

## PPE for Electrical Work

<b>Document no</b>	D2013/80874
<b>Work description</b>	<p><b>Scope</b></p> <p>This Safe Work Instruction shall be applied by workers (employees and contractors of Sydney Trains, Transport for NSW, and Technically Assured Organisations) undertaking electrical work or work in electrical hazardous locations. This document shall be applied in addition to the Person Conducting a Business or Undertaking (PCBU) Safety Procedures (PPE requirements for Sydney Trains employees SMS-06-GD-3323).</p> <p>This Safe Work Instruction applies to all workers:</p> <ol style="list-style-type: none"> <li>1. Entering any electricity substations (also applies to visitors)</li> <li>2. Switch rooms with live exposed conductors (also applies to visitors).</li> <li>3. Hold electrical certifications in accordance with PR D 78701 "Personnel Certifications – Electrical" authorising them to: <ul style="list-style-type: none"> <li>- Operating work on the 1500V dc Traction and Electrical Distribution (HV &amp;/or LV) networks,</li> <li>- Apply working earths or safety earths,</li> <li>- Work on live low-voltage electrical installations,</li> <li>- Work on Overhead Wiring, High and Low Voltage infrastructure.</li> <li>- Testing Overhead Wiring, High and Low Voltage infrastructure.</li> </ul> </li> </ol> <p><b>NOTE:</b> This SWI does not apply to persons performing non-electrical work outside substations.</p>
<b>References:</b>	<p><b>Sydney Trains Electrical Network Safety Management System</b></p> <p>PR D 78100                      Definitions and Conventions for Electrical Safety</p> <p>PR D 78700                      Working around Electrical Equipment</p> <p>SMS-06-GD-3323                Personal Protective Equipment</p> <p><b>Compliance:</b></p> <p>AS 2225:1994                    Insulating gloves for electrical purposes</p> <p>AS/NZS 1336:2014                Eye and face protection - Guidelines</p> <p>AS/NZS 1337.1:2010            Personal eye protection – Eye and face protectors for occupational applications</p> <p>AS/NZS 1801:1997                Occupational protective helmets</p> <p>AS/NZS 2210.1:2010            Safety, protective and occupational footwear – Part 1 Guide to selection, care, and use</p> <p>AS/NZS 2210.3:2009            Occupational protective footwear – Part 3: Specification for safety footwear (ISO 20345:2004, MOD)</p> <p>AS/NZS 4602.1:2011            High-visibility safety garments – Part 1: Garments for high-risk applications</p> <p>ASTM F1891-12                    Standard Specification for Arc and Flame-Resistant Rainwear</p> <p>ENA NENS 09 – 2014            National Guideline for the Selection, Use and Maintenance of Personal Protective Equipment for Electrical Arc Hazards</p> <p>IEC 61482-1-1:2009-05        Live working – Protective clothing against the thermal hazards of an electric arc – Part 1-1: Test methods – Method 1: Determination of the arc rating (ATPV or EBT50) of flame-resistant materials for clothing</p> <p>ISO 14116:2015                    Protective clothing – Protection against flame – Limited flame spread materials, material assemblies and clothing.</p> <p>NFPA 70E                            National Fire Protection Standards</p> <p>ISSC 14                              Guide to electrical workers' safety equipment</p> <p>ISSC 34                              Guide for Height Safety Within the NSW Electricity Industry</p>
<b>Assess the risk</b>	Prior to working in accordance with this SWI the Line Manager shall review and consider the hazards have been risk assessed. A workplace risk assessment may lead to additional PPE requirements.

