ADNOC GROUP PROJECTS AND ENGINEERING

EMERGENCY SHUTDOWN AND ON/OFF VALVES SPECIFICATION

Specification

AGES-SP-04-005

ص ب 898، أبوظبي، الإمارات العربية المتحدة
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GROUP PROJECTS & ENGINEERING / PT&CS DIRECTORATE

CUSTODIAN	Group Projects & Engineering / PT&CS
ADNOC	Specification applicable to ADNOC & ADNOC Group Companies

Group Projects & Engineering is the owner of this Specification and responsible for its custody, maintenance and periodic update.

In addition, Group Projects & Engineering is responsible for communication and distribution of any changes to this Specification and its version control.

This specification will be reviewed and updated in case of any changes affecting the activities described in this document.

INTER-RELATIONSHIPS AND STAKEHOLDERS

a) The following are inter-relationships for implementation of this Specification:

   i. ADNOC Upstream and ADNOC Downstream Directorates and

   ii. ADNOC Onshore, ADNOC Offshore, ADNOC Sour Gas, ADNOG Gas Processing. ADNOC LNG, ADNOC Refining, ADNOC Fertilisers, Borouge, Al Dhafra Petroleum, Al Yasat

b) The following are stakeholders for the purpose of this Specification:

   ADNOC PT&CS Directorate.

c) This Specification has been approved by the ADNOC PT&CS is to be implemented by each ADNOC Group company included above subject to and in accordance with their Delegation of Authority and other governance-related processes in order to ensure compliance

d) Each ADNOC Group company must establish/nominate a Technical Authority responsible for compliance with this Specification.

DEFINED TERMS / ABBREVIATIONS / REFERENCES

"**ADNOC**" means Abu Dhabi National Oil Company.

"**ADNOC Group**" means ADNOC together with each company in which ADNOC, directly or indirectly, controls fifty percent (50%) or more of the share capital.

"**Approving Authority**" means the decision-making body or employee with the required authority to approve Policies & Procedures or any changes to it.

"**Business Line Directorates**" or "**BLD**" means a directorate of ADNOC which is responsible for one or more Group Companies reporting to, or operating within the same line of business as, such directorate.

"**Business Support Directorates and Functions**" or "**Non- BLD**" means all the ADNOC functions and the remaining directorates, which are not ADNOC Business Line Directorates.

"**CEO**" means chief executive officer.

"**Group Company**" means any company within the ADNOC Group other than ADNOC.

"Specification" means this Emergency Shutdown and On/Off Valves Specification.

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GENERAL

1. PURPOSE

The purpose of this document is to define the technical requirements for Emergency Shutdown and On/Off Valves in Plant or Pipeline services.

2. SCOPE

This Standard covers the minimum requirements for the design, manufacturing, identification, inspection, testing, packing and documentation of Emergency Shutdown and On/Off Valves. This standard applies to applications onshore and offshore, excluding subsea. The requirements also do not include those for Sales Gas distribution networks.

This specification excludes wellhead valves.

3. DEFINED TERMS / ABBREVIATIONS / REFERENCES

Abbreviations	
AMS	Asset Management System
ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
Cv	Coefficient Of Flow
DC	Direct Current
DIN	Deutsches Institut für Normung
EBDV	Emergency Blow-Down Valve
EDP	Emergency De-Pressurisation
E/H	Electro-Hydraulic
ESD	Emergency Shutdown System
FAT	Factory Acceptance Test
FC	Fail Close
FL	Fail Last

Abbreviations	
H2S	Hydrogen Sulphide Gas
HART	Highway Addressable Remote Transducer
HPU	Hydraulic Power Unit
IAMS	Instrument Asset Management System
IEC	International Electrotechnical Commission
IP Gas	Initial Production Gas
ISO	International Organization for Standardization
LP Gas	Low Pressure Gas
MAST	Maximum Allowable Stem Torque
MAWP	Maximum Allowable Operating Pressure
NEMA	National Electrical Manufacturers Association
NM	Newton Meters
NPT	National Pipe Tapered
P&ID	Piping & Instrument Diagram
PCS	Process Control System
PST	Partial Stroke Testing
QEV	Quick-Exhaust Valve
SAT	Site Acceptance Test
SMART	Single Modular Auto-ranging Remote
SMYS	Specified Minimum Yield Strength
SOV	Solenoid Operated Valve
SS	Stainless Steel
TSO	Tight Shut Off
UAE	United Arab Emirates

Abbreviations	
V	Volts
OWS	Operator Workstation

References
ADNOC Group Companies ESD and On/Off valve documents part of ESD and On/Off valves Purchase Order shall be referred for design and supply of equipment.

