Part of Energy Queensland

Substation Standard

Standard for Substation Metering

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Abstract: The aim of this document is to define the standard substation requirements for SCADA, Statistical and HV Revenue metering. The prescribed metering shall be fit for purpose and sufficient to allow efficient operation of the plant locally and remotely.

Keywords: Substation, Standard, Metering, Revenue, Statistical

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1 Overview

1.1 Purpose

This document defines standard substation requirements for SCADA, HV Revenue, HV Statistical, and Power Quality Metering. The prescribed metering shall be fit for purpose and sufficient to allow efficient operation and monitoring of the plant locally and remotely.

This standard has been updated to provide consistency and a standard approach for substation metering across all regions within Energy Queensland. In some instances, it may not be feasible to immediately bring an existing installation in alignment with this standard. These instances can be designed using appropriate legacy standards.

With the advancement of substation IED's, especially where used for protection functionality, SCADA metering values can be obtained from these devices. In these cases, the instrument transformers used are of protection class and have varying accuracy characteristics at typical load currents.

Where revenue metering is being installed or proposed to be installed, the accuracy class and equipment shall be selected and installed in compliance with Chapter 7 of the NER (National Electricity Rules, 2018). Failure to do so will attract civil penalties.

1.2 Scope

The metering listed in this standard shall be provided for the various installation types and applications with clarification to augmentation works as detailed below.

This standard shall be applied to all new green field substation designs or where total replacement is occurring. It shall also be applied where a whole section is being replaced or reworked, such as a new panel or bay including new secondary devices. Any modifications to revenue metering related plant requires the installation to meet the minimum standards for the NER designated type.

Instrument transformers associated with revenue installations commissioned prior to 13 December 1998 were exempt from meeting the minimum requirements under schedule 7 of the NER, providing certain conditions were met. This exemption is not enduring, and all replacement instrumentation transformers shall meet the minimum requirements of the NER.

Where secondary equipment only is being replaced, then the secondary equipment shall be designed to comply with this standard. Where a revenue metering installation commissioned prior to the 13 December 1998 is exempt from meeting the minimum specifications for instrumentation transformers then action shall be taken to ensure that the revenue meter is of a higher class than required for the installation type and overall accuracy for the installation meets the minimum requirements prescribed under the NER.

Without impeding operational functions, any surplus equipment resulting from a redesign or upgrade shall be removed, for example where transducer and indicator functionality is replaced by an Intelligent Electronic Device (IED), and the IED provides equivalent or better accuracy to the legacy instrumentation, then the legacy instrumentation shall be removed.

2 References

2.1 Legislation, regulations, rules, and codes

(National Electricity Rules, 2018) (AEMC)

2.2 Energy Queensland controlled documents

Queensland Electricity Connection Manual (QECM) - Manual 01811 (Energex), NA000403T509 (Ergon Energy) - 2912908

Queensland Electricity Metering Manual (QEMM) - Manual 01812 (Energex), NA000403R510 (Ergon Energy) - 2913519

Substation Design Standards - RED00364 (Energex) - 3062554

2.3 Energy Queensland other sources

AC Supplies – SS-1-5.2 (Ergon Energy)

General Specification for SCADA Analogues - TSD0176 (Energex)

SCADA Standard Point List - STNW3106 (Ergon Energy)

2.4 Other sources

(AS 2067, 2016), Substations and high voltage installations exceeding 1 kV a.c

(AS/NZS 3000, 2018), Electrical Installations “Wiring Rules”

(AS 60044.1, 2007), Instrument transformers Part 1: Current transformers

(AS 60044.2, 2007), Instrument transformers – Inductive voltage transformers

(AS 60044.3, 2004), Instrument transformers – Part 3: Combined transformers

(AS 60044.5, 2004), Instrument transformers – Part 5: Capacitor voltage transformers

(AS/NZS 61000.4.7, 2012), Electromagnetic Compatibility – Testing and Measurement Techniques – General Guide On Harmonics And Interharmonics Measurements And Instrumentation, For Power Supply Systems And Equipment Connected Thereto

(AS/NZS 61000.4.30, 2012), Electromagnetic Compatibility – Testing and Measurement Techniques – Power Quality Measurement Methods

(IEC 61869-1, 2007), Instrument transformers Part 1- general requirements

(IEC 61869-2, 2012), Instrument transformers Part 2- additional requirements for current transformers

(IEC 61869-3, 2011), Instrument transformers Part 3- Additional requirements for inductive voltage transformers

(IEC 61869-5, 2015), Instrument transformers Part 5- Additional requirements for capacitive voltage transformers

3 Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this standard, the following definitions apply.

