# Electrical engineering control plan

1. **AIM:** The aim of this plan is to provide a system that allows for the management of the risks to health and safety from electricity at the mine site. The plan will set out the control measures to be used to manage these risks and to ensure that electrical installations are designed, installed, operated, repaired, modified and maintained in a safe manner and in accordance with relevant standards. Our EECP will attempt to adopt all maintenance and inspection requirements as specified by the original equipment manufacturer (OEM) and will be performed by competent persons who hold appropriate qualifications. All repairs, maintenance and inspections will be recorded to provide a history of work completed and to enable better planning of scheduled maintenance.
2. **WHAT:** The purpose of the EECP is to set out control measures to prevent:

* injury to persons caused by direct or indirect contact with electricity
* injury to people caused by working on electrical plant or electrical installations
* the unintended initiation of explosions
* the unintended operation of plant
* the occurrence of uncontrolled fires.

The EECP extends to all areas of the mining operation and applies to the overall life cycle requirements of the electrical aspects of plant and electrical installations that are hired, new, existing or second hand. This includes all plant and electrical installations introduced to site by suppliers and contractors. The EECP applies to all workers, contractors, designers, manufacturers, importers and suppliers that are involved in all aspects of electrical work.

An assessment of risks associated with the electrical aspects of plant and electrical installations will be conducted using (**Form 11 A**). This assessment of risks will be the initial commencement point for the development of the EECP.

1. **WHO:** All electrical work on site will be performed by people who have been trained and who have the necessary competencies and qualifications.

Extra low voltage (ELV) (< = 50 V AC or <= 120 volts ripple free DC). Work will only be performed by our electrical tradesperson, an (auto electrician), or a competent person. Our sites regular auto electrician is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Low voltage (LV) (exceeding ELV but not exceeding 1000 V AC or 1500 V DC). Work will only be performed by a competent and qualified electrical tradesperson. Our qualified electrical tradesperson is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. They have been nominated to perform the statutory function of qualified electrical tradesperson for our site and their nomination has been recorded in our management structure Instructions 2.

They have supplied us with a copy of their trade certificate and a copy of their qualified supervisor certificate, proficiency certificate or evidence of continuous employment at a mine as an electrical tradesperson since 2005. They have also provided a record of their skills and experience in using these qualifications in recent work, as evidence of their maintained competency.

High Voltage (HV) (exceeding 1000 V AC or 1500 V DC). Where high voltage work is required on site or if the total connected power at the mine is greater than 1000 KW, then all electrical work will be supervised by an electrical engineer. Our qualified electrical engineer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. They have been nominated to perform the statutory function of electrical engineer for our site and their nomination has been recorded in our management structure Program 2, (remove if not applicable).

Our electrical engineer has supplied us with evidence of either having an electrical engineering practising certificate (coal mines), or a recognised qualification in electrical engineering, along with their compliance with the Australian Engineering Competency Standards Stage 2 in respect of mining operations at a mine, and verification that they are registered on the National Engineering Register.

1. **HOW:**  The EECP provides guidance on the overall life cycle management and electrical practices to be used to manage electricity and electrical installations on site. Key requirements are identified in each of the life cycle phases for the design, manufacture, installation, commissioning, operation, maintenance (including repair, modifications and overhaul), decommissioning and disposal of electrical aspects of installations.

**Competences:**

**Electrical tradesperson:** The statutory function of our electrical tradesperson is to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

**Electrical engineer** (if applicable): The statutory function of our electrical engineer is to develop, supervise, monitor and and review the standards and procedures for the installation, commissioning, maintenance and repair of electrical plant and installations at the mine, and to also supervise the installation, commissioning, maintenance, modifications and repair of electrical plant and installations at the mine, in conjunction with the electrical tradesperson.

**Safe systems of work**

The development of the site’s safe work management statements (SWMS/procedures) for electrical work will begin with the site risk assessment. The safe systems of work will also be supported by the development of our electrical maintenance schedule and our site electrical services diagram. A copy of the electrical services diagram (**Form 11F**) will be displayed in the main switch room, along with the isolation procedure (**Form 11G**) and the restoration of power procedures (**Form 11H**).

Risk assessment – The electrical risk assessment will be completed to identify all hazards associated with the use of electricity.

This risk assessment (**Form 11A**) will be completed by the quarry manager and the individual nominated to exercise the statutory function of electrical engineer, or if no engineer is required, our competent electrical tradesperson \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (tradesperson’s name).

Once completed all identified hazards will be risk rated and appropriate controls will be determined, implemented and recorded as being completed.

Our mine has several SWMS that detail the controls to manage the risks associated with the use of electricity on site. Our workers and workers of our electrical contractor will be required to perform their work in accordance with these SWMS, unless the electrical contractor has a health and safety management plan, or SWMS, of their own that is consistent with the sites SMS. These documents will be reviewed and written notice given to the contractor to confirm that they are consistent with the sites SMS. The SWMS contained in the EECP will include but not be limited to:

Safe work method statements

1. Isolation procedure, **Form 11G**
2. Restoration of power procedure **Form 11H**
3. Electric shock procedure **Form 11I**
4. Welding procedures **Form 11J**
5. Working near overhead power lines **Form 11K**
6. Use of electrical test instruments **Form 11L**
7. Other SWMS \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Equipment:**

All new circuitry and modified circuitry will be tested in accordance with AS 3000, before the application of power, with a compliance certificate (or equivalent document) supplied to the operator of the mine, (**Form 11E example**). The test results will be recorded on the compliance certificate or on a separate form attached to the compliance certificate. Our electrical services diagram will also be updated to reflect the changes, where applicable.

Maintenance of our electrical equipment will be performed as per the *Planned electrical maintenance/testing schedule* (**Form 11C**). This schedule has been developed in consultation with our statutory electrical engineer and/or electrical tradesperson after considering the suggested testing frequencies in (**Form 11C and 11D**).

A record of all completed electrical maintenance/ testing activities will be kept on record (**Form 11B**) or in an individual plant file/book.

The lifecycle approach to electrical engineering practices includes:

**Procedure or acquisition**

When considering the purchase, acquisition, or construction of any new items of electrical plant and equipment, the compliance, performance and maintenance obligations required of that equipment are to be clearly understood by all parties involved. Additionally, the requirements for effectively maintaining the equipment while it is in service will be considered (e.g. safe access for inspections and maintenance tasks). In short, the equipment must be fit-for-purpose.

