



# **CUSTOMER SUPPLIED HIGH VOLTAGE METERING UNIT SPECIFICATION FOR 11, 22 & 33 kV**

June 2016 – Issue 1

## **1. INTRODUCTION**

Introduction of contestability and the ability of all major customers to become contestable under the National Electricity Market means that customers can elect to provide High Voltage instrument transformers associated with metering installations. Accordingly customer supplied equipment shall be designed to comply with the accuracy and testing requirements of Chapter 7 of the National Electricity Rules.

Where a customer supplies a metering unit they shall be responsible to provide and maintain this as part of their electrical installation. Test certificates for and details of the metering unit shall be provided to Ergon Energy prior to delivery and installation of the equipment on site. The metering unit cannot be connected to the network until these documents have been provided.

Under the National Electricity Rules testing of instrument transformers forming part of a High Voltage (HV) metering installation shall be tested every 10 years. Unless otherwise agreed the costs associated with this testing will be at the customer's expense.

The accuracy details set out in this document are the minimum requirements for instrument transformers as listed in Schedule 7.2 Table S7.2.3.1 of the National Electricity Rules for customers with energy usage between 0.75 to 100 Giga-Watt hours per annum (Type 3).

## **2. SHARED USE OF WINDINGS**

Unless otherwise agreed, instrument transformers are rated and assumed to be for dedicated revenue metering use and shall not be used for any other purpose. Should the customer have a requirement to connect equipment to the secondary windings, then they shall advise the Metering Provider of the proposed use and the burden such equipment will place on the VT and/or CT's. Generally separate CT cores will be required on the load side of Revenue CTs for customer's requirements.

If agreement is reached to share the voltage transformer, then separate fused circuits will be required at the source end. For equipment connected in a CT circuit Ergon Energy will apply security and sealing to restrict access. This will necessitate authorisation and access to work on, or replace such equipment.

The CT Ratio specified in Clause 11.2 of the Performance Requirements are suitable for loads ranging from 0.5 to 6 MVA. For other loads the CT Ratios will be individually specified to meet the customer's expected and future load requirements.

### 3. GUARANTEED PERFORMANCE AT TIME OF ORDERING.

Prior to ordering associated metering equipment the customer or customer's representative shall supply Ergon Energy with type test certificates and specifications of the proposed instrument transformers or metering unit for Ergon Energy's approval.

Schedule A of this document provides details of the required performance criteria which the manufacturer guarantees the instrument transformers or metering unit will be capable of delivering.

### 4. TEST CERTIFICATES

Copies of the instrument transformer or metering unit test certificates shall be forwarded to the 'Metering Provider' and Ergon Energy. All test certificates shall be a certified copy for the unit/s supplied together with documentation proving traceability of testing to either a NATA or ILAC certified laboratory.

### 5. GUARANTEE

The customer is responsible and shall replace or rectify any defect with the VT's or CT's during the lifecycle of the equipment installed for metering use. Replacement equipment shall comply with the requirements and performance requirements set out in this document or future revisions as issued by the Metering Provider or Ergon Energy.

### 6. SWITCHGEAR LAYOUT

The customer or customer's representative is responsible for the development of a Single Line Diagram (SLD) for their installation and switchgear. The SLD shall include the number of incoming and outgoing circuits, VT's, CT's and their position in relation to any switches or bus-ties. Such details will influence the metering design, and enable drawings and meter programming to be finalised prior to installation.

### 7. METER PANEL

It is the Customers responsibility to supply and maintain a suitable meter panel and enclosure.

For a single meter installation a meter panel with minimum dimensions of 450 mm to 600mm wide and 600 mm high is normally adequate. The customer may negotiate with the nominated **Metering Provider for the supply and installation of a suitable meter panel and meter enclosure.** Equipment will be surface mounted and back wired. The Meter Enclosure location must be readily accessible for testing, free from vibration, and protected from mechanical damage.