Accuracy Range:	The range at which the specified accuracy shall be achieved
Measurement Range:	The range at which the measurement shall be taken.

Panel Metering:	Any fixed position (not portable) display of metered quantities (excluding the HMI) it may be on the CB control panel, recloser control panel, protection relay display, battery charger panel etc.
Plant Indication:	Indication is on the physical plant, i.e. CB counter, Oil Temperature
Revenue Metering:	High Voltage kWh and kvarh profile metering used for Wholesale Transmission/Distribution and revenue collection purposes.
Shall:	Means mandatory
Should:	Means advisory
Station Supply Metering:	Metering on the Station Supply, to meter total consumption for revenue metering purposes.
Statistical Metering:	High Voltage kWh, kvarh and QoS profile metering used for planning purposes.

3.2 Acronyms and abbreviations

The following acronyms and abbreviations appear in this standard.

AEMO:	Australian Electricity Market Operator
AFLC:	Audio Frequency Load Control
CB:	Circuit Breaker
CT:	Current transformer
HMI:	Human-Machine Interface
HV:	High Voltage
IED:	Intelligent electronic device – i.e. Protection relay, smart meter etc
ILAC:	International Laboratory Accreditation Cooperation
LCF:	Local Control Facility (same as HMI)
LV:	Low Voltage
MC:	Metering Coordinator
MP:	AEMO registered Metering Provider appointed for the metering installation.
NATA:	National Association of Testing Authorities - Australia
NEM:	National Electricity Market
NER:	National Electricity Rules
OCN:	Operational Communications Network
PoC:	Power of Choice
PQ:	Power Quality

QoS:	Quality of Supply e.g. Sag, Swell, THD, NPS
SCADA:	Supervisory Control and Data Acquisition
SVC:	Static Var Compensator
THD:	Total Harmonic Distortion
TV:	Tertiary Voltage
VT:	Voltage Transformer

4 Deviation to this Standard

The following procedure must be followed when deviating from this standard:

- Where it is felt that different SCADA or Statistical Metering is required for an installation then approval shall be sought for the deviation from the Manager Grid Control.
- Where it is felt that different HV Revenue Metering is required for an installation then approval shall be sought for the deviation from the customer's designated MC and/or MP.
- Where it is felt that different Power Quality Metering is required for an installation then approval shall be sought for the deviation from the Principal Engineer Network Performance

5 Common Requirements

In certain applications, different forms of substation metering may be provided by a single IED. For example, Statistical and SCADA metering data may be sourced from a single device in a substation.

Local HMIs linked to IEDs via substation RTUs shall be used in preference to individual Panel Metering.

The following diagram shows an indicative representation of the various metering points within a substation.

