Vedanta Resources Plc

Sustainability Governance System

Guidance Note GN20

Lock-Out / Tag-Out (LOTO)

Guidance Note – Lock-Out / Tag-Out (LOTO)

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Confidentiality

1. INTRODUCTION

1.1. Who is this Guidance Note aimed at?

This Guidance Note is aimed at all Vedanta subsidiaries, operations and managed sites, including new acquisitions, corporate offices and research facilities and to all new and existing employees and contractor employees. This Guidance Note is applicable to the entire operation lifecycle (including exploration and planning, evaluation, operation and closure).

This Guidance Note is for those operations and individuals responsible for the safe isolation of hazardous energy sources at a Vedanta operation. The Guidance Note should be used in conjunction with the Guidance Notes on Risk Assessment and Permit to Work together with associated Standards as listed in the back of this Guidance Note.

1.2 What is the aim of this Guidance Note?

This aim of this Guidance Note is to outline Vedanta Resources' requirements for Operations to follow in order to safely isolate equipment, machinery and plant. This applies primarily during the servicing and maintenance of equipment but also:

- during its normal operation if this requires operators to remove or by-pass a guard or safety device, or place any part of their body into the danger zone or near the machine's point of operation; and
- during set-up/troubleshooting activities;
- in any other circumstances where the unexpected energization or start-up of the machine or a release of stored energy could cause injury.

1.3 What issues does this Guidance Note address?

This Guidance Note presents the framework for hazardous energy isolations for all Vedanta operations, showing the key technical activities that may apply in each of these contexts, and identifying the main decisions to be taken at each stage.

The focus of the Guidance Note is on the provision of preferred methods and outcomes rather than prescriptions whilst at the same time representing a practical "how to" guide for all Vedanta operators. It is intended that the Guidance Notes will represent standard baseline guidance for all Vedanta staff within all the operations whilst recognising the need for flexibility at a site depending upon specific circumstances or regulatory specific requirements. In this sense, Guidance Notes are not designed to be definitive text, nor are they designed to provide prescriptive methods and procedures for undertaking tasks.

1.4 How should this Guidance Note be used?

This Guidance Note is not mandatory but is intended to reflect good practice and provide the basis for continual improvement across the Vedanta business. However, where this Guidance Note is not used, operations will need to demonstrate (and document) how an equivalent process is in place and how this ensures the safe isolation of hazardous energy sources. Safe isolation is typically either an explicit regulatory requirement or is considered to be a key element in the general duties for the safe operation and maintenance of plant and equipment. General and equipment-specific lock-out / tag-out (LOTO) procedures will need to be developed by each operation, taking into account the range and technical specifications of equipment and plant on-site, local legal

requirements and applicable standards etc. The guidance has been designed to be relevant to all Vedanta operations.

The remainder of this Guidance Note is structured as follows:

- Section 2 – What Do We Mean by Hazardous Energy & LOTO?
- Section 3 – When Does LOTO Apply?
- Section 4 – General LOTO Programme Requirements
- Section 5 – Roles & Responsibilities,
- Section 6 – Competency & Training Requirements
- Section 7 – Isolation Procedures
- Section 8 – Monitoring

At the end of the Guidance Note there is information on Definitions and Related Documentation and Annexes as follows:

Annex A – Example of a LOTO Register

2. WHAT DO WE MEAN BY HAZARDOUS ENERGY & LOTO?

Serious injury or fatality can occur due to the unexpected start-up of equipment or the uncontrolled release of energy during maintenance, servicing and set-up tasks. It is therefore critical when carrying out such tasks that equipment cannot be started and that all hazardous energy sources are properly de-energized, isolated, blocked and/or dissipated.

Types of hazardous energy sources include:

- **Mechanical/kinetic** – in the moving parts of mechanical systems (e.g. rotors, fan blades, conveyers – note that there may be residual kinetic energy even after power has been isolated);
- **Electrical** – from generated electrical power, static sources or electrical storage devices (such as batteries or capacitors);
- **Potential** – stored in pressure vessels, gas tanks, fly wheels, hydraulic or pneumatic systems, compressed or extended springs (potential energy can be released as hazardous kinetic energy) and objects suspended at height (i.e. gravity).
- **Pneumatic**–gas, compressed air, vacuum.
- **Thermal** – high or low temperatures resulting from mechanical work, radiation, chemical reaction or electrical resistance.
- **Chemical**– toxic, corrosive or flammable substances in chemical feed lines within processing operations (1).
- **Radiation** – ionizing and non-ionizing radiation sources.

The following types of isolation are covered in this guidance document:

- Mechanical Isolation
- Electrical Isolation of all equipment.
- Instrument Isolation
- Isolation of other energy sources

These types of isolation are discussed further in the following sections of this guidance document.

Lock-out / tag-out (LOTO) refers to the specific practices and procedures to safeguard employees from the unexpected energization or start-up of machinery, or the release of hazardous energy during maintenance or servicing activities.

