



RP 30-3

INSTRUMENTATION AND CONTROL

SELECTION AND USE OF

CONTROL AND SHUTOFF VALVES

September 1993

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Document Title INSTRUMENTATION AND CONTROL SELECTION AND USE OF CONTROL AND SHUTOFF VALVES (Replaces BP Engineering CP 18 Part 4)											
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SCOPE AND PURPOSE This Recommended Practice provides guidance on the Selection and Use of Control and Shutoff Valves, including actuators and accessories for both onshore and offshore applications. Its purpose is to provide design engineers and plant management with:- (a) guidance on the need and applicability of Control and Shutoff Valves. (b) a basis for evaluating and selecting types of Control and Shutoff Valves for various duties. (c) guidance on health and safety aspects associated with the selection, installation and operation of Control and Shutoff Valves.											
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

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 requirements.

Value of this Recommended Practice

This Recommended Practice gives the basis for the Selection and Use of Control and Shutoff Valves. It has been developed from cross-Business experience gained during capital project developments, operations and maintenance and from equipment developments and evaluations carried out under BP's Business and Corporate R&D programme.

The document gives guidance on equipment selection, application and project development which is not available from industry, national or international codes.

Where such codes exist for established elements of the technology, the document guides the user as to their correct application.

It is intended to review and update this document at regular intervals, because it is essential to maintain BP's commercial advantage from the effective deployment of the rapidly developing technology covered by this Practice.

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.

Principal Changes from Previous Edition

This is a revision of Part 4 of BP Code of Practice CP 18. With its supplementary 'yellow page's' it has been rationalised into a single document BP Group RP 30-3 composed of three sections:-



Section 1	Introduction
Section 2	Regulating Control Valves
Section 3	Power Actuated Isolating Valves

These Sections reflect the applicable previous sections generally retaining previous content but in some cases additional sections and sub-sections have been added (see Cross Reference List, page v).

This document specifies all BP's general requirements for Control and Shutoff Valves that are within its stated scope and is for use with a supplementary specification to adapt it for each specific application.

Detailed requirements for Actuators for Shutoff Valves are defined in the General Specification BP Group [GS 130-6](#).

Principal changes to Sections Issued from March 1991:-

- (a) The Practice has been revised to the new format to rationalise the sections and integrate the commentary into the main text.
- (b) The sections have been updated to include references to new standards and reflect changes in operating practices.
- (c) Section numbering has been amended to suit the applicable part.

The cross-reference at the end of this foreword shows relationships between new documents and the old CP 18.

Feedback and Further Information

Users of BP RPSEs are invited to submit any comments and detail experiences in their application, to assist in their continuous improvement.

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



LIST OF SECTIONS CROSS REFERENCED TO CP 18

RP 30-1 TO RP 30-5

CP 18 PARTS AND SECTIONS

No equivalent in RP 3~X

Part 1 (Foreword and Introduction)

RP 30-1 INSTRUMENTATION AND CONTROL DESIGN AND PRACTICE

Part 2 Systems, Design and Practice

Section 1	Introduction	E Section 1	Introduction
Section 2	Control Engineering Principles	E Section 2	Control Engineering Principles
Section 3	Selection of Instrumentation Equipment	E Section 3	Selection of Instrumentation Equipment
Section 5	Earthing and Bonding	E Section 5	Earthing and Bonding
Section 6	Instrument Power Supplies	E Section 6	Instrument Power Supplies
Section 7	Instrument Air Systems	E Section 7	Instrument Air Systems
Section 8	Hydraulic Power Systems	E Section 8	Hydraulic Power Systems
Section 9	Control Panels	E Section 9	Control Panels
Section 10	Control Buildings	E Section 10	Control Buildings
Section 11	Instrument Database Systems	Section 11	Digital Systems (to RP 30-4 , Sect 2)
		+ Section 12	Advanced Control System (to RP 30-4 , Sect. 5)
		+ Section 13	Telecommunications (to RP 30-4 , Sect. 3)

RP 30-2 INSTRUMENTATION AND CONTROL SELECTION AND USE OF MEASUREMENT INSTRUMENTATION

Part 3 Measurement

Section 1	Introduction	E Section 1	Introduction
Section 2	Temperature Measurement	E Section 2	Temperature Measurement
Section 3	Pressure Measurement	E Section 3	Pressure Measurement
Section 4	Liquid Level Measurement	E Section 4	Liquid Level Measurement
Section 5	Flow Measurement	E Section 5	Flow Measurement
Section 6	Storage Tank Measurement	E Section 6	Storage Tank Measurement
Section 7	On Line Analytical Measurement	E Section 7	Measurement
Section 8	Automatic Samplers for Offline Analysis	E Section 8	Automatic Samplers for Offline Analysis
Section 9	Weighbridges and Weighscales	E + Section 9	Weighing Systems
Section 10	Environmental Monitoring		
Section 11	Instrumentation for HVAC systems		
Section 12	Drilling Instrumentation		

RP 30-3 INSTRUMENTATION AND CONTROL SELECTION AND USE OF CONTROL AND SHUTOFF VALVES

Part 4 Valves and Actuators

Section 1	Introduction	E Section 1	Introduction
Section 2	Regulating Control Valves	E Section 2	Regulating Control Valves
Section 3	Power Actuated Isolating Valves	E Section 3	Power Actuated Isolating Valves

RP 30-4 INSTRUMENTATION AND CONTROL SELECTION AND USE OF CONTROL AND DATA ACQUISITION SYSTEMS

Section 1	Introduction
Section 2	Digital Systems (new commentary added)
Section 3	Telecommunications
Section 4	Subsea Control Systems
Section 5	+ Advanced Control Systems

RP 30-5 INSTRUMENTATION AND CONTROL SELECTION AND USE OF EQUIPMENT FOR INSTRUMENT PROTECTION SYSTEMS

Part 5 Protective Systems

Section 1	Introduction	E Section 1	Introduction
Section 2	Protective Instrument Systems	E Section 2	Protective Instrument Systems
Section 3	Alarm systems	E Section 3	Alarm Systems
Section 4	Fire and Gas Detection and Control Systems	E Section 4	Fire and Gas Detection and Control Systems
Section 5	Pipeline Leak Detection	E + Section 5	Pipeline Leak Detection

E- equivalent (not identical)

+ - yet to be published



1. INTRODUCTION

1.1 Scope

This Recommended Practice provides a guide to the selection and use of control and shutoff valves. It contains sections that have general application to the provision of regulating and isolating valves and associated actuation. These include general principles and documentation requirements.

BP Group [RP 62-1](#) 'Guide to Valve Selection' covers the Mechanical Engineering of Isolation and other valves but excludes control valves.

This Recommended Practice is concerned with the Control Engineering applicable to main process valves, in particular control valves and the actuation and actuator system for all main process valves.

This Practice details specific BP requirements for regulating and isolation valves, including actuators and accessories in both onshore and offshore applications.

The general requirements for subsea technology are included in this Recommended Practice. In addition reference should be made to BP Group RP 30-4, Section 4; Subsea Control Systems.

Other related Practices to BP Group [RP 30-3](#) specify BP requirements for specific equipment, i.e. Instrument and Control Design and Practice, Measurement, Control and Data acquisition systems and Protective systems.

1.2 Application

Reference shall be made to BP Group [RP 30-1](#) to ensure that all relevant BP requirements for instrumentation and control are complied with.

To apply this Practice, it shall be necessary to make reference to other BP RPSEs, national codes and standards as indicated in the relevant text.

* Reference is made in the text to British Standards. These standards are generally being harmonised with other European standards and will be allocated ISO/EN reference numbers. In certain countries, national Standards may apply. BP shall approve use of other standards.

1.3 Units

This Practice employs SI metric units.

Nominal pipe sizes (NPS) are ANSI or API designations which have not yet been metricated. However, metric DN numbers are given in brackets.



bar - Except when referring to a pressure differential, the unit is stated as gauge pressure, bar (ga) or absolute pressure, bar (abs). Gauge pressure is measured from standard atmospheric pressure of 1.01325 bar.

1.4 Quality Assurance

Verification of the vendor's quality system is normally part of the pre-qualification procedure, and is therefore not specified in the core text of this practice. If this is not the case, clauses should be inserted to require the vendor to operate and be prepared to demonstrate the quality system to the purchaser. The quality system should ensure that the technical and QA requirements specified in the enquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free issue materials.

Further suggestions may be found in the BP Group RPSEs Introductory Volume

2. REGULATING CONTROL VALVES

This Section specifies BP general requirements for regulating control valves.

2.1 General Requirements

2.1.1 Materials used and the construction of pressure containing parts of control valves, and their installation in pipework shall conform with BP Group [RP 42-1](#), BP Group [RP 62-1](#) and BP Group [GS 142-6](#).

2.1.2 Globe valves should be flanged to [ANSI B16.5](#) (inch dimensions), the flange finish in accordance with BP Group [GS 142-12](#). In general, flanges to [BS 1560](#): Part 2 may be used as an alternative. The face to face dimensions shall comply with [BS 1655](#).

2.1.3 The minimum size of globe and ball valve bodies shall be NPS 1 (DN 25). Body sizes corresponding to NPS 1 1/4 (DN 32), NPS 2 1/2 (DN 65), NPS 3 1/2 (DN 90) and odd sizes above NPS 4 (DN 100) shall not be used.

