



RP 44-10

ISOLATION OF EQUIPMENT FOR MAINTENANCE

September 1996

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING			
Doc. No. RP 44-10		Issue Date	September 1996
		Latest Draft No.	
Document Title			
ISOLATION OF EQUIPMENT FOR MAINTENANCE			
APPLICABILITY			
Regional Applicability:		International	
SCOPE AND PURPOSE			
For use as a guide on the physical methods of isolation of Mechanical, Electrical and Control equipment. For use by HAZOP and safety review teams for new projects and as a basis for review of isolation facilities on existing plant. Businesses or Regional organisations may elect to align this Recommended Practice with safe practices already established in their operations.			
AMENDMENTS			
Amd	Date	Page(s)	Description
CUSTODIAN (See Quarterly Status List for Contact)			
Operations Support			
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FOREWORD

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and 77 requirements.

Value of this Recommended Practice

This Recommended Practice gives guidance on the physical methods needed for the isolation of mechanical, electrical and control equipment so that maintenance work can be done safely. It will provide a basis for common understanding between design, project and operating groups.

Application

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Recommended Practice, and may discuss alternative options. It also gives guidance on the implementation of any 'Specification' or 'Approval' actions; specific actions are indicated by an asterisk (*) preceding a paragraph number.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Changes from Previous Issue

This document is a general re-write and update of the previous issues, RP 44-10, November 1992.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP Group Research and Engineering or the Custodian. See Quarterly Status List for contacts.



PART 1 - MECHANICAL

1. MECHANICAL

1.1 Applicability

Account must be taken of Nationally and locally enacted legislation where it modifies or adds to the provisions of this Practice.

This Practice is primarily for use as a guide to the provision of safe methods of isolation for new Projects, but is also prepared with due regard to potential limitations of isolating facilities on existing plant.

1.2 Types of Isolation for Mechanical Equipment

The normal methods of isolation for mechanical equipment may be classified as:

- a) Positive Isolation.
- b) Valve Isolation.
- c) Isolation by other devices

1.2.1 Positive Isolation

Positive Isolation must be employed where entry into a confined space is to be undertaken or where high risk fluids are to be contained.

Positive Isolation must be achieved in one of three ways:-

- (a) The removal of a spool piece with blanking of open ends.
- (b) The turning of a spectacle spade (blind).
- (c) The insertion of a spade (blind) between flanges, or replacement of a spacer with a line blind.

Blanks, spades, (blinds), bolting and gaskets shall conform to the piping specification for the line. (In special cases e.g. during an overhaul, it may be acceptable to use non-pressure rated blanks, where they do not perform a full pressure containment function i.e. downstream of fully rated isolation blanks, or to seal vessel nozzles from possible fume/vapour ingress. Special care needs to be taken however, in the use of such non-standard blanks and they shall be identified by a tag, painted circumference or other marking).



Joint faces should be square and fully bolted and pulled-up. For (c) above bolting should be of the correct length to accommodate any extra thickness of the spade.

The designer should consider the amount of flange spread necessary to remove and insert spades, as well as the orientation of the flanges. He should also consider the inclusion of spacers at difficult essential spading points. Because of the difficulty of providing sufficient flange spread for ring-type-joint spades, positive isolation for RTJ systems will usually be by removable spool with blanking of the open ends; the designer should consider ease of removal of such spools e.g. by including a right angle bend.

The designer should also consider line support requirements where a removable spool or spading point is provided.

In addition to the requirement for positive isolation for work involving entry to confined spaces, it is also recommended in the following cases:

- long duration isolations (more than one week).
- where equipment is to be mothballed.
- where hot work is to be undertaken.
- for process fluids at or above auto-ignition temperature.

* 1.2.2

Valved Isolation

Valved isolation is most often used to maintain containment while positive isolation is being made, and where valved isolation only is an acceptable option, i.e. in low-risk, non-entry situations.

Special care should always be taken at this time as valves may allow gas or fluid to pass. The work should be covered by a specific control procedure, for example, a Permit to Work.

Wherever valve isolation is used as the primary protection, prior to breaking of containment it is important that means exist for the confirmation of the integrity of the isolation. This is normally achieved by the use of two separate vent/drain points to confirm satisfactory depressurisation/draining. In cases where only one such point exists additional methods should be used to confirm that the single point is not restricted or blocked in any way.

Valved isolation should be achieved in one of two ways:-

- (a) **Double Block and Bleed** (referred to as 'DBB') Two block valves with interposing bleed valve. The bleed valve should be to a safe location, which may be to atmosphere or a closed vent/flare system. Security measures to prevent inadvertent operation of the valves are essential.



Where the bleed is connected to a closed system, a drain or vent tapping should be provided to confirm adequate depressurisation before spading proceeds.

If an ESD valve is used, e.g. as one of two block valves, it must be ensured that the integrity of the shut down system is not compromised; this usually needs to be considered at the design stage. The valve would have to be disabled and mechanically secured/jacked closed. Disconnection of electrical, pneumatic or hydraulic power sources may be necessary and in some cases additional immobilisation devices may be considered necessary. The effectiveness of valve immobilisation shall be tested by a competent person.

