

EXXON EXXON ENGINEERING	SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	DESIGN PRACTICES	
		Section XV-F	Page 1 of 34
		Date December, 1998	

Changes shown by ↕

CONTENTS

Section	Page
SCOPE	5
REFERENCES	5
DESIGN PRACTICES (IN ADDITION TO OTHER SUBSECTIONS OF SECTION XV)	5
INTERNATIONAL PRACTICES	5
OTHER REFERENCES	5
BACKGROUND	5
DEFINITIONS	6
DESIGN FEATURES OF EMERGENCY BLOCK VALVES	8
INSTALLATION REQUIREMENTS FOR EMERGENCY BLOCK VALVES	8
LOCATION AND OPERABILITY OF EBVS	8
CHOICE OF VALVE BODY	8
SYSTEM FAILURE	8
VALVE ACTUATORS	8
FIREPROOFING FOR EBVS	9
ACTUATING CONTROLS	10
TESTING	10
EMERGENCY ISOLATION	11
LONG LINES	11
TOXIC MATERIALS	11
COMPRESSORS	11
PUMPS	12
VESSELS	12
FIRED HEATERS, BOILERS AND OTHER COMBUSTION DEVICES	13
VULNERABLE EQUIPMENT	14
BATTERY LIMITS	14
TANK TRUCK AND RAIL LOADING AND UNLOADING FACILITIES ISOLATION	14
MARINE TERMINAL FACILITIES ISOLATION	14
DUPLICATE ISOLATION	14
WATER FLOODING PROVISIONS	15
APPLICATION	15
DESIGN	15



Documents

Document Sharing Hub

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DESIGN PRACTICES		SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	 EXXON ENGINEERING
Section XV-F	Page 2 of 34		
Date December, 1998			

CONTENTS (Cont)

Section	Page
EMERGENCY DEPRESSURING	15
VAPOR BLOWDOWN (DEPRESSURING) APPLICATION.....	15
DESIGN OF VAPOR BLOWDOWN CONNECTIONS.....	15
DESIGN OF VAPOR BLOWDOWN RELEASE SYSTEMS.....	17
LOW-TEMPERATURE IMPACT STRENGTH.....	17
CONTINGENCY OTHER THAN FIRE.....	17
USE OF NORMAL DISPOSAL ROUTES AND CONTROLS.....	18
INSTRUMENT FAILURE CONSIDERATIONS.....	18
EMERGENCY SHUTDOWN SYSTEMS	18
DRIVERS.....	18
FIRED HEATERS, BOILERS, AND OTHER COMBUSTION EQUIPMENT (FUEL TO FIRE BOX).....	18
AIR INJECTION / OXIDIZER STREAMS TO PROCESS.....	18
REFRIGERATED LIQUID / GAS FACILITIES.....	18
MARINE TERMINAL SHUTDOWN SYSTEMS.....	18
SPECIAL CASES.....	19
EXOTHERMIC REACTORS.....	20
DESIGN FEATURES OF EMERGENCY SHUTDOWN SYSTEMS.....	21
APPENDIX - PROCEDURE TO ESTIMATE MAXIMUM PUMP SEAL LEAKAGE RATE	30
ASSUMPTIONS.....	30
SEAL LEAKAGE CALCULATION PROCEDURE.....	30
EXAMPLE OF LEAKAGE CALCULATION IN THE EVENT OF PUMP SEAL FAILURE.....	33
TABLES	
Table 1 Location, Size and Operability Requirements for Emergency Block Valves.....	22
Table 2 American Industrial Hygiene Association (AIHA) ERPG-3's 1998.....	23
Table A-1 Clearance in Throttle and Throat Bushing.....	31
Table A-2 Seal Chamber Pressure Estimation Based on Pump Type.....	32
Table A-3 Bushing Length Factor.....	33
FIGURES	
Figure 1 EBV Requirements for Compressors.....	24
Figure 2 EBV Requirements for Pumps.....	25
Figure 3 EBV Requirements for Process and Storage Vessels.....	26
Figure 4 EBV Requirements for Heaters/Boilers or Other Combustion Equipment.....	27
Figure 5 EBV Requirements for Vulnerable Equipment (e.g., Graphite Heat Exchanger).....	28
Figure 6 EBV Requirements for Battery Limits.....	29
Figure A-1 Flow Factor for Close Clearance Bushings.....	33



 EXXON ENGINEERING	SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	DESIGN PRACTICES	
		Section XV-F	Page 3 of 34
		Date December, 1998	

CONTENTS (Cont)