2.1.4 The minimum nominal sizes of eccentric plug valves shall be NPS 2 (DN 50) and of butterfly valves NPS 4 (DN 100).

2.1.5 The pressure ratings of globe valves and ball valves with bodies up to NPS 8 (DN 200) shall be at least Class 300.

There is no economic advantage in insisting on bodies and flanges in cast steel dimensioned to Class 150, as this usually involves machining down a standard Class 300 casting.

2.1.6 All valves shall be drilled and tapped to accept gland lubricators.



- 2.1.7 The shaft on a butterfly valve shall be continuous, through the vane. The vane shall be rigidly locked to the shaft. The shaft shall be supported in outboard bearings.
- 2.1.8 The direction of flow through a valve shall be permanently marked on the body or flanges.
- 2.1.9 The contractor shall specify the acceptable degree of seat leakage for each valve as appropriate to the application
- Remember that the degree of seat leakage is not only dependent upon the relative finish of the plug and seat but also on the strains imposed on the installed trim. Leakage rate should be specified to either [ISO 5208](#) or [ANSI B16.104](#).*
- 2.1.10 Control valves with soft seats (such as PTFE) shall only be employed where the specified degree of tight shut off cannot be achieved using metal seats.
- * 2.1.11 The application and design of extension bonnets shall be subject to approval by BP. They may be specified in the following circumstances:-
- (a) Extension bonnet - for fluid temperatures down to -100°C (-148°F) or above +230°C (+446°F).
 - (b) Cryogenic bonnet - for fluid temperatures below - 100°C (-148°F). The design should allow plug and seat to be withdrawn through the bonnet.
 - (c) Bellows seal bonnets - should be specified only when no stem leakage can be tolerated. They should be provided with a monitor for bellows leakage, e.g. small pressure gauge and excess flow valve.
- 2.1.12 Welded ends may be specified where high temperatures and pressures are expected, or where the controlled fluid is highly toxic. The valve body material shall be weld compatible with the adjoining pipe material.
- 2.1.13 Where the valve body is to be welded into a pipeline, the valve trim should be completely replaceable through the bonnet. Precautions shall be taken during installation to avoid damage to the inner valve.
- 2.1.14 The contractor shall specify the required action of each valve on failure of its control signal or operating medium; with due regard to safe operation and shut down.
- * 2.1.15 Where control valves and accessories are to be installed in locations susceptible to seismic disturbances, all components shall be designed to



sustain the anticipated stresses and to function normally after the disturbances have passed. Valves and components shall be subject to approval by BP.

- 2.1.16 Self-acting valves may be used for local, fixed gain control of utilities (e.g. fuel systems).

Local, fixed gain control can give closer control when the load is nearly constant.

- 2.1.17 The contractor shall specify gland type and packing material in accordance with process conditions. Packing boxes shall be easily accessible for periodic adjustment.

Where 'Through Body Bolted Control Valves' are considered for use, the following criteria should be taken into account.

- (a) The length of the bolts concerned. (The potential for misalignment or leakage with butterfly valves for example is not as great as for valves of significantly greater face to face dimension).
- (b) The duty of the pipeline and control valve concerned together with the line size. Great care should be taken when considering 'Through Body Bolted Control Valves' for Hydrocarbon service and in particular where the line size is large.
- (c) The fire risk in the immediate area of where the control valve is to be sited and what type of fire protection is available.

Through Body Bolted Control Valves' are sometimes considered in order to reduce control valve weight and cost and sometimes because of space constraints. The main concern with 'Through Body Bolted Control Valves' is that the increased bolt length leads to an increased potential for misalignment of the valve flange faces. There is also an increased potential for the unintentional loss or relaxation of bolt tension leading to an increased risk of product leakage. There is also the added risk that a small localised fire will add to the potential for bolt expansion and further leakage. Alternatives could be to use lagged valves (where bolts are protected) or sheet steel physical protection.

2.2 Valve Characteristics

- 2.2.1 The contractor shall specify the type of control valve trim appropriate to the required flow characteristic for the duty (i.e. quick opening, linear or equal percentage. - See 2.2.3).

Quick opening characteristic gives a large flow on opening as the plug initially leaves the seat, but a smaller flow increases as the plug opens further.



Linear characteristic gives equal increases in valve opening for equal increases in stem travel.

Equal percentage characteristic gives equal percentage increases in valve opening for equal increments in stem travel.

The rules outlined cover most cases; a more comprehensive treatment is given in the ISA ([Instrument Society of America](#)) [Handbook of Control Valves](#).

2.2.2 An adequate allocation of pressure drop across the control valve, in conjunction with the selected characteristic, should be applied to ensure a near linear relationship between valve position and the controlled variable over the entire operating range.

* 2.2.3 When 50% or more of the dynamic pressure drop is allocated to the control valve, the valve should have a linear characteristic, otherwise it should be fitted with equal percentage trim. The use of quick opening trims in control valves shall be subject to approval by BP.

2.3 Valve Selection

* 2.3.1 The type of control valve shall be specified to satisfy the process conditions. Generally, control valves of globe, butterfly, ball, angle or eccentric rotating plug design shall be employed. All other valve types shall be subject to approval by BP.

The globe body is traditionally the most commonly used style of control valve. It offers a greater degree of internal (trim) and external (mounting) flexibility than any alternative style.

2.3.2 Large volume flows and high shut-off differential pressures should be controlled by full-bore ball valves or characterised ball valves.

A full-floating ball pattern will give total shut-off but requires a high operating torque. Leakage for a characterised ball pattern is equivalent to a good double seated globe design. A full bore ball pattern has poor low flow control ability whereas a characterised ball pattern exhibits near equal percentage performance for the lower half of its travel. These may be more prone to cavitation.

2.3.3 Large volume flow and low pressure drop should be achieved by the use of butterfly valves or eccentric rotating plug valves.

For low to medium shut-off differential pressures and where a small leakage is acceptable, butterfly valves are an economic alternative to globe and ball valves of size NPS 4 (DN 100) and above.

2.3.4 Angle valves may be provided where it is necessary to prevent the accumulation of solids, and on erosive or flashing service.

* 2.3.5 The selection of specialist valves for conditions where cavitation or flashing are likely shall be determined by the contractor, and submitted



for approval by BP. Account shall be taken of the effects of any particulate matter likely in the process fluid which may result in blockage of small orifices within low noise/anti-cavitation trims.

Cavitation is the transformation of a portion of liquid into vapour bubbles during rapid acceleration of the fluid inside the valve, and the subsequent implosion or collapse of these bubbles downstream. Cavitation occurs in a control valve once the static pressure at the 'vena contracta' reaches the vapour pressure of the fluid.

Control valves with inherent high pressure recovery characteristics (streamlined) are more likely to suffer cavitation effects. Low pressure recovery characteristic globe valves and trim are generally used to minimise the risk.

Flashing occurs when the pressure downstream of the vena contracta remains equal to or less than the vapour pressure of the fluid. Vapour bubbles therefore persist within the fluid and can cause physical damage and decreased valve capacity.

Again, the degree of flashing depends principally upon the pressure recovery characteristics of the valve.

2.3.6 Control valves on discharge lines to flare shall be specified with bubble-tight shut off.

2.3.7 In selecting control valves consideration shall be given to reduce fugitive emissions from control valve glands.

2.4 Valve Materials

2.4.1 Control valve bodies and other pressure containment items shall conform with BP Group [GS 142-6](#).

2.4.2 Control valve trim materials shall be specified to withstand the effects of wear, erosion, pressure drop and corrosion.

Commonly used materials include stainless steel, Monel, Hastelloy and Stellite. For valves where severe wear may occur it is common practice to face a base materials (such as stainless steel) with Stellite, particularly at the seating surfaces and guide posts. In a number of severe services the Company has experience of successfully using ceramic trim.

2.4.3 Materials for sour service shall conform to the requirements of BP Group [GS 136-1](#).

2.4.4 Butterfly valves should be provided with stainless steel vanes and shafts of precipitation hardened materials (e.g. 17-4 PH).

2.5 Valve Sizing

2.5.1 All control valves shall be sized to provide adequate rangeability at minimum cost.



The selection of the correct body and trim size for a control valve is ideally based upon a full knowledge of the actual flowing conditions. Where one or more of these conditions is unknown, certain assumptions will need to be made using sound engineering judgement. Generally, the tendency is to make the valve too large (to be on the 'safe' side) resulting in a valve of limited control capability.

- 2.5.2 The size of control valves shall be calculated from the rates of flow and pressure drops under design conditions, as well as other known factors such as fluid temperature, density, viscosity and vapour pressure.

The flow coefficient, C_v , is accepted as the yardstick of valve capacity. The C_v is defined as the flow through the valve in U.S. gallons per minute of water at 60°F with a pressure drop across the valve of one psi.

There are two basic sizing formulae, one for incompressible fluids (liquids) and one for compressible fluids (vapours and gases). The formulae for compressible fluids utilises the liquid flow coefficient, C_v , by inclusion of an expansion factor, (K), which also accounts for differences between compressible and incompressible discharge coefficients and critical flow factors. This system of valve sizing requires only one C_v value for each valve body and trim combination, regardless of service.

