Network Standard

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NW000-S0111 **NS252 SECONDARY SYSTEMS – REQUIREMENTS FOR WIRING WITHIN PANELS**

ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with secondary systems panel wiring 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Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.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 secondary wiring within substation panels.

It does not apply to:

- Wiring external to substation panels (refer to NS251)
- Termination of wires within a substation panel (refer to NS253)

Where to for more information?

Sections 1, 2

Wiring within panels

The following requirements are covered in the document includes:

- General requirements
- Wiring identification
- Internal panel labelling
- Wiring arrangement
- Use of ducts
- Use of wiring looms
- Handling multicore cable wiring
- Wiring on panel doors
- Layout of terminals
- Wiring sizes
- Special requirements for LV AC wiring

Where to for more information?

Section 5

Tools and Forms

Annexure A – Sample compliance checklist

Network Standard
NS252
Secondary Systems – Requirements for wiring within panels

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1.0 PURPOSE

The purpose of this standard is to describe the requirements for secondary wiring within panels in order to facilitate consistency across the network.

2.0 SCOPE

This standard pertains to secondary wiring within substation panels.

This standard does not include details of secondary wiring external to substation panels. For the requirements for secondary wiring external to substation panels refer to standard NS251 – Secondary Systems – Requirements for cables between panels.

This standard does not include details of terminations of wires within a substation panel. For the requirements for terminations of wires within a substation panel refer to standard NS253 – Secondary Systems – Requirements for termination of wires.

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

- Ausgrid Drawing 114601
- 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
- NS181 Approval of Materials and Equipment and Network Standard Variations
- NS208.2.1Telecommunications Substation Communications Cabinets Architecture
- NS212 Integrated Support Requirements for Ausgrid Network Assets
- NS250 Secondary Systems – Requirements for CT, VT and Tripping circuits.
- NS251 Secondary Systems – Requirements for cables between panels
- NS253 Secondary Systems – Requirements for termination of wires

3.3 Other standards and documents

- AS 2650 Common specifications for high-voltage switchgear and controlgear standards
- IEC 60694 Common specifications for high-voltage switchgear and controlgear standards
- AS/NZS 5000.1 Electric cables – Polymeric insulated – For working voltages up to and including 0.6/1kV

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.
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.

5.0 WIRING WITHIN PANELS

5.1 General

- All secondary wiring must meet the requirements of AS 2650 or IEC 60694.
- Control panel wiring shall comply with the requirements of AS/NZS 5000.1
- Wires must both start and finish at terminations of a type approved in standard NS253 – Secondary Systems – Requirements for termination of wires. Wires must be continuous and are not permitted to be jointed or spliced between terminations.
- Wires are not to be drawn over sharp edges. Where there is a danger of wires coming into contact with sharp edges mechanical protection is to be provided. Penetration of sheet metal must be made through glands or grommets.
- IRIG-B connections must not be marshalled at terminals. An IRIG-B bus shall begin at a repeater and run linearly from device to device until a termination circuit is reached. Branching of IRIG-B buses is not permitted.
- Wiring and terminal blocks will be arranged to give easy access to all terminals. It must be possible to access any unused terminals such that if an unused terminal is later required, a new connection can be made without requiring existing wiring to be broken.
- Optical Fibre cables must not exceed the manufacturer specified bend radius for the specific type of cable as per NS208.
- Use of electrical insulation tape within panels is prohibited.

5.2 Wire identification

All wires shall have identification ferrules fitted at both ends of the wire as close to the terminals as practical (refer to figure 1). The ferrules are to be white and the identifying wire number is to be printed on the ferrule in black with a minimum font height of 2.3mm. Ferrules are to be a tunnel style consisting of a tubular sleeve with pleats to allow expansion and to grip the sheath of the wire which is to be threaded through the ferrules. Clip on style ferrules, tape labels and direct printing on wires are not to be used.

Figure 1 - Ferrule

Ferrules shall be a minimum of 18mm long. Ferrule sizes must be chosen so that they fit the wire securely.

Ferrules on vertical wires shall be oriented such that the text runs from the bottom to the top (refer to figure 2).

