Guideline for Hazardous Energy Control (Isolation or Treatment)

MDG 40

Produced by
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DISCLAIMER

The compilation of information contained in this document relies upon material and data derived from a number of third party sources and is intended as a guide only in devising risk and safety management systems for the working of mines and is not designed to replace or be used instead of an appropriately designed safety management plan for each individual mine. Users should rely on their own advice, skills and experience in applying risk and safety management systems in individual workplaces. Use of this document does not relieve the user (or a person on whose behalf it is used) of any obligation or duty that might arise under any legislation (including the Occupational Health & Safety Act 2000, any other Act containing requirements relating to mine safety and any regulations and rules under those Acts) covering the activities to which this document has been or is to be applied.

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FOREWORD

Sections and clauses of the *Coal Mine Health and Safety Act 2002* and *Coal Mine Health and Safety Regulation 2006* relating to MDG 40 Guideline for Hazardous Energy Control (Isolation or Treatment) are indicated in the References section of the Guideline.

This is a 'Published Guideline'. Further information on the status of a Published Guideline in the range of OHS instruments is available through the Department of Primary Industries Legislation Update Number 2/2001. The range of instruments includes:

- Acts of Parliament
- Regulations made under the Act
- Conditions of Exemption or Approval
- Standards (AS, ISO, IEC)
- Approved Industry Codes of Practice (under the *Occupational Health and Safety Act 2000*)
- Applied Codes, Guidelines or Standards (under part 11 of the *Coal Mine Health and Safety Act 2002*)
- Published Guidelines
- Guidance Notes
- Technical Reference documents
- Safety Alerts

The principles stated in this document are intended as general guidelines only for the assistance of owners and managers in devising safety standards for the working of mines. Owners and managers should rely upon their own advice, skills and experience in applying safety standards to be observed in individual workplaces.

The State of New South Wales and its officers or agents including individual authors or editors will not be held liable for any loss or damage whatsoever (including liability for negligence and consequential losses) suffered by any person acting in reliance or purported reliance upon this Guideline.

The MDG 40 Guideline for Hazardous Energy Control (Isolation or Treatment) was distributed to industry for consultation and comment through the Coal Safety Advisory Committee.

The Department of Primary Industries has a review time set for each Guideline that it publishes. This can be brought forward if required. Input and comment from industry representatives will be much appreciated. The Feedback Sheet at the end of this document can be used to provide input and comment.

R Regan
Director Mine Safety Operations

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Purpose and scope

This guideline is intended to:

1. Assist in the development of safe systems of work for the installation, commissioning, maintenance, testing, repair and decommissioning of mining equipment.
2. Assist in achieving a 'safe state' for equipment through isolation or hazardous energy treatment or a combination of both.
3. Provide a consistent nomenclature for hazardous energy management.

Note that:

- Adherence to guidelines does not of itself assure compliance with the general Duty of Care
- Mine operators should document a risk assessment relating to the work to be carried out. This guideline can be used to give assistance in the risk assessment and treatment process.

References

Legislation

- *Occupational Health and Safety Act 2000*, general duty of care
- Section 23(2)(a) of the *Coal Mine Health and Safety Act 2002* requires a basis of identification of hazards and the assessment risks
- Clauses 19 and 20 of the *Coal Mine Health and Safety Regulation 2006* deal with the provision of mechanical and electrical engineering management plans including standards of engineering practice
- Clause 83 of the *Coal Mine Health and Safety Regulation 2006* deals with the development and implementation of isolation arrangements at a coal operation.

Department of Primary Industries publications

- MDG 1010 Risk Management Handbook
- MDG 1014 Guide to Reviewing a Risk Assessment of Mine Equipment and Operations
- MDG 5002, Section 9.6 & Appendix F, Guidelines for the use of remote controlled mining equipment
- MDG 2004 Guidelines for the safe use of electricity in NSW mines-Supplement to Guidelines for Safe Mining

Standards

Australian Standards/Codes should be complied with so far as those requirements are consistent with this Guideline.

- AS/NZS 4836:2001 Safe working on low voltage electrical installations, Section 3
- AS 4024.1:1996 Safeguarding of machinery, Part 1 General principles, Section 14
- AS/NZS 4240:1994 Remote controls for mining equipment, Appendix G

Other reference

- Chapter 10, IEEE Std 902-1998, IEEE guide for maintenance, operation and safety of industrial and commercial power systems

Hazardous energy control management system

General

As a result of hazard identification and risk assessment, management systems for hazardous energy treatment should be integrated with the Mine Safety Management System (MSMS) and based on a risk management approach to safety. See MDG 1010 Risk Management Handbook for more information on this approach.

