COMPANY RULE

CR-GR-HSE-432

HSE Requirements for the isolation of powered systems: electrical systems

Executive summary

This rule defines the HSE requirements for the isolation of electrical systems.

Organisation

The electrical isolation process is described in a documented procedure which includes the requirements of this rule as a minimum.

The distribution of roles and assignments in the implementation of the process, as well as the possibility for delegation, is clearly defined and communicated to the relevant employees and contractors.

All employees and contractors with a role in the electrical isolation process are trained and receive authorisation. Training is refreshed at least every 5 years.

Preparation

An electrical isolation is based on a risk analysis validated by a visit to the work location in order to physically identify the equipment and electrical system subject to the electrical isolation.

An electrical isolation package is compiled and must be approved by the approving authority.

The electrical isolation plan, as part of the electrical isolation package, is updated according to the isolation operations on site and is accessible to anyone involved.

Implementation

The disconnection devices defined in the electrical isolation package shall completely isolate the equipment or the electrical system from all its power sources.

The disconnection devices implemented in the isolation phase are locked out and tagged out by the isolating authority to secure against re-connection and also locked out and verified at the disconnection point by the work performing authority.

A Zero Voltage Test shall be conducted by the isolating authority before any work intervention and as close as possible to the work location by the work performing authority.

Before any electrical work intervention, the isolated electrical system shall be earthed and short-circuited.

Protection against adjacent live parts shall be implemented before work starts if there are parts of an electrical installation near the work location that cannot be isolated, earthed and short-circuited.

The electrical system can only be released for work once the electrical isolation certificate is issued by the isolating authority and verified by the work performing authority.

Re-energise

All re-energising, including temporary re-energising, is carried out by the isolating authority and recorded on the electrical isolation certificate, after removal of lock-out/tag-out devices by the work performing authority and upon return of the isolation certificate to the isolating authority.

Personal electrical isolation

A personal electrical isolation is implemented for recurring works with a low level of risk, for a maximum duration of one shift or day according to the entity's or affiliate's work regime.

An exhaustive list of works that can be covered by a personal electrical isolation is established after a specific risk analysis and included in the electrical isolation procedure.

A personal electrical isolation is never handed over to another isolating authority.

Long-term electrical isolation

Long-term lock-out devices are identified on the isolation diagrams, listed in a dedicated register and checked at least quarterly.

Audit and performance improvement

The application of the electrical isolation procedure is audited. Performance indicators for the electrical isolation process are defined and reviewed during a process review at least once a year.

REV.	DATE	PURPOSE	AUTHOR	CHECKED BY	APPROVED BY
00	21/02/2025	Creation	DG/STS/HSE/OSH/SPT P. DE ROOVER	DG/STS/HSE/OSH P. HIEGEL	DG/STS/HSE N. BRUNELLE

Date of publication in REFLEX: 26/03/2025

Foreword	This English version must be considered as the reference version.

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1 Purpose

This rule defines the HSE requirements to be respected for preparing, implementing and organizing the electrical isolation process for electrical systems and includes the audits and performance improvement as well as the required competencies of employees and contractors involved.

This rule is established in accordance with CR-GR-HSE-001 *One-MAESTRO HSE Expectations* and complements the requirements of Golden Rule no.7.

For process and mechanical isolation, the reference document is CR-GR-HSE-428.

2 Scope of application

This Rule applies to all TotalEnergies' Companies[1] and other controlled structures[2] of the Company in accordance with their respective decision-making rules and is subject to local statutory and regulatory provisions.

Within companies and structures not controlled by the Company (i.e. TotalEnergies SE or one of its subsidiaries), the representatives of TotalEnergies SE or its subsidiary shall endeavour to promote this rule.

This rule applies to all operations carried out on electrical systems to safely isolate and re-energise them.

This rule does not apply to the work carried out between isolation and re-energising, neither the works on live parts or in the vicinity of live parts of the electrical installation, nor testing of the electrical installation.

3 Requirements

The figure below gives an overview of the electrical isolation process.

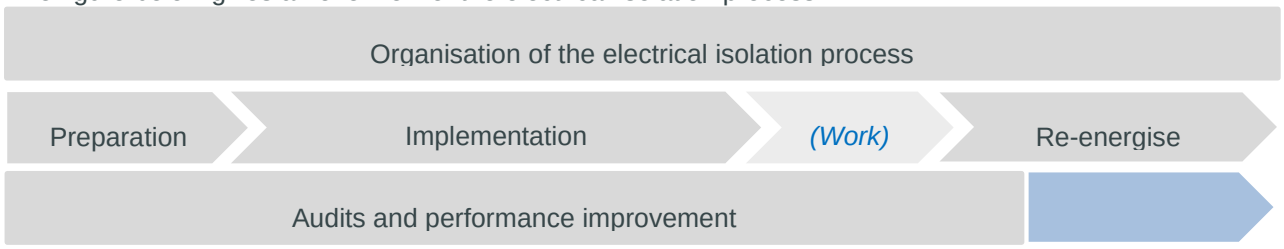


Figure 1 – Main steps of the electrical isolation process

The organization of the electrical isolation process consists of 8 steps (reference Appendix 4).