It should be recognised that errors most frequently occur as a result of non-routine operations.

- * For many services, an acceptable alternative to two block valves with interposing bleed is a double seated block valve, where the seating force is applied mechanically, with cavity bleed valve, but its use on each specific duty and the valve selection must be approved by BP.

Types of double seated block valve with cavity bleed which have been used in place of the two block valves with interposing bleed, and where reliable sealing is required are:-

- (i) *Parallel double disc gate valve with expanding wedge*
- (ii) *High integrity wedge gate valves (i.e. with soft seat)*
- (iii) *Expanding (wedge) plug valve, which has soft seats.*

Most wedge gate valves leak after a time; they may then seal, to greater or lesser degree, on one face only. They should not be considered for use as a double seated block valve with cavity bleed unless (i) spades will be inserted and (ii) leakage during the insertion of spades can be tolerated. Preference for a double seated block valve with reliable sealing will usually arise where weight or space are prime considerations and justify higher valve costs.

*Note. Standard ball valves do **not** provide a double seal*

- (b) **Single valve isolation** (referred to as SVI) A single block valve with a bleed on the side of the equipment to be taken off-line. Any valve used for this purpose must provide a reliable seal. Non-return valves, control valves and other valves which do not provide tight shut-off, must not be used.



For the sake of clarity the categories of single valve and double valve isolations without bleed have been ignored, as it is deemed essential that some form of downstream depressuring facility is available to allow maintenance access. The integrity of the double valve isolation without intermediate bleed is only considered the same as a single valve, because of the inability to confirm the integrity of the upstream valve.

Guidance on the performance and selection of valves for different services is given in BP Group [RP 62-1](#), Valve Selection. It is recommended that whole-life cost and valve performance after a period in service should be taken into account.

1.2.3 Isolating devices

Devices such as mechanically expanded plugs, inflatable bags or frozen plugs must not be used as a primary form of isolation in place of a spade, spool removal/blank or valve.

They may be used downstream of a positive or valved isolation as a vapour or liquid seal to contain and direct to vent any small amounts of vapour, where the pressure differential across the device can be monitored and controlled, where the application has been engineered and where the particular application has been approved by Local Management.

Their use is usually to assist in making a local point of work safe by maintaining an inert buffer, or temporarily holding-back or diverting the flow of a fluid while a particular operation takes place e.g. welding. The danger is unexpected sudden movement of the device.

Each type of device has its own limitations and risks and should not be used without a detailed examination of the potential for failure of effective sealing and implementation of the necessary precautionary measures.

Inflatable bags are sometimes used as a primary pressure containment device for gas systems operating at low pressures i.e. just above atmospheric, where facilities have been specifically designed for this purpose. Their use is however, only acceptable under specified closely controlled conditions and with appropriate approvals.

1.3 Categories for Mechanical Isolation

Table 1 provides guidance on appropriate levels of isolation in the various categories.

Where it is not possible to achieve the required standard of isolation, due to limitations in installed facilities, a risk assessment approach should be utilised to define the required levels of additional checks and controls necessary to achieve safe isolation. If the risk assessment identifies an intolerable level of risk then an alternative acceptable

method must be identified or else the work deferred to a process shutdown.

An important aspect which must be carefully considered when identifying the appropriate degree of isolation is that the act of spade/blind insertion itself necessitates breaking of containment. For large spades or in difficult locations, this can represent a significant time period when containment is breached. This may result in an unnecessary increased risk for a short duration job, which would then better be performed without spading/blinding.



SERVICE TEMP. & PRESSURE	TOXIC		NON-TOXIC & FLAMMABLE		NON-TOXIC & NON- FLAMMABLE			
	(See 1.3.1 for further definition of terms)		Above auto-ign. temp. or flash pt <ambient LPG as defined or H ₂ service as defined		Below auto-ign Temp			
Above 50 barg or Above 200 ^o C	V	DBB	V	DBB	V	DBB	V	SVI
	I	POSITIVE	I	POSITIVE	I	POSITIVE	I	POSITIVE
Between 20 & 50barg and Below 200 ^o C	V	DBB	V	DBB	V	SVI	V	SVI
	I	POSITIVE	I	POSITIVE	I	DBB	I	SVI
Below 20 barg and Below 200 ^o C	V	DBB	V	DBB	V	SVI	V	SVI
	I	POSITIVE	I	POSITIVE	I	DBB	I	SVI
Below 2 barg and Below 200 ^o C	V	SVI	V	SVI	V	SVI	V	SVI
	I	POSITIVE	I	DBB	I	SVI	I	SVI

KEY:-

V Initial valving of live system to allow further isolation to proceed.

I Final isolation if containment is/could be broken. (see 1.4.3)

DBB Double block valve and intermediate bleed isolation.