**Design**

The electrical aspects of plant and equipment will be designed so they are without risks to health and safety to workers throughout the life cycle.

In general, the design of any item of electrical plant and equipment, shall comply with all relevant Australian Standards (AS), and also comply with any specific safety or design features required under the WHS legislation.

Design of new, or modifications to existing electrical installations requires the designer / supplier to provide all of the requisite engineering checks and certifications as part of the scope of supply.

**Manufacture**

The electrical aspects of plant and equipment will be manufactured so they are without risks to health and safety to workers throughout the life cycle.

**Installation, commissioning and construction**

The risks to health and safety associated with installation, construction and commissioning of electrical plant and equipment will be managed in accordance with our risk management procedures (Section 5).

Installation, construction and commissioning activities will be carried out in accordance with the information provided by the designer, manufacturer, importer or supplier of the plant and equipment.

All work will be supervised by our statutory electrical engineer or qualified electrical tradesperson.

**Operation**

No electrical plant and equipment will be operated where a defect would mean that the plant is a risk to the operator or other people.

All electrical plant and equipment will only be operated within its designed operating parameters as described in the equipment’s operating manuals.

Any damage to electrical plant and equipment will be reported to the manager or delegate and a review of controls measures will be conducted to identify remedial actions to be taken.

**Maintenance**

The maintenance of electrical aspects of plant and equipment will be managed in accordance with the OEM servicing requirements and as recorded in the planned electrical maintenance/testing schedule, (**Form 11C**). Maintenance also includes the regular inspections and tests that are controls resulting from the risk assessments, as well as those mandated by WHS laws (e.g. test and tagging).

**Decommissioning**

The risks to health and safety associated with decommissioning of electrical plant and equipment will be managed in accordance with our risk management procedures (Section 5).

**Disposal**

Electrical plant and equipment will be disposed of in a manner that does not harm the environment and is economically responsible. Where electrical plant and equipment is on-sold, all operating manuals, service manuals, maintenance records and a condition report will be supplied to the purchaser.

1. **WHEN:** Maintenance will be conducted on each piece of electrical plant and equipment as per the Planned electrical maintenance/testing schedule (**Form 11C**). These agreed maintenance and testing frequencies have been determined after reviewing the information obtained from the respective plant service manuals, discussions with our electrical tradesperson or electrical engineer (if applicable), and recommended schedules in Australian Standards
2. **ACTION:** If during the course of completing the initial electricity risk assessment or any other subsequent maintenance test, something is found not to meet the site’s standards, or is unsafe, then the person completing the risk assessment will record it on (**Form 11A**) and will notify \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (nominated person) of the problem. If the problem is not fixed immediately because it does not create a health and safety risk to persons using that plant or equipment then the hazard will be transferred into the daily diary or action plan.
3. **Document control:** Larger pieces of electrical equipment may have their own plant file/book located \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(e.g. office). Where the site has a small number of electrical appliances all maintenance will be recorded in a single file/book, the daily diary or (**Form 11B**).

**Scheduled maintenance:** All scheduled maintenance/testing will be recorded on Form 11B) or in the plant file/book (e.g. attach completed supplier service sheets, where if applicable).

**Breakdown maintenance:** All unexpected breakdown maintenance will be recorded on the plant file/book.

**External service provider:** All documentation received during the course of completing service work by external service providers will be recorded in the plant file/book.

The forms for the EECP

1. **11A** Electricity – risk assessment
2. **11B** Electrical register and maintenance/testing results
3. **11C** Planned electrical maintenance/testing schedule
4. **11D** Electrical maintenance schedules for a larger processing plant (example)
5. **11E** Certificates of compliance (example)
6. **11F** Electrical services diagram plan (example and blank)
7. **11G** Isolation procedure (example)
8. **11H** Restoration of power procedure (example)
9. **11I** Electric shock procedures (example and form)
10. **11J** Welding procedures (example)
11. **11K** Working near overhead power lines (example)
12. **11L** Using electrical test instruments (example)

Form 11A: Electricity – risk assessment

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| --- | --- | --- | --- |
| **Mine:** |  | **Inspection area :** |  |
| **Statutory electrical engineer or tradesperson:** |  | **Site representative:** |  |
| **Date:** |  | | |