First is the preparation of the electrical isolation. Subsequently during the implementation, 6 distinct steps are identified:

- isolate completely (separate);
- secure against re-connection (lock-out / tag-out);
- Zero Voltage Test (ZVT);
- earthing & short-circuiting;
- protect against adjacent live parts (demarcate);
- release for work.

The last step of the process is the re-energisation of the electrical system after end of works.

[1]"TotalEnergies' companies" are TotalEnergies SE and all its subsidiaries; a subsidiary being a company in which TotalEnergies SE holds, directly or indirectly, the majority of voting rights.
[2] "Controlled structure" means any structure other than a company, formed in association with third parties and controlled by a TotalEnergies' Company (i.e. joint ventures, EIG, partnerships, etc.).

3.1 Organization of the electrical isolation process

Requirement 3.1.1.: Electrical isolation procedure

The electrical isolation process is described in a documented procedure which includes the requirements of this rule as a minimum.

(Expectation 04.01)

The procedure is written at least in the locally spoken language and English.

On sites where several languages are spoken, the entity or affiliate ensures that the procedure is understood and has been assimilated by all persons involved (as mentioned in Appendix 1).

In compliance with the requirements of this rule, the procedure may include arrangements adapted to the local context, in particular concerning:

- turnarounds for maintenance, construction yards and projects, dismantling or remediation projects.
- work on sites without industrial operations (e.g. offices, living quarters).

These adapted arrangements may concern for example the specific roles and assignments during the construction phase and the commissioning phase prior to hand-over and normal operation.

Requirement 3.1.2.: Roles and assignments

The roles and assignments of people involved in the electrical isolation process are clearly defined in the electrical isolation procedure and communicated to relevant employees within the organization and to contractors.

(Expectations 01.04; 04.07)

Every electrical installation has a designated person responsible for it, known as the "Electrical Asset Authority."

The electrical asset authority is appointed by a written record defining the perimeter of responsibility and the duration of the assignment. The electrical asset authority can delegate certain duties and responsibilities to others. This delegation is documented.

The roles involved in the electrical isolation process are outlined in Appendix 1 and can be adjusted based on the organization of the entity/affiliate.

Requirement 3.1.3.: Training and electrical authorisation

All employees and contractors with a role in the electrical isolation process are trained and receive electrical authorisation to assure their role. The electrical authorisation is a written document proving proficiency after a competency assessment.

The frequency of refresher training and re-assessment, at least every 5 years, is defined in the electrical isolation procedure.

(Expectations 01.04; 06.02)

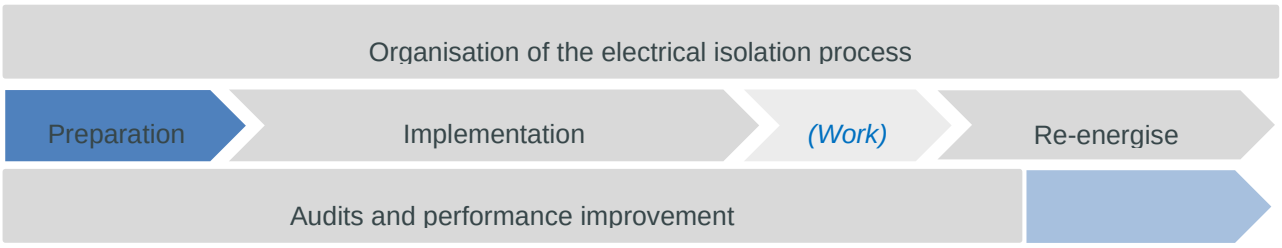
A specific training program, including theory and practical courses, is set out to develop and maintain the electrical authorisation of each individual according to his or her role and assignment as defined in the electrical isolation procedure (reference CR-GR-HSE-601 requirement 3.2.3).

Electrical authorisations are nominative and granted after an assessment in accordance with:

- different voltage levels, e.g. Low Voltage (LV) and High Voltage (HV);
- the tasks to be performed, e.g. type of isolation (single or multiple disconnection points), maintenance, testing, re-energizing;
- equipment, asset or site-specific knowledge, e.g. explosive atmospheres, local operating manuals.

The entity or affiliate ensures that electrical authorisations are kept current, including those coming from local regulations.
In the case where local regulations do not specify a training standard, EN 50110 and NPFA 70 E can serve as a basis. As a minimum, 2 different levels of electrical authorisations will be implemented: a skilled person and an instructed person for the tasks to be performed.

3.2 Preparing the electrical isolation



Requirement 3.2.1.: Risk analysis for electrical isolation

An electrical isolation is based on a documented risk analysis.

This risk analysis is validated by a visit to the work location to physically identify the equipment and electrical systems subject to the electrical isolation.

(Expectations 03.01; 03.04)

The purpose of the risk analysis is to minimize the exposure of an individual, and potentially others nearby, to electrical hazards As Low As Reasonably Practicable (ALARP).

The hazards associated with electrical systems are:

- electrical shock and electrocution;
- electrical arcing;

This dedicated risk analysis determines the level of required Personal Protective Equipment (PPE) during the implementation of all steps of the electrical isolation as well as during re-energizing as well the additional protective measures against live parts (barriers, screens) to be placed.

Appendix 2 details the associated risks.

Requirement 3.2.2.: Electrical isolation package

An electrical isolation package is compiled and must be approved by the approving authority.

