion uncertainty (half a cycle).

5.4.4.2 Aggregation

Aggregation is not applicable for triggered events.

5.5 Voltage interruptions

The basic measurement of the voltage shall be as defined in SANS /IEC 61000-4-30.

5.5.1 Evaluation of a voltage interruption

The voltage interruption threshold is a percentage of U_{din}. On single-phase systems, a voltage interruption begins when the U_{rms} voltage falls below the voltage interruption threshold and ends when the U_{rms} value is equal to, or greater than, the voltage interruption threshold plus the hysteresis. On polyphase systems, a voltage interruption begins when the U_{rms} voltages of all channels fall below the voltage interruption threshold, and ends when the U_{rms} voltage on any one channel is equal to, or greater than, the voltage interruption threshold plus the hysteresis.

The voltage interruption threshold and the hysteresis voltage are both set by the user according to the use. The voltage interruption threshold shall not be set below the uncertainty

of residual voltage measurement plus the value of the hysteresis. Typically, the hysteresis is equal to 2 % of U_{din}. The start time of a voltage interruption shall be time stamped with the time of the start of the U_{rms} of the channel that initiated the event and the end time of the voltage interruption shall be the time stamped with the time of the end of the U_{rms} that ended the event, as defined by the threshold plus the hysteresis. The duration of a voltage interruption is the time difference between the beginning and the end of the voltage interruption.

NOTE 1: The voltage interruption threshold can, for example, be set to 5% or to 10% of U_{din}.

NOTE 2: IEV 161-08-20 considers an interruption to have occurred when the voltage magnitude is less than 1% of the nominal voltage. However, it is difficult to correctly measure voltages below 1% of the nominal voltage. Therefore, this document recommends that the user set an appropriate voltage interruption threshold.

NOTE 3: The interruption of one or more phases on a polyphase system can be seen as an interruption of the supply to single-phase customers connected to that system, even though this would not be classified as an interruption in a polyphase measurement.

5.5.2 **Measurement uncertainty and measuring range**

For duration measurement uncertainty, see 5.4.5.2 of SANS 61000-4-30.

5.5.3 **Aggregation**

Aggregation is not applicable for triggered events.

5.5.4 **Requirements**

The South African definition of a voltage interruption differs from the interruption definition in IEC61000-4-30. Any dip where the depth drops below a pre-defined threshold is classified as either a momentary or a sustainable interruption.

Devices shall classify momentary and sustainable interruption correctly as per latest NRS048 requirement.

5.6 Transient voltages

SANS/IEC 61000-4-30, provides some informative information on the significant parameters necessary to characterise transient voltages. Measurement of transient voltages can be useful but is not mandatory.

NOTE: The measurement of transient voltages is not mandatory, but devices with the ability to measure of transient voltages will be preferred.

5.7 Supply voltage unbalance

Unbalance measurements apply only to 3-phase systems. The supply voltage unbalance is evaluated using the method of symmetrical components. In addition to the positive sequence component U_1, under unbalanced conditions there also exists at least one of the following components: negative sequence component U_2 and/or zero sequence component U_0. The fundamental component of the voltage input signal is measured over a 10-cycle time interval for 50 Hz power systems.

NOTE 1: The effect of harmonics is minimized by the use of a filter or by using a DFT (Discrete Fourier Transform) algorithm.

NOTE 2: Algorithms that use only the RMS values to calculate unbalance fail to take into account the contributions of angular displacement to unbalance, and cause unpredictable results when harmonic voltages are present. The negative sequence unbalance and zero sequence unbalance provide more precise and more directly useful values.

NOTE 3: The zero sequence unbalance by definition is zero when phase-to-phase voltages are measured. However, the phase-to-neutral or phase-to-earth voltages may still contain the zero sequence component in that case.

5.7.1 **Measurement uncertainty and measuring range**

The uncertainty shall be less than ±0,15% for both u2 and u0. For example, an instrument presented with a 1,0 % negative sequence shall provide a reading x such that 0,85 % ≤ x ≤ 1,15 %.

5.7.2 **Measurement evaluation**

No requirements.

NOTE: The uncertainty of measurement transformers, if present, may have a large impact on the calculation of unbalance.

5.7.3 **Aggregation**

Aggregation shall be performed according to SANS / IEC 61000-4-30 .

5.8 Voltage harmonics and Inter harmonics

The basic measurement of voltage harmonics, for Class A, is defined in SANS 61000-4-7 Class I. That standard shall be used to determine a 10/12-cycle gapless harmonic subgroup measurement, denoted $\boldsymbol{U}_{sg,h}$ in SANS /IEC 61000-4-7.

NOTE 1: Other methods, including analogue and frequency domain methods, may be preferred in special cases (see, for example, SANS / IEC 61000-3-8).

Measurements shall be made at least up to the 50th order. If the total harmonic distortion is calculated, then it shall be calculated as the subgroup total harmonic distortion (***THDS***), defined in SANS /IEC 61000-4-7. The recorder shall be able to perform anomaly detection of events which do not conform to an expected pattern.

NOTE 2: This measurement method generates a large amount of data, which, depending on the application, may need to be stored, transmitted, analyzed, and/or archived. Depending on the application, the amount of data may be reduced. To reduce the amount of data, consider applying statistical methods at the measuring location, or storing only extreme and average values, or storing detailed data only when trigger thresholds are exceeded, or other methods.

5.8.1 Measurement uncertainty and measuring range

The maximum uncertainty shall be the levels specified in SANS / IEC 61000-4-7 Class I. Measuring range shall be 10% to 200% of class 3 electromagnetic environment in SANS /IEC 61000-2-4.

5.8.2 Measurement evaluation

No requirements.

5.8.3 Aggregation

Aggregation shall be performed according to SANS / IEC 61000-4-30.

NOTE: To minimize storage requirements, after aggregation has been completed it may be practical to discard source data (such as 10/12 cycle or 150/180 cycle data) if it is no longer required.

5.9 Mains signalling voltage on the supply voltage

Mains signaling voltage, called “ripple control signal” in certain applications, is a burst of signals, often applied at a non-harmonic frequency, that remotely control industrial equipment, revenue meters, and other devices.

5.9.1 Measurement method

The method described here shall be used for mains signaling frequencies below 3 kHz. For mains signaling frequencies above 3 kHz, see SANS / IEC 61000-3-8. This method measures the level of the signal voltage for a user-specified carrier frequency. Mains signaling voltage measurement shall be based on:

– either the corresponding 10/12-cycle r.m.s. value inter harmonic bin;
– or the root of the sum of the squares of the 4 nearest 10/12-cycle r.m.s. value inter harmonic bins (for example, a 316, 67 Hz ripple control signal in a 50 Hz power system shall be approximated by a root of the sum of the squares of 310 Hz, 315 Hz, 320 Hz and 325 Hz bins, available from the DFT performed on a 10/12 cycle time interval).

The first method is preferred if the user-specified frequency is in the center of a DFT bin. The second method is preferred if the frequency is not in the center of a bin. The user must select a detection threshold above 0,3% U_{din} as well as the length of the recording period up to 120 s. The beginning of a signaling emission shall be detected when the measured value of the concerned inter-harmonic exceeds the detection threshold. The measured values are recorded during a period of time specified by the user, in order to give the maximum level of the signal voltage.