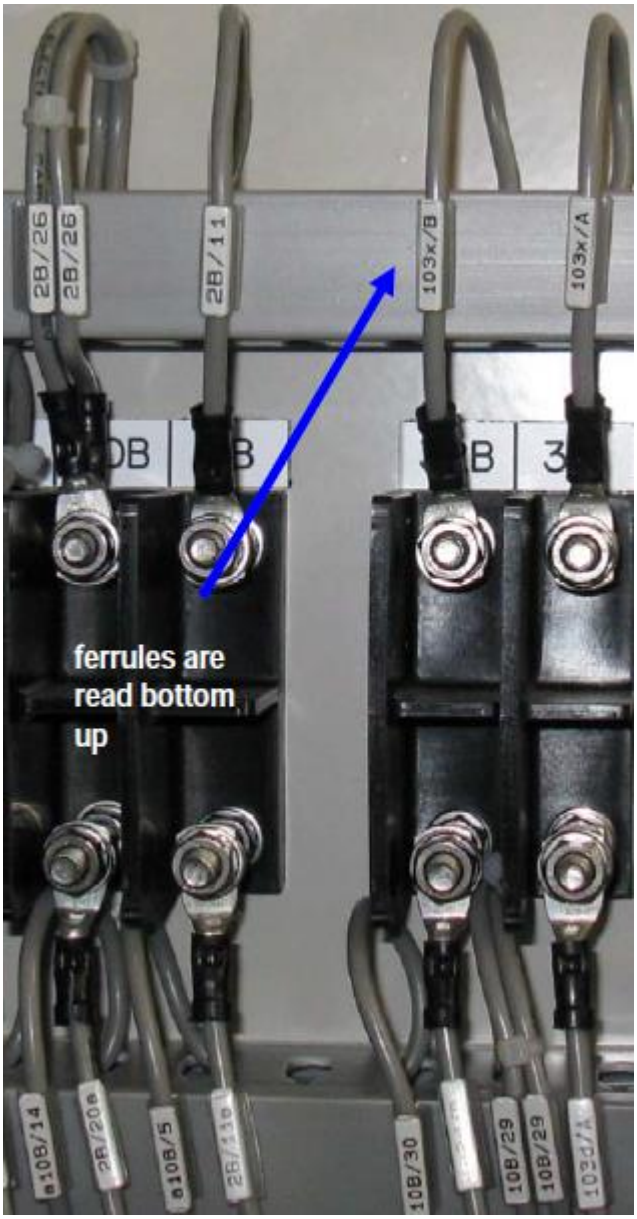

Figure 2 – ferrules on vertical wires

Ferrules on horizontal wires shall be oriented such that the text runs from left to right.

5.3 Internal panel labels

Any equipment labelled on the front of a panel shall also be fitted with a label on the inside of the panel. The internal panel label shall list the short name of the device (e.g. FDRP-A) as shown on the front panel label. Internal panel labels shall be engraved and constructed from traffolyte with black text and white background. Internal labels shall be affixed with 3M VHB 4920 double sided tape. Surfaces are to be cleaned thoroughly prior to installation of labels. The minimum acceptable cleaning standard is wiping of the surface of the panel with isopropyl alcohol wipes.

5.4 Arrangement of wiring

All panel wiring shall be neatly and securely fixed to panels by means of plastic ducts or looming using cable ties. Ducting shall be used in preference to looming.

In all cases, wiring shall be installed such that no pressure or tension is exerted on the termination.

5.4.1 Ducting

The wiring duct system shall be designed to allow for inspection and replacement of the wiring.

Grey PVC slotted ducting with covers will be utilised to secure wires to panels (refer to figure 3).

Grey 40mm (W) x 60mm (H) PVC slotted ducting shall be used along the side of 19” cabinets to facilitate termination to terminals.

Grey 40mm (W) x 25mm (H) PVC slotted ducting shall be used to facilitate connection to relays, battery links and trip links.

Surfaces are to be cleaned thoroughly prior to installation of ducting. The minimum acceptable cleaning standard is wiping of the surface of the panel with isopropyl alcohol wipes. Ducting is to be secured to the panel with 24mm 3M VHB 4945 white double sided tape. The duct must be installed straight and square.

Figure 3 – ducting

5.4.2 Looming

Where the use of duct is not practical wire shall be loomed in accordance with Ausgrid drawing 52474.

All looms shall be neat and constructed so as to allow for easy inspection and the replacement of wiring (refer to figure 4). Each wire must be able to be traced from one end of the loom to the other end of the loom without crossovers. Cable ties are to be used to strap the cables to the cable rungs or tray (refer to figure 4). Cabling shall be arranged to avoid unnecessary crossing over and all stripping of the outer sheaths should be at the same level for each group of terminals. Cores in individual cables are to be untwisted and loomed with cores from any other cables in a neat and tidy fashion. Looming is to be performed using small ties available in 100mm and 140mm lengths. They should be used as required to keep cores in formation without twists. Spare cores are to be left long in the loom for use at a later date. Insulation on spare cores shall be intact up to the end

of the core (ie, not stripped back) and spare cores shall be restrained to prevent the end from touching other conductors.

