MS&L Procedure

PRO-4.5-0001-1-02
Energy Isolation

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1. Purpose

Whenever BP conducts construction, maintenance, demolition, remediation and other similar work that are typical of our industry, there is the potential for harm to people and the environment and for damage to equipment. This document provides requirements for the isolation of energy systems in support of PRO 4.5-0001-0-01 Control of Work and WPCG-PRO-01 Work Authorisation. Energy Isolation is a key component of the system of work that allows tasks to be completed safely and without unplanned loss of containment with the potential to cause environmental damage or to damage a plant or equipment.

This procedure sets out a required approach to isolation of energy systems in accordance with BP's Golden Rules of Safely, the requirements of GDP 4.5-0001 Control of Work, Annex 1 and OMS Group Essentials 3.2.1 and 4.5.1.

This procedure specifically details the requirements of the following documents:

- Group Defined Practice (GDP); GDP 4.5-0001_2016 Control of Work

2. Scope

The requirement specified in this procedure applies equally to BP employees, contractors and visitors engaged in the ANZ MS&L business.

Specific sites, areas and activities may have more detailed OMS requirements and where these exist the requirements will be specified in local procedures, safe work instructions, manuals, handbooks or specific standards.

3. Terms, Definitions and Abbreviations

Table 1: Terms, Definitions and Abbreviations

Close Proximity	Locations on installations, where deliberate, accidental or inadvertent contact with electrical equipment is possible, either direct or indirect through tools, long objects, drills, cutting blades, etc. For the purposes of this practice 'close proximity' is taken to be 500mm.
Competent	An individual in a Control of Work role who can demonstrate that they have professional or technical training, knowledge, actual experience, qualifications and ability to enable them to: a) Perform duties at the level of responsibility allocated to them; b) Understand any potential hazards related to work (or equipment) under consideration; c) Recognise any technical defects or omissions in a task (or equipment) and the adverse implications for health and safety caused by the hazard(s) and / or omission(s); and

	d) Be able to specify corrective action(s) to mitigate the hazards.
Complex isolations	These may include, but are not limited to, work requiring isolation of dual energy sources, multiple sources of energy requiring isolation, isolations required by multiple trades or organisations, and isolations required for confined space entry. Consider all sources, not just electrical, when assessing the complexity of isolations required to safely execute the work.
De-energised (electrical)	Disconnected from all sources of supply but not necessarily isolated, earthed or out of commission.
Electrical Worker	Person or persons engaged in the installation, maintenance, repair and testing of electrical equipment.
Extra Low Voltage (ELV)	Voltage not exceeding 50 V AC or 120 V ripple-free DC
Fault Finding (electrical)	The process of taking measurements or carrying out tests on electrical installations and equipment to locate faults or prove operability. It may also include the process of applying testing instruments or devices to various parts of the electrical installation.
High Energy Electrical System	Electrical systems rated at 800A or where the fault current at the point of the installation exceeds 2,000A.
Isolated (electrical)	The state of equipment when disconnected from all sources of supply by breaks of a length appropriate to the voltage and the insulating medium.
Isolation Plan	A form to specify and record Lockout points for more complex plant isolations. Also referred to as a LOTO Plan.
Isolation Register	Centralised site's register of all current plant isolations in place at the site. Also referred to as a LOTO Register.
Isolator (electrical)	A device which for reasons of safety, provides in the open position, breaks appropriate to the voltage and the insulating medium.
Lock-out	The use of locks and / or locking devices (e.g. chains and locks, clasps and locks) to ensure energy sources and energy control devices such as electrical breakers and valves are secured in a safe position.
LOTO	Lock Out Tag Out
Live (energised)	A term applied to an object when a difference of potential exists between conductors or would exist between it and earth under normal conditions of operation.
Low Voltage	Exceeding extra-low voltage, but not exceeding 1,000 V AC or 1,500 V DC
MCC	Motor Control Centre
On or near (electrical)	A situation where an electrical worker is working on or near exposed energized conductors or live conductive parts and there is a reasonable possibility that the electrical worker's body, or any conducting medium the electrical worker may be carrying or touching during the course of the work, may come closer to the exposed energized conductors or live conductive parts than 500 mm. The term 'on or near exposed energized conductors or live conductive parts' does not apply if the uninsulated and energised part is safely and securely shielded by design, or segregated and protected with barricades or insulated shrouding or insulating material to prevent inadvertent or direct contact.
PLC	Programmable Logic Controller that controls the operation of equipment via software coding.
Positive isolation	Positive isolation is defined as either: a) Spool removal - removal of a pipework section or spool piece and blanking the live end, also called 'air gapping'. b) Blind isolation - insertion between flanges of a blind (spade); the swinging closed of a spectacle blind (plate); or

	replacement of a spacer (slip-ring) with a line blind (spade).
Site Representative	The Site Representative is a person with responsibility for the overall safety on a site, who has the ability to stop work at any time.
Tag-out	The attachment of prominent warning tags to locks and / or locking devices that forbids the operation of energy control device and associated equipment and communicates the reason for lock-out. It bears the name of the person who applied the tag and the date the tag was applied. If more than one group is working on the same item (including different trades) each person from each group should have an individual tag but as a minimum one responsible person from each group shall sign and date a "DANGER, DO NOT START", or equivalent, tag. See Annex C -
Testing (of LOTO)	The act of confirmation that plant and equipment is isolated and de-energised by checking the integrity of the local energy control devices (e.g. valve, isolator), and that plant and equipment is de-energised (e.g. by trying to start equipment or confirming de-pressurisation / drain down. It is critical that all bleeds, vents and drains are checked to be free from blockage prior to testing.

4. Roles and Responsibilities

The roles and responsibilities associated with this procedure are listed in the following table.

