

1. PURPOSE AND OBJECTIVES

This Group Technical Standard defines the minimum requirements to eliminate fatalities, injuries and incidents caused by exposure to uncontrolled release of energy, during operational and maintenance activities on equipment, plant, and systems. A request for non-compliance with this standard must be managed through the *Technical Standard Exemption Request* process.

2. SCOPE

This Standard defines the minimum requirements for identifying and isolating energy sources and applies to all Anglo American Group managed businesses and operations, including contractors and visitors when involved in controlled activities at all phases of the operation's life cycle, including exploration, design, construction, operation and closure. The standard applies, but is not limited to, all sources of energy including potential, kinetic, elastic, chemical, electrical, mechanical, thermal (e.g.: hot liquids, solids, gases), nuclear, static, rotational, out of balance, light and gravitational energy. Energy associated with processes such as materials handling, transport pressure, vacuum, hydraulic, pneumatic and chemical processes are also included. Moving and stationery machinery are included. Live work (work on plant and equipment where energy is present) and High Voltage (HV) Switching (>1000V) are higher-risk activities that require controls beyond normal isolation of energies; for completeness the minimum requirements for these activities are contained in this standard.

This standard provides the controls, processes and means to ensure:

1. The availability of accurate and up to date information related to energy sources,
2. Appropriate energy isolation methods and devices are available,
3. The required competencies to identify and isolate all energy sources prior to commencing a task,
4. The appropriate transfer of custody for equipment, plant and systems from/to operations,
5. The accountabilities and responsibilities of each stakeholder are clearly defined.

This technical standard and associated guideline shall be applied in conjunction with local legislation or applicable national standards of specific countries, regions and/or districts. Where the requirements of such legislation are in conflict with information in this standard (including the guideline) or exceed provisions of this standard, such regulations or standards shall apply.

3. PLANNING AND DESIGN

3.1 A competency-based training system that covers the requirements of this standard and the site-based procedure, shall be in place for all personnel involved in the isolation, lock out and make safe process during the entire life cycle of the plant and equipment. This training system applies to all personnel including employees, contractors and visitors. Personnel shall have their competency assessed at a frequency not exceeding 2 years and be authorised as appropriate to their role.

3.2 Live Work and HV Switching (1000V+) are higher-risk activities that require controls beyond normal isolation of energies. It is a requirement that sites shall eliminate or engineer out live work as far as practical. For live work and HV Switching (1000V+) that cannot be eliminated or engineered out, there shall be site specific procedures in place that cover:

- energy flow analysis,
- risk based tasks,
- register of approved activities,
- relevant permits,



- training & authorisation of relevant personnel,
- specific approval at General Manager (or authorised delegate) level.

3.3 All equipment, plant & infrastructure whether purchased or constructed, (including hired and contracted equipment) shall:

- have the capability of being isolated, physically locked out, and tested for dead from all harmful energy sources,
- have engineered energy release mechanisms (e.g. bleed-off valves, pressure release valves, conveyor take-up winches etc.) to safely release stored energy. In cases where engineered energy release mechanisms are not practical (e.g. conveyor inclines), an engineered and certified energy retention mechanism(s) will need to be incorporated or utilised.

3.4 Isolation and lock-outs shall be in place, prior to the commencement of any activity (e.g. work, cleaning, inspections) where there are sources of energy which present hazards to personnel during the activity. All isolation and lockout shall be done in the main energy source path and not in the control circuit.

Remote isolation systems are approved for use provided they meet the following conditions:

- must be inherently safe and not introduce new isolation related risks but aims to eliminate them,
- must have a full functional safety assessment conducted,
- be installed adjacent to the machine to be isolated,
- must be interconnected with the DCS and SCADA systems,
- isolate the main energy path and be able to maintain the isolation integrity throughout work execution,
- Isolation methods or processes conducted outside the main energy path (e.g. control circuits) must have a full functional safety analysis conducted to confirm that appropriate safety levels have been met. Prior to use these isolation methods must be authorised internally and externally if required (e.g. statutory approval).

3.5 Critical equipment, system or processes as determined by a baseline risk assessment shall have an energy flow analysis developed by a multi-disciplinary group. The energy flow analysis shall be composed of clear and understandable diagrams of energy flow paths, residual or stored energy, associated isolation and lockout points and detailing the energy flows and storages in the machine, equipment or plant. Operations shall comply with this requirement within a period of three years from document publication.

3.6 All isolations shall only be conducted at an approved isolation point. Approved isolation points shall be:

- standardised, clearly identified as an approved isolation point with respect to the associated equipment,
- in the main energy path,
- lockable,
- clear in the state of isolation (on or off), and
- recorded in a central register.

In the case of pipelines, isolation valves in the main energy path would fall within the approved isolation points requirement. However, in the absence of isolation valves, an approved isolation method must be in place. Examples for approved isolation method(s) would include insertion of spades or spectacle blinds or physical removal of a spool piece or section of piping in combination with spades/spectacle blinds or locking of valves.

