Standard

EHV Voltage Transformer Standard

R586391

Version 2.0, June 2018

Authorisations

Action	Name and title	Date
Prepared by	Michael Verrier, Senior Asset Strategy Engineer	June 2018
Reviewed by	Santosh Dhakal, Asset Engineer	June 2018
Authorised by	Darryl Munro, Asset Strategy Team Leader	June 2018
Review cycle	30 months	

Responsibilities

This document is the responsibility of the Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Strategy Leader with any queries or suggestions.

- Implementation All TasNetworks' staff and contractors.
- Compliance All group managers.

Minimum Requirements

The requirements set out in TasNetworks' documents are minimum requirements that must be complied with by all TasNetworks team members, contractors, and other consultants.

The end user is expected to implement any practices which may not be stated but which can be reasonably regarded as good practices relevant to the objective of this document.

Record of revisions

Section number	Details
Entire doc	Copied over verbatim from superseded Transend to TasNetworks template. Updated Transend to TasNetworks document reference numbers where known including Australian Standards.
12	Hold points updated

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1 General

1.1 Purpose

To define the requirements from an extra high voltage (EHV) outdoor post type electromagnetic and capacitor voltage transformers (hereafter both referred to as 'voltage transformer/s' except where separate requirements exist), under the responsibility of Tasmanian Networks Pty Ltd (hereafter referred to as 'TasNetworks).

1.2 Scope

This standard specifies the requirements for the design, manufacture, construction, testing at manufacturer's works, secure packaging, supply, transportation and delivery to site and complete documentation of voltage transformers.

1.3 Objective

TasNetworks has developed this standard for voltage transformer design, manufacture and testing to ensure:

(a) that relevant Australian legal requirements are met;

(b) that the requirements of the Tasmanian Electricity Code and National Electricity Rules are met;

(c) personnel and public safety and environmental hazards are identified, analysed and eliminated or control measures adopted;

(d) risk to TasNetworks' assets is minimised;

(e) ease of operation and maintenance;

(f) minimum disruption to the electricity transmission system following an asset failure;

(g) that the requirements of TasNetworks' business plan are met;

(h) that the exposure of TasNetworks' business to loss is minimised; and

(i) that TasNetworks' responsibilities under connection agreements are met.

1.1 Certificate of conformance

Before any new voltage transformers are put into service in TasNetworks' system, a certificate of conformance with this standard must be submitted to TasNetworks. The certificate of conformance must be duly supported with documents, drawings, test results, test reports, test certificates, completed check lists and other documents as applicable. Where TasNetworks has approved deviation to specific requirements of this standard, all such approvals must be included with the certificate of conformance.

TasNetworks will supply blank forms for certificate of conformance, to be completed by the Contractor.

The voltage transformers will be put into service only after TasNetworks has accepted the certificate of conformance.

1.2 Precedence

Any conflict between the requirements of the standards, codes, specifications, drawings, rules, regulations and statutory requirements or various sections of this standard and other associated documents must be brought to the attention of TasNetworks for resolution.

1.3 Deviation

Special approval for a deviation to this standard may only be accorded if it does not reduce the quality of workmanship, or does not deviate from the objective or intent of the standard. A request for a deviation must follow a designated procedure that involves approval from TasNetworks. Deviations, if any, must be specifically requested and require approval in writing by TasNetworks prior to award of Contract.

1.4 References

As a component of the complete specification for a voltage transformer or a system, this standard is to be read in conjunction with other standards and documents as applicable. In particular this includes the project specifications and the following:

1.4.1 TasNetworks standards

R586386	Extra High Voltage System Standard
R246497	Testing, Commissioning and Training Standard
R590634	Substation Civil Design and Construction Standard
R517371	Insulating oil for Transformers and Switchgear Standard
R586393	EHV Voltage Transformers Deliverables
R586395	EHV Voltage Transformers Schedule

1.4.2 Other standards

Bushings for alternating voltages above 1000 V	AS/NZS 60137
Structural steel welding	AS 1554
Metal finishing and pre-treatment of surfaces	AS 1627
Insulating oil for transformers and switchgear	AS 1767
Degrees of protection provided by enclosures for electrical equipment (IP code)	AS 60529
Switchgear assemblies & ancillary equipment for alternating voltages above 1 kV	AS 2067
High voltage switchgear and control gear Part 301: Dimensional standardization of terminals	AS 62271.301-2005
High Voltage a.c. switchgear and control-gear – Common requirements	AS/NZS 62271.1
Electrical installations (known as the Australian/New Zealand Wiring Rules)	AS/NZS 3000
Steel structures	AS 4100
Instrument Transformers – Part 1: Single-phase inductive voltage transformers	AS 60044.2
Instrument Transformers – Part 5: Capacitor voltage transformers	AS 60044.5

2 Service conditions

Service conditions shall not exceed the limits stated in AS/NZS 62271.1 Clause 2, together with the particulars of the system stated in Table 2 of this standard.