POSITIVE Disconnection, spade, blind or blank isolation.

SVI Single valve with downstream bleed isolation.

NB: **Always** use POSITIVE isolation for entry to vessels or confined spaces.

T Use of breathing apparatus a permit requirement.

(Line sizing and duration of work may necessitate a higher category of isolation)

TABLE 1 - Minimum Isolation Categories For Different Service Conditions And Nature Of Service



This categorisation Table 1 excludes isolations necessary for Entry, which will always be by positive isolation, as highlighted in 1.2.1.

For each category the requirements are given for:-

'V' The required valving of live systems as a preliminary, to allow the type of isolation identified in 'I' below, to be effected.

'I' The type of isolation required if the maintenance work necessitates containment to be disturbed, or if there is a risk of this during the work.

Business or Regional organisations may elect to adjust the Service Temperatures and Pressures to harmonise this Recommended Practice with safe practices already established in their operations.

A review of Table 1 against emerging risk assessment approaches for the identification of isolation requirements (e.g. OIAC 'Isolating Plant and Equipment Safely in the Petroleum Industry') demonstrates this as a more consistent result, which accurately reflects current Industry thinking with respect to recommended isolation requirements. The difficulty with alternative arithmetic approaches is the frequent need for the application of additional 'special' cases, when the numerical result is not consistent with current thinking.

1.3.1

Definitions of terms used in Table 1:-

- (i) **Toxic Service** is defined as any gas vapour or liquid which is, or is mixed with or has picked up by contact, any substance(s) known to be hazardous to health or to the environment and if released from containment may exceed concentrations above the relevant occupational exposure limits or environmental limits.

Substances harmful to health or the environment which occur in our industry include: Hydrogen Sulphide, Hydrogen Cyanide, Sulphur dioxide, Hydrofluoric acid, tetraethyl lead, some drilling muds and kill-fluids, some inhibitors, boiler water treatment chemicals etc.

- (ii) A **Non flammable** fluid is defined as a liquid, vapour or gas which in the presence of air will not burn.
- (iii) **LPG**, for the purpose of this Recommended Practice, includes LPG, LNG whether under pressure or refrigerated and NGLs (condensate) and any other liquid, which on release would vaporise rapidly and substantially to form a flammable vapour cloud.



- (iv) **Hydrogen Service** is defined as Hydrogen, fluids in contact with hydrogen, or gaseous mixtures containing hydrogen in which the partial pressure is 5 bar (abs) or more.

1.4 Essential Requirements for Operating Plant

1.4.1 Entry

When entry into any vessel or confined space is required for maintenance work, it shall be positively isolated from all connected plant and systems, even if the plant is shut down.

Isolation effected by closing and locking valves is not acceptable for entry even when the plant is shut down. There is usually uncertainty about the leak tightness of valves and there can be changes in conditions upstream of the valves which could affect their sealing performance, and, in spite of procedures, valves can be mistakenly opened.

Positive isolations shall be made at vessel nozzle flanges except in circumstances of exceptional mechanical difficulty or where workers could be placed at risk. In these cases the isolation may be made at a more remote location and the additional volume must be treated as an integral part of the vessel or confined space. Due account of this additional volume needs to be taken in the plan for preparation for equipment maintenance, with respect to draining, steaming, inerting, ventilation and content sampling.

The completion of isolations away from the vessel nozzle must not be permitted on grounds of expediency nor convenience. Isolations which can be achieved using conventional scaffolding and lifting equipment should be made at the vessel branches. Isolations in large, elevated, lines (such as some FCCU overhead lines) requiring specialised equipment, such as large cranes, and special controls, might be considered as being of exceptional mechanical difficulty or posing risk to workers.

1.4.2 Interruption and disturbance of containment.

As a general rule, Table 1 identifies that Positive Isolation is required for the majority of cases where there is a risk of containment being interrupted or disturbed. Mandatory and recommended cases requiring Positive Isolation are given in 1.2.1.

In the majority of other cases however, involving short duration work, the requirement for Positive Isolation may be relaxed to Valved Isolation as detailed below:



1.4.3 Substitution of positive isolation with valved isolation for short duration work only.

Not applicable where entry is involved.

Where Table 1. shows positive isolation is required for breaking containment, including toxic service, it may be replaced with valved isolation by double block and bleed valves (or double seated block valve with cavity bleed when accepted by BP for the specific duty) if **all** of following conditions are fulfilled:-

- (a) The expected time for the work is of the same order as the time taken to make the positive isolations.
- (b) The work is of a predictable nature.
- (c) The work shall be detailed in a written procedure and covered by a Permit to Work identifying specific precautions to be taken.

Normal safety requirements for the wearing of breathing apparatus and stand-by personnel etc. remain in force until full containment is reinstated. The requirement for security of valves used for isolation (1.4.5) also remains in force.

1.4.4 Instrument Tappings

For instrument tappings refer to section 3.2.2 in this Recommended Practice.

