Marsh

Marsh Specialty

# Process Isolations

Risk engineering position paper

February 2022

A business of Marsh McLennan

# Contents

# Process isolations

## 1. Background

During the lifetime of an operating process plant, many maintenance activities will occur that require breaking the pressure envelope on hazardous systems. Each time the pressure envelope is broken, there is a potential to increase the risks involved in operating the plant, for example through:

- Inadequate isolation for the system.
- Inadequate understanding of equipment status.
- Inadequate understanding of equipment to be worked on.
- Inadequate reinstatement of equipment.

It is well documented that poor execution of isolations and reinstatement on process plants has contributed significantly to large loss events within the energy industry. Some examples are described throughout this position paper. To avoid such incidents and maintain good operational performance, all sites operating process plants need a robust isolation management system.

The *Lloyds Market Associated Analysis of Common Causes of Major Losses in the Onshore Oil, Gas & Petrochemical industries* report presented in June 2020 stated that “safe isolation and preparation of equipment for maintenance and inadequate plant condition at handback” were among the primary and secondary causes for 20% of the 137 large losses (greater than USD50 million) that were analyzed.

To provide greater resilience against incidents and losses, site personnel must have a clear understanding of the fundamental and supporting steps required to safely execute activities that require breaking the pressure envelope on hazardous systems.

## 2. Objective

In this position paper, Marsh Specialty risk engineers define the key attributes and processes required to establish a good process isolation management system in the oil, gas, and petrochemical industries. These attributes reflect those in the Marsh Specialty risk ranking criteria for standard and operations deep dive control of work underwriting reports. They can be used to support and define risk improvement recommendations, and provide detailed advice to sites seeking to improve their isolation management systems.

## 3. Scope

The scope of this position paper includes the development and application of a process isolations management system to facilitate equipment and plant maintenance.

This document focuses primarily on operating site activities that require a break of the pressure envelope on systems that contain hazardous fluids, or critical utilities that have the potential to lead to significant losses.

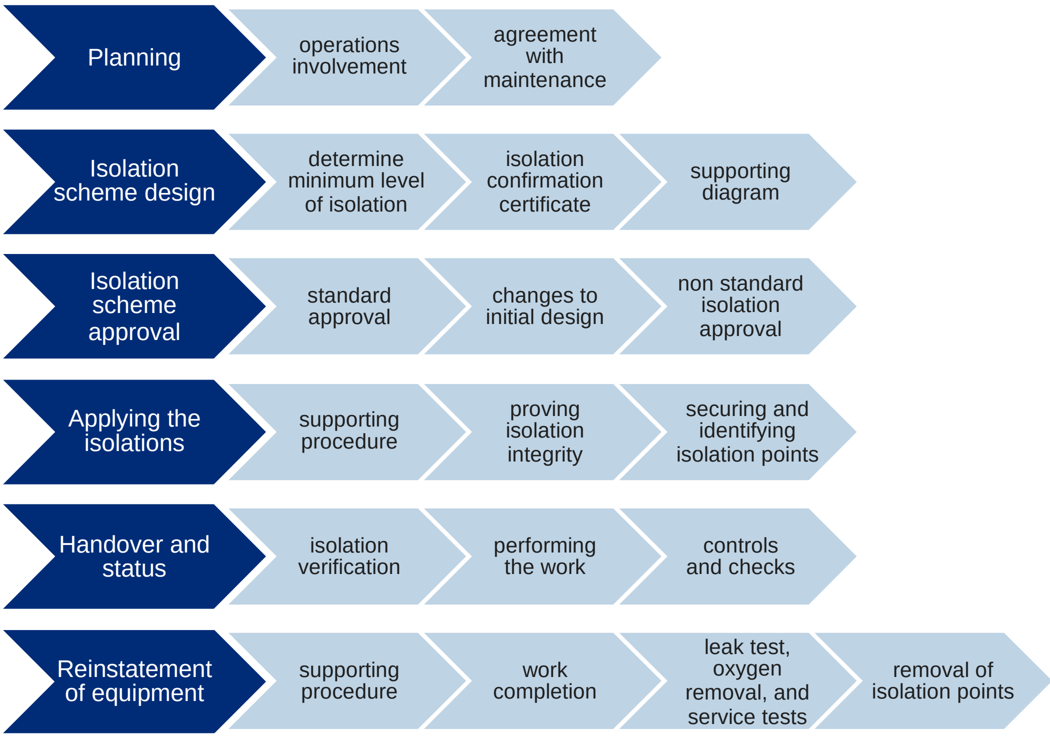
Note that throughout this paper, the word “site” is used to refer to the part of the organization applying the isolation management process. Depending on the nature of the organization, this may be a single plant, multiple plants on the same site, or multiple sites.

## 4. Specific requirements

Over the past 10 years, the process industry has evolved to where the use of electronic systems that link all aspects of a control of work system (including process isolation management) are common practice. Where a fully integrated electronic system for process isolation management is not in place, Marsh Specialty considers that a plan to move towards this practice would be positive.

All sites should have a comprehensive, documented local policy and procedure for the isolation, de-isolation and reinstatement of equipment from hazardous process streams and critical utilities. Any organizational and regulatory expectations for isolation and de-isolation should be available to all operating sites and incorporated into local procedures as appropriate.

The procedure should clearly define the personnel requirements, and the following steps:




See Appendix A for a checklist to assess your process isolation policy and procedure, and Appendix C for an example workflow for an isolation scheme.

## 4.1 Personnel

### 4.1.1 Awareness and training

The site should ensure the competency of all personnel involved with process isolations through formal training, practical assessment, and assessment interviews. The training should cover all systems present at site that may require isolation.

An up-to-date register of authorized personnel should be available at the permit issue station. A RACI chart (responsible, accountable, consulted, and informed) should be available in the maintenance and operations departments to identify which individuals should be engaged for guidance or approvals.