Table 2: Roles and Responsibilities

Planner	The person responsible for planning the Energy Isolation shall ensure that the Permit Receiver is communicated the requirements of this procedure as part of the planning process prior to work. The planner role is often not a dedicated role and may be fulfilled by Project Manager, Project Engineer, Project Delivery Lead, Site Manager, Retail Regional Maintenance Coordinator, etc.
Permit Officer	The Permit Officer shall ensure the requirements of this procedure and conditions of the risk assessment for the task and any associated work permits or work clearances (as applicable) are followed. WPCG-PRO-01 Work Authorisation documents the responsibilities of the Permit Officer for all work permits associated with Energy Isolation. The Permit Officer shall not be the same person as the Permit Receiver.
Permit Receiver	WPCG-PRO-01 Work Authorisation documents the responsibilities of the Permit Receiver for all Work Permits associated with Energy Isolation.
Site Representative	The Site Representative shall be the site manager or delegate, or if the site is unmanned it may be the Permit Officer. The Site Representative is responsible for the overall safety of the site. The Site Representative shall be aware of all planned operations of the site that may interact with the work. Therefore no work shall be undertaken before the Site Representative countersigns the permit. The Site Representative may stop or defer work at any time.

5. Methodology

5.1. General

Where a Work Permit is issued, isolations shall be recorded on the Work Permit or Lock out Tag out (LOTO) Plan. Where a WPCG Work Clearance is issued, the isolations shall be recorded on a LOTO Plan or other associated document for the work such the safe work procedure or risk assessment, as a minimum. Once isolations have been performed, they shall be checked by the Permit Receiver before commencing work.

Locks and tags shall be issued and recorded when plant is to be isolated. The same locks and tags shall be recovered and checked off when the plant is to be re-commissioned. For complex isolations (as identified during the risk assessment for the task) a LOTO Plan shall be prepared, documenting where all locks and tags are to be placed. These should then be checked off the LOTO plan as they are placed and again when they are removed at the end of the work - refer Annex A - for a LOTO plan.

Complex isolations may include, but is not limited to, work requiring isolation of dual energy sources, multiple sources of energy requiring isolation, isolations required by multiple trades or organisations, and isolations required for confined space entry. Consider all sources, not just electrical, when assessing the complexity of isolations required to safely execute the work. Complex isolations should document the sequence of isolation/de-isolation in the LOTO Plan

If more than one work group is required to lock out equipment (including different trades), a minimum of one responsible person from each group shall place their own lock on the energy isolating device using a multi-lock hasp. The lock shall be tagged with the name of the person(s) who applied the lock and who holds the key.

Equipment shall be clearly and unambiguously identified. Where a credible risk is present there should be designation of which equipment will be identified in the field as de-energised, and which equipment will be identified as energised.
The general process for LOTO work is as follows:

- Prior to work being undertaken under the isolation:
  a) Identify all potential energy sources or situations where a release of energy or product may occur.
  b) Identify all isolation points. Competent persons shall agree to the method of isolation. These can be a valve, blind flange, circuit breaker, switch or fitting etc.
  c) Include the isolation requirements on any work permits, work clearances, or procedure. Identify and record isolations that are common to more than one permit, work clearance or procedure.

d) Obtain approval from the Site Representative to place tags and isolations and inform all who may be affected. Locks and tags shall be able to withstand environmental conditions.

e) Place and install isolations as close to the worksite as possible to assist in security and ease of monitoring.

f) Competent persons shall agree to the method by which stored energy will be discharged. A responsible, competent person shall safely discharge stored energy, e.g. drain and depressurize and / or discharge electrical or other sources of energy. It is critical that all bleeds, vents and drains are checked to be free from blockage during discharge of stored energy, and prior to testing the isolation is effective.

g) Test to be conducted to confirm that equipment is isolated and that plant / equipment is de-energized / depressurized and / or cannot be started.

- Whilst work is being undertaken under the isolation

h) Regular monitoring and testing of isolations. Monitoring and testing intervals shall be stipulated in the work permit, risk assessment, or procedure for the task. If there is a possibility of isolations integrity being affected during the work, verifying their integrity by:

1. Testing isolations regularly.
2. Monitoring isolations regularly.

- When work is complete:

i) Check that all people involved in the work have finished.

j) Obtain approval from the Site Representative to remove locks, tags and isolations. Inform all people who have been affected.

k) Check system integrity.

l) Ensure all equipment and personnel are clear.

m) Drain and depressurize and / or de-energise and remove all blinds etc. and reinstate all broken connections to same order as before application of LOTO. Care shall be taken when removing these positive isolation devices as stored energy may develop between it and the next isolation valve / point on the energized side of the plant.

n) "Unlock" lockout system, remove tags and re-commission.

o) Test.

p) Check all Locks and Tags back into the site LOTO system and sign off the LOTO Plan.

5.2. Mechanical Isolation

The method of isolation and discharge of stored energy shall be approved by the Permit Officer (to approve the work as safe to do under the isolation) and Site Representative (to approve any business operational impact) and be executed by the responsible person(s). Isolation of the highest quality and security which is reasonably practicable shall always be used.

5.2.1. Positive Isolation

Positive Isolation is regarded as the most secure method and shall be considered in the development of all LOTO Plans.

Positive isolation is defined as:

a) Spool removal - removal of a pipework section or spool piece and blanking the live end, also called 'air gapping'.
b) Blind isolation - insertion between flanges of a blind (spade); the swinging closed of a spectacle blind (plate); or replacement of a spacer (slip-ring) with a line blind (spade).

Positive isolation by spool removal or air gapping shall be considered as the minimum sole means of isolation for confined space entry - exception for the use of line rated blind only as authorised by the Engineering Authority for the business - refer section 5.8. When a spool or valve is removed, (air gapped) the 'live' pipework side shall be fitted with a blank flange. In most circumstances the isolated equipment (vessel or pipe-work) flange should be left open to allow the vessel or pipe-work to "breathe". Positive isolation by spool removal shall be achieved for any isolation lasting longer than one month.

