2degrees
Electrical Safety Procedure

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Document Review

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Contents

Introduction

Scope

This procedure covers how to manage the risks associated with working with and around electricity for 2degrees operations, including:

- Use of electrical equipment and appliances (in offices or data centres, as well as on work sites); and
- Work near live overhead conductors (power-lines) and line supports.

This Standard does not cover:

- Excavation close to buried electrical cables
- Isolation of equipment prior to maintenance
- Prescribed Electrical Work (as defined by the Electricity Act 1992).

For further information, refer to:

- Electrical (safety) Regulations 2010
- Health and Safety at Work Act 2015

What are Electrical Risks?

Electrical risks encompass the potential dangers of death, injury, or electric shock, whether arising directly or indirectly from the use of electricity. The most prevalent electrical risks and their causes include:

Electric Shock: Electric shock can result in injuries or even fatalities. It may occur through direct or indirect contact, tracking across or through a medium, or by arcing. For instance, indirect contact may happen when a non-energized conductive part (e.g., a metal toaster body or a fence) becomes energized due to a fault.

Fire, Arcing, or Explosion: Electrical faults can lead to fires, arcing, or explosions, causing burns and injuries. These incidents are often triggered by high fault currents.

Electric Shock from 'Step-and-Touch' Potentials: 'Step-and-touch' potentials can give rise to electric shocks.

Toxic Gases: Electrical equipment undergoing burning or arcing can release various gases and contaminants, leading to illnesses or fatalities.

Electric shocks can also lead to secondary injuries, including falls from ladders, scaffolds, or other elevated work platforms. Other potential effects encompass muscle spasms, palpitations, nausea, vomiting, collapse, and unconsciousness.

It's essential to recognize that not only workers using electricity are at risk. Faulty electrical equipment and subpar electrical installations can lead to fires that may pose a threat to the lives and well-being of others.

What is Electrical Work?

Electrical work encompasses the following activities:

- the installation, connection, or maintenance of conductors used in works or installations.
- the installation, connection, or maintenance of fittings where the fittings are connected, or intended to be connected, to conductors used in works or installations.

- the connection or disconnection of fittings to or from a power supply, other than by means of a plug or pin inserted into a socket, or an appliance connector inserted into an appliance inlet
- the maintenance of appliances

Electrical work excludes the following:

- Tasks involving connecting electrical equipment to an electricity supply using a flexible cord plug and socket outlet.
- Work on a non-electrical component of electrical equipment if the person performing the task is not exposed to an electrical risk.
- Assembling, making, modifying, or repairing electrical equipment as part of a manufacturing process.
- Constructing or repairing ducts, conduits, or troughs for electrical wiring installation if:
    - The ducts, conduits, or troughs are not intended to be earthed.
    - The wiring is not energized.
    - The work is supervised by a licensed or registered electrical worker.
- Locating or mounting electrical equipment or fixing it in place, provided it is not related to the connection of electrical equipment to an electricity supply.
- Assisting a licensed or registered electrician in conducting electrical work if:
    - The assistant is under the direct supervision of the licensed or registered electrician.
    - Assistance does not involve physical contact with energized electrical equipment.
    - Assisting an individual in acquiring knowledge and skills for performing the work through training, qualification, or experience.
- Carrying out electrical work, except work on energized electrical equipment, to meet eligibility requirements for becoming a licensed or registered electrician.

General Safety Requirements

Before work is commenced on or near any electrical installation or equipment, a competent person shall determine whether it is safe to do so by carrying out a general risk assessment and applying all relevant control measures (i.e. de-energizing via Isolation and testing). Work shall only be carried out on or near de-energized exposed conductors and parts unless,

- Work is necessary in the interests of safety and the risk of harm would be greater if the equipment or parts were de-energized.
- The work is in accordance with all mandatory risk controls and there are no reasonable alternatives alternative options.
- The Change Management plan has been submitted and approved by the 2Degrees CAB.

General Principles - Verification of De-Energized Electrical Equipment

Person Conducting a Business or Undertaking (PCBU), is responsible for ensuring that electrical work is not carried out on energized electrical equipment unless:

- It is essential for the safety of individuals that the electrical work takes place while the equipment remains energized. For instance, this may be necessary for life-saving equipment to remain operational during electrical work.
- It is necessary for the electrical equipment in question to be energized to ensure the work is performed correctly.