3.7 There shall be two isolation processes used on every site, namely a Level 1 and Level 2 Isolation.

Level 1 Isolation procedures can be utilised where, as a minimum the following conditions are met:

- not more than 3 energy sources need to be isolated,
- there are 8 or less Individuals (workers) involved,
- the test for dead process is conducted or witnessed by all Individuals(workers). New Individuals signing on the work that was not part of the initial test for dead process need to verify that the isolations are still valid and meets their requirements,
- all personal locks used in a level 1 isolation must be removed when the individual leaves the task and/or site.

All site personnel involved with the isolation of energy (i.e. employees, contractors) shall be competent and authorised to execute a Level 1 Isolation. The site induction procedure should cater for visitor training and supervised isolations. This isolation process does not require a formal handover process, Authorised Isolator verification nor the use of a locking box. Coordination with operations on work activities is mandatory for every machine or system controlled by operations. The whole isolation procedure is executed by all the individuals without the need for an Authorised Isolator. No special permits are necessary for Level 1 Isolations, but the isolation must be registered (e.g. captured on the lockout device tag, a work order or pre-operation inspection).

A Level 2 Isolation shall be executed when the requirements of a Level 1 Isolation cannot be met, and include the following as a minimum:

- a formal handover process, or authorisation (e.g. permit) must be generated by operations, indicating the safe conditions of the transferred machine, equipment or plant,
- formal registration of the isolation (in digital or paper form),
- formal verification of the isolation execution by a second competent Authorised Isolator,
- the use of a lock box to control the custody of the keys from the lockout devices used in the Level 2 Isolation,
- a formal hand back (commissioning) process must be in place. This process must include the test protocols that proves the safety and effectiveness of the activities performed,
- visible document that articulates the isolation requirements, the Authorised Isolator, the date the isolation was conducted, the authorised isolation verifier and the applicable work the isolation covers,
- a process should be in place to review the suitability of the isolation procedure when new activities are required on an already isolated machine,
- level 2 Isolation and verification can only be conducted by personnel that have been trained, assessed as competent and authorised as an Authorised Isolator,
- a coordination/shift handover process to be in place to ensure that all stakeholders are aware of the activities being performed.

3.8 The isolation process shall consider 3 stakeholder roles and any/all locks used shall be uniquely differentiable (e.g. colour) according to function. These are:

- Operations: representing the team operating equipment, accountable for the handover and hand back process,
- Authorised Isolator: represents the competent and authorised person who conducts a Level 2 Isolation or verifies another level 2 isolation,

- Individuals: represents every person (worker or contractor) who ensures his/her own safety, is trained, competent and authorised to conduct and work on a Level 1 Isolation or conduct work on a level 2 isolation. Visitors are also required to be trained and authorised to apply a lock to an isolated piece of equipment under supervision but are not able to conduct work on that equipment.

3.9 All equipment used for the test for dead process shall be calibrated, at least annually. Equipment functionality shall be validated by a competent person prior to each use. All equipment specified shall be type test certified or approved for the application.

3.10 An Isolation verification process shall be in place for Level 2 Isolations carried out, prior to the commencement of any work. For Level 2 Isolations a second Authorised Isolator will need to verify the integrity of the isolation process.

3.11 Every energy source shall be diverted to safe potential in the work area whenever possible, e.g. earth probes for electrical energy, hoses or pipes in hydraulic systems. If the implementation of an energy diversion system is not possible/practical, an engineered and certified energy retention device shall be used e.g. wheel chocks for vehicles, rods/pins for fixing moving parts, clamps for conveyor belts etc. This provides a mitigation stage in case all preventive measures fail.

3.12 Personal lockout. All personnel (including contractors and visitors) shall conduct a personal lockout by applying their unique lockout device to the lockout point of the machine, equipment or plant; prior to the commencement of any activity (e.g. work, cleaning, inspections) where there are sources of energy which present hazards to personnel during the activity. Every individual shall remove their lockout device(s) after their work is complete or when leaving site.

Personal locking devices shall be uniquely keyed and:

- not be combination locks,
- not have an unauthorised second-party master override key,
- be kept under the exclusive control of the owning individual and key(s) shall not be transferred to another person for lock removal,
- have clear identification label/tag on the lock (identification of the owner, name and contact information)

3.13 Group lockout using lock boxes that are used for Level 2 Isolations shall have means for every worker to apply his/her lock to ensure the effectiveness of the isolation and lockout procedure.

Requirements for a Lock Box:

- The following documentation is required to be fully contained and visible in such a manner that it cannot be modified without the full level 2 isolation process being re-instigated. The documentation must be legible without having to open the lock-box. (Equipment name/number, work orders, isolations conducted, Authorised Isolator and verifier and handover),
- keys for the isolation locks are stored inside the box,
- it allows for personnel to attach their personal locks and tags outside of the box to avoid the box from being opened,
- group isolation boxes must be as close to the point of work as practical.

3.14 Extensions (e.g. hasps onto group isolation boxes) to install additional locking devices are permitted only if they provide a way to ensure the integrity of the Isolation procedure.

3.15 A process must be in place to ensure the custody of authorised Level 2 Isolation keys.

3.16A coordination/shift handover process to be in place to ensure that all stakeholders are aware of the activities being performed.