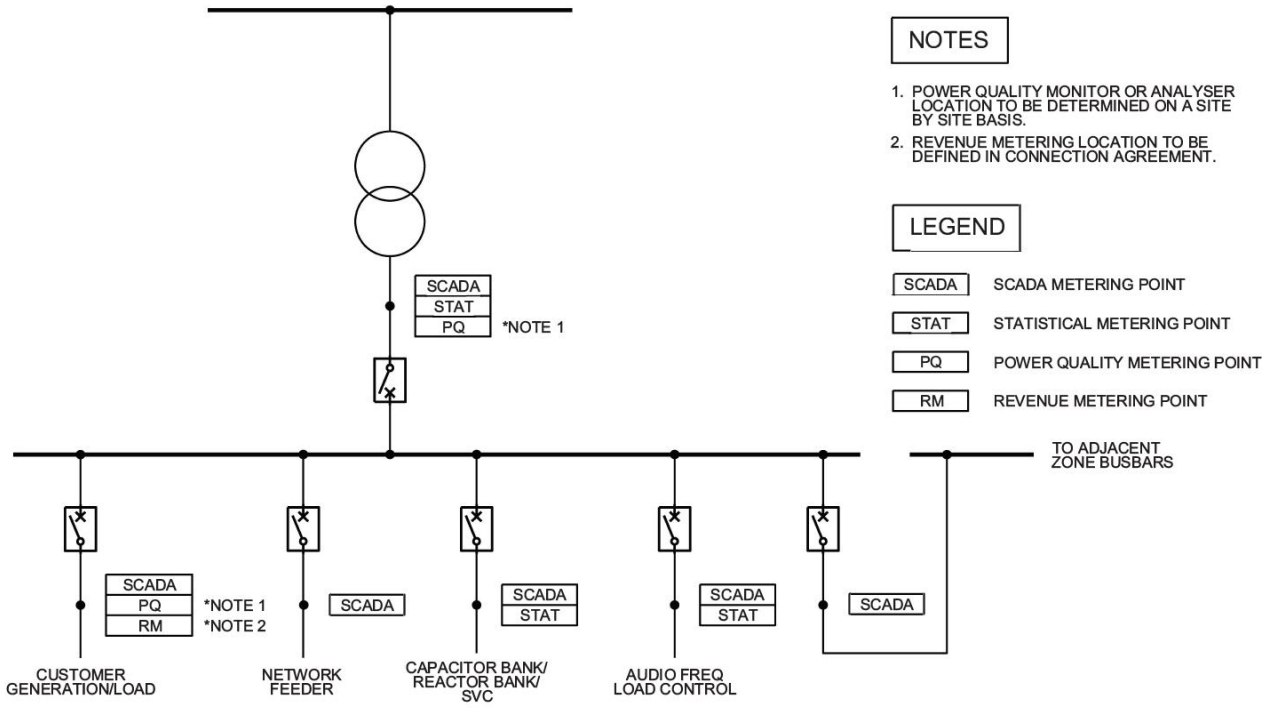

Figure 1: Substation Metering Points

6 Substation SCADA Metering Requirements

6.1 General

This section applies to all green-field installations, or for installations where significant work is being undertaken. As Protection IED's are becoming the source of most of metering quantities, the accuracies of the overall installation will be governed by the accuracy of the Protection relays and Instrument Transformers. It is up to the discretion of Grid Projects to specify the type of IED required, leading to its compatibility for SCADA metering purposes. Where it is advised to not install IED's capable of SCADA metering, legacy arrangements may be followed.

6.2 Accuracy Range

The accuracy of power flow metering quantities shall be specified over a defined accuracy range. This is due to the uncertainty of measurements sourced from Protection Class Instrument Transformers. The Measurement and Accuracy Ranges are defined below in Table 1:

Table 1: Power Flow Accuracy Range

Type	Measurement Range	Accuracy Range
Voltage	0-150%	80-120%
Current		
Real Power		
Reactive Power		

The Measurement Range for other substation equipment, such as auxiliary systems and transformer monitoring shall be specified to suit the installation applicable. These systems shall be monitored using Metering Class devices, either by an IED or by the use of individual measurement transducers. These devices typically have the accuracy defined over the specified measurement range.

6.3 Instrument Transformer Accuracy

As detailed, Protection Class CT's are the main source for power system measurements used for SCADA purposes. Where higher levels of accuracy are required, such as for Voltage Regulation algorithm purposes, Metering Class Instrument Transformers may be used.

The minimum accuracy requirements for Current Transformers used for SCADA Metering shall be:

- Metering Class CT's
    - The accuracy of the CT shall be specified as Class 0.5M or better.
- Protection Class CT's
    - The allowable error shall be no greater than ±1% over the Accuracy Range.

Voltage transformers are required to have both a Protection class and Metering class rating (AS 60044.2, 2007). The minimum Metering class for VT's used for SCADA metering shall be 0.5M or better.

Thermocouples/RTD's/Fibre optic sensors or equivalent shall be accurate to ±0.5% or better at full scale.

Transducer accuracies are specified in Section 12.

6.4 Metering Device Accuracy

Modern IEDs can provide data for import to SCADA. Protection IED's used in the substation environment can provide these measurement quantities and shall be considered the primary option for SCADA metering. The following minimum accuracies shall be met for all new and legacy arrangements:

- IED's providing current and voltage metering, shall have an accuracy of ±1% or better.
    - Where required, sequence components shall be degraded by no more than an additional ±0.5%.
    - Metering quantities for Real and Reactive power shall be accurate to ±5% or better.
- An IED that is providing voltage input into a voltage regulation algorithm, shall have a voltage accuracy of ±0.5% or better.
- IED's that measure sensor input (i.e. temperature), shall have an accuracy of ±0.5% or better.
- All other metering devices on plant items shall have a measurement accuracy of ±1% or better

6.5 Substation Metering Requirements

All phases of Voltage, Current, Real Power and Reactive Power shall be measured for all substation feeders and power transformers (excluding station service supply transformers). This data is derived from Protection IED's installed at the substation.

Where Busbar VT's are installed, Voltage on each bus shall be measured. Where a Bus-Overcurrent protection scheme is installed, bus current metering shall be measured from a suitable IED.

Metering of Substation Audio Frequency Load Control (AFLC) equipment shall measure LV Tuned Signal Voltage and where required, LV tuned signal Current. Where required, Reactive Power metering shall be made available through an approved Statistical Metering device.