- **Lock-out devices** hold energy-isolation devices in a safe or “off” position. They provide protection by preventing machines or equipment from becoming energized because they are positive restraints that no one can remove without a key or other unlocking mechanism, or through extraordinary means, such as bolt cutters.
- **Tag-out devices**, by contrast, are prominent warning devices that an authorized employee fastens to energy-isolating devices to warn employees not to reenergize the machine while he or she services or maintains it. Tag-out devices are easier to remove and, by themselves, do not provide employees with sufficient protection.

The method of energy control depends on the form of energy involved and the available means to control it. *Energy is considered to be isolated or blocked when its flow or use cannot occur.*

(1) Note also that inundation by water or by ore or other solid materials can be a significant risk in particular in the context of work in confined spaces, and should, where relevant, also be addressed within the LOTO programme.

3. WHEN DOES LOTO APPLY?

LOTO applies when employees or contract employees are involved in service or maintenance activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining or servicing machines or equipment. These activities include lubricating, cleaning or un-jamming machines, and making adjustments or tool changes, where the worker may be exposed to hazardous energy.

If a service or maintenance activity is part of the normal production operation, the employee performing the servicing may be subjected to hazards not normally associated with the production operation itself. Workers doing servicing or maintenance activities during normal production operations must therefore follow lock-out/tag-out procedures if they:

- Remove or bypass machine guards or other safety devices,
- Place any part of their bodies in or near a machine's point of operation, or
- Place any part of their bodies in a danger zone associated with machine operations.

Typical activities/equipment requiring isolation may include, but not be limited to:

- Vehicles (e.g. light and heavy vehicles, earth moving equipment, forklifts, haul trucks, shovels, drag lines, locomotives, scoops);
- Confined spaces;
- Work on/in crushers, mills, chutes;
- Conveyers, material transfer and packing lines.
- Power hand tools (e.g. chainsaws, angle grinders, drills, nail guns);
- Line breaking;
- Electrical sub-stations, transformers, power lines, distribution panels.
- Motor control centres;
- Electrical motors, pumps, generators, drill rigs, winches.
- Pressure vessels, boilers and pipe work.

Whenever lock-out / tag-out is applicable, the machinery must be shut off and isolated from its energy sources, and lock-out or tag-out devices must be applied to the energy-isolation devices. In addition, all authorized person(s) must take steps to verify that the energy has been effectively isolated including the use of one lock per person working on the isolated machinery. When there is stored or residual energy, the authorized person(s) must take steps to render that energy safe. If the possibility exists for re-accumulation of stored energy to hazardous levels, it must be ensured that the person(s) perform verification steps regularly to detect such re-accumulation before it has the potential to cause injury.

Exemptions from Lock-Out / Tag-Out

Exemptions from full lock-out / tag-out requirements will apply only in certain limited situations, for example where:

- Exposure to hazardous energy is controlled completely by unplugging the equipment from an electric outlet and where the employee doing the service or maintenance has exclusive control of the plug. This applies only if electricity is the only form of hazardous energy to which employee(s) may be exposed. This exception encompasses many portable hand tools and some cord and plug connected machinery and equipment.

- An employee performs hot-tap operations on pressurized pipelines that distribute gas, steam, water, or petroleum products, for which it is shown that:
  - Continuity of service is essential;
  - Shutdown of the system is impractical; and
  - The worker follows specific documented procedures and uses special equipment that provides proven, effective employee protection.
- The worker is performing minor tool changes or other minor servicing activities that are routine, repetitive, and integral to production, and that occur during normal production operations. In these cases, workers must have effective, alternative protection.

4. GENERAL LOTO PROGRAMME REQUIREMENTS

All Vedanta operations should develop and implement a documented hazardous energy control programme that, as a minimum:

- Establishes formal LOTO procedures;
- Trains all employees in the programme, and
- Enforces the use of the procedures at all times.

Hazardous energy control programmes should outline the following safe work practices to be carried out by suitably competent personnel:

- Identify each piece of equipment, machine or plant that could deliver hazardous levels of energy;
- Once the equipment has been identified, then identify tasks that may expose workers to hazardous energy and therefore require LOTO;
- Identify a specific method to de-energize all hazardous energy sources, including those in adjacent equipment – this will include:
  - reviewing the physical ability/means of equipment to be locked out/isolated and making modifications of existing equipment to allow for lockout where this is feasible (see Section 7.1);
  - development of equipment-specific work instructions that detail the energy sources and all locations of isolations needed to make the equipment safe prior to work being carried out on it - ideally this should include diagrams/photographs of the relevant isolation methods and locations.

The following steps should be followed for all isolations conducted:

1. Notify all employees who may be affected that a section of equipment is to be taken ‘out of service’ and it will be isolated from all sources of Hazardous Energy.
2. The authorised employee shall refer to the company safe operating procedures to verify the location, type and number of isolation points. In the absence of a procedure the additional requirements of the Permit to Work Standard will apply.
3. Shut down the equipment using the normal shutdown sequence where possible. If possible try to start the equipment to verify that the correct start controls have been identified and then shut down again
4. Isolate the equipment from all sources of hazardous energy using the previously identified isolation points and appropriate isolation devices.