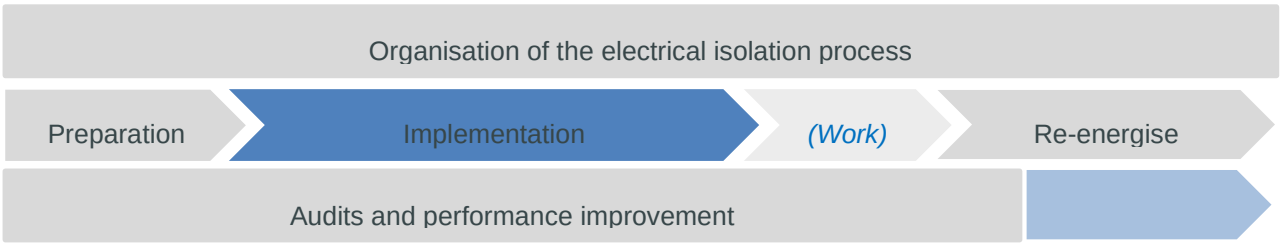
The electrical isolation plan – as part of the electrical isolation package – is updated according to the isolation operations on site and is accessible to anyone involved.

(Expectation 03.01)

The electrical isolation package comprises:

- risk analysis for electrical isolation;
- detailed up to date electrical isolation diagram(s), e.g. single line diagrams, electrical layout drawings;
- the electrical isolation plan (table with sequential actions), including:
  - the list of all the disconnection points and disconnection devices, e.g. disconnecting switches, removable fuses, …
  - a record of the installed lock-out devices to secure against re-connection on disconnection devices with reference to the electrical isolation diagram,
  - the points for Zero Voltage Test with reference to the electrical isolation diagram,
  - the points for installing the earthing and short circuit devices with reference to the electrical isolation diagram;
- the electrical isolation certificate (reference appendix 6 for a typical example);
- an operating instruction detailing the different steps to secure the electrical devices and equipment (releasing stored energy, Zero Voltage Testing);
- the electrical re-energising plan (table with sequential actions) including the removal of the used earthing and short-circuit devices, and lock-out devices referred in the isolation plan.

3.3 Implementation of the electrical isolation



The implementation phase of the electrical isolation comprises 6 different steps:

- isolate completely (separate);
- secure against re-connection (lock-out / tag-out);
- Zero Voltage Test (ZVT);
- earthing & short-circuiting;
- protect against adjacent live parts (demarcate);
- release for work.

Requirement 3.3.1.: Isolate completely (separate)

The disconnection devices defined in the electrical isolation package shall completely isolate the equipment or the electrical system from all its power sources.

(Expectation 03.04)

This separation is achieved by disconnecting all the power and auxiliary circuits and the active conductors, including distributed neutral (except for a network with combined protective and neutral conductor 'TN-C').

The disconnection takes the form of an air gap or equally effective insulation that will ensure that the disconnection point does not fail electrically.

Requirement 3.3.2.: Secure against re-connection (lock-out / tag-out)

The disconnection devices implemented in the isolation phase are locked out and tagged out by the isolating authority to secure against re-connection.

Those devices are verified physically at the disconnection points by the work performing authority.

The disconnection devices are also locked out by the work performing authority with different lock-out devices from those utilised by the isolating authority.

(Expectation 03.04)

All disconnection devices that have been used are secured against re-connection by locking their respective operating mechanisms.

If an auxiliary power source is required for operating the disconnection device, the power source should be made inoperative and locked-out, once the disconnection device is in the disconnected status.

Lock-out devices are singularly identified. The usage of each lock-out device is restricted to a single authority, at any given time.

If the work performing authority is unable to place his or her lock-out device on the disconnection device(s), a lock-out box can be introduced. The usage and management of a lock-out box would typically be specified in the electrical isolation procedure of the entity or affiliate.

Tag-out devices, installed on disconnection devices, explicitly indicate that the electrical system cannot be operated.

Requirement 3.3.3.: Zero Voltage Test (ZVT)

The isolating authority verifies the absence of voltage during the execution of the electrical isolation plan and logs this on the electrical isolation certificate.

The work performing authority verifies the absence of voltage as close as possible to the work location before any intervention.

(Expectation 03.04)

The Zero Voltage Test is carried out on all phases or poles of the separated and locked-out electrical system, including the neutral, at the work location or as near as practicable to the work location.

The Zero Voltage Test is carried out prior to earthing and short-circuiting, except when by system design earthing is automatically applied.

The work performing authority performs a Zero Voltage Test after each work interruption prior to restart of the work, except when the electrical system remained earthed and short-circuited.

The electrical isolation package defines the requirement for the applied voltage detecting systems or voltage detectors. Non-contact voltage detectors and multimeters are prohibited. For specific situation, e.g. direct current sources, additional measures are required. Appendix 3 details those technicalities.

For work on non-electrical components of electrical driven rotating equipment, the Zero Voltage Test is replaced by performing a start-stop test, also known as a try-out test. This start-stop test considers the possible presence of a remote control device (e.g. Programable Logic Controller (PLC)) which may adversely affect the start-stop test results. (reference CR-GR-HSE-428, Requirement 3.3.4)

Requirement 3.3.4.: Earthing and short-circuiting

Before any electrical work intervention, the isolated electrical system shall be earthed and short-circuited.