SECTION A

4. NORMATIVE REFERENCES

4.1 International Code(s) and Standards

The following codes and standards, to the extent specified herein, form a part of this specification. They have been rationalized to avoid duplication between the many regulatory organisations. When an edition date is not indicated for a code or standard, the latest edition in force at the time of VENDOR'S proposal submittal shall apply.

Standard	Description
American Petroleum Institute (API)	
API STD 598	Valve Inspection and Testing
API STD 600	Steel Gate Valves - Flanged and Butt-welding Ends, Bolted Bonnets
API STD 607	Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats
API STD 608	Metal Ball Valves - Flanged, Threaded, and Butt-Welding Ends
API STD 609	Butterfly Valves: Double Flanged, Lug- and Wafer-Type
API STD 941	Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants
API STD 6FA	Specification for Fire Test for Valves
API Spec 6A	Specification for Wellhead and Christmas Tree Equipment
API Spec 6D	Specifications for Pipeline and Piping Valves
API RP 520	Sizing, Selection and Installation of Pressure-relieving Devices
American Society of Mechanical Engineers (ASME)	
ASME B 16.5	Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch Standard
ASME B 16.10	Face to Face and End-to-End Dimensions of Valves

ASME B 16.34	Valves Flanged, Threaded and Welding End
ASME B 16.47	Large Diameter Steel Flanges: NPS 26 through NPS 60 metric / inch Standard
ASME B 46.1	Surface Texture (Surface Roughness, Waviness and Lay)
ASME Section VIII	Boiler and Pressure Code, Div. I
ASTM International	
ASTM G93	Standard Practice for Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen Enriched Environments
ASTM A240l240M	Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate. Sheet. and Strip for Pressure Vessels and for General Applications
ASTM A269/269M	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
National Association of Corrosion Engineers (NACE)	
ANSI/ NACE MR 0175/ISO 15156	Petroleum and Natural Gas Industries – Materials for use in H2S-containing environments in Oil and Gas Production
ANSI/NACE MR0103/ISO 17945	Metallic Materials resistant to Sulfide Stress Cracking in corrosive petroleum refining environments
NACE TM0177	Laboratory Testing of metals for resistance to sulfide stress cracking and stress corrosion cracking in H2S environments
European Committee for Electrotechnical Standardization	
CENELEC EN 60947-5-6	Low-Voltage Switchgear and Control gear Part 5-6: Control Circuit Devices and Switching Elements DC Interface for Proximity Sensors and Switching Amplifiers (NAMUR)
CEN EN 10204	Metallic Products – Types of inspection documents
CEN EN 12266-1	Industrial valves Testing of Metallic valves Part 1: Pressure tests, test procedures and acceptance criteria Mandatory

	requirements
CEN EN 12266-2	Industrial Valves - Testing of Metallic Valves Part 2: Tests, Test Procedures and Acceptance Criteria Supplementary Requirements
International Electrotechnical Commission (IEC)	
IEC 60079 all parts	Electrical Apparatus for Explosive Gas Atmospheres
IEC 60085	Electrical insulation — Thermal Evaluation and Designation
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60947-5-2	Low-voltage switchgear and controlgear - Control circuit devices and switching elements - Proximity switches
IEC 60947-5-6	Low-Voltage Switchgear and Control gear Part 5-6: Control Circuit Devices and Switching Elements - DC Interface for Proximity Sensors and Switching Amplifiers (NAMUR).
IEC 61000 (All parts)	Electromagnetic compatibility (EMC)
IEC 60534-4	Industrial-process control valves. Inspection and routine testing
IEC 60534-5	Industrial-process control valves marking
IEC 61508	Functional safety of electrical, electronic, and programmable electronic safety-related systems.
International Organization for Standardization (ISO)	
ISO 9001	Quality Management Systems - Requirements.
ISO 19011	Guidelines for Auditing Management Systems
ISO 5208	Industrial Valves – Pressure Testing of Metallic Valves
ISO 5211	Industrial valves — Part-turn actuator attachments
ISO 15848-1	Industrial valves Measurement, test and qualification procedures for fugitive emissions Part 1: Classification system and qualification procedures for type testing of valves.
ISO 15848-2	Industrial valves Measurement, test and qualification procedures

