Plant Isolation, Testing and Re-commissioning

WHAT IS WRONG IN THIS PICTURE?

BETTER?

Plant Isolation, Testing and Re-commissioning

Important reasons for plant isolation.

- To ensure that the equipment is de-energised while work is undertaken
- To ensure that no equipment can be re-energised while work is being undertaken
- To establish there is no current flowing through the electrical equipment
- To keep all site-workers safe from electrical shock
- To ensure compliance with New Zealand electrical legislation

Plant Isolation, Testing and Re-commissioning

What PPE should be used when carrying out plant isolation?

- As per AS/NZS 4836 minimum
- Plus site and company policies

TABLE 9.2

GUIDE TO THE SELECTION OF PERSONAL PROTECTIVE EQUIPMENT

TASK	CURRENTS UP TO AND INCLUDING 100 A	CURRENT EXCEEDING 100 A AND UP TO AND INCLUDING 400 A	CURRENTS EXCEEDING 400 A
Work (isolated and verified)	Footwear Protective clothing (if required) Eye protection (if required) Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing (if required) Eye protection (if required) Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing (if required) Eye protection (if required) Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)
Switching, isolating, removing fuses or links	Footwear Protective clothing Eye protection Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing Eye protection Gloves Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing Eye protection Gloves Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)
Isolation verification, testing or fault finding	Footwear Protective clothing Eye protection Gloves Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing* Eye protection Gloves Arc flash suit and hood (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required) Face shield (if required)	Footwear Protective clothing* Eye protection Gloves Face shield Arc flash suit and hood (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)
Live electrical work	Footwear Protective clothing* Eye protection Insulating gloves Arc flash suit and hood (if required) Flame-resistant gloves (if required) Face shield (if required) Safety helmet (if required) Hearing protection (if required) Respiratory protection (if required)	Footwear Protective clothing * Eye protection Safety helmet Insulating gloves Arc flash suit and hood (if required) Flame-resistant gloves (if required) Face shield (if required) Hearing protection (if required) Respiratory protection (if required)	Footwear Protective clothing * Eye protection Insulating gloves Flame-resistant gloves Arc flash suit and hood Hearing protection Respiratory protection (if required)

'(if required)': Determined by the risk assessment.
* Collar up, top buttons done up and sleeves down.

Bracelets, rings, neck chains, exposed metal zips, watches, and other conductive items shall not be worn while working on or near exposed energized conductors or live conductive parts.

Plant Isolation, Testing and Re-commissioning

What types of electrical equipment that need to be isolated?

- Rotating machinery
- Live conductors
- Remote controlled equipment
- Electrical components that operate other services
- Electrical energy storage devices (battery banks, capacitors etc.)