(Expectation 03.04)

The earthing of the electrical system is necessary to ensure that any stored or induced electrical energy is released. The earthing and short-circuiting are carried out only after confirmation of absence of voltage unless the electrical system is specifically designed to automatically apply earthing when disconnected.

Earthing and short-circuiting prevent the work location being live from upstream, downstream, or independent sources. It also contributes to protect against the effects of magnetic induction and capacitive coupling.

Earthing and short-circuiting are required for High Voltage (HV) electrical isolation and for Low Voltage (LV) wherever there is a risk of the system is being made live (induced voltage or stored electrical energy).

The earthing and short-circuiting devices are visible from the work location, whenever possible. Otherwise, the earth connections should be applied as close to the work location as is reasonably practical.

Precautions are taken to ensure that the earthing remains secure during the time the work is in progress. This can be established by locking-out or tagging-out the devices explicitly indicating that their removal is prohibited. Those earthing devices are numbered and referenced on the electrical isolation certificate.

Additional or alternative special precautions are taken to prevent danger if the earth connections are removed during measurement or testing.

Requirement 3.3.5.: Protect against adjacent live parts (demarcate)

If there are parts of an electrical installation near the work location that cannot be isolated, earthed and short-circuited, then additional protective measures are necessary and shall be applied to protect against adjacent live parts before work starts.

(Expectation 03.04)

Marking of the work location is carried out by the isolating authority. Working in the vicinity (near) of live parts should be carried out in accordance with local legislation. Field monitoring arrangements are put in place as defined in CR-GR-HSE-402, Requirement 3.5.4.

To mitigate electrical hazards in the vicinity of live components, protective measures should be implemented such as screens, barriers, enclosures, or insulating covers to maintain a safe minimum clearance distance in accordance with the voltage level.

If it is not feasible to implement those protective measures, protection is ensured by maintaining a clearance distance that is greater than the minimum required distance corresponding to the voltage level. This clearance distance should be visibly demarcated, and if necessary, supervised.

In the case where local regulations do not specify a minimum clearance distance related to the voltage level and constraints near live parts, both standards EN 50110 and NPFA 70 E can serve as a basis.

Requirement 3.3.6.: Release for work

The electrical system can only be released for work once the electrical isolation certificate is issued by the Isolating authority and verified by the work performing authority.

The electrical isolation certificate is not required for a personal electrical isolation.

(Expectation 01.04; 04.02)

The permission to start work will be given to the work performing authority only by the issuing authority under the condition that the electrical isolation certificate is issued and signed by the isolating authority.

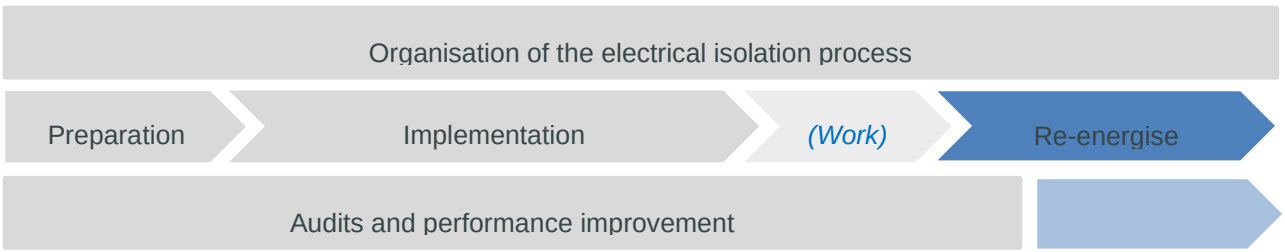
Earthing, additional protective measures and Zero Voltage Test will be checked and confirmed on the work location by the issuing authority and the work performing authority.

If the Zero Voltage Test (ZVT) at work location can only be performed by intrusive works, this works will be covered by a separate work permit and the electrical isolation certificate will be issued in steps.

- The first 2 implementation steps – separation and securing against reconnection – will be done and noted on the isolation certificate.
- The Permit To Work will be issued to start the intrusive works.
- The Zero Voltage test will then be performed by the work performing authority and witnessed by the isolating authority.
- The electrical isolation certificate is completed accordingly.

The electrical isolation certificate is issued once the Zero Voltage Test is performed by the Isolating authority and the electrical isolation plan is fully implemented. This can be applicable to for example junction boxes, rotating equipment driven by electromotor or electrical distribution panels.

3.4 Re-energise



Requirement 3.4.1: Re-energise

All lock-out devices and tag-out devices are removed in the sequence below:

- first by the work performing authority:
  - when all the works covered by these devices are finished and the corresponding permits to work have been closed out and,
  - the electrical isolation certificate is returned to the isolating authority;
- Then by the isolating authority.

(Expectations 01.04; 04.02)

Temporary re-energising is possible, for example to carry out tests, while withholding (suspending) of all permits to work and issuing a specific permit to work for this activity.

Those tests are validated upfront by the approving authority and monitored by the isolating authority.

Such tests typically include rotation direction checks of electrical motors, functional tests, …

The electrical isolation procedure of the entity or affiliate specifies how this temporary re-energising for testing is managed and how it is coordinated in case of multiple permits to work for multiple work performing authorities on the same system. Co-activities during testing of electrical systems should be avoided.