| **Category** | **Risk assessment questions** | **Risk**  **If NO = H** | | | **Audit observations – controls** |
| --- | --- | --- | --- | --- | --- |
| **H** | **M** | **L** |
| **Systems** |  |  | | |  |
| Management | If High Voltage electricity (HV) is used on site, or if there is over 1000KW of electrical equipment installed, is there an electrical engineer nominated by the mine as the statutory electrical engineer? (Notification form to be submitted) |  | | |  |
|  | If HV is delivered to the site is there a high voltage management plan as required by the local supply authority service rules? |  | | |  |
|  | If there is no HV on site, or less than 1000KW installed, has there been nominated an electrician as the “qualified electrical tradesperson”. |  | | |  |
|  | Is there an electrical engineering control plan? |  | | |  |
|  | Does the EECP include a planned electrical maintenance/testing schedule? |  | | |  |
|  | Does the maintenance schedule refer to compliance with AS/NZS 3000 and AS/NZS 3760? |  | | |  |
|  | Does the electrician issue a statement of compliance for new installations? *(section 8 tests performed – AS/NZS 3000)* |  | | |  |
|  | Is there an electric shock protocol? |  | | |  |
|  | If HV is delivered to the site is there a high voltage management plan as required by the local supply authority service rules? |  | | |  |
|  | Are there electrical circuit diagrams on site and available for use and a site plan of electrical distribution? |  | | |  |
|  | Does the mine operator require the regulator to be informed of a new power source? (Not required if an electrical engineer is nominated) (Form to be submitted) |  | | |  |
|  |  |  | | |  |
| Isolation | Is there an isolation system (tag out / lock out)? *(including documented procedure)* |  | | |  |
|  | Does it include a “test before you touch” policy and procedure? |  | | |  |
|  | Is there a removal and restoration of power procedure? *(SWMS)* |  | | |  |
|  | Is there a “No Live Work” policy at the mine? |  | | |  |
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| **Competencies** |  |  | | |  |
|  |  |  | | |  |
| Tradesperson | Is electrical work only conducted by qualified people? |  | | |  |
|  | Has the site obtained copies of the electrician’s qualifications? |  | | |  |
|  | Has the electrician been given a site induction? |  | | |  |
|  | Does the site induction include the site isolation procedures? |  | | |  |
|  | Does the site induction include the site removal and restoration of power procedures? |  | | |  |
|  | Does the site induction include the site the “Test before you touch “policy? |  | | |  |
|  | Does the site induction include the site policy for “No Live Line Work”? |  | | |  |
|  | Does the site induction include the site’s “Electric Shock Protocol”? |  | | |  |
|  |  |  | | |  |
| Employees | Do mine workers know the electric shock protocol? |  | | |  |
|  | Have mine workers been trained in the isolation procedure? |  | | |  |
|  | Have mine workers been trained in the Removal and Restoration of Power procedures? |  | | |  |
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| **Equipment** |  |  | | |  |
|  |  |  | | |  |
| General | Are all installations appropriately IP rated to prevent ingress of contaminants? |  | | |  |
|  | Are all cables routed to protect them against physical damage? |  | | |  |
|  | Are all cables supported to prevent strain? |  | | |  |
|  | Have all redundant cables been removed or terminated properly? |  | | |  |
|  | Is permanent equipment supplied by fixed cables? (Should not be flexible leads) |  | | |  |
|  |  |  | | |  |
| OHL | Have OHLs (overhead lines) been assessed to confirm clearances, voltages, signage and exclusion zones? |  | | |  |
|  | Are all OHLs drawn on a site plan, including clearances and isolation points? |  | | |  |
|  | Is there no stockpiling, loading or storage of material and equipment under OHL? |  | | |  |
|  | Have local authorities been contacted to confirm clearances? *(clearance depends on voltage)* |  | | |  |
|  | Does your emergency procedure include OHL emergencies? |  | | |  |
|  | Are power lines, poles and transformers included in workplace inspections? |  | | |  |
|  | Are all underground cables drawn on a site plan, including voltage, depth, isolation points? |  | | |  |
|  |  |  | | |  |
| Unauthorised access | Are all cabinets and switch room access doors labeled to highlight “no unauthorised access”? |  | | |  |
|  | Are all cabinets labeled to warn of the danger of electricity and with the maximum contained voltage? (e.g. Danger 415 Volts) |  | | |  |
|  | Do all cabinets require the use of a tool to access live parts and terminals >50 volts? |  | | |  |
|  | Are all cabinets and switch room clean and in good physical condition? |  | | |  |
|  |  |  | | |  |
| Generators < 25kW  (portable and standalone) | Are portable 240-volt generators provided with earth stakes?  Are generators fitted with RCDs with a sensitivity of no more than 30mA?  Are extension leads screened, with the screening connected to earth.  On generators with isolated windings, does the circuit breaker operate in both supply conductors?  On generators with isolated windings, are the supply conductors isolated from earth?  On generators with isolated windings, is it mandated that power boards are not to be used, and that no earthed device is connected, and maximum of one double insulated device can be used) |  | | |  |
| Generators > 25kW  (mobile & standalone) | Is there earth leakage protection fitted? *(refer to* [EES 014 Technical principles for the use of standalone generators](https://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0008/280754/OUT10-2110-EES-014-Technical-principles-for-the-use-of-stand-alone-generators-_version-2__5_.pdf)*)*  Is there an earth stake?  Is equipotential earth bonding provided between the generator and the equipment being supplied  Is the generator being operated in parallel with another generator? If there is then has it been checked by a qualified electrician or engineer? |  | | |  |
| Large generators with fixed installations | Was the system designed by a professional electrical engineer?  (Requirement for earth stake depends on design system used) |  | | |  |
|  |  |  | | |  |
| Earthing | Have earthing arrangements for the site been tested and confirmed compliant to AS/NZS3000. |  | | |  |
|  | Are the electrical protection arrangements suitable for detecting and clearing all faults to maintain touch potential clearance times to as AS/NZS3000 Fig. B4 |  | | |  |
|  | Are all socket outlets protected by 30mA RCDs in accordance with AS/NZS3000? |  | | |  |
|  | Is there documented evidence that electrical tests are performed and recorded in accordance with AS/NZS 3000? |  | | |  |
|  | Has the mine considered hand tools powered by an energy source other than mains power? (e.g. battery or compressed air?) |  | | |  |
| Hand-held tools | Are tools and extension leads tested and tagged in accordance with AS 3760? (min six monthly, depends on exposure) |  | | |  |
|  |  |  | | |  |
| Switchboards | Are there resuscitation signs in place? |  | | |  |
|  | Are circuits regularly tested for quality of insulation? (i.e. insulation testing) |  | | |  |
|  | Are RCDs tested as per AS/NZS 3760 (by a qualified electrician)? |  | | |  |
| Welding | Do procedures (SWMS) exist to control welding activities? *(AS 1674.2)* |  | | |  |
|  | Are welders regularly inspected and tagged by your electrician? |  | | |  |
|  | Are HRD (hazard reduction devices) fitted to welders?  VRD (voltage reduction device), or  trigger switch, or  open circuit safety switch |  | | |  |
|  | Does the mine restrict electric welding to qualified persons? |  | | |  |
|  | Are people trained in electric welding and assessed as competent? |  | | |  |
|  | Are welding machines, leads, clamps and handpieces regularly inspected? |  | | |  |
|  | Are welding machines regularly overhauled (each two years)? |  | | |  |

Form 11B: Electrical register and maintenance/testing results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Location of plant or electrical equipment | Equipment typePrimary plant **(motors)** | Specific details  - make  - size (kw)  - item number  - serial number | Maintenance / test results | | |
| Type of maintenance / test | Result | Performed by whom |
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| **Total installed power (Kw)** | (if >1000Kw – statutory elec engineer required) |  |  |  |  |
|  | Secondary plant  **(hand tools, generator etc)** |  |  |  |  |
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Form 11C: Planned electrical maintenance/testing schedule