Revision Memo

12/98	Page 5	Various references were updated.
	Page 6	Added definitions for Combustible Liquids and ERPG-3.
	Page 7	Added definitions for Flammable Liquids, Flammable Materials, and Light Ends.
	Page 7	Toxic Material: Removed reference to EBSI report; Updated the reference to the latest AIHA guidelines; Included the ERPG-3 concentration in the definition of toxic materials.
	Page 8	Relocated the DESIGN FEATURES OF EMERGENCY BLOCK VALVES and the INSTALLATION REQUIREMENTS FOR EMERGENCY BLOCK VALVES to this page from their further back location in the previous document.
	Page 8	Location & Operability of EBVs: Added reference to flexible remote valve actuators.
	Page 8	Valve Body: Added note that greater than NPS 4 soft-seated valves are not recommended if they're not fireproofed, while soft-seated valves are preferred for manual isolation of burners; also, updated examples of accepted manufacturers.
	Page 9	Electric Motor: Sentences deleted referencing connections to different bus bars.
	Page 9	Fireproofing of EBVs: Indicated acceptance of test method ASTM E-1529 and lower heat flux of 50,000 Btu/hr-ft ² .
	Page 10	Revised the location of EBV actuating controls and addressed the identification of the stations and buttons.
	Page 11	Testing: Added reference to a CSC bypass valve to allow online testing of EBVs.
	Page 11	Long Lines: Added new paragraph.
	Page 11	Toxic Materials: Added new paragraph.
	Page 11	Compressors: Added sentence on EBV position switches for tripping the compressor.
	Page 12	Pumps Figure 2 : Removed requirement that a minimum of Type B EBV would be required if the material is toxic but a spill doesn't result in ERPG-3 at the fence.
	Page 12	Pumps-1: Clarified the criteria for installing EBV's at pump suction lines to be consistent with the newly added definitions for flammable and combustible liquids.
	Page 12	Pumps-2: Added reference to newly added APPENDIX .
	Page 12	Pumps-4: Added note that EBVs are not required on flare blowdown drum pump suction lines.
	Page 12	Pumps-5: Added paragraph on EBV requirements for offsite pump suction lines.
	Page 12	Vessels (general): Added reference to closed-cup (Pensky-Martens) flash point; added 250 gal (900 l) inventory in line requirement; moved to first paragraph, from the last, the notes on avoiding connections between vessel and EBV, and on the proper location for the closed drain connection; added paragraph on worst contingency evaluation for determining type of EBV to install; in Figure 3 , removed requirement that a minimum of Type A EBV would be required if the material is toxic but a spill doesn't result in ERPG-3 at the fence.
	Page 12	Vessels-1 (and Figure 3): Removed requirement for Type A EBV if ERPG-3 cannot be reached at the fence.
	Page 12	Vessels-2: Specified "offsites" vessel for light ends storage; clarified type of EBV to be installed and indicated that EBVs should be on lines located below the maximum working level.



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DESIGN PRACTICES		SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	EXXON EXXON ENGINEERING
Section	Page		
XV-F	4 of 34		
Date December, 1998			

CONTENTS (Cont)

Page 13	Vessels-3: Specified location of EBVs to be on lines below the maximum working level; changed the requirement for Type A EBVs to be on all lines (not just those normally open). Added comment concerning Type A EBVs on normally closed lines when special factors apply.
Page 13	Vessels-3, 4, 5 and 6: Referenced item 7.
Page 13	Vessels-4: Replaced "normally open" lines with "all" lines and added "below maximum working level."
Page 13	Vessels-5: Added reference to closed-cup (Pensky-Martens) flash point; replaced "normally open" lines with "all" lines and added "below maximum working level."
Page 13	Vessels-6: Replaced "normally open" lines with "all" lines, and added "below maximum working level."
Page 13	Vessels-7: Added paragraph on lines between towers and associated reboilers.
Page 14	Vulnerable Equipment: Clarified wording in Par. 1 to reflect the newly added definition for flammable materials; in Figure 5 removed requirement that a minimum of Type B EBV would be required if the material is toxic but a spill doesn't result in ERPG-3 at the fence.
Page 14	Battery Limits-5: Clarified wording to reflect newly added definition for flammable materials and combustible liquids.
Page 14	Added paragraphs on Tank Truck and Rail Loading and Unloading Facilities and on Marine Terminal Facilities.
Page 15	Water Flooding Design: Clarified water flooding requirements.
Page 15	Emergency Depressuring: Indicated that liquid blowdown is no longer recommended.
Page 15	Vapor Blowdown (VB): Clarified the services for which vapor blowdowns are installed; noted that facilities to stop feed should also be provided when vapor blowdowns are installed.
Page 15	Design of VB-1: Added design to avoid plugging.
Page 16	Design of VB-2: Added restriction orifice requirement and tight-shutoff, fail-open control valve alternative.
Page 16	Design of VB-3a: Added feed and heater shutdown requirement.
Page 16	Equation (2): Included new equation for sizing control valves and updated constants accordingly.
Page 17	Design of VB Release Systems: (1) added requirement for locking open release system until depressuring is complete; (2) indicated that VB may also discharge into a flare header.
Page 18	Added paragraph on MARINE TERMINAL SHUTDOWN SYSTEMS.
Page 19	Special Cases: Expanded section to include more emergency shutdown systems details for Catalyst in-situ Conditioning and Regeneration, Unsaturated Naphtha Hydrofiners, C ₃ / C ₄ Splitters, and FCCU units.
Page 20	Added new section on Exothermic Reactors.
Page 21	Action for stop hydrogen make-up flow for unsaturated naphtha hydrofiner changed to manual with note 2 added.
Page 23	Updated ERPG-3 table to include latest AIHA chemicals and values.
Pages 24-29	Figures 1-6: Updated as necessary to reflect text changes.
Page 30	Added APPENDIX, PROCEDURE TO ESTIMATE MAXIMUM PUMP SEAL LEAKAGE RATE.