NOTE: The purpose of this method is to measure the maximum level of the signal voltage, and not to diagnose mains signaling difficulties.

5.9.2 Measurement uncertainty and measuring range

The measurement range shall be at least 0% to 15% of U_{din}. For mains signaling voltage between 3% and 15% of U_{din}, the uncertainty shall not exceed ±5% of the measured value. For mains signaling voltage between 1% and 3% of U_{din}, the uncertainty shall not exceed ±0.15% of U_{din}. For mains signaling voltage less than 1% of U_{din}, no uncertainty requirement is given.

5.9.3 Aggregation

Aggregation is not mandatory.

5.10 Rapid voltage changes (RVC)

An RVC event is a quick transition in RMS voltage between two steady-state conditions, during which the voltage does not exceed the dip/swell thresholds. The RVC threshold is set by the user according to the use, as a percentage of U_{din}.

NOTE: Thresholds in the range of 1% to 6% might be considered. In IEC 61000-3-7, for example, RVC thresholds of 2, 5% to 6% of *U*din for medium voltage are considered. In SANS IEC 61000-3-3, RVC thresholds of 3, 3% to 6% for low voltage are considered. In both standards, the thresholds are linked to the number of RVC events per hour or per day. In SANS IEC 61000-4-15, a threshold of 0,2% is considered for a similar, but not identical, parameter.

5.10.1 RVC Event evaluation

An RVC event is characterized by four parameters:

5.10.1.1 The start time of an RVC event shall be time stamped with the time that the 'voltage-is-steady state' logic signal became false and initiated the RVC event.

5.10.1.2 The RVC event duration is 100/120 half cycles shorter than the duration of the false state of the 'voltage-is-steady-state' logic signal.

5.10.1.3 The RVC event ΔU_{max} is the maximum absolute difference between the $U_{rms(1/2)}$ values during the RVC event, and the final $U_{rms(1/2)}$ value during the preceding steady-state condition.

5.10.1.4 The RVC event ΔU_{ss} is the absolute difference between the final $U_{rms(1/2)}$ value during the preceding steady-state condition and the $U_{rms(1/2)}$ value when the steady-state logic signal goes back to true.

5.10.1.5 It is useful to count the number of RVC events per hour, or per day, or both.

NOTE: if the calculated duration is 0 or is negative, the duration shall be set to one half cycle.

NOTE 1: for counting purposes the user or manufacturer will use a counting period according to the use.

NOTE 2: The period may be an "hour" and based on calendar time or based on a sliding window comprising the most recent 60 minutes sliding once per minute on the minute. The period may also be a "day" and based on calendar time or based on a sliding window comprising the most recent 24 hours, sliding once per hour on the hour.

5.10.2 Measurement uncertainty

The uncertainty of an RVC is dependent on the accuracy for the $U_{rms(1/2)}$ and on the correct and complete implementation of the algorithm described above.

5.11 Under deviation and over deviation

See Annexure D of SANS IEC 61000-4-30, (informative).

5.12 Current

In a power quality context, current measurements are useful as a supplement to voltage measurements, especially when trying to determine the causes of events such as voltage magnitude change, dip, interruption, or unbalance. The current waveform can further help associate the recorded event with a particular device and an action, such as a motor being started, a transformer being energized or a capacitor being switched.

Linked with voltage harmonics and inter-harmonics, the current harmonics and inter-harmonics can be useful to characterize the load connected to the network. This document does not define any trigger or threshold methods for current. If current changes, but the change is not sufficient to trigger one of the voltage threshold methods, then that change in current is not a power quality event.

NOTE: Current transients are not considered in this document. Some useful comments are provided in Annexure A of SANS/IEC 61000-4-30.

5.12.1 Magnitude of current

A full-scale r.m.s current shall be specified, with a minimum crest factor of 3,0.

For consideration of full-scale, the measurement shall be the $I_{rms(½)}$ value as defined in SANS/ IEC 61000-4-30 .

NOTE: The r.m.s. value includes, by definition, harmonics, inter-harmonics, etc.

5.12.2 Measurement uncertainty

The measurement uncertainty shall not exceed ±0.2% of reading in the range of 10% to 100% of the specified full-scale r.m.s current as stated in the SANS/IEC 61000-4-30.

NOTE: This uncertainty requirement does not take into account uncertainties introduced by current sensors. Guidance on sensors can be found in in SANS / IEC 61557-12 annexure C or D.

5.12.3 Measurement evaluation

Aggregation intervals as described in SANS / IEC 61000-4-30 shall be used.

NOTE: For single-phase systems, there is a single r.m.s. current value. For 3-phase 3-wire systems, there are typically 3 r.m.s. current values; for 3-phase 4-wire systems, there are typically 4 current values. The earth current may be measured as well, either by measuring current in an earth conductor or by determining residual current.

NOTE: Additional aggregation techniques might be used for smoothing, for example with a digital filter as specified in SANS/IEC 61000-4-7.

5.12.4 Current recording

Whenever an r.m.s voltage channel is recorded, the corresponding r.m.s current channel shall also be recorded at an equivalent aggregation level. This applies both to triggered voltage events, such as dips and swells and RVC, and to continuing aggregation, such as 10-min and 2-hr.

5.12.5 Harmonic currents

The basic measurement of current harmonics, for the purpose of this standard, is defined in SANS / IEC 61000-4-7. Aggregation intervals as described in SANS/IEC 61000-4-30, shall be used. A 10/12-cycle current harmonic measurement is marked "flagged" if either a voltage dip or voltage swell occurs during this time interval.

NOTE: This measurement method generates a large amount of data, which, depending on the application, may need to be stored, transmitted, analyzed, and/or archived. Depending on the application, the amount of data may be reduced. To reduce the amount of data, consider applying statistical methods at the measuring location, or storing only extreme and average values, or storing detailed data only when trigger thresholds are exceeded, or other methods.

5.12.6 Inter harmonic currents

The basic measurement of current inter-harmonics, for the purpose of this standard, is defined in SANS / IEC 61000-4-7. Use that standard to determine a 10/12-cycle gapless centered inter-harmonic sub-group measurements, denoted $C_{isg,n}$. Aggregation intervals as described in SANS /IEC 61000-4-30 shall be used. A 10/12-cycle inter-harmonic current measurement is marked "flagged" if either a voltage dip or voltage swell, or a voltage interruption occurs during this time interval.

5.12.7 Current unbalance

The basic measurement method for current unbalance shall be identical to the measurement method for supply voltage unbalance. Aggregation intervals as described in SANS / IEC 61000-4-30 shall be used.

5.12.8 Energy as per SANS / IEC 61000-4-30

The minimum energy to be measured for shall be as follows:

5.12.8.1 Active power (Watt): Export, Import and Total
5.12.8.2 Reactive power (VAr): Export, Import and Total
5.12.8.3 Apparent power (VA): Export, Import and Total
5.12.8.4 Watt-hr Export, Import and Total;
5.12.8.5 VA-hr Export, Import and Total;
5.12.8.6 VAR-hr Export, Import and Total;
5.12.8.7 Power demand shall be calculated using a sliding window comprised of a configurable amount of 1 second sub-intervals. The meters shall be supplied with set to but selectable from 1 to 30 minute time intervals.