Re-energising and reconnection can only be granted when the work performing authority confirms the end of work by returning the electrical isolation certificate to the isolating authority and removing his or her lock-out and tag-out devices.

Re-energising and reconnection are then subsequently carried out in the reverse order of the isolation implementation phase. The re-energising plan (table with sequential actions) is part of the electrical isolation package.

3.5 Personal electrical isolation

Requirement 3.5.1: Personal electrical isolation

A personal electrical isolation is implemented for recurring works with a low level of risk, for a maximum duration of one shift or day according to the work regime of the entity or affiliate.

The electrical isolation procedure includes the exhaustive list of works – resulting from a specific risk analysis – that can be performed with personal electrical isolation.

(Expectation 03.04)

For any work not completed at the end of the shift or at the end of the day, the electrical system is either returned to normal operational status (re-energised) or an electrical isolation certificate is issued by the isolating authority.

This personal electrical isolation implementation may only comprise the first 3 implementation steps of an electrical isolation:

- separate,
- lock-out and tag-out
- Zero Voltage Test (ZVT).

Those steps are recorded in the format of a checklist and is part of a standard operating procedure which may also contain preparation checks, the requirements for electrical Personal Protective Equipment (PPE) and confirmation of the equipment identification to be isolated.

Personal electrical isolation allowance is recorded in the electrical authorisation of each individual according his or her role and assignment. The minimum level of authorisation for this personal electrical isolation is a skilled person.

Examples of works categories that may be secured by a personal electrical isolation are provided in Appendix 5.

Requirement 3.5.2: Restriction of use of personal electrical isolation

A personal electrical isolation is never handed over to another isolating authority.

A personal isolating authority may only have one personal electrical isolation in place on one electrical system at any given time.

Personal electrical isolation is prohibited for High Voltage (HV) and equipment with multiple sources.

(Expectation 03.04)

Personal electrical isolation is not allowed for any works requiring earthing and short-circuiting installation during implementation.

A personal isolating authority may have only one lock-out device which can be used for this purpose.

Isolation by more than one personal Isolating authority on one equipment is not allowed.

3.6 Long -term electrical isolation

Requirement 3.6.1: Long-term electrical isolation

Long-term lock-out devices are identified on diagrams, listed in a dedicated register, and inspected at least once every quarter.

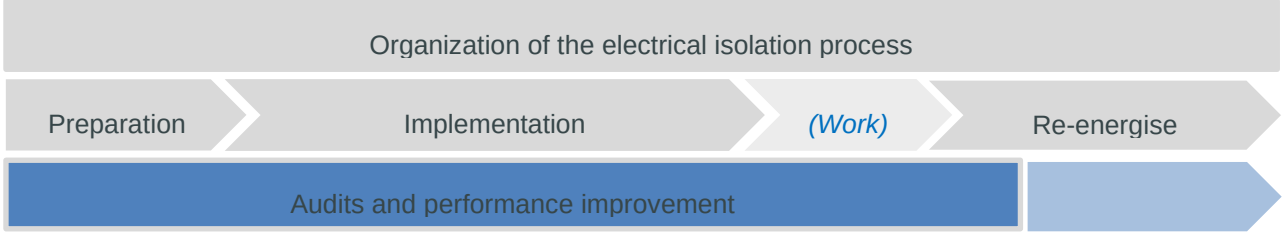
Removal of long-term lock-out devices requires a joint site visit to be carried out by the isolating authority and the approving authority that confirms those devices are no longer needed.

(Expectation 01.04)

Long-term electrical isolation covers the following scenarios:

- Electrical isolation remains implemented even after work activities have been halted and the permit to work has been formally closed out
- As part of mothballed electrical systems, i.e. equipment and installations being temporarily or permanently decommissioned

The periodic inspection of long-term lock-out devices enables to assess whether there is a continued need to keep them in place.



3.7 Audits and performance improvements

Requirement 3.7.1: Internal Audits and Performance Improvement

An audit program is put in place in the entity or affiliate, to make sure that the electrical isolation procedure is applied.

Performance indicators are defined and monitored, including as a minimum the verification of the isolation process with the use of dedicated checklists.

These indicators are analyzed during a process review at least once a year. The review gives rise to an action plan to improve the whole electrical isolation process.

(Expectations 01.04; 01.06; 02.01; 09.01; 09.02; 09.03)

The electrical isolation process should be audited on a regular basis as defined by the entity's or affiliate's procedure. These specific audits focus on the 8 essential steps of the process. These audits are not part of the work permit audits. Examples of performance indicators to monitor the process are given in Appendix 7.

3.8 Archiving

The conditions for archiving electrical isolation packages are defined by the entity or affiliate in compliance with the Company's document retention policy and the applicable regulations.

4 Terms and definitions

All the terms in the document defined in this paragraph are underlined in dotted lines throughout the document.

Control device

Device for manually or automatically, locally or remotely, modifying the functioning of a system such as: on/off push buttons, emergency shut-down functions, selector switches, programmable logic controller output relays, safety interlocks, etc.

Disconnection device

An electrical device used to disconnect the electrical system from the electrical installation such as fuses, disconnector switch, circuit breaker.

Disconnection point

A physical location where the disconnection device is used to separate the equipment or system from the electrical installation.

