Network Standard

NW000-S0035

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Supersedes Network Standard (NETWORK) NW000-S0035 Amendment No.2

NW000-S0035 NS171 FIRESTOPPING IN SUBSTATIONS
ISSUE
For issue to all Ausgrid and Accredited Service Providers’ staff involved with the installation of firestopping materials in openings in substation walls, floors and ceilings in an electrical substation 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Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document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 standard details requirements for the application of firestopping in openings in walls, ceilings and floors, as well as cable conduits. The standard has the following scope/limitations:
- Only applies to openings for electrical services, such as cables, electrical conduits and busbars.
- It does not address firestopping of other service penetrations.
- All buildings must comply with the Building Code of Australia with respect to fire segregation and firestopping.
- Applies to cables in or adjacent to the structure including cable risers, cable turning rooms and pits.
- Applies to Ausgrid, ASPs, and contractors, as well as their employees, working in Ausgrid substations.
- Aims to minimise risk of fire spread via electrical services that penetrate building elements (walls, floors, ceilings).
- Documents product performance requirements of firestopping products required to achieve Ausgrid approval.

**Where to for more information?**
- Section 1, 2, 5

#### Fire Risk & Material Safety

This standard identifies risks relating to the spread of fire within substations. These include:
- Spread of fire through openings in the building structure no matter how small.
- Tracking of fire along cables/conduits.
- Ignition of combustible material subsequent to equipment failure, such as oil-filled switchgear.
- Damage is not limited to effect of fire burning and smoke but also fire fighting activities.
- Firestopping should be installed during construction when a risk assessment deems it to be necessary.
- Temporary fire stopping may be required where appropriate during construction.
- Safety Data Sheets should be available for all firestopping materials when being installed, removed, disturbed or otherwise interfered with.
- All new installations should not use inhalable man made mineral fibres (MMMF).
- The listed precautions should be used for existing installations where MMMF is confirmed or suspected.
- Asbestos shall not be used or reused at any site.

**Where to for more information?**
- Section 6, 7

#### Firestopping Penetrations

The following specific requirements relate to fire stopping of penetrations:
- All services that penetrate building elements required to have a FRL shall be sealed unless required otherwise by this NS171.
- Tables 1 and 2 in this standard nominate the minimum FRL required for various penetration seals.
- Where there is any doubt on the extent of penetration seals it should be referred to Asset Engineering Policy and Standards.
- Penetration seals are not required in some situations in external basement walls (Refer Cl. 9.3).
- Penetration seals should generally be sealed at both ends. Special considerations apply for short penetrations.
- Special precautions are required where floor penetrations may become a hazard for pedestrians.
- PVC conduits require an intumescent seal when the conduits penetrate a building element required to have an FRL.
- Other services (non-electrical) may require similar penetration treatment.

**Where to for more information?**
- Section 8, 9, 10

#### Firestopping Penetrations (cont.d) and Cable Fire Protection

- Access provisions for seals are included for cable fault location requirements.
- Where seals are subject to exposure to moisture or oil a seal a protective coating will be applied.
- All existing penetrations that are disturbed shall be re-instated to an equivalent or better standard than the original.
- Re-installment of seals should be done on a daily basis prior to leaving site.
- Where water seals are required do not use firestopping.
- All penetration seals shall be identified.
- Installation certification is required.
- A final inspection of installation works will be undertaken by Ausgrid.
- Cable fire protection can be in the form of cable coating products, approved cable wraps and blankets or approved flame retardant cable sheaths.
- Cable fire protection that is part of approved product specific installation detail must be installed.
- Specific cable fire protection requirements are listed for secondary cables in buildings, HV and LV cables within buildings and specific cables in external switchyards.
- Firestopping products shall be supplied/installed only by Ausgrid approved installers/suppliers.

**Where to for more information?**
- Section 8, 9, 10

#### Tools and Forms

**Tools and Forms**
- Annexure A – Firestopping identification
- Annexure B – Approved products/materials
- Annexure C – Sealant Properties
- Annexure D – Flowcharts for firestopping and cable protection

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1.0 PURPOSE

This Network Standard for the installation of firestopping materials in openings in substation walls, floors and ceilings applies in particular to penetrations caused by cables, cable ducts, encased busbars and other openings unique to an electrical substation.

This standard also deals with firestopping around Poly Vinyl Chloride (PVC) (including Unplasticised Poly Vinyl Chloride (UPVC)) and similar electrical conduits where they pass through walls and floors. Finally, this standard outlines the extent of approved cable fire protection required to limit potential fuel sources and fire damage to cables.

The primary objectives of this Network Standard are:

- to minimise fire spread via electrical services that penetrate substation building elements (walls, floors and ceilings) that are required to have an FRL or a resistance to the incipient spread of fire.
- to minimise fire spread and cable damage within the substation due to potential hazards such as arc chutes and HV cable joints.
- to document the product performance requirements that suppliers of fire stopping products shall meet to achieve approval from Ausgrid to supply these products.

Firestopping materials and products used in Ausgrid substations shall comply with the requirements of this Network Standard. A list of currently approved product specific installation details is included in Annexure B of this Network Standard.

All requests for variations to this Network Standard shall be undertaken using the approval process outlined in NS181 Approval of Materials and Equipment and Network Standard Variations.

2.0 SCOPE

This Network Standard is Ausgrid’s specification and requirements for the installation of firestopping materials in openings in substation walls, floors and ceilings, and for the fire protection of cables within the substation. The openings referred to include holes, slots and other penetrations for electrical services, such as cables, electrical conduits and busbars. This document does not address fire stopping of other service penetrations.

The requirements of this Network Standard apply to all substations and similar installations, except where indicated otherwise. In addition to this Network Standard, all buildings shall comply with the Building Code of Australia, Australian Standards and any other relevant codes and standards in respect to fire segregation and firestopping for the purpose of maintaining structural adequacy, integrity and insulation.

The requirements of this Network Standard also apply to associated cable installation facilities external to a substation chamber, but contained in or adjacent to the structure housing the substation, including cable risers, cable turning rooms and pits.

This Network Standard applies to all persons including Ausgrid staff, Accredited Service Providers, Contractors, sub-contractors and associates, and employees of any of the above and any other persons involved with electrical and/or construction work in substations.

The requirements of other relevant Network Standards shall also be complied with.
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.

The requirements of this standard should always be adhered to.

As specified in NS261 Compliance Framework for Network Standards, designers shall develop and maintain a compliance framework, related to the compliance with Ausgrid Network Standards and other technical documents in accordance with AS ISO 19600:2015.

Where non-compliance is the result of specific site conditions or design decisions, this needs to be identified for each non-compliance and approval sought as per NS181 prior to their implementation.

3.2 Ausgrid documents

- Company Procedure (Network) – Network Standards Compliance
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- NS181 Approval of Materials and Equipment and Network Standard Variations
- NS187 Passive Fire Mitigation Design of Substations
- NS211 Working With Asbestos Products
- NS212 Integrated Support Requirements for Ausgrid Network Assets
- NS259 Requirements for protection system segregation
- NS261 Requirement for Design Compliance Framework for Network Standards

3.3 Other standards and documents

- All relevant WorkCover documentation.
- AS/NZS 1170 Structural design actions – Series
- AS 1530.4 Methods for fire tests on building materials, components and structures - Fire-resistance test of elements of construction
- AS 1851 Maintenance of fire protection systems and equipment
- AS 2865 Confined spaces
- AS 3600 Concrete structures
- AS 4072.1 Components for the protection of openings in fire-resistant separating elements - Service penetrations and control joints
- AS 4100 Steel structures
- National Construction Code Series (NCC)
- Underwriter Laboratory Standard UL 1479 ‘Fire Test on Through Penetration Fire Seals’