5.12.9 Graphical Phasors as per SANS / IEC 61000-4-30

The Graphical Phasors to be measured for shall be as follows:

5.12.9.1 Graphical Phasors of line-to-neutral voltages, line-to-line voltages and currents. The device shall allow the user to select which parameters to show.

5.12.9.2 The system must enable comparison between various recorders' graphical phasors.

6 VOLTAGE AND CURRENT TRANSFORMER RATIOS FOR CHECK METERING & BILLING

6.1 A range of external VT's and CT's ratios shall be programmable.
6.2 Compensation for external VT and CT errors shall be programmable.

7 CONNECTION TERMINAL REQUIREMENTS FOR CHECK METERING

Voltage and current terminals shall satisfy the relevant requirements of SABS/IEC 1036.

8 MEASURING QUADRANTS FOR CHECK METERING

The meters shall be capable of measuring quantities in all four quadrants.

9 LOAD PROFILE RECORDING FOR CHECK METERING

9.1 In addition to the memory required for billing data, the meters shall be fitted with sufficient memory to record up to four half-hourly load profile quantities for up to 240 days, for subsequent retrieval via the optical or RS232 communications ports.

9.2 Load profile recording shall be possible in 15, 30 and 60 minute time intervals. The active time interval shall be the same as the programmed integration period for maximum demand measurement.

10 HISTORICAL REGISTERS FOR CHECK METERING

At the end of each billing period all billing register data shall be transferred to historical registers which shall retain the data for at least the four most recent completed billing periods.

11 DATA EXTRACTION FOR CHECK METERING

11.1 It shall be possible to extract all billing, load profile, programmable set-up data, and instantaneous values from the meter via the optical port by using a hand held unit or a personal computer, as well as remotely.

11.2 In the case of downloading load profile, it shall be possible to select downloading of all load profile data stored in the meter at the time, or only that part of the load profile that has not been downloaded previously.

11.3 It shall be possible to extract all billing, load profile, programmable set-up data and instantaneous values from the meter, irrespective of which data has been programmed to be displayed on the meter.

12 PROGRAMMING AND SECURITY FOR CHECK METERING

To enable programming or resetting of registers, meters shall perform security checks which verify that the programming is authorized. Programming shall be disabled if this verification fails.
The following shall be password protected:

12.1 Programming of meters
12.2 Setting and resetting of time and date
12.3 Resetting of billing and accumulative registers that are not reset by the normal end of billing period reset signal.
12.4 Changing of passwords
12.5 Downloading of meter setup file where applicable.

13 SOFTWARE MASTER RESET FOR CHECK METERING

It shall be possible to reset all billing registers (including accumulative registers) on the meter by means of a software function using the master station. This reset function shall not alter the meter password or set-up data. It shall be possible to change tariff tables (active times) on a batch basis by means of instructions programmed into the hand held unit/master station system.

13.1 End of integration period

The end of integration period shall be programmable to be initiated by any of the following means:

13.1.1 Automatically by an internal timer.
13.1.2 An external signal via an auxiliary input.

13.2 Real time clock and calendar

13.2.1 Meters shall be provided with a crystal controlled real time clock that will not drift by more than ± 3,5 seconds per day over the full temperature range specified for the meters.
Note: *Tenderers shall state the accuracy of the real time clock.*

13.2.2 The calendar shall automatically cater for leap years.

Note: Tenderers must state up to which year the calendar will be programmed for.

13.2.3 It shall be possible to synchronise the clock and calendar via the optical and RS232 ports, as well as remotely via the proposed remote meter reading system, as a specific operation as well as part of the operation of extracting data from the meter.

13.2.4 It shall be possible to synchronize the clock and calendar without resetting any other parameters in the meter.

14 METER DIAGNOSTICS

Meters shall be capable of performing self-diagnostic checks to ensure correct operations of ROM, EEPROM, clock and battery.

15 POWER SUPPLY FOR CHECK METERING

15.1 The auxiliary power supply shall be derived from all three phase to phase voltages or all three phases to neutral voltages.

15.2 Meters shall remain operative in the event that only two phases are energized on a 3 wire system or single phase energized in a 4 wire system.

16 POWER CONSUMPTION

The requirements given in SANS /IEC 62055-31 shall apply with the exception that the power consumption requirements for voltage circuits.

16.1 Internal battery

Meters shall be provided with a back-up battery (Lithium battery) to support the clock and calendar in the event of an AC power failure. Life expectancy of a back -up battery should last for a minimum of 10 years.

16.2 Auxiliary Inputs

Two auxiliary inputs shall be provided for the purpose of resetting the integration period and end of billing period when the meters are so programmed.

16.3 Auxiliary Outputs

Four programmable auxiliary outputs are required for synchronization of other meters, indication of active season, active tariff period, and output of active and reactive energy pulses for energy management use.

17 MAINTENANCE

OEM's shall include documentation of the equipment offered in terms of this specification, guaranteeing that they are able to provide full repair and calibration services for the equipment offered.

18 SPARES

OEM's shall include documentation of the equipment offered in terms of this specification, guaranteeing the availability of spares for the equipment supplied up to 10 years

19 SAMPLES

19.1 If the product offered was not previously purchased by City Power, a sample shall be lodged within two working days on request, at City Power Head Office, 40 Heronmere Rd, Reuven, and Booysens Johannesburg.

19.2 Samples shall be properly labeled to show the:

a) Contract number
b) Item number
c) Name of bidder.

20 INPUT CHANNEL FOR QOS RECORDING

The Input channel to be measured for shall be as per SANS /IEC 61000-4-30:

20.1 The QoS recorder shall be able to measure the supplied Voltage and Current for three phase 3-wire (Delta), 4-wire (Star) or single phase loads;

20.2 All the three phase line currents and voltages shall be measured; also substation protection DC on a separate channel from the three phase meter to monitor substation DC

20.3 The recorder shall measure the neutral line current in combination with the neutral to earth voltage;
20.4 The current interfaces shall be through 1/5A circuits or current transducer inputs (exp. 5A:1V transducer) not to cut into exciting metering or protection CT circuits;
20.5 The measurements shall be 99.9% accurate for voltage and 99.8% for current; and
20.6 The recorder shall be able to at least measure peak currents of up to 50A for 3 second as per the SANS/ IEC61000-4-30 Class A requirements after the Current Transformer (CT), for a short duration.

21 MEMORY CAPACITY

The instrument shall be able to measure simultaneously and store all 10 min trended data required to monitor compliance with minimum standards without overwriting captured data.

21.1 The QoS recorder on-board storage capacity shall be ≥1Gigabyte.
21.2 The instrument shall be designed not to lose data, if without power for a period of 50 days.
21.3 The instrument shall not lose its configuration or set-up information, if not energized for a period of six months.

22 CALIBRATION RETENTION

The instrument shall be designed not to lose calibration parameters in if not energized for a period of 5 years.

23 INTERNAL ENERGY SOURCE

The life expectancy of the internal energy source shall be five years under normal operating conditions.