Any additional specific environmental conditions for particular works will be stated in the project specifications.

3 Design requirements

Voltage transformers supplied must comply with the requirements within Table 2 of this standard, the requirements detailed in AS 60044.2 and AS 60044.5 and other applicable Australian and International Standards. Where a conflict exists, the most onerous requirement shall apply.

Any additional specific design, installation, operation and maintenance criteria for particular works will be stated in the project specifications.

Table 1 Parameters for voltage transformers

Sr. No.	Parameter	Unit	Value	
	Particulars of the System			
1.	Nominal system voltage	kV	110	220
2.	Highest voltage (U_M)	kV	123	245
3.	Power frequency withstand voltage (PFWV)	kV_{rms}	230	460
4.	Lightning impulse withstand voltage (LIWV)	kV_{peak}	550	1050
5.	Normal voltage variation (criteria for equipment design)	$\%V_n$	$^{238}_{93}10$	
6.	Frequency (f_R)	Hz	50	
7.	Normal operating frequency excursion band	Hz	48.8 to 52	
8.	Power system frequency range	Hz	44.8 to 52	
9.	Normal combined voltage and frequency variation (criteria for equipment design)	%	$^{238}_{93}$ 10	
10.	System earthing	-	solidly earthed	
11.	Number of phases	-	3	
12.	Minimum ambient air temperature	°C	minus 10	
	Particulars of Voltage Transformers			
13.	Number of phases	-	single	
14.	Installation	-	outdoor	
15.	Construction (preferred)	-	post type	
16.	Type		electro-magnetic or capacitor	capacitor
17.	Number of identical windings per phase	-	2	
18.	Insulation medium	-	oil	

Sr. No.	Parameter	Unit	Value	
19.	Minimum creepage distance of bushings	mm	3075	6125
20.	Primary terminal palm type (AS 62271.301-2005)	-	8	
21.	Static withstand load (horizontal and vertical) on primary terminal	kN	1	1.25
22.	Dynamic withstand load (horizontal and vertical) on primary terminal	kN	1.4	1.75
23.	Rated primary voltage (U_{PR})	kV	110 / √ 3	220 / √ 3
24.	Rated transformation ratio (K_R)	-	1000	2000
25.	Rated output, accuracy and accuracy range for each winding	-	refer Table 2	
26.	Rated secondary voltage (U_{SR})	V	110/√3	
27.	Rated voltage factor (F_V)	-	1.5	
27.1	Rated time for F_V	s	30	
28.	Degree of protection by enclosure of secondary terminal box	IP	54	

4 Voltage transformer design requirements

Voltage transformers must utilise the electromagnetic or capacitor construction principle.

Voltage transformers other than those working on inductive or capacitive technology may be accepted only if proven to be more reliable and present lower whole-of-life costs. All such evidence must be submitted to TasNetworks prior to award of Contract.

Optical voltage transformers and other technology such as sensors can be proposed as an alternative only if they have been tested in accordance with Australian Standards and have certification from relevant authorities in Australia for application to revenue metering measurement applications as per the Code. Any such technology proposed must have been in commercial service for at least three years in the electricity supply industry.

4.1 Performance requirements

Specific parameters for secondary windings for voltage transformers are listed in Table 2.

Other voltage transformer parameters, such as additional windings, modified connections, ratios or accuracy class will be allowed only if it is requested in the project specifications or it is proven to TasNetworks' satisfaction that the proposed parameters are more onerous than those listed in Table 2.