Earthing device

Device for earthing the disconnected parts of an electrical system, capable of withstanding for a specified duration electric current under abnormal conditions, but not required to carry electric current under normal operating conditions of the electrical system. This device can be a fixed earthing switch or portable equipment including earthing sticks, leads and clamps to perform works without danger of electrical shock.

Electrical authorisation

Formalized recognition by the electrical asset authority of a person's ability to safely perform the tasks entrusted to him or her in the context of works on or near electrical systems.

Electrical installation

Assembly of electrical systems to fulfill specific purposes. e.g. transporting, distributing or converting electricity.

Electrical system

A group of electrical equipment that are permanently electrically connected, which are a subsystem of the electrical installation. e.g. electromotor, cable and circuit breaker is a system.

High Voltage (HV)

Voltage range > 1 000 volts alternating current (AC), and >1 500 volts direct current (DC).

Instructed person

Person adequately advised or supervised by electrically skilled person to enable him or her to perceive and to avoid hazards that electricity can create.

Intrusive work

Works which requires dismantling and dismounting parts of an equipment to get access to the internals of the equipment.

Isolation certificate

Formal written document issued by the isolating authority stating the safe and secure status of an electrical system.

Lock-out

Operation that consists of securing the electrical separation using an appropriate lock-out device.

Lock-out box

A lockable box designed to securely hold lock-out devices (padlocks, interlock control keys).

Lock-out device

A specialized tool or mechanism designed to physically secure an electrical system, ensuring the safety of personnel during maintenance or servicing by blocking the power source and preventing accidental re-energization (mechanical blocking using a padlock, lock, nylon cable tie).

Low Voltage (LV)

Voltage range > 50 volts and ≤ 1 000 volts alternating current (AC), and>120 volts et ≤ 1500 volts direct current (DC).

Personal electrical isolation

A personal electrical isolation is defined as a system that is electrically isolated by simple separating and locking-out a single disconnection device and whereas the work performing authority has exclusive control over the isolation (i.e. the work performing authority and the Isolating authority are the same person).

Skilled person (electrically)

Or qualified person as per NFPA definition

Person with relevant education, knowledge, and experience to enable him or her to analyse risks and to avoid hazards which electricity could create.

Tag-out device

Visible warning device (label, sign) affixed to a disconnection device to show that the locked-out equipment or system cannot be operated until the lock-out device is removed by the Isolating authority or an authorised person.

Tag-out

Operation that consists of providing physical information on the state of the locked-out equipment or system using an appropriate tag-out device.

5 Reference documents

Reference	Title - Company documents
CR-GR-HSE-001	One-MAESTRO HSE Expectations
CR-GR-HSE-402	Permit to work process
CR-GR-HSE-428	HSE requirements for the isolation of powered systems: Process and mechanical systems
CR-GR-HSE-601	HSE competencies and training
GM-GR-HSE-450	Guide for detection of buried networks

6 Bibliography

Reference	Title – External documents
EN 50110-1	Operations of electrical installations – Part 1: general requirements
EN 50110-2	Operations of electrical installations – Part 2: national annexes
IEC 60479-1	Effects of current on human beings and livestock – Part 1: general aspects
IEC 61243-1	Live working – Voltage detectors – Part 1: Capacitive type to be used for voltages exceeding 1kV AC
IEC 61243-3	Live working – Voltage detectors – Part 3: Two-pole low-voltage type
IEEE 1584	Guide for performing arc-flash hazard calculations
NFPA 70E	Standard for Electrical Safety in the Workplace

7 List of appendices

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APPENDIX 2	Electrical risks: electrical shock and arc
APPENDIX 3	Zero voltage testing
APPENDIX 4	Supporting pictograms for the 8 steps of the electrical isolation process
APPENDIX 5	Examples of typical works that may be covered by personal electrical isolation
APPENDIX 6	Example of a typical electrical isolation certificate
APPENDIX 7	Examples of performance indicators to monitor the electrical isolation procedure application

8 Distribution and effective date

Effective date is 12 months following date of publication in REFLEX.

9 Revisions

REV.	DATE	PURPOSE	AUTHOR	CHECKED BY	APPROVED BY
00	21/02/2025	Creation	DG/STS/HSE/OSH/SPT P. DE ROOVER	DG/STS/HSE/OSH P. HIEGEL	DG/STS/HSE N. BRUNELLE

Appendix 1 - Typical functions exercised in the electrical isolation process

One person can have several functions within the entity or affiliate.