### 4.1.2 Key roles and responsibilities

The following definitions describe key personnel roles for an effective process isolation management process.

**Isolation applier**

An isolation applier (IA) is a member of the team who has completed the necessary competency assessment designing isolation schemes and the field application. The IA drafts isolation schemes, applies isolation management controls, performs second checks of isolations, and monitors the system throughout the duration of the activity.

**Isolation supervisor**

An isolation supervisor (IS) is an experienced IA (normally with a minimum of 5-10 years demonstrable experience) or shift leader. The IS can perform all duties of an IA, as well as authorizing isolation scheme designs, changes to isolation design, and alteration of isolation points to facilitate leak tests.

**Isolation manager**

An isolation manager (IM) is part of the operations management team, for example, a shift manager, head of department, offshore installation manager, etc. An IM can perform all duties of an IS, as well as authorizing non-standard isolations, and commissioning.

**Responsible engineer**

The responsible engineer (process, mechanical, electrical & instrumentation) supports the isolation review and authorization process for non-standard isolation, or where an isolation scheme may affect process safety or environmental systems.

## 4.2 Planning

It is essential that operational teams are provided with full details of work activity requiring isolations, for both planned (scheduled) and unplanned (for example, breakdown scenarios) maintenance processes.

Planning of maintenance activities should include an IS at the task risk assessment stage, when operations and maintenance teams are outlining the requirements for safe isolation of the system. This is best achieved through a site visit, where consideration of test points, bolt change requirements and a break point plan can be discussed and agreed.

To aid the planning process, it is good practice for a site to hold and keep an active valve register, which provides the operations team with an accurate condition of a valve. Details should refer to ease of valve travel, previous integrity issues, and any seized valves.

## 4.3 Isolation scheme design

The isolation points should be as close to the work location as possible and recorded on a single document, referred to in this position paper as an 'isolation confirmation certificate', with supporting diagrams providing visual representation of the isolation point locations.

If an isolation scheme is required to facilitate a higher standard of isolation (for example, a positive isolation) these should be two separate isolation schemes, to ensure that the permit issued for positive isolation references a complete and live isolation scheme. One to facilitate installation of the positive isolation, and the second for the positive isolations and subsequent maintenance activity.

### 4.3.1 Determining the standard of isolation

A site should have guidance in place that provides employees with the minimum standard required for safe isolation of system or equipment to be worked on.

Determination of the minimum standard required for safe isolation should consider the following factors:

- Line diameter and potential for pipe spring for larger diameters, for example greater than 6 inch.
- System maximum operating pressure and temperature.
- Other fluid characteristics for example, flammable, corrosive, carcinogenic, flash point, toxicity etc.
- The nature of the activity, for example, hot work naked flame, breaking of containment, confined space entry.
- Location and duration of the task.

The site should provide employees with a methodology for determining the required minimum level of isolation. A good example is provided in *HSE Guidance 253, Appendix 6: Example of a selection tool to establish the 'baseline standard' for a final isolation*. The site may choose to provide a calculation spreadsheet for isolation authorities to input data from the system they are isolating.

Another option is for maintenance teams to use isolation tables. These should have a minimum requirement for the system (fluid and maximum operating pressure) to be isolated and the line diameter that intersects to provide the minimum required level of isolation.

The decision on which type of tool to provide should be based on meeting the specific needs of each site, for example, the use of tables for may be more appropriate for a gas terminal; a calculation sheet may be more relevant to a refinery. See Appendix F for examples of these tools.

If positive isolation is defined as the minimum standard required to release a system of a specific task, the site should select the highest available level of valve isolation to facilitate the positive isolation, see Appendix E for definitions. The site should aim for completion of the maintenance activity within a shift. In all cases, an IS should review and authorize the work, refer to section 4.4 of this document.

### 4.3.2 Isolation confirmation certificate (ICC)

A document or electronic page showing all the isolation points and test points associated with the isolation scheme should be made available to all authorized personnel. The document should have a minimum of the following information:

- Title, reason for the isolation and unique document number.
- Cross-referenced documents, for example, management of change (MoC), radiation source isolation certificates, etc.
- List of permits dependent on the ICC for authorization.
- Register of all isolation points with the following detail for each point:
  - Isolation point identification numbers and lock numbers.
  - Test point identification and lock numbers.
  - Description of each isolation point.
- Section for recording second check of each isolation point.
- Section for recording removal of each point on the isolation scheme.
- Diagram showing all points on the isolation scheme.
- Isolations in long-term application (commonly documented as greater than 7 days).

Refer to Appendix B for an example.

### 4.3.3 Supporting diagram

The supporting diagram, for example, the process and instrumentation diagram (P&ID), must be in good condition, and the latest revision of the engineering drawing. Where master redline P&ID's are available and awaiting update, the responsible engineer should be engaged for clarification before documents are used. Pre-drawn, marked up supporting diagrams may be stored for reuse but care must be taken to ensure the diagram is the latest version, and that the existing isolations are suitable.

In some cases where complex machinery such as large compressors are to be isolated, P&IDs reference vendor drawings that detail additional equipment, for example, lube oil system, these should also be used.

Isolation types should be given a standard colour code when identified on the diagram. A site may choose what colours to use but they should be distinguishable from each other. The following is a good example:

- Red – closed valve isolation.
- Green – open valve isolation.
- Yellow – test point.
- Blue – positive isolation.

Isolation point numbers on a supporting diagram should be clear with distinguishable connection lines to the associated valve/positive isolation point.

## 4.4 Isolation scheme approval

### 4.4.1 Standard approval

A site should have defined levels of approval to validate the isolation scheme design before an isolation scheme design is authorized as fit for purpose. The first step is a review and approval/authorization of the draft design by an IA, IS and/or IM based on the standard and nature of the work activity. The final stage is confirmation that the isolation points are in place by an IA.

Where the isolation does not meet the site standard, a higher level of risk assessment should be performed involving the site safety team, responsible engineer, and IM.