Table 2 Specific parameters for secondary windings for voltage transformers

Sr. No.	Secondary Winding Parameter	Unit	Winding 1	Winding 2
1.1	Duty	-	Protection & metering	Protection & metering
1.2	Rated output per winding	VA	50	50
1.3	Measuring accuracy class	-	0.5M for Type 2 or 3 Metering Installations, or 0.2M for Type 1 Metering Installations (Specified at time of tender)	0.5M for Type 2 or 3 Metering Installations, or 0.2M for Type 1 Metering Installations (Specified at time of tender)
1.4	Protection accuracy class	-	3P	3P
1.5	Output range	%	5 to 100	5 to 100

4.2 General design requirements

Voltage transformers must:

(a) comply with this standard and requirements detailed in AS 60044.2, AS 60044.5 and AS/NZS 60137 for 'normal service conditions' and other applicable Australian Standards;

(b) be oil insulated, with insulating oil as per AS 1767 and satisfy the requirements of TasNetworks' insulating oil for Transformers and Switchgear standard (R517371);

(c) be hermetically sealed;

(d) be designed to minimise the risk of accidental short circuit by animals, birds and vermin;

(e) be manufactured with reliable components to provide for an expected 50 year service life; and

(f) have terminal markings and rating plate in accordance with AS 60044.2 and AS 60044.5. Polarity markings must be provided on the primary and secondary terminals of each voltage transformer and affixed so that they can be easily read without requiring any disconnection of the voltage transformer.

4.1 Primary circuit requirements

Voltage transformers must:

(a) be capable of withstanding the highest voltage continuously;

(b) have composite polymeric bushing insulation, silver grey in colour, capable of withstanding all environmental conditions, including those imposed by fauna, heavy pollution and salt spray;

(c) have insulators with sufficient static and dynamic mechanical strength to withstand normal loads, operating forces, together with electro-magnetic forces produced from short-circuits;

(d) have an insulated primary neutral terminal. The neutral end of the primary winding must be brought out to a separate insulated terminal in the secondary terminal box. A slide-disconnect link must be provided to securely connect the primary neutral terminal to the earthed base; and

(e) have a test tap provided for Dielectric Dissipation Factor (DDF) tests and for Partial Discharge (PD) tests. The tap shall be brought out as a hermetically sealed test terminal housed in the secondary terminal box and connected to earth through a slide-disconnect link. The earthed shield shall be earthed through the test terminal and slide-disconnect link.

4.1.1 Primary line terminal

(a) Voltage transformers must be provided with an aluminium alloy primary terminal.

(b) The terminal must be of a type as listed in Table 1 of this specification, as per AS 62271.301-2005.

(c) The primary terminal must be supplied in a vertical orientation.

4.1.1 Capacitor voltage transformers

Capacitor voltage transformers (CVT) must:

(a) be capable of supporting a line trap for a power line carrier application, if stated in the project specifications; and

(b) have a cover securely fitted over the primary terminal of the intermediate voltage transformer.

4.1 Secondary circuit requirements

Voltage transformers must have:

(a) a nominal secondary voltage as per Table 1 of this specification for both secondary windings;

(b) a secondary burden capability as per Table 2 of this specification for both windings;

(c) the secondary windings capable of being connected in a star configuration as part of a three phase set of voltage transformers with an earth neutral point in a remote junction box;

(d) ratio and phase angle errors that conform to AS 60044.2 and AS 60044.5 requirements for both secondary windings; and

(e) windings are arranged such that a change in burden of one winding does not affect the performance of other windings.

4.1.1 Electromagnetic voltage transformers

Secondary circuits for electromagnetic voltage transformers must obtain the specified performance without recourse to compensation devices or ancillaries for calibration.

4.1.2 Capacitor voltage transformers

Secondary circuits for capacitor voltage transformers must:

(a) be capable of including carrier frequency accessories, such as drain coil and voltage limitation device, for a power line carrier application, if stated in the project specifications; and

(b) have damping device circuits connected to terminals for testing purposes.

4.1.1 Secondary wiring and terminals

Unless otherwise approved by TasNetworks in writing, secondary wiring must:

(a) use the following colour code:

(i) Unspecified phase and neutral cores – Black; and

(ii) Earth – Green/Yellow.

(b) be brought out through a hermetically sealed barrier and terminated in a marshalling/termination box;

(c) utilise not less than 0.6/1.0 kV grade wiring; and

(d) not be jointed or teed between terminal points.

Terminals must be:

(a) comprised of Weidmuller type WTL 6/1, Phoenix type URTK/Sor equivalent slide-disconnect terminals for all protection, metering or test circuits;

(b) comprised of yellow/green feed-through terminals for secondary earthing circuits;

(c) fully shrouded;

(d) arranged to not clamp wiring directly under screws;

(e) consecutively and permanently labelled to indicate the applicable winding of the voltage transformer to AS 60044.2 and AS 60044.5;

(f) grouped according to function, providing for neat use of an external PVC insulated, copper screened, multi-core cable for each separate voltage transformer; and

(g) arranged to allow for connection of external cables and wires to the bottom of each terminal.