Where spool removal cannot be achieved, isolation by a valve and line rated spade provides the next highest quality and security. The valve shall be locked and the spade inserted for that particular isolation. The valve and spade shall be tagged in their secure position to prevent inadvertent operation and removal.

Spectacle blinds, blank flanges, bolting, and gaskets shall, as a minimum, be adequate thickness for the line rating. New, correctly rated gaskets shall be installed and all correctly sized bolts shall be installed and tightened.

Isolation by valve and line rated spade shall be considered as the minimum sole means of isolation for hot work, and shall only be acceptable for isolations of less than one month duration. These conditions shall form part of a risk assessment, which shall form part of the Work Permit and be kept with the permits.

5.2.2. Valve Isolation

5.2.2.1. Double Block and Bleed

Double block and bleed is the most secure form of valve isolation, but should only be used if the valve(s) can provide a reliable seal under the particular conditions of service. The main valve shall be locked and tagged closed and the bleed shall be wired and tagged open to prevent inadvertent operation.

Double block and bleed valve isolations may be considered as the minimum sole means of isolation for routine short duration cold work for moderate and high pressures. This type of isolation shall only be used if the duration of the work is short (less than 4 hours) and the immediate work site shall not be left

unattended. These conditions shall form part of a mandatory risk assessment which shall form part of the Work Permit and be kept with the permit.

5.2.2.2. Single Valve

In single valve isolations the integrity of the isolation is critically dependent upon the reliability of the seal under the particular conditions of service and the security of the single valve operating stem.

Isolation against a tested single valve may be used for the purpose of swinging a spectacle blind, inserting a line rated spade or fitting a blind flange to achieve higher integrity isolation.

Single valve isolations may be considered as the sole means of isolation for routine, short duration, cold work where pressures on the active side are less than 200 kPa g. The duration of work shall be short (less than 4 hours) and the immediate work site shall not be left unattended. These conditions shall form part of the risk assessment which shall form part of the Work Permit and be kept with the permit.

Figure 1: Single Valve Isolation with Lock and Tag

5.2.2.3. Tagged Isolation

Isolation by tagging out with tags only is not considered sufficient and may only be used in exceptional circumstances where inadvertent operation will not compromise HSSE. Tagged isolation shall require approval by the Permit Officer and Site Representative.

5.2.2.4. Valve Actuators

When used for isolation:

a) Manually operated valves shall be locked and tagged to prevent unauthorized or inadvertent operation.
b) Electrically actuated valves shall have the power supply positively isolated and any manual override shall be manually locked.

c) Pneumatic and hydraulic operated valves which fail closed shall have the control lines isolated and physically disconnected. Pneumatic and hydraulic operated valves which fail open or fail as is shall not be used for isolation purposes.

5.2.2.5. Isolation of other Energy Sources

Other energy sources can include heat, gas, steam, gravity and pressure. These shall be isolated by a physical break which is identified by a tag and secured by a lock or an equivalent mechanical means that cannot be neutralized without the use of tools. Open ends shall be blanked or capped.

Persons performing the work shall test the operation of equipment before work commences to ensure effective isolation.

5.2.3. Steps in Isolating and Making Safe

The following key steps shall be applied when making safe mechanical installations.

a) Identify
b) Isolate
c) Secure
d) Discharge
e) Test

5.2.3.1. Identify

The equipment to be worked on and all isolation points shall be clearly identified. For Complex Isolations, a copy of the plant P&ID's shall be marked showing which items are isolated and attached to the LOTO plan.

5.2.3.2. Isolate

The equipment to be worked on shall be isolated from all sources of energy by the highest method of isolation as reasonably practical and meeting the minimum isolation requirements as per sections 5.3.1 and 5.3.2. Consideration should also be given to locking out and tagging any originating sources of energy (e.g. pump motor circuit breakers) of the system.

5.2.3.3. Secure

All isolation points shall be locked out to ensure energy control devices, such as valves, are secured in a safe position from inadvertent operation.

Appropriate warning tags shall be placed at all isolation points, which forbids the operation of the energy control device and associated equipment, communicates the reason for lock-out, the name of the person who applied the tag and the date the tag was applied. Consideration should also be given to locking out

and tagging any originating sources of energy (e.g. pump motor circuit breakers) of the system. See Annex C -

5.2.3.4. Discharge

Once isolations have been made, all stored energy as is reasonable practicable shall be discharged. Prior to breaking containment of a pipeline or piece of equipment (e.g. filter vessel), it shall be de-pressurised to atmospheric pressure by means of a vent or drain to atmosphere. Any product or contaminated water shall be captured. Product or contaminated water shall not be allowed to drain to ground or be directed into open drains. It is critical that all bleeds, vents and drains are checked to be free from blockage prior to testing.

5.2.3.5. Test

The energy control devices (e.g. valves,) as well as plant and equipment which is isolated, shall be tested prior to conducting work to prove effective energy isolation

5.3. Electrical Isolation

5.3.1. Key Considerations

Electrical equipment shall be considered to be energised (i.e. live) until proven de-energised.

5.3.2. Steps in Isolating and Making Safe

The following key steps shall be applied when making safe electrical installations.

a) Identify
b) Isolate
c) Secure
d) Discharge
e) Test

5.3.2.1. Identify

Electrical equipment to be worked on and the appropriate point of supply shall be clearly identified. Identification of equipment should include labelling that is both consistent and clear at the equipment to be worked on and all points of possible isolation, e.g. control isolator and main point of supply.

5.3.2.2. Isolate

The electrical equipment to be worked on shall be isolated from all sources of supply (e.g. mains, generator, battery or solar) either by opening switches, removing fuses or switching circuit breakers. Where isolation is effected at a removable or rack-out circuit breaker or combined fuse switch or a removable fuse the device should be racked out or removed to provide a visible break for isolation verification.