Systems and procedures for each of the steps discussed below should be developed in consultation with persons working at mines and their representatives where appropriate.

Procedures for monitoring and evaluating the entire energy control process should be developed as an initial part of developing systems and procedures – that is, no system/procedure is complete without a monitoring/evaluation/review component.

Record keeping and documentation

To be able to effectively control and confine the energy flow in any given system or process, consistency with regard to basic terms and approaches towards various tasks is required.

Inconsistency with isolation and hazardous energy treatment procedures has the potential to create confusion, the likelihood of human error and possibly not achieving a 'safe state'.

Documentation should be kept of all stages of the process for achieving a 'safe state', from the identification, reduction, isolation and hazardous energy treatment through to a task to the hand over and re-energising of equipment for work.

At some point of the equipment or process life cycle there will be a requirement for personnel to conduct work, where to do it safely, a 'safe state' must be achieved. This work should be properly documented and records kept and each of the points outlined below should be integrated within the MSMS:

- document hazards associated with the work area
- document equipment and materials used to isolate, control or contain the hazardous energy source
- testing procedures to ensure the hazardous energy is isolated or controlled and that the isolation and/or hazardous energy treatment is effective throughout the task being undertaken
- service and maintenance reports regarding component changes and modifications
- transfer of ownership between tasks or at the end of shift
- procedures and work instructions
- permit to work
- written reports of task performance, including but not limited to:
  - variation to task procedures
  - non-conformance found during either the initial inspection or equipment operations
  - problems identified
  - corrective action taken

Emergency preparedness

Emergencies as a result of the failure of isolation and/or hazardous energy treatment should be considered in developing emergency preparedness procedures. In particular, consider:

- safety equipment needs
- procedures for circumstances in which safety equipment should be used, and how
- training for persons working at mines in use of safety equipment

Training

The Mine Safety Management System should include a training plan that ensures all persons working at mines are appropriately trained and assessed for competency to perform the tasks required of them.

Specific training needs and competencies associated with isolation and hazardous energy treatment systems should be identified and integrated into the training system. Training and skills should be documented on personnel files.

Where there is a need for a 'competent person', the competencies should be defined and a list of persons working at mines who have those competencies created and kept up-to-date. For the isolation and/or hazardous energy treatment system this may be necessary for persons working at mines whose roles and responsibilities include:

- identifying energy hazards
- in charge of achieving a safe state
- in charge of isolation procedures
- in charge of hazardous energy treatment procedures
- controlling energy hazards

- in charge of the work
- controlling hand over procedures

All persons working at mines must be trained in recognising potential hazardous energy sources, warning tags or signs and isolation hardware, exclusion zones and 'all clear' start-up signals (pre-start warning).

The required competence should be verified by a formal assessment of theoretical knowledge and practical skills. Following satisfactory assessment, personnel may be authorised to carry out isolation and/or hazardous energy treatment. In this regard all isolation test and clearance procedures should relate to the various levels of isolation.

Monitoring, systems audit and review

Isolation and hazardous energy control should be part of the continuous improvement process under the MSMS. This includes action to:

- monitor record-keeping
- analyse results, both regularly and after special occurrences or problems
- feed results of the analysis back into future planning and operations
- integrate the monitor and review of isolation and hazardous energy treatment into the MSMS review and continuous improvement process