5. Lock-out all energy isolating devices to prevent inadvertent or unauthorised reactivation/start-up(each person at risk should apply an individual Lock-out/Tag-out device to each source of hazardous energy so there may be many locks or tags on each device)
6. Apply a Tag providing extra information if required by the local safe working procedure
7. Ensure that stored or residual energy (such as capacitors, springs, elevated machine parts, fly wheels, hydraulic systems, and air, gas, steam or water pressure etc.) is dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding etc
8. Ensure that the equipment is disconnected from all energy sources by first checking that no personnel are exposed, and then verify the isolation of the equipment by operating the normal starting controls to test that the equipment will not operate.
9. The personnel working on the equipment shall complete a Risk Assessment to make a final check that no potential hazard is overlooked and that all required safety equipment is available and in use.
10. After work is complete, verify that all personnel are clear of danger points before re-energizing the system. This is normally completed by the use of one lock per person involved in the work programme.

Note: - If the equipment is left unattended a check must be made before work recommences to verify that the lockout has not been removed or damaged.

The process flow provided below is an example of the various steps of a LOTO procedure.

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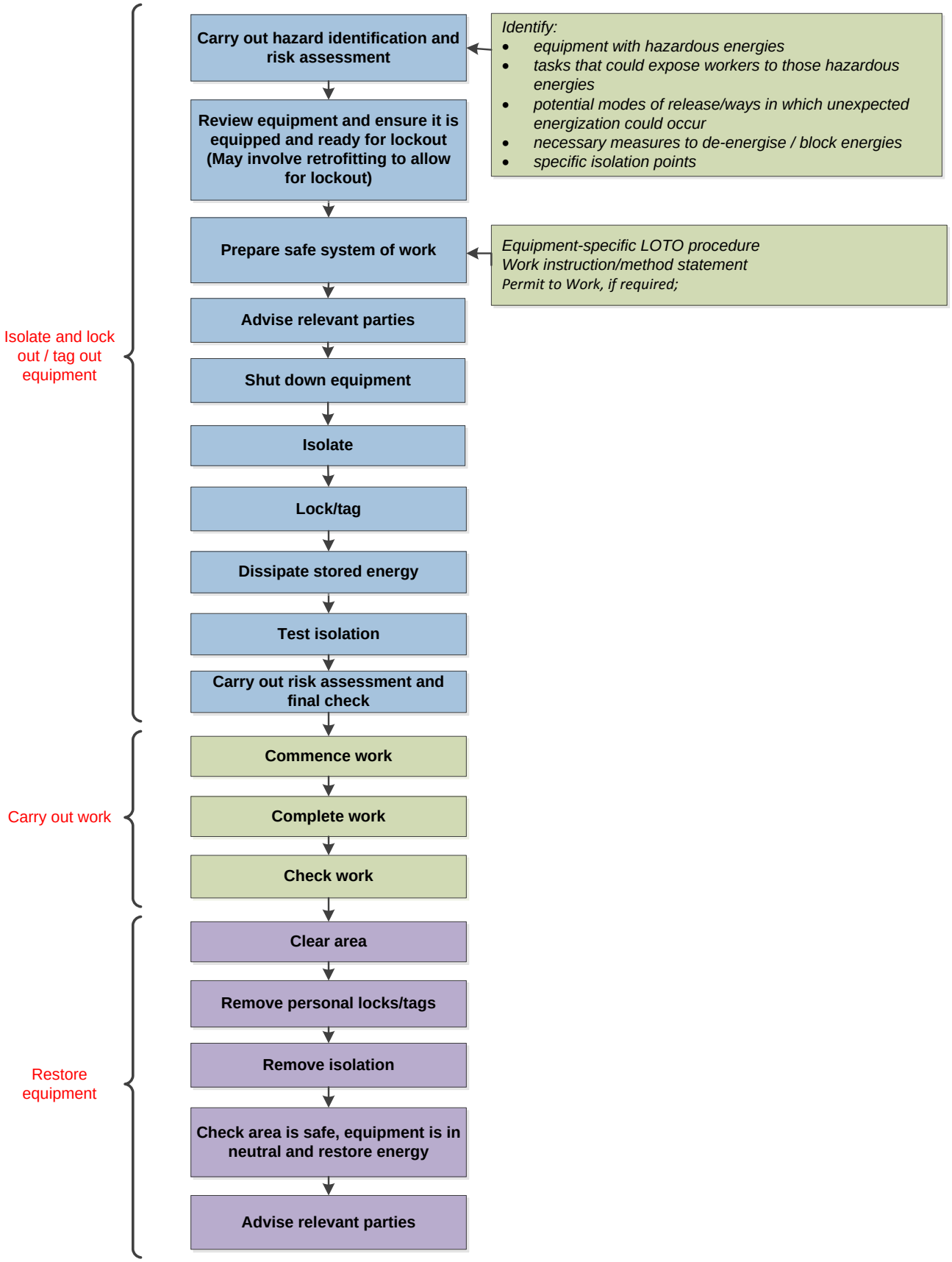


Further guidance on the various elements of a LOTO programme is provided in the following Sections.