Where isolation is provided by the removal of fuses in a distribution board or motor starter the following shall apply:

a) Removed fuses shall not be stored in the same panel as the fuse holder.
b) Fuses shall be tagged and stored in a secure location during the period in which equipment is isolated.
c) Blank or empty fuse cartridges, preferably painted yellow and tagged 'for isolation purposes' shall be inserted into the fuse holder to prevent inadvertent contact with exposed conductors and to clearly identify that equipment is under isolation.

Confirmation shall be made that all required isolations are in place. For complex isolations, this confirmation may be by a nominated second person if deemed necessary to manage the risk of incorrect isolation.

5.3.2.3. Secure

a) Tagging

Tags shall be placed at all points of switching, isolation or disconnection. Such tags shall be clearly understandable and signed and dated by the person placing the tag or by the supervisor in charge of the work party. Identification labels should also include warnings for any abnormal hazards, e.g. multiple points of supply, etc. See Annex C -

b) Lock Out

Where a facility exists to lock an isolation point, it shall be used. All points of isolation for the work (e.g. circuit breakers, switches and combined fuse switch units forming part of the power or control circuit) should be locked out. Where locking facilities are not available, temporary securing devices should be used. Securing devices shall be able to withstand any disrupting environment, e.g. not become ineffective due to vibration.

If lock out facilities do not exist at the isolation point, other measures shall be implemented to ensure the isolation is secure for the safety of personnel conducting the work. This may include locking out the switchboard cabinet door, the room door, or a spotter to remain in attendance.

The need to implement alternative measure should be reported to the BP representative.

Where fitted, all fuses in the power and control circuits requiring isolation for the work shall be removed.

Where fitted, three phase field isolators in the power circuit requiring isolation for the work shall be tagged in the off position and should be locked off.

Local field isolators for equipment shall be tagged in the off position and should be locked out.

Where an isolation is secured (lock out) a padlock should be used and should be uniquely keyed to prevent inadvertent removal by others. The use of a multi-lock device should be employed where more than one person is to attach a personal lock to an isolator.

Figure 2 shows a typical method for tagging and locking out circuit breakers on a distribution board.

Figure 2: Electrical Circuit Breaker with Multiple Lock hasp, Single Lock and Tag

5.3.2.4. Discharge

Any stored energy shall be discharged e.g. capacitors.

5.3.2.5. Test

All electrical equipment, unless proven to be de-energised, shall be treated as live.

Voltage tests shall be carried out between all phase conductors and between all phase conductors and earth.

The testing of equipment with an approved test meter for the purpose of confirming that the equipment is isolated is not considered live work under this local practice. This position may vary from jurisdiction to jurisdiction in Australia and local requirements shall be applied.

Any voltage tests used to prove de-energization shall be conducted in the following sequence:

a) Test the voltage tester on a known voltage source for correct operation.
b) Test between all conductors and a known earth.
c) Test between all conductors.
d) Retest the voltage tester on a known voltage source for correct operation.

WARNING: WHEN VOLTAGE TESTERS ARE USED TO PROVE DE-ENERGIZATION, THEY SHALL BE TESTED FOR CORRECT OPERATION IMMEDIATELY BEFORE USE, AND AGAIN IMMEDIATELY AFTER USE, PARTICULARLY IF THE TEST RESULT INDICATES ZERO VOLTAGE, TO CONFIRM THAT THE INSTRUMENT IS STILL WORKING CORRECTLY.

Only competent persons shall perform the tests.

WARNING: THE USE OF TESTERS THAT DETECT AN ELECTRIC FIELD SURROUNDING AN ENERGIZED CONDUCTOR ARE NOT SUITABLE FOR CABLES THAT ARE SURROUNDED BY A METALLIC SCREEN, CABLES CARRYING DIRECT CURRENT AND IN SIMILAR CIRCUMSTANCES.

5.3.3. Interlocks and Automatic Starting of Equipment

During the isolation consideration shall be given to the possibility of circuit wiring or electrical equipment becoming live due to the operation of automatic control devices, e.g. thermostats, float switches, PLCs and other interface and interlock devices.

To prevent the inadvertent or automatic starting of equipment from remote locations the respective output from a PLC or DCS to equipment being isolated shall be disconnected as part of the isolation process. This includes connections to motor starters, valve solenoids, motorised valves, instrument power etc.

Disconnection of the PLC/DCS output may be achieved by one of the following;

a) Physically disconnecting wiring at the output module,
b) Physically disconnecting wiring or removal of a fuse at a terminal strip in a wiring enclosure,
c) Physically disconnecting wiring at the field device; or,
d) Through the use of a disconnect switch on the PLC/DCS or at the equipment.

5.3.4. 'Try' Step

Where practicable, persons performing the work shall try to start the equipment via the field isolator or PLC once the isolations are in place. This step is sometimes referred to as the 'try' step.

5.3.5. Cutting of Electrical Cables

When carrying out work which involves cutting existing cables, the cable shall be treated as live until positive tests proving the cable is de-energised can be made at the point where the cable is to be cut.

5.3.6. Opening of Enclosures

Opening of enclosures while circuits remain energised is often required to facilitate inspections, troubleshooting and maintenance activities. However, consideration shall be given to the potential for hazardous atmospheres. This shall be considered in the risk assessment for the task and a gas test shall be conducted by a competent person (as defined in WPCG-PRO-01 Work Authorisation) for all such work in hazardous areas.

Opening of electrical enclosures or cabinets for purposes of troubleshooting, inspecting or investigation, where the person is not coming into close proximity with exposed electrical circuits, is not considered live electrical work under this local practice.

Opening of enclosures or cabinets where there is the presence of exposed voltage higher than 32Vac shall only be permitted by qualified persons i.e. electrical engineer, electrical worker.

While there is low risk for a competent person when opening a panel to observe the status of wiring or to inspect components as part of troubleshooting or maintenance activities, a safe approach distance of 500mm to exposed and live conductors shall be observed.

Placing hands or any part of the body within 500mm of live and exposed conductors shall be considered live work and additional safeguards shall be in place to protect the person from direct or indirect contact with energised conductors.