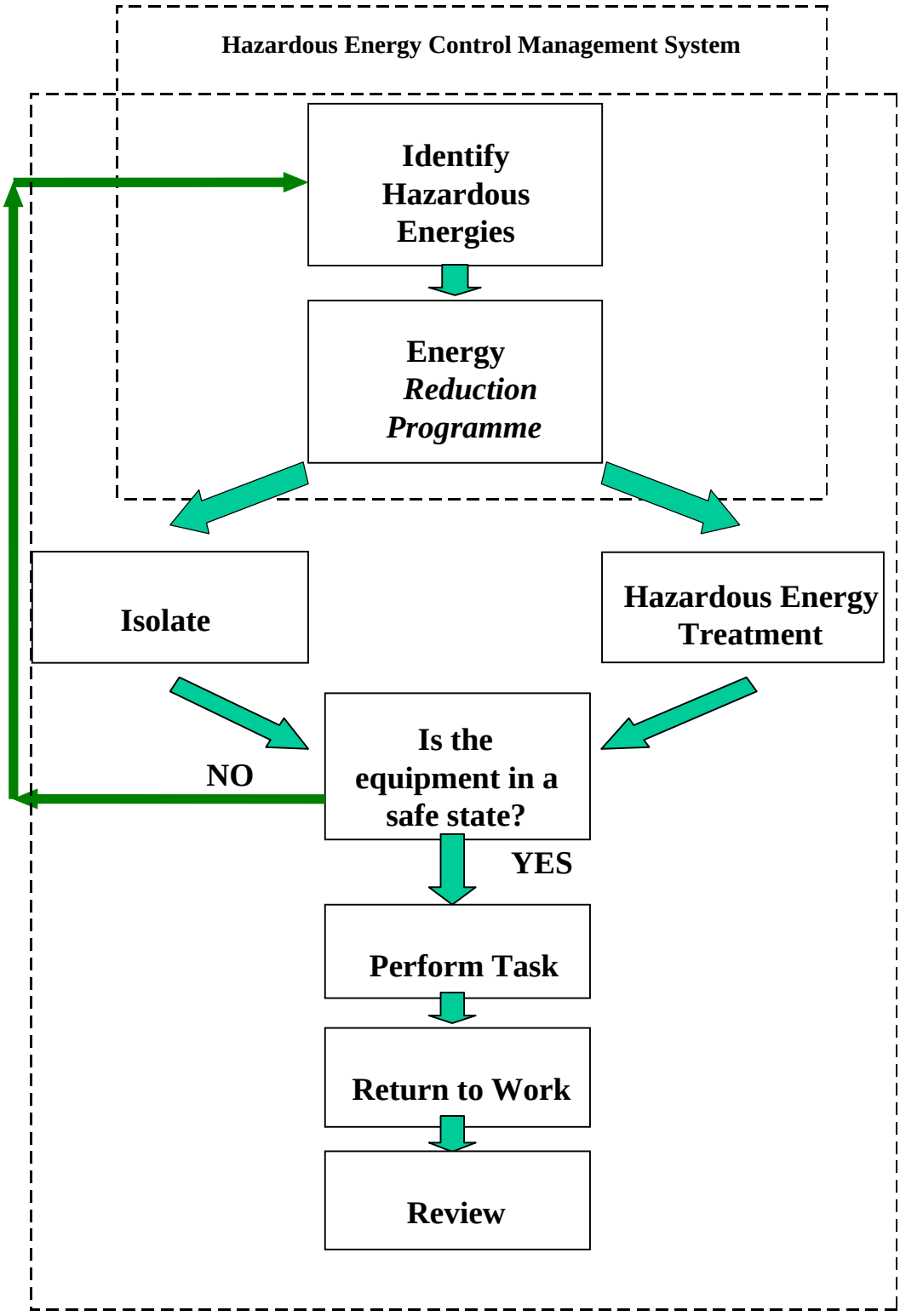
Risk identification and assessment

For more information on how to conduct a risk assessment, please refer to, Risk Management Handbook (MDG 1010) and Guide to Reviewing A Risk Assessment of Mine Equipment and Operations (MDG 1014).

Further, legislation is quite specific in regard to the assessment of, and dealing with, risks to health and safety. In particular the hierarchy of control whereby, if the risk cannot be eliminated, then a barrier or safe system of work must be implemented.

The figure on the next page indicates key hazardous energy control elements.

FLOWCHART OF HAZARD ENERGY CONTROL ELEMENTS



The hazardous energy control process - elements and considerations

Definitions

Hazardous energy control - Hazardous energy control is the act of isolating a hazardous energy source, or the act of hazardous energy treatment or a combination of both.

Hazardous energy treatment - Hazardous energy treatment is the act of preventing hazardous energies from injuring people by methods where isolation is not possible.

Isolation - Isolation is the act of removing and disconnecting energy and prevention of inadvertent restoration of energy. It includes removal and disconnecting of energy sources, discharge of residual energies, tagging and/or locking out and testing the removal or disconnection of hazardous energies has been effective.