Terminal blocks must:

(a) utilise 32 mm DIN rail mounting to ensure easy and safe access to terminals; and

(b) have a separator plate to segregate each set of terminals for each winding of the voltage transformer and to segregate any earth or test terminals.

5 Other requirements

5.1 General construction

(a) All equipment associated with the voltage transformer assembly must be designed to avoid pockets in which water can collect.

(b) Lifting lugs must be provided near the base of each voltage transformer and stabilising lugs provided near the top of each voltage transformer.

(c) Ferrous surface finishes must be hot dip galvanised, in accordance with AS 1650.

5.1 Fittings

(a) All fittings must be located in positions to minimise risk of mechanical damage.

(b) An internal oil expansion system must be provided.

(c) A pressure relief device or rupture disc must be provided to prevent uncontrolled explosion in the event of an internal insulation failure and shall be positioned near the top of the voltage transformer.

(d) O-ring seals, where required, must be employed to eliminate water ingress.

(e) Any vents in the base of the secondary terminal box must be screened by fine gauze to prevent ingress of insects and designed to prevent the ingress of water.

(f) Screw threaded parts must utilise ISO metric head and nut sizes and ISO metric threads.

(g) An oil level indicator must be provided and be capable of being read while the equipment is in-service, reliably indicating oil level. The oil level indicator material and indicating colours must be capable of withstanding continuous exposure to ultra-violet radiation.

5.1 Oil sampling

(a) An oil sampling valve must be provided, located at the base of the voltage transformer, suitable for obtaining samples for dissolved gas analysis (DGA) at recommended intervals.

(b) The oil sampling valve must have at least 20 mm bore.

5.1 Support structures

If specified within the project specifications, support structures supplied for the voltage transformer must:

(a) be hot dipped galvanised, constructed of tubular steel and be of at least 300 mm diameter;

(b) be of a height specified within the project specifications;

(c) conform to AS 1554, AS 1627 and AS 4100 for steel structures and welding; and

(d) comply with the requirements of TasNetworks' Substation Civil Design and Construction standard, (R590634).

5.1 Earthing

(a) Frames of all equipment supplied must be provided with reliable earth connections and comply with relevant Australian Standards.

(b) Earthing terminals must be suitable for connecting copper earthing strip size 40 mm x 6 mm using at minimum 2 x 13 mm bolts with 44 mm centres.

5.1 Special tools

Any special tools required for the operation or maintenance of the voltage transformer must be provided. Tools and equipment for obtaining oil samples for DGA must be provided.

5.2 Documentation requirements

(a) Dimensional plan and section drawings for the voltage transformer and its associated accessories must be produced and submitted for approval by TasNetworks. The drawings must show the final outline dimensions, total mass, centre of gravity, mass and volume of oil, details of insulator, primary and earth terminals, support structure attachment points, lifting lugs, oil level indication, oil sampling device, other fittings and accessories, and the materials utilised.

(b) Separate rating, nameplate and warning label drawings must be produced and submitted for approval by TasNetworks.

(c) Separate schematic and wiring diagrams must be produced and submitted for approval by TasNetworks.

(d) A material safety data sheet (MSDS) for the insulating material must be provided.

(e) Details on packaging and handling the equipment during transport and erection must be provided and submitted for approval by TasNetworks.

(f) Operation and maintenance manual must be provided and submitted for approval by TasNetworks.

(g) Separate construction drawings must show recommended mounting structures and all detail required to install the equipment, including minimum clearances in air (between poles and to earth), rated static and dynamic mechanical terminal loads.

(h) All documents and drawings must be clear, legible and free from errors or omissions.

(i) All documents and drawings must be in the English language ONLY.

(j) Only SI system of units can be used. Units must be stated for all values.

(k) Scales, wherever used, must be as per the applicable Australian Standards.

(l) All drawings that are made to scale must include a scale block.

(m) Electronic copies of drawings must be supplied on CD-Rom in both Adobe Acrobat 'pdf' and AutoCad formats.

(n) Only information relevant to the supplied voltage transformer must be shown in the documentation and drawings.