Cable ties will be used inside cabinets and panels.

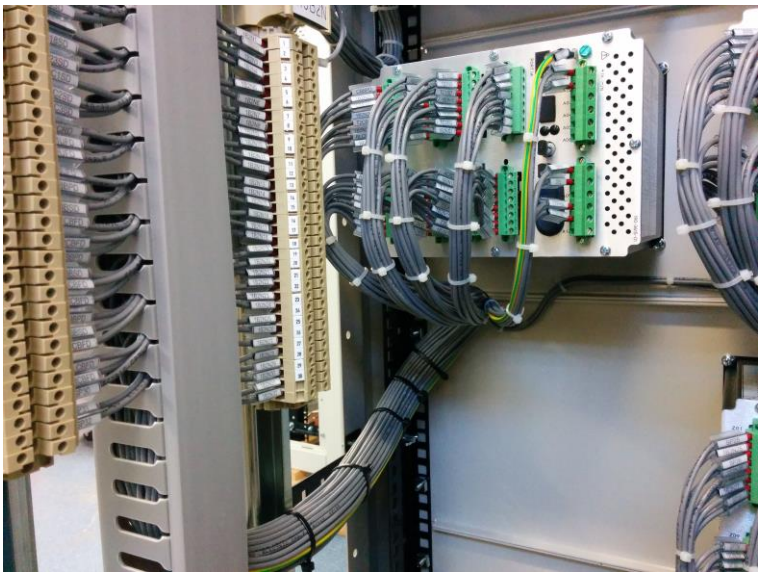

Figure 4 – neat looming secured with cable ties

5.4.3 Provision for future reterminating

5.4.3.1 General

Sufficient extra length must be allowed in all multicore cables and wires to facilitate future reterminating.

5.4.3.2 Provision for reterminating multicore cables and wires entering panel

Multicore cables and wires entering a panel must be looped prior to separation and termination at the interface between the external panel wiring and internal panel wiring (refer to figure 5).

5.4.4 Breakout of multicore cables

5.4.4.1 General

The point where the inner cores of a multicore cable emanate from the outer sheath shall be protected by heatshrink tubing which extends over the both the inner cores and the cable sheath by not less than twice the cable diameter.