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

<table>
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<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access Permit</strong></td>
<td>Refer to Ausgrid Electrical Safety Rules.</td>
</tr>
<tr>
<td><strong>Approved Installer</strong></td>
<td>An Accredited Service Provider (ASP) who has been trained and nominated in writing by an Approved Supplier of firestopping product. Note: Ausgrid may have additional safety training requirements depending on where the product is being installed. Refer to Development Services.</td>
</tr>
<tr>
<td><strong>Approved Product</strong></td>
<td>List of products attached in Annexure B which satisfy the requirements listed in Annexure C Sealant Properties. To be used in locations identified in this Network Standard. These approved products shall be installed in accordance with Ausgrid’s Approved Product Specific Installation Details.</td>
</tr>
<tr>
<td><strong>Approved Product</strong></td>
<td>Listed in Annexure B</td>
</tr>
<tr>
<td><strong>Specific Installation</strong></td>
<td>Listed in Annexure B</td>
</tr>
<tr>
<td><strong>Details</strong></td>
<td>Listed in Annexure B</td>
</tr>
<tr>
<td><strong>Approved Supplier</strong></td>
<td>An individual or entity accredited by the NSW Department of Planning, Industry and Environment, in accordance with the Electricity Supply (Safety and Network Management) Regulation 2014 (NSW).</td>
</tr>
<tr>
<td><strong>Accredited Service</strong></td>
<td>A business unit in the Ausgrid organisational structure within the Asset Management Group.</td>
</tr>
<tr>
<td><strong>Provider (ASP)</strong></td>
<td>A function under the Ausgrid organisational structure within the Technical Operations Group.</td>
</tr>
<tr>
<td><strong>Asset Engineering</strong></td>
<td>The Building Code of Australia (BCA) is Volume One and Volume Two of the National Construction Code Series (NCC).</td>
</tr>
<tr>
<td><strong>Policy and Standards</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Development Services</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BCA</strong></td>
<td>An intumescent rectangular or plug shaped brick with a firm spongy texture. They are fire rated and tested for use with cables and satisfy the requirements of Annexure C, Sealant Properties.</td>
</tr>
<tr>
<td><strong>Cable Bricks</strong></td>
<td>A coating that provides heat protection to cables not by thermal insulation but by an endothermic reaction. Large amounts of heat energy are required to decompose the coating, thus the reaction takes heat away from the cable. The coating shall comply with the requirements of Annexure C, Sealant Properties.</td>
</tr>
<tr>
<td><strong>Cable Coating</strong></td>
<td>A mortar that is fire rated and tested for use with cables, and satisfies the requirements of Annexure C, Sealant Properties.</td>
</tr>
<tr>
<td><strong>Cable Mortar</strong></td>
<td>An intumescent putty with the texture of firm plasticene. It is fire rated and tested with cables and satisfies the requirements of Annexure C Sealant Properties.</td>
</tr>
<tr>
<td><strong>Cable Putty</strong></td>
<td>To separate a compartment from others by providing fire rated seals to any penetration that is common between compartments.</td>
</tr>
<tr>
<td><strong>Compartmentalise</strong></td>
<td>Ausgrid employees who work with printed copies of document must check the document repository regularly to monitor version control. Documents are considered “UNCONTROLLED IF PRINTED”, as indicated in the footer.</td>
</tr>
<tr>
<td><strong>Document control</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Endothermic Reaction</strong></td>
<td>A process by which energy is consumed when any material is changed from one state to another.</td>
</tr>
<tr>
<td><strong>Expandable</strong></td>
<td>Expands during the setting process.</td>
</tr>
<tr>
<td><strong>Factory Mutual</strong></td>
<td>An insurance organisation that provides testing and approvals for firestopping products to be used for specific applications.</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Fire Collar</strong></td>
<td>A pre-fabricated penetration seal system for PVC conduits. Collars shall be type tested and shall satisfy the requirements of Annexure C, Sealant Properties.</td>
</tr>
<tr>
<td><strong>Fire Pillows</strong></td>
<td>Fire rated bags that resemble pillows that are specifically for sealing penetrations where cables pass through walls etc. Fire pillows shall be type tested and shall satisfy the requirements of Annexure C, Sealant Properties.</td>
</tr>
<tr>
<td><strong>Fire Rating</strong></td>
<td>The period that a firestopped seal will withstand the fire test without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the seal.</td>
</tr>
<tr>
<td><strong>Firestopping</strong></td>
<td>Measures that are adopted to prevent the spread of fire, smoke, and acid residues from one compartment to another.</td>
</tr>
<tr>
<td><strong>Fire Resistance Level (FRL)</strong></td>
<td>The ability of an element of construction, component or structure to maintain its structural adequacy, integrity and thermal insulation during exposure to a fire for a specific fire resistance period.</td>
</tr>
<tr>
<td><strong>Fuel Source</strong></td>
<td>Any combustible item that will burn and will sustain a fire; such as some type of cable insulation (PVC, XLPE, HDPE etc), oil, paper, timber, etc. Concrete, porcelain, bare copper conductors, and other exposed steel or metallic objects are not considered to be fuel sources.</td>
</tr>
<tr>
<td><strong>HV Cables</strong></td>
<td>Refers to 5kV and higher voltage cables.</td>
</tr>
<tr>
<td><strong>Ignition Source</strong></td>
<td>A source of energy sufficient to ignite a flammable atmosphere</td>
</tr>
<tr>
<td><strong>Intumescent</strong></td>
<td>Expands when heated.</td>
</tr>
<tr>
<td><strong>Major LV Cables</strong></td>
<td>Cables associated with the auxiliary transformer supply, main AC switchboards and submains, and which are protected by a fuse or miniature circuit breaker (MCB) exceeding 32Amps.</td>
</tr>
<tr>
<td><strong>Mastic Sealant</strong></td>
<td>A sealant that can be used to provide a gas seal only.</td>
</tr>
<tr>
<td><strong>Moisture</strong></td>
<td>Intermittent exposure to water such as by rain and does not submerge the seal.</td>
</tr>
<tr>
<td><strong>Network Standard</strong></td>
<td>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 document repository and available externally on Ausgrid’s website.</td>
</tr>
<tr>
<td><strong>Penetration Loading</strong></td>
<td>The aggregated cross-sectional area of cables or busbars that occupy a related cross-sectional area of a penetration.</td>
</tr>
<tr>
<td><strong>Penetration Seals</strong></td>
<td>The fire-stopping system used to seal openings in walls, floors or ceilings that carry cables or busbars.</td>
</tr>
<tr>
<td><strong>Pre-seal</strong></td>
<td>A seal that is formed outside the penetration usually due to penetrations congested with cables (more than 60% of the penetration occupied by cables). Can also be used where there is insufficient depth in the opening to accommodate the seal.</td>
</tr>
<tr>
<td><strong>Review date</strong></td>
<td>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</td>
</tr>
</tbody>
</table>
in legislation, organisational changes, restructures, occurrence of an incident or changes in technology or work practice and/or identification of efficiency improvements.

**Secondary Cables**
Cables used within a substation for control, protection, communications and metering purposes.

**Submersion**
Where one side of a seal is completely covered in a depth of water for a short or long period of time

**Substation**
Includes sub-transmission substations, zone substations, switching stations, distribution substations, customer substations, control points, chambers for control and metering of supply to high voltage connections (HVCs), and any other installations where contract documents or other instructions specify that this Network Standard is to apply.

**Temperature Rating**
The temperature rise above initial, on the unexposed (non-fire side) face of a sample due to transmission of heat during the temperature rating period, measured by any thermocouple on the unexposed face.

The transmission of heat through the sample during the rating period shall not raise the temperature measured by any thermocouple on the unexposed face by more than 180°C above its initial temperature.

**Temporary Firestopping**
Firestopping intended to remain in service for a short period of time. Typically, the duration shall not exceed six (6) months and shall be significantly less at high risk locations. Approval is required for any longer durations due to work sequencing, staged equipping etc.

**Trafficable area**
Any area in a floor, corridor or passageway where there are no barriers in place to prevent persons from stepping on the seals.

**Underwriter Laboratory**
An insurance organisation that provides testing and approvals for firestopping products to be used for specific applications.
5.0 FIRE RISK

5.1 General

Without firestopping, a fire may spread and damage other parts of the substation building simply by finding its way through any penetration no matter how small.

The fire propagation velocity for PVC insulated cable bundles can be 20 m/m (metres/minute) for vertical installation, and 5 m/m for horizontal installation, as determined by the British Central Electricity Generating Board (CEGB). Other types of plastic insulation, such as polyethylene or polypropylene will propagate fire more quickly.

Standard concrete or sand cement is not fire rated when used as a sealant where cables pass through penetrations.

A fire that is tracking along a cable may pass through a penetration that has been sealed with standard concrete or sand cement and will possibly burst out the sealant in the process.

In addition to generic fire ignition sources (e.g. human error), fires could also be started when oil filled electrical equipment such as transformers or oil filled switchgear fail. When this occurs, the fire is fuelled by the oil and also possibly by bituminous compound in busbar compartments or end boxes. Other fuel sources include the secondary, HV and LV cables and the low voltage boards.

Importantly, the damage to a substation is not just limited to the spread of flames, but includes the damage caused by fire fighting and the spread of hydrochloric acid and smoke damage from any burning PVC coated secondary cables.

Firestopping limits the extent of cable and equipment damage and the amount of fire spread from burning cable insulation.

5.2 Fire risk during construction

A risk assessment shall be conducted to identify the appropriate stages of the construction and/or commissioning processes that firestopping is to be installed.

The risk assessment should be undertaken by a person or persons competent in assessing the fire risks. Based on the findings of the risk assessment, penetrations shall be fire stopped where deemed to be necessary. Penetrations that do not have cables in place as yet shall also be considered.

The firestopping in new buildings shall be installed in stages in accordance with the risk assessment. During these stages, the use of easily installed and removable firestopping such as fire pillows may be more appropriate.

The progressive installation of firestopping shall be included as a check item in inspections conducted by Ausgrid’s Project Manager or delegated officer.

