Network Standard

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Supersedes Network Standard (NETWORK) NW000-S0109 Amendment No. 0

NW000-S0109 NS250 SECONDARY SYSTEMS – REQUIREMENTS FOR CT, VT AND TRIPPING CIRCUITS

ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design and installation of CT, VT and tripping circuits and is for reference by field, technical and engineering staff.

Ausgrid maintains a copy of this and other Network Standards together with updates and amendments on www.ausgrid.com.au.

Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.

DISCLAIMER

As Ausgrid's standards are subject to ongoing review, the information contained in this document may be amended by Ausgrid at any time. It is possible that conflict may exist between standard documents. In this event, the most recent standard shall prevail.

This document has been developed using information available from field and other sources and is suitable for most situations encountered in Ausgrid. Particular conditions, projects or localities may require special or different practices. It is the responsibility of the local manager, supervisor, assured quality contractor and the individuals involved to make sure that a safe system of work is employed and that statutory requirements are met.

Ausgrid disclaims any and all liability to any person or persons for any procedure, process or any other thing done or not done, as a result of this Standard.

All design work, and the associated supply of materials and equipment, must be undertaken in accordance with and consideration of relevant legislative and regulatory requirements, latest revision of Ausgrid's Network Standards and specifications and Australian Standards. Designs submitted shall be declared as fit for purpose. Where the designer wishes to include a variation to a network standard or an alternative material or equipment to that currently approved the designer must obtain authorisation from the Network Standard owner before incorporating a variation to a Network Standard in a design.

External designers including those authorised as Accredited Service Providers will seek approval through the approved process as outlined in NS181 Approval of Materials and Equipment and Network Standard Variations. Seeking approval will ensure Network Standards are appropriately updated and that a consistent interpretation of the legislative framework is employed.

Notes: 1. Compliance with this Network Standard does not automatically satisfy the requirements of a Designer Safety Report. The designer must comply with the provisions of the Workplace Health and Safety Regulation 2011 (NSW - Part 6.2 Duties of designer of structure and person who commissions construction work) which requires the designer to provide a written safety report to the person who commissioned the design. This report must be provided to Ausgrid in all instances, including where the design was commissioned by or on behalf of a person who proposes to connect premises to Ausgrid's network, and will form part of the Designer Safety Report which must also be presented to Ausgrid. Further information is provided in Network Standard (NS) 212 Integrated Support Requirements for Ausgrid Network Assets.

2. Where the procedural requirements of this document conflict with contestable project procedures, the contestable project procedures shall take precedent for the whole project or part thereof which is classified as contestable. Any external contact with Ausgrid for contestable works projects is to be made via the Ausgrid officer responsible for facilitating the contestable project. The Contestable Ausgrid officer will liaise with Ausgrid internal departments and specialists as necessary to fulfil the requirements of this standard. All other technical aspects of this document which are not procedural in nature shall apply to contestable works projects.

INTERPRETATION

In the event that any user of this Standard considers that any of its provisions is uncertain, ambiguous or otherwise in need of interpretation, the user should request Ausgrid to clarify the provision. Ausgrid's interpretation shall then apply as though it was included in the Standard, and is final and binding. No correspondence will be entered into with any person disputing the meaning of the provision published in the Standard or the accuracy of Ausgrid's interpretation.

KEYPOINTS

This standard has a summary of content labelled "KEYPOINTS FOR THIS STANDARD". The inclusion or omission of items in this summary does not signify any specific importance or criticality to the items described. It is meant to simply provide the reader with a quick assessment of some of the major issues addressed by the standard. To fully appreciate the content and the requirements of the standard it must be read in its entirety.

AMENDMENTS TO THIS STANDARD

Where there are changes to this standard from the previously approved version, any previous shading is removed and the newly affected paragraphs are shaded with a grey background. Where the document changes exceed 25% of the document content, any grey background in the document is to be removed and the following words should be shown below the title block on the right hand side of the page in bold and italic, for example, Supersedes – document details (for example, "Supersedes Document Type (Category) Document No. Amendment No.").

KEY POINTS OF THIS STANDARD

Scope and Risks Addressed

This network standard describes the requirements for Current Transformer, Voltage Transformer and Circuit Breaker Trip circuits..

- The requirements are in addition to those of NS251, NS253, NS259 and other relevant network standards

Where to for more information?

Sections 1, 2

Circuit requirements

The requirements covered in the document include:

- CT and VT circuit wiring specifications
- Earthing arrangements
- Provision for shorting of terminals
- Provision for isolation links
- Circuit segregation
- Fusing arrangements
- Trip coil arrangements

Where to for more information?