The requirement to open or close a controlled valve as part of an isolation scheme should be captured under an approved procedure, with authorization from an IS or IM. In cases where movement of a controlled valve is not captured under an approved procedure, a temporary MoC should be raised.

It is sometimes the case that personnel can be authorized at multiple levels, for example, a person can be an IA and an IS. The electronic system should prevent a person authorizing at multiple levels, for example, an IS should not be able to authorize their own isolation scheme.

### 4.4.2 Change to the initial design

During the application of process isolations, issues are often encountered that require a change to the initial authorized design, for example, a passing isolation valve, change to positive isolation location etc. The site should have a process for altering isolation schemes that have been previously authorized, ensuring each step of verification and authorization is repeated. Refer to section 4.4.1 for more guidance.

Where isolation points have been removed, comments should be added to provide reasons why, which will help subsequent auditors to understand the thought process and reasoning. Every isolation scheme should have a visible timeline of actions taken in the development and execution, and this should include any alterations.

### 4.4.3 Non standard isolations

***Passing isolation valve***

If valve isolation integrity cannot be proven to a satisfactory standard, and no additional isolation valve is available without unit shutdown, a decision to continue should only be authorized by an IM through risk assessment, to determine if additional controls mitigate the risk sufficiently. A decision to continue should only be authorized by an IM through risk assessment to determine if additional controls mitigate the risk sufficiently. In many cases, the risk assessment outcome may determine that shutdown is still required.

***Line plugs***

Where hot work is required on pipelines, the closest isolation point can be far from the work location. Use of line plugs can provide isolation against migration of flammable vapour that may remain in the line after preparation and positive isolation. The site should have a clear definition of acceptable plug types.

***Others***

Isolation methods such as stopples, line crimping, line freezing, etc. should be subject to extensive review, and controlled through the site MoC procedure involving an IM.

**ISOLATION SUMMARY #1 Flash Fire at a Delaware refinery, November 2015**

The incident occurred during preparation of equipment for maintenance on the sulphuric acid alkylation unit, a process involving LPG to produce a high-octane motor gasoline-blending component.

During the preparation, day shift operators isolated the coalescer and caustic settler from the depropaniser column on a single valve and depressurised to flare, and continued with a water condensate wash of the vessels to displace residual hydrocarbons. The night shift had the task of completing a second wash by draining to the oil water sewer (OWS) used for preparation once hydrocarbon levels were low enough.

It was later determined that the isolation between the depropaniser and equipment under preparation was passing internally, allowing pressurised LPG to enter the coalescer and settler. Opening of the drain for the second wash allowed LPG to pass to the OWS, which later ignited causing flash fires in the drains system.

The US Chemical Safety Board determined that no procedure or process was in place to ensure the integrity of the isolation points to confirm all hydrocarbons had been removed. A poor level of isolation, involving a single valve, had been chosen to perform a task that required multiple shifts to complete.

## 4.5 Applying isolations

### 4.5.1 Supporting procedure

Approved procedures are an excellent way to ensure operations teams maintain good critical equipment condition, achieve the correct preparation specification, and ensure the correct standard of isolation is in place for breaking the pressure envelope.

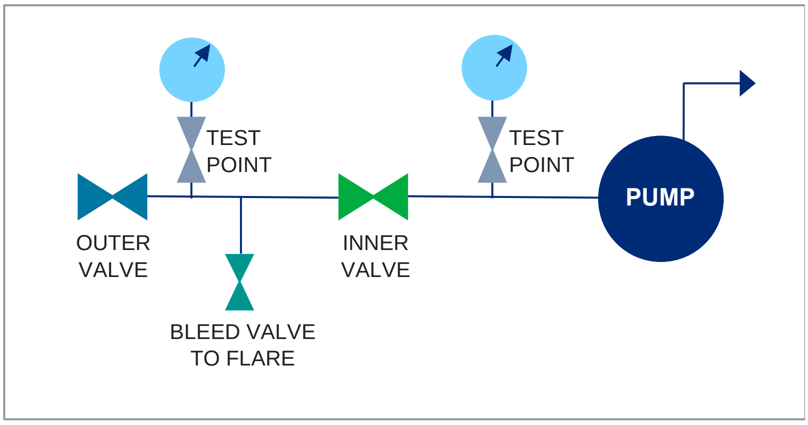
**Only suitably trained personnel, such as an IA should apply and confirm process isolations are in place.**

### 4.5.2 Proving isolation integrity

Guidance should be provided to personnel on how to prove an isolation is good. As a minimum, this should cover:

- Identifying test point.
- Pressure build up testing.
- Proving test points.
- Pressure build up monitoring.

Example: Proving a double block and bleed on a pump with 100mm diameter suction and 75mm discharge lines.




1. Ensure all pressure monitoring gauges are in good working condition.
2. Close the inner valve.
3. Depressurize pressure envelope to 0barg.*
4. Monitor for minimum of 15 minutes (this should increase as the pressure envelope increases).
5. If no build up, close outer isolation valve.
6. Depressurise interspace via bleed valve to 0barg.
7. Close bleed valve and monitor for 15 minutes.
8. Fit pressure gauge, monitor at start of work activity, occasionally during work, and after each work break. Open bleed valve.**

*If working on a low pressure system, for example, flare header, the IA should consult the responsible engineer for assurance that the test will provide an accurate indication of valve performance. Perform a pressure drop-down test, by increasing pressure on one side of the valve by use of nitrogen where possible.

**If bleed valve is not hard piped to vent or drain system, use of a temporary system authorized through MoC should be used. **DO NOT LEAVE BLEEDS OPEN TO ATMOSPHERE**.

Actuated valves should be used as a last resort. Where actuated valves are in use for an isolation scheme, the site procedures should specify that once closed, operation of the valve should be tested to provide assurance that it will not reopen inadvertently. For example, resetting the valve, switching from manual back to automatic, etc.