24 CONNECTION OR INTERFACE PORTS

Local Connection and Remote connection shall be via these ports:

24.1 USB port,
24.2 Serial port and
24.3 RJ45 (Ethernet) port.

25 COMMUNICATIONS PROTOCOLS

25.1 Communication protocols for Check Metering

25.1.1 Optic-Electronic Communications Port

25.1.1.1 A bi-directional infra-red communications port shall be provided which complies with SANS/IEC 1107 to allow reading of all stored data, programming of meter configuration data and checking of diagnostic registers.
25.1.1.2 The interface between the meter and programming device shall also comply with this specification.
25.1.1.3 The port shall be accessible from the front of the main cover.
25.1.1.4 It shall be possible to interface to a hand held unit, as well as a personal computer (PC).

25.1.2 RS232 / RS455 Port

25.1.2.1 A RS232/RS455 or equivalent port shall be provided to enable the meter to communicate with a modem for direct interrogation from a remote point.
25.1.2.2 The port shall only be accessible via a sealable cover.
25.1.2.3 The port shall be isolated from the rest of the meter circuitry to Class II as required in SANS/IEC1036.

25.1.3 GSM modems

The manufacturer shall make provision, in their pricing for items detailed above, but fitted with an internal cellular modem for communication on the GSM network with provision for, and

including, an external aerial, for the purpose of remote interrogation and programming of the meter.

25.2 Communication protocols for Quality of Supply

The instrument shall have a RS232, Ethernet and USB communication interface through which the instrument can be configured, Data download, synchronized, and software and firmware upgraded.

Communication protocols requirements shall be:

25.2.1 SANS / IEC61850,
25.2.2 Modbus – RTU,
25.2.3 Modbus – TCP/IP,

The instrument shall have integral web server, which is capable of monitoring all real-time information using latest Internet Explorer. The web server shall provide access to all devices features, such as real-time monitoring, power quality status, remote control and full device configuration. The instrument shall communicate to a designated PC.

NOTE: Required information form the respective meter, installed on site, to be transmitted to a remote server via the wireless modems or Multiplexer.

26 SYNCHRONISATION

26.1 A GPS (Global Positioning System) shall be supplied with every recorder so that accurate time data can be obtained.
26.2 Multiple devices shall have the ability to synchronise to themselves, maximum time difference between them shall be 100 microseconds
26.3 The GPS shall be installed, configured and tested with the recorder to verify the time synchronisation.
26.4 All data shall be time stamped with one microsecond resolution.

27 PANEL MOUNT

The instrument shall be suited for panel chassis (DIN rail) mounting inside metering panel.

28 RIDE-THROUGH

The Instrument shall have ride-through capability of 16.7 minutes (This requirement was derived from NRS048 dip chart that stops at 1,000 seconds.) when the supply is interrupted to the instruments. The instruments shall regain full ride-through capability within 30 minutes of the supply being restored. During the course of such a supply interruption, all measured data up to the point of shutdown shall be recorded and interpreted correctly on the following power-up.

29 INSULATION

The instrument and its incorporated auxiliary devices, if any, shall retain adequate dielectric qualities under normal conditions of use, while taking into account the atmospheric influence and different voltages to which the instrument will be subjected.

30 ELECTRICAL PARAMETERS FOR QUALITY OF SUPPLY INPUTS

Voltage quality measurement shall be performed on single phase or three phase supply systems. Depending on the context, it might be necessary to measure phase-to-phase, phase-to-neutral, and or phase-to-earth voltages. Star or delta configurations shall be taken into account.

30.1 Power Supply

The burden, (Volt-Amperes), or the impedance of the input circuits, (mega-ohms), and the power consumption of the auxiliary supply, shall be stated in schedules. If the instrument takes power from the measured terminals of a voltage transformer (VT), the instrument shall not alter the characteristics of the voltage on the measured terminals (e.g. surge protective devices, harmonic current).

30.2 Mains supply frequency

The mains supply frequency range shall be 50Hz for all instruments. When tested for the influence of the supply frequency, the functionality of the instrument shall not be impaired and there shall be no loss of previously stored information.

30.3 Supply protection requirements

In the event of an instrument developing an internal electric fault or if the supply voltage exceeds the specified operational voltage level, the instrument shall disconnect itself (internally) from the external power supply, or shall not exceed 20VA burden in the case of a fault.

30.4 Electrical connections

The terminal type and the size of wire that can be accepted shall be 2.5mm^2 solid.

30.5 Electromagnetic compatibility (EMC)

The instrument shall not generate noise that could interfere with other equipment. The instrument shall be so designed that when immunity tested (fast transient burst test, immunity to electromagnetic HF fields and to electrostatic discharge, and surge immunity), emitted electromagnetic disturbances and electrostatic discharges do not damage or substantially influence the operation and functionality of the instrument, or change any stored information.

31 MECHANICAL

All parts that are subject to corrosion under normal working conditions shall be protected effectively. Under normal working conditions, the protective coating shall not be damaged due to exposure to air nor by ordinary handling.

31.1 Case – SANS/IEC 60068-2-63

The case shall be constructed and arranged in such a manner that, when the spring hammer test is performed, any non-permanent deformation shall not prevent the satisfactory operation of the instrument.

31.2 Resistance to shock – SANS/IEC 60068-2-27

When the mechanical shock test is performed, the instrument shall show no signs of damage or change in stored information.

31.3 Resistance to vibration – SANS/IEC 60068-2-6

When the vibration test is performed, the instrument shall show no signs of damage or change in stored information.

31.4 Resistance to heat and fire – SANS/IEC 60068-2-1/1

The terminal block, terminal cover and meter case shall ensure reasonable safety against spread of fire and shall not ignite by thermal overload of live parts in contact with them.

32 POWER QUALITY DATA ACQUISITION AND INFORMATION SYSTEM

32.1 General requirements

The Power Quality Data Information and Acquisition System (PQ DIAS) shall contain the following main components:

32.1.1 A central data base to host and serve recorded data.

32.1.2 An automated data collection & data import module to acquire data from online PQ measurement devices and other open data sources supported by legacy and other third party devices.

32.1.3 A data analysis and enrichment module to turn raw measured data into information. It includes an automated report generation tool to generate NRS048 compliant reports and report per incident.

32.1.4 An interactive mobile friendly web interface module from where users can access and configure devices, retrieve data and visualise retrieved data in various formats.

32.1.5 An alarming module that can distribute instrument and other system generated alarms directly to authorised end-users via SMS, Push Notifications and E-Mail.

32.2 Infrastructure

The power quality data acquisition information system (PQDAIS) shall have the following features as detailed on below.

32.2.1 Central data base

The supplier or OEM must specify all server/cluster hardware, server rack, UPS and communication infrastructure and supply, install and commission software required running the PQ DIAS.

The supplier or OEM must supply all database administration and technical support services required to fully operate and maintain the PQ DIAS system for the duration of the contract. The PQ DAIS must have the following basic capabilities:

32.2.1.1 Hardware Scalable

32.2.1.2 All functionality must be accessible via a mobile friendly web browser interface.

32.2.1.3 Supports and manages at least 1,000 simultaneous users

32.2.1.4 Supports role-based security and rights management.

32.2.1.5 Supports and manages at least ± 20,000 simultaneous instruments.

32.2.2 Web-Based

The system shall provide an interactive and mobile friendly web interface to browse data.