5. ROLES & RESPONSIBILITIES

Isolations should only be carried out by appropriately trained, competent and authorised to do so. Responsibilities and competency requirements in relation to isolations should be clearly described in the operation's LOTO procedure. The procedure should specify the following key roles:

- **Competent (Responsible) Person** –An employee who is responsible for ensuring there is a safe procedure recorded for all aspects of the Control of Hazardous Energy in the systems/areas for which they are responsible. This will either be an established local procedure or referenced on a Permit to Work.

- **Authorised Person**– An employee or contractor who is permitted to lockout equipment to perform a service or maintenance on that equipment. This includes both operators and maintenance personnel. They will have received sufficient information and training to enable them to carry out the safe efficient isolation of hazardous energy on nominated machines or pieces of equipment. (Also sometimes referred to as an Isolation Officer).

- **Affected Employees** - Employees who operate the relevant machinery or whose jobs require them to be in an area where service or maintenance is performed.

Registers/records of those authorised to carry out isolations (i.e. Authorised Persons/Isolation Officers) must be maintained, including equipment competencies, site/work area limitations and competency durations.

It should be ensured that all contractors carrying out isolations or working on isolated equipment on behalf of Vedanta do so in accordance with the Vedanta Operation's own procedure, that they are competent (through provision of written evidence of training, examination etc.) and that they are appropriately supervised. If, however, it is agreed that the contractor may use their own LOTO procedures (for example in a defined work area where no Vedanta personnel could be present) then this should be clearly communicated to all personnel who could be affected such that they understand and comply with the requirements.

A communication plan should be developed to inform relevant employees and third parties about the need for LOTO and the arrangements in place within the operation to manage energy isolation.

6. COMPETENCY & TRAINING REQUIREMENTS

The Competent (Responsible) Person will need sufficient knowledge, experience and training to manage all aspects of safety on the Control of Hazardous Energy in the systems/areas for which they are responsible.

Authorised Persons need the knowledge and skills necessary for the safe application, use and removal of energy-isolating devices. Their training should cover aspects such as:

- Recognition of applicable hazardous energy sources;
- Details about the type and magnitude of the hazardous energy sources present in the workplace; and
- The methods and means necessary to isolate and control those energy sources (i.e. the elements of the LOTO procedures, including relevant equipment-specific procedures/instructions).

Affected Employees need to be trained in the purpose and use of LOTO procedures, including:

- Recognition of when the LOTO procedure is being used;
- Understanding of the purpose of the procedure;
- Understanding of the importance of not tampering with LOTO devices and not starting or using equipment that has been locked or tagged out.
- Issuing with a personal lock.

Training requirements should be clearly documented within the LOTO programme and appropriate records maintained. This should include arrangements to test understanding on the completion of training and for the periodic testing of competency.

Re-training/refresher training should be considered in the event of significant changes to the process, equipment, working practices and/or if workplace inspections, post-accident investigation or risk assessment activity identifies shortcomings in the existing level of competency.

7. ISOLATION PROCEDURES

7.1 Identification of Relevant Equipment, Tasks and LOTO Methods

Hazard Identification and Risk Assessment

The LOTO programme should be based on a thorough review – using hazard and risk assessment – of all items of equipment, machinery or plant that could deliver hazardous levels of energy, and then the identification of tasks (both routine and non-routine) that may expose workers to hazardous energy and will therefore require LOTO.

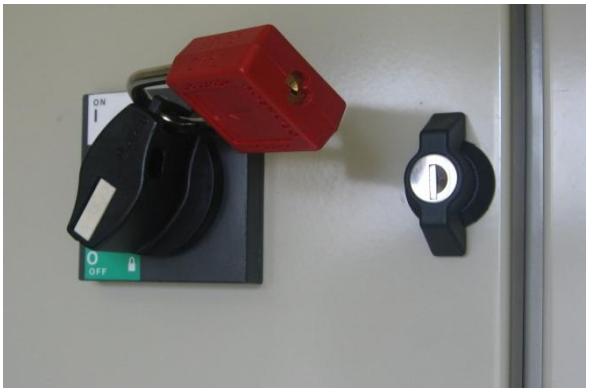
Equipment Review and Preparation

The review of the equipment referred to above should ensure that:

- All sources of potentially hazardous energy can be shut off and isolated.
- All sources of potentially hazardous energy that accumulate in a piece of equipment can be dissipated or blocked.

It should be ensured that all new plant and equipment purchased or hired has the capability of being physically isolated from all energy sources as required. An energy-isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy-isolating devices are capable of being locked out, if lockout can be achieved, without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability. Some examples of lockable isolation devices are shown below.

Lockable Valves
Examples of valves with integral lockout provision. If this is not provided then alternative lockout devices are available as discussed in Section 7.3.



Distribution Panels
Electrical distribution panels should be provided with lockable switches/breakers.

Lockable Rotary Isolator Switches
These are a common means of isolating electrical power to specific items of plant/equipment. They may already be installed or may need to be retrofitted to older items/circuits.