Title	Function	Illustrations of equivalent titles in the different branches	Intervention steps in the electrical isolation process
Electrical asset authority	Nominated person (employee or contractor) with the overall responsibility to ensure the safe operation of the electrical installations by setting rules and organization or framework for the entity/affiliate or site.	Site manager, site responsible, can be delegated to others as required, e.g. electrical engineer, electrical operations and maintenance manager	Preparation Implementation of the isolation Re-energise
Approving authority	Designated function in the entity/affiliate (employee or contractor), Approves the isolation preparation, by signing the electrical isolation package (risk analysis, isolation diagram, isolation plan, isolation certificate & isolation procedure), Authorises implementation of the electrical isolation (isolate, lock-out/tag-out, zero voltage test, earthing & short-circuiting, protection against adjacent live parts, release for works), and re-energise (including temporary re-energising for test). Removes long-term lock-out devices jointly with the isolating authority.	*Responsable de zone, Responsable opérationnel, Responsable du site, Contremaître, Chef de Quart*, electrical operations manager, operating authority, permit issuer, responsible person	Preparation Implementation of the isolation Re-energise
Work performing authority	Designated function in the entity/affiliate (employee or contractor), in charge of the execution of work. Accepts the permit to work in the approval phase, countersigns it when the permit is issued before execution of work and closes it out when work has been completed. Performs the work or supervises a group of people performing the work.	Performing authority, Acceptor, nominated person, Work leader, Person in charge of the work, *Superviseur d'intervention, Chef d'équipe intervention, chargé travaux électriques*, work teamleader	Verification of the isolation
Issuing authority	Designated function in the entity/affiliate, issues the permit to work, authorises execution of the work and closes out the permit to work when work has been completed.	Permit coordinator, asset shift supervisor, area manager, shift manager, operating authority	Verification of the isolation
Requestor	Designated function in the entity/affiliate (employee or contractor), initiates the isolation request linked to the work package. He or she is not always familiar with all electrical risks and has to collaborate with electrical asset authority	Requestor as per the definition given in CR-GR-HSE-402, *Responsable du site, Contremaître, Chef de Quart*, superintendents, work preparers	Preparation

Isolating authority	Designated function in the entity/affiliate (employee or contractor), prepares and implements, according to the type of electrical isolation, the isolation phase (isolate, lock-out, zero voltage test, earthing/short circuiting, release for works), and re-energise (including temporary re-energising for test). This person is responsible for physically performing the on-site electrical isolations and de-isolations that fall within his or her accreditation level (Low Voltage/ High Voltage, single fed systems,...). Oversees management of the lock-out and tag-out devices and updates the isolation certificate according to changes on site. Periodically monitors the lock-out devices on work location whilst they are in place. Removes long-term lock-out devices jointly with the Approving Authority	*Responsable de Zone, Chef de quart, Chef de poste, Opérateur, Electricien habilité, Chargé de manœuvre en électricité*, authorised worker, area operator, electrical supervisor, *electrical construction superintendant*	Preparation Implementation of the isolation Re-energise

Appendix 2 - Electrical risks: electrical shock and arc

Electrical shock

The hazardous nature of electricity comes from the effect of current running through the human body and varies depending on the path the electrical current takes through the body. The severity of the injuries caused by electric shock is influenced by several factors, including the followings

- Current strength: the higher the current (measured in Ampère), the more potential for harm.
- Voltage: voltage (measured in Volt) determines the force with which the electric current flows. Higher voltages are more likely to cause injuries.
- Resistance: the resistance of the body varies and may vary a lot depending on several factors like weight, gender, skin dryness. Dry skin has higher resistance compared to wet or sweaty skin, so the path of least resistance can affect the severity of the shock.
- Duration: the length of time the current flows through the body matters. A brief shock may cause less harm than prolonged exposure.

The following table illustrates those effects with threshold values as a summary of IEC 60479-1.

Effect on body	Alternating current (AC)	Direct current (DC)
Barely perceptible	0.5 mA	2 mA
Breath is paralyzed	30 mA	50 mA
Heart fibrillation (irreversible)	75 mA	130 mA
Heart failure	1 A	-

The effects can range from minor discomfort and muscle contractions to severe burns, cardiac arrest, and even death. It is essential to exercise caution around electricity, follow safety procedures, and seek immediate medical attention if someone experiences an electric shock, as the consequences can be life-threatening.

Electrical arc

Electric arcs occur in several circumstances: short circuit, fault live circuit disconnection and distance between two conductor's inferior to arcing limit.

This is independent of the voltage and can happen even with extra low voltage. The severity comes from the capability of the system to provide current and then energy to the arc. The only way to stop arcing is to open a breaker to switch off the circuit.
An electric arc generates a large amount of energy, potentially leading to:

- a blast with a risk of fall, hear loss, …
- projection of melted conductor (coper, aluminum) or casing (iron) with risk of heavy burns,
- intensive radiation with risk of eye burns and blindness.

An arc-flash study can be performed to establish the risk assessment and the measures to be taken to control the risks. One of the items in such an arc flash study is the calculation of the possible amount of energy of an electric arc using for example the guide IEEE 1584. The calculation is based on assumptions including the duration of the arc, the fault current and the distance of the individual from the arc. This gives an estimation of the incident energy emitted, expressed in cal/cm^2.

The incident energy should be calculated by the equipment manufacturer and displayed on the equipment. This is used to determine a safety perimeter around the equipment and the type of Personal Protective Equipment to be worn when entering this perimeter.

Appendix 3 - Zero Voltage Test

WHAT

Zero Voltage Testing (ZVT) is also known in different other abbreviations:

- VAT: Verify Absence of Tension,
- TBT: Test Before Touch.

WHY

All have the same goal, the verification of the absence of voltage.

HOW

To perform this test only a real voltage detector guarantees correct test results and therefore has to comply with IEC61243-3 for low voltage and IEC61243-1 for high voltage (above 1000 Vac or 1500 Vdc).

The advantages of low voltage detectors compared with multimeters are:

- no error on selector switch possible (AC or DC, current,...);
- no error on test lead connection (current input instead of voltage);
- works ALWAYS without batteries;
- auto-test functionality;
- single pole test (without potential difference).