### 8. WIRING FROM THE METERING UNIT TO METER PANEL

Wiring from both the VT and CT terminal box will run in conduit using 2.5 or 4 mm<sup>2</sup> cable. Cable sizes are dependent on distance from the instrument transformer or metering unit terminal box to

the meter panel and marshalling cubicle. Typically a 10 core or two x 6 core cable with identifiable colour coding or numbered cores is sufficient.

All taps of multi-tap CTs must be wired to the marshalling cubicle such that an outage is not required to change a CT ratio.

## 9. METER COMMUNICATIONS

Remote communications access to the meter will normally be via a digital mobile phone where adequate signal strength is available. The Customer may be required to provide mounting facilities for an external antenna. The Metering Provider should be consulted and may require assistance to mount and install an external phone antenna.

In areas where there is no mobile phone coverage the Customer will be required to arrange and install a PSTN or fixed line phone connection with suitable phone isolation equipment to allow remote reading of the meter.

## 10. GENERAL DESIGN and CONSTRUCTION

The following sections should be read in conjunction with the Queensland Electricity Connection and Metering Manual – Chapter 11 – High Voltage Metering. (Available from [www.ergon.com.au](http://www.ergon.com.au))

Where the Ergon Energy has negotiated a high voltage connection agreement detailing the point of supply and advised the customer they are responsible for the provision of the high voltage metering switchgear, the customer or customer's representative is responsible for ensuring the supplied high voltage instrument transformers meet the required specification. This shall include all aspects of performance, construction (materials and protective coatings), and suitability to meet service conditions and incorporates the requirements of this document for the Metering Unit component of the switchgear.

Instrument transformers provided for revenue metering purposes shall be installed electrically as close as practical to the point of supply with the primary current transformer terminals connected to the line side (P1 side) of the network supply. Additionally, section 11 below forms the acceptable criteria for instrumentation transformers for use of revenue metering, any variation to these requirements shall be by negotiation with the Metering Provider.

Both the voltage and current transformers shall be effectively secured in their housing, so that normal handling and transportation do not cause any displacement. Where any removable covers allow access to high voltage chambers they shall have permanent signage affixed to indicate "Danger High Voltage".

Where the metering unit is to be installed in areas subject to corrosive or salty conditions it shall be enclosed in a suitable housing for those conditions, for example enclosed in a stainless steel tank. Furthermore, primary voltage insulators will be rated in accordance with AS1824, where the creepage distance of all insulators shall be appropriate for the primary voltage and severity of pollution determined at the installation site.

## 11. PERFORMANCE REQUIREMENTS

### 11.1. Voltage Transformers (VT's)

#### 11.1.1. Single Phase Unit

Where individual single phase voltage transformers are connected to make a Star/Star arrangement they shall meet the requirements as per AS 60044.2 – 2007.

Single phase Voltage Transformer ratios for connection in Star/star will be either:

- ◆  $(11,000 / \sqrt{3}) / (110 / \sqrt{3})$  Volt
- ◆  $(22,000 / \sqrt{3}) / (110 / \sqrt{3})$  Volt
- ◆  $(33,000 / \sqrt{3}) / (110 / \sqrt{3})$  Volt

|                          |   |
|--------------------------|---|
| Rated output:            | 25 VA per phase   |
| Accuracy Class:          | 0.5   |
| Category of Performance: | Rated voltage factor 1.2 continuous and 1.5 for 30 seconds. |

**Note: Where the VT's rated burden exceeds 25VA per phase** the voltage transformer should be designed so that it is **within accuracy Class at zero burden** and tests shall be conducted to confirm this requirement.

The high voltage star point of the primary side of the voltage transformers shall be earthed at the star point.

The star point for the secondary winding shall be accessible at the same location as the other secondary voltage terminals.

#### 11.1.2. Three Phase Unit

Although less common, where a three phase voltage transformer is supplied it shall meet the requirements of AS1243 – 1982.