- It is required for testing purposes to confirm that the equipment has been de-energized.
- There are no reasonable alternative methods available to carry out the work.

These provisions do not apply to work conducted by or on behalf of electricity supply authorities on electrical equipment, including electric line-associated equipment, controlled or operated by the authority for electricity generation purposes. This exemption does not extend to the electricity generation sector.

Isolation and Testing

Before performing electrical work on electrical equipment, it must be tested by a competent person to determine that it is de-energized. You must ensure that:

- Each exposed part is treated as energized until it is isolated and verified as de-energized.
- Each high-voltage exposed part is earthed after being de-energized.

Electrical equipment, once de-energized for work, the Lock Out, Tag Out, LOTO process is to be followed to ensure that it cannot be inadvertently re-energized.

WARNING: All electrical conductors and parts, including neutral and earthing conductors, shall be treated as energized until proven de-energized. Always test before touch.

Isolation, Lock Out/Tag Out, and Access

To maintain electrical equipment or circuits in a de-energized state while performing work, effective isolation from all relevant electricity supply sources is essential. This may involve using opening switches, removing fuses or links, opening circuit breakers, or disconnecting circuit connections.

Refer to the lock out/tag out process in Appendix 1.

To ensure conductors are de-energized always apply the principle “Prove, Test, Prove” in the following sequence to determine correct circuit isolations.

1. Visually check test equipment for any signs of damage.
2. Check the suitability for the Voltage present.
3. Check the Voltage tester on a known voltage source for the correct operation.
4. Test between all known conductors and a known earth.
5. Test between all conductors.
6. Retest the Voltage tester on a known voltage source for correct operation.

Panel boards or other visual indicators should not be the sole method for determining whether an electrical conductor is de-energized. Any exposed conductors in the work area should be adequately separated, insulated, or protected to prevent inadvertent or direct contact.

Work on Cables (Including Cutting Cables)

Work on cables is not an activity that is usually undertaken by 2degrees workers; when required the activity is generally outsourced. When working on a cable, including cutting it, the cable should be de-energized, and the isolation point secured by tagging and locking out. Cables must be treated as energized, and procedures for working on energized electrical equipment must be followed, including testing by a competent person to determine whether they are energized. If the cable's connections are exposed, the connections and attached live parts should be verified as de-energized and identified before commencing work.

Cutting cables presents specific risks. Both ends of the cable should be checked for isolation before cutting. Schematic or 'as-built' diagrams should be reviewed carefully to identify secondary or metering circuits in multi-cored cables before cutting. Additional precautions are necessary to ensure insulated or covered cables are de-energized, irrespective of their voltage level. Depending on the situation, alternative precautions may include:

- Using cable spiking or stabbing devices or
- a combination of verifying de-energization and physically tracing the cable.

Energized Electrical Work

Prohibition on Energized Electrical Work

Energized electrical work refers to electrical work performed on or near exposed energized conductors. In general, energized electrical work is prohibited unless the conditions below are met.

- Work is necessary in the interests of safety and the risk of harm would be greater if the equipment or parts were de-energized.
- The work is in accordance with all mandatory risk controls and there are no reasonable alternatives alternative options.
- The Change Management plan has been submitted and approved by the 2Degrees CAB.
- The work is carried out by competent individuals (preferably Electrically licensed personnel).

For further guide on risk control for working on or near energized conductors all controls are outlined in AS/NZS 4836:2023.

Hazards Indirectly Caused by Electricity - Conductive Materials

Individuals can be exposed to electrical risks, including the risk of electric shock, arcing, and explosion, even without direct contact with exposed energized parts of electrical equipment. Other conductive materials can serve as current paths for electric shock or fault current.

It is essential to treat all materials as conductive unless proven otherwise. Gases and liquids should also be assumed to be conductive. Caution should be exercised when exposed energized parts are in proximity to grounded situations.

The path for electric shock to reach the ground can involve conductive materials such as concrete, moisture-laden timber, or water. For instance, ladders that are damp or soiled can become conductive, potentially creating a hazard.