Capacitor Banks can be installed as single stage or multi-stage units. Metering quantities for Current shall be measured for each stage. Capacitor Banks can be installed in Containers or Cubicles. Metering quantities for enclosure air Temperature shall be measured for each stage. Where required, Reactive Power metering shall be made available through an approved Statistical Metering device.

Metering of substation DC systems is required to monitor the status and overall condition. There may be more than one DC system, and all should be monitored at their DC switchboards or an accessible measurement point. The following measurements taken at the are required as a minimum:

- DC system Voltage
- DC system Load Current
- X Battery String Current
- Y Battery String Current

All Power Transformers Winding and Oil Temperatures shall be made available to SCADA using the Power Transformer Condition monitoring device.

Any other substation equipment requiring SCADA metering shall be determined on a case-by-case basis.

6.6 Interposing CT's

When using a protection CT to drive a metering instrument susceptible to damage from high currents under network fault conditions, an interposing saturation CT shall be installed between the protection CT and the metering device. The preference is that the metering instrument is short time rated for 20 times current (typically 20 x rated for 1 second, repeated 5 times at 5 second intervals).

For legacy installations in the South-East, Interposing CT's used to interface with the SICM device, shall have a transformation ratio of 1000/1, to directly feed SCADA equipment.

7 Statistical Metering

Statistical Metering provides information for input into planning and system load growth studies for regulatory reporting and network planning requirements. Statistical Metering also provides information pertaining to network power quality, reliability and network utilisation. The following sections outline the minimum requirements for Statistical Metering installations.

7.1 General Requirements for Statistical Metering

Statistical Metering shall be performed at any point in the substation such that total substation transformer loads can be determined, with and without the impact of reactive loads. Typical metering points are on and LV winding of a Power Transformer, SVC's, Capacitors, Reactors, Load Control Cells. Refer to Section 6 Figure 1 for typical locations.

Quantities metered shall include three-phase voltage and power particularly import/export kW and kvar. Please refer to Figure 2 and Figure 3 for power flow conventions.

All CT and VT shall be wired in 3 phase 4 wire configuration. Legacy arrangements can be followed where this is not practicable.

Without limiting Section 11, devices shall be wired to conform to CT polarity markings and ensure the correct power flow convention is maintained.

7.2 Revenue Class Meters used for Statistical Metering

There is no requirement for new installations of Statistical Metering to meet the Revenue Metering requirements of the NER (National Electricity Rules, 2018). However, where an installation requires the use of a Revenue class meter for Statistical Metering, the following shall be followed.

The class of the meter shall be a minimum of Class 1 to maintain a sufficient level of accuracy.

To be consistent with legacy arrangements, test blocks may be installed at the meter to provide isolation, however, are not generally required. Sealing of CT & VT wiring is also not required.

Statistical Meters may be installed in existing Statistical Metering panels, however where there is no existing panel, alternative locations can be explored, such as wall mounting.

Metering devices are not required to have an individual DC auxiliary supply connected. However, where the device provides additional substation functionality, such as input into voltage regulation algorithm, a DC auxiliary supply shall be wired.

Telecommunications shall be connected via the use of cellular modems as a first preference. Where this is not feasible, devices can be connected to the Operational Communications Network utilising local network connectivity.

7.3 IED's used for Statistical Metering

IED's that are used for Statistical Metering purposes may also be providing additional functionality within the substation. The use of these devices for Statistical Metering is allowed, subject to the following minimum requirements.

The accuracy of the IED providing Statistical Metering shall be ±1% or better.

Devices may be installed at any location in the substation, typically housed in the protection panel for the plant it is monitoring.

Isolation of the device from the CT's and VT's shall be as per standard isolation links.

Telecommunications shall be connected to the Operational Communications Network utilising local network connectivity.

8 Power Quality

Ergon Energy and Energex as Network Service Providers are required to meet various network power quality performance requirements in accordance with Schedule 5.1 of the NER (National Electricity Rules, 2018). The use of Power Quality (PQ) devices installed in substations allow the measurement and monitoring of these requirements.

Many modern protection relays with a voltage input can record basic PQ events, such as voltage dips, excursions and transient events, negating the requirement for dedicated disturbance recorders.

Utilising existing protection relays in the substation for basic PQ analysis and data capture shall be explored prior to the installation of a dedicated PQ device.

A PQ device may be installed in various locations within an Energy Queensland substation. The requirement of these devices shall be specified on a site-by-site basis by Grid Projects in consultation with the Principal Engineer for Network Performance.

A PQ device shall be of Accuracy Class A according to AS/NZS 61000.4.30 and the measurements are to be taken in accordance with AS/NZS 61000.4.7. PQ device can either be connected in either 3 wire or 4 wire AC circuits. Devices shall have provision for an auxiliary DC supply to allow continuous operation in the event a VT source is disconnected.