1.4.5 Security of valves used for isolation

Each valve used in an isolation sequence must be immobilised or locked so that it cannot be operated. It should have a traceable identification tag attached to indicate the reason why the valve is immobilised.

This can be achieved, preferably by locking or chaining and padlocking. Some sites rely on the use of stainless steel wires rather than locks. Others perform 'symbolic' locking by the use of plastic tags. Whatever the means of immobilisation, it should be of such as to make a would-be operator aware that the valve is intended to be immobilised. The importance of such 'immobilising' systems must be clearly stressed through appropriate training/ procedural instructions.

All isolations should be checked, tested and shown to be effective before containment is broken. All vents and drains should be checked to ensure they are free from obstruction.



It is important to realise that a bleed which is hard-piped to a closed drain or flare line will provide single valve isolation only from the flare/drain line, when shut.

The effectiveness of isolation devices must be monitored at suitable intervals to detect any actual leakage or deterioration in condition caused, for example, by vibration, or disturbance.

This is particularly relevant for shift changes or any periods of extended work-break e.g. awaiting spare parts.

On completion of the task, de-isolation and recommissioning of the system must be performed with the same care as that used during the isolation.

Removal of the positive isolation must be preceded by integrity testing of the valved isolation.

1.4.6 Management of Isolations

There shall be Site Procedure(s) for all Positive Isolations. The procedure should provide for the specification of the isolations required for each maintenance or entry task on each equipment item or system. A Blinding list should be developed from up-to-date P&ID's and by physical inspection of the facility. The Blinding list accompanied by a diagram or sketch showing the location of isolating point, serial number, size, rating, isolation in/out, signature, should be attached to the Work Permit. It should safeguard the integrity of the isolations while work is in progress and assure their withdrawal only when safe to do so. The accounting for blanks to be inserted and removed is considered to be a "high priority task".

For small jobs, the normal Permit to Work procedure could provide the required management.

Any variations from normal isolations should be highlighted and explained.

When new plant or modifications are proposed isolation requirements should be part of the early documentation, and approved by the site operating and maintenance authorities.

1.5 Essential Requirements for Isolation for Turnaround.

1.5.1 Positive Isolation at battery limit/section/system shall be installed.

Isolation of Electrical and Control equipment shall be made according to the work requirements and following the methods in Parts 2 and 3 of this recommended practice.



- 1.5.2 Once the plant/system is shut-down, depressured, cooled down and gas free, individual equipment should be isolated for opening and cold work.

If gas freeing and removal of liquid hydrocarbon/toxic residues (e.g. from low points and pockets) has been successful many of the isolations will fall into the single block valve category. Isolation requirements for hot work should be assessed separately.

- 1.5.3 When entry into a vessel or other item of equipment is required, it shall be positively isolated from all connected plant and systems. The Isolations shall be at the vessel branch flanges or as otherwise described in paragraph 1.4.1.

- 1.5.4 A group of equipment having no provision for isolation in the interconnecting pipework shall be considered as one item of equipment. Additional care is necessary in such cases with respect to equipment gas freeing and related work being performed within the confines of the same isolation.

- 1.5.5 Where entry into one of a group of equipment as in 1.5.4 above, is required, work around, on or in the adjacent items must be controlled or halted so that no harmful effect could occur in the item being entered.

Particular care is required during turnarounds regarding the maintenance of security of Positively isolated systems, particularly when equipment pressure testing is ongoing, when additional isolations are inserted/removed. Also during mechanical completion, when previously removed items may be replaced e.g. control valves, spools etc.



PART 2 - ELECTRICAL

2. ELECTRICAL

2.1 Applicability

This section of the Recommended Practice is applicable, irrespective of voltage levels, to fixed electrical systems, whether permanently installed or temporary in nature. The design of electrical systems using BP Group [RP 12](#) 'Electrical Systems and Installations' will ensure many of the requirements below are included.

2.2 Definitions

- 2.2.1 Isolation: means the disconnection and separation of electrical equipment from every source of electrical energy in such a way that this disconnection and separation is secure.
- 2.2.2 Charged: means that the item in question has acquired a charge either because it is live or because it has become charged by other means such as static, induction charging or has retained a charge due to capacitive effects - even though it may be disconnected
- 2.2.3 Live: means that the item in question is at a voltage by being connected to a source of electricity.
- 2.2.4 Dead: means that the item in question is neither live nor charged.
- 2.2.5 Authorised Electrical Person: A person appointed in writing to carry out duties incidental to the generation, conversion, storage, transmission, transformation or utilisation of electricity.
- 2.2.6 Competent Electrical Person: A person who has sufficient technical knowledge, training and experience to undertake defined tasks and avoid danger.
- 2.2.7 Specialist Electrical Person: A Technician or Engineer employed by a supplier, agent or specialist company and having detailed knowledge and expertise of a specific piece of electrical equipment.
- 2.2.8 Low Voltage: A voltage not exceeding 1,000 V a.c. or 1,500 V d.c.
- 2.2.9 High Voltage: A voltage level exceeding 1,000 V a.c. or 1,500 V d.c.