Where test points are not available between a valve and positive isolation break point, a site should consider the valve as a passing valve and conduct a higher level of review, see section 4.4.3.

### 4.5.3 Securing and identifying isolation points

All isolation and test points detailed on an isolation scheme must be secured through a lock and tag arrangement. The system used should have a minimum of the following:

- Locks should have unique numbers.
- Tags, as a minimum must detail the following:
  - Isolation point identification number.
  - Associated isolation confirmation certificate number.
  - Time and date applied.
- Cables should be sufficiently strong, and secure the lock and tag tightly through a valve handle and body that provides a deterrent against tampering.
- Locks, cables and tags should be constructed of weather proof materials.
- If locks have keys, these should be kept in a secure box within an IS office.
- Tags should be secured on lock/cables in field.
- Tags and locks should have corresponding colour to the valve positon as noted earlier.

**INCIDENT SUMMARY #2 Ludwigshafen, Germany, October 2017**

Maintenance work was taking place on a transfer line between the plant's processing areas and a jetty facility located on a river nearby, relatively near to the jetty. It is understood that at some point during the maintenance work, a cut was made in a line that was live, instead of the prepared line. This led to a release of hydrocarbon, causing a gas cloud to form. The cloud ignited, leading to an explosion and fire, which led to releases from at least one other pipeline nearby. It is understood that both ethylene and propylene were released as a result of the incident.

## 4.6 Handover and status

### 4.6.1 The second check

Where isolations are required to facilitate breaking the pressure envelope, there should be a second check complete by an IA who was not responsible for applying the isolations in the first instance. This ensures a second pair of eyes that may identify any deficiencies in the isolation design, or application.

### 4.6.2 Performing the work

To mitigate the potential for breaking into the wrong system, for example, opening a flange on pump A instead of pump B, an IA and maintenance team member should positively identify each break point prior to issuance of the permit. At the time of permit issue, the initial break of containment must be attended by an IA, who will agree the correct break points on the supporting diagram.

If there is a change to the maintenance work party, for example, a shift changeover, an IA should repeat the above field checks with the new team members.

### 4.6.3 Registers

***Status***

Isolation schemes should be assigned a specific stage of progress to allow personnel to understand where different process isolations are up to on their area of responsibility. As a minimum, isolation scheme status should cover:

- Under development.
- Authorized.
- Live.
- Under sanction to test/reinstatement.
- Complete.
- Long term.

For a new isolation scheme or where the status has changed, it should be recorded on the shift log and discussed during shift handover. Refer to *Marsh Specialty's position paper: Shift Handover* for more information.

***Long-term isolations (LTI)***

A site should have a defined period of time that triggers live isolation schemes moving to a long-term classification, typically seven days. Long-term isolation scheme(s) should be stored separately from standard isolations to declutter the day-to-day lists that the operations team manage, and ensure specific targets are set for auditing.

***Controlled valves***

A site procedure should ensure that controlled valve positions that require altering to facilitate an isolation are recorded on a controlled register, for example, a locked open/locked closed register.

***Disturbed flanges***

A site register that records disturbed flanges in the field relating to the isolation scheme should be available. The register should detail the break points, reference the isolation scheme number and person responsible at each stage from breaking to completion.

**INCIDENT SUMMARY #3 Heat exchanger rupture and ammonia release, Texas, 2008**

A manufacturing company used pressurized anhydrous ammonia to cool reactor effluent products that included styrene and butadiene. Operators closed an isolation between the heat exchanger shell (ammonia side) and a relief stream to allow a maintenance activity to replace a ruptured bursting disc.

The bursting disc was replaced on the day, but the closed valve was not re-opened as operators did not fully understand the status of the task as work completion documentation had not been signed, and was not kept at the production control station.

The following day an operator closed a block valve isolating the ammonia pressure control valve from the heat exchanger as part of a cleaning process for the tubes using steam. As the operator cleaned the tubes, the liquid ammonia trapped on the shell side absorbed the heat, resulting in an increase in pressure. As the relief stream was still isolated, the pressure ruptured the shell side of the exchanger, resulting in one fatality and multiple injuries.

## 4.7 Reinstatement of equipment

### 4.7.1 Supporting procedure

An approved procedure should support the safe reinstatement of an item of equipment or system that facilitates the removal of process isolations and introduction of system fluids. The procedure should have a method that prevents damage to equipment, unplanned release of fluids to atmosphere, or migration of fluids to incorrectly connected systems.

If actuated valves with an emergency isolation function are used in an isolation scheme by disconnection of the motive fluid, after a successful leak test as described in the following sections, the instrumentation department must test and prove the functionality of the valve before the associated equipment or system is fully reinstated into service.

### 4.7.2 Work completion

A facility should have a clear procedure in place to provide assurance that systems and equipment are safe for reinstatement to service, or hot standby after maintenance. The procedure should require all permit certificates referenced on the ICC, and any other certificates, to be signed-off as complete.

Physical checks of the equipment against master P&ID’s, should look at every aspect of the program of work, for example, main equipment, bolting, gaskets, instrumentation, barrier fluid etc. Documentation should allow recording of anomaly items to resolve before progression to leak test.

The system should provide a hold point to allow review and authorization to proceed with a leak or service test by an IS.

For guidance and additional information on completion of multiple systems, for example, after a major maintenance event, refer to *Marsh Specialty's Position Paper: Pre-Start Up Safety Review*.

### 4.7.3 Leak test and oxygen removal

The site should provide guidance on how to perform leak tests and oxygen removal for the different systems and equipment at the facility. As a minimum, the guidance should cover:

- Test medium, for example, nitrogen, water, helium tracer, etc.
- Leak test pressure, for example, 110% of maximum operating pressure or 95% of set pressure if pressure safety valve (PSV) in envelope. Special cases may require input from responsible engineer.
- Specific guidance leak test of compressor seal systems.
- Use of calibrated pressure gauge with correct range.
- Oxygen removal methods, for example, cycle purge, sweep purge etc.
- Duration of leak test.
- Draining and purging where appropriate.