	for fugitive emissions Part 1: Classification system and qualification procedures for type testing of valves.
ISO 14313	Petroleum and Natural Gas Industries – Pipeline Transportation Systems – Pipeline Valves.
ISO 28921-1/2	Isolating Valves for Low-Temperature Applications.
ISO 27895	Vacuum Technology Valves Leak Test
ISO 10474	Steel and steel products - Inspection documents
ISO 12490	Mechanical integrity and sizing of actuators and mounting kits for pipeline valves
International Society of Automation (ISA)	
ISA TR96.05.01	Partial Stroke Testing of Automated Valves.

4.2 ADNOC Specifications

Document Number	Title
AGES-SP-04-004	Emergency Shutdown (SIS) System Specification
AGES-PH-03-002	Fire & Gas Detection & Fire Protection System Philosophy
AGES-SP-09-002	Piping Material Specification Index
AGES-SP-09-003	Piping & Pipeline Valves Specification

5. REFERENCE DOCUMENTS

5.1 Standard Drawings

Valve Data Sheet IEC 60534-7 Control Valve Data Sheet

5.2 Other References

Not Applicable

6. DOCUMENTS PRECEDENCE

The Codes and Standards referred to in this specification shall, unless stated otherwise, be the latest approved issue at the time of Purchase Order placement.

It shall be the VENDOR'S and CONTRACTORS'S responsibility to be, or to become, knowledgeable of the requirements of the referenced Codes and Standards.

The VENDOR/CONTRACTOR shall notify the COMPANY of any apparent conflict between this specification, the related data sheets, the Codes and Standards and any other specifications noted herein.

Resolution and/or interpretation precedence shall be obtained from the COMPANY in writing before proceeding with the design/manufacture.

In case of conflict, the order of document precedence shall be:

1. UAE Statutory requirements
2. ADNOC Codes of Practice
3. Equipment datasheets and drawings
4. Project Specifications and standard drawings
5. Company Specifications
   National/International Standards

7. SPECIFICATION DEVIATION/CONCESSION CONTROL

Deviations from this specification are only acceptable where the VENDOR has listed in his quotation the requirements he cannot, or does not wish to comply with, and COMPANY/CONTRACTOR has accepted in writing the deviations before the order is placed.

In the absence of a list of deviations, it will be assumed that the VENDOR complies fully with this specification.

Any technical deviations to the Purchase Order and its attachments including, but not limited to, the Data Sheets and Narrative Specifications shall be sought by the VENDOR only through Concession Request Format. Concession requests require CONTRACTOR'S and COMPANY'S review/approval, prior to the proposed technical changes being implemented. Technical changes implemented prior to COMPANY approval are subject to rejection.

8. PROCESS SAFETY REQUIREMENTS

SR.No.	Description
1	Failure action of ESD valves shall be assessed during HAZOP.
2	A detailed safety integrity assessment review to establish SIF integrity targets (SIL) shall be completed by CONTRACTOR and approved by COMPANY during FEED and Detailed Design engineering phase.
3	ESD valves shall be fire-rated to an approved standard, but additionally passively fire protected if thermal radiation is above the fire-rating of the valve or above 32 kW/m^2.
4	Valves for the isolation of large inventories of flammable liquids shall be fireproofed.
5	Instrument air buffer vessels shall be provided for all blowdown valves and ESD valves identified during HAZOP.

9. DESIGN CONSIDERATIONS /MINIMUM DESIGN REQUIREMENTS

9.1 General

There are four main categories of On/Off valves considered in this standard:

i. Emergency Service (ESDV & EBDV)
ii. Inventory Isolation
iii. Pipeline Sectioning/Isolation
iv. Process Service (Routing, Sequencing, etc.)

For the purpose of this standard, these services are defined as follows:

i. Emergency Service.