5.4. Working On or Near Live Electrical Equipment

5.4.1. Key Considerations

Working on live electrical equipment shall only be considered as a last resort and when an adequate risk process has been undertaken and documented in accordance with the risk assessment for the task.
The recommended safe guards, as listed in section 5.4.2, should be identified on risk assessment for the task.
When working in the vicinity of live exposed electrical conductors consideration shall be given to the potential arc flash hazards and level of PPE required.

Note: electrical work on switchboards with fully enclosed busbar chassis assemblies with integrated isolation switch for each individual tee-off is permitted provided that:

a) All the spare poles are isolated at the busbar; and
b) The circuit or tee-off which is being worked on is isolated at the busbar; and
c) The circuits immediately adjacent the circuit being worked on are isolated at the busbar.

5.4.1.1. High Energy Installations

When working, testing or fault finding on energised electrical equipment, workers should be aware that a fault current of up to 20 times the rated current of the supply transformer can flow for short duration during fault conditions.

Arcs that are produced under these conditions have the energy to cause an explosion and/or melt metallic switchboard cubicles. Arcs can cause severe burns to the skin and/or flash burns to the face and eyes. Inhaled hot gases and molten particles can cause serious internal burns to the throat and lungs. Injury can also occur through the impact from flying debris and dislodged components. Overcurrent circuit protection may not operate in such circumstances.

For installations rated above 800A or where the fault currents exceed 2000A special precautions are required.

5.4.2. Safeguards

When working on live electrical equipment the safeguards outlined in 5.4.2.1 through 5.4.2.8 (inclusive) shall apply.

5.4.2.1. Assessment

Prior to commencing any work on live electrical equipment an assessment of the associated risks shall be undertaken. This assessment shall include a consideration to the available fault current and the requirement for appropriate PPE based on the arc flash hazard.

5.4.2.2. Stand-by Person

Where in the judgment of the person doing the work it cannot be carried out safely without assistance or a safety observer, that person shall be provided with the assistance required. If assistance is not provided, work shall be delayed until isolation can be arranged.

When troubleshooting involves the use of approved test equipment and the measuring of voltages by direct contact with exposed conductors exceeding 32Vac or 50Vdc the person undertaking the work shall be supported by a safety observer of stand-by person.

5.4.2.3. Competency

Any persons undertaking work on live electrical equipment shall be skilled and competent in the work to be carried out.

5.4.2.4. Precautions

The person responsible for authorising work to be carried out live shall specify any particular precautions to be taken to eliminate hazards and to prevent injury.

5.4.2.5. Safety Apparel (PPE) for Electrical Work

Electrical workers and assisting personnel shall wear protective clothing suitable for the task when working on, or in close proximity to, live (energised) electrical equipment.

a) PPE for Low Energy Installations:

1. The minimum PPE requirements that shall be followed for working in close proximity to live low voltage exposed electrical equipment in low energy systems are;
    i. Safety glasses
    ii. Long sleeve cotton shirt
    iii. Long cotton pants
    iv. Leather safety shoes
    v. Leather gloves

Note: the above is the minimum PPE requirement for low voltage, low energy work.

b) PPE for High Energy Installations:

1. Where working on or in the vicinity of exposed conductors for installations rated above 800A or where the fault currents exceed 2000A additional PPE requirements apply.
2. PPE shall be suitable for the arc flash hazard.
3. For these installations consideration shall be given to the use of flame resistant and non-synthetic clothing as well as insulating gloves and full face shield.

5.4.2.6. Earthing

When working on live electrical equipment having earthed metal, precautions shall be taken to ensure earthing continuity is maintained to any component part of the equipment at all times.

Bonding conductors may be required to be installed when removing electrical equipment from earthed metal, e.g. live component part separated from its connected earthing medium. Bonding conductors shall be rated to withstand the 'let through' energy of the primary protection without failing.

5.4.2.7. Neutral Connections

Particular care should be taken when removing neutral connections as tests may have indicated a de-energised situation. However, when these connections are removed, a voltage may be present between conductors or between conductors and earth.

5.4.2.8. Barriers & Insulation Mediums

Only conductors at one potential should be worked on at any one time and insulated barriers should be utilised in the work area between conductors of different phases or voltage potentials.

Insulating mats or barriers should be used between electrical workers and conductors and between electrical workers and earth including building structures such as concrete and steel which may be earthed.

5.4.3. Fault Finding

Isolation of power shall always be the first choice when undertaking electrical work.

However consideration shall be given that there may be instances when fault finding, commissioning or testing is only possible while equipment is live and in these instances other safety precautions are required to be taken.

The electrical worker shall be competent in the work being undertaken and be familiar with the equipment involved and the safeguards for requirements for working on live electrical equipment shall be applied.

5.4.4. Electrical Test Equipment

5.4.4.1. Key Considerations

Refer to BP STP ANZ 32-51 "In Service Inspection of Electrical Equipment - Program Requirements" for electrical inspection requirements.

All test equipment, including leads and probes, shall be suitable for its intended purpose and periodically inspected to ensure that it remains operational and safe

Before carrying out any tests, equipment shall be checked to ensure that it is correctly set, functional and in good condition.

Testing equipment used for detecting a live (energised) source should undergo trial operation on a known live circuit to prove that it is functioning correctly immediately before and after the test has taken place.

5.4.4.2. Requirements for Electrical Test Equipment

Electrical test equipment (including test leads) used for direct contact on low voltage systems shall comply with the requirements of AS 61010.1 or an equivalent standard and shall be a minimum of CAT III 600V design.

Contact probes and leads shall be checked for damage to insulated parts, ensure continuity and verify connections prior to use.

Insulation resistance testers shall be able to maintain a terminal voltage within +20% and -10% of the nominal open-circuit terminal voltage, when measuring a resistance of 1 MOhm on the 500 V range or 10 MOhm on the1000 V range.

Voltage indicators such as high impedance volt meters shall only be used to verify the presence of a voltage. They shall not be used to verify the conductivity of a cable, as they will operate satisfactorily with high resistances within the circuit under test.