For more detailed information regarding the sizing of control valves, reference should be made to the applicable codes and standards. In addition, most control valve manufacturers produce sizing handbooks.

- 2.5.3 For pumped circuits, at least 25% of the total dynamic pressure drop at the design flow rate shall be allocated to the control valve.

A general rule only. In applications where the pressure drop has been determined by other means, this value should be used in the sizing formulae.

- 2.5.4 A control valve shall be selected such that its capacity is between 120% to 140% of design for linear trim and 130% to 160% for equal percentage trim.

- 2.5.5 The effect of any reduced inlet and outlet pipe sizes and valve pressure recovery shall be taken into account when sizing control valves.

- 2.5.6 Control valves should be designed to operate within the limits of 10% to 90% of their stroke. Where the control required is greater than the normal range, two valves in parallel may be used.

Control greater than the normal range is likely to occur where 'start-up' and 'normal' flow requirements are encountered.

2.6 Valve Noise

- * 2.6.1 Control valves can develop noise due to mechanical vibration (resonance), cavitation and turbulent flow. All valves shall be assessed for their noise (sound power) level and shall be subject to approval by BP. Noise levels at the operator working positions should be less than 85 dB(A).



- * 2.6.2 Special purpose valves shall be used for noise avoidance. Proposals to employ higher schedule piping, restrictor plates or silencers shall be subject to approval by BP.

Noise due to mechanical vibration can be eliminated by a change in stem diameter, a change in the mass of the plug or sometimes reversal in flow direction. Cavitation noise can be avoided by the use of a suitable trim or valve type. Noise produced by fluid turbulence is almost negligible with liquids but can cause major problems with vapours or gases due to greater than sonic velocities at the valve orifice.

- 2.6.3 Control valves with special trim for noise reduction should have globe bodies and cage trims.

Ball and butterfly patterns are high pressure recovery valves presenting a small flow area leading to increased velocities and hence noise.

Cage trims split the flow path and are inherently 'low noise'.

2.7 Actuators

- * 2.7.1 General Requirements

The type of control valve actuator shall be specified to suit the choice of operating medium, the thrust and stroke requirements, and the type of control valve body.

The design of the actuator shall ensure that the action of the control valve on failure of the control signal or operating medium shall be to a predetermined safe position.

Actuator for Shutoff valve duty shall conform to BP Group [GS 130-6](#).

Actuators are usually classified as direct acting or reverse acting. For an air-operated direct acting valve, an increase in air loading extends the actuator stem, and for a reverse acting valve, an increase in air loading retracts the actuator stem.

Selection of direct or reverse action is usually based upon the failure requirements of the control valve, where the spring is used to drive the valve to the desired position in the event of failure of the operating medium.

All control valves shall be provided with an indicating device to show the position of the valve, whether under the action of the control signal or handwheel.

Pneumatic actuators are preferred and shall be designed to give full functionality on a supply of 4 bar g maximum. (Note that BP sizes the reserve air capacity in the distribution system on the basis of decay time from normal generation pressure to 4 bar g).



Hydraulic actuators may be used, subject to BP approval, where the pneumatic alternative is impractical or uneconomic (e.g. no air supply unavailable, very high powers involved).

BP will specify any special requirements for materials of construction for actuators and accessories.

The purchaser should specify alternatives if the operating environment is likely to affect the commonly used aluminium/aluminium alloy materials used for actuators and accessories (e.g. offshore service).

2.7.2 Diaphragm Actuators

With air as the operating medium, the normal operating range should be 0.2 to 1.0 bar (ga) (3 to 15 psig), but shall not exceed 4.0 bar (ga) (58 psig).

Diaphragm actuators may be operated by the control signal or through positioners or booster relays.

'Bench setting' shall be avoided by the use of adequately sized actuators.

When the valve is working under operating conditions the air pressure required for stroking the valve (operating range) often varies from that experienced at the manufacturers works (bench range) due to the loads induced by the process fluids.

Reverse-acting spring diaphragm actuators incorporating seals or glands shall be avoided.

2.7.3 Piston Actuators

Piston actuators may be used for operating control valves, and are particularly suited to applications where long strokes or high forces are required.

Double-acting pneumatic piston actuators which do not automatically fail to a safe position in the event of air failure shall be supplied with a close coupled air receiver, with sufficient capacity for at least two operations over the full travel of the valve. Loss of air from the local air receiver shall be prevented by a non-return valve on the air supply inlet.

Double acting hydraulic actuators shall be afforded the above functionality by the use of a hydraulic accumulator.

* 2.7.4 Electric Motor Actuators

The use of motor actuators for control valves shall be subject to approval by BP. (See also BP Group [GS 112-2](#)).

Electric motor actuators should be mounted so that the motor is above the gear box, to prevent gear oil from saturating the motor windings.



2.8 Accessories

2.8.1 Positioners

Pneumatic actuators shall be provided with positioners when:-

- (a) The valve size is NPS 6 (DN 150) and over.
- (b) The valve size is NPS 2 (DN 50) and over with operating temperature outside the limits -20°C (-4°F) and +230°C (+446°F).
- (c) The valve has a rotary action.
- (d) The valve is used in a split range application.
- (e) The valve actuator has a spring range which is not compatible with the control air pressure range.
- (f) The distance between a pneumatic controller and its valve exceeds 75 m (250 ft).
- (g) The calculation $\frac{p \times s}{A}$ yields a result greater than 0.1 bar (1.5 psi).

where p = pressure differential across the valve, determined with the valve in the closed position in bar (psi).

s = effective valve seat area opposing the actuator in mm² (in²).

A = effective diaphragm area in mm² (in²).

- (h) The valve is positioned by a controller with an integral time exceeding 2 minutes, e.g. averaging liquid level controllers, temperature controllers.
- (i) The actuator requires a positioner by virtue of its design.

The positioner is a device which provides an accurate means of obtaining a valve stem position corresponding to the signal generated by the controller. If the stem is incorrectly positioned the positioner either increases or decreases the air in the actuator until the correct stem position is obtained.

Pneumatic positioners shall be fitted with by-passes except where reverse acting or split range positioners are required, or where the actuator operating air pressure range is not compatible with the control signal.



Hydraulic actuators shall always be provided with a positioner; the input signal being electric or pneumatic.

Positioners shall be provided with gauges to indicate input signal, supply pressure and output pressure.

2.8.2 Signal Converters

Converters (e.g. electro-pneumatic, electro-hydraulic, pneumatic-hydraulic) shall not be mounted on the control valve, but located adjacent to the valve.

Electro-pneumatic converters are transducers that convert the electrical output signals from electronic controllers into pneumatic signals that may be used to operate diaphragm actuators.

2.8.3 Solenoid Valves

Trip solenoid valves initiated by a shutdown system to isolate and depressure the supply to the control valve actuator shall be provided directly in the actuator supply line.

For double acting actuators, the solenoid valve must only dump the appropriate side of the piston whilst maintaining the full supply pressure to the other.

2.8.4 Handwheels

A permanent side-mounted handwheel should be provided on control valves where no alternative manual by-pass arrangement is installed.

Suitable means shall be provided to prevent rotation of the handwheel by vibration.

Permanently mounted handwheels should not be fitted to any control valve forming part of:-

- (i) an emergency shutdown system.
- (ii) a control scheme where local manual control is impractical (e.g. fast acting, highly interactive).

When engaged, handwheels may prevent a valve travelling to its air/hydraulic supply failure position.

2.8.5 Relays

Pressure and volume booster relays shall be provided where necessary to increase the speed of response of the control valve. They shall be attached to the valve actuators.

Lock-up relays may be used where the process conditions demand that the control valve temporarily holds its last position in the event of supply failure (e.g. to permit an orderly plant shut-down).

Lock-up relays are not considered good design practice where continued plant operation after utility failure is a requirement.

2.8.6 Pressure Protection

Valves and actuators should be protected from any over-stressing should the primary air supply regulator fail to high output pressure. Refer to BP Group [RP 30-1](#), Section 7.

3. POWER ACTUATED ISOLATING VALVES

This Section gives guidance on BP's general engineering design requirements for power actuated isolating valves, and is applicable to:-

- (a) Emergency Shutdown Valves.
- (b) Process Isolation Valves used on flowmetering systems.
- (c) General Process Isolation Valves.
- (d) Sequential (on/off) Control Valves.
- (e) Solenoid Actuators where they are used on valves for direct process isolation.

These requirements are not applicable to the following:-

- (a) Wellhead and Christmas Tree Valves.
- (b) Downhole Safety Valves.
- (c) HVAC Dampers.

3.1 Selection of Isolating Valves

- 3.1.1 When selecting isolation valves, factors taken into consideration should include, process properties, capacity requirements, normal and shut-off pressure drop, closure time constraints, weight and cost. Consideration should also be given to the implications on human health, safety and environment.



Isolation valves shall be rated and specified in accordance with BP Group [RP 62-1](#), BP Group [RP 42-1](#) and BP Group [GS 142-5](#), which give guidance in the selection of type, materials of construction, pressure containment and end connections.