Section 5

Tools and Forms

Annexure A – Exceptions for trip coils
Annexure B – Sample compliance checklist

Network Standard
NS250
Requirements for CT, VT, and tripping circuits

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1.0 PURPOSE

The purpose of this standard is to describe requirements for Voltage Transformer (VT), Current Transformer (CT) and Circuit Breaker (CB) trip circuits.

2.0 SCOPE

This standard describes the following circuits within zone and subtransmission substations:

- CT circuits
- VT circuits
- CB trip circuits

This standard describes requirements which apply in addition to the requirements described in NS251, NS253, NS259 and other relevant network standards.

3.0 REFERENCES

3.1 General

All work covered in this document shall conform to all relevant Legislation, Standards, Codes of Practice and Network Standards. Current Network Standards are available on Ausgrid's Internet site at www.ausgrid.com.au.

3.2 Ausgrid documents

- Company Form (Governance) - Network Technical Document Endorsement and Approval
- Company Procedure (Governance) - Network Technical Document Endorsement and Approval
- Company Procedure (Network) – Network Standards Compliance
- Company Procedure (Network) - Production / Review of Engineering Technical Documents within BMS
- Division Workplace Instruction (Network) – Production /review of Network Standards
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- NS251 Secondary Systems – Requirements for cables between panels
- NS253 Secondary Systems – Requirements for termination of wires
- NS259 Secondary Systems – Requirements for segregation

3.3 Other standards and documents

- AS/NZS 1125 - Conductors in insulated electric cables and flexible cords
- AS 2067 - Substations and high voltage installations exceeding 1 kV a.c
- AS/NZS 3808 - Insulating and sheathing materials for electric cables
- AS/NZS 5000.1 - Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1 (1.2) kV
- AS/NZS 5000.3 - Electric cables - Polymeric insulated - Multicore control cables

3.4 Acts and regulations

- Electricity Supply (General) Regulation 2014 (NSW)
- Electricity Supply (Safety and Network Management) Regulation 2014
- Work Health and Safety Act 2011 and Regulation 2011

4.0 DEFINITIONS

Accredited Service Provider (ASP)	An individual or entity accredited by the NSW Department of Industry, Division of Resources and Energy, in accordance with the Electricity Supply (Safety and Network Management) Regulation 2014 (NSW).
Business Management System (BMS)	An Ausgrid internal integrated policy and procedure framework that contains the approved version of documents.
CB trip circuit	The circuit which actuates the tripping coil of a circuit breaker.
CT circuit	The circuit connected to the secondary side of a current transformer.
Document control	Ausgrid employees who work with printed copies of document must check the BMS regularly to monitor version control. Documents are considered “UNCONTROLLED IF PRINTED”, as indicated in the footer.
Low Voltage	Voltages up to and including 1kV
Network Standard	A document, including Network Planning Standards, that describes the Company's minimum requirements for planning, design, construction, maintenance, technical specification, environmental, property and metering activities on the distribution and transmission network. These documents are stored in the Network Category of the BMS repository.
Review date	The review date displayed in the header of the document is the future date for review of a document. The default period is three years from the date of approval however a review may be mandated at any time where a need is identified. Potential needs for a review include changes in legislation, organisational changes, restructures, occurrence of an incident or changes in technology or work practice and/or identification of efficiency improvements.
Termination	An interface between a wire and an approved end point. Approved end points include links, terminals, and devices installed in panels such as relays and meters.
VT circuit	The circuit connected to the secondary side of a voltage transformer.

5.0 REQUIREMENTS FOR CT, VT AND TRIPPING CIRCUITS

5.1 General

All VT circuits shall be supervised for loss of continuity.

Circuit breaker trip circuits shall be supervised for loss of continuity whenever the relay directly initiating the trip is capable of performing the supervision function.

5.2 CT circuits

Total secondary wiring loop resistance at 75°C should be less than 25% of rated CT secondary resistance at the lowest ratio tap and:

- Less than 1.0 Ohm for 1A nominal CTs.
- Less than 0.2 Ohm for 5A nominal CTs.

If CTs are connected in a high impedance differential protection scheme, the above rule shall apply to wiring between the CTs and the summation point.

If unused, CTs shall be shorted and connected to an earth bar at the terminals nearest the CT which are accessible without an access permit.

CT shorting shall be between maximum ratio taps only.

All CT circuit cable terminations shall be bolted using ring type lugs.

All CT circuits shall be earthed at one point only, with the earth connection:

- On the set of isolation links nearest to the CT.
- Such that the earth cannot be removed from the CT by opening of links.
- On the starpoint side of three-phase CT sets.