 EXXON ENGINEERING	SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only		DESIGN PRACTICES	
			Section XV-F	Page 5 of 34
			Date December, 1998	

SCOPE

This section covers the requirements for emergency shutdown and isolation of compressors, pumps, vessels, combustion devices, vulnerable equipment, and isolation at battery limits. Also covered is depressuring or displacement of the flammable material inventory of process units. Emergency shutdown and isolation for offsite facilities are covered further in [Section XV-J](#).

REFERENCES

DESIGN PRACTICES (IN ADDITION TO OTHER SUBSECTIONS OF SECTION XV)

Section II	Design Temperature, Design Pressure and Flange Rating
Section XII-F	Instrumentation
Section XXXI-I	Safety Considerations for the Design of Marine Terminals

INTERNATIONAL PRACTICES

IP 3-2-3,	Firewater Systems
IP 3-5-1,	Fill and Discharge Lines, and Auxiliary Piping for Storage Tanks and Vessels
IP 3-6-1,	Piping for Instruments
IP 3-6-3,	Utility Connections to Piping and Equipment
IP 3-7-1,	Piping Layout, Supports, and Flexibility
IP 3-12-1,	Valve Selection
IP 14-3-1,	Fireproofing
IP 15-1-1,	Instrumentation for Fired Heaters
IP 15-1-2,	Instrumentation for Compressors and Drivers
IP 15-7-1,	Electric Power Branch Circuit Design for Instrumentation
IP 15-7-2,	Protective Systems
IP 15-9-2,	Electric Motor Operators for Valves
IP 15-10-1,	Instrument Transmission Systems
IP 16-2-1,	Power System Design
IP 16-3-1,	Wiring Methods and Material Selection
IP 18-10-1,	Additional Requirements for Materials

OTHER REFERENCES

- Guidelines for Selection and Installation of Emergency Block Valves*, Report No. EE.27E.84.
- Piping Vibration Evaluation Guide*, Report No. EE.21E.89.
- SOC Communication 97-01, Remote Operation of Manual Valves*, Report No. 97 ECS3 20.
- Suggested Design Considerations for Refrigerated Liquefied Gas Facilities*, Report No. 79.ECS.729.
- FCCU Emergency Shutdown Systems Minimum Requirements*, Report No. EE.67E.97.
- Emergency Shutdown Systems (ESSs) for Marine Terminals, Report No. EE.108E.98.
- The AIHA (American Industrial Hygiene Association) 1998 Emergency Response Planning Guidelines (ERPGs) and Workplace Environmental Exposure Level (WEEL) Guides Handbook.
- ANSI/FCI 70-2 1991, Quality Control Standard for Control Valve Seat Leakage.

BACKGROUND

Safety design philosophy is to eliminate foreseeable risks of fire, explosion or accident. However, it is recognized that such incidents may still occur, therefore, plant designs must include features to minimize the resulting damage. Of major importance in this respect are emergency facilities to rapidly stop the uncontrolled release of toxics or of flammable material that is feeding a fire. These facilities comprise:

- Emergency isolation.
- Emergency depressuring.

DESIGN PRACTICES		SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	 EXXON ENGINEERING
Section XV-F	Page 6 of 34		
Date December, 1998			

BACKGROUND (Cont)

- Emergency shutdown systems.
- Liquid displacement and water flooding provisions.