- 2.2.10 Switching Log Book: A document for recording switching operations of main electrical equipment.
- 2.2.11 Cautionary Notice: A notice applied to an isolated piece of equipment conveying a warning against interference with such equipment.
- 2.2.12 Danger Notice: A notice applied to equipment or parts of equipment which are live or otherwise dangerous, calling attention to the danger of approach to or interference with such equipment or parts thereof.

2.3 General Requirements

2.3.1 Isolation Procedures

There shall be Site Procedures for isolation. They should contain the particular control procedures, personnel accountabilities and site specific methods for the isolation of each type of electrical circuit and equipment.

2.3.2 Personnel Certificates

All personnel employed in the isolation of equipment for maintenance shall be issued with a certificate detailing the level of their 'Authorisation' or 'competency'. A centralised register shall be kept for each site/project listing all personnel so designated along with a copy of their certificate.

The exact format of certificates will vary depending on particular site requirements, however all certificates should contain the following minimum information: Certificate Number; Bearer's name; Bearer's job (and Plant if applicable); Limits as to date when the certificate is valid (if required); Duties covered by the certificate (and Plants if applicable); Bearer's and Issuer's signatures; Date of issue.

In addition to the range of authorisation or competency awarded to electrical discipline personnel, a personal certificate may be issued to a non electrical person enabling them to perform isolations on equipment for restricted maintenance activities following training to achieve the appropriate level of competence.

There is no requirement for Specialist Electrical Personnel to be issued with certificates as they are deemed authorised to work on their own equipment. Specialist Electrical Personnel are however required to work under the control of a Permit to Work. Site procedures should ensure personnel are familiar with particular site requirements, permits etc. to ensure isolation of a particular piece of equipment does not affect other equipment.

2.3.3 Switching Logs

Each location shall have a logging system for recording switching operations for routine or maintenance purposes. The system may be



centralised or distributed depending on the geographical spread of substations/ switching rooms, but should provide clear indication as to the status of equipment, the reason for all operations and the time the action was carried out.

2.3.4 Confirmation of Isolation

Each location shall have a method for recording that isolations are complete to enable work to commence.

Suitable systems are:-

- (i) *Isolation Confirmation Certificates*
- (ii) *'Isolation' section on the Permit to Work*
- (iii) *Isolation log books.*

2.3.5 Electrical Manual

Each location shall have an electrical manual which shall be issued to all Authorised and Competent Electrical personnel. It should contain, amongst other items, all appropriate parts of the Isolation Procedures in an easy-to-carry format.

It is intended that the manual should be carried by electrical personnel and so should be an appropriate size. It should, as a minimum, contain essential safety instructions, hazardous area and Permit to Work requirements and isolation instructions.

2.4 Physical Requirements

2.4.1 Security

High voltage switchgear, motor control centres, battery chargers instrumentation supplies and centralised switchgear arrangements should be installed in buildings (Substations and switchhouses) with facilities for restricting access to people with the appropriate authority only. Such buildings shall have notices, fitted permanently on external doors, drawing peoples attention to the danger and access restrictions.

People with the appropriate authority may be Authorised Electrical Persons, Competent Electrical Persons or others issued with an appropriate access permit or permit to work.

In addition to electrical hazards physical hazards such as those associated with CO₂ equipment should be addressed in any notices or procedures.



2.4.2 Locks and Keys

See also section 2.5.9.

Each site shall have sufficient locks and keys to ensure unique isolations in the event of the most major shutdown likely to occur. Locks and keys shall be identified by permanent means (such as engraving) and held in a secure manner. Facilities shall be provided to store keys and locks that are part of isolations separately from those which are not currently in use.

Suitable means are Lock-out boxes or Key Cabinets.

2.4.3 Test Equipment

Each site shall have sufficient and appropriate test equipment to ensure all isolations and de-isolations can be safely completed. It shall be routinely tested and tested before and after use.

Site procedures should ensure that all test equipment is routinely inspected/calibrated in addition to tests before and after use.

2.4.4 Notices

Suitable and sufficient Danger and Cautionary notices shall be available so that the status of all isolated equipment can be identified, and appropriate warnings given when adjacent equipment or parts of the same equipment may still be live.

Notices should be of durable material and be suitable for fixing to prominent parts of the equipment being isolated.

2.4.5 Labelling of equipment

Equipment must be clearly and unambiguously identified. All switchgear, cables, control gear and protective devices must be labelled to permit positive identification of the circuits. Individual circuit identification must relate clearly and unambiguously to the equipment supplied.

Access panels to cable connections or terminal rails provided on some switchgear should be clearly identified with the corresponding circuit identification.

Where auxiliary circuits having remote sources, such as control or indication, are incorporated within switchgear cubicles, the cubicles should be identified as such. The circuit voltage must also be clearly displayed.



2.5 Isolation Devices

2.5.1 All equipment/circuits must be provided with off-loading and isolating devices. These should generally form part of the source switchgear.