For a Three phase Voltage Transformer (VT), Star/star ratios of either:

- ◆  $(11,000 / \sqrt{3}) / (110 / \sqrt{3})$  Volt
- ◆  $(22,000 / \sqrt{3}) / (110 / \sqrt{3})$  Volt
- ◆  $(33,000 / \sqrt{3}) / (110 / \sqrt{3})$  Volt

|                 |  |
|-----------------|--|
| Rated output:   | 25 VA per phase  |
| Accuracy Class: | 0.5M   |
| Performance:    | Category B Rated voltage factor 1.1 continuous and 1.5 for 30 seconds. |

**Note: Where the VT's rated burden exceeds 25VA per phase** the voltage transformer should be designed so that it is **within accuracy Class at zero burden** and tests shall be conducted to confirm this requirement.

The star point for the secondary winding shall be accessible at the same location as the other secondary voltage terminals.

## 11.2. Current Transformers (CT's)

The current transformers shall meet the requirements of AS 60044.1- 2007. They can be included with the Voltage Transformer as part of a metering unit, or installed in each phase in a high voltage metering chamber.

The following Table provides the preferred ratios and accuracy class for each supply voltage for loads within the specified load range (kVA). Single ratio CTs may also be used where they meet the present and future load of the customer, typically though alternate ratios and specifications must be agreed with the Metering Provider prior to installation.

**Table 1 - Required Current Transformer Characteristics**

| <b>Voltage<sup>1</sup><br/>(Volts)</b> | <b>CT Ratios<br/>(Amps)</b> | <b>Class &amp;<br/>Capacity</b> | <b>Load Range<br/>(kVA)</b> |
|--|-----------------------------|---------------------------------|-----------------------------|
| 11,000                                 | 200 - 100/5                 | 0.5 Ext 200% FS10               | 500 - 6000                  |
| 22,000                                 | 100 - 50/5                  | 0.5 Ext 200% FS10               | 500 - 6000                  |
| 33,000                                 | 100 - 50/5                  | 0.5 Ext 200% FS10               | 500 - 8000                  |

The rated output on any CT shall be a minimum of 5 VA on the lowest tap setting. If the load range is outside the above table then the Metering Provider needs to be consulted for the size of the CT's required. For loads less than 50% of the lowest tap or are intermittent or seasonal in nature (i.e. Wind Generation, Sugar Mills, Cotton Gins etc.) accuracy Class 0.5S CT's are required to be installed.

## 11.3. Standard Specifications

Except as otherwise detailed herein, the equipment is to comply with all appropriate Australian Standard Specifications and the latest amendments thereof. It is the customer's responsibility to check that the supplied equipment adheres to the latest revision of the Standards referenced on the Australian Standards website.

## 11.4. Service Conditions

The following service conditions shall apply in the absence of any being specified by the customer, or their agent and will depend upon exposure to environmental conditions. The conditions need to be endorsed / agreed on by Ergon Energy before the unit is accepted for installation on the Network.

### 11.4.1. Environmental Conditions

For the purpose of the Metering Unit or individual instrument transformer, the following environmental conditions shall apply: (Note: Not all conditions apply if switchgear is for indoor use.)

|                        |  |
|------------------------|--|
| Ambient Temperature:   | +45°C summer day time.<br>-5°C winter night time.<br>The temperature exposed to direct sunlight of 75°C is accepted. |
| Solar Radiation Level: | 1.1 kW/m <sup>2</sup> with high ultraviolet content  |
| Precipitation:         | Tropical summer storms with gust wind speeds above 160km/h, and an annual rainfall in excess of 1500 mm.             |

<sup>1</sup> The voltages specified are phase to phase voltage.

|                             |   |
|-----------------------------|---|
| Humidity:<br>relative       | Ranging from negligible to extended periods of humidity in excess of 90% R.H.   |
| Atmospheric Classification: | Typical of all areas defined in AS/NZS 2312, Clause 2.2, namely mild, moderate, tropical, industrial, marine and severe marine. |
| Thunder-day Activity:       | The general level of thunder day activity is 25-35 days per year.   |

#### 11.4.2. System Conditions

Operating system voltages: 9.9 to 12.1 kV, 19.8 to 24.2 kV & 30.1 to 34.2 kV

Number of Phases: Three Phase

Frequency: 50 Hz

Insulation level: 75kV peak/28kV rms for 11kV Unit  
125kV peak/50kV rms for 22kV Unit  
170kV peak/70kV rms for 33kV Unit

11, 22 or 33 kV earthing system: Normally operated with the neutral solidly earthed.