Safe state - A safe state is defined as one in which all HAZARDOUS energies have been identified and controlled. Isolation is probably the main method of achieving a safe state, however, for example, where gravity is involved the hazardous energy is often difficult to isolate, but it can be made safe by hazardous energy treatments such as blocking or chocking.

Identify hazardous energies

The following table gives examples of hazardous energy sources. It is worth noting that there will always be other hazards, including site-specific hazards such as noise, gas and dust, which must be identified, assessed and controlled before and during the performance of any tasks. The following Table includes examples of hazardous energy sources:

Table: Hazardous Energy Source

ENERGY	HAZARDOUS SOURCE EXAMPLE
Gravity	Material hung up in a raised dump truck tray.
Mechanical	Moving machinery parts or material subject to tension or compression.
Electrical	Any item that is in contact with an electrical power source, including batteries.
Chemical	Any substance that leads to a chemical reaction, and includes fuel or gas to drive combustion.
Thermal	Apart from fire, sources could include hot water or metal and welding.
Radiant	Arising from welding activities.
Radiation	Any object that emits radiation as its source of energy.
Hydraulic	Any machinery part or object that contains compressed fluid.
Pneumatic	Any machinery part or object that contains compressed gas or vapour.

Employers should use job site surveys to ensure that all hazardous energy sources (including those in adjacent equipment) are identified before beginning any installation, commissioning, maintenance, service, repair, modification or decommissioning tasks.

The equipment supplier or manufacturer should provide the purchaser safety information regarding installation, commissioning, operational, maintenance, service, repair, modification or decommissioning procedures. A comprehensive list of all equipment required to achieve a 'safe state' should be included. However the manufacturer has little control of the work environment in which the equipment is used. The end-user (the mine) should conduct a site specific risk assessment on the equipment to determine fit for purpose applicability and the appropriateness of the manufacturer's information.

Energy reduction programme

Safe systems of work should be based on elimination of all hazardous energy sources. Where this is not feasible employers should institute a programme of substituting less harmful energy sources, such as substituting a 'porta power' for alignment purposes.

All forms of hazardous energy should be isolated (where possible) prior to the commencement of the task. The process by which a 'safe state' is achieved depends on the location and complexity of the task, isolation and hazardous energy treatment requirements. In this regard, where positive isolation cannot be applied, alternative hazardous energy treatments must be implemented to achieve a safe state.

Safe state, isolation and hazardous energy systems

When working on equipment, the equipment must be in a '**safe state'**. A safe state is defined as one in which all hazardous energies have been identified and isolated and/or hazardous energy treatments implemented. The method of isolation and/or hazardous energy treatment depends on the form of energy involved and the available means to isolate and/or control it. Equipment is considered to be in a safe state when hazardous energy flow or use cannot cause hazardous movement of equipment or expose workers in any way to hazardous energy.

The preferred method of achieving a safe state (other than totally eliminating the hazardous energy source) is by isolation. Isolation is the act of removing and disconnecting energy and prevention of inadvertent restoration of energy. It includes removal and disconnecting of energy sources, discharge of residual energies, tagging and/or locking out and testing the removal or disconnection of hazardous energies has been effective.

To achieve positive isolation the following steps should be followed:

- Identify the hazardous energy
- Isolate the hazardous energy source
- 'Tag' where appropriate to identify the isolation
- Prove the isolation is effective

The application of a checklist or 'clearance' provides a record that indicates the hazard identification process has been performed and that isolation has been completed correctly.

To isolate or control energy, take the following steps:

- Disconnect or shut down engines or motors that power mechanical systems
- De-energise electrical circuits by disconnecting the power source from the circuit. This disconnection should only take place by the unplugging of cables, opening of switches or circuit breakers. It should not rely on the opening of contactors as a means of disconnection.
- Note: The unplugging of cables (including those with restrained plugs) should only occur after the cable circuit has been isolated at a switch or circuit breaker.
- De-energise or control equipment in a safe state by blocking fluid (gas, liquid, or vapour) flow in hydraulic, pneumatic, or steam systems by using control valves or by capping or blanking[1] the lines
- Maintain machine parts in a safe state by blocking machine parts against motion that might result from gravity (falling)

Some forms of energy must also be dissipated after a system has been de-energised. System components such as components subject to gravity, springs, electrical capacitors and other electrical equipment with inherent capacitance (eg cables), hydraulic accumulators, or air reservoirs may retain sufficient energy to cause serious injury or death even though the component has been de-energised, isolated, or blocked from the system and locked out.