Suitable isolating devices are:-

- (i) *Circuit breakers and Contactors having withdrawal facilities.*
- (ii) *Fused switches and switched fuses.*
- (iii) *Moulded-case circuit breakers (MCCBs) and miniature circuit breakers (MCBs)*

2.5.2 Isolating devices should normally allow a view of the isolation (a clean break in air). Enclosed devices, including miniature circuit breakers, should be of a design which will only move to the isolated position when all phases have been positively disconnected.

Where the isolation device does not allow viewing of the physical gap, a test must be made after isolation, using an appropriate test instrument, to ensure contacts have broken.

2.5.3 Isolating mechanisms shall have provision for securing (locking) in the isolated position. Where fuses/links form part of the isolation device a method of securing them after removal must be provided.

Site procedures must ensure that the method of securing the fuses /links prevents similar fuses/links from being inserted and the circuit de-isolated. This is also a requirement of [BS6423](#). Alternatively, fuse lock out devices may be fitted to the fuse base preventing the insertion of fuses or links.

2.5.4 Auxiliary circuits provided on major items of equipment for control, indication and protection purposes must also include isolation facilities. These may consist of:-

- (a) Auxiliary contacts mounted integrally with the switchgear withdrawable part.
- (b) Fuses or links mounted in the same cubicle but not on the withdrawable part.
- (c) Fuses or links mounted remotely.

Method (a) provides the greatest degree of safety, but can lead to problems in the testing of instrument and control loops during maintenance which require the loop to be complete; in this situation method (b) is preferred as it allows testing without the need to defeat the switchgear auxiliary contacts, but for changeover systems the design must ensure that the system does not believe isolated equipment is available (or running).

- 2.5.5 Systems including Transformers, battery chargers and other equipment with a number of supply sources must include facilities for the isolation of all such sources.
- 2.5.6 Voltage transformers shall be the withdrawable type having the facility for locking in the withdrawn position.
- 2.5.7 Any isolation device with a withdrawable part shall have facilities for locking 'closed' busbar or circuit shutters mounted on the fixed portion.
- 2.5.8 Where certified electrical equipment is installed in hazardous areas the isolation provided shall include the neutral conductor.

Isolation of the neutral conductor by using one pole of the switching device is preferred as it reduces the scope for error in removing and replacing bolted links.

- 2.5.9 Where isolations may be the subject of work by external agencies (e.g. by Electricity Authorities) or multiple parties, all locking devices should be suitable for the use of multi-hasps locks to allow individual isolations by each party.

Further guidance on the facilities to be provided on switchgear to meet the above requirements are to be found in:-

- (a) BP Group [GS 112-9](#) 'High-Voltage Switchgear & Control gear '.
- (b) BP Group [GS 112-8](#) 'Factory Built Assemblies of Low Voltage Switchgear and Controlgear'.

2.6 Earthing-down Requirements

2.6.1 Provisions

Devices must be provided to facilitate the application of an earth connection to the following pre-isolated equipment:-

- (a) High voltage equipment
- (b) Equipment which has the potential to become charged by some other means.

This should normally be achieved with an integral facility at the controlling switchgear or by a separate circuit breaker. Such devices must be provided with means for securing in the locked on position.

For main Low Voltage switchboards, methods of earthing the incoming and busbar sides of the incomer circuit breakers should be considered



to allow for maintenance of the supply transformers and switchboard busbars. Devices may be any of the following:-

- (a) Integral with the switchgear.
- (b) Separate earthing circuit breakers.
- (c) Suitably rated attachments or clamps provided by the switchgear manufacturer.

Where integral earths are not provided and earthing is achieved with clamps or earthing spouts, the use of these devices shall be covered with specific procedures.

2.6.2 Capacitors

Large capacitors and capacitor banks with the potential to store dangerous levels of energy must be provided with discharging facilities complete with locking devices.

2.7 Batteries

Batteries are a source of electrical supply. While they should have provision for their isolation from connected circuits, chargers and load, they cannot be made dead for maintenance purposes. Safe working on batteries should therefore be controlled by appropriate procedures.

Appropriate procedures should include the wearing of protective equipment and the use of insulated tools.

2.8 Regional Annex for United Kingdom

2.8.1 This part (Electrical) of the Recommended Practice addresses the relevant requirements of the following regulations:-

- (a) Statutory Regulations - [Electricity at Work Regulations](#) 1989 (and the memorandum of guidance on the electricity at work regulations 1989)
- (b) [IEE Wiring Regulations for Electrical Installations](#), 16th edition
- (c) [HSE Safety Notice 3/84](#) 'Safe Isolation of Electrical Equipment'.
- (d) [SI 1019](#) The Offshore Installations (Operational Safety, Health and Welfare) Regulations.



- (e) [IEE Recommendations for the Electrical and Electronic equipment of Mobile and Fixed Offshore Installations.](#)
- (f) [AODC Code of Practice for the safe use of electricity Under Water.](#)

2.8.2 National Reference Documents:-

The following are documents which give additional guidance on aspects of isolation referred to in the main body of this Practice.