Each of these four subject areas is covered in this section, along with minimum design requirements. Individual risk assessments on specific cases may justify a higher level of protection.

DEFINITIONS

For general definitions, see [Section XV-A](#).

Battery Limits

Battery limits are the boundaries of the smallest geographical subdivisions of a processing equipment area which are separated by at least 50 ft (15 m) from each other and from adjacent facilities, and which contain either a complete process or a group of integrated processes which may be shut down together for turnaround.

♦ Combustible Liquids

High-flash liquids [flash points 100°F (38°C) or higher] when handled at temperatures more than 15°F (8°C) below their closed cup (Pensky-Martens) flash point.

Emergency Block Valve (EBV)

Emergency Block Valves (EBVs) permit the control of hazardous situations. These are valves for emergency isolation or vapor blowdown and are referred to as Type A, B, C or D (see **DEFINITIONS**, below). Requirements for these valves are summarized in **Table 1** and appropriate International Practices. Contingency considerations concerning a single EBV are always limited to the source of the potential leak for which the EBV is installed.

♦ Emergency Response Planning Guideline - Level 3 (ERPG-3)

The ERPG-3 is defined by the American Industrial Hygiene Association (AIHA) as: "the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life threatening health effects." There are also an ERPG-1 and an ERPG-2. These guidelines have been developed to aid in community emergency response planning. **Table 2** lists the ERPG-3's for all materials included in the AIHA 1998 Handbook. The most recent publication should always be checked when using this practice.

Equipment with High Fire Potential

Equipment with High Fire Potential shall include:

1. Pumps with a rated capacity over 200 gpm (45 m³/h) handling flammable liquids.
2. Compressors over 200 HP (150 kW) handling flammable gasses.
3. Fired heaters handling flammable liquids in tubes.
4. Vessels, heat exchangers, and other equipment containing flammable liquids over 600°F (315°C) or above their auto ignition temperature, whichever is less.
5. Certain reactors that operate at high pressures or are capable of producing exothermic or runaway reactions.

Fire Hazard Area

A fire hazard area shall generally be considered as the area within a horizontal distance of 20 ft (6.0 m) from equipment with high fire potential with the following qualifications:

1. For tanks, spheres and spheroids, containing flammable material, the fire hazard area shall extend to the dike wall or 20 ft (6.0 m) from the storage vessel, whichever is greater.
2. For rotating equipment, the 20 ft (6.0 m) distance will be taken from the expected source of leakage.
3. For marine docks where flammable liquids are handled, the fire hazardous area shall extend 100 ft (30 m) horizontally from the manifolds or loading connections.

 EXXON ENGINEERING	SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	DESIGN PRACTICES	
		Section XV-F	Page 7 of 34
		Date December, 1998	

DEFINITIONS (Cont)

♦ Flammable Liquids

Low-flash liquids [flash point below 100°F (38°C)], and high-flash liquids [flash point 100°F (38°C) or higher] when handled at temperatures above or within 15°F (8°C) of their closed cup (Pensky-Martens) flash points.

♦ Flammable Materials

Flammable liquids, hydrocarbon vapors, and other vapors, such as hydrogen and carbon disulfide, that are readily ignitable when released to atmosphere.

♦ Light Ends

Light ends are volatile flammable liquids, which are significantly vaporized at normal ambient conditions. This indicates a type of material of greater fire hazard than heavier hydrocarbons because of the large volume of vapor generated by a liquid leak or spill. For the purposes of this Design Practices Manual, the definition of light ends is a material having a Reid Vapor Pressure (RVP) of 15 psia (103 kPa) or greater, as determined by the standard ASTM D-323 test. By common usage, this covers the following:

- Pentane and lighter hydrocarbons (either pure hydrocarbons or mixtures).
- Unstabilized naphthas, which meet the RVP criterion.
- Flammable chemicals which meet the RVP criterion.

When used as a criterion of hazardous properties for safety design purposes, the term is applied to the above materials only when they are in the liquid phase or a combination of liquid and vapor phases.

A process unit is considered to be a light ends unit when a significant part of the equipment handles light ends. Pipestills and sidestream hydrofiners, for example, are not included in this category, but pipestill overhead gas recontacting and naphtha fractionation systems are considered as light ends units.

♦ Toxic Materials

A toxic material is one which has the inherent ability to cause adverse biological effects. Some toxic materials are listed in The AIHA (American Industrial Hygiene Association) 1998 Emergency Response Planning Guidelines (ERPGs) and Workplace Environmental Exposure Level (WEEL) Guides Handbook. **Table 2** lists ERPG-3 for common chemicals. A material is considered to be toxic if the ERPG-3 concentration would be present in the vapor space at the stream temperature and one atmosphere.