The inductance of CT connections to the earth grid shall be minimised by using the shortest possible path. Earthing conductors shall be stranded copper of at least 2.5 mm² with green-yellow coloured insulation and appropriate earth clamp or terminal.

5.3 VT circuits

Total voltage drop on VT circuits shall not exceed 0.25% of nominal VT secondary voltage with the expected maximum burden.

Three phase VTs and VT sets shall be connected in star.

All VT secondary circuits shall be earthed at one point only, with the earth connection:

- On the set of isolation links nearest to the VT.
- Such that the earth cannot be removed from the VT by opening of links or fuses.
- On the starpoint side of three-phase VTs and VT sets.

Where a single VT winding supplies both A and B protection equipment, secondary fusing shall occur downstream of the A-B split. Fuse grading shall not be relied upon for A and B protection segregation.

All VT circuits leaving the marshalling box shall be fused individually. A maximum of two fuses shall be connected in series in any protection, control or indication VT circuit. The first set of fuses shall be located as close to secondary winding terminals as practicable (e.g. inside VT terminal box mounted close to VT tank or inside local control panel).

The maximum length of any unfused cable shall not exceed:

- 2.5m for cast resin type VTs at 66kV and below
- 0.5m for other types of VT

If the unfused VT cable exits the VT terminal box, the portion outside the box shall be enclosed within rigid conduit. The rigid conduit shall be robust and UV stabilised if exposed to sunlight.

Two sets of operator isolation links shall be located in easily accessible marshalling box or indoor panel. Opening of these links shall isolate the VT secondary.

MCBs shall not be used for VT secondary circuit protection.