Voltage indicating neon type devices shall not be used as the only means to verify the presence of a voltage.
Test equipment that has the potential to generate a spark and is intended for use within a hazardous area shall be certified in accordance with BP STP ANZ 12-08 Hazardous Area Certification Requirements.

If equipment is not hazardous area approved and has a spark potential, the normal requirements of WPCG-PRO-01 Work Authorisation shall be followed.

5.4.4.3. Prohibited Electrical Testing Equipment

Neon or LED test 'pencil' devices, similar to those shown in Figure 3 below, requiring the user to form part of the test circuit **shall not** be used as electrical test devices.

Figure 3: Neon Test Pencils - Prohibited for Use.

5.5. Powered Fixed Equipment Isolation

Prior to any work starting on powered equipment it shall be positively isolated.

Electrically powered equipment shall be isolated, locked and tagged out from its power supply in accordance with the requirements of this local procedure.

Diesel driven equipment shall be positively isolated by removal and tagging out of ignition key, securing of electrical isolation switch and consideration to disconnection of the battery, which has its own risks of generating sparks and damage to circuit boards.

Steam, hydraulic or pneumatic equipment shall be positively isolated from its energy source by positive isolation of its motive force. Further isolation will depend on the type of equipment and may include pipe and additional physical isolation.

Persons performing the work shall test the operation of equipment before work commences to ensure effective isolation.

5.6. Vehicles and Portable Equipment

The following procedure should be followed to lock out / tag out any vehicle to conduct work on the vehicle or any equipment on the vehicle;

a) Park the vehicle safely; if possible at the maintenance workshop.
b) Turn off the vehicle ignition, remove the vehicle keys and turn the master battery isolation switch OFF.
c) Install a lock out tag on the steering wheel, with the fleet number of the vehicle, the date and time and name and signature. If possible install a lock out tag on the master battery isolation switch.
d) Inform all who may be affected.
e) Follow General LOTO procedure as described in Section 5.1 to undertake the necessary repair works.
f) The lock out tag shall only be removed by the maintenance fitter or the manager, following repair work and test driving / operation has been conducted.

5.7. Application of Isolation

Plant isolations shall be approved by the Permit Officer (to approve the work as safe to do under the isolation) and Site Representative (to approve any business operational impact) and executed by the responsible person(s). All isolations shall be viewed and tested the isolations to confirm they are in place prior to work under the isolation.

If the work is covered by a task breakdown the isolations shall be specified within the procedure.

5.7.1. Area Isolation

The work area shall be clearly identified and cordoned off to ensure that there is no risk from traffic, personnel not associated with the work, or other external sources.

5.7.2. Vessel Isolation (not for confined space entry)

Isolation of the highest quality and security which is reasonably practicable shall always be used. Positive isolation shall be provided for all work other than cold work. Vessel Isolations (e.g. filter changes) for routine, short duration, cold work which are not positive isolation shall be subject to a risk assessment. This shall only be allowed where the work duration is short (less than four hours) and the immediate work site shall not be left unattended.

5.7.3. Confined Space Entry Isolation (General)

Given the specific hazards of Confined Space Entry, LOTO Plans shall be risk assessed.

Isolations shall be made to prevent the accidental introduction into the confined space of materials, through equipment such as piping, ducts, vents, drains, conveyors, service pipes or firefighting systems. The method of isolation shall be by Positive Isolation. The preferred method of isolation is air gapping. Isolations should be made as near as possible to the Confined Space to be entered. Where isolation at the vessel cannot be achieved due to the size of a piping connection, or where piping connections are welded to the vessel / equipment, the isolation should be made at the nearest available place to the vessel / equipment. The interconnecting piping between the vessel / equipment then becomes an integral part of the Confined Space and shall be taken into account when preparing for entry and issuing Confined Space Entry Permits.

Particularly important aspects that should be considered are:

a) The natural "chimney effect" of large vertical tower, vessels, pipework (e.g. overheads lines),
b) The effects of winds to create a low pressure area downwind of manways and other openings which could result in an airflow and contaminants moving inside a vessel / equipment in the reverse direction to that expected,
c) Connecting piping can contain harmful materials not removed from the systems during purging and gas freeing, which can be subsequently released due to airflow and / or solar heating, or Hot Work.

5.7.4. Confined Space Entry Isolation (Tanks)

Positive isolation of all sources of energy is mandatory for confined space entry into tanks. Valves and/or sections of pipe from each connecting pipeline including foam pipelines (where installed) shall be removed from as near to the shell as possible and the open end of the pipelines shall be sealed with an appropriately line rated blank flange.

All electrical connections other than extra low voltage equipment complying with Australian Standards (AS 3000) shall also be positively isolated.

Potential energy sources shall also be discharged e.g. floating suctions, by landing these onto solid supports.

5.7.5. Confined Space Entry Isolation (valve chambers and tank turrets)

Positive isolation of all external sources of energy is often not practically achievable for pipeline valve chambers and tank turrets. The highest level of isolation practically achievable shall be determined in the risk assessment with appropriate controls and monitoring of isolation detailed and response to the loss or containment detailed in emergency response plans.

5.7.6. Confined Space Entry Isolation (vehicles)

It is often not practically achievable to fully drain down and gas free pipework associated with aviation refuelling vehicles. If entry into aviation vehicle compartments is required, pipework shall be disconnected and isolated from compartments, pipework sealed and external vapour sources from refuelling equipment controlled. The risk of vapour migration into vehicle confined spaces shall be determined in the risk assessment with appropriate controls and monitoring of isolation detailed.

5.8. Removal of Locks and Tags (De-isolation and Commissioning)

Equipment that has been removed from service for maintenance (whether routine or non-routine) shall on completion of maintenance, be tested in service to confirm the integrity of the system. If this is not possible at the time the maintenance is completed, then maintenance shall be deemed incomplete and the equipment shall remain locked out / tagged out until testing in service can be undertaken.