The meter shall store any events when set PQ parameters are exceeded. PQ device shall connect to the VT's and CT's for the network being monitored. The physical location of PQ devices shall be conveniently located adjacent other equipment associated with the monitored network component, such as housed in a feeder protection panel.

Instrument transformers used for Power Quality purposes shall be of Metering Class and have an Accuracy Class of 0.5M or better. Protection Class CT's can be used where a Metering CT is not available, subject to the measurement accuracy does not exceed ±1% over the required measurement range. Measurement range to be specified on a case-by-case basis.

Connection shall be via the Operational Communications Network utilising local network connectivity.

9 HV Revenue Metering and Isolated Generation Revenue Metering

In accordance with Section 9 of the Queensland Electricity Connection Manual (QECM, 2020), all HV Revenue Metering is to be carried out by the customer, within the customers premises, where the customer owns the associated HV plant for metering purposes. Under no circumstances should Energy Queensland and the customer share ownership of joint assets or should the customer own plant located within an Energy Queensland substation or premises.

Legacy HV customer connection points were typically located within Energy Queensland substations, utilising the feeder CT's and busbar VT's for revenue metering purposes. Where an upgrade to this connection is required and the customer and Energy Queensland agree to not change the connection point, the installation shall follow the requirements specified in Section 10.1.

Within the North West Mineral Province region, Ergon Energy will be the customer's elected Metering Co-ordinator (MC) and Metering Provider (MP) and is responsible for providing revenue metering which shall meet the minimum requirements detailed in this section. Any major upgrades to these connections, resulting in a complete re-design, shall follow the requirements specified in Section 10.1.

9.1 Substation Customer Revenue Metering Design Requirements

This section details the minimum requirements for Customer Metering where the metering point is agreed to be within the substation switchyard.

- Instrument transformers required for Revenue Metering shall be installed as close as practical to the nominated connection point.
- Instrument transformers shall be manufactured in accordance with AS 60044 or IEC 61869 series.

- Instrument transformers shall include a Metering Class core with an accuracy class of M or MS as defined in AS 60044.2/3/5 and minimum accuracy as prescribed in Schedule 7 of the NER.
- Energy Queensland to make provision outside of the substation (typically on fenceline or building exterior) for the mounting of the Customer owned Metering equipment.
- Customer to install and maintain Metering Panel in accordance with the QECM/QEMM. Customer to specify panel dimensions of Metering Panel to EQL's nominated MC. Metering Panel shall be fitted with CT isolation links and fuses for VT circuits.
- Customer owned Metering Panel to have terminals in a separate compartment to allow the termination of EQL owned multicores. Where this is not feasible, an intermediate termination point, such as an interface panel, may be facilitated for the termination, maintenance and testing of EQL multicores. Where possible, intermediate termination points should be avoided.
- Energy Queensland to own and install multicores from instrument transformers to the Customer Metering Panel. CT ratio connection shall be specified by the Customer.
- Energy Queensland to provide earthing to the Customer Metering Panel and appropriate grading ring around the designated work area, as to not introduce hazards associated with earth potential rise.
- Energy Queensland will not provide, auxiliary supplies (AC or DC) or monitoring for the metering installation unless otherwise agreed to in the connection agreement.
- All metering terminations within an EQL Substation, shall be covered and sealed with an identification label specifying "Revenue Metering".

9.2 Revenue Metering Types and Requirements

As defined below in Table 2, connection points with annual energy consumption exceeding 100GWh shall incorporate partial check meter. Additionally, installation with annual energy consumption exceeding 1000GWh shall incorporate full check metering.

Check and partial check metering shall be designed in accordance with the minimum specification prescribed in schedule 7 of the NER.

Subject to the customer's elected MP's advice, where it is expected that a customer's annual energy consumption (volume) will exceed that specified on their connection agreement, provisions shall be taken to provide metering equipment compliant with a single installation type higher than that applied for.

Note: Volume Limit for annual consumption relates to the addition of all meters associated with a connection point.

9.3 Revenue Check Metering

For type 1 installations with annual energy consumption greater than 1000GWh a full check metering scheme shall be installed.

This full check scheme shall be a complete duplication of the revenue meter scheme and without exception shall include separate voltage transformer windings and current transformer cores for both the main revenue metering and check metering circuits. As prescribed in Schedule 7 of the NER, secondary CT circuits shall be dedicated and shall not be used for any other purpose.

9.4 Revenue Partial Check Metering

Partial check metering will be subject to advice from the customer's elected MP. As a guide the following may apply.