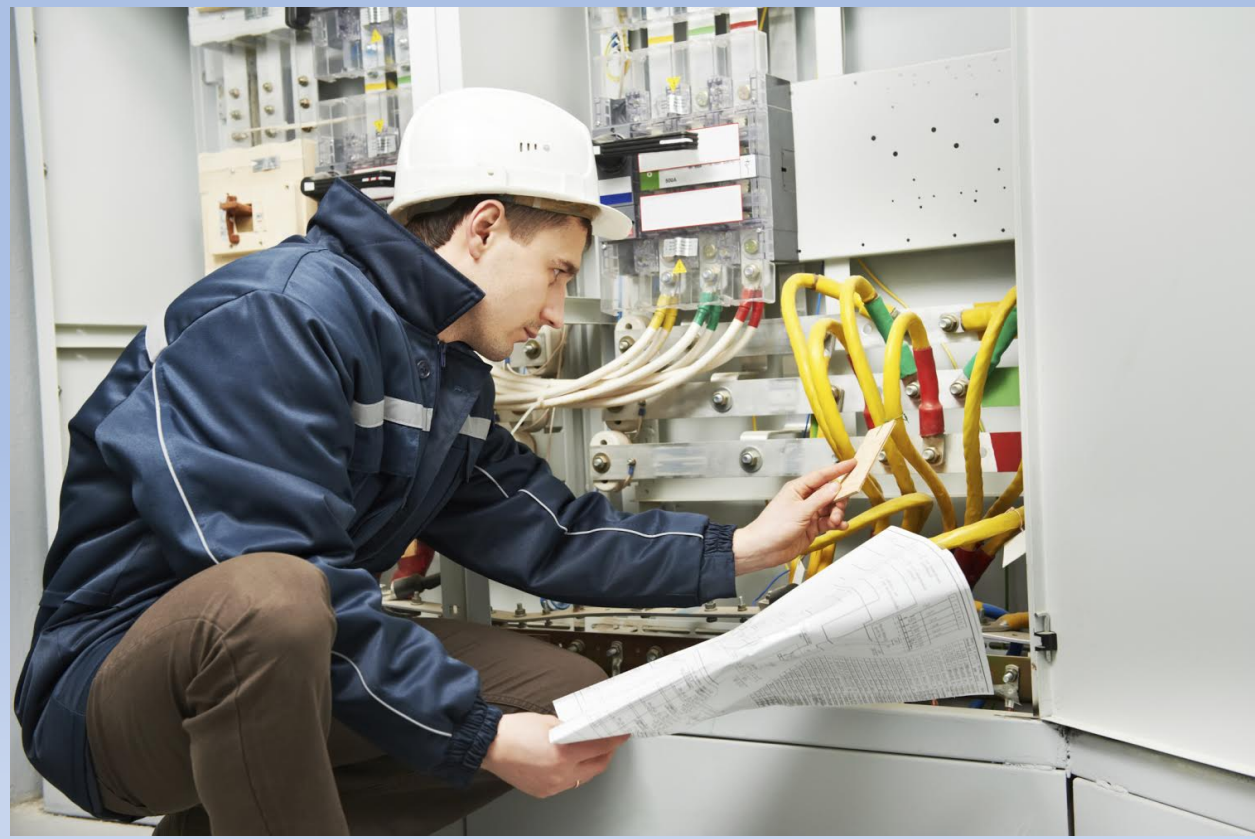
Why do they need to be isolated?

- Risk of damage to equipment or people if the machinery was to operate without warning.

Plant Isolation, Testing and Re-commissioning

What types of mechanical equipment that need to be isolated?

- Moving machinery
- Air services
- Hydraulic services
- Chemical services
- Water services
- Refrigerant services



Why do they need to be isolated?

- Risk of damage or harm to property or people if the services are operated unintentionally by electrical equipment.

Plant Isolation, Testing and Re-commissioning

What is the difference between switching an electrical appliance off and isolating an electrical appliance?

- Switching off (hopefully) removes electrical power from the appliance but does not verify that fact or prevent other sources of energy operating the appliance.
- Isolating ensures the appliance is at a zero energy state and will stay there.

Plant Isolation, Testing and Re-commissioning

Commonly used methods of achieving continued isolation.

- Tripping of circuit breaker. Must ensure a lockout is used to ensure continued isolation
- Removal of fuses. Ensure a blank fuse is inserted with a warning tag so no one re-connects it.
- Lock-off isolation switch. Physically locks a switch in the off position.
- Removal of plug from socket. Place a lockout cover over the plug to make sure no one plugs it back in.
- Disconnection of circuit conductors by a registered person. Physical disconnection of live conductors from supply.
- Personal locks, warning tags. Lock out system where only you have the key, always put a warning label on with the details of the job and completion date / contact details etc.

Plant Isolation, Testing and Re-commissioning

What switches are not acceptable as isolating devices and why are they are unacceptable.

- Push button switches. It could be accidently operated.
- Emergency stop button. May only isolate the control equipment only.
- Tags Could be removed accidentally
- Switches on control stations. May not be the only isolation point.

Plant Isolation, Testing and Re-commissioning

Describe the test method and instruments used to ensure that the supply is disconnected.

Method	Instrument used	Description of test method
Prove test prove	Suitably rated voltmeter or solenoid type voltage tester (Duspols)	Prove meter on a known working supply, test the equipment, prove your meter has not failed during the test on a known supply
Test before touch	Suitably rated voltmeter or solenoid type voltage tester (Duspols)	Test the equipment you are about to work on before you physically touch it
Phase to Earth	Suitably rated voltmeter or solenoid type voltage tester (Duspols)	One probe on a suitable earth point the other probe then connected to one of the phase conductors
Phase to phase	Suitably rated voltmeter or solenoid type voltage tester (Duspols)	One probe on one of the phases and the other probe on another,
Visual	Eyes	Check for obvious faults such as contacts not opening or physical damage

Plant Isolation, Testing and Re-commissioning

Describe possible actions that could result in ineffective isolation and the consequences.