When working in the vicinity of exposed energized parts or performing work while energized, it is crucial to utilize tools and equipment that are either non-conductive or insulated. This applies to various items, including:

- Flashlights
- Telescopic devices
- Rulers and tape measures
- Insulated hand tools, such as screwdrivers, pliers, cable cutters, spanners, and crimpers.
- Electrical or hydraulic-powered tools

Workers should refrain from wearing metallic personal items, including watches and watchbands when working near exposed energized parts. These metal objects elevate the risk of electric shock.

Moreover, in case of electrical burns, these items can exacerbate the severity by retaining heat and providing contact points for current to flow.

Other examples of metallic personal items include jewellery, body piercings, and metal spectacle frames.

Tools and Equipment

Maintenance and Inspection

Tools, instruments, and equipment that are poorly maintained, improperly used, or unsuitable for the task can lead to injuries. Examples of these include:

- Inadequately insulated tools and test instruments.
- Incorrectly rated instruments.

Unsecured tools may fall into energized switchboards, compromising equipment integrity and safety. To mitigate these risks, consider using lanyards around wrists, tool holders, and restraints like tool pouches and baskets.

Tools, instruments, and equipment used by electrical workers often have specific design characteristics, such as insulation. All insulated tools and equipment should be suitable for the work and undergo regular maintenance, inspection, and testing. Neglecting maintenance could lead to significant electrical risks, such as concealed mechanical defects that could disrupt a testing device.

If there is any doubt about the adequacy of the insulation of tools and equipment, they should not be used. Maintenance and inspection should follow the manufacturer's instructions.

Ladders, Scaffolds, and Similar Equipment

Consider avoiding the use of metallic, wire-reinforced, or otherwise conductive ladders for electrical work. These types of ladders should be discouraged and should not be used near equipment where electrical hazards could arise.

Metallic or wire-reinforced ladders and scaffolds are conductive and may create a path for electric shock. For example:

- A ladder slipping while work is being carried out, causing the worker to touch exposed energized parts.
- Wind blowing an extension ladder into nearby overhead powerlines.
- In switch rooms and switchyards, conductive devices like aluminum ladders, steps and scaffolds may create electric shock paths and ground faults if they come into contact with live busbars.
- In situations with large current-carrying lines, conductive scaffolds may be subject to induction.

Also, consider electrical risks when using ladders, scaffolds, and similar equipment, as workers are more likely to come into contact with open wiring, such as overhead lines. Portable scaffolds may damage insulation when moved if they come into contact with conductors or leads.

Additional control measures may include:

- Identifying exposed energized parts nearby and implementing control measures like de-energizing, using covers, having a safety observer, or combining these methods.

- Practicing safe work procedures, such as using two or more people to carry long devices below shoulder height in switchyards and switch rooms, using two people to handle extension ladders in windy conditions, and using head ropes or footropes to restrain ladders.
- Bonding conductive scaffolding to the earthing system when used within high-voltage enclosures or areas susceptible to induction.

Insulating Barriers and Mats

Insulating covers and mats used for electrical safety purposes should comply with AS/NZS 2978:1995: Insulating mats for electrical purposes. Insulated barriers should be made of suitable material to effectively separate electrical workers from adjacent energized equipment. Before and after each use, visually inspect insulated covers and mats for possible defects.

Test Instruments

As a person conducting a business or undertaking (PCBU), you must ensure that the person performing energized electrical work has suitable tools, testing equipment, and personal protective equipment (PPE). These should be properly tested and maintained in good working order.

Workers carrying out electrical testing must be appropriately trained and competent in test procedures and equipment usage. This includes understanding how to use the device safely, inspect it for safety, recognize its limitations, be aware of its impact on others' safety, and know how to respond to inconclusive or incorrect results.

Test probes and equipment should be designed to prevent inadvertent short circuits between live conductors or live conductors and earth. Appropriate shrouding and safeguards should prevent contact with live test sockets or conductors when equipment is in use. Test leads and devices used in hazardous flammable areas should be suitable and clearly marked for such conditions.