Examples of energy dissipation are given below:

- Vent fluids from pressure vessels, tanks, or accumulators until internal pressure is at atmospheric levels. However, do not vent vessels or tanks containing toxic, flammable, or explosive substances directly to the atmosphere.
- Discharge capacitors by grounding
- Release springs that are under tension or compression
- Dissipate inertial forces by allowing the system to come to a complete stop after the machine or equipment has been shut down and isolated from its energy sources

NOTE: Some electrical systems are complex and can be influenced by overhead lines or cables that run parallel or are in close proximity to the electrical circuit being worked on. Specialist expertise should be referred to.

[1] Lines can be blanked by inserting a solid plate between the flanges of a joint.

Isolation and hazardous energy treatment hardware

The level of isolation or hazardous energy treatment will depend on the work to be performed. There are a number of locking devices available for ensuring isolation or hazardous energy treatment is not inadvertently defeated and a risk assessment should consider the use of locking devices or hardware appropriate for the type of isolation or hazardous energy treatment. Locking devices that require the use of a key or special tool to achieve its removal can be used in conjunction with identification tags. Push buttons, stop switches, interlocks and emergency stops should not be considered as a sole means of isolation or hazardous energy treatment.

If necessary additional barriers should be used to define the boundary of the isolated or hazardous energy treatment area or provide a warning of additional hazards. Part of the isolation or hazardous energy treatment process may require structures or flagging, bunting or tape, as appropriate, to secure the access and egress to an isolation or hazardous energy treatment area.

Requirement for lockout/tagout devices

When attached to an energy-isolating or hazardous energy treatment device, both lockout and tagout devices are tools that the employer can use in accordance with the requirements of this Guideline to help protect persons working in mines from hazardous energy.

The lockout device provides protection by holding the energy-isolating or hazardous energy treatment device in the safe position, thus preventing the machine or equipment from becoming energised. The tagout device does so by identifying the energy-isolating or hazardous energy treatment device as a source of potential danger: it indicates that the energy-isolating or hazardous energy treatment device and the equipment being controlled may not be operated until the tagout device is removed. Strong encouragement is given to consider the use of lockout devices for particular high risk activities such as High Voltage work..

Note: Clause 20(1)(v) *Coal Mine Health and Safety Regulation 2006* requires the application of locks when accessing high voltage installations. It states:

"(v) access procedures for working on high voltage installations that include the isolation of electrical installation, testing for the presence of electricity, the application of locks to switch gear to prevent inadvertent energisation of an isolated circuit and the application of working earths."

Whichever devices are used they must meet the following requirements.

- **Durable** - Lockout and tagout devices must withstand the environment to which they are exposed for the maximum duration of the expected exposure. Tagout devices must be constructed and printed so that they do not deteriorate or become illegible, especially when used in corrosive (acid and alkali chemicals) or wet environments.
- **Standardised** - Both lockout and tagout devices must be standardised according to colour, shape, or size. Tagout devices must also be standardised according to print and format.
- **Substantial** - Lockout and tagout devices must be substantial enough to minimise early or accidental removal. Locks must be substantial to prevent removal except by excessive force of special tools such as bolt cutters or other metal cutting tools. The device for attaching the tag also must have the general design and basic characteristics equivalent to a one-piece nylon cable tie that will withstand all environments and conditions.
- **Identifiable** - Locks and tags must clearly identify the employee who applies them. Tags must also warn against hazardous conditions if the machine or equipment is energised and must include a legend such as the following:

DO NOT START

DO NOT OPEN

DO NOT CLOSE

DO NOT ENERGISE

DO NOT OPERATE

Perform task

In general, the lockout/tagout procedure should require that the equipment which is isolated or where hazardous energy treatments have been applied should not have its status changed until the task is complete.

Before performing any task the equipment must first be tested to ensure the isolation and/or hazardous energy treatments are effective and that the achievement of a safe state has been effective.

Where it is necessary to re-apply energy or remove a hazardous energy treatment to perform adjustments or confirm machine status the procedure must include steps to control the changed status including notification to all persons working at mines who may be

endangered. The physical actions of a temporary release are the same as if persons were removing their lockout/tagout permanently. Those who have to return to working on that job after the temporary release should re-apply their lockout/tagout devices before resuming any work.