Nominal System Voltage: 11, 22 or 33 kV

Short Circuit level: 250 MVA (unless otherwise specified)

#### 11.5. Windings and Terminations

The tails of all instrument transformer secondary windings shall be anchored separately from the windings, so that any stresses applied to the tails does not affect the winding proper. The ends of all available secondary windings shall be brought out into a common **sealable** waterproof terminal box where this is part of a metering unit.

A common terminal box is preferred but not required where the voltage transformer (i.e. truck type) is located separate from the current transformers. All secondary terminals shall be marked in accordance with the applicable standards.

Should the customer have terminals which need to be accessible in the same terminal box as the metering terminals, then the metering terminals shall be capable of being sealed in their own right (i.e. use of a Perspex cover with sealing screws.).

The terminal box shall be capable of IP56 level of protection (AS 1939) if it is going to be located in an outdoor location. The box should be designed so that it is able to breath and condensation doesn't accumulate.

The voltage secondary terminals shall be fused with 10 Amp HRC sealable fuses.

If the current transformers have multiple tap ratios than all ratios must be available in the marshalling box and accessible to change the CT tap ratio.

### **11.6. Insulation Level**

The voltage transformers shall be insulated to withstand the test voltages as specified in AS 60044.2, Table 4 and for three phase units AS 1243 Clause 1.6. Each current transformer shall have an impulse withstand level as specified in AS60044.1 Table 3.

### **11.7. Oil Filled Metering Units (where applicable)**

The metering unit shall be supplied complete with oil (where applicable), impregnated and ready for service. Oil shall comply with the provisions of AS1767, and certified to contain less than 1ppm of PCBs. Oil filled Metering Units shall be of the sealed tank construction type (like sealed transformers) in accordance with AS 2374, Part 1, Clause 8.2 but neither pressurised nor incorporating gases other than air. An oil level indicator shall show the correct level under normal operating conditions.

### **11.8. Air Insulated Metering Units (where applicable)**

The internal secondary wiring in the HV chamber for Current and Voltage transformers shall be segregated from the main circuit by earthed metallic partitions or separated by partitions made of insulating material in accordance with Clause 5.4 of AS 2086, except for short lengths being defined as no greater than 400mm. All secondary wiring shall be adequately restrained to maintain clearances when pressure is applied to secondary wires so they do not encroach within the required HV clearances.

If considered necessary by the manufacturer, the HV chamber shall have a heater to prevent condensation. Where supplied it shall be of the wire wound (non-inductive) type, sturdy and fitted inside the HV chamber such that it can be easily replaced without having to remove other components. The heater shall be separately fused and where possible supplied from a separate voltage source to the VT. If the heater is supplied from the Voltage Transformer, it is preferable that heating elements burden each phase equally and be protected by a circuit breaker on each phase. The manufacturer shall state what impact this will have on the VT's stated accuracy.

### **11.9. High Voltage Fuses**

Where the metering unit has internal high voltage fuses fitted to each voltage transformer primary winding, then a spare set of High Voltage fuses shall be supplied, and retained for use at the customer's site. High Voltage Fuses shall be of the Instrument Cartridge type and shall be accessible and removable via a high voltage fuse cover without the need to dismantle any internal part of the Metering Unit.

## **12. MANUFACTURER TO PROVIDE**

### **12.1. Quality Assurance**

It is expected that the customer or customer's representative will purchase metering unit equipment from sources that demonstrate the ability to supply quality products, and have formal Quality Assurance (QA) accreditation to AS/NZS ISO 9001 or AS/NZS ISO 9002 or equivalent.