A partial check meter scheme as required for type 2 metering installations should be supplied from a separate voltage transformer winding to the revenue meter. Where this is not practical the partial check meter may be supplied from the same VT circuit as the revenue meter however shall be separately fused with 6A HRC fuses as a minimum.

Partial check meters should be supplied from a separate current transformer core to the revenue meter where available. In installations where this is not practical then the check meter may be supplied from the same current transformer core as the revenue meter.

Alternative class and protection core current transformers are permissible providing the accuracy class of the core doesn't exceed twice the minimum allowable accuracy limit as prescribed under schedule 7 of the NER. Additionally, the secondary through fault current shall not exceed the allowable limits of the check meter. This decision will be at the discretion of the Metering Coordinator and/or Metering Provider.

9.5 Revenue Metering Security and Indication

Without exception all meter terminals, fuses, test blocks, marshalling and terminal points for revenue metering shall have the provision to be sealed and sealed by the relevant Metering Provider.

If voltage transformers, current transformers and marshalling boxes are located inside a customer's installation, all secondary terminals shall be sealable and sealed by the applicable Metering Provider. Interfacing terminals should be prevented, if possible, to avoid additional sealing points.

9.6 Revenue Metering Certification

For revenue metering, all metering instrumentation transformers shall be supplied with test certificates to the relevant Australian or IEC Standards. Copies of all accuracy certification shall be provided to the customer's elected Metering Provider (MP) for validation.

Test certificates shall state the levels of measurement uncertainty and traceability to NATA, or to a relevant national accreditation with mutual recognition by an ILAC certified testing authority.

9.7 LV Station Supply Metering

LV supply provided by substation station supply transformers used for the purpose of suppling substation auxiliary load does not require statistical or revenue metering. This supply can be considered as network losses.

For instances where Energy Queensland requires an LV supply from a customer, either as a backup station service supply or primary LV supply, it is desirable that the supply shall form part of the connection agreement between Energy Queensland and the Customer.

10 Power Flow Convention

10.1 Operational

The convention of power flow is from the source or generating point to the load for active power (watts). For reactive elements (capacitive and inductive), the convention of reactive power (vars) flow is from the capacitive source to the inductive load.

The point of reference in a substation application is the busbar which imports power, watts or vars, from a source and exports to a load. The sign convention shall be negative for import and positive for export. This will show the power flow in and out of the respective busbar for multiple sources and loads.

The symbol used to show the active power shall be an arrow pointing in the direction of the active power flow. The symbol to indicate the reactive power flow shall be an arrow pointing in the direction of the reactive power. The arrows should be placed close to the reference point.

A typical substation example is shown in Figure 2.