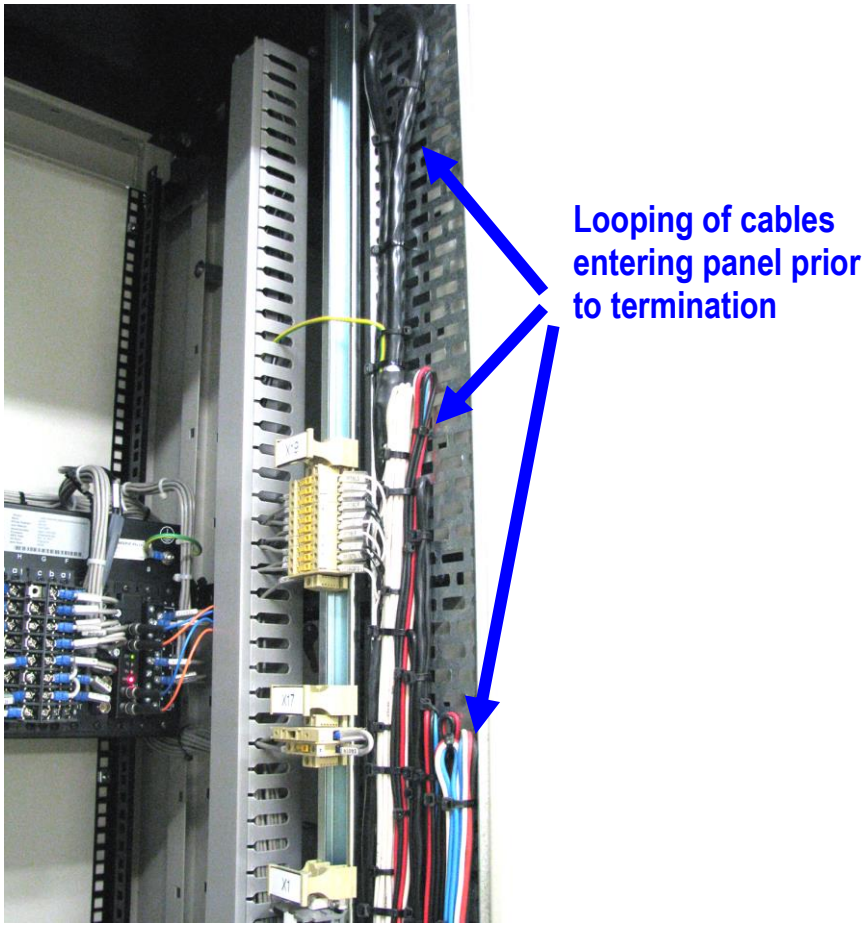

Figure 5 – looping of cables entering panel

5.4.4.2 Provision for reterminating individual wires within a panel

Provision for reterminating individual wires within a panel will be achieved in most cases by forming the wire into a loop adjacent to the terminal (refer to figure 6). The loop will have an approximate diameter of 30mm.

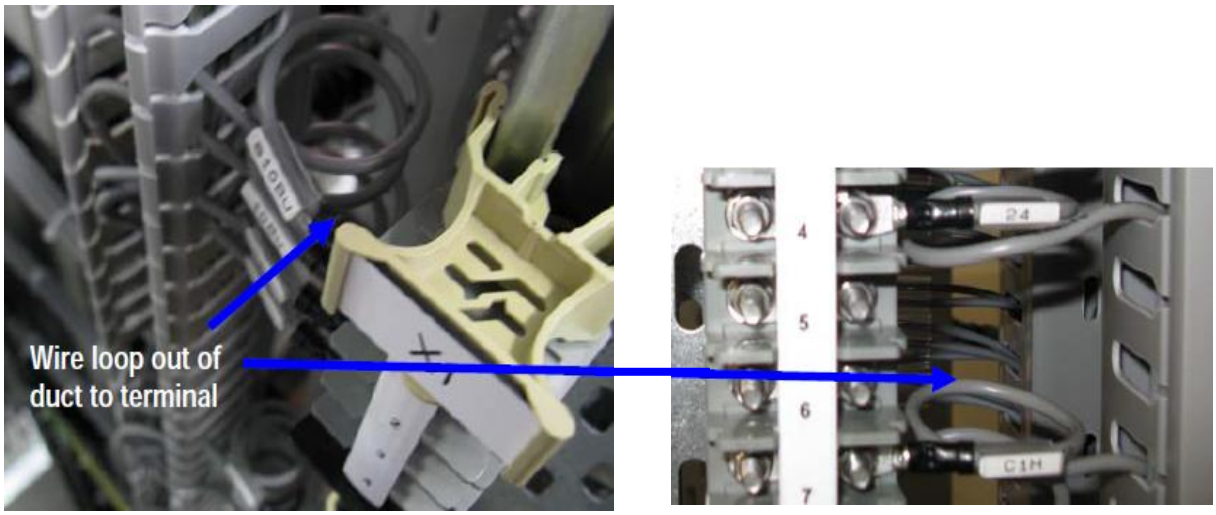

Figure 6 – provision for reterminating

5.4.4.3 Provision for reterminating individual wires to links via ducts

Where practical wire shall exit the side of the duct opposite the link and pass over the duct (refer to figure 7). A neat, consistent loop shall be maintained when terminating the wire to the links.

Figure 7 – wiring over ducts

5.5 Panel doors

The wiring loom between a panel door and the terminal rails within the panel shall be provided with a loop having a length from anchor point to turning point of at least 300 mm for control of bending fatigue. A spiral wrap shall be installed over all door looms to provide mechanical protection (refer to figure 8). A loom securing device is to be provided if required on both the panel door and the cabinet.