## PPE for Electrical Work

<b>Minimum PPE for Electrical Work</b>	The minimum PPE to be worn for electrical work consists of arc-rated <b>base garments</b> and <b>safety footwear</b> .
<b>Pre-Work inspection</b>	<p>All PPE including base garments shall be inspected prior to use. Verify the PPE has the manufacturers tag for laundering instructions and the tag nominating it's Arc Thermal Performance Value (ATPV) in Cal/cm<sup>2</sup>. Inspect PPE in accordance with Manufactures, and PCBU instructions.</p> <ul style="list-style-type: none"> <li>• Only wear clothing that is in good condition. <ul style="list-style-type: none"> <li>○ No missing fasteners</li> <li>○ No Holes or tears as that will allow an arc to enter the gap.</li> <li>○ No Chemical Contamination or stains from petroleum or other flammable, or conductive material. Contamination may compromise the protection provided by the PPE.</li> <li>○ No Faded PPE as it will affect visibility of the user in the workplace and on track.</li> <li>○ No excessive dirt or staining</li> </ul> </li> </ul> <p>All persons entering electrical substation, &amp;/or accompanying Electrical Workers undertaking electrical work shall be verified as wearing Electrical PPE at Pre-Work Brief or site induction.</p>
<b>Hazards and Warnings</b>	<ul style="list-style-type: none"> <li>• Exposed metal jewellery and other adornments (such as bracelets, rings, neck chains, watches, clothing with metal threads or metal components, or other conductive items) must not be worn when working on or near live exposed electrical equipment.</li> <li>• Short sleeves or short trouser outer garments are not permitted for electrical work or in electrical facilities (i.e. substations, switch rooms, sectioning huts etc).</li> </ul>
<b>Storage</b>	<p>Avoid storing PPE in proximity to chemicals known to fade or damage fabrics, such as bleach or chlorine.</p> <p>For longer life of reflective materials, store at room temperature out of direct sunlight.</p>
<b>Work in the rail corridor</b>	The base, outer and rain weather garments shall be suitable for work in the rail corridor in accordance with Sydney Trains Organisational Guide SMS-06-GD-3323.
<b>Maintenance &amp; Replacement</b>	<p>PPE shall be maintained, used, laundered in according to the manufacturer's and PCBU instructions.</p> <p>PPE shall be disposed of and replaced when they have deteriorated, damaged or have a limited life as indicated by the label or swing tags.</p> <p>Disposal of PPE shall be in accordance with the PCBU policies. Sydney Trains employees shall comply with Section 5.8 of <a href="#">Sydney-Trains-uniform-and-presentation-standard</a>. For Security reasons all clothing with corporate logo's shall not be disposed in General waste, all uniform clothing with Sydney Trains logo shall be disposed through the uniform and PPE disposal contract managed by Sydney Trains Customer Experience using uniform disposal bins.</p> <p><b>NOTE:</b> Previous base garments were treated with flame resistance during the manufacturing process and had a nominal life of 50 machine washes, after which they should be disposed, these garments are labelled as treated.</p> <p>The current base garments material is inherently non flammability and does not have a wash limit to maintain the non-flammability or arc rating.</p>

## PPE for Electrical Work

### Hazardous equipment

**All personnel undertaking tasks in the following locations** shall wear arc-rated electrical PPE providing protection not less than 6 Cal/cm<sup>2</sup> – including face shield, neck guard (or, balaclava) and arc rated gloves:

- When within 1m of the rear of indoor HV switchgear with any section of the bus bar or incoming feeders LIVE, that vents to the rear, including (but not limited to):
  - 33kV AREVA/Schneider WSA switchgear,
  - 33kV Nuova Magrini Galileo switchgear,
  - 33kV Alstom Normafloor DNF7,
  - 33kV Merlin Gerin FLUARC FG4,
  - 11kV Merlin Gerin type DIS 10T2,
  - 11kV South Wales D4X4.
  - 11kV ABB SafeRing

Operating or working within 1m, with any section of the bus bar or incoming feeders LIVE of 11kV Nebb, Andelec and Holec Switchgear.

### Layering of PPE

Combining two or more Arc Flash garments into a layered system, may work to achieve a higher level of protection, performance, and comfort for the wearer.

Layers of arc-rated garments may provide additional protection; only arc rated systems can count. Putting an 8-cal coverall over a 4-cal shirt doesn't automatically give you a 12-cal system. Layering up PPE may increase the total Arc Thermal Protective Value (ATPV) to a level greater than the sum of the individual garments.

Consult the manufacturers of the garments prior to layering to verify they are suitable for layering, and what the combined ATPV would be.

**NOTE:** When working in high temperature conditions, heavy weight clothing or multiple layers should only be worn for the duration of the task, so that the risk of heat stress is reduced.