On completion of the work, removal of locks and tags, de-isolation and recommissioning of the system shall be performed with the same care as used during the isolation, locking and tagging. For example, integrity testing of the point of isolation shall precede the removal of any blank flanges, swinging of spectacle blinds or reinstatement of pipework to test for the presence of stored energy or product which could be released.

Lockout locks and tags shall only be removed by the person who applied them.

Exceptions

Only under exceptional circumstances, locks and or tags may be removed by the site manager (authority not to be delegated) according to the following procedure:

a) Verify that the person who placed the Lock and Tag is not on site.
b) Make all reasonable efforts to contact the person.
c) Ensure that the plant is in a safe and operable condition, by inspection by a competent person.
d) Remove lockout and tag.
e) Re-commission plant.
f) Ensure that the person who applied the tag and lock is informed that the plant has been returned to service and the documentation has been signed off by the site representative.

5.9. Commissioning

Equipment that has been removed from service for maintenance (whether routine or non-routine) shall on completion of maintenance, be tested in service to confirm the integrity of the system. Pressure, leak and functional testing of the reinstated system shall be performed as required for the equipment. Particular care should be taken of electrically, pneumatically or hydraulically operated valves which may open or close on reinstatement of the energy source. If this is not possible at the time the maintenance is completed, then maintenance shall be deemed incomplete and the equipment shall remain locked out / tagged out until testing in service can be undertaken.

5.10. LOTO Equipment

To enable compliance with the Lock Out Tag Out requirements of this procedure, each site shall have lock out equipment available for the work, e.g. lockout tags, padlocks, multiple lock hasps etc. This may be provided for the period of the work by the Permit Receiver or persons conducting the work.

6. Verification

The key process steps outlined in this procedure shall be included in a Self-Verification Programme.

Refer to PRO-8.2-0001-0-01 MS&L Self Verification Procedure for further details to developing self-verification protocols.

7. Associated Documents

The following associated documents:

- Have been referenced in this procedure.
- Should be considered in understanding and applying the instructions provided in this procedure.

Table 3: Required References

Document Name	Document No	Document Location
Group Defined Practice - Control of Work	GDP 4.5-0001 2016	OMS Library
Control of Work	PRO-4.5-0001-0-01	Controlled Document Register
WPCG Work Authorisation	WPCG-PRO-01	WPCG website
In Service Inspection of Electrical Equipment - Program Requirements	STP ANZ 12-08	Standards Library
Hazardous Area Certification Requirements	STP ANZ 32-51	Standards Library
MS&L Self Verification Procedure	PRO-8.2-0001-0-01	Controlled Document Register

8. External References

This procedure was prepared with reference to relevant legislation/regulations including but not limited to, relevant Acts, Regulations, Australian Standards and industry codes and practices.

Details of current legislation/regulations can be provided by the HSSE Team on request.

9. Version Summary

The table below provides a summary of version history of this procedure.

Table 4: Document Version Summary

Version	Prepared by	Description of Change	Date	MoC
1	Adrian Connolly	Document created. Initial, replacing STP 35-20 LOTO	14 Nov 2014	
2	Adrian Connolly	Updates to document format and layout for readability. Minor spelling and grammar corrections. Minor changes to wording of clauses to improve clarity of requirements, and to meet Standards requirements wording ('shall/should/may'). Some areas for further clarification and documentation of existing practices. No significant changes to actual requirements for Energy Isolation above standard practices.	06 Aug 2015	11233
3	Adrian Connolly	Updates to add clarity particularly with regards to LOTO minimum requirements and working on live equipment.	23 Sep 2017	11374
4	Adrian Connolly	Minor update for implementation of WPCG-PRO-01 Work Authorisation	22 Aug 2018	11449

Annex A - Example LOTO Plan

	LOTO PLAN **Lock Out / Tag Out**	LOTO Plan # Page of

LOTO Plan Prepared by:	**Description of work:**

Instructions

1 Review Site Procedure for the Isolation of Equipment (Lock Out / Tag Out)
2 Note lock out points in left column (attach P&ID or equipment drawing indicating isolation points)
3 Install Plant Locks at points outlined in left column
4 Record lock number(s) beside corresponding lockout point,
5 Complete "Installed by" and "Date Installed"
6 Confirm all isolations, locks and tags installed, and stored energy discharged
7 Attach copies of LOTO PLAN to permit.
8 When locks are removed, complete "Removed by" and "Date Removed" columns.
9 Confirm all isolations, locks and tags removed and to confirm system integrity
10 File completed copy of LOTO PLAN with completed Work Permit

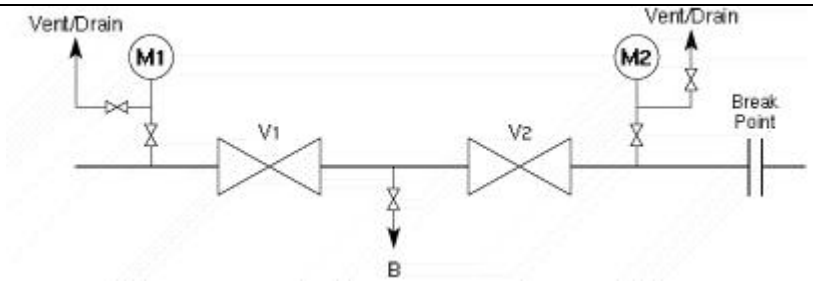
#	**Identification of Electrical Disconnect, Valve, or other energy source to be Locked Out**	**Site lock Number:**	**Installed by:**	**Date Installed:**	**Removed by:**	**Date Removed:**

All locks have been installed: _____ **Date**: _____
(Signature)