Consideration for health, safety and environment include:-

- (a) *Product Stewardship - Prior to selecting actuators and valves for particular processes, consideration should be given to the product, its proposed applications and markets of sale.*
- (b) *Effects on human health and the environment. The engineer will need to consider selecting higher integrity equipment if the raw materials, intermediates, by-products, products, wastes etc., pose a potential serious risk to human health and the environment.*
- (c) *High noise levels may arise from the following sources:-*
 - *Pneumatic actuators, particularly diaphragm operation.*
 - *Process flow noise due to throttle restriction, as well as noise due to high flow rates.*
 - *Valve modulation.*
 - *Valve chatter*

Having regard to the noise levels which may arise during operation of the plant, the Engineer should discuss with the actuator and valve supplier the noise levels which may be produced under all operating conditions. A realistic specification for noise may then be produced which must be met when fully installed under any operating condition.

The manufacturer shall also provide an estimate of the leakage that may occur up the valve stem and from the seal which may enter the operators breathing zone or the environment.

Selection of valve seat materials should take into account the process media, possible contaminants and any particulate matter present. Also physical constraints such as shutoff.

The selection of valves and seat materials should also take into account the impact on human health and the environment of the substances used, the potential for operator exposure or environmental release as well as product contamination (particularly if the product is intended to be used in food or medical applications).

3.1.2 On process lines which require pigging, full bore trunnion mounted ball valves or gate valves shall be used.

3.1.3 Reduced bore valves may be used on services where the developed pressure across such a valve is acceptable. Reduced bore isolation valves often offer the advantage of low capital cost and increased operability. Also, space and weight savings.

It may not be necessary to use a full line sized valve for each application. A smaller valve may be acceptable and cost effective when expensive materials are



used in its construction. However, overall installed cost has to be addressed since the provision of reducers in the pipework may negate any cost advantage.

- 3.1.4 All isolation valves on process shutdown shall have a minimum class of seat leakage of Rate 1, [ISO 5208](#), i.e. shut off type.
- 3.1.5 Isolation valves on emergency shutdown duty shall have a minimum class of seat leakage of Rate 2, [ISO 5208](#), i.e. tight shut off type.
- 3.1.6 Trip valves on heater fuel service shall have a minimum class of seat leakage of Rate 3, [ISO 5208](#), i.e. bubble tight shut off. Refer to BP Group [RP 22-1](#).
- 3.1.7 Isolation valves for metering systems shall be double seating with integral intermediate bleed for testing. Both seats shall be bubble-tight. Refer to BP Group [RP 30-2](#) Section 5.
- * 3.1.8 Subject to BP approval, control valves in accordance with Section 2 may be used for sequential control duties, and for some shutdown applications. (Refer to BP Group [RP 30-6](#)).

For non-critical Category 2 applications, a control valve may be used for combined control and shut-off duties. In which case slight leakage is to be expected and the designer should ensure that this is acceptable. The control valve should be designed for tight shut-off.

A separate shut-off valve should be used for Category 1 applications (refer to BP Group [RP 30-6](#)) where specified in national codes, and where necessary to satisfy operational criteria. Examples are:-

- (a) *Fuel to boilers or fuel to compressors where it is necessary to fully isolate the fuels for safety reasons.*
- (b) *Isolation of tanks or vessels to contain the inventory under emergency conditions.*
- (c) *Isolation to prevent measurement errors or cross product contamination (e.g. metering stations, tankage and product loading facilities).*

- * 3.1.9 The use of globe valves, solenoid valves, diaphragm valves, poppet valves and floating ball valves for power actuated isolation shall be subject to approval by BP.

Globe valves design results in the fluid flow changing direction during its passage through the valve (i.e. flow is turbulent). Wear can take place on the valve seat and impair valve shut-off characteristics. Erosive fluids can cause rapid seat wear. Also, pressure drop can be high.

High integrity of shut-off is not normally available. However, soft seats are sometimes provided to improve shut-off characteristics; with consequent operating temperature and other materials limitations.



Globe valves can provide reliable service provided that their inherent limitations do not compromise the integrity of the plant design. They may be cost effective for sequential or batch operations.

- 3.1.10 The design of the valve and actuator assembly shall ensure that any pressure release of process media (e.g. gland leakage) cannot contaminate the instrument air or hydraulic fluid supply system. Collars between valve body stems and integral actuators shall be provided with a vent to atmosphere or closed drain dependant on the process materials used.

3.2 Selection of Valve Actuators

- 3.2.1 The actuator shall be selected to provide the correct valve operating action as detailed by the valve specification; including speed of operation. They shall conform to the requirements of BP Group [GS 130-6](#) 'Actuators for Shutoff Valves'.

- 3.2.2 The actuator vendor should be responsible for the mechanical compatibility and provision of the mechanical coupling between the valve and actuator.

Non-linear torque/thrust characteristics of the actuator shall be taken into account, since maximum torque/thrust available from an actuator may not coincide with that required by the valve. This is particularly applicable to spring return actuators.

- 3.2.3 For ESD applications or ball valves the actuator design torque/thrust shall be capable of delivering twice the valve requirement throughout its stroke.

For other valves and non-ESD applications the actuator design torque/thrust shall be capable of delivering 1.5 times the valve requirements throughout its stroke.

The valve/thrust characteristic used in the calculation shall be traceable to actual tests and exclude the manufacturers own safety factors.

The total rated value of torque/thrust is nominally defined as the break torque/thrust from closed position under full differential pressure for a valve in good condition.

Recent tests however indicate that the valve seating torque's/thrusts required may be greater than the break torque's/thrusts in the case of ball, butterfly, plug and gate valves.

Also, the torque/thrust characteristics of isolating valves vary significantly from the characteristics of a factory condition valve, particularly in abrasive or dirty service. Break and sealing torque/thrust required for a valve in service may be up to 2.5 times greater than the torque/thrust required for a new valve.



Therefore, in torque/thrust calculations for sizing actuators, care should be exercised in selecting the total rated value of torque/thrust. Where the sealing torque/thrust can be determined, and is greater than the break torque/thrust under test conditions, the sealing torque shall be used in determining the rated value.

The minimum torque/thrust output to overcome at least twice the total rated value of valve torque/thrust is justified in the light of recent research into valves in service. In extreme cases even this safety margin may be compromised.

Actuators shall be selected to deliver the minimum required torque/thrust at minimum supply pressure. The minimum supply pressure shall be set by the supply low pressure trip setting.

Rack and pinion type linkages are preferred for rotary valves.

On rotary action valves, the use of rack and pinion gearing is preferred as this ensures the development of a constant torque throughout the valve stroking cycle.

If other linear to rotary motion conversion mechanisms are specified, such as scotch yoke, care must be taken to ensure that the variable torque characteristics realised by the actuator can match the minimum torque requirements on the valve actually encountered in practice.

On single-acting spring-return actuated valves, it is important to ensure that the spring maintains the specified actuator design torque at the end of the spring actuating stroke.

- 3.2.4 The actuator shall be sized such that the maximum torque/thrust capabilities can be safely transmitted to the valve without mechanical damage to the valve, actuator or coupling. Where actuator calculations indicate that mechanical damage is likely to occur by applying 3.2.3, valve/actuator re-selection is required.

The maximum torque capabilities of rotary actuators shall be determined under maximum power supply conditions. If the maximum stem torque is exceeded, re-selection of actuator/valve or design of power supply over-pressure protection is required.

- 3.2.5 The actuator shall operate the valve with smooth uniform motion.

- * 3.2.6 The use of variable thrust/torque actuator linkages shall be subject to approval by BP.

- 3.2.7 Adjustable mechanical stops shall be provided to limit actuator travel independent from any valve stops.

- 3.2.8 The actuator shall be capable of driving the valve from fully open to fully closed and vice versa, within the specified time limits, against the maximum differential pressure acting across the valve.

For offshore pipeline ESDV's speed of closure should (in the U.K.) be in accordance with [SI 1029](#).



For hydraulic or pneumatic linear actuators the standard speed of operation is 1 inch/second. For electric actuators the standard speed is 24 rev/min.

Where necessary the control system shall include speed control facilities to limit the speed of operation and avoiding surge.

- * 3.2.9 On emergency shutdown service or any other service where a fail safe mode of operation is necessary on loss of actuating power, single acting spring-return type actuators are preferred. Where the use of spring return actuators is impractical, double acting actuators shall satisfy 3.2.10, and be subject to approval by BP.

The preference for emergency shutdown duty is for pneumatically operated spring return actuators. This combination however produces actuators of the largest size for a given torque requirement. Double acting actuators are significantly cheaper, lighter and more compact than spring return actuators. However, when a comparison is made between spring return and double acting actuators account must be taken of the need for a backup supply reservoir and more complex controls for the double acting actuator.

- 3.2.10 Electrically powered actuators are a non-preferred option for safety systems because of the difficulty in ensuring a high availability power supply; and the inherent 'fail-fixed' nature of the device (e.g. motor winding failure, motor overload trip).

- 3.2.11 Double acting actuators shall be provided with a close coupled back-up supply sufficient for the required number of operations.

- (a) For pneumatic systems this shall be achieved by a local air receiver, with loss of reserve capacity protected by a non-return valve in the supply line to the actuator-receiver assembly.
- (b) For hydraulic systems the reserve capacity shall be afforded by a close coupled accumulator, with loss of reserve protected by a non-return valve in the supply to the accumulator-actuator assembly.