[BS 6423](#) 'Maintenance of Electrical Switchgear and Control gear for voltages up to and including 1kV'.

[BS 6626](#) 'Code of Practice for Maintenance of Electrical Switchgear and Controlgear for voltages above 1kV and up to and including 36kV'.

[BS 6867](#) 'Code of Practice for Maintenance of Electrical Switchgear for voltages above 36kV '.



PART 3 - CONTROL

3. CONTROL

3.1 Applicability

This section covers the essential requirements for isolation of Instrumentation and Control equipment for permanent and temporary installations. Installation of instrument and control equipment in accordance with the BP Group [RP 30](#) series of practices will ensure many of the requirements below are included.

3.2 Essential Requirements

3.2.1 In-line Equipment

3.2.1.1 In line equipment shall be provided with isolation facilities in accordance with PART 1 (mechanical) of this Recommended Practice.

3.2.1.2 The number of individual isolation facilities should be kept to a minimum.

In some cases instruments may be isolated in groups or as part of other equipment. Maximum use should be made of this to reduce the number of valves used

3.2.2 Off-line Process Instruments

3.2.2.1 Off-line process instruments. Isolating valves (i.e. those which isolate the equipment from the pipeline or vessel) shall be in accordance with Part 1 (mechanical) of this Recommended Practice.

Where instruments contain large inventories of process fluid e.g. level transmitters, or where frequent blowdown of instrument impulse lines is envisaged, vents and drains should be in accordance with BP Group [RP42-1](#). For all other instrumentation, small volumes of non-toxic process fluid (less than 2 litres) may be vented or drained to atmosphere provided that safe disposal can be assured. Special care is necessary where the installation is above grade and where hot, flammable or toxic materials are involved.

3.2.2.2 For lines of 3/4" or less, the V and I levels of isolation (see table 1) may be achieved by a combination of the process line isolation valves and/or instrument manifold valves.



This shall not apply:

- a) Where hot work or entry is involved
- b) For hazardous process fluids

This substitution allows for valved isolation of many instrument lines. The requirement for security of valves used for isolation (1.4.5) and the preference to blank or close open pipework remains.

Care should be exercised in assessing the suitability of instrument manifold valves to ensure suitability for the duty e.g. pressure/ temperature rating and the requirements of a primary isolating process valve.

- 3.2.2.3 Work on instrumentation typically features isolation for short periods, with equipment in-situ, where work is continuously attended and completed within a shift period. Should the worksite be left unattended or instrumentation be removed, the installation shall be made safe by capping, plugging or blanking any open connections, with the appropriate fitting. Where vents or drains which form part of an instrument are removed, facilities shall be provided, such that any fitting used for temporary closure can be safely removed.

The arrangement of single or double block valves followed by vent valve after the block valve(s) is common in existing instrument installations. Whilst the vent is after the block valve(s), this is considered an acceptable method of initial valving (V) of live systems for further isolation of instrument systems. For example, if the instrument were removed, this arrangement should not be substituted for a DDB as final isolation (I) requirement and any open connections should be capped, plugged or blanked with safe removal facilities.

3.2.3 Tank Level Measurements

- 3.2.3.1 Float type tank level equipment should be provided with isolation facilities which will allow the float or electronic sensor to be removed from the tank for maintenance or isolation.

- 3.2.3.2. Bubbler systems shall be supplied only with facilities to isolate the gas supply.

This facility is included to allow replacement of the more unreliable part of the equipment. The dip tube is considered sufficiently reliable not to need replacement between tank inspections.

3.2.4 Electrical Field Instruments

- 3.2.4.1 Where power is supplied to an electrical field instrument power isolation shall be provided in accordance with Part 2 (electrical) of this Recommended Practice.



The equipment should be isolated electrically before removal. This may be effected by the use of switches, fuses or MCB's which are usually located in the control building or equipment room.

3.2.4.2 Transmitter signals shall be isolatable at the terminals in the equipment/control room. Isolation shall be by use of isolation terminals equipped with removable pins, swing-links or similar purpose designed arrangements. Isolation shall not require the removal of the cable cores themselves from the terminal strips. The use of isolation terminals shall be such that they do not infringe certification requirements for Intrinsically Safe type equipment.

3.2.5 Instrument Electrical Control Equipment

3.2.5.1 All discrete electrical equipment (e.g. controllers, indicators and annunciator units) shall be individually isolatable.

3.2.5.2 Each panel section or rack of equipment shall be isolatable.

3.2.6 Instrument Pneumatic Control Equipment

3.2.6.1 The air supply to individual instruments both in the control panel and in the field shall be isolatable by a suitable block valve.

3.2.6.2 The dual input filter regulators feeding instrument air to a pneumatic panel shall be provided with isolation both upstream and downstream of each filter regulator set.