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| --- | --- | --- | --- |
| Maintenance and inspections | | | |
| Example of maintenance frequencies | | | |
|  | **Actions** | **Frequency** | **Record agreed frequency (if applicable)** |
| Emergency stop testing |  | Monthly |  |
| Lanyard testing |  | Monthly |  |
| Portable electrical tools and appliances |  | Before and after use |  |
| Test and tag |  | Three monthly |  |
| Insulation resistance testing of each circuit |  | Annually |  |
| Continuity testing of each circuit |  | Annually |  |
| Earth leakage circuit breaker/RCD/relay | Push button testing | Three monthly |  |
| Injection testing | annually |  |
| Welders | Inspect for damage | Before and after use |  |
| Insulation | Three monthly |  |
| Competence person inspection | Annually |  |
| HRD open circuit voltage testing | Three monthly |  |
| Thermography |  | Annually |  |
| Connections/terminations |  | Annually |  |
| Verify currency of buried services drawing |  | Annually |  |
| Low voltage rescue kits |  | Six monthly |  |
| Test instruments |  | Annually |  |
| Earthing system (include magazines) |  | Annually |  |
| General lighting, visual |  | Monthly |  |
| Emergency lights, performance |  | Three monthly |  |
| Housekeeping |  | Monthly |  |
| Signs and labelling in place and legible |  | Six monthly |  |

Form 11D: Example electrical services diagram

Draw the electrical services on your site with all services included.

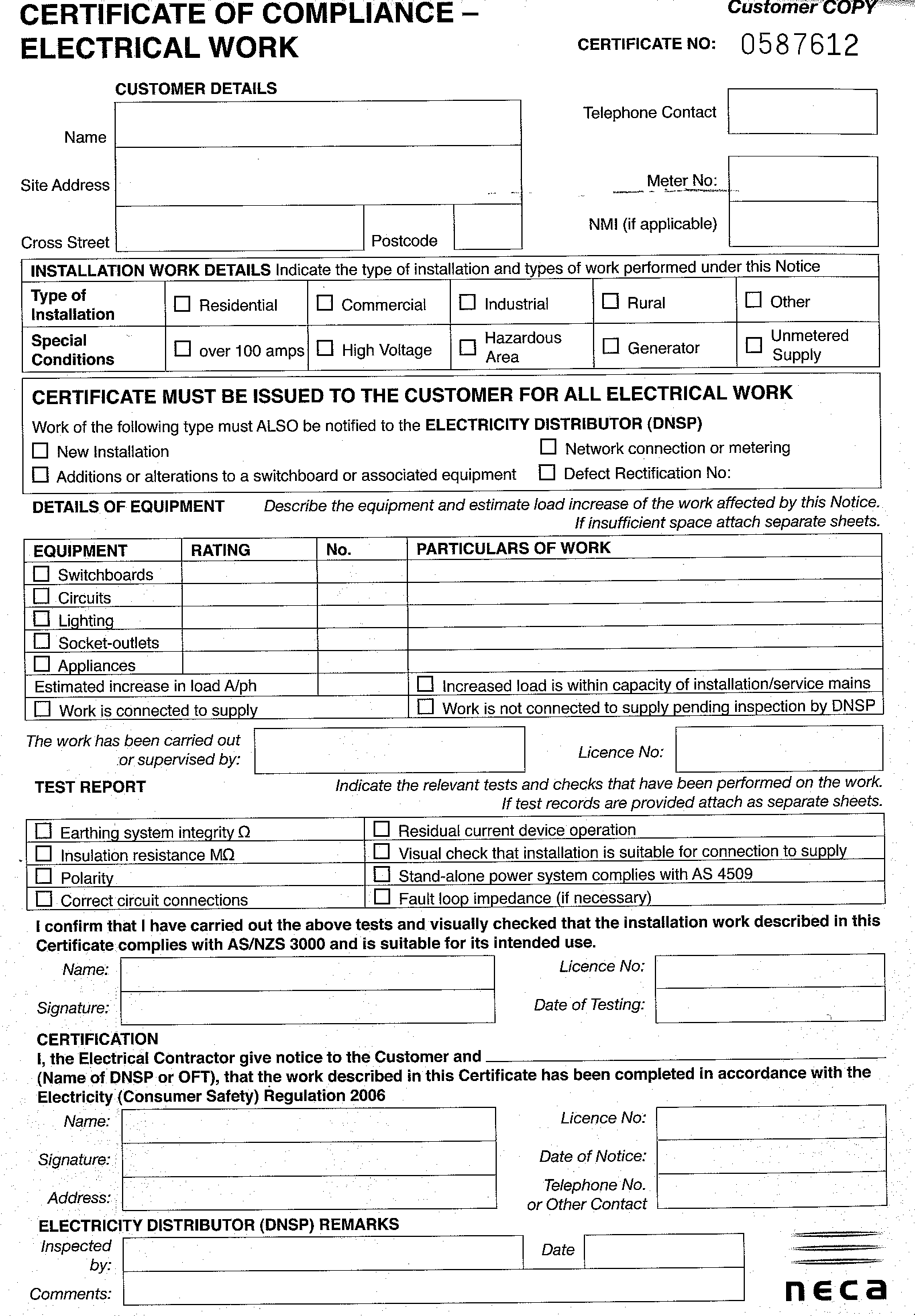
This is an example of an electrical maintenance schedule for a **larger** process plant.

|  |  |  |
| --- | --- | --- |
| **Process plant** | | |
| **Description of plant and maintenance task.** | **Frequency of maintenance tasks** | **Scope of maintenance task** |
| **Control panel power supply cable**  External examination  Condition monitoring  Overhaul / replace | Monthly  6 Monthly  As required | External inspection  Insulation and earth continuity tests  As determined by inspections & electrical tests |
| **Control / distribution panels**  External examination  Internal examination  Condition monitoring  Condition monitoring  Overhaul | Monthly  6 Monthly  12 Monthly  12 Monthly  As required | External inspection  Internal inspection  Insulation and earth continuity tests  Thermograph study – Accessible areas  As determined by examinations & electrical tests |
| **Protection systems**  Operational function test  Operational function test  Operational function test  Internal examinations  Calibration  Calibration  Electrical protection grading  Overhaul / replace | Monthly  Monthly  6 Monthly  12 Monthly  12 Monthly  12 Monthly  As required  As required | Fire detection system - Conducted by external specialists  Belt slip, signal line, brake lift, blocked chute, man on belt, tracking limits, emergency stops  Earth leakage test  Internal inspection – Mechanical devices (tracking switches), junction boxes (slip, blocked chute etc.)  Certification of performance of earth leakage, overload & short circuit – specialised task  Certification of fire detection system – specialised task  Determined by fault level/load flow study  As determined by examinations, electrical tests, certification process or failure |
| **Motors**  Internal examination  External examination  Lubrication  Internal examination  Condition monitoring  Condition monitoring  Overhaul | Monthly  Monthly  6 Monthly  6 Monthly  6 Monthly  12 Monthly  As required | Carbon brush examination – replace as required  External inspection  Grease motors-type and quantity of grease specified  Internal inspection  Insulation and continuity tests  Thermograph study – Accessible areas  As determined by examinations & electrical tests |