### **12.2. Testing Requirements**

The Manufacturer is responsible for testing, and shall include all tests set out in the Standard Specification for the various portions of the plant. Test results for accuracy shall state the level of uncertainty that applies to the measurements, the reference conditions, and equipment used.

Test results shall state the level of certification, and traceability for the testing to National Association of Testing Authorities (**NATA**) Lab or International Laboratory Accreditation

Cooperation (**ILAC**). Tests results must be stated with a level of uncertainty  $\pm 0.1\%$  to 95% Confidence interval.

### **12.2.1. Additional Accuracy Test Requirements**

Where certificates of type tests performed are supplied in accordance with clause 7.1 of AS 60044.2 and Clause 1.15 of AS 1243 for voltage transformers and clause 6.1 of AS 60044.1 for current transformers then routine accuracy tests with the following additional test points will be sufficient.

In addition to the routine accuracy tests for current transformers, tests shall be performed at 10% and 50% primary current value at unity power factor for Class 0.5 CT's.

If **No Type Test Certificates** are available then Type Tests are to be included and conducted as part of the supply contract as specified in the applicable standards.

Upon completion of all tests the manufacturer shall forward to the customer or their agent certified test sheets which are referenced to the manufacturer's serial numbers and showing the results of each such test. Wiring diagrams, construction diagrams and nameplate details shall also be supplied prior to delivery.

If the results on any test certificates furnished by the Manufacturer are found to be incorrect, outside specification or are not traceable, the customer or their agent shall arrange for the defective plant to be replaced or retested.

If additional windings or ratios are available on the instrument transformers as per the instrument nameplate than the test certificate submitted to Ergon Energy shall include test results for all windings and CT ratios (including inter-taps if applicable) tested as per AS 60044.1, AS 60044.2 and AS 1243.

A copy of the test results shall be supplied to the Customers Metering Provider and to Ergon Energy.

### **12.3. Chemical and Chemical Substances**

Manufacturers (Tenderers) are required to provide a Material Safety Data Sheet (MSDS) for every chemical substance used in the electrical and thermal insulation, impregnation, and paint finish or for any other purpose in the completed product. All metering panels/switchgear provided must be vermin proof.

## **13. PRIMARY INJECTION TESTING**

The National Electricity Code requires accuracy tests to be performed on all Instrument Transformers every 10 years. The manufacturer shall provide details, and drawings on what steps and disassembly have to be performed to enable primary injection tests to be performed on the current and voltage transformers to determine ratio and phase errors. This shall include means of isolation, earthing, and connecting the test equipment to the primary conductors.

## **14. ERGON ENERGY CONTACT DETAILS:**

Manager Meter Provision - Ergon Energy  
 P.O. Box 308  
 Rockhampton 4700  
 Phone: 07 4932 7238  
 Fax: 07 4921 4891



Email: [MeterProvision@ergon.com.au](mailto:MeterProvision@ergon.com.au)

Principal Engineer Metering - Ergon Energy

P.O. Box 308

Rockhampton 4700

Phone: 07 4932 7243

Fax: 07 4921 4891

Email: [Network.Metering@ergon.com.au](mailto:Network.Metering@ergon.com.au)