- * For on/off control and sequence duty, a back-up supply common to a number of valve actuators may be used provided that it is an economic solution; and common mode failures (e.g. in distribution system) do not compromise the integrity of the process design (e.g. designed relief capacity).

Use of a common back-up supply to valves forming part of a safety system shall be subject to approval by BP.

Where double-acting actuators or any other non-fail safe actuators are employed on emergency shutdown systems, standby pneumatic supplies should be available with sufficient capacity for three strokes of the valve.



Three strokes are normally considered necessary to enable the valve to be re-opened after closure to allow clearing of the valve if jamming has accrued or clearing of inventory then subsequent closure.

Standby supplies should preferably be charged from the local air supply system via a non-return valve. As the integrity of the non-return valve is vital in this sort of emergency back-up installation, further protection should be provided on the back-up vessel inlet. This may be achieved by means of a pilot operated isolation valve, closing on falling pressure.

Alternate standby supplies may be used where the use of a local pneumatic supply is not practicable.

Back-up reservoirs shall be sized on the basis of the following criteria:-

- (a) Reservoir capacity shall be capable of three operations of the actuator in the event of permanent air supply failure.
- (b) The reservoir shall be sized to maintain the minimum design torque/thrust requirements at the end of the third stroke of the valve. Speed of closure also needs to be considered.
- (c) The minimum reservoir pressure shall be regulated to ensure a final actuator pressure sufficient to develop the minimum design torque/thrust at the end of the third stroke.

For guidelines on back-up pressure reservoir sizing calculations see Appendix C.

For guidelines on pneumatic standby system configurations see Figures 1 and 2.

Pneumatic back-up reservoirs should be fitted with over-pressure protection if there is a danger of the maximum torque/thrust capacity exceeding stem or seat torque/thrust limits.

Hydraulic Cylinder Type Actuators

Pressure greater than 200 bar can be used and may be beneficial when a high speed of operation is necessary. High pressure actuators may also be smaller and lighter. However, the overall effect of the higher operating pressure on the size, weight and cost of complete hydraulic system should be considered.

Attention should be given to the design and construction of associated hoses, umbilicals and connectors; particularly at high hydraulic pressure. These have proved a source of weakness.

Spring-return actuators are normally preferred because they are less complex, cheaper to install, require less maintenance and have an inherent failure position on loss of hydraulic power. However, they are usually larger and heavier than an equally rated double acting device, and may prove impractical in high torque applications.

Hydraulic Accumulators

Where hydraulic accumulators are required, they shall be specified in accordance with BP Group [RP 30-1](#) Section 8; hydraulic power systems.



Careful consideration should be given to the type of accumulator specified. Of the two types of accumulator available; piston and bladder, bladder type accumulators have tended to be the most commonly specified. This type of accumulator however, suffers from the major drawback that the condition of the bladder is difficult to ascertain without either discharging the system or overhauling.

The piston accumulator, although more expensive, is easier to maintain and troubleshoot with the use of piston position indicators. Piston type accumulators can operate at higher discharge pressures, reducing on volume, and display superior fluid delivery qualities than the bladder type.

On emergency shutdown valves, accumulators shall be sized on the basis of the following criteria:-

- (a) Accumulator capacity shall be capable of three operations of the actuator in the event of permanent hydraulic supply failure.
- (b) The accumulator shall be sized to maintain the minimum design torque/thrust requirements at the end of the third stroke of the valve.

When pre-charged hydraulic accumulators are used the fluctuations in ambient temperature should be considered when specifying the pre-charge pressure.

Where possible accumulator systems should be designed as three independent accumulator banks connected to a common discharge manifold. This configuration allows sections to be removed for maintenance while maintaining the capacity to operate the valve in an emergency.

For guidelines on accumulator system configurations see Figures 3 to 8.

3.2.12 Pneumatic piston actuators are preferred for general isolation on onshore and offshore above-surface installations and should be used where practicable.

3.2.13 Hydraulic rather than pneumatic actuators may be used if:-

- (i) Large valve torques are required.
- (ii) The cost of installation and maintenance is significantly lower.
- (iii) A more compact assembly results and is proved to be an advantage.
- (iv) The use of instrument air is proved to be impracticable.
- (v) The weight of the whole unit is considerably less and this proved to be an advantage.
- (vi) The application is subsea.

3.2.14 Electrically powered actuators may only be used where both a fail fixed mode of operation is a requirement or is acceptable and a slow

actuating speed is acceptable. They should not be used for category I & II systems unless a fail fixed mode is a necessity. These actuators shall be in accordance with BP Group [GS 112-2](#).

Occasionally size constraints will preclude the use of hydraulic or pneumatic actuators, e.g. on gate valves and it is necessary to use electrical actuators. In this case a reliable electric power supply with a back-up where necessary (e.g. on ESD systems), will be required and extra blast proofing or fire protection may also be required.

- * 3.2.15 The use of instrument air may be impracticable for various reasons, for example, size, power, quality of air supply, operability or cost. Alternative power mediums such as hydraulic fluid, nitrogen, process gas or electric power may be provided subject to approval by BP.
- 3.2.16 Actuators shall be designed and rated in accordance with the operating fluid pressure and service rating.

Any pressure regulating valves used in the supply system shall be fitted with a relief valve to protect the actuator from overpressure should the regulator fail. Refer to BP Group [RP 30- 2](#), Sections 7 and 8.
- 3.2.17 Where arrangements are provided for overriding valve actuation, such overrides should only be possible at or with the full knowledge of Control Room Personnel.

Local manual controls are normally provided to allow operation of isolating valves following a loss of primary operating power or a loss of the remote control signal. The facility may be necessary to isolate plant or utilities under emergency conditions, or to maintain plant operation pending remedial action.

Local manual controls should not be provided on emergency shutdown valves.

When activated, local manual control features often override automatic protection or remote control functions. Therefore, consideration should be given to security measures (e.g. padlock to retain in the 'remote' position) or an indication of override status at the appropriate control centre.

The use of override facilities on valves incorporated within a protection system (e.g. for proof testing) should comply with the requirements of BP Group [RP 30-5](#) Section 2 the Protective Instrumentation Systems.
- 3.2.18 Local manual controls or overrides shall not be provided for actuators on emergency shutdown systems duty. Where a valve has a dual operational isolation and shutdown role, manual override facilities shall not be fitted. Refer to BP Group [RP 30-5](#), Section 2.
- 3.2.19 Actuators requiring oil mist lubrication depend upon the flow of air through pilot valves and the cylinder to distribute the lubricant to the working parts.



Careful assessment of the effectiveness of the lubrication system for the particular valve application is essential. The valve may only be operated infrequently (e.g. emergency shutdown duty). Therefore, adequate cylinder lubrication may not be present when the valve is called upon to operate.

Maintenance requirements should be addressed, such as the frequency of checking lubrication efficiency and regular topping up of oil reservoirs.

3.3 Action on Supply Failure

3.3.1 Valves on emergency shutdown duty shall fail safe on loss of motive power.

3.3.2 A spring return actuator should be tripped on low supply pressure before its hold open pressure is reached.

3.3.3 On a double acting actuator a low pressure trip on the supply shall operate the valve in the event of a supply failure.

It may be appropriate for the low pressure detection to trigger more general shutdown actions rather than waiting for the consequences of valve closure.

3.3.4 On pneumatic systems the pressure switch for the trip function shall be local to the valve.

3.3.5 On hydraulic systems, a pressure switch mounted with the hydraulic power pack, possibly serving several users, is acceptable.

On pneumatic systems there will in many cases exist a low pressure trip associated with the air supply at source. However, its likely distance from the point of use could allow the fracture of a local supply line (i.e.. of small diameter) to remain undetected from a point on the main header. This is much less likely to happen on a hydraulic system, and pressure loss would eventually be caused by loss of fluid.

3.4 Valve Status Indication

3.4.1 All isolation valves shall be provided with a mechanical visual position indicator for easy verification of valve position status

3.4.2 Where remote valve status or position indication is required, the displacement detection device shall be directly coupled to the valve stem.

Alternative means of position indication may be considered provided it can be shown that the arrangement is reliable and failure is unlikely to mislead the operator.

The method of presenting valve status information to the operator should be carefully assessed. In some circumstances it may be beneficial to report by exception (e.g. to give status information only on those valves which have not

reached their correct position a preset time after initiation of emergency shutdown). A flood of information at a critical moment may confuse rather than help the operator.

On critical applications consideration should be given to also provide facilities to monitor valve/actuator performance.

3.5 Pneumatic and Hydraulic Supply Systems

3.5.1 The maximum supply pressure shall be defined as the upper pressure limit under which the actuator shall be required to operate. This will normally correspond to the upper control limit of the supply system. For a pneumatic system this will be the upper pressure limit under setpoint control with all compressors unloaded. For a hydraulic system it may be the setting of the supply pressure relief.

3.5.2 The pressure containing parts of the actuator should be capable of withstanding the pressure as limited by the supply system overpressure protection.

3.6 Subsea Actuators

3.6.1 For subsea applications the points made in this section of the Recommended Practice should be considered in addition to the previous sections.

3.6.2 The actuator package shall be separately mountable/dismountable from the valve body as built up assemblies. To facilitate removal and replacement, provision should be made for the use of actuator handling frames.