32.2.2.1 Real-time view Dashboards

The following live dashboards will give situational awareness:

- Individual and combined consumption for a selection of sites
- Quality of supply parameters for a specific site, including voltage magnitude, THD, flicker, voltage unbalance
- Quality of supply parameter overview for a selection of sites, including voltage magnitude, THD, flicker, voltage unbalance
- Real time waveform display of minimum 4 cycles of line-to-line voltages and currents. The device shall be capable of displaying at least 3 different parameter waveforms simultaneously.
- The system must enable comparison between various recorders' waveform and phasor.
- Voltage and current harmonics and inter-harmonics at the point of measurement

32.2.2.2 Incidents

A dedicated incident exploration tool shall be provided performing at least the following functions:

- Allow user to enable viewing NRS048-2:2015 compatibility criteria on graphs
- Display events contained in aggregated incident
- Show sequence of events

- Allow user to split and combine incidents
- Allow user to re-assign events to another incident
- Allow browsing of event diagnostic data (e.g. event waveform and RMS data) in an interactive manner, including zoom and pan
- Allow export of event diagnostic view to: CSV, picture format

32.2.2.3 Trended data

A dedicated trended data exploration tool shall be provided performing at least the following functions:

- Allow browsing of trended data in an interactive manner, including zoom and pan
- Allow export of data view to: CSV, picture format
- Allow user to enable viewing NRS048-2:2015 compatibility criteria on graphs
- Allow data from multiple sites to be viewed on the same graph

32.2.2.4 Security and Encryption

Access to the instrument as well as to the software shall be obtained according to minimum three access levels: Viewer, Operator and Administrator. Each level shall have a pre-set access password, which can be changed. The system shall provide modern secure communications with the web-server. It shall have the capabilities to allow the access of data in the system from any site on the web without the need for a private network.

32.2.2.5 **Users**

The system shall support different users. Access to system functionality shall be granted based on the role of the user in the system.

- Viewer,
- Operator; and
- Administrator

32.3 Measurement QoS Sites

The system shall manage a number of measurement sites. It shall be possible to create/update/delete/view sites. The system will provide tools to manage data availability at all sites. The system shall provide functionality to define site connectivity (line diagram) in order to provide NRS-048-6 and NRS-048-8 interruption reporting.

32.4 Data acquisition

The system shall be able to download and import data from a number of instruments such as:

32.4.1 Vectograph,
32.4.2 Provograph,
32.4.3 Vecto II or III
32.4.4 Impedo DUO and
32.4.5 Elspec Blackbox.

The data download shall be automatic and continuous. The support software supplied with each of the above-mentioned devices does have the ability to export its data in PQDIF format. Data may therefore be directly retrieved from these devices and automatically imported into the central data store (preferred choice), or it may be automatically imported into the data store by using the PQDIF file format.

32.5 Alarms

Alarms shall be created on the following type of events:

32.5.1 When a PQ event was recorded
32.5.2 When pre-defined assessment criteria levels on trended parameters were to be exceeded.
32.5.3 When system health assessment criteria levels were exceeded (e.g. device temperature too high).
32.5.4 When the system or PQ measurement device status change (e.g. when a connected device goes offline).

The system shall support the following special type of assessments:

32.5.5 Create alarm on specific NRS048-2:2015 classified types of dips and swells (e.g. create alarm on S class dips only).

32.5.6 Create alarm when one of a combination of contractual obligations at key customers was to be exceeded.

32.5.7 Create alarm when planning or design levels of a combination of parameters for a particular asset were to be exceeded.
When any assessment fails, a ticket shall be opened in the system and relevant users notified (according to their notification preferences).

32.5.8 Notifications shall be delivered according to user preference and can be any of:

- E-mail
- SMS
- Mobile push notification.

The notification shall contain a link to navigate the user directly to the ticket and related data.

32.6 Reporting

The system shall be able to generate the following types of reports.

32.6.1 Energy reports:
32.6.1.1 Billing audit report (system wide)
32.6.1.2 Compare measured with expected data
32.6.1.3 Summate data collected in a node and calculate the balance (loss)
32.6.1.4 Maximum demand (Import and Export)
32.6.1.5 Consumption report (per site)
32.6.1.6 Combined consumption report (sum of sites)
32.6.1.7 Derived feeder (calculated by combining load profile for the remaining feeders at a node)
32.6.1.8 Typical weekday profile
32.6.1.9 Typical weekend profile
32.6.1.10 Technical losses
32.6.2 Power Quality reports:
32.6.2.1 Site assessment report as per NRS 048-2:2015
32.6.2.2 Interruption statistic report as per NRS 048-6 and 8
32.6.2.3 Network incident report
32.6.2.4 NERSA yearly report
32.6.2.5 Characteristic voltage dip/swell values

Note: Reports can be requested ad hoc, or scheduled for delivery at a set interval.

32.7 Analysis functions

The system shall be capable of the following analysis functions:

32.7.1 The software shall allow device management including defining device names, description, adding/removing devices, setting the polling frequency; allow manual polling and showing device status.

32.7.2 Automatically group related events from different sites into incidents and report on them (time and location aggregation) and

32.7.3 Incident editing

32.8 Licences

The conditions of the license shall be described in technical schedules. The Service Provider shall provide free of charge upgrades to the software for at least two (2) years.

32.9 Database

All database requirement shall be discussed with City Power ICT Department. As request for clarification or information sharing shall be facilitated.

33 TEST REQUIREMENTS

33.1 Tests conducted for Check metering and installation

The type test shall be made on one or more specimens of the meter, selected by the manufacturer, to establish its specific characteristics and to prove its conformity with the requirements of the relevant standard as per SANS/IEC 1524-1 or SANS/IEC 62055-31 .

All the tests subjected to the meter shall be Test of Climatic influence
33.1.1 Mechanical
33.1.2 Test of load switching

In accordance to SANS/IEC 1524-1 or SANS/IEC 62055-31, as follows:
33.1.3 Test of insulation properties
33.1.4 Test of Accuracy
33.1.5 Test of Electrical
33.1.6 Test of Electromagnetic compatibility (EMC)

33.2 Tests conducted for Quality of meter and installation

Type tests reports shall be provided, as per the design of the instrument in accordance to this standards to prove compliance with the requirements of this specification and the schedule A stated parameters as per SANS/IEC 61000-4-29 .

A type-test report detailing the listed tests and a functionality tests shall be provided to the relevant City Power responsible person.

33.2.1 Inspection test
33.2.2 Electrical test
33.2.3 Insulation test
33.2.4 EMC test
33.2.5 Climatic influence test
33.2.6 Accuracy measurement test
33.2.7 Influence quantities test
33.2.8 Mechanical test

33.3 Routine tests

All routine tests should be done as per 33.1 above for the metering equipment and all routine tests should be done as per 33.2 above for the Quality of supply measuring equipment.