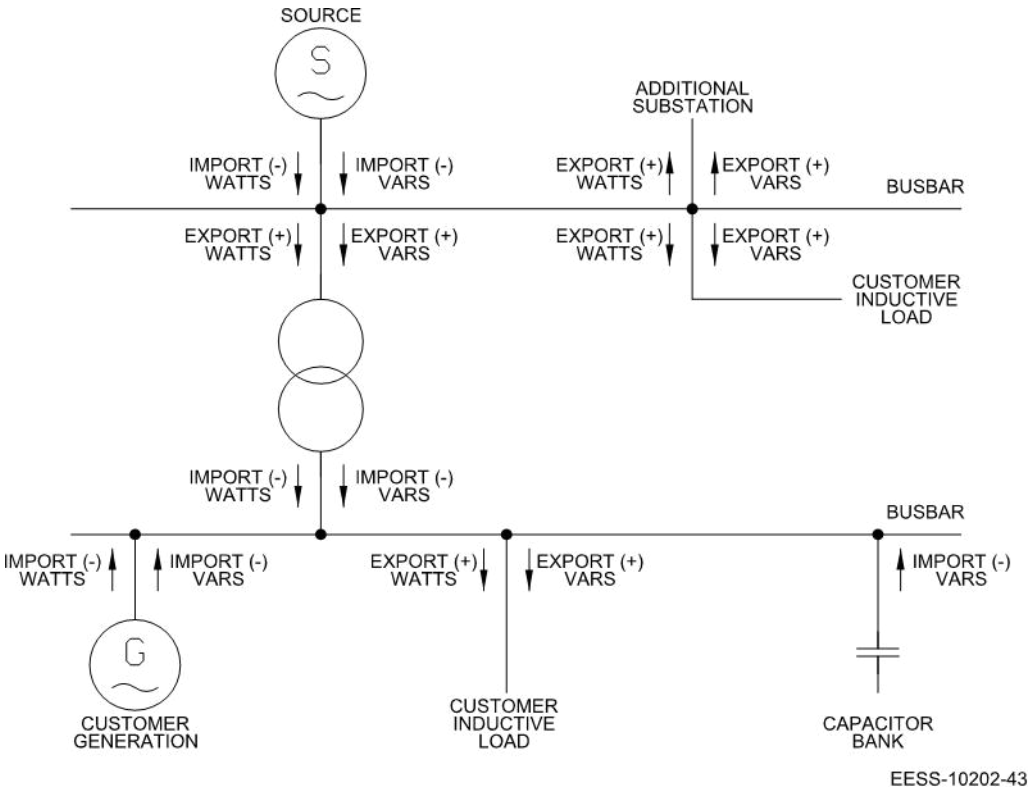

Figure 2: Operational Power Flow Convention

10.2 Statistical and Revenue Metering

The convention of power flow for statistical and revenue metering purposes is subject to the capability of each meter. The conventional power flow shall be as follows:

- All flows are in relation to their direction to/from the connection point node (e.g. busbar), with reference taken from the supply source.
- All energy leaving the node is considered as export (i.e. energy consumed by a customer is export).
- All energy into the node is considered as import (i.e. energy taken into the node is import).

This then gives the net power flow as

Net = Export – Import

The same convention will be used for Reactive Power, i.e.:

- Reactive Power supplied to a customer's inductive load is export.
- Reactive Power received from a customer's capacitive load is import.

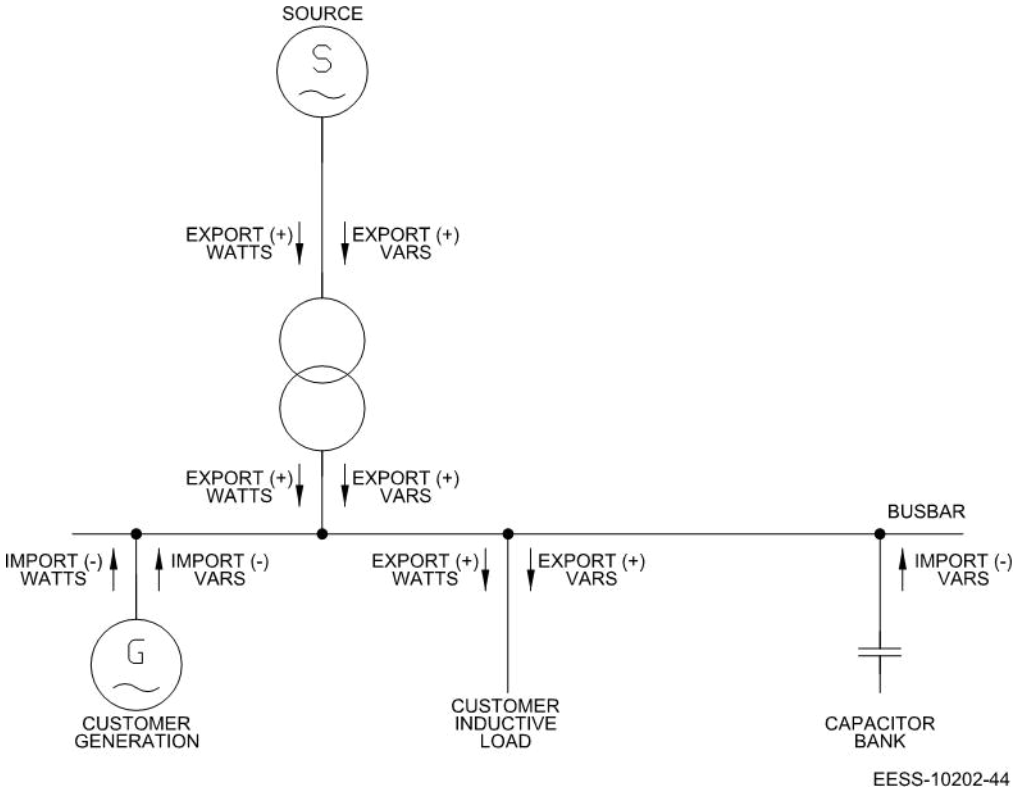

Figure 3: Statistical and Revenue Metering Power Flow

The four-quadrant system for metering purposes is shown in Figure 4. Quadrants 1 and 4 are for power delivered to the load, whether inductive or capacitive, while quadrants 2 and 3 are for power supplied from a source.