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| --- | --- | --- |
| **Process plant** | | |
| **Description of plant and maintenance task.** | **Frequency of**  **Maintenance tasks** | **Scope of maintenance task** |
| **Motor supply cable**  External examination  Condition Monitoring  Overhaul / replace | Monthly  12 Monthly  As required | External inspection  Insulation and earth continuity testing  As determined by examinations & electrical tests |
| **Vibratory Feeders**  External examination  Calibration  Internal examination  Condition monitoring  Overhaul | Monthly  6 Monthly  12 Monthly  12 Monthly  As required | External inspection  Confirmation of feeder stroke setting – specialised task  Internal inspection – general condition  Insulation and earth continuity tests  As determined by examinations & electrical tests |
| **Overhead crane**  External examination  Lubrication  Internal examination  Condition monitoring  Lubrication  Overhaul | Monthly  3 Monthly  12 Monthly  12 Monthly  6 Monthly  As required | External inspection  Grease motors-type and quantity of grease specified  Internal inspection – general condition – connections, contamination ingress  Insulation and earth continuity tests, including pendants  Grease motors with specified grease  As determined by examinations & electrical tests |
| **Field devices**  External examination  Operational function test  Lubrication  Calibration  Internal examination  Condition monitoring  Internal examination  Overhaul / replace | Monthly  Monthly  3 Monthly  6 Monthly  6 Monthly  12 Monthly  12 Monthly  As required | External inspection  Confirm effective operation i.e. emergency stops, isolators, indicators etc.  Lubrication of moving mechanical parts  Certification of belt coal weigher operating parameters – specialised task  Internal inspection – Marshalling boxes, welding outlets, conveyor belt winding outlet – connections , contamination ingress  Insulation and earth continuity testing  Internal inspection  As determined by examinations & electrical tests |
| **Air conditioning systems**  External examination  Internal examination  Operational function test  Service / Overhaul | 6 Monthly  12 Monthly  12 Monthly  12 Monthly | External inspection  Internal inspection – Conducted by external specialists  Conducted by external specialists  Conducted by external specialists |

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| --- | --- | --- |
| **PROCESS PLANT** | | |
| **DESCRIPTION OF PLANT AND MAINTENANCE TASK.** | **FREQUENCY OF MAINTENANCE TASKS** | **SCOPE OF MAINTENANCE TASK** |
| **General power & lighting circuits**  External examination  Condition monitoring  Operational function test  Calibration  Internal examination  Internal examination  Overhaul / replace | Monthly  12 Monthly  12 Monthly  12 Monthly  12 Monthly  As required  As required | External inspection  Insulation and continuity tests  Audit performance of circuits and report.  Circuits protected by RCD’s –test RCDs for trip current and time  Internal inspection – distribution board(s) – connections, contamination ingress  Electrical fixtures – Carried out at time of repair  As determined by examinations & electrical tests. |
| **Metal Structure earthing**  External examination  Condition monitoring | Monthly  12 Monthly | External inspection  Earthing resistance test conducted by external specialists Done during routine earth continuity testing |
| **Control Room**  External examination  Internal examination  Operational function test  Service / Overhaul | 6 Monthly  6 Monthly  12 Monthly  12 Monthly | External inspection  Internal inspection  Conducted by external specialists  Conducted by external specialists |

Form 11E: Example certificate of compliance



Form 11F: Electrical services diagram (plan) example

A map of a military base

Description automatically generated

Electrical services diagram (plan) blank

A white paper with black text

Description automatically generated

Form 11G: Isolation procedure example

|  |  |
| --- | --- |
| **PROCEDURES:**   * The person placing the lock and tag is responsible to see that correct procedures are followed.   Prior to any work commencing:   * The appropriate padlock and key is to be taken from the Isolation (Lockout) Station and used to lock out the field isolation switch. * Isolator switches are to be turned off, and locked where possible. Where a piece of plant does not have an isolator, the key will be removed and will remain in the custody of the person completing the task. * Danger tags are to be attached to the field isolating switch in a position readily visible. Where an isolator does not exist, affix the tag at the ignition switch where the key was removed from. * Prior to the commencement of work, a ‘test for dead’ of the equipment will be undertaken to establish that the plant has been successfully isolated. * Where more than one person is required to work on the piece of plant each person will place a separate lock on the isolator.   On completion of work:   * A check is made to ensure that there is no danger from placing the equipment back in service. * Isolation switches can have the tag removed, be unlocked and turned on. * The padlock and key is to be returned to the Isolation (Lockout Station) along with the personal danger tags. * The person charged with completing the task will check the immediate area to establish that no other person will be affected by re starting the equipment. * If a person is not able to be located then they should be contacted directly and requested to return to remove their tag. If they cannot be contacted the supervisor must be sure that the person is off site prior to re energising any equipment and will record his observations. * The main control panel switches can be turned on and operation re-commenced   End of shift   * If work is incomplete at the end of a shift, all personal danger tags are to be removed and replaced with an out of service tag, which indicates the plant is not able to be operated safely. | Image result for electrical lockoutImage result for personal danger tagsImage result for electrical lockoutImage result for lock out battery isolatorA close-up of a lockout station  Description automatically generated |

**Application:** This procedure is to be used when people are carrying out work on faulty equipment and where energy sources need to be isolated. This procedure will be used for all electrical and mechanical equipment and other situations where people could be harmed due to an uncontrolled release of energy, (gravity, pressure etc).

**IDENTIFY SWITCH / ISOLATE LOCK TAG TEST**

Form 11H: Restoration of power procedure – example

**Application:** Electrical power is removed (switched off) and restored (switched on) for various reasons, including operational requirements and electrical safety.

There are increased risks to operators and maintenance personnel if the process of switching off and switching on is not carried out systematic and rigorous manner.