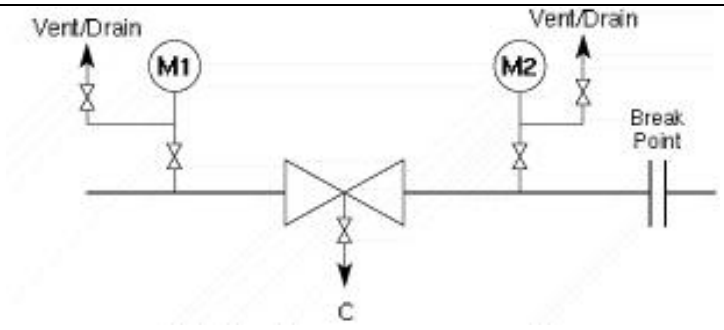
All locks have been removed: _____ **Date**: _____
(Signature)

Annex B - Typical Valve Isolation Integrity Tests

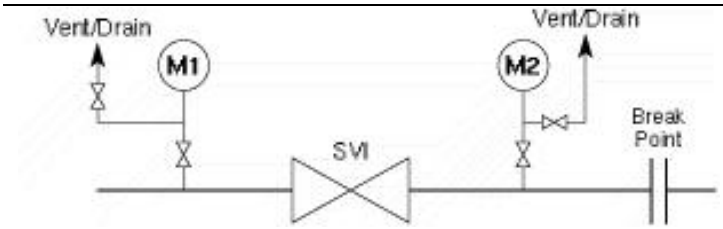
B.1. Double Block and Bleed Isolation Integrity Test (2 Valves)

Diagram	
Key	V1 - First (upstream) isolation valve from live system. M1 - Live side monitoring point (pressure gauge or vent/drain). V2 - Second (downstream) isolation valve from live system. M2 - Monitoring point between valves and break point (pressure gauge or vent/drain). B - Bleed point between the isolation valves.
Procedure	1. If possible, ensure tapings at M1, M2 and B are not blocked and pressure gauges, where installed, are operating. 2. Close downstream valve V2 and lock in closed position, tag out and record on LOTO plan. 3. Record pressure at monitoring points M1 and M2. 4. Vent/drain section of line to be broken and monitor at M2 until the pressure is near zero. 5. Close vent/drain at break point and monitor at M2 for a minimum of 10 minutes. No pressure build-up at M2 indicates the integrity of the downstream valve V2. 6. Close upstream valve V1 and lock in closed position, tag out and record on LOTO plan. 7. Record pressure at M1 and B. 8. Vent/drain between V1 and V2 (B) and monitor at B until pressure is near zero. 9. Close vent/drain (B) and monitor at M1 and B for a minimum of 10 minutes. (No pressure build-up at B indicates integrity of upstream valve V1). 10. Open vent/drain (B) and lock in open position, tag out and record on LOTO plan.
Isolation Summary	Both block valves are now closed, the bleed valve is open and all three are secured. Any fluid passing via the upstream valve is vented through the intermediate bleed valve and no pressure builds up against the downstream valve.

B.2. Double Block and Bleed Isolation Integrity Test (1 Valve)

Diagram	
Key	M1 - Live (upstream) side monitoring point. M2 - Monitoring point between valve and break point (downstream). C - Cavity drain (between seals).
Procedure	1. If possible, ensure tapings at M1, M2 and C are not blocked and pressure gauges, where installed, are operating. 2. Close isolation valve and lock in closed position, tag out and record on LOTO Plan. 3. Record pressure at M1, C (in cavity) and M2. 4. Vent/drain downstream section of line to be broken and monitor pressure at M2 until pressure is near zero. 5. Close vent/drain at break point and monitor at M2 and C for a minimum of 10 minutes. (No pressure build-up at M2 and no pressure fall-off at C indicates integrity of downstream seal.) 6. Record pressure at M1 and C. 7. Vent/drain off fluid in cavity (between seals) and monitor at C until the pressure is near zero. 8. Close cavity vent/drain (C) and monitor at M1 and C for a minimum of 10 minutes. (No pressure build-up at C indicates integrity of upstream seal). 9. Open cavity vent/drain (C) and lock in open position, tag out and record on LOTO Plan.
Isolation Summary	The double sealed, single block valve is now closed, the cavity bleed valve is open and both are secured. Any fluid passing through the upstream seal is vented through the intermediate cavity bleed valve and no pressure builds up against the downstream seal.

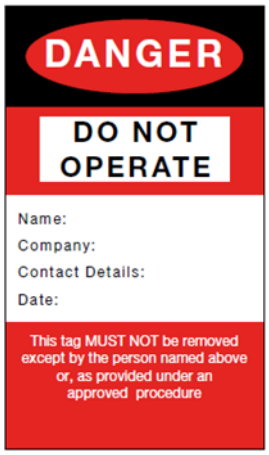
B.3. Single Valve Isolation Integrity Test

Diagram	
Key	M1 - Live (upstream) side monitoring point. M2 - Monitoring point between valve and break point (downstream).
Procedure	1. Ensure tapings at M1 and M2 are not blocked and pressure gauges, where installed, are operating. 2. Close isolation valve and lock in closed position, tag out and record on LOTO Plan. 3. Record pressure at M1 and M2. 4. Vent/drain downstream section of line to be broken into and monitor at M2 until pressure is near zero. 5. Close downstream vent/drain and monitor at M2 for a minimum of 10 minutes. (No pressure build-up at M2 indicates integrity of single valve.) 6. Open downstream vent/drain at break point and lock in open position, tag out and record on LOTO Plan.
Isolation Summary	The single isolation valve is now closed, the downstream vent/drain is open and both are secured. Arrangements shall be made to monitor any fluid passing through the single valve seal.

Annex C - Tagging

All energy control devices (e.g. valves,) as well as plant and equipment which is isolated, shall have an identification tag attached. For Lock Out Tag Out, "DANGER - DO NOT OPERATE" or equivalent tags shall be used. Additional "Out of Service" or "Information" tags may be attached to equipment, but these tags do not form part of the isolation for the protection of workers performing work under the isolation.

NOTE: AS1319 specifies requirements for the design and use of safety signs.



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