If modification or reasonable adjustments cannot be made to facilitate lockout on existing plant and equipment, then an alternative safe system of work will need to be developed that provides equivalent levels of protection, e.g. tagging combined with at least one added safety measure that prevents unexpected re-energization. Such measures might include removing an isolating circuit element, blocking a controlling switch, opening an extra disconnecting device or removing a valve handle

Dedicated isolation points should be identified and clearly and consistently labelled to identify the circuit or system being isolated or locked out. The positions of state (i.e. open/closed) of cut-off, isolation, dissipation and blocking points should be visible by means of an indicator. Switches and other isolation points should be positioned in readily accessible locations.

Equipment-Specific Isolation Procedures

Based on the above, specific documented methods and procedures should be developed for the de-energization, isolation and re-energization of each of the identified pieces of machinery/plant and the associated tasks. These isolation procedures may include relevant line drawings, diagrams and/or photographs of the relevant isolation methods and locations.

7.2 Planning & Documenting the Work

The person in charge of the operation of the equipment (the Operator) should be clearly identified, and this should be recorded.

In order to ensure that that there is no confusion about the equipment that is to be worked on and isolated (i.e. to prevent the wrong equipment being isolated),all parties involved – including the Operator and those who will be carrying out the work - should identify the equipment before the Authorised Person de-energizes, isolates or locks it out.

The Authorised Person shall refer to the defined isolation procedure to verify the location, type and number of isolation points. In the absence of an equipment-specific procedure the general LOTO procedure should be used (i.e. laying out the generic LOTO requirements) and the additional requirements of the Permit to Work Standard will then also apply.

Once the Operator has handed control of the equipment in writing to an Authorised Person, they may not operate or attempt to operate that equipment again, until the equipment has been handed back in writing.

Any other Affected Persons should be notified that the equipment is to be taken out of service and that it will be isolated from all sources of hazardous energy.
It is a good practice to document each isolation in a LOTO register which records:

- the equipment worked on;
- the work carried out;
- which isolations have been carried out, when and by whom;
- the names of all individuals who have applied personal locks;
- the date and time of removal of each isolation.

An example template of a LOTO register is provided in Annex A.

7.3 Shutting Down the Equipment - Isolation of Energy Sources

All forms of hazardous energy should be de-energized, isolated, blocked and/or dissipated using the previously identified isolation points. This may involve:

- Disconnecting or shutting down engines or motors that power mechanical systems;
- De-energizing electrical circuits by disconnecting the power source from the circuit; possible disconnecting means include the power cord, power panels (look for primary and secondary voltage), breakers, the operator's station, motor circuit, relays etc.;
- Blocking fluid (gas, liquid or vapour) flow in hydraulic, pneumatic, steam or chemical systems by using control valves (1)or by disconnecting, capping or blanking pumps, compressors and lines. Some systems may have electrically controlled valves. If so, they must be shut off and locked/tagged out.
- Blocking machine parts against motion that might result from gravity (falling).
- Isolating control systems and instrumentation.

A wide variety of LOTO devices are available to enable the effective isolation of different energy sources. Operations should ensure that they maintain a suitable stock of devices, the number and type of which will depend on the size and complexity of operations and the nature of the isolations that need to be carried out. Ready availability of such devices – for example in suitably located lock-out stations – will help to promote the consistent application of the lock-out programme.

Devices should be readily accessible when needed. Good practice is to maintain a stock of devices in lockout kits and/or at lockout stations positioned at appropriate locations around the operation.

Lockout Kits/Stations
Examples of portable lockout kits and lockout stations. Lockout stations are typically wall-mounted and are available in a range of different sizes, allowing easy local access to lockout equipment.

(1) Depending on the energy source/risk it may be appropriate to specify that two valves in series are needed to be isolated rather than relying on a single control valve.

Devices should be:

- of appropriate **durability** – e.g. tags should not deteriorate or become illegible when used in corrosive or wet environments);
- **standardised** – according to colour, shape, size and format;
- **substantial** – devices should be substantial enough to minimise early or accidental removal, e.g. tag means of attachment should be non-reusable, attachable by hand, self-locking and non-releasable; locks should be substantial enough to prevent removal without the use of excessive force or unusual techniques such as with the use of bolt cutters or other metal cutting tools;
- **identifiable** – locks and tags must clearly identify the employee who applies them; tags should also warn against hazardous conditions if the machine or equipment is energized and should include a legend such as: "*Do Not Start*", "*Do Not Open*", "*Do Not Close*", "*Do Not Energize*", "*Do Not Operate*";
- the **only devices used for control of energy** and should **not be used for other purposes**.

Some examples of the range of devices that are available for use on different types of energy sources and controls are illustrated below.

Cable Lockout
Integrated Safety Hasp and cable used for multiple circuit panel and side by side gate valve lockouts.

Electrical Plug Lockout
Surrounds the electrical plug and protects against accidental reconnection.

Universal Wall Switch Lockout
Locks Out Both Toggle and Decora Paddle Wall Switches.