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| **PROCEDURES:**  **Removal of power**  There are 2 methods for the removal of power:  1. Manual: where switch devices are physically operated to switch the power supply off i.e. switching power off as a part of an isolation process and remote switching.  Remote switching includes control circuits such as emergency stops and lanyard control systems.  2. Automatic: where switching devices are operated and tripped by electrical protection systems. i.e. overload, short circuit and earth fault protection.  **Restoration of power**  There are 2 methods for the restoration of power:  1. Manual: where the power has been removed MANUALLY the restoration of power could be the reverse action that was used in removing the power.  The process of restoring power should require the person restoring the power supply to check and confirm the circuit is safe to re-power. i.e. following isolation.  2. Automatic: where the power is removed AUTOMATICALLY, the restoration of the power should require an investigation and, if required, testing by a licenced electrician for the safe application of power.  **Fuse replacement**  Where the restoration of power involves the replacement of a fuse, the mine should not fit fuses to live fuse holders.  The replacement of fuses should only be undertaken by qualified electrical workers.  The reason why the fuse operated (tripped) should be investigated by a qualified electrical tradesperson.  **Circuit breaker reset**  If the cause of the trip is able to be identified as a short circuit or earth leakage fault, the circuit breaker should not be re-closed and an electrician called.  If a proper investigation into the cause of a trip is not done, this may result in restoring power onto a fault. This can have very high consequences of injuring people, catastrophically damaging equipment or initiating fires.  **Access to switchgear**  Some access will be restricted to competent and authorised people.  Where access is restricted conspicuous, durable and legible signage should be posted in appropriate positions to warn of the restrictions. Restriction could be applied to switch rooms and electrical enclosures.  **HV switching**  High voltage switching should only be carried out by qualified competent electrical workers trained in high voltage switching. Where high voltage switchgear is part of the infrastructure of the mining operation, all switching of high voltage circuits should conform to the site’s high voltage management plan. | Image result for earth fault protection  Image result for e stops  Related image  Image result for main supply switch  Related imageImage result for replacing fuses  Image result for high voltage areasRelated imageImage result for circuit breaker |

Form 11I: Electric shock procedure – example

**Application:**

* A person suffering an electric shock may sustain delayed effects to their health and welfare from irregular heart beat (delayed ventricular arrhythmias.)
* The purpose of this procedure is to provide a systematic approach for people to follow in the event that a person(s) is suspected of receiving an electric shock from a voltage above extra low voltage.
* The procedure identifies a minimum level of treatment and medical diagnosis.
* This procedure applies to any person suffering an electric shock, regardless of how minor the contact may appear.

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| **PROCEDURES:**   * Extra low voltage is a voltage not exceeding 50 volts A.C. or 120 volts ripple free DC. * ECG: means electro cardio graph * Any person suffering an electric shock from a voltage **greater than extra low voltage**, while on the mine site, is to follow the procedure below. * If the person is unconscious or disabled, the person attending is to follow the procedure below.   **Step 1: Establish a safe area.**   * If the person is in contact with live apparatus, above extra low voltage, the electric power source must be isolated. * The site is to be secured to prevent injury to other people.   **Step 2: Access condition and stabilise person.**   * The person is to be assessed and rendered the necessary first aid treatment. * Check person’s breathing and pulse. * If necessary, give artificial respiration and/or cardio resuscitation. * Note: Directions must be made available in the form of resuscitation signs posted at electrical distribution boards. * Check for burns. * If the mine has a first aid room, arrangements are to be made to transport the person to the first aid room. * The supervisor should arrange an escort for the person to monitor their condition and provide first aid treatment if required.   **Step 3: Arrange transport to the nearest medical facility.**   * The supervisor is to arrange for transportation to a medical facility. * The person must not be left alone or allowed to drive to the medical facility. * The type of transportation will be determined by the person’s condition. i.e. ambulance, taxi etc. * The supervisor is to notify the quarry manager of the mine.   **Step 4: Record relevant details of incident.**   * The supervisor is to obtain the relevant information relating to the electrical shock incident and record it on the electric shock protocol form (below)   **Step 5: Electric shock protocol form to be sent with person.**   * The electric shock protocol form is to be sent with the person and given to the medical facility.   **Step 6: Notify the medical facility**   * The supervisor is to contact the medical facility and advise the facility of the incident and transport arrangements.   **Step 7: Provide incident information to medical facility reception.**   * Upon arriving at the hospital, the p is to be registered with the medical facility reception and advise that:   *The victim was attending (name of the operation) where (name of the victim) received an electric shock and that the details are documented on the electric shock protocol form.*   * Present the completed electric shock protocol form to the medical facility. * Note: At this time, a 12 lead ECG is to be request for the person. * The person escorting the injured person should provide updates to the mine’s quarry manager of the situation and the person’s progress. * The mine’s quarry manager is to notify the person’s family of the situation. * **Step 8: Return to work.** * Where the person is released from the medical facility for return to work, the mine will arrange transportation. * Upon arrival back at the mine, the person shall report to the supervisor and advise of the results of the tests. * The supervisor is to notify the mine’s quarry manager. * **Step 9: Notification to the Resources Regulator.** * The mine operator’s representative is to notify the Resources Regulator of the incident, immediately ring 1300 814 609. | Image result for isolator power switch  Image result for ambulance nsw  Image result for return to workImage result for 12 lead ecgImage result for hospital |

Electric shock protocol form

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| **Instructions:**  Form to be completed when a casualty presents to the mine first aid room after suffering a suspected electric shock.  Attach completed form to the mine incident investigation report when complete  *(Note: Provide copy to medical practitioner, who sees the person)* | |
| Name: | Employer: |
| Date: | Location: |
| Approximate time shock received: | |
| Temperature: | Pulse bpm: |
| **Nature of symptom (one or more may be present):** (Circle those applicable)  burns swelling irregular heartbeat difficulty breathing muscular soreness  loss of consciousness disorientated loss of cohesion cold/hot sensations | |
| **Area of Body affected / displaying symptoms** (mark on diagram)  *“Where are you injured and where did you feel the electric shock?”*  Description: http://www.lead-edu.info/images/body_diagram.gif | |
| **Casualty’s description of sensation:** (Circle those applicable)  heat cool tingle muscle spasm pin prick sharp  jolt shaking dizzy can’t let go electric fence | |
| **Specific comments on sensation:**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |
| **Inspect casualty for entry/exit marks** (mark on diagram)  *Note: Footwear may need to be removed to find marks. There may be 2 or more marks on the casualty. Check underneath jewellery and watch bands If metal-framed glasses are worn, check behind ears.* | |
| **General condition of clothing/PPE:** (Circle those applicable)  dry wet clean dirty intact damaged | |
| **Specific comments on clothing/PPE**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |
| **Person completing form**  Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Position: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |

Form 11J: Welding procedures – example

**Application:** The purpose of this procedure is to provide a consistent and structured approach to the conduct and management of electric welding activities on our mine site.