The risk assessment shall consider and document the following items when performing the assessment:

(a) Most accidents occur when commissioning new equipment.
(b) All non-ventilation openings should be considered, not just openings carrying cables.
(c) Building fire systems may not be fully operational.
(d) Fire zoning into multiple compartments should be considered where substation design permits.
(e) Fire rated protection to cables by boxing in cables may be necessary in high risk locations. This will also provide mechanical protection.
(f) Re-instating firestopping on a daily basis should be considered during installation of equipment.
(g) Hot work may occur during construction and cable jointing.
(h) Storage of materials and building refuse will occur during construction.
(i) The cost and risk associated with loss of equipment if a fire occurred prior to or after commissioning should be assessed.

During the installation of equipment, consideration should be given to installing temporary firestopping where appropriate.

Prior to commissioning equipment in new substations or altering existing substations, the associated firestopping for that equipment and compartment shall be fully installed.

Firestopping needs shall be continuously monitored during all phases of construction and commissioning.

6.0 MATERIAL SAFETY

6.1 General
Both new and existing firestopping materials may contain harmful ingredients and appropriate measures must be taken to manage any risks.

6.2 Safety data sheets
A copy of current Safety Data Sheets (SDS) shall be readily available at all times when firestopping products are being installed, removed, disturbed or interfered with in any way. These SDS's are required by Work Health and Safety legislation and must be provided for all products.

Safety Data Sheets (SDS) shall be followed and complied with when using firestopping materials.

Safe Work Method Statements must be provided and contain the safe method of work to be followed including storage, handling, disposal and clean up after use. All staff and contractors (including ASPs) must be trained in the application of the Safe Work Method Statements.

6.3 Existing seals

6.3.1 Man-made mineral fibres (MMMF)
Some existing fire seals may contain inhalable Man Made Mineral Fibres (MMMF). There are now alternate products that do not contain inhalable MMMF and these shall be used for all new installations.

Where existing seals containing MMMF need to be disturbed or removed, precautionary measures shall be used to mitigate against the potential hazards associated with this material. The requirements shall consist of the following:

(a) Personal protective equipment (PPE) equivalent to "Level 1" under the Work Procedures General of NS211 Working with Asbestos Products, and consisting of:

(i) half face respirator with P2 particulate filter

(ii) disposable Nitrile gloves or leather gloves

(iii) gum boots or boot covers

(b) Material potentially containing MMMF shall be wetted down using water or a wetting agent like PVA/water solution prior to removal. The removal procedure shall be designed to minimise and control the generation of dust using a water spray method when applicable and the careful application of hand tools. Power tools shall not be used unless a procedure has been approved that specifically allows their use.

(c) All waste material potentially containing MMMF shall be single bagged in heavy duty low density 200µm thick polyethylene bags. Currently, the waste classification of this material is General solid waste (in accordance with DECCW's Waste Classification Guidelines) and disposal can be into general waste bins.
6.3.2 Asbestos
Some existing fire seals may contain asbestos, in particular old NC compound. Additionally, some duct lines and cable bandage tape may also contain asbestos. Refer to Section 7.0 Asbestos.

7.0 ASBESTOS
Asbestos shall not be reused. Refer to Ausgrid’s Asbestos Location Register for details on asbestos locations. Removal and disposal of asbestos shall be in accordance with NS211 and to The National Occupational Health and Safety Commission’s NOHSC: 3002 (1988) and NOHSC: 2002(1988) requirements.

8.0 FIRESTOPPING OF PENETRATIONS
8.1 General
Unless indicated otherwise by this Network Standard, all services that penetrate building elements that are required to have a Fire Resistance Level (FRL) or a resistance to the incipient spread of fire shall be sealed to provide compartmentalisation. Where the requirements for the extent of compartmentalisation is not clear refer to Ausgrid’s Network Standards, Annexure B of this document and Asset Engineering Policy and Standards for direction.

8.2 Fire rating of penetration seals
NS187 Passive Fire Mitigation Design of Substations nominates the minimum FRL required for the various building compartments and elements affected by potential fire sources.

On this basis, Ausgrid’s approved penetration seals are required to achieve a minimum fire rating as indicated in Tables 1 and 2 below (derived in part from NS187).

For existing substations, any existing penetration seals which are disturbed by new works shall be reinstated to a level that is equivalent to, or better than, the original seal. Refer to Clause 8.11.
### Table 1 – Minimum fire rating of penetration seals – Fire source

<table>
<thead>
<tr>
<th>Fire Source</th>
<th>Minimum Fire Resistance Period (hours) to protected equipment or building elements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CBD Zone</td>
</tr>
<tr>
<td>Transformer/reactors – oil filled (external &amp; internal)</td>
<td>3 (Note 4)</td>
</tr>
<tr>
<td>Transformers non-oil filled (external &amp; internal)</td>
<td>3</td>
</tr>
<tr>
<td>Distribution centre Oil Filled</td>
<td>3 (Note 4)</td>
</tr>
<tr>
<td>Distribution centre Non-oil Filled</td>
<td>3</td>
</tr>
<tr>
<td>Other oil filled equipment</td>
<td>3 (Note 4)</td>
</tr>
<tr>
<td>Other non-oil filled equipment</td>
<td>3</td>
</tr>
<tr>
<td>Cable marshalling areas (basements etc) (see Note 5.)</td>
<td>3 (Note 4)</td>
</tr>
<tr>
<td>Cable Risers</td>
<td>3 (Note 4)</td>
</tr>
<tr>
<td>Control Room</td>
<td>3</td>
</tr>
<tr>
<td>Battery Room (where provided)</td>
<td>3</td>
</tr>
<tr>
<td>Battery Enclosures</td>
<td>Non-combustible</td>
</tr>
<tr>
<td>Communication Room (where provided)</td>
<td>3</td>
</tr>
<tr>
<td>Capacitors (where provided)</td>
<td>3</td>
</tr>
</tbody>
</table>

* Refer to Development Services for suitable penetration seal design details.
Table 2 – Minimum fire rating of penetration seals - Function

<table>
<thead>
<tr>
<th>Function</th>
<th>CBD Zone</th>
<th>STS</th>
<th>Zone</th>
<th>Distribution &amp; Chambers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amenities, foyers and other areas not containing substation equipment</td>
<td>Not required except for BCA compliance.</td>
<td>Not required except for BCA compliance.</td>
<td>Not required except for BCA compliance.</td>
<td>Not required except for BCA compliance.</td>
</tr>
<tr>
<td>Audio Frequency Load Control (AFLC)</td>
<td>N/A</td>
<td>Not required except for BCA compliance.</td>
<td>Not required except for BCA compliance.</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Notes:

1. Penetration seals shall adopt the highest fire rating applicable to either side of the building element being penetrated.
2. The fire rating of all penetration seals shall meet or exceed the fire resistance period noted in Tables 1 and 2.
3. Ausgrid may require a higher fire resistance period than those nominated in Tables 1 and 2 for specific sites where loss of supply and/or safety issues dictate.
4. Applicable only to the penetration seals at these locations. A higher fire resistance period (4 hours) is required by NS187 for the associated building elements to ensure survival and re-use of the structure.
5. Penetration seals may not be required for conduits in external basement walls under specific conditions. Refer to Clause 8.3.

The penetration seals are also required to achieve an equivalent temperature rating. However, where this is not possible due to heat transfer through the cable core, suitable cable fire protection is to be provided over a minimum length of 150mm to prevent the cable from igniting on the other side. Refer to Annexure B for approved penetration seals.

In some instances, a higher fire and temperature rating may be required by the BCA or other relevant specification, code or standard. Where a greater fire rating is required, refer to Ausgrid Asset Engineering Policy and Standards.

A reduced fire rating may be acceptable for short-term, temporary penetration seals installed during the equipping and commissioning stages. Where a reduced fire rating is proposed, refer to Ausgrid Asset Engineering Policy and Standards.

Ausgrid may accept alternative designs for penetration seals where the approved penetration seals are deemed to be unsuitable. Alternative designs shall meet or exceed the performance requirements for approved penetration seals and shall have a relevant testing certificate. All alternative designs shall be subject to the written approval of Development Services.

Annexure D, Figure D.1 provides a flowchart which summarises the requirements of this Network Standard for firestopping using penetration seals.

8.3 Basement penetration seals

Penetration seals are not required for conduits in external basement walls provided the conduits comply with all of the following requirements:

- are buried below ground or fully encased outside the basement wall; and
- do not lead to any oil filled equipment enclosures (e.g. transformers); and
- do not enter an adjacent cable installation facility within a distance of 10m; and
- are clearly identified as external conduits within the basement; and
• have been granted prior approval by Ausgrid for deletion of the penetration seal at specific locations.

All other conduits in external basement walls shall have appropriate penetration seals applied in accordance with this Network Standard.

Conduits in external basement walls may require the use of water seals to prevent the ingress of water into the basement. Refer to Clause 8.12 for requirements relating to water seals.

### 8.4 Sealing of elongated penetrations

Where penetration seals are required, conduits, ducts and cable risers that penetrate a building element shall generally be sealed at both ends.

The purpose of sealing both ends is to ensure that no penetration seals will be missed. There is also a possibility that if both ends were not sealed, a fire would spread to other parts of the building via a wall cavity or void between the faces of the walls.