5.1 Labels

(a) Warning labels fitted within the secondary terminal box must be traffolyte, with black text on yellow background.

(b) Danger labels fitted within the secondary terminal box must be traffolyte, with black text on red background.

(c) Warning labels, must be fitted within the secondary terminal box and clearly state:

(i) 'ATTENTION: WHEN HIGH VOLTAGE IN-SERVICE, BOTH THE DDF TERMINAL AND PRIMARY EARTH TERMINAL MUST BE CONNECTED TO GROUND'.

(ii) 'ATTENTION: DO NOT SHORT-CIRCUIT THE VT SECONDARY OUTPUT TERMINALS'.

(d) Danger labels for CVTs, must be fitted on the cover over the primary terminal of the intermediate voltage transformer and clearly state:

(i) 'DANGER HIGH VOLTAGE'.

5.1 Nameplates

(a) The voltage transformers must be provided with nameplates that are:

(i) legible and in the English language;

(ii) permanently and indelibly marked;

(iii) securely fixed in position to the body of the secondary terminal box of the voltage transformer (not to be fixed to a removable component, such as a hinged door);

(iv) weather proof and corrosion-proof;

(v) made of brass, stainless steel or material of equal durability; and

(vi) readable from ground level.

(b) In addition to the requirements of clause 11.1 of AS 60044.2, the following information must be included on the electro-magnetic voltage transformer nameplate:

(i) Mass of the oil (in kg) and volume of the oil (in litres);

(ii) Mass of the device (in kg), indicating whether the filled and unfilled mass is provided;

(iii) Thermal limiting output for each secondary winding (VA)

(iv) Purchaser: Tasmanian Networks Pty Ltd; and

(v) Purchaser's contract number: refer to project specifications.

(c) In addition to the requirements of clause 16.1 of AS 60044.5, the following information must be included on the capacitor voltage transformer nameplate:

(i) Type designation for the intermediate voltage transformer and capacitor units;

(ii) Intermediate voltage transformer's nominal primary voltage;

(iii) Warning labels for power line carrier connections;

(iv) Purchaser: Tasmanian Networks Pty Ltd; and

(v) Purchaser's contract number: refer to project specifications.

6 Data for Asset Management Information System

(a) TasNetworks maintains a comprehensive 'Asset Management Information System' (AMIS) that contains all design, test results and the condition of all TasNetworks assets. The AMIS also contains maintenance regimes for all assets.

(b) The supplier must provide information required to maintain the currency of AMIS for each asset in standard forms. TasNetworks will provide the forms to the selected supplier. Forms are required to be filled in for all new assets.

7 Maintenance procedures and plans

(a) Detailed maintenance procedures covering the entire life of the voltage transformer must be provided, including installation, commissioning, maintenance and decommissioning procedures.

(b) Oil sampling procedures and diagrams must be provided.

(c) Blank inspection and test plans for commissioning, maintenance and routine testing, for use by TasNetworks maintenance personnel, must be provided.

8 Testing

(a) All components of the voltage transformer must be duly tested in accordance with applicable Australian and International standards. Where tests are optional in the standards, it will be considered that these tests are required by TasNetworks, unless otherwise requested by Contractor and agreed in writing by TasNetworks before the award of Contract.

(b) All test reports must be forwarded to TasNetworks for approval and acceptance. The tests will be considered as completed only after approval and acceptance of test results by TasNetworks in writing. The tests to be conducted on voltage transformers are referred to in the following sections.

8.1 Type tests

(a) Type tests are intended to prove the soundness of design of the voltage transformer/s and their suitability for operation under the conditions detailed in the standards. Type tests must be carried out before delivery. A test report, detailing the results of such tests along with the procedures followed, must be provided to TasNetworks. These tests must have been applied to a voltage transformer of identical design with that offered, or on a voltage transformer of a design which does not differ from that offered in any way which might influence the properties to be confirmed by the type test.

(b) Where such tests have already been performed, a copy of type test report that qualifies for the exemption from conducting these tests must be provided with the tender.

(c) Type tests must be performed to the relevant Australian Standards. Where type tests differ from the requirements under the relevant Australian Standards, the Contractor/Supplier must detail and submit a list of non-conformances to TasNetworks for consideration.

(d) Type tests for electromagnetic voltage transformers must include all type tests and special tests listed in clause 7.1 and 7.3 of AS 60044.2.