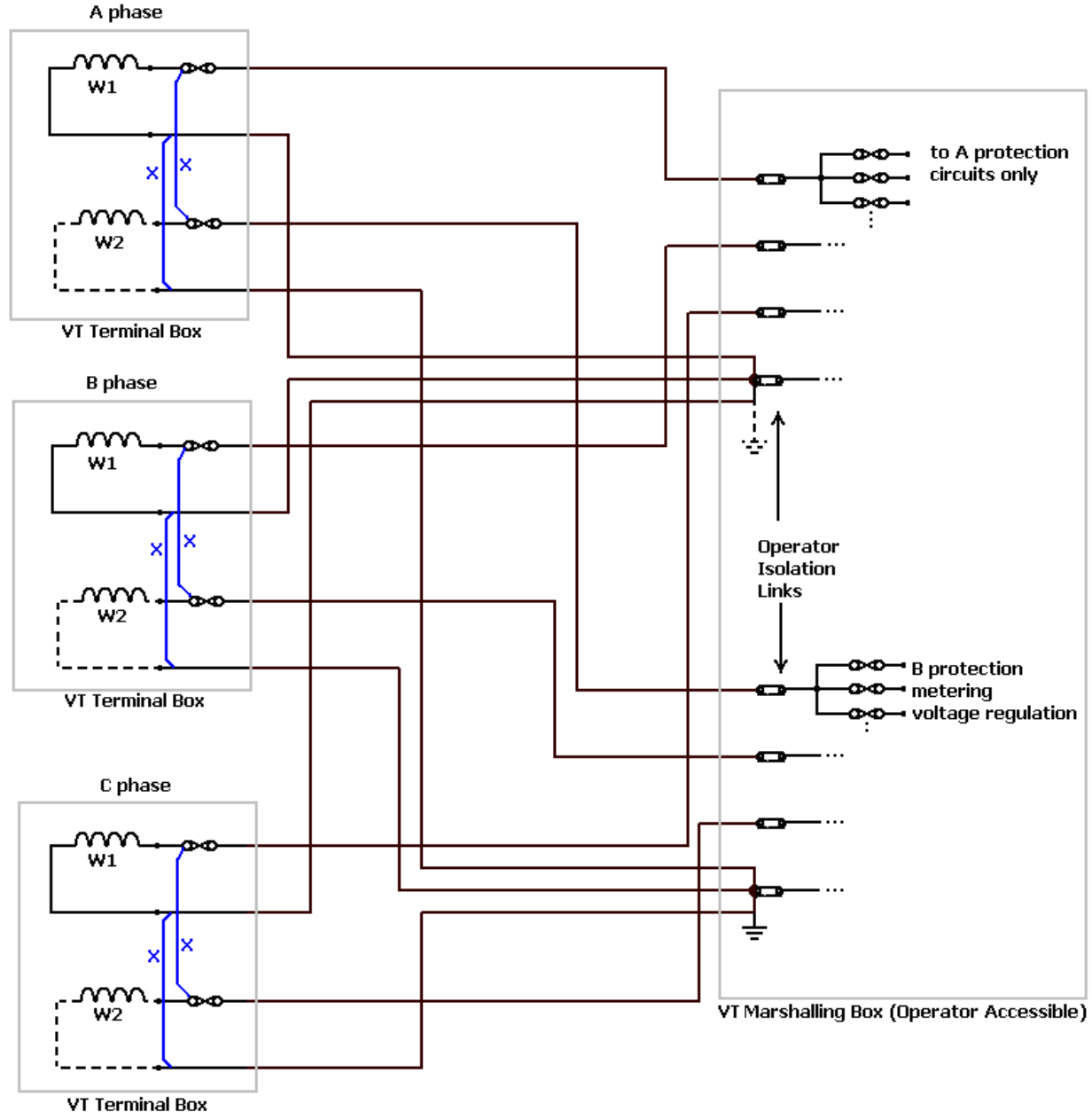

Figure 1 Typical outdoor single phase post type VT connection

For two winding VTs connections marked with X are omitted and connections shown dotted are included.

For single winding VTs connection marked with X are included and connections shown dotted are omitted.

5.4 Trip circuits

5.4.1 General

Two galvanically isolated independent trip circuits shall be used on every circuit breaker.

All tripping contacts must have current ratings which match or exceed the required duty.

Trip circuits shall not have any other devices connected in series other than the following:

- DC supply.
- Protection relay tripping contacts.
- Approved links and terminals.
- **Withdrawable breakers only**: A single approved umbilical plug/socket for CB removal.
- Circuit breaker 'a' pallet.
- Trip coil.

No blocking contacts (e.g. low gas blocking, CB racking, etc.) may be connected in series between protection tripping contacts and the trip coil.

SCADA control contacts and manual operation switch contacts can be connected as a parallel branch input to the 'B' protection trip circuit. Exceptions to this rule are allowed in the specific cases listed in Appendix B, which have been risk assessed by P&C.

No diode, transient suppressor, or other device with a short-circuit failure mode may be connected in parallel with a circuit breaker trip coil.

CB Trip circuit cabling shall be sized to prevent the voltage drop across the cable exceeding 5% of nominal substation battery voltage.

The CB Trip circuit shall be designed to ensure that voltage across trip coil during tripping, at the minimum allowed battery charge, exceeds 120% of the voltage that guarantees operation of the trip coil.

All CB Trip circuit cable terminations shall be bolted using ring type lugs, unless the termination is directly to an Ausgrid approved protection relay. Termination of trip circuits on Ausgrid approved protection relays shall be per NS253 – Requirements for termination of wires. Exceptions to this rule are allowed in the specific cases listed in Appendix B, which have been risk assessed by P&C.

5.4.2 Trip coil requirements

Trip coils shall have a resistance no greater than the values listed in Table 1.

Table 1 Minimum trip coil DC resistance

Nominal DC Supply Voltage	Minimum Trip Coil DC Resistance
110V	20 Ohm

6.0 RECORDKEEPING

The table below identifies the types of records relating to the process, their storage location and retention period.

Table 2 – Recordkeeping

Type of Record	Storage Location	Retention Period*
Approved copy of the network standard	BMS Network sub process Standard – Company	Unlimited
Draft Copies of the network standard during amendment/creation	HPRM Work Folder for Network Standards (HPRM ref. 2014/21250/17)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	HPRM Work Folder for Network Standards (HPRM ref. 2014/21250/17)	Unlimited

* The following retention periods are subject to change eg if the records are required for legal matters or legislative changes. Before disposal, retention periods should be checked and authorised by the Records Manager.

7.0 AUTHORITIES AND RESPONSIBILITIES

For this network standard the authorities and responsibilities of Ausgrid employees and managers in relation to content, management and document control of this network standard can be obtained from the Company Procedure (Network) – Production / Review of Engineering Technical Documents within BMS. The responsibilities of persons for the design or construction work detailed in this network standard are identified throughout this standard in the context of the requirements to which they apply.

8.0 DOCUMENT CONTROL

Content Coordinator : Manager Secondary Systems

Distribution Coordinator : Engineering Information & Services Manager

Annexure A - Allowed Exceptions to trip coil requirements

The following exceptions to specific sub-parts of clause 5.4 are approved based on an assessment of the specific situation. The assessment considered the risk to Ausgrid, the way the equipment is used on the network, available alternatives, and the cost of changing the switchgear internals for compliance.