For short penetration lengths, a one-sided penetration seal may be permitted where all of the followings requirements are satisfied:

- the penetration is less than 500mm in length; and
- there is no cavity or void in the wall or floor element; and
- the penetration seal is visible from the other side.

Where applied to suspended floors, one-sided penetration seals shall be applied to the underside (soffit or ceiling side) of the floor.

### 8.5 Structural adequacy of penetrations through floors

Pedestrian traffic on fire seals is to be prevented as a person could fall through the penetration and the seal can be damaged. Therefore, the measures indicated below are required to protect the seal and to prevent pedestrians from falling through.

1. The following are all the requirements for cable penetrations in corridors, passageways or floors where pedestrian loading is possible:
   - (a) Provide handrails where possible to prevent traffic over the seal or provide trafficable deck plates over seal with a 20 mm gap underneath; and
   - (b) Paint ‘No Step’ on the seal at 1.5 metre intervals and at open sections; and
   - (c) Provide support underneath for accidental pedestrian loading.

2. The following are all the requirements for cable penetrations greater than 200 mm in width in non-trafficable areas:
   - (a) Paint ‘No Step’ on the seal at 1.5 metre intervals and at open sections; and
   - (b) Provide support underneath for accidental pedestrian loading

3. The following are all the requirements for cable penetrations less than 200 mm in width in non-trafficable areas:
   - (a) Paint ‘No Step’ on the seal at 1.5 metres intervals and at open sections; and
   - (b) Provide support underneath for dead weight of the fire seal.

Any structural supports shall conform to relevant Australian Standards including, but not limited to:

- AS/NZS 1170 Structural design actions – Series
- AS 3600 Concrete structures
- AS 4100 Steel structures
The underneath supports of fire seals in Items 1 and 2 above shall be designed for an accidental pedestrian loading of 1 kN point load or 0.25 kPa whichever is greater. Trafficable deck plates shall be designed in accordance with the loading requirements in AS/NZS 1170.

8.6 PVC conduits
Exposed internal PVC conduits (e.g. small wiring etc) can provide a fuel source. Unless treated with the appropriate seal, they allow a fire to be easily spread by the conduit giving way when heated, or through the inside of the pipe itself, or along the cables inside.

To prevent the spread of fire in conduits, an intumescent seal is required for those building elements required to have a FRL. An approved intumescent seal is detailed in Annexure B, Drawing A4-125652.

Where waterproofing of the conduits is also a requirement alternate approved firestopping measures shall be used. Refer to Clause 8.12.

Note: This Network Standard addresses electrical conduits only.

8.7 Penetrations for other services
This Network Standard covers electrical services only, however, appropriate consideration shall be given to all other service penetrations. Where penetration seals are required, these shall be installed to provide a fire and temperature rating in accordance with this Network Standard.

Note: The BCA requires all services running through fire barriers to be firestopped without exception. In some instances, the BCA or other relevant standard may require a higher fire rating.

8.8 Provision of access points for cable fault location
Where floor penetration seals are required below a group of high voltage switchgear, an access point shall be provided near the switchgear group for temporary installation of earth cables during cable fault location.

The access point shall be a 125 mm diameter PVC conduit through the full thickness of the seal. The PVC conduit shall be filled with a fire pillow, which can be removed during fault location, and reinstated afterwards. Where sheeting supports the seal, the 125 mm diameter PVC conduit shall be located over a 50 mm diameter hole in the sheeting.

Note: The requirements of this Clause do not apply to distribution substations.

8.9 Access points for further cable access
Where large mortar seals are provided, and it is envisaged that frequent future access is required, spare conduits shall be placed as needed to allow easy access and resealing for additional cables. Refer to Annexure B, Drawing A4-128118 for details.

This does not apply to switchgear cable slots where the requirements of Clause 8.8 apply.

8.10 Protective coatings for seals
Where required, a protective coating shall be provided to protect the seal from exposure to moisture such as rain (not full submersion) or to oil. Refer to Annexure B for approved protective coatings.

8.11 Reinstating existing penetration seals
8.11.1 Requirements
All existing penetration seals which are disturbed by new works in the substation shall be reinstated to a level that is equivalent to, or better than, the original seal.

Existing penetration seals that are partially disturbed shall be reinstated using the same approved product as the original seal. Where this cannot be achieved, the entire seal shall be replaced using the approved product specific installation details included in Annexure B.
The reinstatement of existing firestopping shall be the direct responsibility of the works Project
Manager, Project Officer or Supervisor, as applicable. Reinstatement of fire stopping and shall be
included as a check item in the routine and final inspections of works on site to be conducted by
the Site Manager.

Disturbed penetration seals shall be reinstated prior to leaving the site on a daily basis. During
ongoing site works the use of easily installed and removable temporary firestopping such as fire
pillows may be appropriate.

Where an entire seal has been removed or disturbed it shall be reinstated in accordance with this
Network Standard. See Clause 8.11.2 below for reinstatement requirements for larger penetrations.

Any structural support systems and signs shall be reinstated to this Network Standard and made
safe at all times.

8.11.2 Reinstating large penetration seals
Where a small amount of disturbance has occurred in a large penetration, e.g. a new cable in a
long switchgear cable slot, advice shall be sought from Development Services for requirements for
reinstating the seal prior to removing the material.

For large disturbances the entire seal shall be replaced in accordance with this Network Standard.

8.12 Water seals
Where water seals are required, do not use firestopping products unless they form part of a
certified water seal system. There is no guarantee that some firestopping products will work if
submerged for any length of time. Additionally, non-porous fire seals may dislodge due to water
head pressure. Water proofing of substations is not covered in this Network Standard.

At locations where an effective water seal cannot be provided, consideration should be given to
suitable drainage of firestopping products using a small diameter drainage line or by appropriate
gap spacing of cable fire pillow seals.

8.13 Signage and identification
Each compartment that has been fire sealed shall be provided with a firestopping sign as detailed
in Annexure A.

In addition, all penetration seals shall be identified on-site using a suitable system which allows for
ease of reference and future maintenance. The identification of each seal, or group of seals, shall
include the following information as a minimum;

- A unique number for the site
- A general location marker (i.e. BA = Basement)
- The date of installation
- The product name or material used for the seal

Where possible, the numbering system should align with the conduit numbering adopted for the
substation.

8.14 Installation certification

8.14.1 General
Certification is required to ensure the product is installed or applied to the manufacturer’s
requirements.

8.14.2 New installations
It is the responsibility of the approved installer to provide certification that all seals are installed to
the manufacturer’s requirements. The approved installer shall certify that they have undertaken the
firestopping in accordance with this Network Standard and the manufacturer’s recommendations.
Certification documentation or otherwise shall be provided to Development Services.
8.14.3 Cable slots
Where the top of the penetration seal is not visible (e.g. in a slot between a switch room and a cable basement, where switchgear restricts access to the top of the slot), it will be necessary to measure the seal installation depth by other means, such as by obtaining an Access Permit and opening a panel to test the depth.

The tool used to test the depth shall be non-conductive and not damaging to cable sheaths. A suitable tool may be made from a section of PVC conduit, of diameter not more than 25 mm, and with the end bevelled on the outside at 30° to the axis of the conduit.

The hole made by the tool shall be restored with penetration seal product equivalent to the original, for the full depth of the seal, promptly after the depth test has been completed.

8.14.4 Long term management
Regular inspection and maintenance is required in accordance with AS 1851 to ensure the integrity of fire segregation. Also refer to the requirements of the Building Code of Australia.

8.15 Final inspection
Following completion of the installation works, Ausgrid shall arrange for a final inspection and sign-off to ensure that the extent of installation works comply with the requirements and intent of this Network Standard.

The approved installer shall rectify any defects or outstanding items identified and shall undertake any additional works where directed by Ausgrid.

9.0 CABLE FIRE PROTECTION

9.1 General
Cable fire protection can be in the form of approved cable coating products, approved cable wraps and blankets, or approved flame retardant cable sheaths.

The extent of approved application of cable fire protection is detailed below. All other applications of cable fire protection shall be assessed on a site by site basis and prior written authorisation obtained from Asset Engineering Policy and Standards.

The objective behind fire protection of cables is to remove the ability of a cable to provide a fuel source in a fire.

Annexure D, Figure D2 provides a flowchart which summarises the requirements of this Network Standard for overall cable fire protection.

9.2 Protection for cable penetration seals
Cable fire protection for penetration seals that is shown as part of an approved product specific installation detail (refer to Annexure B) must be installed.

Cable fire protection at these locations is required as a part of a cable penetration seal to prevent the cable from igniting due to heat conduction along the cable core.

9.3 Secondary cables in buildings

9.3.1 Control rooms
Secondary cables located within a control room shall not be cable fire protected unless approved in writing by Asset Engineering Policy and Standards.

Where cable fire protection is deemed necessary and cables enter control or protection panels, the cable fire protection shall not extend into the panel.