Emergency service valves are operated in emergency situations to:

a. Minimise inventory available to a fire or loss of containment by closing the incoming supply of flammable/toxic material to a unit/facility and sectioning the facility into manageable fire areas (ESDVs)
b. Minimise the hazard caused by an upset by removing gaseous inventory to flare or vent (EBDVs).

ii. Inventory Isolation

Inventory isolation are operated, usually in an emergency situation, to minimise the amount of liquid inventory available to a fire or loss of containment by isolating tanks or vessels that contain significant volumes of flammable or toxic liquid.

iii. Pipeline Sectioning/Isolation

Pipeline valves are installed to divide pipelines into isolated sections in the case of damage, for maintenance or for operational purposes.

iv. Process Service

Process service is defined as any valves that are required as part of the normal operation of the plant/facility but have no emergency functions dependent on them. These are typically used for sequencing, routing, feed selection, selection of equipment items or process streams.

Valves that are only actuated due to their size exceeding reasonable limits for manual operation, such as large maintenance isolation valves will also fall into this category.

In the following sections the basic requirements for general process service valves are defined, followed by more specific requirements for each of the more demanding service categories. Where the category requirements differ from the generic one, the more stringent requirement in the applicable category section shall be applied

9.2 Operation & Design Life

Emergency Shutdown and On/Off valves shall be designed for a service life of 30 years. Only field proven hardware/technology shall be used. Field proven shall be defined as minimum 2 years of operation in similar operating environments similar to that in which the new equipment is to be deployed.

9.3 Environmental Requirements

The environmental conditions experienced at ADNOC facilities vary widely due to the range of locations, from Offshore, to littoral, to far inshore; and range of atmospheric contaminants, including sulphides and chlorides. Environmental conditions shall therefore be taken from the project Design Basis and specified on the equipment data sheets.

All equipment shall be designed to capable of operating continuously under the specified environmental conditions for planned service life.

Valve bodies and actuators shall be suitable for unshielded operation in the specified environment. Sunshades shall be provided for ancillary instrumentation where necessary to maintain the instrument within its operating temperature range, or where performance would otherwise be affected.

9.4 Utility Data

The following utility supplies may be available for valve actuators:

i. Instrument Air: Minimum supply pressure 4.5 kg/cm2; Maximum supply pressure 9.0 kg/cm2
ii. Electrical Three Phase Supply for Motors: 415 VAC, 50 Hz
iii. Electrical Single Phase Supply: 240 VAC, 50 Hz
iv. Transmission gas at pipeline pressure.
v. Hydraulic Oil: available pressure set by HPU.

See Section 10 for acceptable usage in specific applications.

9.5 Hazardous Area Protection

Instruments and Valves located in hazardous area shall comply with IEC 60079 requirements. Minimum protection category shall be IEC Ex IIB T3 Zone 2.

For instrumentation installed in hazardous area, with the exception of solenoid valves and electric actuators, Ex i (Intrinsically Safe) design shall be used. Solenoid valves shall be Ex'd' or Ex'm' certified. Alternative

protection methods may be used for SOVs, only if specifically approved by COMPANY. MOV actuators shall be Ex'd' or Ex'd e'

Instrumentation in hazardous areas shall be certified by recognised certifying body to. IECEx or equivalent.

9.6 Ingress Protection

The degree of Ingress Protection (IP) for equipment enclosure shall comply with IEC 60529 and equipment data sheets. The equipment minimum IP rating shall be as follows:

a. IP 42 for Indoor climate-controlled environments
b. IP 65 for Outdoor field environments
c. IP 66 for offshore environments

9.7 Electromagnetic Compatibility

All electrical equipment shall meet the relevant requirements of IEC 61000.

9.8 Engineering Units

Reference shall be made to Project Engineering Design basis for Units of Measurements

SECTION B

10. TECHNICAL REQUIREMENTS

10.1 General

Emergency Shutdown and On/Off valves shall be supplied as a complete assembly by the VENDOR. Each valve assembly comprising valve body, actuator, mounting yoke, local control station and all accessories such as solenoid valves, limit switches, air filter regulators etc. as detailed in this specification and purchase datasheets.

The complete assembly shall be suitable for installation and operation outdoors under the environmental conditions specified in purchase requisition.

Motor Operated Valves (MOVs) shall not be used for ESD application requiring fail-safe valve position but can be used for general process On/Off valve functions such as tank selection. They may be used for application in Offsite and Tankage and Pipeline Applications. MOVs may also be used in other non-critical applications where other options are impractical, for example due to unavailability of instrument air supply. MOVs shall only be used in such cases if the selection and consideration of emergency power to the actuator is specifically approved by COMPANY.