33.4 Type Test

33.4.1 Factory acceptance tests should be done as per 33.1 , and including the tests outlined in the SANS/IEC 62052-11 for metering equipment with the independent accredited laboratory ,
33.4.2 Factory acceptance tets should be done as per 33.2 , and including the tests outlined in the SANS/IEC 61000-4-29 , SANS/IEC 60068-2-63 and SANS/IEC 60068-2-6 for quality of supply measuring equipment with the independent accredited laboratory

34 PERFORMANCE VERIFICATION

Performance verification for Class A for Quality of Supply and Class 0.2 for check metering measurement methods may be found in SANS /IEC 62586-2 1002, which includes influence quantities and performance verification tests. Table 1 of SANS/IEC 61000-4-30, provides an informative summary of the requirements for class A and Class 0.2. In case of any conflict between Table 1 of SANS/IEC 61000-4-30,

Note: Any compliance with the requirements in Table 1 is NOT sufficient for certification to this document. The measurement and aggregation methods in this document shall also be met.

35 MARKING AND PACKAGING

35.1 Marking and labelling for Check Metering

Marking of meter (Name-plates: Every meter shall bear the following information as applicable0

35.1.1 Manufacturer's name or trade mark and,

35.1.2 Designation of type and space for approval mark;

35.1.3 The number of phases and the number of wires for which the meter is suitable (for example, single phase 2-wire, three-phase 3-wire, three-phase 4-wire); these markings may be replaced by the graphical symbols given in SANS/IEC 60387;

35.1.4 The serial number and year of manufacture. If the serial number is marked on a plate fixed to the cover, the number shall also be marked on the meter base or stored in the meter's non-volatile memory;

35.1.5 The reference voltage in one of the following forms:

I. the number of elements if more than one, and the voltage at the meter terminals of the voltage circuit(s);

II. the rated voltage of the system or the secondary voltage of the instrument transformer to which the meter is intended to be connected.

35.1.6 For direct connected meters, the basic current and the maximum current expressed, for example: 10-40 A or 10(40) A for a meter having a basic current of 10 A and a maximum current of 40 A; for transformer-operated meters, the rated secondary current of the transformer(s) to which the meter should be connected, for example: /5 A; the rated current and the maximum current of the meter may be included in the type designation;

a) The reference frequency in Hz;
b) The meter constant;
c) The class index of the meter;
d) The sign of the double square for insulating encased meters of protective class 0.2.

35.1.7 Information under points a), b) and c) may be marked on an external plate permanently attached to the meter cover. Information under points d) to J) shall be marked on a name-plate preferably placed within the meter. The marking shall be indelible, distinct and legible from outside the meter.

Connection diagrams and terminal marking

Every meter shall preferably be indelibly marked with a diagram of connections. If this is not possible reference shall be made to a connection diagram. For polyphase meters, this diagram shall also show the phase sequence for which the meter is intended. It is permissible to indicate the connection diagram by an identification figure in accordance with national standards for a purchaser and supplier

35.2 Marking and labelling for Quality of Supply installation

Each instrument shall bear the following information, in permanent and legible marking, on the outer side:

35.2.1 Manufacturer's name or trade mark,
35.2.2 Serial number, model number and type,
35.2.3 Supply voltage range, frequency and maximum VA consumption,
35.2.4 Input measurement range,
35.2.5 Measurement terminals,
35.2.6 Calibration certificate.

36 DOCUMENTATION

36.1 Documentation for Quality of Supply installation

Each instrument shall be supplied with a calibration certificate. Calibration shall be traceable to national standards. The calibration certificate shall state the following:

36.1.1 Software version,
36.1.2 Calibration factor,
36.1.3 Reference instrument traceability,
36.1.4 Date of calibration,
36.1.5 Recommended calibration interval,
36.1.6 User manuals and maintenance manuals.

36.2 Documentation for Check Metering installation

36.2.1 Full technical and functional details for all items offered in terms of this specification shall be submitted.

36.2.2 All instruction manuals shall be provided for the equipment offered in terms of this specification.

36.2.3 The manuals must be in English and sufficiently detailed to enable metering staff to install, maintain, test, configure and use each item of equipment

37 DECLARATION

The instrument manufacturer shall declare the limit range of operation and the influence quantities which are not expressly given and which may degrade performance of the equipment.

38 TRAINING

38.1 Training on Check Metering installation

The supplier shall provide the following details with regard to certified staff training offered:

38.1.1 The available training courses and their duration;
38.1.2 The cost per delegate and the first four shall be cost inclusive on provision of meters.
38.1.3 The minimum number of delegates required;
38.1.4 The certification of delegates;
38.1.5 On-site training, and
38.1.6 Training course content.

38.2 Training on Quality of Supply recorder installation

The following training courses, for City Power's staff, shall be provided:

38.2.1 Insulation;

38.2.1.1 PQ measurement device
38.2.1.2 Support software
38.2.1.3 Device installation & commissioning
38.2.1.4 Communications

38.2.2 Programming and Configuration;

38.2.2.1 Programming and configuration of devices
38.2.2.2 PQ DIAS system

38.2.3 Monitoring:

38.2.3.2 PQ DIAS system
38.2.3.3 Data analysis & interpretation
38.2.3.4 Benchmarking & characteristic values
38.2.3.5 Report generation

38.2.4 The associated costs for the training courses above shall be quoted per person. The supplier or OEM will supply all notes and training material.

39 SUPPORT SERVICES FOR THE PQCMMS (POWER QUALITY AND CHECK METERING MONITORING SYSTEM).

39.1 Maintenance and Support for Power Quality and Check metering Monitoring System

The contracted company or OEM shall maintain data availability for all meter points, analysis and visualisation software system, as stipulated in this specification, for the duration of the contract. Thereafter the fully functional monitoring system be handed over to the relevant City Power Personnel or departments. All meter points be in a position to provide all parameters and the associated reports as necessary for metering or billing and quality of supply requirements

The successful contractor or OEM shall monitor and manage the system in such a way that any potential data loss, be identified and restored within seven (7) consecutive days as stipulated by the regulatory standard.

The contractor or supplier or OEM shall make available all server hardware, system software and other related infrastructure required in implementing a fully functional data availability, analysis and visualisation system as described in this specification for the duration of the contract.

Hosting service shall include database administration functions required to operate and maintain the system at an optimum level.

The contractor or supplier or OEM shall configure and commission the new data hosting and visualisation system software and all other systems required to operate. System configuration and commissioning is a once-off transaction and must include the following as a minimum:

- Make or Create, configure and commission the new account entity and Internet presence
- Make or Create different user roles , for QoS and metering personnel
- Make or Create default measurement campaign templates for billing , check metering and QoS
- Make or Create new user accounts and assign user roles when necessary
- Make or Create new metering point accounts as per City Power requirements and by-laws

The contractor or supplier or OEM shall provide all cellular infrastructure and APN needed to establish secure broadband cellular links between measurement devices and the central data storage.

At the end of the contract the contractor or supplier or OEMM shall make available, a set of fully functional VM-Ware based virtual machines that contains all recorded data and all software and systems required to display the recorded data. This is very critical as this is the only way City Power Personnel can verify the success of this project. Simple because City Power aims at the end of this project to use the recorded information or data for Billing, Check metering and QoS purposes as defined by the regulator

39.2 Installation & Commissioning

The contractor or supplier or OEM shall install, commission and maintain measurement equipment and its accessories on all measurement points for the duration of the contract.

The contractor shall supply all wires and other material required to complete a professional installation.

Access, authorisation to the location of installation and all necessary switching to secure the point of installation shall be provided upon request from the contractor.