Type A Valve

A Type A EBV is manually operated and is installed at the equipment or vessel nozzle. Manual operation may be augmented with locally controlled power actuators in cases where valve size, flange classification or ergonomics is a factor (see **Table 1**).

Type B Valve

A Type B EBV is installed at least 25 ft (7.5 m) horizontally from the equipment it is to isolate. It is manually operated, 8 in. (200 mm) size or smaller, no higher than 15 ft (4.5 m) above grade, and up through flange class 300. Exception: Battery Limit Type B EBV may be any flange class or any height (see **Table 1**).

Type C Valve

A Type C EBV is installed at least 25 ft (7.5 m) horizontally from the equipment it is to isolate. It is power operated with the actuating push button located at the valve. It is located no higher than 15 ft (4.5 m) above grade (see **Table 1**).

Type D Valve

A Type D EBV is power operated. Its actuating button is located at least 40 ft (12 m) horizontally away from the source of potential leak and such that it can be operated from grade. Consideration should also be given to locating the actuating button in the control house(see **Table 1**).

DESIGN PRACTICES		SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	 EXXON ENGINEERING
Section XV-F	Page 8 of 34		
Date December, 1998			

S DESIGN FEATURES OF EMERGENCY BLOCK VALVES

Location, accessibility, and other design requirements for emergency block valves are summarized in **Table 1**.

The Design Specification shall identify all EBVs and indicate Type A, B, C, or D, as appropriate. When unknown layout could effect the type of EBV selected, the option should be specified. For example, if a pump could be located within 25 ft (7.5 m) of its upstream vessel a Type D EBV would be necessary instead of a Type B. Design specification notes shall define these types, or reference **IP 3-7-1**, and require color coding or signs to identify the EBVs and their actuating push buttons in the field.

S INSTALLATION REQUIREMENTS FOR EMERGENCY BLOCK VALVES

LOCATION AND OPERABILITY OF EBVs

Table 1 presents requirements for location, size and operability for EBVs. The distances stated in **Table 1** are minimum values based on experiences with average fires.

Access to Type B and C valves and to Type D push buttons must be direct and safe during an emergency. In addition to distance, other factors have to be evaluated carefully during detail design. For example, if a Type B or C EBV is located at the proper distance from a potential leak but is positioned near a catch basin that will drain that potential leak, then the valve should be relocated or designated as a Type D since the intent of the spacing guideline is not met. Also, if the height limitation for Type B and C EBVs is met but access is only possible from platforms elevated above the actual installation, then the valve should be either relocated or designated as a Type D since easy access is not possible.

- Hand wheels for Type A and B valves as well as hand wheels for Type C and D actuators must be operable from either grade or a platform. Chain wheels are not permitted on any EBV installation (**IP 3-12-1**), but flexible remote valve actuators may be considered for certain applications (Report 97 ECS3 20, *SOC Communication 97-01*).

CHOICE OF VALVE BODY

The valve body choice for emergency block valves depends on application and on location. In areas where an EBV might be exposed to fire (such as in process areas) and must remain closed in an emergency, the valve body must be capable of withstanding prolonged fire impingement without leaking. Therefore, EBVs in isolation service should be either a gate valve, a lubricated plug valve, or a high performance ball or butterfly valve. High performance ball or butterfly valves have metal seats without soft seals and are considered inherently fire safe. (As an example, here are some manufacturers that have been accepted in the past: Velan, Bray-McCanna, Tyco Valves (Vanessa), Neles Controls, Nordstrom, and Adams.) (**IP 3-12-1**)

Soft seated, fire-tested (fire safe) type ball, plug or butterfly valves greater than NPS 4 (100 mm) (**IP 3-12-1**) are only to be used if they are fireproofed, because non-uniform flame exposure of the valve body may lead to only partial melting of the seal and subsequent leakage. However, such "fire safe" soft seated valves are allowed in areas where there is only a remote chance of fire. Such an area would be the shoreside end of a marine finger or T-head pier where the valves are at least 100 ft (30 m) from the source of potential leak (**IP 3-12-1**). Soft seated valves are preferred for manual isolation of burners.