SPECIFIC SITUATIONS

Direct current sources

On continuous direct current sources – battery strings and solar panels – an additional test is required because voltage remains present on the terminals.

Disconnecting and interrupting strings in DC circuits can generate arcs which are self-maintaining if the currents remain flowing.

For these typical direct current systems, the first two steps in the implementation of the electrical isolation (isolate completely and secure against re-connection) must be done at the end of the string on the point of disconnection (disconnector, fuse).

Prior to opening the battery string or solar panel string between two elements, an additional test shall be done by measuring the zero current by a current clamp meter on the location where the string will be interrupted.

Cable connected systems

In the case of cable connected electrical system, Zero Voltage Test (ZVT) at work location is not always possible. Cables shall so be positively identified. If the cables that have been isolated cannot be positively identified at the work location, other means of ensuring safety are put in place. This may include the use of suitable remote operated cable cutting devices.

Appendix 4 - Supporting pictograms for the 8 steps of the Electrical Isolation process

	Preparation (of electrical isolation process)
	Isolate completely (separate)
	Secure against re-connection (lock-out / tag-out)
	Zero Voltage Test (ZVT)
	Earthing & short-circuiting
	Protect against adjacent live parts (demarcate)
	Release for works
	Re-energise

Appendix 5 - Examples of works that may be covered for personal electrical isolation

Hereunder are examples that may be listed in the entity or affiliate procedure.

Works on:

- lighting;
- building automation and control systems;
  - telecom,
  - fire detection,
  - closed-circuit television (CCTV),
- Heating Ventilation and Air Conditioning systems (HVAC);
- Electrical Vehicle (EV) chargers;
- on-stream analyzers and samplers;
- instrumentation transmitters;
- fuel dispenser.

The list is to be established following a risk analysis for each of the tasks on the equipment. Criteria which can be considered for this analysis can be:

- no special Personal Protective Equipment (PPE) required during isolation, in addition to the standard electrical Personal Protective Equipment;
- no special electrical isolated tools needed during works;
- no bare live parts in vicinity and no additional protection necessary (reference Requirement 3.3.5);
- no earthing or short-circuiting required (reference Requirement 3.3.4).

Those criteria are linked with the assessment of the 2 electrical risks, i.e. electrical shocks and electrical arcs.

Works on batteries are excluded from personal electrical isolation in this example. Cause source remains charged and additional tools and personal protective equipment are required when performing tasks during disconnection.

Appendix 6 - Example of a typical electrical isolation certificate

TotalEnergies

Electrical Isolation Certificate no.:

Electrical system/equipment (TAG-number/identification)
Issued by (Isolating Authority):
Date:

Electrical Isolation plan no.:
Approved by (Approving Authority) :
Date:

The equipment has been separated, locked and earthed according the approved isolation plan

No attempt will be made to remove safety devices until this certificate is closed-out.

Lock-out device(s) / padlock number(s):

Earthing / short circuiting devices number(s) (if applicable):

Isolation diagram (single line, layout)
with disconnection devices, lock-out devices and earthing / short circuiting devices (if applicable)

	Zero Voltage Test	**Earthing/ short circuiting**	**Demarcation & Protections**
Isolating Authority	ZVT done ☐	implemented ☐	implemented ☐
Work Performing Authority	ZVT checked ☐	confirmed ☐	confirmed ☐

Release for works

Signature of the Isolating Authority	**Signature of the Work Performing Authority**
I confirm the complete electrical isolation Name: Date:	I hereby acknowledge the receipt of the certificate Name: Date:

! A valid permit to work is still required, this certificate shall be referenced on the permit to work !

Re-Energize

Signature of the Work Performing Authority	**Signature of the Isolating Authority**
I declare all works are finished and removed my personal padlock(s) Name: Date:	I confirm the close out of the electrical isolation certificate Name: Date:

Appendix 7 - Examples of performance indicators to monitor the electrical isolation procedure application

Monitoring the implementation of the electrical isolation process is crucial for ensuring safety and compliance. Here is a proposal list of key performance indicators (KPIs) that can be used to assess the effectiveness of the electrical isolation process.

- Isolation compliance rate: the percentage of isolation procedures that are correctly implemented compared to the total number of procedures initiated.
- Isolation verification checks by the work performing authority: the frequency of post-isolation verification checks to confirm the effectiveness of isolation measures.
- Incident and near-miss reporting: the number of electrical incidents, accidents, and near-miss events related to isolation, indicating the effectiveness of the process.
- Training and competency:
    - the number of individuals involved in isolation procedures who have received proper training and are certified as competent;
    - the number of individuals with overdue refresher training.
- Lock-out / tag-out device inspection:
    - the percentage of lost lock-out/tag-out devices on the total number of lock-out/tag-out devices;
    - the number of missing lock-out devices (no padlock) on the disconnection points. Differentiation can be made between isolating authority and work performing authority.
- Documentation accuracy: the accuracy and completeness of documentation (isolation packages) related to isolation procedures, including isolation plans, permits, and operating manuals.
- Long term isolation: the total number of outstanding long term isolated electrical systems. Differentiation can be made in total time since isolation (>3, 6, 12 months)
- Isolation process feedback: gathering feedback from personnel involved in isolation to identify areas for improvement.

End of document

Original version signed