The contractor shall provide an installation certificate to prove correct installation.
The certificate shall contain once again the following as a minimum:

- Name of the metering point (substation, mini-sub, ring main unit, client and so forth
- Address of location
- Name of feeder
- GPS Coordinates of installation
- VT Ratio
- Type of current sensor used
- CT Ratio
- IP Address (If fixed addresses are to be used)
- Cellular signal strength

39.3 Site Restoration/Repair Service

As per NRS048:2015 requirements, data per individual metering point needs to be available for 95% of the year. This translates into a maximum allowed data loss per individual metering point of ±18 days per annum.

All measurement instruments shall be installed with the ability to easily disconnect it from the voltage measurement from power circuits, to short out and safely disconnect it from the current transformer circuits. All repair or replacements shall therefore be done while the network is still fully in operation.

In the event of equipment failure or when the installation is suspect, the contractor or supplier or OEM shall visit the site within 5 working days to correct or restore the installation. If the equipment needs to be repaired or replaced under warranty, then the contractor shall remove the device, equipment and replace it from the floating stock.

The contractor or supplier or OEM shall send the faulty or suspect unit to a certified repair centre for repair/replacement. The repaired/replaced unit shall be returned within 15 working days to become part of the floating stock.

If the faulty equipment is written off or the repair falls outside the warranty, then the manufacturer shall send a quotation for the repair or replacement of the faulty device.

City Power shall be responsible for the restoration of any system failure due to network related faults. The contractor or supplier or OEM shall notify City Power of any network failures within the next working day. The contractor or supplier or OEM shall restore the measurement point to be fully operational within seven consecutive days after the restoration of the network failure during the duration of the contract.

39.4 Data Analysis and Reporting Service

For the duration of the contract the successful contractor or supplier or OEM shall provide City Power access to a suitably qualified and experienced Power Quality and Check metering engineer.

The assigned engineer shall do the following:

- Assist in Analysing and reporting on events and trends recorded over the past month at no extra charge.
- Assist QoS and Check metering on a monthly one-day workshop with various internal departments and management to discuss the past month's performance and to identify focus areas for the next month at no extra cost.
- Assist in reporting on Power Quality to a quarterly workshop with City Power and any other involved parties to the problem being analysed. At this workshop all involved parties shall report and discuss Power Quality and check metering related issues and jointly prioritise a way forward.

The recorder shall be in a position to automatically provide all Power Quality parameters. Dips should be provided in a format as outlined by NRS 048-2:2015 dip window. The dip window should automatically reflect the following:

- S-Class dip
- T-Class dip
- X1-Class dip
- X2-Class dip
- Z1-Class dip
- Z2- Class dip and
- Y-Class dip

In addition all billing parameters as needed for check metering and billing should be made available as outlined in this specification. Failure to demonstrate the above parameters, the contract will automatically be null, void and will be terminated.

It is also very critical that the benefits of having accurate billing when billing meter is installed as a Check metering instrument or as a large power user metering instrument. In both of these installations the accuracy of the data it is very important.

The idea it is to make it sure the following technicalities are addressed at all times:

- Operational efficacy
- Non-technical losses or theft of electricity
- Billing accuracy
- Automated meter reading performance
- Revenue recovery
- Load limiting , all measured in
- Real-time

40 QUALITY MANAGEMENT

A quality management plan shall be set up in order to assure the proper quality management of the quality of supply statistics and check metering instrument with billing capabilities during design, development, production, installation and servicing phases. Guidance on the requirements for a quality management plan may be found in the SANS/IEC 1507-4 and ISO 9001:2015. The details shall be subject to agreement between City Power and the Supplier.

41 ENVIRONMENTAL MANAGEMENT

An environmental management plan shall be set up in order to assure the proper environmental management of quality of supply statistics and check metering instrument with billing capabilities throughout its entire life cycle (i.e. during design, development, production, installation, operation and maintenance, decommissioning and disposal phases). Guidance on the requirements for an environmental management system may be found in SANS /IEC 1507-4 and ISO 14001:2015

standards. The details shall be subject to agreement between City Power and the Supplier. This is to ensure that the asset created conforms to environmental standards and City Power SHERQ Policy.

42 HEALTH AND SAFETY

A health and safety plan shall be set up in order to ensure proper management of the quality of supply statistics and check metering instrument with billing capabilities compliance of the queuing system during installation, operation, maintenance, and decommissioning phases. Guidance on the requirements of a health and safety plan may be found in OHSAS 18001:2007 standards. This is to ensure that the asset conforms to standard operating procedures and City Power SHERQ Policy. The details shall be subject to agreement between City Power and the Suppliers

ANNEXURE A - Bibliography

None

ANNEXURE B – Revision information

DATE	REV .NO	NOTES
December 2003 February 2010	0 1	First issue Second Issue Added the normative references Reduce the equipment required to 3 item Added the required internal battery life expectancy Reduced the number of items on the GMS Modems Consolidated the ISO family on the quality assurance
May 2017	0	First Issue The separate Specification for Quality of supply instrument and information system was finalised
May 2019	2	Third Issue
		Rewording Specification for three phase bulk or intake meters Added accuracy class 0.2 Edited Annexure C and D

November 2019	3	Combined the specification for three phase bulk intake meters with the specification for quality of supply instruments and information system. The name changed to Specification for Quality of Supply Statistics and Check metering instrument with billing capabilities. Added Power Quality and Check metering Management System (PQCMMS) .The Specification retained CP_TSSPEC_003 , as a specification number

ANNEXURE C(1) - Technical schedules A and B

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_003	Description		Schedule A	Schedule B
1	xxxx	**Details of OEM**			
		Manufacturer		XXXX	
		Country		XXXX	
		Supplier		XXXX	
2	xxxx	**Operating conditions**			
		a) Max temperature	^{0}C	40	
		b) Min temperature	^{0}C	- 10	
		c) Altitude (ABSL)	m	1800	
		d) Relative humidity		≥ 95	
		e) Operating conditions		As per clause	
3	**xxxx**	**General Instrument requirements**			
4	xxxx	Safety tests based on SANS/IEC		61010	
5	xxxx	Instrument classification		Class A	
6	xxxx	Compliance to SANS/IEC 61000-4-30		Provide	
7	xxxx	EMC immunity test based on SANS/IEC		61000-6-5	
8	xxxx	Climate requirements		As per clause	
9	xxxx	Mechanical requirements		As per clause	
10	xxxx	Degree of protection by enclosure(IP code)		IP52	
11	xxxx	Parameter requirements based on class A, SANS/IEC		150/180	
12	xxxx	Aggregation algorithm		As per clause	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.
Note: Please note that the tenderer shall provide proof of compliance to the requirements.