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| **PROCEDURES:**  Welding activities are likely to be carried out in a number of areas on site:   * **Classification of welding areas:**   **Category A** environment is an environment where:   1. the risk of an electric shock or electrocution by arc welding is low; 2. normal work practice is used; and 3. it is not possible for a welder or any other worker to be in contact with the work piece, in the event of being in contact with a live part of the welding circuit.   *Category A environments require considerable effort to insulate the welder and others from the work piece. The type of work would typically be bench-top welding where the work piece is small and /or is a repetitive operation in an area such as a workshop. Under some conditions a category A environment could become a category B environment. e.g. change of weather conditions – cool at start (in the morning) and increased temperature during the day causing the welder operator to sweat freely,*  **Category B** environment is an environment where there is a significant risk of the welder contacting the work piece or other parts of the welding circuit. Such an environment may be found where the ambient temperature is less than 32oC and,   1. freedom from movement is restricted, so that an operator is forced to perform welding activities in a cramped position (e.g. kneeling, sitting, lying), with physical contact with conductive parts (e.g., the work piece); or 2. there is a high risk of accidental or unavoidable contact by the operator with conductive element, which may or may not be in a confined space as defined in AS/NZS 2865.   *In Category B environments it is recognised that there is an increased risk of electric shock and include general fabrication activities, large work pieces, steel structures, inside pressure vessels, processing tanks and conductive confined spaces. Under some conditions, e.g. hot weather and/or working in direct sun light, a category B environment could become a category C environment.*  **Category C** environment is where the risk of an electric shock or electrocution by arc welding is greatly increased due to low body impedance of the welder operator and a significant risk of the welder operator contacting the work piece or other parts of the welding circuit.  *Category C environments include, but are not limited to, trenches, underground welding tasks, splash zones and wet work areas.*  **There are no Category A welding environments at our mine site.**  All electric welding areas at our mine have been classified as Category C unless a detailed and documented risk assessment, carried out by the mine, has determined the work area to be classified as a Category B environment.   |  |  |  | | --- | --- | --- | | **Hazards to consider for Category B areas** | | | | 1. Electric shock from the power supply equipment and cables | 1. Electric shock from the welder output power - The electrode and work piece are to be regarded as electrically alive | | | 1. Radiation burns to eye or body from welding arcs. | 1. Fire to the surrounding environment | | | 1. Eye injury due to flying materials | 1. Slips trips and falls around work site. | | | 1. Asphyxiation or illness – due to inhalation of gasses created during welding. | 1. Burns – due to heating of work piece, weld spatter, hot molten material or ignition of clothing | | | **Additional hazards to consider for Category C areas** | | | | 1. Electric shock – Perspiration resulting in lower body electric resistance. | | 1. Electric shock – Welder operator becoming part of the welding circuit | | 1. Electric shock – Work conducted in damp or wet area. | | 1. Electric shock – Work conducted in a confined space. |  |  |  | | --- | --- | | **Considerations for Category B areas** | | | 1. Power supply protected by an RCD. | 1. Ventilated work place. | | 1. Welding equipment that has current inspections | 1. Clean and dry work area | | 1. Fit for purpose PPE | 1. Arc barrier screen(s) | | 1. Welding machine fitted with a Hazard Reduction Device–HRD (VRD, or Hand piece trigger switch fitted to MIG and similar type welders) | 1. Welding equipment in good condition | | 1. Equipment required for confined spaces – includes confined space permit (Refer AS2865), hot work permit, an observer, rescue equipment and a Welding Safety Switch in the electrode lead. | 1. Insulation material – rubber mats, duckboards etc. | | **Additional considerations for Category C areas** | | | 1. Equipment required for confined space work - including an observer, rescue equipment, ventilation fan to cool the welder operator, gas detection equipment (flammable gas, deficiency of oxygen etc.) | 1. Safety equipment required for damp and wet work areas – includes an observer, Welding Safety Switch in the electrode lead, insulation material, duck boards, tarpaulins (or equivalent). | | 1. Dry change of cloths, gloves and foot ware for the welder operator. |  |   **Electric welding preparation steps**   |  | | --- | | **Preparation steps – Category B areas** | | 1. Welder operator to be dressed in dry fireproof clothing that covers the legs and arms. | | 2. Welder operator has steel cap rubber soled safety footwear. The steel cap of the footwear is to be totally covered. | | 3. Welding gloves are to be in good condition, dry and fitted to both hands. | | 4. Leads and components (electrode holders, cable connectors and earth clamps etc.) have been inspected for damage. Damaged leads and components are not to be used but tagged out of service and removed for repair or discarded. | | 5. Leather cushions, rubber matting, wooden duckboards or other means will be used to insulate the welder operator from any damp floor areas any exposed parts of the work piece. | | 6. Where necessary, welding arc screen(s) are in position. | | 7. The welding machine is fitted with a **H**azard **R**eduction **D**evice. | | 8. If a VRD is fitted, test the VRD for correct operation. | | 9. Check correct operation of the VRD indicator lights – ex. GREEN (reduced voltage output) RED (full voltage output). | | 9. Welding machine is powered from an outlet protected by a 30 milliamp RCD. | | 10. The welding machine is to have an “S” in a square on the nameplate to identify compliance with AS 60974.1. If the marking is not on the nameplate, the welding machine is not suitable for use. | | 11. For confined space welding activities - A permit for confined space entry is required, (PROGRAM 8) | | 12. An observer is to be present for confined space tasks. | | 10. Where required, apply a Hot Work Permit, (PROGRAM 8) | | **Additional preparation steps – Category C areas** | | | 12. The work piece is to be isolated and tagged and locked out. (Any power cables are to be physically disconnected to prevent welding currents from travelling in these cables instead of the proper earth return welding cable.) | | | 13. Check leads for correct size and lengths – voltage drop. | |   **Electric welding process steps**   |  | | --- | | **Process steps – Category B area** | | 1. The work piece is to be connected to the work lead by a suitable attachment. e.g. work lead clamp (not damaged) | | 1. The work area is to be kept tidy & free from tangled leads, discarded off-cuts & electrode stubs | | 1. Welding gloves are to be worn whilst welding activities occur and while changing electrodes. | | 1. Insulation mats, insulation or duck boards to be positioned. | | 1. While tacking two pieces together, the arc is to be struck on the piece connected to the work lead. | | 1. The electrode holder or gun is not to be placed on the work piece where it may short circuit, but placed in an area isolated from the work piece. | | 1. Before replacing electrodes the power to the welding machine is to be turned off. | | 1. The power to the welder is to be switched off and the disused electrode removed from the electrode holder:  * before the welder operator leaves the work area * whenever the leads have to be moved. | | 1. At completion of work, clean up area and store welding equipment away. Report any defects to supervisor. | | 1. If an operator or other experiences an electric shock the supervisor is to be informed and electric shock protocol is to be applied. |  |  | | --- | | **Additional process steps – Category C area** | | 1. Consider the use of secondary gloves to be worn under the welding gloves- added personal protection against electric shock. | | 1. If the gloves and clothing become damp through perspiration or water, replace the gloves and clothing with dry PPE. | | 1. Where required, insulation rubber mats and / or duck boards to be positioned. | | 1. For confined space work, use a fan, or similar system, to keep the welder operator cool. | | 1. Position the observer at Welding Safety Switch and maintain vigilance on the welder operator. | | Image result for bench welding  Image result for welding in a kneeling position  Image result for welding in a confined space  Image result for welding rubber mats  Image result for welding ventilation requirements  Image result for welding ppe  Image result for welder vrd  Image result for rcd  Image result for arc barrier screens  Image result for welding earth clamp  A metal table with several tools  Description automatically generated with medium confidence |