To confirm the correct functioning of a proximity voltage tester, use an alternative test instrument with a visual display immediately before and after the test. Proximity voltage testers may not be suitable for certain situations, such as cables surrounded by metallic screens or enclosed in metallic pipes.

Personal Protective Equipment (PPE)

PPE for electrical work, including testing and fault finding, should be selected to minimize health and safety risks. It should also be maintained, repaired, or replaced to ensure continued effectiveness and should withstand the energy at the work location when working energized.

The PCBU directing the work must provide workers with information, training, and instruction on the correct use and wearing of PPE. Depending on the nature of the work and associated risks, the following PPE should be considered:

- Face Protection: An arc-rated full-face shield may be appropriate for high-current and arcing scenarios.
- Eye Protection: Avoid wearing metal spectacle frames.
- Gloves: Use gloves insulated to the highest expected voltage for the work, and leather work gloves may be suitable for de-energized electrical work.
- Clothing: Wear non-synthetic, flame-resistant clothing made of non-fusible material. Avoid clothing with conductive materials or metal threads.
- Footwear: Use non-conductive footwear, such as steel-toe cap boots or shoes meeting the necessary standards.

- Safety Belt/Harness: Inspect safety belts and harnesses for issues like buckles, rings, hooks, clips, and webbing before each use.

Emergency Response

If working with or around electricity, there must be an Emergency Response Plan, and then sufficient resources provided to implement the Plan if/ when necessary. The Plan should cover as a minimum:

Electric Shock

- If someone comes into contact with a live electrical source do not touch them.
- Switch the power off, either at the source or at the main power switch. If you touch the person while they are still in contact with the electrical current, you will also get an electric shock or be electrocuted.
- The longer a person is in contact with the power source, the more likely the shock will be fatal. If it is not possible to turn the power off, use an insulated object such as a broom with a dry wooden handle to push the victim clear of the source of shock. Wear rubber soled shoes if possible.
- Never choose anything even slightly damp to help rescue the victim.
- Phone for an ambulance immediately – dial 111.
- Administer appropriate first aid such as CPR.
- In all cases of electric shock, even if the victim feels fine, seek medical treatment and advice immediately.
- Report all electrical accidents to WorkSafe NZ.

Electrical fire

- Never throw water on an electrical fire. If possible, disconnect the faulty appliance or turn off the power. Always keep a multi-purpose fire extinguisher handy.
- In a building, raise the alarm to initiate a safe evacuation.
- If necessary, phone the Fire Service – dial 111.
- Report electrically caused fires to WorkSafe NZ.
- Dispose of faulty appliances or get electrical installations checked by a Registered Electrician with a current practicing license.

Contact with Overhead Power-line

- Treat all overhead power-lines as “live” and get back at least 10m
- If the power-line has come down, isolate and evacuate the immediate area
- If you are in a vehicle, stay in the machine if it is safe to do so
- If you are at serious risk from another hazard (eg. fire) and must leave the vehicle, jump well clear and ensure you are not touching the vehicle and the ground at the same time
- Notify the asset owner immediately.

High Voltage Electrical Work

Requirements for electrical work on high voltage equipment after switching, isolation, short-circuiting, and earthing are specialized and stringent. Only competent electrical workers who have undergone appropriate training in high voltage electrical work are authorized to work on high voltage electrical equipment.

For comprehensive guidance on working on or near high voltage electrical installations, it is strongly recommended to seek expert advice from a specialist electrical contractor or the local electricity supply authority.

All high voltage work with in the 2Degrees portfolio of infrastructure is Vector owned, operated and maintained. Any Maintenance of these assets are subject to a submission and approval by the 2Degrees CAB under Change Management maintenance planning

Appendix 1 – Lock out/Tag Out process

The following steps to complete the lockout and tagout process are to be followed:

1. **Identify –** Identify the electrical equipment and conductors, all energy sources and the points of isolation.