In some instances there may be a requirement to alter the position of an isolation point to facilitate a leak test. There should be a clear procedure for this, sometimes known as 'sanction to test', with authorization given by an IS or IM.

### 4.7.4 Service test

Generally, service tests are completed on systems processing non-flammable or non-toxic systems, for example, cooling water, or steam and condensate. Another example is a lube oil system, where introduction of nitrogen may adversely affect the system operation. Such service tests should be completed under an approved procedure.

Service tests on flammable or toxic systems should be used as a last resort, and only after completion of a higher level of risk assessment involving an IM, responsible engineer, and relevant team, demonstrating the risk is as low as reasonably practicable (ALARP).

### 4.7.5 Removal of isolation points

Removal of isolation point tags and locks should only be authorized after a successful leak test and all relevant documentation is complete. An IA should physically remove all tags and locks and either store for reuse or discard in line with site procedures, before signing off the ICC.

In some cases it may be required to leave isolation points in the position recorded on the ICC, for example, valve remains closed, spade remains in place. The shift leader must agree, and in some cases, consult the responsible engineer for potential MoC implications. In all cases, the state of each point that is not in its normal operating position should be clearly communicated to all operating teams.

# 5. Stewardship of isolation management

## 5.1 Audit

A site should have a standard audit form for process isolations that covers fundamental and supporting attributes described in section 4 of this paper, as well as testing the understanding of individuals.

Audits should be completed at all stages described in section 4.6.3. Good practice is to ensure that a broad range of audits are carried out across various stages; this should be reviewed monthly.

A recommended practise is to have a firm schedule that meets defined target percentages, that notifies individuals of the requirement to complete the audit by a specified date.

It is important for process isolation management system audits to be complete by representatives from different levels of the organization, for example, operator, department head, plant manager. Equally important is that an auditor has a good understanding of the system, through training and experience, to maintain the quality of audits and any subsequent action that may be required.

Periodic external auditing should be completed to provide an impartial view on how the system is working. This can be by external regulators or from a central audit team where one exists.

## 5.2 Key performance indicators

It is important that audits performed translate into measurable information that provide departments and senior management with clear information about how the organization is performing, and an indication or recommendations of key focus areas, or where retraining may be required. As a minimum, organizations should track the following KPIs:

- Percentage complete audits per month for each stage and type.
- Average monthly compliance, for example, percentage score or absolute score.
- Number of non-conformances.
- Number of open and overdue actions.
- Number of long-term isolations.
- Number of isolation scheme authorized below standard.

## 6. References


Health and Safety Guidance 253 – Safe Isolation of Plant and Equipment, The safe isolation of plant and equipment - HSG253 (hse.gov.uk)

LMA Analysis of Losses in the Oil, Gas, and Petrochemical Industries, An analysis of common causes of major losses in the onshore oil, gas & petrochemical industries (lmalloyds.com)

Marsh Speciality – 100 Largest Losses in the Hydrocarbon Industry 1974-2019, 100 Largest Losses in Hydrocarbon Industry (marsh.com)

US Chemical Safety and Hazard Investigation Board, Delaware City Refining Company

IChemE Loss Prevention Bulletin 279, 2021 - IChemE

Isolate, de-energise, lockout and tagout plant - WorkSafe (www.worksafe.giv.gov.au)

29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)." 7/1/10, 1910.147 - The control of hazardous energy (lockout/tagout). Occupational Safety and Health Administration (osha.gov)

Fatal explosion hits BASF's Ludwigshafen site acs.org


## Appendix A

# Process isolation checklist

The following checklist provides sites with key questions to test their existing processes against the attributes in this position paper.

| Procedure | Yes | No | Comments/Actions |
|---|---|---|---|
| Do you have a procedure for application of process isolations at your site? | | | |
| Has the procedure been reviewed and updated within last three years? | | | |
| Is the procedure accessible by all relevant departments on site? | | | |
| **Personnel** | | | |
| Can you demonstrate competency of workforce in process isolations? | | | |
| Do you have specific training for process isolations? | | | |
| Do you have specific roles for process isolations? | | | |
| Do you have a register for authorized personnel for applying isolations? | | | |
| Do you have register for who can authorize non-standard isolations? | | | |
| **Planning** | | | |
| Is the operations team involved in planning of maintenance activities? | | | |
| Do maintenance and operation teams complete field-planning visits? | | | |
| **Isolation Scheme Design** | | | |
| Do you have standard guidance for determining levels of isolation? | | | |
| Do you have definitions of different isolation types used at your facility? | | | |
| Do you have a standard certificate for defining isolation schemes? | | | |
| Do you use *As Built* engineering drawings for supporting diagrams? | | | |
| Do you cross reference isolation certificates to permit certificates? | | | |
| Does each isolation on the certificate require an independent check? | | | |

| Procedure | Yes | No | Comments/Actions |
|---|---|---|---|
| **Isolation Scheme Approval** | | | |
| Do you have a workflow for approving a standard isolation scheme? | | | |
| Do you have a procedure for authorization of non-standard isolations? | | | |
| Do you have a workflow for altering authorized isolation schemes? | | | |
| **Applying the Isolations** | | | |
| Do you have approved procedures for preparation of equipment for maintenance? | | | |
| Do you have guidance for proving isolation integrity? | | | |
| Do you secure and label each isolation? | | | |
| Do the locks, cables and tags provide a deterrent to tampering? | | | |
| Do you perform a second check on isolations? | | | |
| **Handover and Status** | | | |
| Do you have a requirement for independent check and sign- off for equipment isolation status? | | | |
| Do you have a specific location for storage of isolation certificates? | | | |
| Do you have a specific location for storage of isolation certificate for reinstatement? | | | |
| **Reinstatement of Equipment** | | | |
| Do you have standard guidance for reinstatement of equipment? | | | |
| Do you have standard guidance for service or leak test and oxygen removal? | | | |
| Do you have approved procedures for reinstatement of equipment after maintenance? | | | |
| Do you have a pre start-up safety review procedure for multiple systems? | | | |
| **Stewardship of the Isolation Management System** | | | |
| Do you have a process for auditing process isolation schemes? | | | |
| Do you have targets for auditing isolation schemes? | | | |
| Do you have an isolation audit form for completing auditing? | | | |

## Appendix B

# Isolation Confirmation Certificate (ICC)

The following example provides a format for the ICC described in this position paper. Where an electronic system is in use, these attributes should be included, although layout will likely be different.