10.2 Valve Body

10.2.1 Valves for General Process Applications

Valve body types shall generally be selected in line with piping specification requirements. However, for general service valves, body types that are not covered by piping specifications may be accepted for special applications if approved by COMPANY. Applications requiring such considerations are typically those where valves are regularly operated frequently and/or in the presence of abrasive material, such as in mol sieve sequencing, H2 Service in PSA units or slurries.

Valve body type, and selection shall be governed by process conditions and selection shall be in accordance with the Piping Material class and AGES-SP-09-003. The selected body type shall be indicated on the valve data sheet.

Wafer-style bodies (with or without lugs) shall not be used in hydrocarbon or critical services. All bodies, other than wafer or lug styles, shall be flanged at both ends, except for pressure ratings greater than class 1500#, where hub ends may be specified as an alternative to flanges, if permitted by the specified piping class. Other configurations shall only be accepted if specifically approved by COMPANY.

For flanged ends, flanges shall be in accordance with AGES-SP-09-003

Valve leakage classes and fugitive emission requirements shall be as specified in AGES-SP-09-003, unless otherwise specified for process reasons. Requirements for these shall be defined on a case-by-case basis and specified in data sheets.

‘Polymer-proof’ or ‘solid-proof’ designs with seals resistant to build-up and suitable for high cycling rates shall be specified as required in polymer services.

All On/Off valves shall have anti-blow-out stems with the anti-blow-out elements integral to the stem.

Valve designs in liquid service and having a cavity between two seals shall have provision for relief of cavity pressure, either by bleed to the upstream side or via external relief provision.

For general service, VENDOR may offer alternative body designs as additional options within bids if they consider that the alternative offers economic or performance advantages over the standard selection. Such options will only be accepted if approved by COMPANY.

Dimensions of shall be in accordance with AGES-SP-09-003 or, for special valves, ASME B16.10, unless otherwise agreed by COMPANY.

Where double-block-and-bleed action is needed for process actions (e.g. meter run isolation) this may be provided by a single valve with bidirectional sealing and a vented cavity, such as vented cavity ball valves or double-expanding wedge gate valves.

For quarter-turn valves in general service, MAST shall be greater than 1.2 times the maximum torque capability of the actuator.

For linear-stroke valves in general service, SMYS of the shaft shall be greater than 1.2 times the maximum force capability of the actuator.

Locking devices, where fitted, shall require the use of tools or a key to disengage them.

Valves weighing more than 250 kg shall be provided with lifting lugs (2 or 4) that allow the valve to be lifted as an assembly with the actuator in place. Lugs shall be located such that the actuator, when the assembly is installed, does not impede access to them.

10.2.2 Additional Requirements for Inventory Isolation Valve Bodies

The following requirements for inventory isolation valves are in addition to, or override where appropriate, those for General Service valves.

Wafer or lug type bodies shall not be used for valves in inventory isolation service. All bodies shall be flanged at both ends. Flanges shall be integral to the body casting/forging. Slip-on or weld-neck flanges shall not be used.

Inventory isolation valves shall be metal-seated or provide metal-to-metal sealing backup in the event of fire. They shall be certified fire-tested types in accordance with API 6FA. Valves shall be operable under fire conditions for at least 30 minutes after the onset of fire. Where additional fire protection is specified, this may be provided either by a fireproof enclosure or jacket around the valve or by intumescent coating of the body.

Ball valves shall be of three-part side-entry body design with-trunnion mounted ball. Inventory isolation valves may be reduced bore types, if approved by COMPANY.

Inventory isolation valves shall meet the tightness requirements of API 598 for metal-seated valves (ISO 5208 class CC) as minimum.

All quarter turn valves in inventory isolation service shall have bearings at both ends of the shaft. Floating ball types shall not be used.

For quarter-turn valves in inventory isolation service, MAST shall be greater than 1.5 times the maximum torque capability of the actuator.

For linear-stroke valves in inventory isolation service, SMYS of the shaft shall be greater than 1.5 times the maximum force capability of the actuator.

Valves using resilient (elastomer) seat materials shall be fitted with an antistatic device meeting the requirements of API 6D.

Valve bonnets shall be bolted to the valve bodies.

Inventory isolation valves shall be provided with a locking device to lock them in the closed position.

10.2.3 Additional Requirements for Emergency Valve (ESD, EBDV) Bodies

The following requirements for Emergency Valves are in addition to, or override where appropriate, those for Inventory Isolation valves.