Electrical/Pneumatic Lockout
Accommodates a large variety of electrical plugs as well as male air hose connectors.


Gate Valve Lockout
Completely surrounds the valve handle, ensuring it stays closed. Available in a range of sizes.

Ball Valve Lockout
Example locks quarter-turn ball valves in OFF position.

Fuse Blockout
Designed to be placed where fuses have been removed to prevent accidental re-insertion of fuses.


Gas Cylinder Lockout
Surrounds the gas valve handle to protect against accidental valve opening.

Circuit Breaker Lockout
Example shown designed for breakers that have holes in the switch tongue.

A Note on the Use of Emergency Stops and Circuit Control Systems for Isolation

Emergency stops cannot be used as means of LOTO as (i) they do not physically disconnect the source of power from downstream components and (ii) they do no release stored energy in the system.

Similarly, circuit control systems such as PLC systems and trip devices (e.g. interlocks, light beams) are not energy isolating devices. Reliance on such systems to control machine or equipment safety functions, such as stopping or preventing hazardous energy (motion), is not considered to provide effective employee protection from injuries resulting from hazards such as component failure, programme errors, magnetic field interference, electrical surges, and improper use or maintenance. However, if it can be demonstrated that a

PLC or similar control system is an alternative measure which provides effective protection, the system may be used only to protect employees who are performing minor tool changes and adjustments, and other minor servicing activities that take place during normal production operations and are routine, repetitive, and integral to the use of the equipment for production. To meet this exception, it must be demonstrated that there is effective employee protection, through the use of a system hazard analysis. In other words, the PLC system, on a case-by-case basis, would need to be designed, installed, used, and maintained in accordance with the generally-recognized good engineering practices (e.g., applicable manufacturers' recommendations; prior operating experience; reliability data) so as to protect employees from hazardous energy sources during the minor servicing activities.

7.5 Lockout of Energy Isolating Devices

Each energy isolating device should then be locked out. Dedicated isolation locks (not normal padlocks) should be used, and there should only be one key for each lock (combination locks are not acceptable).

In most LOTO programmes, two types of locks are used:

- "**Operations Lock**", "**Job Lock**" or "**Project Lock**". These are dedicated isolation locks, uniquely numbered or coded and normally distinguished by being a particular colour. They are kept either by authorised individuals or at lockout stations and are then "booked out" for a specific isolation (normally recorded in the Isolation Log).

- **Personal locks**. These are issued to individuals. They should be engraved ideally with worker's name and/or sequential numbering that can be traced to the individual together with a durable tag to identify the worker assigned to the lock. They can also have photo identification document applied.

Although not mandatory, locks can also be colour coded according to the department owners or according to the type of energy.

The lock-out procedures should ensure that all workers secure energy control devices with their own individually assigned locks.

If more than one worker is relying on the protection of an isolation, then all workers should apply their own locks, e.g. using a multi-lock hasp or lock box. Each worker has the right to inspect all the energy sources to ensure they are properly locked out before they apply their personal locks.

If the Authorised Person is working on equipment which requires isolation but where no one else is involved and the work is no longer than one shift, then it is normally acceptable for them to apply only their own personal lock (i.e. an Operations Lock", "Job Lock" or "Project Lock" is not needed).

Master Lockout Box

Prevents keys from being accessed until last padlock or lockout hasp is removed from the box. Provides the highest level of security available in a group lock box. Each lockout point on a piece of equipment is secured with a single padlock. Keys are placed in the group lock box and then each authorised employee places their personal padlock on the lock box. When work is complete, employees take their personal padlocks off the lock box, freeing the keys inside. Keys inside cannot be accessed until the last employee removes their padlock.

Multi-lock Hasp

Allows a number of users to apply their personal locks to the same isolation. This can be applied directly to the lockout point or to a lockout box if needed.

7.6 Application of Tags

All designated isolation points fitted with a locking device should be tagged. The tagging system should ensure that:

- Isolation points are positively identified, including the name of the person locking out;
- The reason for the isolation is clearly identified;
- Isolation tags are highly visible to prevent inadvertent operation.

Examples of tags are shown below.

A typical tag, either attached to a lock or applied solely as a tag-out.

This example includes photo ID of the worker who is applying the isolation.

Dedicated “Out of Service” tags may also be used to differentiate between equipment that is out of service (which could be for an extended period of time) and that which is subject to an active isolation.

When the use of lockout devices and procedures is impossible, a tag must be placed to indicate that the operation or movement of energy isolating devices from the "safe" or "off" position is prohibited. When possible, the tags must be placed at the same point at which a lockout would have been attached. If this is not feasible, the tag must be placed as closely as safety allows to the device in a position that will be immediately obvious to anyone who attempts to operate the device. Additional means should be implemented to provide an equivalent level of employee protection to that provided by lockout. This may include measures such as removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.