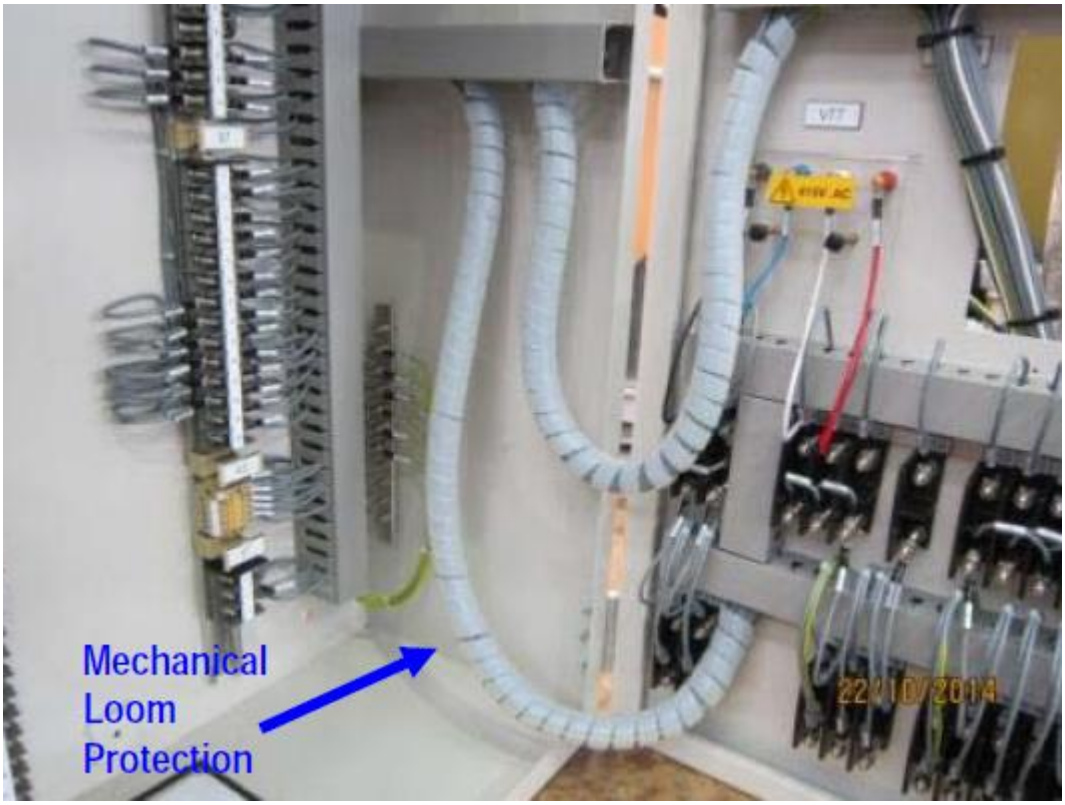

Figure 8 – wiring between panel doors and cabinets

5.6 Layout of terminals

Where terminals are to be positioned on a rail inside a 19 inch cabinet and the positioning is not sufficiently specified on the associated layout or wiring drawings, links shall be arranged such that:

- The first set of terminals will start 400mm from the top of the rail
- A gap of 100mm will be left between each group of terminals. The gaps shall apply to both protection and SCADA terminals

Refer to figure 9.

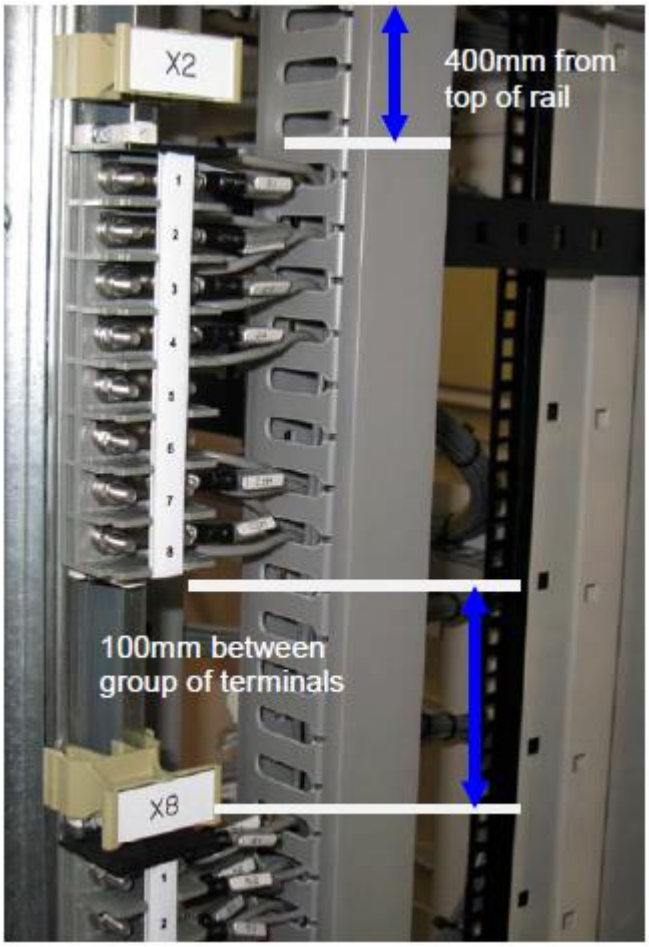

Figure 9 – layout of links

5.7 Looping and bridging

Looping connections between three or more devices on a panel are to be arranged to achieve the shortest practical path and mounted so that they are protected against damage and vibration.