3.2.7 Distributed Control and PLC Based Systems

3.2.7.1 All distributed control and PLC based systems shall be fully maintainable. The isolation requirements for this shall be fully taken into account in the design stages.

The isolation requirements for the hardware side of distributed control or PLC based systems shall generally be as electrical field equipment and discrete electrical control equipment. However, the configuration of the units should be such that when discrete components, such as I/O are isolated only the specific part of the plant should be affected. A full design study should be done before the system is configured to ensure that the operational requirements are met.

The method of maintenance should be fully agreed at the design phase.

Maintenance by card replacement does not require any additional isolation, however card replacement should not effect operation of the plant. Facilities should be included for this. Detailed equipment maintenance will normally be by replacement of cards. The manufacturers standard shall be used for this.



3.2.7.2 The system shall be configured to allow isolation of the instrumentation of a single equipment item of a plant and a whole plant without affecting other equipment items or plants.

3.2.7.3 Where dual systems are supplied (such as dual input/output modules and dual power supplies) each shall be capable of isolation without affecting the safety or operation of the plant.

The types of isolation which may be used are:-

- (a) by removal of the faulty card to allow replacement with a working card..
- (b) By insertion of a maintenance card to allow replacement of the faulty card.

3.2.7.4 System power packs shall have isolation on both the input and output.

3.2.7.5 When a PLC System has more than one plant under its control it shall be configured so that the instrumentation for one or more plants can be isolated without affecting the in-service plants.

3.2.8 Fiscal Metering Systems

Fiscal Measuring Systems shall be capable of being isolated in the same way as plant used for non-fiscal purposes. However in the case of fiscal systems the isolations shall be sealed or lockable.

3.2.9 Instrument Utilities Systems

Utility Systems to instruments (e.g. purge air, cooling water and hydraulic oil) should be supplied with isolation valves to each user.

3.2.10 Motor Operated Valve Actuators

Motor operated valve actuators shall have isolation provided in accordance with Part 2 (electrical) of this Recommended Practice.

Isolation may be individually from a MCC. In groups from a MCC or in groups from an MCC with individual local isolators. The choice of which isolation system to be used shall be based on the operational requirements of the system.

3.2.11 ESD Systems

3.2.11.1 All ESD Systems must be supplied with test facilities. Testing may be by isolation of the equipment under test or by shutting-down the plant to be tested.



In this case isolation facilities should include the normal plant isolation for transmitters (as in section 3.1.4.2). Switches shall be included as necessary to isolate inputs and outputs from the ESD system to allow testing to take place without the plant shutting down. Where shown by the test requirements the input to final elements shall also be overridden in the field to allow testing of this equipment. Overrides to allow isolation shall also be provided in this case. The requirement for and type of isolation shall be included in the system design. The isolation provided shall fully conform to the system design requirements.

Where isolation of part of an ESD System is effected, the position of the isolation equipment should be monitored and recorded automatically.

- 3.2.11.2 All isolators for ESD Systems should be key operated or lockable.
- 3.2.11.3 Where auto test facilities are used isolation shall be internal to the auto test System.



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

Abbreviations

ESD	Emergency Shutdown
HAZOP	Hazard and Operability Study
IS	Intrinsically Safe
LNG	Liquefied Natural Gas
MCB	Motor Control Board
MCC	Motor Control Centre
NLG	Natural Liquefied Gases
PLC	Programmable Logic Controller
RTJ	Ring Type Joint



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless otherwise stated.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

Standards and Industrial Documents

[BS 6423](#) Code of Practice for maintenance of electrical switchgear and controlgear for voltages up to and including 1kV.

[BS 6626](#) Code of Practice for maintenance of electrical switchgear and controlgear for voltages above 1kV and up to and including 36kV

[BS 6867](#) Code of Practice for maintenance of electrical switchgear for voltages above 36kV

[Electricity at Work Regulations - 1989](#)

[Memorandum of Guidance on the Electricity at Work Regulations 1989](#)

[IEE Regulations for Electrical Installations, 16th edition.](#)

[HSE Safety Notice 3/84 'Safe Isolation of Electrical Equipment'.](#)

[SI1019](#) The Offshore Installations (Operational Safety, Health and Welfare) Regulations

[AODC](#) Code of Practice for the Safe use of Electricity Under Water

[IEE Recommendations for the Electrical and Electronic Equipment of Mobile and Fixed Offshore Installations](#)

BP Group Documents

BP Group [GS 112-8](#) Factory-built assemblies of low voltage switchgear and controlgear (replaces BP Std 227)

BP Group [GS 112-9](#) High voltage switchgear and controlgear (replaces BP Std 225)

BP Group [RP 42-1](#) Piping Systems to ANSI B42.1 (replaces BP CP 12)

BP Group [RP 12 series](#) Electrical systems and installations (replaces BP CP 17)



BP Group [RP 62-1](#)

Guide to Valve Selection (replaces BP CP 33)

BP Group [RP 30](#) series

Control and Instrumentation (replaces BP CP 18)