1. Wrong circuit isolated

- Electric shock through failure to isolate correct circuit
- Electric shock through failure to isolate all live conductors
- Disruption to equipment operation and possible injury through isolating wrong circuit
- Damage or injury through removing a fuse that is still carrying current

2. Wrong isolation device operated

- Electric shock through failure to isolate correct circuit
- Electric shock through failure to isolate all live conductors
- Disruption to equipment operation and possible injury through isolating wrong circuit
- Damage or injury through removing a fuse that is still carrying current

Plant Isolation, Testing and Re-commissioning

Describe possible actions that could result in ineffective isolation and the consequences.

3. Damaged insulation between different circuits

- Electric shock due to damaged equipment
- Electric shock due to failure to test before touch

4. Inoperative test instrument used

- Electric shock due to failure to prove test prove
- Electric shock due to failure to isolate the correct circuit,
- Electric shock through failure to isolate all live conductors
- Injury through isolating wrong circuit,
- Damage or injury through moving a fuse that is still carrying current
- Injury through isolating wrong circuit
- Damage or injury through removing a fuse that is still carrying current

Plant Isolation, Testing and Re-commissioning

Describe possible actions that could result in ineffective isolation and the consequences.

5. Not all phases of a polyphase appliance are isolated

- Electric shock through failure to isolate correct circuit
- Electric shock through failure to isolate all live conductors
- Disruption to equipment operation and possible injury through isolating wrong circuit
- Damage or injury through removing a fuse that is still carrying current

6. Appliance supplied from two sources

- Electric shock through failure to isolate correct circuit
- Electric shock through failure to isolate all live conductors, disruption to equipment operation and possible
- Injury through isolating wrong circuit, damage or injury through removing a fuse that is still carrying current

Plant Isolation, Testing and Re-commissioning

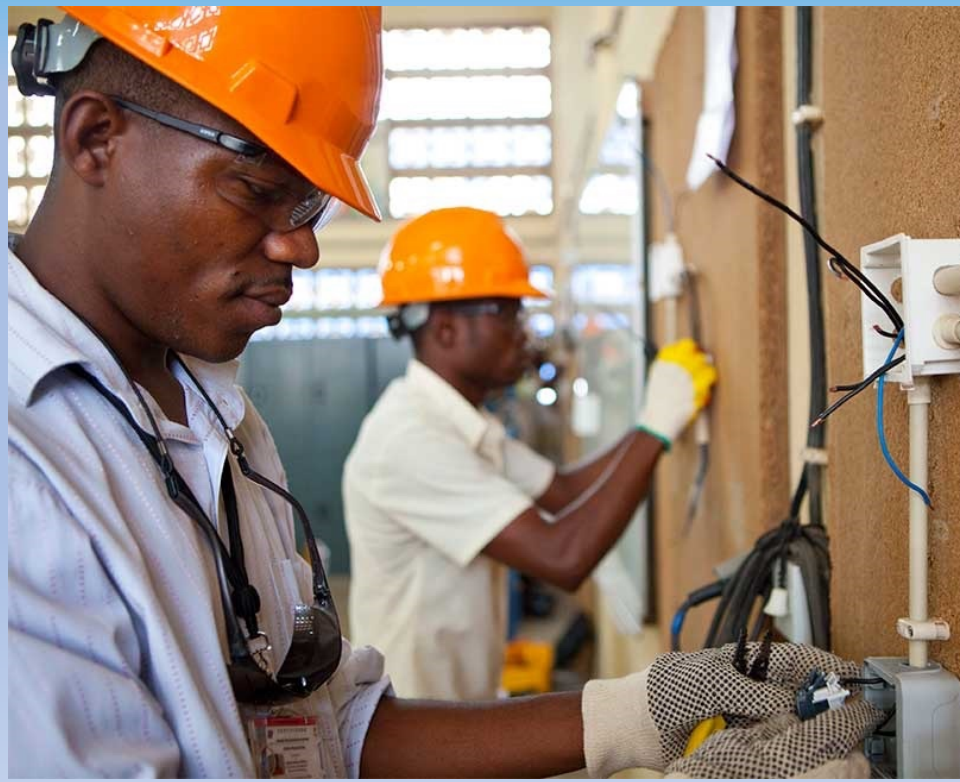
What fittings may still be live after having been switched off?