For depressuring systems, the situation is different since tight shutoff is needed during normal operation and the EBV is required to open in an emergency. In this case, an acceptable and economical solution would be a tight shutoff diaphragm operated valve with a fail open action under fire exposure conditions. A gate valve may be used with an orifice plate, but if it is not fail open, it shall be fireproofed as required below. (**IP 3-12-1**)

SYSTEM FAILURE

Consideration of system failure must be included in the design of EBV, both on a plant-wide and an individual basis. The design used for many EBVs is such that the valve remains stationary upon loss of the control signal, the actuating medium or a mechanical component failure. This design, also known as "Fail-Stationary," avoids nuisance trips of the valves.

In a "Fail-Safe" design, the valve would always move to the position considered safest in an emergency upon loss of the control signal or actuating medium. This design is generally recommended for EBVs in emergency depressuring systems or air to oxidation processes. No fireproofing is needed for such designs since loss of the control signal or actuating medium would result in the valve moving to its "Fail-Safe" position. Such emergency block valves should mechanically lock in the "fail-safe" position regardless of whether the valve was purposely moved or failed to the "fail-safe" position.

VALVE ACTUATORS

Valve actuators for Type C and D valves can be energized by electric power, hydraulic oil, instrument air, nitrogen or natural gas. The reliability of the energy source system at each location may influence the choice. Specific requirements and restrictions for the different types of actuators are as follows:

 EXXON ENGINEERING	SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	DESIGN PRACTICES	
		Section XV-F	Page 9 of 34
		Date December, 1998	

S INSTALLATION REQUIREMENTS FOR EMERGENCY BLOCK VALVES (Cont)

1. Electric Motor

Electric motor actuators in conjunction with gate valves have proven to be highly reliable in many locations and are therefore recommended as a first choice (IP 15-9-2). However, since this system "Fails-Stationary," operation can only be guaranteed as long as it cannot be damaged by fire. Thus, within the presumed fire hazard area, the actuator and cables must be fireproofed. The power supply for the electric motor should be from a secondary selective power system. Motor overload protection, if furnished, shall be deactivated. (IP 16-2-1)

2. Hydraulic Piston

Hydraulic pistons may be used for emergency isolation valves when a reliable hydraulic system has already been designed for other use (e.g., slide valve actuation on some FCC units). Since hydraulic systems are expensive and need considerable maintenance, they may not be justified for power operated EBVs alone.

3. Air Drivers

Double-acting, heavy duty air piston operators have shown acceptable reliability and are therefore recommended if quarter turn valves (requiring a 90° movement for closure) are used.

The instrument air system should be used to provide motive energy for driving EBV air pistons. The capacity of the main air surge drum and system line sizes should be evaluated to ensure that there is adequate air available to move the valve, even with an air compressor failure. For retrofit cases, where there is insufficient air holdup capacity, installation of individual air surge drums, pressurized through a check valve, may be justified.

Rotary air motors and single acting air piston operators are not recommended in emergency service. They have been installed in several locations and have demonstrated poor reliability.

Diaphragm operated valves are not acceptable for isolation purposes but they are allowed in "fail-safe" services as indicated previously. If a diaphragm operator is specified in isolation service where it is expected that the valve will remain closed if exposed to fire, the spring, even if fireproofed, could relax its pressure due to overheating. This would lead to reopening of the valve, which cannot be tolerated.

FIREPROOFING FOR EBVS

EBVs are intended to operate during the first phase of a contingency when in some cases a fire may already have started. Therefore, from a safety standpoint, the best location for an EBV is outside the presumed fire hazard area. For most fires, this means 25 ft (7.5 m) away from the equipment where the leak might occur. However, for some offsite isolation situations, where the possibility of greater fire spread exists and where the impact of a fire can be significant, increased spacing for EBVs may be justified. An example of this is a marine terminal where the valve should be located at least 100 ft (30 m) from the manifold where the leak may occur. Beyond those distances no fireproofing would be needed.

1. D Type EBVs (not fail safe)

If it is not justified to locate an EBV 25 ft (7.5 m) or more from a potential fire source, a fireproofed Type D EBV may be installed. The installation has to be done in such a way that fire damage does not impair the operation of the valve. Therefore, the preferred cable routing and fireproofing for Type D EBVs are as follows:

- Underground routing of power and signal cables up to the point vertically below the valve actuator. If power and signal cables cannot be run underground from outside the fire hazard area to the point vertically below the valve actuator, they shall be fireproofed within the fire hazardous area of the protected equipment.
- Fireproofing of power and signal cables between grade and the actuator.
- Fireproofing of the actuator.