Unless otherwise specified, ESD valves shall be full-bore, trunnion-mounted, side/top entry ball type or as specified in piping valve specifications. Other types of valve body may be selected if they comply with piping specifications and are specifically approved by COMPANY.

ESD valves shall provide tight shut-off (TSO) where specified. Valves shall be subject to “Seat Tightness Tests” as prescribed in API 598 and comply with “Acceptable Seat Test” criteria defined in ISO 5208.

In liquid service for tight shut-Off ESD valves ISO 5208 Rate B shall be used and for non-TSO Rate CC (equivalent to API 598) shall be used.

In gas service for TSO ESD valves ISO 5208 Rate A shall be used and non-TSO API 598 shall be used.

EBD valves shall meet the requirements of ISO 5208 Rate A

Valve design, dimensions, marking and rating shall comply with API 6D.

The selection of ‘polymer-proof’ and similar special design valves shall be subject to prior COMPANY approval.

Where locking devices are specified on data sheets:

ESD valves shall be provided with a locking device to lock them in the closed position.

EBD valves shall be provided with a locking device(s) to lock them in either the open or the closed position.

10.2.4 Pipeline Sectioning/Isolation Valve Bodies

The following requirements for pipeline valves are in addition to, or override where appropriate, those for General Service valves.

Pipeline valve bodies shall be gate, plug or ball types designed and tested in accordance with ISO 14313.

Valve body types shall be selected to suit the fluid(s) and service for which the pipeline is used.

Valves in pipelines that require to be pigged shall be full-bore types providing uninterrupted circular cross-section passage through the valve. Valves in lines to be pigged shall have metal seats or seats that are protected from contact with pigs or pigging detritus.

Pipeline valves do not normally require to be fire-tested types. Special requirements shall be included on data sheets.

For quarter-turn valves, MAST shall be greater than 1.5 times the maximum torque capability of the actuator.

For linear-stroke valves, SMYS of the shaft shall be greater than 1.5 times the maximum force capability of the actuator.

10.3 Actuator Specification by Service

10.3.1 General

The 'actuator assembly' shall consist of all of the top works necessary to ensure consistent and safe execution of all the specified requirements for the valve to which it is fitted.

In general, instrument air shall be the first choice for supply of motive power to on-off valve actuators. Some exceptions to this are noted below. Other options may also be used if specified and if specifically approved on a case-by-case basis by COMPANY.

For any valve where stroke time faster than one inch per second or where the stroke time must be greater than a specified minimum, or very slow stroke is acceptable, stroke time shall be specified on the data sheets. If no stroke time is specified a nominal requirement of one inch per second shall be assumed.

10.3.2 Actuators in General Process Applications

Actuators for general process applications shall normally be spring-return pneumatic types, either spring-opposed piston or spring-opposed diaphragm. Where space is restricted, or to save weight, double-acting actuators may be used if there is no requirement for a defined failure position.

For rotary-stem valves with low torque requirements (e.g. small ball valves or butterfly valves in low-pressure service) rack-and-pinion actuators may be used, if approved by COMPANY. Generally, these actuators shall not be used for any valve larger than 6" or in systems rated above 300#, and shall not be used for torque-seated valves larger than 4".

Valves that are infrequently operated, where a 'fail locked' failure mode is acceptable, and which are located in areas where instrument air is not readily available, such as tank/oil movement selection on tank farms, may use electric motor actuators. Maintenance isolation valves that require actuation because they are too large/high torque for manual operation may also use electric motor actuators.

Actuators for valves in general service shall provide a minimum torque/thrust of 125% of the maximum required to stroke/seat the valve.

Actuators shall provide limit stops according to valve types in accordance with API 6D. Actuators for other valve types that rely on torque or thrust for tight seating shall not have limit stops for the closed position.

10.3.3 Actuators in Inventory Isolation Applications

The following requirements for inventory isolation valve actuators are in addition to, or override where appropriate, those for general service.

Actuators shall be pneumatic, spring-return, fail-closed types (thus inherently fail-safe). Actuators for quarter-turn valves shall be Scotch-yoke types.

Actuators and all ancillaries necessary for actuator function (SOVs, volume boosters, quick-exhaust valves) shall be fire-protected to withstand the API 607 fire test conditions, either by provision of 'fireproof' enclosures or by other means approved by COMPANY.