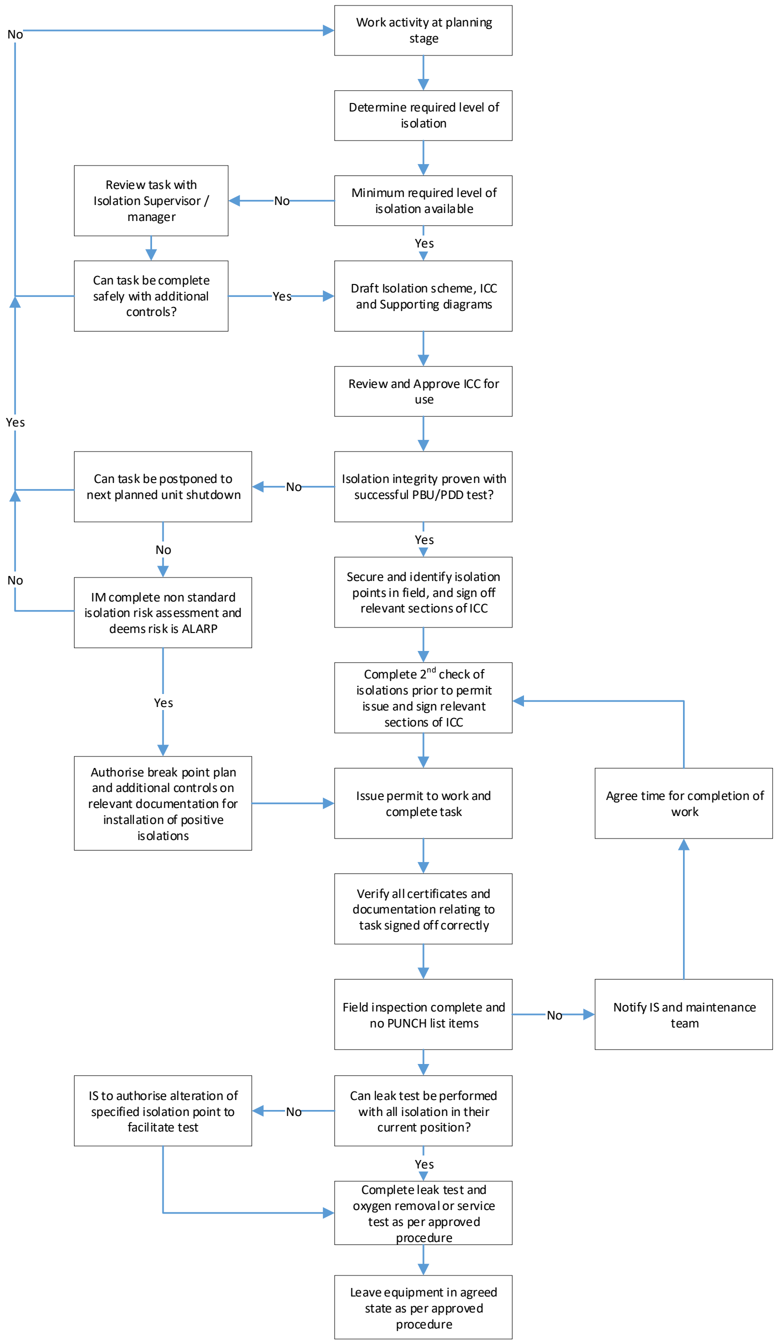
| **Unique reference number** | | | **Date of creation** | ***dd/mm/yy*** | | **Drawings attached** | |
|---|---|---|---|---|---|---|---|
| **Equipment and reason for isolation** | | | | | | | |
| **Authorization to use** | Name | | Sign | | Date | | |
| **Permit to work certificates** | | | | | | | |
| Certificate no. | | | | | | | |
| Status (live, suspended, closed) | | | | | | | |

| **Valve isolations (including trace heating)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Isolation point number | Description | Date applied | Sign | 2nd check date & sign | Lock number | Sanction to test | Date removed | Sign removed | Comments |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| **Actuated valve** | | | | | | | | | |
| ***Valve on air to ESDV-123 closed and line disconnected*** | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| **Positive isolations** | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| **Electrical isolation (including trace heating)** | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Unique reference number | | Date of creation | *dd/mm/yy* | Drawings attached | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Alterations** | | | | | | | | | |
| Isolation point number | Description | Date applied | Authorized by | Sign | 2nd check date & sign | Lock number | Date removed | Sign removed | Comments |
| | | | | | | | | | |
| | | | | | | | | | |
| **Isolation moved to long term isolation status** | | | | | | | | | |
| | | | | | | | | | |
| **Isolation archived** | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

## Appendix C

# Detailed isolation management work flow



## Appendix D

# Process isolation audit template

The following example provides a format for the ICC described in this position paper. Where an electronic system is in use, these attributes should be included, although layout will likely be different.