7.7 Dissipation of Stored Energy

Some forms of energy must be dissipated or restrained (by grounding, re-positioning, blocking, bleeding down etc.) after a system has been de-energized. System components such as electrical capacitors, hydraulic accumulators, or air reservoirs may retain sufficient energy to cause serious injury or death. For example, energy can be dissipated by taking the following steps:

- Vent fluids from pressure vessels, tanks or accumulators until internal pressure is at atmospheric levels (but do not vent vessels or tanks containing toxic, flammable or explosive substances directly to the atmosphere).
- Discharge capacitors by grounding.
- Release or block 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.

All machinery or equipment in the immediate area, or linked mechanically, electrically or through a control system, must also be made safe, and the work area controlled to prevent unauthorised access.

7.8 Verification of the Isolation

Once the isolation has been carried out, the Authorised Person should safely test that the equipment has been made safe and has zero energy. The type of test will depend on the equipment, but in all cases, all potential and other forms of stored energy must be discharged or controlled. This test should be described in the isolation procedure for the equipment. Only instruments approved for the purpose should be used. Tests may include (but not be limited to):

- Pressure;
- Voltage (including induced voltage);
- Redundant charges;
- Elevated equipment;
- Enclosed areas;
- Hazardous chemicals (particularly in confined spaces);
- Stored electrical energy;
- Temperature;
- Equipment under tension (e.g. cables, conveyer belts);
- Sources of gas.

Finally, after checking that no personnel are exposed, the isolation of the equipment should be verified by operating the normal starting controls to test that the equipment will not operate. Return operating control(s) to neutral or "off" position after verifying the isolation of the equipment.

Before beginning work, the personnel working on the equipment should complete a risk assessment to make a final check that no potential hazards have been overlooked and that all required safety equipment is available and in use.

If there is a possibility of re-accumulation of stored energy to a hazardous level, verification of isolation should be continued until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

7.9 Maintaining Continuity of the Isolation - Shift/Personnel Changes

The operation's LOTO procedures should provide for continuity of LOTO protection. This includes the orderly transfer of LOTO devices between outgoing and incoming shifts. Whilst there are a number of different ways that this can be achieved, the following two typical scenarios provide an example of an appropriate approach:

- Isolation involving a single personal lock (i.e. where an Authorised Person is carrying out a job on their own and where they have used their own personal lock to isolate)

In this scenario there should be a handover between the outgoing and incoming Authorised Persons. The outgoing Authorised Person will remove their personal lock and the incoming Authorised Person will apply theirs.

Another method used in some operations is that of a "shift change lock" to which only authorised employees have access. The shift change lock is applied until the next Authorised Person is ready to start their work – note, however, that as more than one person has access to this type of lock –

and therefore the ability to remove it - it does not provide personal protection. If using this approach it is important to train employees are trained never to use shift change locks for personal protection.

- Work involving multiple persons (i.e. where "job" isolation lock(s) have been applied by an Authorised Person and then each member of the work team applies their personal lock(s)).

Control of the job lock(s) used to effect the isolation will then be transferred between the outgoing and incoming Authorised Person (as this is not a personal lock it may remain in place and only control of the device – i.e. the key – is transferred). The incoming work team will then apply their personal locks to the isolation and the outgoing work team will then remove their personal locks

When LOTO devices remain on energy isolation devices from a previous shift, the incoming shift members should verify for themselves that the machinery is effectively isolated and de-energized.

If the equipment is left unattended a check must be made before work recommences to verify that the lockout has not been removed or damaged.

7.10 Removing the Isolation

When work has been completed a check should be made that all employees and contractors have completed the necessary tasks and the work area should be inspected to ensure that it has been made safe (guards replaced, tools removed, personnel removed to a safe area etc.).

After verifying that any controls (where appropriate) are in neutral, workers will then remove their personal locks and tags followed by the Authorised Person, who will then remove their own lock, tag and lock-out device.

Re-energization of the equipment or systems will then occur in line with normal start-up procedures after communication to all staff affected by the isolation.

A final check should be made that normal operation has resumed correctly and the lock-out register and/or permit to work completed and closed.

It is critical that the worker who installs a lock should be the one who removes it after work is completed. If for any reason this is not possible then a specific procedure must be followed (this should be documented in the operation's lock-out tag-out procedure). Only the site manager or appointed nominee may then authorise removal of the lock after:

1. Determining why the owner cannot remove the lock;
2. Making every reasonable effort to contact the lock owner or establishing their whereabouts;
3. Ensuring that the area and equipment is safe for the removal of the lock;
4. Authorising the removal of the lock in writing (often an Abnormal Lock Removal Form is established for this purpose); and
5. Advising the owner at the earliest opportunity that the lock has been removed.

8. MONITORING

The consistent application and effectiveness of the LOTO programme should be monitored through an appropriate audit/inspection regime carried out by suitably competent personnel. This should include review of:

- competencies (through observation, discussion and review of records);
- written LOTO records/registers and completed permits to work;
- content and adequacy of procedures; and
- on-site observations of the application of LOTO.
- Number of audits conducted
- Number and type of non-compliances identified

Changes to procedures and systems (including training and competency assessment, where appropriate) must be made and documented to eliminate non-compliance.