Cable identification tags are to be kept free of any approved cable coating.
9.3.2 Cable basements, trenches, cable risers and other internal locations

Secondary cables should be segregated from the following potential hazards wherever possible:

- Arc chutes on internal arc classification (IAC) switchgear which face directly onto, and are in the immediate vicinity of, the secondary cables,
- Major LV cables (exceeding 32Amps) and distribution boards,
- HV cables and joints,
- Other site specific hazards as advised by Ausgrid.

In addition, secondary cables should also be segregated as follows wherever possible:

- “A” scheme and “B” scheme secondary cables segregated from each other when they are exposed to a common potential hazard. Refer also to NS 259 - Requirements for protection system segregation.

The preferred segregation is either spatial separation sufficient to prevent ignition, or a suitably fire rated barrier protecting the secondary cables.

Where effective segregation cannot be achieved, suitable measures should be implemented to locally fire protect the exposed secondary cables in the following locations:

- At locations in the direct path of arc fault products from IAC switchgear,
- At locations in close proximity to major LV cables (exceeding 32Amps) and distribution boards,
- Where required by Clause 9.5 – at locations in close proximity to any HV cable joints,
- At other specific high hazard locations nominated by Ausgrid.

Further cable fire protection of secondary cables is not required. Approval shall be obtained from Asset Engineering Policy and Standards where more extensive cable fire protection is proposed.

The design of local fire protection measures proposed for secondary cables shall be subject to the review and written approval of Development Services. The local fire protection measures should aim to shield the exposed secondary cables from the short-term effects of heat and/or flame arising from an arc fault, a failure of a nearby major LV cable, failure of a HV cable joint, or other specific hazard.

Refer to Annexure B for details of approved secondary cable fire protection measures near HV cable joints.

Cable coating shall not be used for cable fire protection of secondary cables unless approved in writing by Asset Engineering Policy and Standards.

9.4 HV and major LV cables in buildings

9.4.1 Cable basements, trenches, cable galleries and vertical surface mounted cables

High voltage cables should be segregated from the following potential hazards wherever possible:

- Cable joints in other HV cables (where present),
- Other site specific hazards as advised by Ausgrid.

The preferred segregation is either spatial separation sufficient to prevent ignition, or a suitably fire rated barrier protecting the HV cables.

The requirements for segregation of secondary cables from HV and major LV cables in buildings are described in Clause 9.3.2.

Where effective segregation cannot be achieved, suitable measures should be implemented to locally fire protect the exposed HV cables in the following locations:

- At locations with exposed, multiple storey, vertical surface mounted cables,
- Where required by Clause 9.5 – at the HV joints and for a length of cable on either side,
• Where required by Clause 9.5 – at locations in close proximity to any HV cable joints in other cables,
• At other specific high hazard or critical locations nominated by Ausgrid.

In addition, cable fire protection shall be provided to HV cable penetration seals as required by Clause 9.2.

For major LV cables where effective segregation cannot be achieved, suitable measures should be implemented to locally fire protect the exposed major LV cables in the following locations;

• Where required by Clause 9.5 – at locations in close proximity to any HV cable joints in other cables.

Further cable fire protection of HV cables and major LV cables is not required. Approval shall be obtained from Asset Engineering Policy and Standards where more extensive cable fire protection is proposed.

Where required, exposed HV cables and major LV cables should be locally fire protected using one of the following measures as applicable:

a) Approved flame retardant cable sheath material for HV cables, or
b) Approved cable coating for HV and major LV cables, or
c) Approved cable wraps or blankets for HV and major LV cables, subject to an evaluation of the potential cable de-rating impacts.

Refer to Annexure B for details of approved HV cable fire protection measures at, or near, HV cable joints.

The use of cable wraps or blankets for fire protection shall consider the potential cable de-rating impacts of the installation. For cable blankets, an initial assessment indicates that this method should be limited to short cable lengths of no more than three (3) metres long. Approval shall be obtained from Asset Engineering Policy and Standards where more extensive lengths of cable blanket are proposed.

Cable fire protection for HV and major LV cables, as noted in this Clause, is not required where there are other effective means of fire protection in the compartment, such as the installation of sprinklers.

The application of cable coating to HV and major LV cables shall be in accordance with the manufacturer’s requirements and this Network Standard. Masking-off to protect against overspray is generally only required for the floor area and for sensitive plant items. Additional masking-off of other areas should only be undertaken where essential or where minimal additional cost is incurred.

Note: The requirements of this Clause do not apply to distribution substations.

9.5 Cable fire protection near HV cable joints

HV cable joints within substation buildings should be avoided to minimise the risk of a joint failure damaging adjacent cables or initiating a fire.

The results of a cost benefit analysis (Annexure E) indicate that HV cable joints external to substation buildings can remain cost competitive at up to 30% higher capital cost. This is based on a risk-cost assessment and applies when compared to HV cable joints within a building using approved cable fire protection measures.

Where HV cable joints are required within a building, suitable risk mitigation measures should be implemented to locally fire protect exposed secondary cables, HV cables or major LV cables that are in close proximity to the joint.

Suitable local cable fire protection measures near HV cable joints should always be implemented for the following substations:

a) All Sub-Transmission Substations (STS), and
b) All Sydney CBD Zone Substations, and

c) All new substations under development or recently completed, and

d) All substations where full fire separation and firestopping is NOT provided to rooms located above or adjacent to the HV cable joint installation, and

e) All other substations, except where exempted by this Clause below.

Based on the results of a cost benefit analysis (Annexure E), local cable fire protection measures near HV cable joints may be omitted for some specific zone substations, but only where ALL of the following conditions are satisfied:

- The zone substation is NOT covered under Items a) to d) of this Clause above, and

- The zone substation is exempted by Table E2 in Annexure E.

Annexure E outlines the methodology used for the cost benefit analysis of risks associated with HV cable joints. Table E2 provides a list of exempt zone substations where local cable fire protection is NOT required near HV cable joints. Figure E1 provides a flowchart which summarises the requirements of this Network Standard for cable fire protection near HV cable joints.

Refer to Annexure B for details of approved cable fire protection measures at, or near, HV cable joints.

Note: The requirements of this Clause do not apply to distribution substations.

### 9.6 Cable fire protection in external switchyards

Cable fire protection shall be provided in the splash zone in front of external oil filled equipment as described in Annexure B, Drawing A4-128123 to prevent catastrophic failures causing cable trench fires. Suitable cable fire protection includes approved cable coating, cable wraps or cable blankets.

Cable fire protection shall not be provided elsewhere for cables in cable trenches or at other locations in external switchyards unless approved in writing by Asset Engineering Policy and Standards.

Site specific measures for the fire protection of critical external cables may need to be considered at identified high risk locations. Typical high risk locations include the following:

- Substations deemed to be in bushfire prone areas where cables and other equipment is exposed to radiant heat and possible ember attack

- Areas adjacent to oil filled transformers which may be subject to oil fire radiant heat effects but are located outside the bunded areas.

NS187 Passive Fire Mitigation Design of Substations provides guidance on the radiant heat exposure limits for cables and other elements within substations.

### 10.0 AUSGRID LIST OF APPROVED PRODUCTS AND PRODUCT SPECIFIC INSTALLATION DETAILS

Firestopping products shall be supplied and installed only by Ausgrid approved installers and approved suppliers.

Ausgrid’s currently approved product specific installation details are included in Annexure B. These penetration seal details are designed to achieve a fire rating as indicated.

The penetration seals are also designed to achieve an equivalent temperature rating. However, where this is not possible due to heat transfer through the cable core, suitable cable fire protection is to be provided over a minimum length of 300mm to prevent the cable from igniting on the other side. The cable fire protection details are designed to minimise the spread of fire along cable routes.
Firestopping systems shall be installed using the approved product specific installation details as shown in Annexure B and the manufacturer’s instructions.

Modifications will NOT be allowed to the approved product specific installation details unless prior written approval is granted by Development Services and a relevant testing certificate is provided.

11.0 RECORDKEEPING

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

<table>
<thead>
<tr>
<th>Type of Record</th>
<th>Storage Location</th>
<th>Retention Period*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved copy of the network standard</td>
<td>Document repository Network sub process Standard – Company</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Draft Copies of the network standard during amendment/creation</td>
<td>HPRM Work Folder for Network Standards (Trim ref. 2014/21250/298)</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Working documents (emails, memos, impact assessment reports, etc.)</td>
<td>HPRM Work Folder for Network Standards (Trim ref. 2014/21250/298)</td>
<td>Unlimited</td>
</tr>
</tbody>
</table>

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

12.0 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.

13.0 DOCUMENT CONTROL

<table>
<thead>
<tr>
<th>Document Owner</th>
<th>Head of Asset Engineering Policy &amp; Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Coordinator</td>
<td>Manager Asset Engineering Standards</td>
</tr>
</tbody>
</table>
Annexure A – Firestopping Seal Identification and Details Markers

The sign in this Annexure is to be applied once the firestopping is completed.

Fire seal identification markers, as indicated, must be A4 size.

THIS COMPARTMENT HAS BEEN FIRE SEALED

REINSTATE FIRE SEALS TO THE REQUIREMENTS OF NS 171
Annexure B – Ausgrid’s Approved Product Specific Installation Details

Ausgrid’s currently approved product specific installation details are included in this Annexure. The use of these approved products is only accepted by Ausgrid when installed in accordance with the following approved product specific installation details.