The presence of an exception in a specific scenario does not constitute acceptance in the general case.

Switchgear type	Contract details	Exceptions
Siemens 11kV NXPLUS C	EA2493/10A	One transient suppressor built in to each trip coil assembly, as supplied by Siemens, is accepted.
		Use of the following trip circuit connectors, within the switchgear instrument compartment, as supplied by Siemens, is accepted: - Phoenix VBST 4-FS (8-2, 8-0, 8) ST 4 terminals. - Phoenix STG 10-VBST 4 plugs. - Fast-on connectors.
		Use of a Siemens 3RH122 relay for trip circuit isolation, within the switchgear instrument compartment, as supplied by SIEMENS, is accepted.
Tamco 33 kV GV3	EA1970/10A	Use of a Kraus & Naimer C26A292MYC598 padlockable switch for trip circuit isolation, within the switchgear instrument compartment, as supplied by TAMCO, is accepted.
Siemens 132 kV 8DN8	EA8402/06A	Use of Harting HAN46 EE industrial plugs and sockets between switchgear instrument compartment and circuit breaker compartment, as supplied by Siemens, is accepted.

Annexure B – Sample Compliance Checklist

Network Standard Checklist Form

NS250 Secondary Systems – Requirements for CT, VT and trip circuits

Project Identification:	
Prepared by: <Name & Position Title>	Date:

This checklist is for internal Ausgrid use only and does not apply to ASPs or contractors who have specific compliance requirements in relation to Contestable project works. The checklist is unique for each network standard and is available within BALIN and the BMS as a separate form that can be amended as required, completed and saved in HPRM with the other project documentation.

This section is used to identify compliance checks that when applied to the work associated with this Network Standard will satisfy an audit process to establish that the requirements of the standard have been followed. It is expected that applicable items would normally be checked as Comply (Yes) as non-compliance is generally not tolerated.

Where non-compliance is the result of specific site conditions or design decisions this needs to be identified in the notes section of the form for each non-compliance and approval sought from an appropriately authorised Ausgrid manager responsible for design approval per NS261 Compliance Framework for Network Standards.

Should additional information be available to document non-compliance decisions, these can be attached to the checklist form. The checklist and any attached explanatory notes should be saved in the project document repository.

Item	Description	Refer Clause	Completed/ Actioned
	Scope		
	This standard describes requirements for Voltage Transformer (VT), Current Transformer (CT) and Circuit Breaker (CB) trip circuits specifically. Other network standards (NS251, NS253 and NS259 apply to more general requirements for secondary systems wiring).	2	
	Circuit wiring		
1	VT circuits monitored for circuit continuity.	5.1	Yes/No/NA
2	Circuit breaker trip circuits monitored for continuity under the specified conditions.	5.1	Yes/No/NA
3	Wiring loop impedance for CT circuits less than 25% of rated CT secondary resistance at 75°C.	5.2	Yes/No/NA
4	Unused CTs shorted and connected to earth bar as required.	5.2	Yes/No/NA
5	Ring-type lugs used for cable terminations.	5.2	Yes/No/NA
6	CT circuits earthed at one point only, using 2.5mm green-yellow cable in accordance with requirements.	5.2	Yes/No/NA
7	Circuit wiring layout in accordance with requirements.	5.2	Yes/No/NA
8	Total voltage drop on VT circuits does not exceed 0.25% of nominal VT secondary voltage with the expected maximum burden.	5.3	Yes/No/NA
9	Connection arrangement of VTs in accordance with requirements.	5.3	Yes/No/NA

Item	Description	Refer Clause	Completed/ Actioned
10	VT circuits earthed at one point only, using 2.5mm green-yellow cable in accordance with requirements.	5.3	Yes/No/NA
11	VT secondary fusing in accordance with requirements.	5.3	Yes/No/NA
12	VT circuits leaving the marshalling box are fused individually.	5.3	Yes/No/NA
13	Fusing requirements for VT circuits meet requirements.	5.3	Yes/No/NA
14	Isolating links provided as required.	5.3	Yes/No/NA
15	Two galvanically independent trip circuits used on every circuit breaker.	5.4	Yes/No/NA
16	Tripping circuits have appropriate current ratings.	5.4	Yes/No/NA
17	Circuit breaker trip circuit design in accordance with requirements.	5.4	Yes/No/NA
18	No blocking contacts connected in series between protection tripping contacts and the trip coil.	5.4	Yes/No/NA
19	Trip circuit design in accordance with requirements.	5.4	Yes/No/NA

Notes:

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