3.6.3 The actuator should be pressure compensated using a balance device to equalise pressures inside and outside the actuator during raising and lowering.

3.6.4 The actuator internal pressure should be slightly higher than the surrounding water pressure so, if there is any leakage, hydraulic fluid leaks out rather than water leaking in.

3.6.5 Removal of the actuator package shall not break the pressure containing integrity of the valve. All chambers without pressure compensation shall utilise pressure relief systems to avoid over pressurisation.

3.6.6 The actuator calculations shall take into account the pressure containment requirements at the rated and shallow operational water depths.

The actuator shall be designed for 1.5 times the hyperbaric pressure at its operational water depth.

- 3.6.7 The actuator piston rod to valve stem connection shall be shown to be strong enough to react to all possible load cases.
- 3.6.8 Subsea actuators shall be hydraulic and spring return or double acting with subsea accumulation of sufficient capacity for a minimum of three operations.
- 3.6.9 The power unit and accessories should be in accordance with BP Group [RP 43-3](#) Subsea isolation systems.
- 3.6.10 The actuator should move the subsea isolation valve to the fully closed position in the minimum time practicable, without imposing any unacceptable stresses in the valve and actuator mechanism and unacceptable surge pressures in the pipeline.
- 3.6.11 The actuator system shall be fail safe closed.
- 3.6.12 Where specified, the actuator shall be provided with remote position status indication in the adjacent platform central control room. The actuator should also incorporate a position indicator for the safe and convenient verification by diver or remotely operated vehicle of the valve status in poor visibility conditions.
- 3.6.13 The actuator shall be provided with the facility for cylinder flushing subsea (by the diver) and incorporate a hydraulic override device to enable operation of the valve by attachment of a hydraulic 'hot line'.
- 3.6.14 The Joule-Thompson effect (the effect of low temperatures) on the torque required to close a valve following rupture of a gas pipeline, shall be taken into account when initially sizing an actuator.

3.7 Corrosion and Environmental Protection

- 3.7.1 Materials of construction of the actuator shall be electrochemically compatible with the valve body.
- 3.7.2 Materials of construction of the valve shall be suitable for the application and be electrochemically compatible with process piping and ancillary securing bolts and brackets.
- 3.7.3 Materials of construction of the valve and actuator shall be suitable for prolonged service in the environment at the point of installation.
- * 3.7.4 Any coating or corrosion protection system to be applied for external protection of actuators shall be subject to approval by BP.



When the valve and actuator are coated to prevent corrosion, it is necessary to take into account all applicable conditions (e.g. salt spray, humidity, temperature, spillage, line leaks). Electrical earthing and bonding should not be impaired by the coating.

- 3.7.5 When isolating valves are installed in locations susceptible to seismic disturbance, all components shall be suitable for the anticipated bending stresses and strains.

3.8 Testing and Inspection

- 3.8.1 For guidance on the identification, registration, inspection, testing or test frequency of protective instrumentation refer to BP Group [RP 30-6](#), BP Group [RP 30-5](#) and Section 2 of this Recommended Practice.

3.9 Installation

- 3.9.1 Isolation valve actuators shall be installed in accordance with the design specification, equipment specification relevant approved drawings and manufacturers specifications. Valves incorporating plastic or elastomer parts should be covered by the appropriate fire certificate.
- 3.9.2 Ancillary tubing, piping, and electrical systems shall be installed in accordance with BP Group [RP 30-1](#) Sections 3 and 4.

When selecting a valve actuator, particularly air driven or motorised systems, the noise level during operation should be obtained. Controls for normal operation and manual override shall be positioned, colour coded and labelled to ensure correct operation at all times, particularly in an emergency.

3.10 Fire Protection

- 3.10.1 Isolation valves and actuators should be located outside any area of special fire risk.
- 3.10.2 Isolation valves on emergency shutdown service, or valves unavoidably located in an area of special fire risk shall have passive fire protection provided in accordance with BP Group [RP 24-2](#). This shall protect the valve, the actuator, the actuating power supply system, and relevant instrument signal and power transmission systems. Valves incorporating plastic or elastomer parts should be covered by the appropriate fire certificate.

In order to define the type and extent of fire protection detailed studies should be carried out. The studies should consider:-

- (a) *The type, severity and duration of anticipated fires.*
- (b) *The minimum duration for which the integrity and operability of equipment to be protected must be maintained.*



- (c) *All foreseeable equipment failures caused by fires, which could impair the ability of the system to close and remain closed, to seal, and to maintain its integrity.*
- (d) *All foreseeable equipment failures which could result in loss of containment.*
- (e) *The type of fire protection measures available.*
- (f) *Existing fire protection measures.*
- (g) *Site philosophy/design philosophy for the purpose of the shutdown valves i.e. is it for mechanical plant protection or is it to prevent threat to life.*
- (h) *The limitations of the fire protection measures, particularly with respect to:-*
 - (a) *Their reliability*
 - (b) *Their effect on the equipment being protected during normal operation, emergency operation, maintenance and testing; e.g. passive protection in the form of a fire protection coating, protective cladding or enclosures should not hinder inspection or maintenance nor encourage corrosion.*
 - (c) *The practicability of and hazards associated with retrospective application/installation of the fire protection measures.*

Whilst both passive and active fire protection measures may be used it should be noted that passive systems do not require prime movers and distribution systems, and are therefore likely to be more reliable and have higher integrity than active systems. Active fire protection systems acting on their own may not suffice and consideration should also be given to passive systems. In fact we recommend the use of passive fire protection.

Consideration should also be given to the incorporation of components in pneumatic or hydraulic control lines (such as fusible links or other temperature sensitive devices) which can initiate rapid valve closure and thereafter prevent inadvertent re-opening of the valve due to expansion effects.

The studies should pay due regard to any tests that are performed in order to establish the behaviour of the fire protection measures under the anticipated fire conditions. Where such tests have not been performed, or the test is not totally representative of the coating/equipment configuration, then appropriate conservative allowances should be made in the studies.

Account should be taken of the reduced heat loss of actuator with passive fire protection fitted. This may cause increased temperatures at the actuator.

Fire criteria.

In the absence of more appropriate data it should be assumed that both a hydrocarbon jet fire and pool fire could occur. With respect to the jet fire it should be anticipated that:-



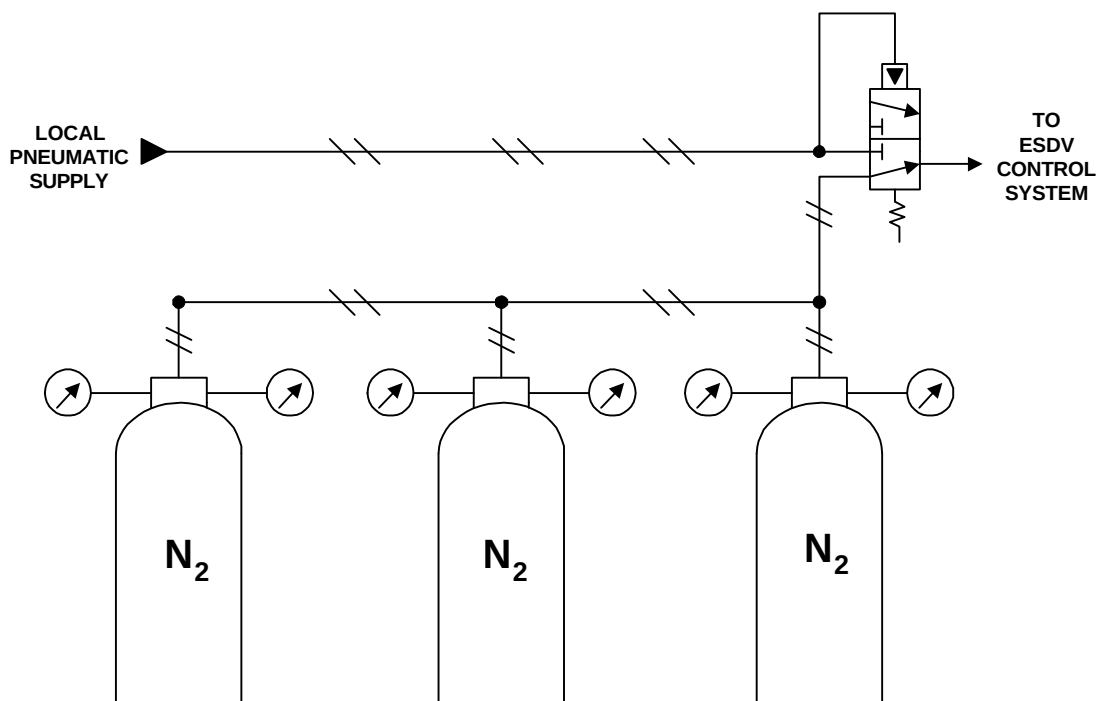
The jet stream can reach sonic velocity.

Such fires are capable of developing a heat flux of up to 300 kwm-2 at the outer surface of the coating.

With regard to pool fires it should be anticipated that they are capable of exposing the coating surface to a temperature of 1100°C.

- 3.10.3 Fire protection for offshore pipeline ESDV's shall be in accordance with [SI 1029](#).