Modifications will NOT be allowed to the approved product specific installation details unless prior approval is granted by Development Services and a relevant testing certificate is provided.

Where a suitable detail does not exist for a specific installation, contact Development Services for guidance.

Variations and additions to these details may be included in future amendments to this Network Standard. It is therefore essential that the users of this Network Standard refer to the latest version including all amendments.

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
<th>Suppliers Product Name</th>
<th>Comments</th>
<th>Contract</th>
<th>Stockline Number</th>
<th>Inhalable MMMMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Mortar</td>
<td>3M</td>
<td>3M Fire Barrier Mortar</td>
<td>Tested to drg 128080. Not be used where submersion in water is likely</td>
<td>Not yet set up</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boards</td>
<td>Promat</td>
<td>Promatec H 25 mm thick</td>
<td>Use two layers. Approved for empty cable slots.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promasil 1100S 60 mm thick</td>
<td>Replaces Vermiculux boards. Approved for cables slots with cables.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable Fire Pillows</td>
<td>Hilti</td>
<td>CP651 Firestop Cushion</td>
<td>Only available for Ausgrid stock number #386262. Tested to drg 128080. Not to be used where submersion in water is likely</td>
<td>CW2223139</td>
<td>185068</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable Bricks</td>
<td>Hilti</td>
<td>CFS-BL Firestop Block</td>
<td>Hilti stock number #20652863. Tested to drg 128080. Not be used where submersion in water is likely</td>
<td>CW2223139</td>
<td>185066</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Promat</td>
<td>Promastop Cable Bricks</td>
<td>Tested to AS1530 using drg 230284. Not be used where submersion in water is likely</td>
<td>Not set up yet</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td>Manufacturer</td>
<td>Suppliers Product Name</td>
<td>Comments</td>
<td>Contract</td>
<td>Stockline Number</td>
<td>Inhalable MMMF</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------</td>
<td>---------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Cable Coating</td>
<td>Hilti</td>
<td>CP679A Firestop Cable Coating</td>
<td>Approved for all outdoor and indoor areas including wet areas – imminent FM Approved</td>
<td>CW2223139</td>
<td>185067</td>
<td>None</td>
</tr>
<tr>
<td>Cable Bandage</td>
<td>Trafalgar / SVT</td>
<td>Pyro-Safe DG</td>
<td>Approved for indoor and outdoor use – IEC tested 120 min.</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Promat</td>
<td>PROMA-BLANKET</td>
<td>Made to order. Available for large orders only. Approved for indoor dry area use only – Tested to AS 1530-1999.</td>
<td>None</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Hilti</td>
<td>CFS-P BA Firestop Putty Bandage</td>
<td>For secondary cables or spare conduits only</td>
<td>None</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Cable Wrap</td>
<td>Promat</td>
<td>Promaseal Flexi-Wrap</td>
<td>Approved for use with Promasil 1100S seals in cable slots</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Conduit Collars</td>
<td>Promat</td>
<td>Promaseal Conduit Collars</td>
<td>Tested for four hours</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Conduit Plugs</td>
<td>Hilti</td>
<td>CFS-PL Intumescent Firestop Plug</td>
<td>For secondary cables or spare conduits only. Hilti Stock Item - 107 mm #2059530 132 mm #2059531 158 mm #2059532 202 mm #2059533 Approved for indoor and weather protected (rain, UV) outdoor use.</td>
<td>CW2223139</td>
<td>185069 185070 185071 185072</td>
<td>None</td>
</tr>
<tr>
<td>Fire Sealant</td>
<td>Hilti</td>
<td>CP611A Intumescent Firestop Mastic</td>
<td>Hilti Stock Item - #220351</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Protective Coating</td>
<td>Parbury</td>
<td>Emer-Clad &amp; Emer-Seal</td>
<td>Indoor use Colour – Red</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>
## B1 List of Standard Installation Drawings

<table>
<thead>
<tr>
<th>Title</th>
<th>Drawing Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetrations with more than 60% cable loading</td>
<td></td>
</tr>
<tr>
<td>Refer to Ausgrid / Development Services</td>
<td></td>
</tr>
<tr>
<td><strong>Duct penetration</strong></td>
<td></td>
</tr>
<tr>
<td>Mortar and pillow cable duct seals for floor and wall penetrations</td>
<td>A4-128468</td>
</tr>
<tr>
<td>- indoor</td>
<td></td>
</tr>
<tr>
<td><strong>Other small penetrations and frequently disturbed penetrations</strong></td>
<td></td>
</tr>
<tr>
<td>Pillow seal for cables in floors or walls - indoor</td>
<td>A4-128120</td>
</tr>
<tr>
<td>Pillow seal for cable and cable trays in floors and walls - indoor</td>
<td>A4-128121</td>
</tr>
<tr>
<td>Spare conduit seal for trenches and other large mortar seals.</td>
<td>A4-128118</td>
</tr>
<tr>
<td><strong>Conduit penetration</strong></td>
<td></td>
</tr>
<tr>
<td>Conduit collar for small diameter conduits</td>
<td>A4-125652</td>
</tr>
<tr>
<td><strong>Outdoor Floor Conduit Penetrations</strong></td>
<td></td>
</tr>
<tr>
<td>Penetration seal for outdoor floors</td>
<td>A4-190509</td>
</tr>
<tr>
<td>Penetration seals for secondary cables – bund floors</td>
<td>A3-225716</td>
</tr>
<tr>
<td><strong>Cable slots and cable risers</strong></td>
<td></td>
</tr>
<tr>
<td>Mortar seal for new cable slots - indoor</td>
<td>A4-128467</td>
</tr>
<tr>
<td>Mortar seal for cable slots and cable risers - indoor</td>
<td>A4-128113</td>
</tr>
<tr>
<td>Floor Seal – Spare Switchgear Cable Slot Seal</td>
<td>A4-184895</td>
</tr>
<tr>
<td>Mortar seal for transformer tails – outdoor</td>
<td>A4-190509</td>
</tr>
<tr>
<td>Spare conduit seal detail</td>
<td>A4-128118</td>
</tr>
<tr>
<td>Cable Slot Seal – Cable Openings Through Floor Slabs - indoor</td>
<td>A4-208655</td>
</tr>
<tr>
<td>Cable Slot Seal – Alternative Configurations - Cable Openings Through Floor Slabs – indoor</td>
<td>A4-208657</td>
</tr>
<tr>
<td>Cable Brick floor penetration seal – Power Cables – indoor</td>
<td>A4-230284</td>
</tr>
<tr>
<td><strong>Cable Fire Protection</strong></td>
<td></td>
</tr>
<tr>
<td>Cable Blanket Fire Protection of Power and Secondary Cables near Cable Joints – Plan at Cables on Trays – Sheet 1</td>
<td>A3-252098</td>
</tr>
<tr>
<td>Cable Blanket Fire Protection of Power and Secondary Cables near Cable Joints – Section at Cables on Trays – Sheet 2</td>
<td>A3-252099</td>
</tr>
<tr>
<td>Cable Blanket Fire Protection of Power and Secondary Cables near Cable Joints – Section at Cables on Trays – Sheet 3</td>
<td>A3-252100</td>
</tr>
<tr>
<td>Cable Blanket Fire Protection of Power and Secondary Cables near Cable Joints – Section at Cables on Floor – Sheet 4</td>
<td>A3-252101</td>
</tr>
<tr>
<td>Cable Blanket Fire Protection of Power and Secondary Cables near Cable Joints – Section at Cables on Trays – Sheet 5</td>
<td>A3-252111</td>
</tr>
<tr>
<td><strong>Cable trenches</strong></td>
<td></td>
</tr>
<tr>
<td>Pillow seal for cable trench</td>
<td>A4-128119</td>
</tr>
<tr>
<td>Brick Seal for cable trenches</td>
<td>A4-128473</td>
</tr>
<tr>
<td>Cable trench coating near oil filled equipment in external yards</td>
<td>A4-128123</td>
</tr>
<tr>
<td>Spare conduit seal detail</td>
<td>A4-128118</td>
</tr>
<tr>
<td><strong>Customer substation busbar seal</strong></td>
<td></td>
</tr>
<tr>
<td>Mortar or cable brick busbar seal</td>
<td>A4-128117</td>
</tr>
<tr>
<td>Steel busway duct penetration seal</td>
<td>A4-232355</td>
</tr>
</tbody>
</table>
Annexure C – Sealant Properties

The purpose of this Annexure is to specify the properties required for cable coating and penetration seals that provide firestopping to substation buildings.

To be accepted for use in Ausgrid’s substations, the products or system of products shall satisfy all of the following requirements detailed below. Approved products and approved product specific installation details are listed in Annexure B.

C.1 Fire and temperature rating requirements

In general, fire sealing products shall be capable of achieving the required fire rating and the equivalent temperature rating (where possible) unless they are providing a gas seal only. In some instances, a higher fire and temperature rating may be required by the BCA or other relevant specification, code or standard.