The operation's Management of Change programme should trigger a review of LOTO requirements when there are modification to plant or equipment, or when new equipment is installed.

The isolation LOTO programme should be periodically reviewed (at least annually).

DEFINITIONS

Definitions of key terms used in this document are shown in the following table.

Term	Definition
Affected Person/Employee	An employee whose job requires him/her to operate or use a machine or piece of equipment on which servicing or maintenance is being performed under lock-out or tag-out, or whose job requires him/her to work in an area in which the servicing or maintenance is being performed.
Authorised Person/Employee	A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment.
Capable of being locked out	An energy-isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy-isolating devices are capable of being locked out, if lockout can be achieved, without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability.
Competent (Responsible) Person	A person with sufficient knowledge, experience and training to manage all aspects of safety on the Control of Hazardous Energy in the systems for which they are responsible. This person ensures there is a safe procedure recorded for all aspects of the Control of Hazardous Energy. This will either be an established local procedure or referenced on a Permit to Work. (Depending on the size and complexity of the operation, there may be a single Responsible Engineer / Competent (Responsible) Person or there may be a number of competent persons responsible for the LOTO programmes in different parts of the organisation, all reporting to a single Responsible Engineer).
Contractor / Contract Employee / Contract Worker	An employee of a contracted company engaged or commissioned by Vedanta to undertake work or provide services, but who are not directly employed by Vedanta. For example, contractor employees working on Vedanta operations, persons working for Vedanta through staff/employment agencies, contract cleaners etc.
Energized	Connected to an energy source or containing residual or stored energy.
Energy-isolating device	A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit-type devices are not energy-isolating devices.
Energy source	Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy, including sources of potential energy.

Term	Definition
Employee	An individual who is engaged to work directly for Vedanta on either a part-time or full-time basis and for a fixed period or on permanent basis and is salaried. By virtue of the individual's contract of employment, the employee is obliged to adhere to Vedanta's terms and conditions of employment (specific to Group or the subsidiary employing the individual), and is protected by national (where it exists) and international laws concerning labour and working conditions.
Formal Training	Recognised, accepted and prescribed training with a set and replicable structure.
Hazard	An object, property or an activity that can cause adverse effects e.g. a high voltage electricity supply or a toxic chemical may present a hazard, meaning that they present the potential for harm.
Hot tap	A procedure used in the repair, maintenance, and services activities, which involve welding on a piece of equipment (pipelines, vessels, or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.
Lock-out	The placement of a lock-out device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the lock-out device is removed.
Lockout device	A device that uses a positive means such as a lock to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.
Operation(s)	A location or activity that is operated by a Vedanta Company and is part of the Vedanta Group. Locations could include mines, refineries, ports or transportation activities, wind farms, oil and gas development sites, offices including corporate head offices, and research and development facilities.
Responsible Engineer	A single person with overall responsibility for the content, application and regular review of the isolation programme and LOTO procedure. This person will also typically be responsible for the creation of equipment-specific isolation procedures or method statements.
Risk	The effect of uncertainty on objectives (as defined by the ISO 31001 Standard). Uncertainties include events (which may or not happen) and uncertainties caused by a lack of information or ambiguity.
Risk assessment	The formal process of identifying, assessing and evaluating the health and environmental risks that may be associated with a hazard.
Servicing and/or maintenance	Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubricating, cleaning or un-jamming machines or equipment and making adjustments or tool changes where the employee may be exposed to the unexpected energization or start-up of the equipment or release of hazardous energy.
Setting up	Any work performed to prepare a machine or equipment to perform its normal production operation.

Term	Definition
Tag-out	The placement of a tag-out device on an energy isolating device, in accordance with an established procedure, to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tag-out device is removed.
Tag-out device	A prominent warning device, such as a tag and a means of attachment, which can be fastened securely to an energy-isolating device in accordance with an established procedure, It indicates that the energy-isolating device and the equipment being controlled may not be operated until the tag-out device is removed.
Vedanta Company	A subsidiary of Vedanta Group either fully or majority owned that has its own management structure (e.g. Hindustan Zinc Limited, Vedanta Aluminium Limited, Sterlite Industries Limited, etc.)

RELATED DOCUMENTATION

A summary of the references and supporting documents relevant to this document is provided in the following table.

Doc. Ref.	Document name
POL 06	HSE Policy
MS 1	Leadership, Responsibilities and Resources
MS 3	New Projects, Planning Processes and Site Closure
MS 6	Competency, Training and Awareness
MS 9	Documentation and Records Management
MS 11	Incident Reporting and Investigation
MS 12	Auditing and Assurance
MS 14	Management Review and Continual Improvement
TS 06	Supplier and Contractor Management
GN 07	Risk Assessment
GN 10	PPE
GN 19	Permit to Work

ANNEX A – EXAMPLE OF A LOTO REGISTER

Equipment to be isolated	*Activities to be undertaken*	*Isolation method and location/Work permit number*	*Isolation implemented (date/time)*	*Lock Number*	*Person applying the isolation (Printed name and signature)*	*Removal of isolation (date/time)*	*Signature*