(e) Type tests for capacitor voltage transformers must include all type tests and special tests listed in clause 8.1 and 8.3 of AS 60044.5.

8.1 Routine tests

(a) The routine tests must be conducted on the complete system to prove quality of manufacture and conformance with the relevant performance requirements of the applicable standards. Splitting of routine tests into separate phases for individual components of the system is not acceptable. Routine testing must be performed at the manufacturer's works prior to delivery.

(b) Procedures for routine tests with supporting documentation must be submitted to TasNetworks for approval and acceptance. Routine tests must not be conducted unless the routine test procedures have been accepted and approved by TasNetworks.

(c) Routine test results and certificates must be submitted to TasNetworks for approval and acceptance. Routine tests will be considered as completed only after TasNetworks approves and accepts the test results.

(d) Routine factory test results must be approved and accepted by TasNetworks prior to dispatch of equipment to site.

(e) Routine tests for electromagnetic voltage transformers must include all routine tests listed in clause 7.2 of AS 60044.2 on the primary and both secondary windings and include special test listed in clause 7.3 (b) of AS 60044.2, for capacitance and dielectric dissipation factor.

(f) Routine tests for capacitor voltage transformers must include all routine tests listed in clause 8.2 of AS 60044.5 on the primary and both secondary windings.

(g) DGA, electrical strength and oil quality test results are to be provided for the parent batch of insulating oil used as per TasNetworks' Insulating oil for Transformers and Switchgear standard, (R517371).

8.1 Accuracy Testing

Where required by the project specifications, the manufacturer must conduct metering accuracy testing.

Complete accuracy tests according to AS 60044.2 (including Clause 12, Accuracy requirements for single phase inductive measuring voltage transformers) or AS 60044.5 (including Clause 9.8, Accuracy tests) are required by TasNetworks for the purposes of registration of a metering installation with the Australian Energy Market Operator (AEMO).

The tests results shall be submitted in the format provided in Appendix D of TNM-GS-809-0024 (D11/86620), Metering Standard. It is particularly important that the table of test results included in this document is fully completed for each voltage transformers secondary metering winding and for burdens of both 25 per cent and 100 per cent.

8.2 Testing Authority Accreditation

All reference/calibration equipment utilised for the purpose of testing or inspection must comply with and be tested to ensure full traceability to test certificates issued by a NATA accredited body or a body recognised by NATA under the International Laboratory Accreditation Corporation ('ILAC') mutual recognition scheme and documentation of the traceability must be provided to AEMO on request. The certification number, description and serial numbers of test equipment recorded on the test certificate for each voltage transformer.

9 Packaging

(a) The supplier is responsible for ensuring that adequate packaging and external signage is provided to minimise the risk of damage to equipment during delivery and removal from packaging. The packaging must be suited to the particular methods of delivery and provide protection against damage from all foreseen hazards.

(b) Packaging must be externally labelled for ease of identification of the voltage transformer.

(c) Details of packaging methods must be submitted to TasNetworks for review.

10 Information to be provided with tender

Requirements for information to be submitted as part of the tender are outlined in EHV Voltage Transformers document (R586395).

11 Deliverables

Requirements for voltage transformer deliverables are outlined in EHV Voltage Transformers Document (R586393).

12 Hold points

The requirement of documentation is listed in the deliverable schedule in document R586393.

The hold points for EHV voltage transformers include:

(d) "Analysis and preparatory documentation" must be submitted prior to "detailed design" for TasNetworks' review, comments and approval.

(e) "Detailed design documentation" must be submitted prior to manufacturing or procurement of equipment, for TasNetworks' review, comments and approval.

(f) "Inspection and Test Plan" must be submitted prior to any testing of equipment, for TasNetworks' review, comments and approval.

(g) "Invitation to witness testing" must be submitted prior to any testing of equipment, for TasNetworks' arrangements to witness.

(h) Complete updated design documentation, operations and maintenance manuals must be submitted prior to "Factory Acceptance Testing (FAT)" for TasNetworks' preparation to attend FAT, if required.

(i) Final training manuals must be provided at least two weeks prior to training, for use of training team.

(j) FAT results must be submitted to TasNetworks for approval with any non-conformances identified rectified prior to shipment.

(k) All as-built documentation, operation and maintenance manuals, test results and test certificates must be submitted to TasNetworks and be accepted by TasNetworks prior to acceptance.

(l) Inspection of the equipment on site is required by TasNetworks prior to acceptance.