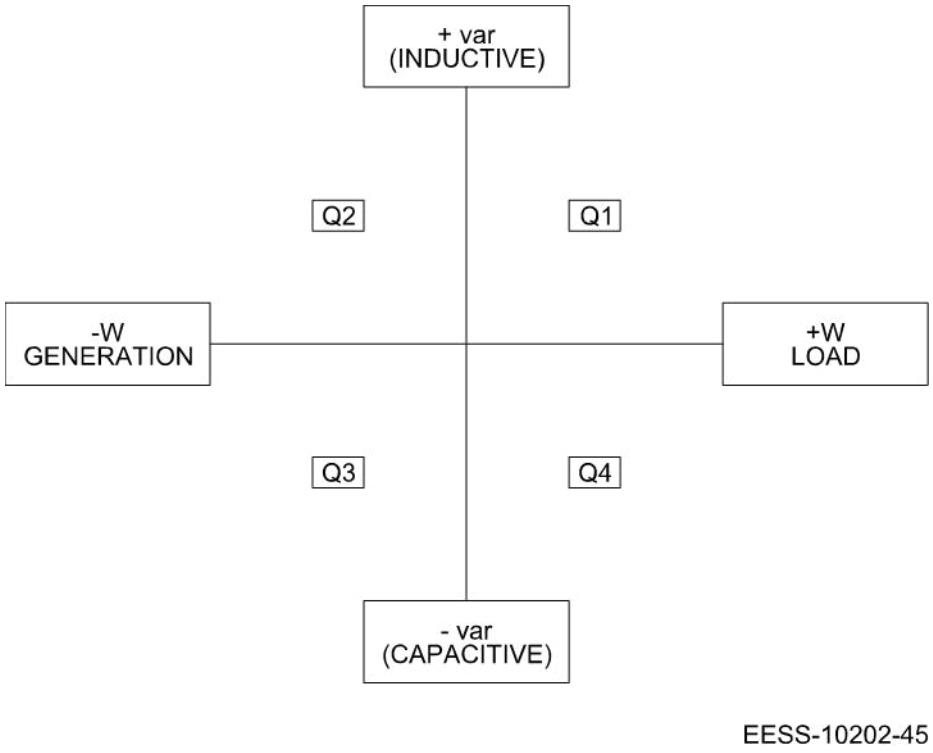

Figure 4: Four Quadrant Assignment for Metering

10.3 Metering Design Considerations

The following items are to be considered when designing metering systems:

- Where CTs are orientated with P1 towards the source, S1 will be polarity and tappings will be the return. Hence S1 must be connected to the current input terminal of the meter (e.g. R Ph terminal 1) such that the meter measures positive (Export) energy flow.
- Where CTs are orientated with P2 towards the source, the tappings will be polarity and S1 will be the return. Hence S1 must be connected to the current return terminal of the meter (e.g. R Ph terminal 3) such that the meter measures positive (Export) energy flow.
- For HV metering purposes, 4 wire connections are to be used with S1 taps commoned and earthed within the marshalling cubicle. S1 must always be connected in circuit so CT ratio changes are done by altering tapping connections not S1 connection (inter-tap ratios are not recommended). This is required since manufacturers accuracy test reports are generally referenced to the S1 terminal and any compensation to the CT is generally applied to the S1 terminal.

11 Analogue Output Transducer Requirements

DC voltage transducers require a suitable auxiliary supply based on the DC supply at the proposed substation, typical voltages are 32, 48, 110 and 125 V DC. Due to the battery charger's influence on the actual voltage, variations in the DC supply voltage from 75% to 125% shall be tolerated.

Where the transducer provides an analogue to digital conversion function for reading into an RTU device, then it shall have its auxiliary supply powered by the substation DC supply.

Analogue inputs to an RTU via transducers shall be 0 to 20mA for unidirectional points and -10 to 10mA for bidirectional points. Voltage transducers used for AVR control shall be suppressed scale input, i.e. +/- 20% of the nominal input voltage as per Section 9 of Standard STNW3106, SCADA Standard Point List.

For a transducer providing SCADA metering, the accuracy shall be Class 1.0M or better. Where the transducer provides additional functionality, such as input into AVR algorithm, the accuracy shall be Class 0.5M or better.

11.1 Transducer General Requirements

Insulation level	2 kV rms
Auxiliary supply if required	32/48/110/125V DC or 110V AC supplied via a VT
Output burden	0 - 1k Ohm
A.C. voltage inputs	110V voltage transformer secondaries
A.C. current inputs	1A current transformer secondaries
Short time thermal withstand	20x rating for 1 second, repeated 5 times at 5 second intervals
CT open circuit resistant	

Revision History

Revision date	Version number	Author	Description of change/revision
25/2/02	1.0	D Thompson	Approved
28/01/2021	2.0	David Aitken	Document re-written to Joint Standard.
08/11/2022	3.0	Addison Gabriel	Removed requirement for statistical energy measurements
6/7/2023	4.0	Addison Gabriel	Update for ECM audit