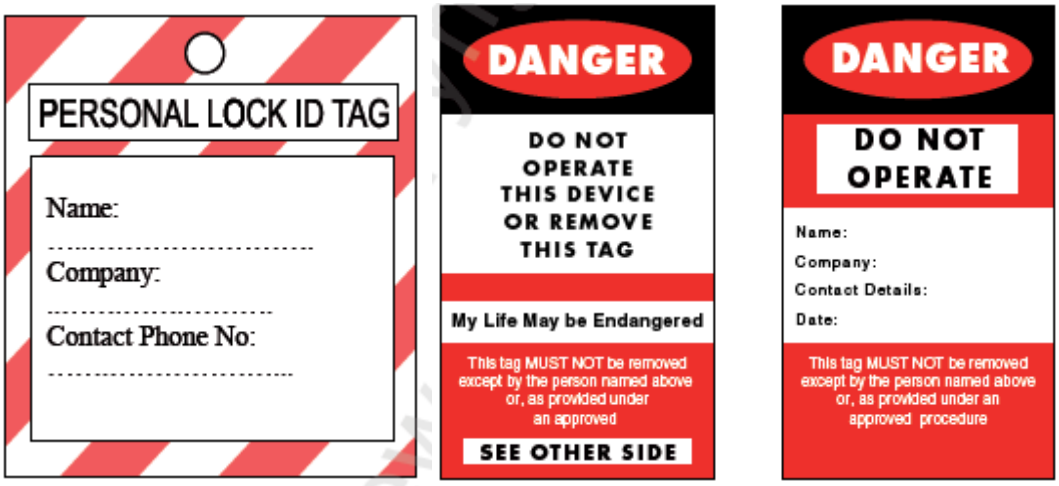
2. **Assess –** Assess the risk of isolating including risk to people, downstream effect of De-Energizing and potential hazards or dangers.

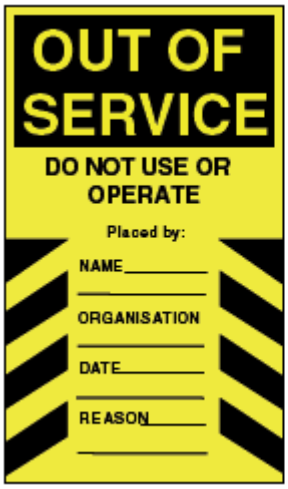
3. **Notify –** Notify all relevant workers and stakeholders of the intended Isolations.

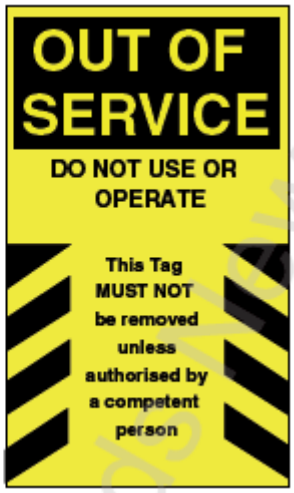
4. **Isolate –** Isolate all identified points of isolation from electrical supply by opening switches, removing fuse links, opening breakers, or removing circuit connections.

5. **Lock Out –** Personal padlocks should be used for locking isolating devices. They should be **RED** in colour and uniquely keyed to prevent inadvertent removal by others. Each padlock should identify the person's name, company and contact details. The Examples below shows a typical personal red lock and a multi lock device.

6. **Tag Out –** Tags shall be applied with a lock, string or Tie, the entries on the tag Shall be legible and permanent. Where a padlock cannot be used Danger Tags shall be placed at all points of switching, isolation or disconnection. Out of service tags shall be attached to devices or electrical equipment that is not to be operated. The Examples below shows typical Lock out ID tag, Danger Tag and Out of service tag.







7. **Confirm Isolation -** To ensure conductors are de-energized always apply the principle “Prove, Test, Prove” in the following sequence to determine correct circuit isolations.
    1. Visually check test equipment for any signs of damage.
    2. Check the suitability for the Voltage present.
    3. Check the Voltage tester on a known voltage source for the correct operation.
    4. Test between all known conductors and a known earth.
    5. Test between all conductors.
    6. Retest the Voltage tester on a known voltage source for correct operation.

8. **Removal of tags and Locks –** Danger Tags and locks may only be removed with the approval of the person who applied the Locks and Tags. Out of service tags may only be removed when a competent person deems the plant or equipment is safe to operate.

    If necessity arises for the need to remove another person's tag or lock, this shall only be carried out by a competent person with thorough investigation, testing and risk acceptance by the 2Degrees manager of the works.