| Equipment Identification | Yes / No / NA | Comments |
|---|---|---|
| Is the equipment and reason for the isolation detail sufficient? | | |
| Do the equipment description and identification number align? | | |
| Is the equipment under long-term isolation? | | |
| Is permit to work referencing correct? | | |
| **Personnel** | | |
| Does the permit issuer understand the status of the isolation? | | |
| Does the control room understand the status of the isolation? | | |
| Is the IA aware of how to determine the required level of isolation? | | |
| Does the IA understand the actions in the event of an unsuccessful isolation integrity test? | | |
| **Planning** | | |
| Were the isolation points agreed between maintenance and operations prior? | | |
| Have the positive isolation points been altered from initial design? | | |
| **Isolation scheme design** | | |
| Does the isolation design meet minimum standard for the task? | | |
| Is there a higher level of assessment and approval in place? | | |
| Are all test points identified? | | |
| Is there a fully marked-up diagram attached capturing all isolation points? | | |
| Do all isolation point identification numbers match the supporting diagram? | | |
| Are the correct review and authorizations in place for the isolation? | | |

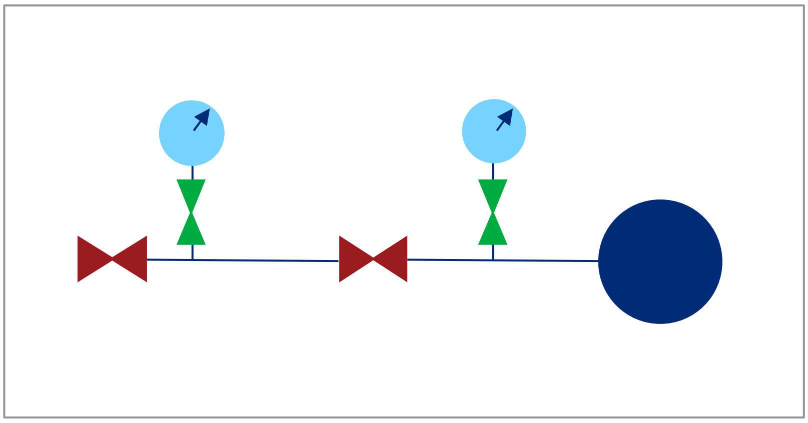
| Equipment Identification | Yes / No / NA | Comments |
|---|---|---|
| **Applying the isolations** | | |
| Is the condition of the documentation, locks and tags acceptable? | | |
| Does the status of isolation point in the field match the documentation? | | |
| Are the locks and tags secure? | | |
| Do lock and tag numbers align with isolation documentation? | | |
| If applicable, are actuated valve air supplies disconnected? | | |
| If applicable, are trade locks secured on electrical drives? | | |
| If applicable, has the isolation been converted to long-term isolation? | | |
| Are all test points in the correct position, and if required, are they fitted with a blanked flange? | | |
| Does the break flange register detail all positive isolation points? | | |
| Is the second check of the isolation points complete, and are they signed for? | | |
| Are all correct signatures in place? | | |
| **Isolation scheme approval** | | |
| Are the isolation scheme approvals correct in line with procedure? | | |
| Have changes to the isolation points been correctly authorized? | | |
| Is the non-standard isolation subject to correct level of authorization? | | |
| **Handover and status** | | |
| Has the isolation scheme been in place longer than seven days? | | |
| If yes to above, is the isolation scheme now long-term? | | |
| Is the isolation standard in place for the LTI adequate for the system? | | |
| Are any altered isolation points recorded on isolation scheme and authorized? | | |
| If equipment is fully reinstated, is sign-off of all isolation points complete? | | |
| Are completed documents stored in correct area? | | |

| Equipment Identification | Yes / No / NA | Comments |
|---|---|---|
| **Reinstatement of equipment** | | |
| Is all documentation relating to the task correctly signed off? | | |
| Is the break flange register complete? | | |
| Does the leak test pressure meet site standards? | | |
| Was the service test complete under approved procedure? | | |
| Is equipment free of all locks and tags? | | |
| **Detail any other observations not covered in the above questions below.** | | |
| | | |
| | | |
| **Percentage compliance**<br>**(if <90% there must be actions to correct)** | | |
| **Actions complete during the audit** | Actionee | Comments |
| | | |
| | | |
| **Actions remaining** | Actionee | Comments |
| | | |
| | | |

# Appendix E
# Definitions

**Single valve block isolation** – closed valve with successful pressure build up/pressure drop down test providing integrity assurance.

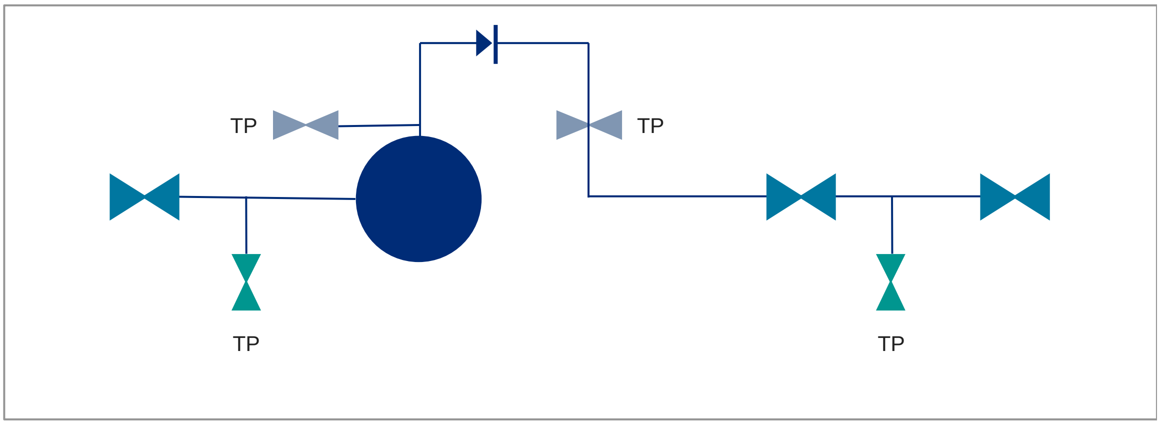
**Proven Double Block** – two closed valves in series, with successful pressure build up test. See below example:



**Double block and bleed** – two closed valves in series, both with successful pressure build up test, and bleed valve that can depressurise the interspace to a waste stream system, for example, the flare system. See section 4.5.2 for example diagram.