Looping between consecutive Utilux H3820 terminals can be performed using Utilux bridging links (see picture). Bridging of consecutive Weidmuller terminals must be performed using premade bridging strip (small copper strip with captive screws that can be cut to any length and is fixed down the centre of the terminals or inserted down the side of the Weidmuller terminal).

Figure 10 – bridging link

5.8 Panels containing low voltage AC wiring

Panels that contain terminations or other items connected to low voltage AC must have these parts shrouded, a danger label provided and a note made on the associated wiring diagram. Clear perspex sheeting shall be used to shroud exposed studs. It must be possible to read labels and trace wires with shrouds in place.

AC voltage transformer circuitry shall be treated as low voltage AC.

5.9 Standard wire sizes

All wiring shall be multi-strand annealed copper insulated with 0.6/1.0kV, V75 grade or better plastic insulation. Wire insulation must be capable of withstanding an insulation resistance test at 500V DC to earth. Insulation resistance must be greater than 100MΩ for new wiring installations and 1MΩ for existing wiring installations.

All AC wiring in panels shall be 7/0.67 ($2.5mm^2$).

Screened twisted pair 7/0.50 ($1.5mm^2$) cable shall be used for

- Wiring to binary inputs of IEDs for the purpose of high speed trip or intertrip initiation
- IRIG-B signalling

Termination and earthing of twisted pair cable screens shall be as per the associated drawings.

All remaining DC wiring in panels shall be 7/0.50 ($1.5mm^2$).

5.10 Wire numbering and colours

Wire numbers and colours shall be in accordance with Ausgrid drawing 114601.

6.0 RECORDKEEPING

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

Table 1 – 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. 2014/21250/19)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	HPRM Work Folder for Network Standards (HPRM ref. 2014/21250/19)	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 – Sample Compliance Checklist

Network Standard Checklist Form

NS252 Secondary Systems – Requirements for wiring within panels

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 pertains to secondary wiring within substation panels. It does not apply to wiring terminations or wiring external to a substation panel.	2	
	Wiring within panels		
1	All secondary wiring meets requirements of either AS2650 or IEC 60694	5.1	Yes/No/NA
2	Control panel wiring meets requirements of AS/NZS 5000.1	5.1	Yes/No/NA
3	Wiring starts and finishes at terminations (refer NS253) and are continuous and not jointed or spliced.	5.1	Yes/No/NA
4	Mechanical protection of wiring has been applied where required.	5.1	Yes/No/NA
5	IRIG-B connections and wiring comply with requirements.	5.1	Yes/No/NA
6	Manufacturer specified maximum bend radius of optical cables not exceeded.	5.1	Yes/No/NA
7	Wiring identification complies with requirements.	5.2	Yes/No/NA
8	Internal panel labels comply with requirements.	5.3	Yes/No/NA
9	Arrangement of wiring complies with requirements.	5.1, 5.4	Yes/No/NA
10	Use of wiring ducts meets with requirements.	5.4.1	Yes/No/NA
11	Wiring looms used where use of ducts not practical.	5.4.2	Yes/No/NA

Item	Description	Refer Clause	Completed/ Actioned
12	Provision allowed for future wiring requirements.	5.4.3	Yes/No/NA
13	Special requirements for breakout of multi-core cables have been met.	5.4.4	Yes/No/NA
14	Panel door wiring requirements have been met.	5.5	Yes/No/NA
15	Layout of terminals in accordance with requirements.	5.6	Yes/No/NA
16	Looping and bridging wiring comply with requirements.	5.7	Yes/No/NA
17	Special requirements applying to LV AC wiring have been met.	5.8	Yes/No/NA
18	Wiring size, electrical and physical requirements comply with requirements.	5.9	Yes/No/NA
19	Wiring numbers and colours in accordance with Ausgrid drawing 114601	5.10	Yes/No/NA

Notes:

The signatures panel of this document has been removed for privacy considerations. the remainder of the document is unchanged.