4. IMPLEMENTATION & EXECUTION

4.1 Every site shall have a Site Isolation of Energies Procedure in place which contains as a minimum:

- the requirements of this standard,
- complying to local regulations,
- special site requirements and permitting,
- restrictions and conditions on isolation points, locking devices, procedures and people competencies,
- a colour coding process for identifying isolation stakeholders locking devices,
- a process to deal with the emergency removal of personal locks,
- a process for ensuring the integrity of isolations during shift changeovers,
- defined accountabilities and responsibilities,
- explicit requirements and procedures for energy isolation,
- requirements for marking and labelling of isolation points, locking devices and service conditions,
- a commissioning process to ensure and document the results and final condition of machinery after maintenance activities,
- segregation and barricading requirements,
- a process to deal with long term isolations.

4.2 Each site shall have a process in place to develop and maintain the energy flow analysis.

4.3 Each site shall have in place a Management of Change (MoC) Process. The MoC process shall consider; a) isolation of energies (equipment, process and people), b) isolation procedures and c) energy flow analysis.

4.4 Site Equipment/systems isolation procedures shall be in place for high risk or frequently executed activities and include the following:

- a listing of involved energies,
- detailed and step by step isolation, test for dead and lockout procedures for each energy as defined in the energy flow analysis,
- energy diversion means where applicable,
- barricading and segregation requirements.

5. PERFORMANCE MONITORING

5.1 A system must be in place to ensure that:

- a site isolation procedure is in place, operable, widely available, current and complete,
- energy flow analyses are available and current,
- people are competent on the development and execution of isolation procedures,
- isolation devices are operative and well maintained.

- 5.2 An audit of the requirements and compliance of this standard shall be undertaken at an annual frequency. Documentation related to the design, modification and maintenance of isolation of energies systems and hardware shall be an element of this audit.
- 5.3 All incidents related to this standard shall be reported and investigated according to the site procedures or local legislation.

APPENDIX A: REFERENCED DOCUMENTS

Document Number	Previous Number(s)	Title
AA TS 106 002	AA GTG 06	Isolation of Energies Guideline

APPENDIX B: RECORD OF AMENDMENTS

- Version 1 : Revised document based on Control of Energy Bowties conducted in May 2019. Name change to Isolation of Energies. Supersedes Isolation Standard (AA GTS 06 - 2013). (Responsible person Peter Ellen, January 2020)

APPENDIX C DEFINITIONS

Approved Isolation Point	A point which can be used for the isolation of energy and has been approved for such purpose.
Authorised Isolator	Trained, competent and formally authorised person accountable for making the work area free of harmful energies. This includes performing the isolation, lockout, test for dead, and energy diversion procedures for a Level 2 Isolation.
Competent Person	Person with theoretical required understanding, knowledge of the system and practical experience on the required procedures to execute the task.
DCS	A distributed control system (DCS) is a computerised control system for a used to control a process or plant.
Energy diversion	To deviate (or safely dissipate) an unexpected energy release outside the work area.
Energy flow path	The route energy follows or is conducted inside an equipment or system.
Isolation	To physically remove any connection or means to supply any form of energy to equipment in order to make energisation of such equipment impossible.
Individual	Person with the required theoretical understanding, knowledge of the system and practical experience on the associated procedures to safely execute Level 1 Isolation. This includes all workers and contractors that will conduct Level 1 Isolations or sign on to a Level 2 Isolation.
Level 1 Isolation	This is an Isolation where 3 or less energy sources need to be isolated, and there are 8 or less workers involved.
Level 2 Isolation	This is an Isolation where multiple energy sources (more than 3) need to be isolated or there are more than 8 workers involved in the work. It is an Isolation in which more rigour in the isolation process is required. It is any isolation that does not meet the criteria of a Level 1 Isolation.
Live Work	Work conducted on plant and equipment which is still energised.

Lock box	Box specially designed to control the custody of keys used for lockout devices used in a Level 2 Isolation.
Lock Out	To put a personal lock or appropriate device on to equipment in such a way that it would be impossible to connect, switch on or start, utilise or energise the equipment without removing the lock or device.
Lockout device	Device used to keep a system in an isolated condition.
Make safe	To remove any threat or potential threat to health and safety posed by the source of energy, equipment, any equipment in the vicinity, any other substance or charge in the immediate area. This includes, but is not limited to, barricading, clamping, chocking, constraining, de-pressurising, earthing, neutralising, purging and ventilating.
Residual energy	Energy remaining on a system as stored energy inside of it.
SCADA	SCADA systems are used to monitor and control plant or equipment. It is an acronym for Supervisory Control and Data Acquisition.
Stored energy	Energy potential inside an equipment that has not reached a safe energy potential.
Tag	Label used to identify a lockout device.
Test for Dead	A process of confirming the effectiveness of isolation, by verifying that all energy sources are at a safe potential.
Visitor	Is a temporary person on site for activities other than work, who is not fully inducted but has been trained and authorised to apply a lock as part of a level 1 or level 2 isolation, under the supervision of an authorised isolator.