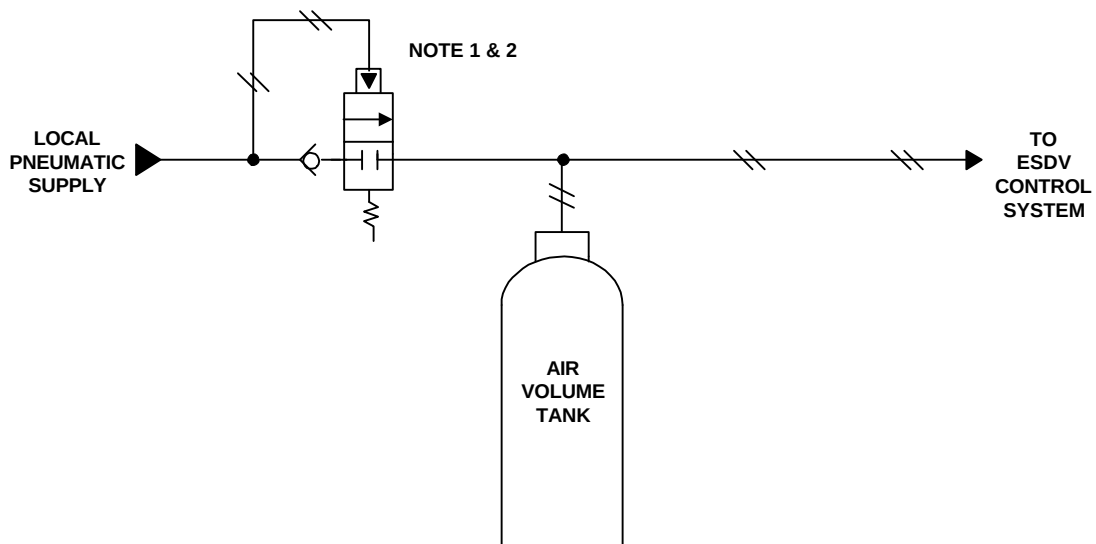




NOTE:

1. PILOT VALVE TO BE FULL BORE.
2. EACH BOTTLE REPRESENTS A BANK OF BOTTLES WITH THE CAPACITY OF FOUR STROKES.

FIGURE 1
PNEUMATIC BACK-UP SYSTEM - N₂ BOTTLES



NOTE:

1. PILOT VALVE TO BE FULL BORE
2. PILOT VALVE TRIPS ON DECREASING PRESSURE.

FIGURE 2
PNEUMATIC BACK-UP SYSTEM - VOLUME TANK

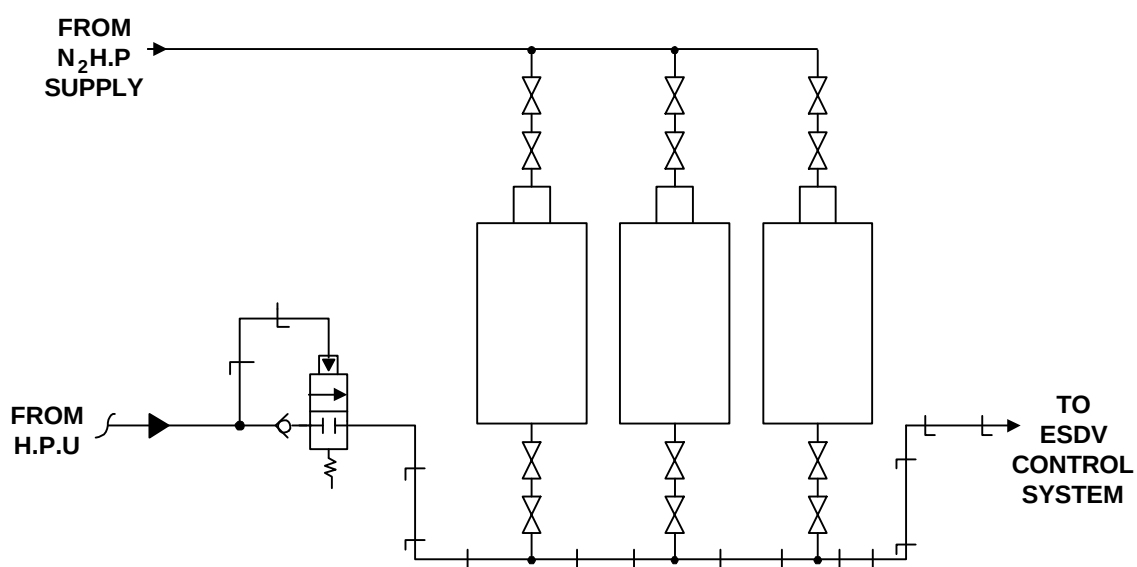
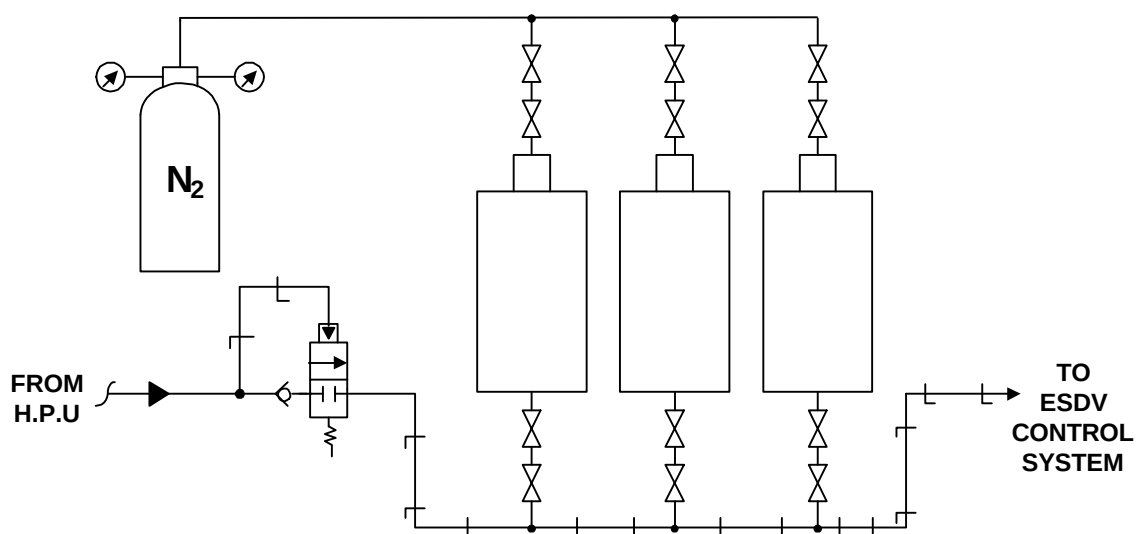


FIGURE 3

**HYDRAULIC BACK-UP SYSTEM -PISTON ACCUMULATORS WITH CONSTANT
N₂ CHARGE SYSTEM**

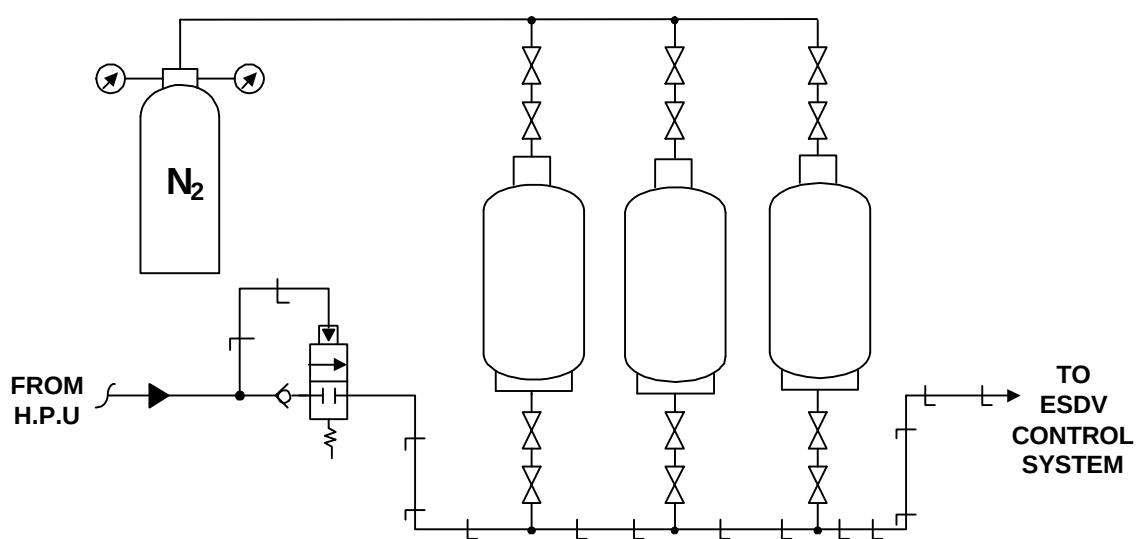


NOTE:

1. PILOT VALVE TO BE FULL BORE.
2. PIPING DIMENSIONS BETWEEN BACK-UP BOTTLE AND ACCUMULATORS TO BE SPECIFIED BY VENDOR.

FIGURE 4

HYDRAULIC BACK-UP SYSTEM - PISTON ACCUMULATORS WITH BACK-UP N₂ BOTTLE

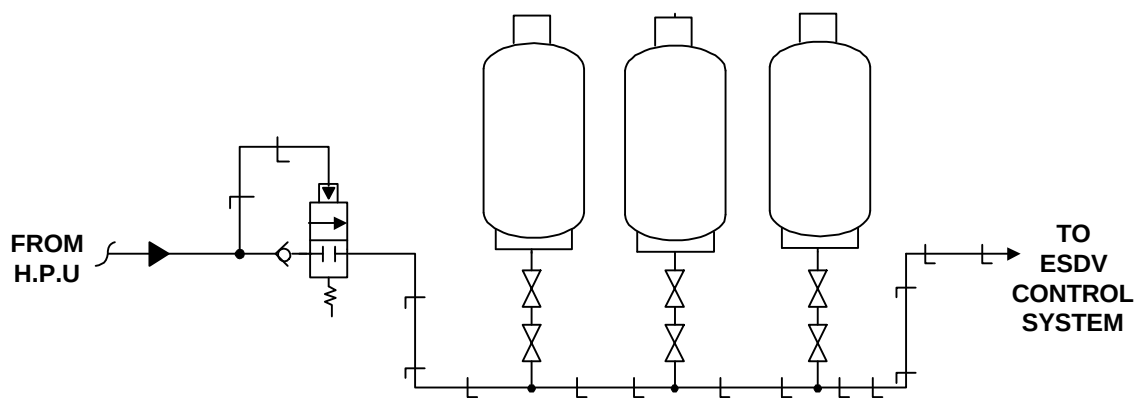


NOTE:

1. PILOT VALVE TO BE FULL BORE.
2. PIPING DIMENSIONS BETWEEN BOTTLE AND ACCUMULATORS TO BE SPECIFIED BY VENDOR.

FIGURE 5

HYDRAULIC BACK-UP SYSTEM - BLADDER ACCUMULATORS WITH BACK-UP N₂ BOTTLE

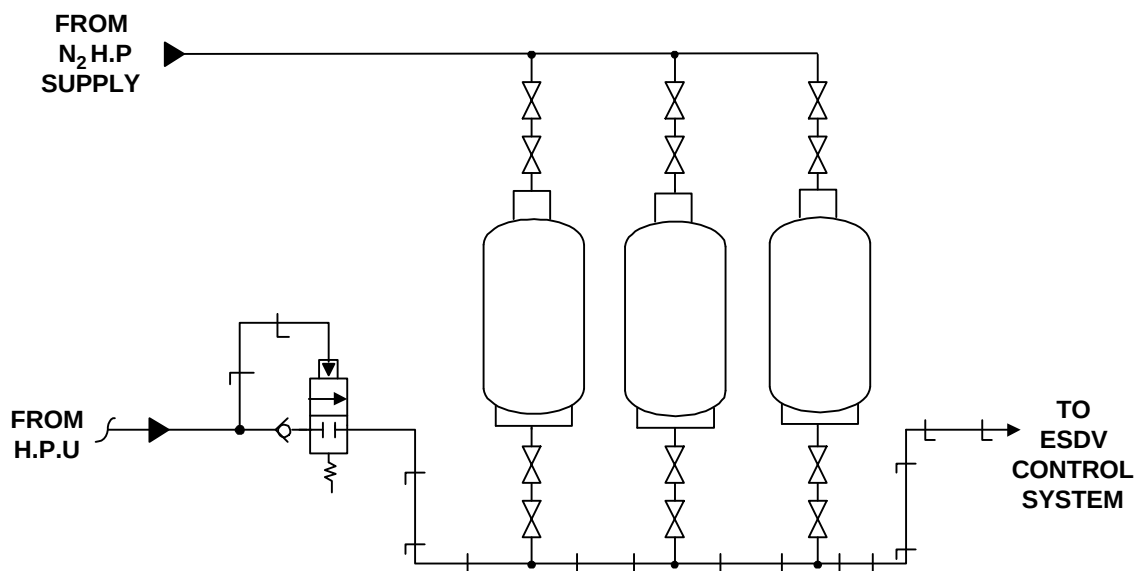


NOTE:

1. PILOT VALVE TO BE FULL BORE

FIGURE 6

BACK-UP SYSTEM - PRE-CHARGED BLADDER ACCUMULATORS

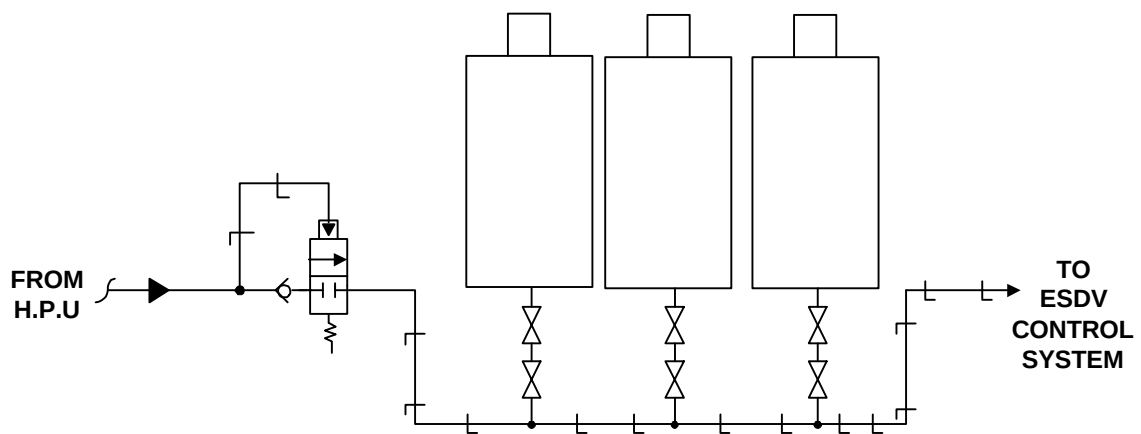


NOTE:

1. PILOT VALVE TO BE FULL BORE.

FIGURE 7

**HYDRAULIC BACK-UP SYSTEM -BLADDER ACCUMULATORS WITH
CONSTANT N₂ CHARGE SYSTEM**



NOTE:

1. PILOT VALVE TO BE FULL BORE.
2. EACH ACCUMULATOR REPRESENTS A BANK OF ACCUMULATORS WITH THE CAPACITY FOR ONE STROKE OF VALVE.

FIGURE 8

HYDRAULIC BACK-UP SYSTEM - PRE-CHARGED PISTON ACCUMULATORS

DEFINITIONS AND ABBREVIATIONS

Definitions

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

contract:	the agreement or order between the purchaser and the vendor (however made) for the execution of the works including the conditions, specification and drawings (if any) annexed thereto and such schedules as are referred to therein.
cost of ownership:	the life cost of a system including initial supply contract value, installation cost, ongoing support costs (e.g. spares, maintenance and service charges).
works:	all equipment to be provided and work to be carried out by the vendor under the contract.

Abbreviations

ANSI	American National Standards Institute
API	American Petroleum Institute
BS	British Standard
DN	Nominal Diameter
EC	European Community
EN	European Standards issued by CEN (European Committee for Standardisation) and CENELEC (European Committee for Electrotechnical Standardisation)
ESD	Emergency Shutdown
HVAC	Heating, Ventilation and Air Conditioning
ISA	Instrument Society of America
ISO	International Organisation for Standardisation
NACE	National Association of Corrosion Engineers
NPS	Nominal Pipe Size
PTFE	Polytetrafluorethylene
QA	Quality Assurance
SI	Système International d'Unités



LIST OF REFERENCED DOCUMENTS

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

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

ISO 5208	Industrial Valves - Pressure Testing for Valves
ANSI B16.5	Pipe Flanges and Flanged Fittings.
BS 1560	Specification for Steel Pipe Flanges (Nominal Sizes 1/2 in to 24 in) for the Petroleum Industry Part 2: Metric Dimensions
BS 1655	Specification for Flanged Automatic Control Valves for the Process Control Industry (Face-to-Face Dimensions)
NACE MR-01-75(90)	Sulphide Stress Cracking Resistant Metallic Materials for Oil Field Equipment
BP Group RP 22-1	Fired Heaters (replaces BP CP 7)
BP Group RP 42-1	Piping Systems (replaces BP CP 12)
BP Group RP 43-3	Subsea Isolation Valves
BP Group RP 44-1	Overpressure Protection Systems (replaces BP CP 14)
BP Group RP 24-2	Passive Fire Protection (replaces BP CP 16)
BP Group RP 62-1	Guide to Valve Selection (replaces BP CP 33)
BP Group RP 30-6	Process Design Requirements for Protective Instrumentation Systems (replaces BP CP 48)



BP Group GS 112-2	Electric Motor Operated Valve Actuators for Intermittent Operation of Isolation Valves (replaces BP Std 152)
BP Group GS 130-6	Actuators for Shutoff Valves
BP Group GS 136-1	Materials for Sour Service to NACE Std MR-01-75 (replaces BP Std 153)
BP Group GS 142-6	Piping Specifications (replaces BP Std 170)
BP Group GS 142-12	Pipe Flanges and Fittings (replaces BP Std 260)
BP Group GS 142-5	Pipeline Fittings (replaces BP Std 166 Pt 6)