## **APPENDICIES - THE GUARANTEED PARTICULARS FOR CUSTOMER SUPPLIED 11kV, 22kV or 33kV METERING UNITS.**

| <b>SCHEDULE A - GUARANTEED PARTICULARS</b>  |                                    |
|---|------------------------------------|
| <b>PARTICULARS</b>  | <b>GUARANTEED PERFORMANCE</b>      |
| Quality Assurance Rating  |                                    |
| Equipment Supplier  |                                    |
| Equipment Type  | Air / Oil insulated                |
| Type Test certificates supplied   | Yes / No                           |
| Voltage Transformation Ratio  | / 110 / $\sqrt{3}$                 |
| Voltage Transformer output and class  | VA / phase Class                   |
| Three phase VT Performance Category   | Cat A / Cat B / N/A                |
| VT Rated Voltage Factor and duration  |                                    |
| VT tested will need to be within Class at zero burden.  | Yes / No                           |
| Current transformer Ratio, output and class (specify for each tap if multi-ratio CT will be supplied)   | Ratio: VA Class<br>Ratio: VA Class |
| Expected performance values:<br><ul style="list-style-type: none"> <li>• test equipment measurement uncertainty</li> <li>• temperature voltage / phase coefficients</li> <li>• Which Testing authority has certified the test equipment?</li> </ul> | +/- %<br>+/- crad / min / °C       |
| Impulse withstand level   | kV                                 |
| Rated short time current and rated short time factor  | kA                                 |

| <b>SCHEDULE B - GENERAL PARTICULARS</b>  |                            |
|--|----------------------------|
| <b>PARTICULARS</b>   | <b>GENERAL PARTICULARS</b> |
| 1. Manufacturers name  |                            |
| 2. Metering Unit type /model reference   |                            |
| 3. Plant Serial Numbers  |                            |
| 4. Rated Operating Voltage   |                            |
| 5. Country of manufacture  |                            |
| 6. With which Standard Specifications does plant comply, and Accuracy tests performed? (Clause 12 - MANUFACTURER TO PROVIDE TEST RESULTS)  |                            |
| 7. Has the Metering Unit been Type tested? (Clause 12 - MANUFACTURER TO PROVIDE TEST RESULTS)  |                            |
| 8. Copies of Type test certificates attached?  |                            |
| 9. Copies of construction / assembly attached? (Clause 10 - PRIMARY INJECTION TESTING)   |                            |
| 10. Are MSDS supplied as required? (Clause 12.3)   |                            |
| 11. Does the unit include internal high voltage fuses? If so what is the proposed Type and rating. (Clause 11.9 HIGH VOLTAGE FUSES)  |                            |
| 12. Has a spare set of high voltage fuses been included with the unit? (If used) (Clause 11.9 HIGH VOLTAGE FUSES)  |                            |
| 13. Please state the Authority which will perform the accuracy tests, level of Quality Assurance, provide documentation of testing competency and traceability to NATA (or ILAC). (Clause 12.2 MANUFACTURER TO PROVIDE TEST RESULTS & QUALITY ASSURANCE) |                            |
| 14. Will all test points be included in the test certificate as required in Clause 12.2?   |                            |
| 15. Test certificates shall state the level of uncertainty that apply to the voltage and phase error test results. Is this available? (Clause 12.2 MANUFACTURER TO PROVIDE TEST RESULTS)   |                            |
| 16. State the voltage and phase error temp coefficients. As per AS60044 & AS1243.  |                            |
| 17. Will the Voltage Transformer be within accuracy Class at zero burden, and included in the test results? (Clause 11.1 Voltage Transformers (VT's))  |                            |
| 18. Have drawings of the metering unit and details been provided on  |                            |

|   |  |
|---|--|
| how to gain access for Primary Injection tests. (Clause 13 PRIMARY INJECTION TESTING)   |  |
| 19. Has the requirements for sealing of voltage and current terminals been met? (Clause 11.5 WINDINGS and TERMINATION)                            |  |
| 20. Are the secondary voltages fused? (Clause 11.5 WINDINGS and TERMINATION)  |  |
| 21. If Air Insulated, is a heater supplied for the HV chamber? Rating, Type (Clause 11.8 AIR INSULATED METERING UNITS ( <b>where</b> applicable)) |  |
| 22. Means (if any) of relieving excess gas pressure   |  |
| 23. Firms supplying oil ( if applicable)  |  |
| 24. Grade of oil ( if applicable) (Clause 11.7)   |  |
| 25. Is tank sealed? ( if applicable)  |  |
| 26. Total quantity of oil required ( if applicable)   |  |