## Base Garments

Base garments are garments which are considered as outer wear, which may be worn in direct contact with the skin. Base garments shall be always worn in an electrical environment.



Arc Flash Shirt



Arc Flash Trousers



Non conductive belt

Base garments consist of either a long-sleeved shirt with popover placket, gusset sleeve cuffs; and long trousers, or one-piece coveralls (overalls), as defined in ENA NENS09 National Guideline for the selection, use and Maintenance of Personal Protective Equipment for Electrical Arc Hazards. They must:

- a) Be labelled stating the fabric or garment is arc-rated not less than **6 Cal/cm<sup>2</sup>**;
- b) Be labelled stating the fabric or garment has been tested (in accordance with either IEC61482-1-1, ASTM F1959) or complies with ISO 14116.
- c) Be worn so that the body is covered from neck to wrist to ankle. Shirt, coat, jacket, and/or coveralls must be fastened at both the wrist and neck area.
- d) Have non-metallic fasteners or have fasteners protected by a layer of the same material as that of the garment on both the top and undersides.
- e) Be worn such that shirts shall be tucked into trousers and sleeves shall be rolled down and fastened to protect against entanglement and arc flash injury.
- f) Have colours and flame retardant retroreflective hi-visibility tape.
- g) Not be modified or altered after their original manufacture. In instances where altering is required e.g. shortening of pants contact [railelectricalsafety@transport.nsw.gov.au](mailto:railelectricalsafety@transport.nsw.gov.au)

Thermal outer garments (pullovers, jumpers) and/or rainwear shall be worn over the base garments.

## PPE for Electrical Work

### Safety Footwear

Safety footwear shall be compliant to AS/NZS 2210.3 and maintained to AS/NZS 2210.1.

Electrical footwear Requirements

- Electrically non-conductive safety footwear complying with AS/NZ 2210.
- Uppers must not consist of woven nylons or other synthetics.
- Safety Footwear must have ankle support. Elastic sided Safety Footwear is not permitted.
- Safety footwear shall have toe protection.
- ASTM F2413 “Electrical Hazard Resistant” (marked with the symbol EH)

Where gumboots are used, they shall be:

- Safety gumboots.
- Made of rubber or PVC.
- In good condition; and
- Compliant with either:
  - Australian Standard AS/NZS 2210 “Electrically non-conductive” (Marked with the symbol “I”); or
  - ASTM F2413 “Electrical Hazard Resistant” (marked with the symbol EH).

## Headwear



**Protective Helmet  
(hard Hat)**

Protective helmets shall be worn in the following circumstances.

- When working in an area where cranes or plant, including elevating work platforms are operating.
- When operating electrical equipment at or above head height
- Where there is a risk of being struck by falling objects
- Where required by a risk assessment, or site safety plans.

Any accessories fitted to a protective helmet (such as chinstrap, earmuffs) shall be fitted and used in accordance with the requirements of the manufacturer/supplier of the helmet and accessory.

Under no circumstances shall a protective helmet be worn over any headwear such as a sun hat, cap, or beanie, unless specifically approved for this purpose. These items present a fire risk and reduce the effectiveness of the helmet’s internal webbing and protective structure that is designed so that the helmet is a snug fit around the wearer’s head.

A 100% woollen cap or beanie may be worn where protective helmets are not required.

### Eye, face Protection



**Carry/storage bag  
for face shield.**

Where indicated by the risk assessment, Additional PPE that may be worn over or in combination with the base garments. Eye protection, complying with Australian Standard AS 1337 must be worn when working on or near live low voltage equipment.

Arc rated face shields shall be used where there is a potential to be exposed to an arc flash at face level (e.g. Working (including fault testing) on a live Low Voltage switchboard, when 1500V rectifier unit doors are open, and it is live etc.)

- Face shield (with chin flap covering the chin, or a balaclava),



**Balaclava**



**Face shield with arc-rated hood and chin flap**

Balaclavas are designed for use with arc rated goggles or face shield to provide addition protection to the neck and head. Flame-resistant balaclava, constructed from two layers of Nomex rated to not less than **10 Cal/cm<sup>2</sup>** and complying with NFPA 70E Hazard/Risk Category 2.