Form 11K: Working near overhead power lines – example

**Application:** This procedure documents a systematic and structured approach to managing the hazards associated with working near or around overhead power lines (OHL).

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| **PROCEDURES:**  The person tasked with work that may be near or around OHL’s is required to adhere to the following procedures when planning and performing the task.  Prior to any work commencing:   * Before work begins a risk assessment will be conducted with the other members of the work team. This will focus on the identification and control of hazards associated with the OHL and more specifically establish the safe limits of approach distances as per (Code of Practice 2006 - Work Near Overhead Powerlines – Safe Work NSW) * Contact the electricity utility to determine the operating voltage of the line and confirm the safe limits of approach distances. * Request assistance from the electricity utility if the work must be performed at a distance that is less than those specified by the Code of Practice. In this situation have the electrical utility disconnect or relocate the line if needed. * If this is not feasible to do, carry out the following; * Before operating equipment, review the documented controls in the risk assessment that are to be implemented to prevent contact with the lines, * Plan your work area and movements to establish whether there are power lines to pass under or avoid, * Check the height of your equipment or load against the specified safe limit of approach. * Do not allow equipment or objects to approach power lines closer than the safe limit of approach specified, * Look for uneven ground that may cause your vehicle to weave, bob or bounce, * Think about wind and temperature that may affect the power lines height, * Never ride or climb on equipment or load when near a power line, * Work around power lines in daylight hours only, * Use a trained spotter to act as an observer where work is required to be near the safe limit distance, * Do not place materials under the OHL that could reduce the clearance distance to the lines, * Do not allow excavations to reduce the support required of power poles. * Install agreed signage to alert workers to the hazards associated with working near the power lines.   In an emergency   * Activate your sites emergency procedure. * If you are alone and don’t have a radio, stay in the vehicle until help arrives, as this is the safest place. * Stay alert and keep other workers away from the area. * Try to break contact with the lines by moving the vehicle. * Don’t try to break contact if the cable or equipment appears to be welded to the line, as this may create a whip lash hazard. * If the line is on the ground, it could be charging the surrounding area. * Stay well back from the area as walking towards the scene may. expose you to an electric shock through your legs due to a graduated ‘step potential difference’ created in the ground. * If you must navigate ground which has the potential to be alive, ‘bunny hop’ without stepping to reduce the potential of electric shock. * Do not assume the lines are dead as transmission lines generally have an automatic recloser. * If possible contact the electrical utility provider to turn the power off. * Isolate any rubber tyred vehicles for 24 hours that have come into contact with live OHL, as the potential exists for tyre explosions. * Once the emergency has been managed conduct an investigation into the effectiveness of the controls with your team. * Where required report to the Regulator. | Image result for working near power lines  A blue and white background with a letter x  Description automatically generated  Image result for spotter when working near power linesImage result for working near power linesRelated image  Image result for 000  Image result for power lines that have fallen to the ground  Image result for working near power lines  Image result for electrical step potential in the ground |

Form 11L: Using electrical test equipment – example

**Application:** This procedure documents a systematic and structured approach to using electrical test equipment and managing the hazards associated with electrical test equipment.

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| **IMPORTANT**   * It is a policy of the mine that there is no live electrical work to be done on electrical circuits that are either low voltage (LV) or high voltage (HV). * Testing on HV circuits, and associated equipment will be determined by the nominated electrical engineer. * This procedure only applies to circuits that are LV.   **EQUIPMENT REQUIREMENTS**   * Multi-meters are to be complaint to category IV 600V or better (CAT IV) * Multi-meters must have current limiting fuses fitted, with a rupturing capacity of 10KA * Instruments that are being used for measurements for records should be calibrated at least annually. (Examples include RCD testers, PAT testers and earth continuity testers.) * Test instruments should be stored in cases that prevent damage to the instrument. * Test leads should be free of damage, be securely attached to the instrument.   **PROCEDURES:**   * All test instruments are to be used as per the original equipment manufacturers (OEM) directions. * Carry out a visual inspection of the instrument before use. If it is damaged then it is not to be used. * **Insulation testing**   + Ensure power is isolated before testing insulation   + If the instrument has a discharge function then follow the OEM directions to discharge any accumulation of electric charge during the testing process; * **RCD testing**   + Isolate power to the circuit under test;   + Insert the testing leads into the test points   + Re-energise the circuit;   + Operate the RCD tester as per the OEM’s instructions * **Earth continuity testing, earth testing**   + Ensure power is isolated to the circuit that is having the earth continuity tested;   + Isolate any adjacent circuits that are energised that may induce unwanted voltages into the circuit under test.   + Follow the OEM instructions |  |