- Thermostat
- Control sensor
- Control wiring
- Ceiling rose

Plant Isolation, Testing and Re-commissioning

Explain the need to keep the person in charge informed of the reason for, the extent of, and estimated duration of the work, and tell them when the equipment is to be re-energised.

- The person in charge is responsible for safe and timely completion of the work.
- The person in charge is responsible for safety of others who may be working in the area.
- It also helps the person in charge organise other work that may be being done at the time.



Plant Isolation, Testing and Re-commissioning

Explain the terms electrical appliance and electrical fitting

- AS/NZS 3000 and define the following terms:
- Section 1.4.6 Electrical appliance:
- Is a device that converts electricity into energy or is altered electrically. The energy is typically converted into heat or motion. Lamps are typically not included as appliances.

- Section 1.4.46 Electrical Equipment
- Electrical equipment includes control gear, switch gear, fittings or luminaires. The equipment is typically used for electrical energy generation, conversation, transmission, distribution, utilisation or storage

Plant Isolation, Testing and Re-commissioning

Why must appliances be connected in a parallel configuration.

- This ensures the correct voltage is supplied to an appliance wherever it is used.

Plant Isolation, Testing and Re-commissioning

Describe connection methods, and their applications.

Appliance	Connection type	Give reasons why appliance is connected that way
Toaster	Flexible cord using approved plugs & sockets	Portability of appliance
Heated towel rail in a bathroom	Flexible cord and permanent connection unit	Damp environment and doesn't need to be moved regularly
Freestanding (oven)	High current flexible cord and Approved plug and socket	High current draw possible multiphase Standards require connection by plug and socket
3 Phase induction motor	Polyphase flexible cable connected to an approved box and connectors	Multiphase appliance and possible vibration
Ceiling extract fan in a bathroom	Fixed wiring terminated into appliance terminal box	Direct connection, possible vibration

Plant Isolation, Testing and Re-commissioning

Procedures to follow when re-commissioning electrical and mechanical plant.

AS/NZS 4836:2011

Section 4: Re-energizaton of electrical installations and equipment

For re-energization the following steps **shall** be carried out. They should be done in the order listed below:

(a) All relevant persons shall be notified that testing is about to commence or supply is about to be restored.

(b) A visual inspection shall be conducted to ensure that all tools, surplus material and wastes have been removed and the work site has been reinstated.

(c) Visual inspection and tests required by AS/NZS 3000 shall be carried out.

(d) Applicable work permits shall be cancelled.

(e) Applicable personal tags and locks shall be removed.

(f) Re-energization as appropriate is carried out.

(g) Functional testing as required, e.g. phase rotation, are carried out

(h) Confirmation that all guards and covers are reinstated is obtained.

AS/NZS 4836:2011

Section 4: Re-energizaton of electrical installations and equipment

- NOTES:

1. AS/NZS 3017 provides guidance on testing of low voltage electrical installations.
2. It is recommended that the earth be connected first followed by the neutral and the actives.
3. See AS 4741 and the Electricity Engineers Association of New Zealand, *Livening of service connections to premises*, for reconnecting electrical installations.

Plant Isolation, Testing and Re-commissioning

Describe procedures to follow and precautions to observe when re-commissioning electrical and mechanical plant (reorder the list below).

All work has been tested
The plant operates according to manufacturer's requirements
Any recommissioning documents or processes are followed and signed off where needed
All required services have been restored (such as water, air etc.)
All work has been completed
Other trades have completed their work (where appropriate)

Plant Isolation, Testing and Re-commissioning

Explain re-commissioning test procedures and outline expected test results.

- Follow test procedures from manufacturer's instructions to ensure that the plant or machinery operate as designed.
- Ensure the plant or machinery complies with current legislation
- Ensure the plant or machinery is tested in accordance with current legislation

Plant Isolation, Testing and Re-commissioning

A basic isolation and re-commissioning plan is needed to:

- ensure that all required plant and equipment are isolated in a safe and logical order.
- provide information regarding the work required and who may be undertaking that task.
- list completion dates, times and any other relevant information.
- list the sequence for recommissioning which may involve multiple people and trades.
- provide information as manufacturers specifications / tests results / special testing procedures that may be used for compliance or reporting etc.

Plant Isolation, Testing and Re-commissioning

Draft a basic isolation and re-commissioning plan for a given plant including the reasons for the stated sequences.