Safety glasses shall be worn where the hazard of eye injury exists or required by the site safety plan.



**Safety Glasses**

When undertaking electrical work requiring face or eye protection, if glasses with metal frames are worn, they should be covered by protective over-glasses.

Prescription safety glasses shall be applied in accordance with the PCBU instructions and shall be on a non-conductive frame, fitted with side shields

# PPE for Electrical Work

## Hearing protection – Di-Electric

The primary criterion when selecting a hearing protector is that the level of noise entering the worker’s ears (the in-ear noise level) must be reduced (attenuated) to below the criteria in the exposure standard for noise (Clause 56 of the Workplace Health and Safety Regulation 2017), which are:

- a) a total noise of 85dB(A) averaged over an 8-hour period, or
- b) a peak noise level that exceeds 140dB(C)

The recommended target in ear exposure level for workers is 80dB.



## Handwear

### Gloves



Glove Storage bag.

Flame resistant/arc rated Hazard/Risk Category 2 gloves should be worn while performing HV, 1500VDC operating work on manual switches (i.e. Air-break Switches, 1500V links and Switches, Negative links etc.), Testing Dead or applying portable Earths/Rail Connections.



Flame-resistant and cut protection gloves, Arc flash rated Cat 2 (9.4 cal/cm<sup>2</sup>)



Arc –rated gloves Cat 2 (18 cal/cm<sup>2</sup>)

Insulated gloves (or Voltage Rated Gloves) are used to provide protection for workers from the risk of electric shock.

- Insulated gloves compliant to AS/NZS IEC 60903 to be worn on both hands when undertaking live LV work, or when the hazard assessment shows a need.
- Except for rescue situations, Riggers or cut resistant gloves shall be worn as outer gloves when undertaking work to ensure the insulation is not compromised; and where cutting and tearing hazards exist.
- Inspect and air-test insulating gloves before each use.
- Optional Inner gloves are thin fabric worn under insulating gloves to absorb perspiration. Inner gloves also provide an additional thermal barrier in the event of exposure to an arc.



Low Voltage Insulated Glove



# PPE for Electrical Work



Leather overglove cut resistant



Leather/rigger over glove



Optional Cotton inner glove seamless



Optional Cotton inner glove knitted

## Seasonal Clothing

### Thermal Outerwear

Thermal outer garments shall have an outer layer that is flame retardant in accordance with ISO 14116 or arc rated in accordance with ASTM F 1891 and have no flammable melting layers or components (e.g. no synthetic fabrics or plastic components). 100% woollen knitwear is recommended. These outer garments must not be relied on for protection against arcs, base garments must still be worn.



Arc Rated Jacket



100% Woollen jumper.

### Undergarments

Undergarments are optional clothing work next to the skin and under base garments. Thermal underwear shall have not less than 90% natural fibres.



Thermal bottom



Thermal tops

### Arc Flash Rain Wear

Orange arc-rated wet weather coats and trousers may be worn over base clothing. The orange jacket must be suitable for electrical work, i.e. flame resistant in accordance with ASTM F 1891 or ISO 14116, labelled stating compliance with that standard, and have no flammable melting layers, fasteners, or components.



Coat.

Trousers

## PPE for Electrical Work

### Harnesses

Sydney Trains worker harnesses shall be in accordance with D2013/80857 Harnesses, Lanyards and Attachment Hardware (Physical Restraint Systems)

The following mandatory features are required for Lineworker and Overhead worker harnesses:

- Side D-rings for the pole strap attachment are to be as far forward as possible to provide ease of attachment of the pole strap. They can be Tang D-rings or Swinging D-rings with a 22.5mm minimum inside radius and a section diameter of 7 to 10mm
- The rope rescue points are to be webbing loops with a suitable attachment system to enable attachment to a single rescue hook. The rescue point is also to be suitable for use with snaphooks or karabiners and can be incorporated with the front arrest point
- The two fall arrest points are to be an over-shoulder dorsal extension strap and a chest high front fall arrest point. The dorsal extension strap can be velcroed to the harness shoulder strap
- The buttock support can be fixed or free to be attached to the waist belt when not in use