Tender Number: _____

Tenderer's Authorized Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

ANNEXURE C(1) - Technical schedules A and B

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_003	Description	Schedule A	Schedule B
13	xxxx	150/180 cycle aggregation	As per clause	
14	xxxx	10min aggregation	As per clause	
15	xxxx	2hour aggregation	As per clause	
16	xxxx	Time clock uncertainty	As per clause	
17	xxxx	Flagging concept	As per clause	
18	xxxx	**Power Quality parameters**		
19	xxxx	Power frequency	As per clause	
20	xxxx	Magnitude of the supply voltage	As per clause	
21	xxxx	Flicker	As per clause	
22	xxxx	Supply voltage dips and swells	As per clause	
23	xxxx	**Detection and evaluation of a voltage dip**		
24	xxxx	Voltage dip detection	As per clause	
25	xxxx	Voltage dip evaluation	As per clause	
26	xxxx	**Detection and evaluation of a voltage swell**		
27	xxxx	Voltage swell detection	As per clause	
28	xxxx	Voltage swell evaluation	As per clause	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorized Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

ANNEXURE C(1) - Technical schedules A and B

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_003	Description	Schedule A	Schedule B
29	xxxx	Calculation of a sling reference voltage	As per clause	
30	xxxx	Measurement uncertainty and measuring range	As per clause	
31	xxxx	Voltage interruptions	As per clause	
32	xxxx	Transient voltage	As per clause	
33	xxxx	Supply voltage unbalance	As per clause	
34	xxxx	Voltage harmonics and inter harmonics	As per clause	
35	xxxx	Mains signalling voltage on the supply voltage	As per clause	
36	xxxx	Rapid voltage changes(RVC)	As per clause	
37	xxxx	Under deviation and over deviation	As per clause	
38	xxxx	**Current**	e	
39	xxxx	Magnitude of current	As per clause	
40	xxxx	Measurement uncertainty	As per clause	
41	xxxx	Measurement evaluation	As per clause	
42	xxxx	Current recording	As per clause	
43	xxxx	Harmonic current	As per clause	
44	xxxx	Inter harmonic currents	As per clause	
45	xxxx	Current unbalance	As per clause	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorized Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

ANNEXURE(1) C - Technical schedules A and B

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_003	Description	Schedule A	Schedule B
46	xxxx	**Input channel for QOS recording**		
47	xxxx	Measure voltage and current	As per clause	
48	xxxx	Measure substation protection DC	As per clause	
49	xxxx	Measure Neutral line current	As per clause	
50	xxxx	Current interface	As per clause	
51	xxxx	Measurements accuracy	As per clause	
52	xxxx	Measure peak currents	As per clause	
53	xxxx	Memory capacity	As per clause	
54	xxxx	Calibration retention	As per clause	
55	xxxx	Internal energy source	As per clause	
56	xxxx	Connection or interface ports	As per clause	
57	xxxx	Communication protocols	As per clause	
58	xxxx	Synchronisation	As per clause	
59	xxxx	Panel mount	As per clause	
60	xxxx	Ride-through	As per clause	
61	xxxx	Insulation	As per clause	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorized Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

ANNEXURE C(1) - Technical schedules A and B

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_003	Description	Schedule A	Schedule B
66	xxxx	**Electrical for QoS Inputs**		
67	xxxx	Power supply	As per clause	
68	xxxx	Mains supply frequency	As per clause	
69	xxxx	Supply protection requirements	As per clause	
70	xxxx	Electrical connections	As per clause	
71	xxxx	Electromagnetic compatibility (EMC)	As per clause	
72	xxxx	**Mechanical**		
73	xxxx	Case	As per clause	
74	xxxx	Resistance to shock	As per clause	
75	xxxx	Resistance to vibration	As per clause	
76	xxxx	Resistance to heat and fire	As per clause	
77	xxxx	**PQDIAS**		
78	xxxx	General requirements	As per clause	
79	xxxx	**Infrastructure**		
80	xxxx	Central data base	As per clause	
81	xxxx	Web-based	As per clause	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorized Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

ANNEXURE C(1) - Technical schedules A and B

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_003	Description	Schedule A	Schedule B
82	xxxx	Security and Encryption	As per clause	
83	xxxx	Users	As per clause	
84	xxxx	Measurement sites	As per clause	
85	xxxx	Data acquisition	As per clause	
86	xxxx	Alarms	As per clause	
87	xxxx	Reports	As per clause	
88	xxxx	Analysis functions	As per clause	
89	xxxx	Licences	As per clause	
90	xxxx	Database	As per clause	
91	xxxx	**Tests for QoS capability**	As per clause	
92	xxxx	**Performance verification**	As per clause	
93	xxxx	**Marking and packaging**	As per clause	
94	xxxx	**Documentation**	As per clause	
95	xxxx	**Declaration**	As per clause	
96	xxxx	**Training**	As per clause	
97	xxxx	**Quality management accreditation**	As per clause	
98	xxxx	**Environmental management accreditation**	As per clause	
99	xxxx	**Health and safety accreditation**	As per clause	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorized Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

Technical schedules A and B

Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.		
Item	**Sub-clause of CP_TSSPEC_003**	**Proposed deviation**

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

ANNEXURE C(2) - Item No. 1 – 10 Amp 56/400 volt Thee Phase Bulk or Intake Meters – SAP NO.

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_003	Description		Schedule A	Schedule B
1		Manufacturer		xxx	
2		Rated voltage	V	56/400	
3		Rated amperage	A	1 - 10	
4		Rated frequency	Hz	50	
5		Class accuracy		Class 0.2	
		Reactive Energy		Class 1	
6		Lightning protection		Required	
7		Over voltage protection		Required	
8		Communication- Optic-Electronic Port		Required	
9		Communication-		Required	
10		Programming and security comply?		Required	
11		Clock and calendar		Required	
12		Meter provided with internal battery?		Required	
13		Number of auxiliary inputs		2	
14		Number of auxiliary outputs		4	
15		Number of LED pulses per kWh		xxx	
16		Number of LED pulses per kVarh		xxx	
17		LCD display comply?		Required	
18		Auxiliary power supply derived from all three phase to phase voltages?		Required	
19		Auxiliary power supply derived from all three phase to neutral voltages		Required	
20		Load profile recording comply?		Required	
21		*Programmable demand measurements*	*kVA*		
22		Energy measurement	kVAR/kWH	Both	
23		Data retention	Years	10	
23		Data extraction comply?		Required	
24		Is the meter capable of self-diagnostics?		Required	
25		Does the meter provide for minimum time of use?		Required	

26		Is the meter programmable for external VT's and CT's		Required	
27		Meter sealable		Required	
28		Hand held units available		Required	
29		Capable of AMR		Required	
30		Available software and hardware	Reset / Programming	xxxx	
31		Marking and labelling comply		Required	

Note: Ticks, Cross [√, X], Astrick [*], Word [Noted] or TBA ["To Be Advice"] will not be accepted.

Tender Number:

_____

Tenderer's Authorised Signatory: _____

_____

Name in block letters Signature

Full name of company: _____

Item No.1 – Three Phase Bulk or Intake meter

Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition. Evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.		
Item	**Sub-clause of CP_TSSPEC_003**	**Proposed deviation**

Tender Number:

_____

Tenderer's Authorised Signatory: _____

_____

Name in block letters Signature

Full name of company: _____

ANNEXURE D – Stock Items

Material Group:

Item	SAP No.	SAP Short Description	SAP Long Description
1.	3861	Class A,QOS INSTRUMENT, BULK OR INTAKE METER 1-10A 56-400V CLASS 0.2	Class A, QUALITY OF SUPPLY INSTRUMENT AND METER.THREE PHASE BULK OR INTAKE METER 1 - 10 AMPS. 56-400 VOLTS. THREE PHASE. 50 HERTZ. CLASS 0.2. ITEM SPECIFICATION NO.CP_TSSPEC_003