Fireproofing shall not include the valve body and hand wheel. Fireproofing of power cables, signal cables, and the actuator shall be designed so that the system will function for at least 15 minutes when exposed to a 2000°F (1100°C) fire with an incident heat flux of at least 50,000 Btu/hr-ft² (160 kW/m²) at the conditions set forth in UL-1709, ASTM E-1529, or equivalent test method. For fireproofing details see IP 14-3-1. There shall be no uncovered sections at junctions, bends or terminal entries. Fire resistant cable that meets the above temperature, heat flux, and time criteria may be used without additional fireproofing. For actuators, an easily installed or dismantled fireproof enclosure is recommended.

In hot services greater than 700°F (370°C) the functioning of a fireproofed electric motor can be impaired by heat transfer through stem and yoke into the actuator. In such cases, the EBV should either be installed in a location where no fireproofing is needed or the valve should be refitted with a longer stem and yoke to facilitate cooling.

DESIGN PRACTICES		SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only	EXXON EXXON ENGINEERING
Section XV-F	Page 10 of 34		
Date December, 1998			

S INSTALLATION REQUIREMENTS FOR EMERGENCY BLOCK VALVES (Cont)

If underground routing of power and signal cables is impractical, conduits should be routed via the shortest distance possible away from the area of the potential leak. Normal cable banks should not be used for convenience if their use results in enlarging the exposed EBV cable length. For dock installations, the system has to be fireproofed within a horizontal distance of 100 ft (30 m) from the potential leak. Vulnerable parts in LPG storage vessel isolation valve systems have to be fireproofed within and beyond the dike area. For all other installations, the above ground power and control wiring associated with remote actuation has to be fireproofed within a horizontal distance of 25 ft (7.5 m) of the equipment being protected, or further if the equipment fire hazardous area demands.

Depressuring systems and air to oxidation processes (actuators and cables), when not designed to be "Fail-Safe," have to be fireproofed within battery limits if above ground. This increase in fireproofing is required since this system is counted on to be available assuming the fire can occur anywhere in the unit.

Careful engineering may result in a solution where aboveground power and signal cables are always routed outside other potential fire hazard areas (IP 15-10-1). However, if power and signal cables are routed through areas where they might be endangered by a fire not requiring the use of this EBV, they need not be fireproofed. It is not EXXON philosophy to require reliability for EBVs regardless of cost to assure operability under all potential fires. Furthermore, it is reasonable to assume that one contingency does not necessarily result in another. Only when a hazard analysis reveals that one event leads to another is additional fireproofing justified.

2. C Type EBVs

Type C EBVs by definition are installed at a horizontal distance of at least 25 ft (7.5 m) from the potential leak and therefore do not need fireproofing. This implies that cables serving a Type C EBV are routed outside the presumed fire hazard area associated with this valve. It would not be acceptable if cables for such valves were routed back through the presumed fire hazard area. Even if fireproofed, this would not meet the intent for Type C EBV requirements. As with Type D EBVs, it is preferable to route cables serving Type C EBVs underground.

ACTUATING CONTROLS

Actuating controls for Type C and D EBVs should consist of push buttons for moving the valve in the opening and closing directions. Valve travel once initiated should continue until the valve has moved to its full travel position in the required direction. For testing purpose, a stop push-button shall be provided allowing the valve travel to be stopped at any intermediate point. All actuating buttons must be provided with a protective guard to prevent inadvertent operation.

With Type D EBVs, the actuation push buttons for remote operation should be located 40 ft (12 m) from the potential leak. The rationale for increasing the distance from the potential leak for Type D EBV push buttons is that this would reduce operator exposure at little additional cost since the push buttons must be located remote from the Type D EBV in any event. Control room activation for Type D EBVs in toxic service should be considered because the field push button could be in the toxic cloud.

Additional push buttons for compressor, fired heater and depressuring system EBVs must be located in the control house (IP 3-7-1). These push buttons should be placed on the appropriate section of control panel covering the unit involved in a logical process relationship to the layout of the other instrumentation.

- ♦ All field mounted buttons should be grouped, located at battery limits and should not be less than 40 ft (12 m) away from the nearest potential leak. These unit EBV (D) actuation stations should be clearly marked (to enable personnel to locate during an emergency) and have the emergency action buttons (for example, the close button for a normally open EBV) clearly identified. Valve position indicating lights should be provided.