A key concept in isolation or hazardous energy treatment is the transfer (hand over) and return back (hand back) of control over the equipment or process. Hand over and hand back is often referred to the act of transferring ownership between personnel for an agreed reason or time period. The extent to which the steps are formalised and documented depends on the complexity of the operation and tasks to be undertaken.

The transferring of ownership requires a checklist and record document indicating that the correct steps have been taken so that the equipment is transferred to a particular standard. Before commencing work all isolations and/or hazardous energy treatments should be checked against the standard and corrected if required.

Change of status

It is permissible to temporarily re-energise equipment in order to ensure proper repair and adjustment before returning to service. Check with the operator before re-energising any equipment. The re-energisation of the equipment should require the operator to oversee the following:

- Ensure that it is safe to re-energise this equipment and that other equipment or systems are not adversely affected
- Clear the equipment of tools and materials
- Remove persons working at mines from the equipment area
- Remove the lockout or tagout devices as necessary
- Energise and proceed with testing and adjustment
- If further work is required then return the equipment to a 'safe state'

Return to work

Inspect repair work before re-energising the equipment

To ensure that equipment will operate as expected when it is re-energised, employers should require qualified persons to inspect completed installation, maintenance, service, modification or repair work. The inspection should verify that installation, maintenance, service, modification or repair work was performed correctly and that any replacement parts were of the correct rating and that it is safe to re-energise the equipment. (Note: verification that the correct parts were used may also be done by a quality system approach – not by inspection alone).

When equivalent or updated parts must be substituted for original parts, the system may need to be modified. Re-energised equipment should be tested closely then monitored for several operating cycles to ensure that is functioning correctly and safely. The inspection should include an inspection of the workplace to ensure it is safe to hand over to the production team on the next shift.

Make sure that all persons working at mines are clear of danger points before re-energising the system

Employers should develop procedures to verify that all persons working at mines are clear of danger points (not exposed to the release of hazardous energies) before re-energising the system. Locks and tags should be removed only by the workers who installed them - and only after workers have been cleared from the danger points. This may require visual inspections and searches of areas around machinery or electrical circuits to assure that workers will not be exposed to the release of hazardous energy when equipment is re-energised.

Workers should be informed about impending equipment start-up with warning devices they can see and/or hear. Such devices will help assure that workers are clear before equipment is re-energised. (Note: warning devices should be activated for a sufficient time before start up so that personnel can avoid the release of hazardous energies).

Review

The isolation and hazardous energy treatment standards used at the work place should be continually assessed for compliance, understanding and, if necessary, improvement.

All authorised personnel should be able to demonstrate that they have the skills, tools and knowledge of procedures to safely carry out their responsibilities for isolations and hazardous energy controls. This can normally take the form of a self assessment questionnaire relating to certain tasks as well as regular auditing of isolation and hazardous energy control systems.

Permit to work systems

A permit to work system may be required when the task involves several personnel and is of a complex nature. This may also apply where the uncontrolled risks are too high to rely on normal isolation or hazardous energy treatment procedures or where the isolation of an energy source may create a safety hazard elsewhere.

Other areas in which a permit to work should be considered include those tasks that can result in catastrophic events or are of a high risk nature. In this regard, the task could require working in confined spaces, working at height or in shafts, working in gas hazardous areas, working in dust hazardous areas and work performed in areas that contain additional hazards such as high voltage cables or near overhead power lines.

Under these circumstances an authorised person (Permit Holder) who understands the operation of the equipment, and has the knowledge to carry out systematic isolation or hazardous energy treatment procedures, will have control during a task that involves additional hazards and requires multiple points of isolation or hazardous energy treatment.

The system may also require an isolator, depending on the nature of isolation required. The process involves the raising of permits for each task to which a competent person will sign on and off for a specific task. In general, equipment should not be energised until all permits have been signed off and returned to the authorised permit holder.

Note: It is common practice in many industries to only access high voltage installations using a permit to work system. Mine operators are strongly encouraged to use a permit to work system as part of the safe work procedures before accessing any high voltage installation.

Feedback sheet

Your comment on this Guideline for Hazardous Energy Control (Isolation or Treatment) will be very helpful in reviewing and improving the document.

Please copy and complete the Feedback Sheet and return it to:

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How did you use, or intend to use, this Guideline?

What do you find most useful about the Guideline?

What do you find least useful?

Do you have any suggested changes to the Guideline?

Thank you for completing and returning this Feedback Sheet