**Positive isolation** – mechanical break in system preventing flow of fluids, for example, spectacle blind, spade, or spade and air gap.

**Test point** – valves within the isolation boundary, positioned to provide representative information regarding system conditions, for example, residual fluid, gas testing, and pressure build up testing. In this example, TP1, TP2, and TP3 should provide accurate indication if isolation integrity is successful and LPG has been removed sufficiently. Nitrogen purge flow from TP2 to TP1 to account for non-return valve.



**Actuated valve** – can be motive fluid supply or electrical motor design. For motive fluid type, the fluid supply must be isolated and disconnected. For electrical motor driven actuator, isolate the electrical supply once fully closed, if the valve has the facility to place in manual, it is recommended this option is taken. Only use valves designed as tight shut off, for example, a shutdown ball type valve. Types of actuated valve not recommended are globe type valves, valves with minimum stop design, and valves that do not have with air fail close design.

**Electrical isolation (isolator, fuse removal, disconnection)** – an electrical drive is considered isolated when the main isolator is locked in the closed position, and the IA has demonstrated the equipment is not live through attempting start in the field. As a minimum, the IA should lock isolator in the closed position, secure, label, and record in the isolation scheme. A facility for all maintenance personnel to apply their own personal lock to the isolation should be available to prevent premature re-energizing, for example, a mechanical fitter applying a lock when working on a pump coupling.

**Own trade isolations (instrument air, 24v, instrument impulse line)** – Marsh Specialty recognizes that asking the operations team to apply every isolation required for maintenance is not practical, and in some cases maintenance personnel may apply their own isolations. A clear procedure must be in place that defines what is acceptable, who is authorized, and how individuals communicate the change.

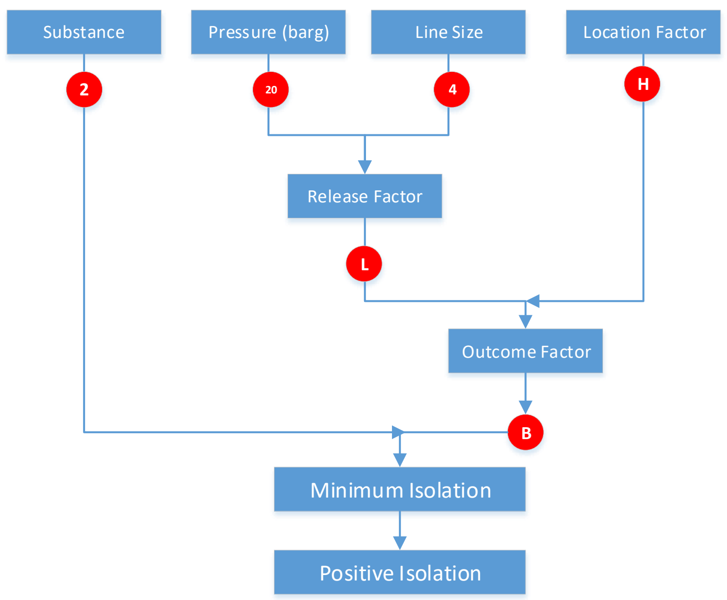
**Non-standard isolation methods** – these are methods not normally used and require additional controls through a MoC or standard authorized procedures, for example, stopples, twin tyre hydro-plugs, and line freezing. These should be undertaken with separate risk assessment and not be the part of the normalised isolation procedure.

Refer to HSG 253 Safe Isolation of Plant and Equipment, Paragraph 119, Figure 4, and Appendix 5: Isolation Methods, for further information on isolation definitions.

## Appendix F

# Determining isolation standard methods

## Example calculation flow chart




| Substance | | | Location Factor | | |
|---|---|---|---|---|---|
| **1** | **2** | **3** | **H** | **M** | **L** |
| Highly toxic<br><br>Carcinogenic | Highly flammable – operate above flash point<br><br>Explosion risk<br><br>Critical utility | Operate below flash point<br><br>Standard Utility | Congested area<br><br>Main Process plant area | Low congestion<br><br>Storage area or tank farm | Remote location |

# Example of isolation table

The site should determine the minimum isolation standard based on volume and consequence of release for the facility. To illustrate this approach, see below tables for some examples.

| **System fluid** | **Max Operating Pressure (barg)** | **Line Diameter (mm)** | | | | |
|---|---|---|---|---|---|---|
| | | **50** | **75** | **100** | **150** | **300** |
| LPG | > 30 | HAV = FIM<br>MRV = FPI | | PI = FIM<br>HAV = FPI | SDR | |
| Diesel | > 30 | | HAV = FIM<br>MRV = FPI | | PI = FIM<br>HAV = FPI | SDR |
| Crude Oil | > 30 | | HAV = FIM<br>MRV = FPI | | | |
| Steam | > 30 | HAV = FIM<br>MRV = FPI | | | | |
| LPG | >10<30 | | | HAV = FIM<br>MRV = FPI | | PI = FIM<br>HAV = FPI |
| Diesel | >10<30 | | | | HAV = FIM<br>MRV = FPI | |
| Crude Oil | >10<30 | | | HAV = FIM<br>MRV = FPI | | |
| Steam | >10<30 | | | | MRV = FIM<br>MRV = FPI | |
| LPG | <10 | | | HAV = FIM<br>MRV = FPI | | |
| Diesel | <10 | MRV = FIM<br>MRV = FPI | | | HAV = FIM<br>MRV = FPI | |
| Crude Oil | <10 | | | | | HAV – FIM<br>MRV - FPI |
| Steam | <10 | | | | MRV = FIM<br>MRV = FPI | |

**Table Legend:**

**MIS** – Minimum Isolation Standard

**FIM** – For Intrusive Maintenance

**FPI** – For Positive Isolation

**PI** – Positive Isolation

**HAV** – Highest available valve isolation

**MRV** – Minimum

**SDR** – Shutdown required

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