The firestopping test with an appropriate test period shall comply with the details for cable loading, cable sizes and cable types shown on Drawing 128080. Details of the proposed product system to achieve Ausgrid’s requirements shall be provided by the supplier/manufacturer.

Where the temperature rating for cable penetrations cannot be achieved for cable types shown on Drawing 128080, measures shall be put in place to prevent the cables igniting before the end of the fire test period.

Note: For fire retardant coatings, product approvals relate to various international classifications not based on fire time/temperature ratings.

C.2 Approved testing standards

All products used by Ausgrid shall have testing that reflects Ausgrid’s requirements in terms of cable loading, size and types. Typical cable types can be found on Drawing 128080.

Suppliers/manufacturers shall specify all limitations applicable to their products. All flame retardant Cable Coating products are to be approved by Factory Mutual for use as a flame retardant coating (which includes a cable de-rating test).

C.3 Health and safety

The product shall not be hazardous to workers during or after application, in its powder form, or when broken out. In the event of a fire, the product shall not emit toxic gases or substances.

Products that contain harmful ingredients will not be considered for use by Ausgrid where there is a less harmful alternative product.

C.4 Further testing and compliance

Fire and temperature penetration sealing products shall comply with AS 1530.4 Methods for fire tests on building materials, components and structure – Fire resistance tests of elements of buildings, and shall be tested to Factory Mutual and/or Underwriter Laboratory standards (or an Ausgrid approved equivalent), and shall be approved for application around cables that are typically found in Ausgrid substations. Compatibility with cable materials shall be demonstrated.

Where these test results are not available, or where Ausgrid is not satisfied with the level of testing performed, the product(s) shall then be tested to Underwriter Laboratory Standard UL 1479 ‘Fire Test on Through Penetration Fire Seals’, or AS 1530.4 using Drawing 128080.

It is important to ensure that supplier’s and manufacturer’s firestopping product performance is supported by test results, which are to Ausgrid approved testing standards. Test results shall be inspected by Development Services, to ensure that testing has provided for Ausgrid’s typical cable types and configurations. Where this has not occurred, Ausgrid may consider the level of testing unsatisfactory and will require further testing as detailed in this Clause.
Where a supplier/manufacturer provides test results that do not satisfy Ausgrid’s requirements for testing of products; the supplier/manufacturer, when requested by Ausgrid, shall re-test the products at their expense, in accordance with Ausgrid’s requirements. Ausgrid will provide the test penetration cables and cable tray only for the test.

C.5 Structural capacity
The cable mortar supplier shall verify that their products are self-spanning for a distance up to 800 mm (without pedestrian loading and without supports). Where supports are required for pedestrian loading and self-weight, suppliers are to verify that the details in Annexure B are sufficient for the required loading (Refer to Clause 8.5 for loading details).

C.6 Consistency
The consistency of mortar type seals shall be able to be altered for various application methods, including pumping where applicable.

C.7 Removal
Once in place and set, cable mortar product shall be easily removable with hand tools with minimum effort, to avoid damage to existing cables. Product suppliers shall submit a procedure for the product removal method. The product removal method shall not require the use of electrically conductive tools, or sharp objects, which could damage cables.

Ausgrid will assess the ease of product removal for each of its intended applications. As part of this assessment, Ausgrid shall give consideration and preference to products that allow the safe removal of product from around energised cables.

Fire retardant cable coating is required to be non-removable once applied.

C.8 Intumescent seals
Cable fire pillows, cable bricks and cable putty must all be intumescent to a minimum of 30% of the original volume of the product when exposed to heat. Products must not expand below 100°C.

C.9 Non-shrink requirements
Cable mortar shall not shrink when cured.

C.10 Weather resistance
Where subjected to external application, all firestopping products shall be weatherproof and UV proof. A system of various products may be used to provide a weatherproof and UV proof seal.

Cable coating products shall be weatherproof, UV proof and resistant to water penetration when submerged.

C.11 Resistance to oil
All firestopping products shall be able to resist exposure to oil and still function as intended. Systems of products are permitted to achieve oil resistance. If penetrations, including conduits, have openings less than 100 mm above floor level (e.g. in a pit), the sealant shall also prevent the spread of any oil spillage.

C.12 Vermin and termite
It is essential for all firestopping products to be vermin and termite resistant or to be provided with other means of preventing attack.

C.13 Design life
The Design Life of firestopping products shall be not less than 30 years, and the Design Life for cable coating systems should be suitable for the typical substation / cable life, i.e. 50 years.

C.14 Compatibility
The materials and installation techniques of all firestopping and cable coating products shall be physically, chemically, electrically and thermally compatible with the relevant cable materials and other electrical equipment, to ensure that there is no adverse reaction or damage to the cables or other electrical equipment.

**Note:** Cable coating systems shall not cause any electrical de-rating.
Annexure D – Flowcharts

Figure D1
NS171 - Firestopping in Substations

Start

Is the penetration for an electrical service?

Yes

Consider use of penetration seals where required. All service penetrations shall comply with the BCA Clause 8.7

No

Does the electrical service penetrate a building element?

Yes

NS.171 does not apply

No

Does the building element have an FRL?

Yes

Penetration seals for conduits below ground are not required

No

Provide a penetration seal to achieve the required fire rating (e.g. FRL/180/180) Clause 6.2

Continues next page
Provide for the following as required in Clauses 8.8 to 8.13:
- Access for fault location
- Protective coatings
- Future cable access
- Reinstatement
- Water seals
- Signage

Arrange for certification of penetration seals and products Clause 8.14

Does the installation pass Final Inspection by Ausgrid Clause 8.15?

Additional works and/or rectification of defects to be undertaken by the approved installer Clause 8.15

End
Figure D2a
NS 171- Cable Fire Protection in Substations

Start

Is cable casing or fire protection specifically required by Section 9

Yes

Cable Penetration Seals
Clause 9.2

Provide cable fire protection at penetration seals where required

End

No

Secondary Cables
Clause 9.3

Are the secondary cables in the Control Room?

Yes

Basements, Trenches, Cable Risers and other internal locations

Is effective segregation of secondary cables possible from:
- specified HV & LV hazards
- "A" from "B" scheme
Clause 9.3.2

No

Use suitable segregation measures (spatial, physical) to protect these secondary cables where possible
Clause 9.3.2

End

No

All other applications are to be approved by Ausgrid Section 9

End

HV & Major LV Cables
Clause 9.4

No cable fire protection unless approved by Ausgrid Clause 9.3.1

Refer to Figure D2b

HV Cable Joints
Clause 9.5

Refer to Figure E1

External Switchyards
Clause 9.6

Refer to Figure D2c

Continues next page
From previous page

Consider local fire protection for the following exposed secondary cables ONLY:

- In direct path of arc fault products
- Near major LV cables (exceeding 32A)
- Near HV cable joints. Refer to Clause 9.5
- At Ausgrid nominated high hazard locations

Clause 9.3.2

Design suitable local fire protection measures for exposed secondary cables

Clause 9.3.2

Cable coating shall not be used on secondary cables unless approved by Ausgrid

No

Do the local fire protection measures have Ausgrid approval

Yes

End
Figure D2b
NS 171 - Cable Fire Protection in Substations

Continues next page
Annexure E –
Cable Fire Protection Near HV Cable Joints

E.1 General

The purpose of this Annexure is to outline the methodology used for the cost benefit analysis of risks associated with HV cable joints. Figure E1 provides a flowchart which summarises the requirements of this Network Standard for cable fire protection near HV cable joints.

NS 171 includes specific provisions for the fire protection of secondary, HV and LV cables near cable joints within substation buildings.

E.2 Cost Benefit Analysis – Methodology

A CBA was prepared to assess the following Options in relation to HV cable joints and the use of cable fire protection in substation basements:

- OPTION 1  Do Nothing – No Fire Protection Near Joint
- OPTION 2  Remove Joint from Basement
- OPTION 3  Retain Joint with Fire Mitigation

The CBA approach was based broadly on the methodology used for other Ausgrid equipment (Concord Zn 11kV Switchgear Replacement).

The key data entry and assumptions used in the CBA were as follows:

1. Single Joint - The CBA was based on a single new joint at a given substation, the estimated failure risk of that joint, and the cost of various mitigation controls.
2. Failure Rate - The cable joint failure rate (fires) for the Base Case was based on the single Ausgrid fire event (Hornsby Zn, Feb 2019).
3. Fire Event - The Hornsby Zn fire event indicates 100% of energy was at risk, with an effective switching time of 16hrs (50% of customers on), and a repair time of 216hrs (9 days).
4. Energy at Risk - For the Base Case, the CBA assumed 100% of energy at risk to determine the Expected Unserved Energy (EUE) during the effective switching time. The EUE during the post-switching has allowed for the substation effective Load Transfer Capacity.
5. Risk Costs - The Total Risk Costs are the sum of annualised values for Expected Unserved Energy, Repair Cost and Safety Impact Cost. The Net Present Value (NPV) of these annual risk costs was used in the CBA calculations.
6. VCR - The adjusted NEM Value of Customer Reliability (VCR) applied to the EUE was $40.036 $/kWh for the Base Case.
7. Safety Impact - The Safety Impact Cost was based on the Value of a Saved Life with an appropriate disproportionate factor (x10) and exposure rate applied.
8. **Option Costs** – The CBA Option Costs are capital costs (Year 0) for the mitigation controls used under Options 2 and 3. These values were budget estimates for the works, with a suitable range to cover various site conditions.