Local actuating buttons for Type D EBVs are desirable for startup and local testing of equipment such as compressors. It is recommended to use the existing buttons at the valve actuator instead of installing additional buttons on the local control panel. However, if additional push buttons are installed on the control panel, the wiring for an actuating circuit shall be such that remote operation will still function even though a local actuation point is lost. If this cannot be accomplished, the local actuating system has to be fireproofed. (IP 14-3-1)

TESTING

The availability of an EBV installation is highly dependent upon how frequently the system is checked since valves can foul and circuits can fail. For testing, the following is required as a minimum:

 EXXON ENGINEERING	SAFETY IN PLANT DESIGN EMERGENCY ISOLATION, DEPRESSURING, AND SHUTDOWN SYSTEMS PROPRIETARY INFORMATION - For Authorized Company Use Only		DESIGN PRACTICES	
			Section XV-F	Page 11 of 34
			Date December, 1998	

S INSTALLATION REQUIREMENTS FOR EMERGENCY BLOCK VALVES (Cont)

- The EBV system should be tested periodically by actuating all functions. Where it is not possible to test an EBV at a frequency suitable to ensure availability without impacting operations, facilities should be provided for on-line testing. For normally open, isolation EBVs (C or D) smaller than 8 in. (200 mm), a CSC (carsealed closed) bypass valve shall be provided, because partial closing of the EBV online can restrict flow and hinder operations. The cost of a bypass valve is not justified for EBVs equal to or greater than 8 in. (200 mm) which are normally open (isolation valves), provided the EBV can be partially closed for on stream testing, and full closure is carried out periodically (e.g., during a turnaround). An exception is made for normally open isolation EBVs installed in a furnace outlet. In this case, a CSC bypass valve shall be provided around the EBV for onstream testing, regardless of its size.
- EBVs, which are normally closed (depressuring valves), should be provided with a CSO block valve upstream and adjacent to the EBV.
- It is required that the open/close position of an emergency valve can be clearly determined by visual observation of the valve, even when the valve actuator is fireproofed. Extension rods on gate valve stems or indicators on quarter turn valves can serve this purpose. (IP 3-7-1)

S EMERGENCY ISOLATION

Manually or power operated EBVs located at strategic points throughout the equipment (on both geographical and process flow bases), permit an affected section to be isolated from other sections of the plant, so that the inventory of fuel feeding a fire or release is limited. On a larger scale, in the event of a widespread fire, it is necessary to shut in the whole unit by closing valves at battery limits. Mechanical failures of machinery, fired heater tubes, and other vulnerable equipment are recognized as a common cause of major fires, and individual EBVs for this equipment are specified in the following paragraphs.

In order to simplify the selection process and insure the correct type of EBV is used, logic flow diagrams are provided in **Figures 1** through **6**. To use these figures, choose the figure corresponding to each piece of equipment in a system and follow through the logic. For example, if you have a vessel and a pump, use both **Figures 2** and **3**. In this case if both pieces of equipment require an EBV, see the section on Duplicate Isolation below.

When considering EBVs for equipment such as pumps and compressors, the intent is to provide an isolation capability where there is fire directly associated with that equipment. The approach is to provide valving and protection to maximize the isolation capability for the designated risks at a reasonable added cost relative to reliance on normal process valving. It is not intended to provide design features to insure operability under all possible fire conditions regardless of cost.

EBVs for isolation should be provided in accordance with guidelines given below. The method of isolation required in each case is referred to as Type A, B, C, or D. These types are defined above under **DEFINITIONS**. Detailed design requirements are given in **Table 1**.

LONG LINES

Where emergency isolation is needed in long lines, such as those present in marine loading facilities, consideration should be given to the time it takes for the EBV to close fully. The possibility of creating a potentially damaging hydraulic pressure surge should be evaluated (Report No. EE.21E.89, *Piping Vibration Evaluation Guide*) and the valve closing time appropriate to the specific situation should be used.

TOXIC MATERIALS

Where toxic materials are present and a release to the atmosphere can occur, either due to a failure of a small connection [e.g., 3/4 in. (19 mm) bleeder] or a flange leak (one half of a flange gasket blows out), and the resulting toxic vapor concentration can exceed the ERPG-3 at the fence line, then either a Type D EBV should be installed, or alternative isolation means should be considered. When a Type D EBV is required for toxic service, control room activation should be considered because the field push button could be in the toxic cloud.

COMPRESSORS

A simplified flowchart summarizing the EBV requirements for compressors may be found in **Figure 1**.

- 1. Type D EBVs are required in the suction and discharge of any compressor of 200 HP (150 kW) and higher handling flammable or toxic gases. These EBVs should be equipped with position switches set to trip the compressor when they are less than 50% open (see **IP 15-1-2**), but the EBVs should not be actuated (automatically closed) by the compressor shutdown system. For compressors less than 200 HP (150 kW), no EBV is required.
- 2. For compressors meeting the above criteria which have multiple suctions or discharges connected to different pressure stages, Type D EBVs are required in all suction and discharge lines that leave the compressor area and are normally open.