9. **Residual Risk** - For the Base Case, the CBA assumed a residual total risk cost of 20% for the fire mitigation controls used under Option 3.

10. **Benefit to Cost Ratios** - For the CBA, the Risk Benefit to Cost ratios were based on the level of risk reduction v’s cost relative to Option 1 - Do Nothing, namely;

\[
\begin{align*}
\text{B/C Ratio 1} & \quad \frac{R(\$) \text{ (OPTION 1 - OPTION 2)}}{\$ \text{ (OPTION 1 - OPTION 2)}} \\
\text{B/C Ratio 2} & \quad \frac{R(\$) \text{ (OPTION 1 - OPTION 3)}}{\$ \text{ (OPTION 1 - OPTION 3)}}
\end{align*}
\]

B/C Ratios > 1.0 indicate that the benefits exceed the costs when compared to Option 1 – Do Nothing, and indicate when options apart from “Do Nothing” should be implemented.

A summary of the Base Case data entry values for the CBA is provided in Table E1, together with possible alternative low / high values for further sensitivity analysis, as required.

### Table E1 – CBA Base Case and Sensitivity Scenarios

<table>
<thead>
<tr>
<th>Key Data Entry</th>
<th>CBA Scenario</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Limit</td>
<td>Base Case</td>
</tr>
<tr>
<td>Cable Joint Failure Return Period (Fires)</td>
<td>Years 40</td>
<td>20</td>
</tr>
<tr>
<td>Repair Time (MTTR)</td>
<td>Hrs 72</td>
<td>216</td>
</tr>
<tr>
<td>Switching Investigation Time</td>
<td>Hrs 1</td>
<td>2</td>
</tr>
<tr>
<td>Energy at Risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-switching</td>
<td>% 20</td>
<td>100</td>
</tr>
<tr>
<td>Load Transfer Effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-switching</td>
<td>% 100</td>
<td>90</td>
</tr>
<tr>
<td>Value of Customer Reliability (VCR)</td>
<td>$/kWh 28</td>
<td>40.036</td>
</tr>
<tr>
<td>Repair Cost</td>
<td>$ 80,000</td>
<td>404,000</td>
</tr>
<tr>
<td>Economic Evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Life</td>
<td>Years 20</td>
<td></td>
</tr>
<tr>
<td>Discount Rate</td>
<td>% 7</td>
<td>5</td>
</tr>
<tr>
<td>Option 1 Cost - Do Nothing</td>
<td>$ 0</td>
<td>0</td>
</tr>
<tr>
<td>Option 2 Cost - Remove Joint</td>
<td>$ 9,000</td>
<td>35,000</td>
</tr>
<tr>
<td>Option 3 Cost - Retain Joint and Protect</td>
<td>$ 4,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Residual Risk - Joint Failure Fire – Option 3</td>
<td>% 10</td>
<td>20</td>
</tr>
</tbody>
</table>
E.3 Cost Benefit Analysis – Outcomes

A Cost Benefit Analysis (CBA) has been prepared for the use of cable joints within substation buildings, comparing the level of risk reduction provided by the two alternative controls (elimination of joints v's cable fire protection).

The key data entry and assumptions used in the CBA have been outlined, and several alternative low / high values have been provided for sensitivity analysis.

The CBA is sensitive to several of the input variables, including the substation average load, cable joint failure rate, repair time, load transfer capacity and option cost.

Several scenarios were developed to address the key sensitivities, establish the range of possible outcomes, and provide a basis for selection of the most appropriate risk reduction method.

The broad outcomes of the CBA and sensitivity can be summarised as follows;

- The substation Yearly Average Load (MVA) and Load Transfer Capacity (at time of peak load) (MVA) are the key determinants of the B/C Ratio, with other risk factors held constant.

- A sensitivity analysis using a range of input variables and scenarios indicates that B/C Ratios < 1.0, namely “Do Nothing”, can be justified in some circumstances. Generally, this outcome applies where either one of the following conditions can be satisfied;
  - The zone substation peak loading DOES NOT exceed 10MVA, or
  - The zone substation peak loading is between 10MVA and 35MVA and the substation Load Transfer Capacity (at time of peak load) exceeds 5MVA.

- The use of HV cable joints external to substation buildings (Option 2) can remain cost competitive at up to 30% higher capital cost, when compared to HV cable joints within a building using approved cable fire protection measures (Option 3). This is based on a risk-cost assessment considering the likely residual risk of a cable joint fire under Option 3.

The outcomes of the CBA outlined above have been incorporated into the design requirements of this Network Standard (Clause 9.5 and Table E2).
E.4 List of Exempt Zone Substations

Based on the results of the Cost Benefit Analysis, local cable fire protection measures near HV cable joints may be omitted for some specific zone substations.

Table E2 provides a list of exempt zone substations where local cable fire protection is NOT required near HV cable joints. These zone substations are generally lightly loaded, or medium loaded, with adequate load transfer capacity.

In preparing Table E2, other factors such as the zone substation criticality (e.g. supplying a major hospital) and the expected remaining life (e.g. zone substation soon to be replaced) have also been considered.

Table E2 – List of Exempt Zone Substations

<table>
<thead>
<tr>
<th>Zone Name</th>
<th>Zone Name</th>
<th>Zone Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aberdeen</td>
<td>Gateshead</td>
<td>New Lambton</td>
</tr>
<tr>
<td>Adamstown</td>
<td>Harbord</td>
<td>Newdell</td>
</tr>
<tr>
<td>Avondale</td>
<td>Hurstville North</td>
<td>Newport</td>
</tr>
<tr>
<td>Blackwattle Bay</td>
<td>Jewells</td>
<td>Noraville</td>
</tr>
<tr>
<td>Blakehurst</td>
<td>Killarney</td>
<td>Nulkaba</td>
</tr>
<tr>
<td>Brandy Hill</td>
<td>Maitland</td>
<td>Paxton</td>
</tr>
<tr>
<td>Broadmeadow</td>
<td>Maryland</td>
<td>Rouchel</td>
</tr>
<tr>
<td>Cardiff</td>
<td>Matraville</td>
<td>Sans Souci</td>
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<td>Charlestown</td>
<td>Medowie</td>
<td>Stockton</td>
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<tr>
<td>Croudace Bay</td>
<td>Mitchell Line</td>
<td>Telarah</td>
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<td>Denman</td>
<td>Mitchells Flat</td>
<td>Tomago</td>
</tr>
<tr>
<td>Dulwich Hill</td>
<td>Moonan</td>
<td>Wamberal</td>
</tr>
<tr>
<td>Empire Bay</td>
<td>Mt Hutton</td>
<td>Williamtown</td>
</tr>
<tr>
<td>Enfield</td>
<td>Mt Thorley</td>
<td>Woy Woy</td>
</tr>
<tr>
<td>Galston</td>
<td>Narrabeen</td>
<td></td>
</tr>
</tbody>
</table>
Figure E1
NS171- Fire Protection Near HV Cable Joints

Start

Is the Cable Joint in:
- an STS, or
- a Sydney CBD zone substation, or
- a new substation.

Yes → Provide Risk Mitigation Measures for all new HV Cable Joints

No → Is fire separation and firestopping provided to substation rooms above and adjacent to the HV Cable Joint?

Yes → No Risk Mitigation is required for new HV Cable Joints

No → Is the Substation listed as exempt in NS 171 Table E2, Annexure E? (Note 1)

Yes → Provide Risk Mitigation Measures for all new HV Cable Joints

No → NS 130 Clause 15.6.3—Joints within the cable basement of zone substation buildings should be avoided.

End

Continues next page
Can the HV Cable Joint be located external to the substation?

Yes

NS 130 Clause 15.6.3 - Use a dedicated cable joint pit, where a joint pit is present and space is available.

Calculate U1 capital costs for the following scenarios -
- Cost A - New Cable Joint external to the substation.
- Cost B - New Cable Joint inside substation using NS 171 cable fire protection measures.

Does Cost A exceed Cost B by 30% or more? (Note 2)

Yes

Internal HV Cable Joint
Design cable fire protection measures in accordance with NS 171 Section 9.

No

External HV Cable Joint
Design new Cable Joint as external to the substation buildings.

The Designer shall record all details of the new HV Cable Joint and cable fire protection measures in the Ausgrid GIS System.

No

End

From previous page

NS 130 Clause 15.6.3 - Are options available to eliminate the need for a HV Cable Joint altogether?

Yes

End

No

End

Note 1 – Based on a Cost Benefit Analysis using reasonable risk cost assumptions.

Note 2 – Based on a 30% residual risk for internal HV cable joints.