Actuator shall provide a minimum of twice (2x) the maximum torque/force required at all points in the valve stroke from start of closure to fully seated, under all specified operating conditions. VENDOR shall provide these calculations with tender.

Actuator stroke time from fully open to fully seated shall not be greater than 1 second/inch of valve nominal size.

10.3.4 Actuators for Emergency Valves (ESD, EBDV)

The following requirements for Emergency Valve actuators are in addition to, or override where appropriate, those for inventory isolation.

Actuators for ESDVs shall be pneumatic cylinder, spring-return, fail-closed types (thus inherently fail-safe) unless other factors (remoteness, unacceptable size and weight offshore) make it unfeasible to use these. In these case electro-hydraulic (or hydraulic if there is a facility HPU) types may be used. Use of types other than pneumatic is only permitted if specifically approved by COMPANY.

Double-acting actuators shall not be used for ESDVs. Spring-diaphragm actuators shall not be used for ESDVs.

Actuators for EBDVs shall be pneumatic cylinder, spring-return, fail-open types. Double-acting actuators shall not be used for EBDVs. Spring-diaphragm actuators shall not be used for EBDVs.

Actuators for ESDVs shall stroke the valve from fully open to fully seated in a stroke time equal to or shorter than the maximum specified on the data sheets. If a minimum stroke time is specified, valve stroke shall be longer than this minimum. If both minimum and maximum are specified, stroke time shall fall between these values. If no stroke time is specified, travel shall be nominally 1 second/inch of valve diameter.

10.3.5 Actuators for Pipeline Valves.

The following requirements for pipeline valve actuators are in addition to, or override where appropriate, those for general service valve actuators.

Pipeline valve actuators that respond to a trip shall close the valve in a stroke time between maximum and minimum specified on the data sheets.

Pneumatic cylinder spring-return actuators shall be selected where pneumatic supplies are available, unless the valve has only a maintenance function, in which case electric actuators may be used.

For sites where no instrument air supply is available and the valve is required to respond to a trip, two options are available for spring-return actuation.

Where valve operation is infrequent and release of pipeline gas from the actuator during valve closure can be accepted, gas-over-oil hydraulic actuation may be used. Pipeline gas shall not be used directly in the actuator cylinder.

For locations where the release of pipeline gas is unacceptable, high-pressure pneumatic actuators using air bottles may be provided.

In all cases where a trip response is required, the design margin requirements for Inventory Isolation valves (10.3.3) shall apply.

Actuators for pipeline valves do not normally require fire protection. Specification of actuator fire protection shall follow the requirements for the valve.

For valves that are installed for operational or maintenance reasons only, with no associated trip functions, electric motor actuators may be used.

10.4 Actuator Ancillaries

10.4.1 General

All actuator ancillaries shall be suitable for continuous operation in all environmental conditions specified for the installation. Where the component is not suitable for continuous operation at the maximum solar surface temperature specified, either due to construction or certification, sunshades shall be provided to prevent insolation and maintain temperatures within acceptable limits.

All electrical ancillaries, with the exception of SOVs (see 10.4.2), shall have a minimum hazardous area certification of EX'ib' IIB+H_2 T3 in accordance with IEC 60079 unless special process hazards require more demanding classification.

10.4.2 Solenoid-Operated Valves

Solenoid-operated valves (SOVs) shall be the standard interface device between logic systems and actuators' pneumatic/gas or hydraulic elements for all types of on-off valves.

Pilot-operated SOVs shall not be used.

SOV body and trim materials shall be 316 stainless steel.

SOVs for valves in Emergency Service or Inventory Isolation service, or spring-return actuators in general service shall be 3-port, 2-position (3/2) universal types. For General Service valves with double-acting actuators, 5/2 valves should be used.

All SOVs that vent to atmosphere shall have exhaust port(s) fitted with port protectors to prevent ingress of insects or sand

Minimum port size for SOVs shall be 1/4”

Unless otherwise specified and specifically approved by COMPANY, SOVs shall have 24 V DC coils with a maximum power rating of 10 W. Coils shall be fitted with ‘flywheel’ diodes to prevent electrical surge on de-energisation. Coils shall be rated for continuous energisation at temperatures up to the maximum surface temperature specified on the data sheets.

Coils shall be supplied with IEC 60085 Class 180 (formerly Class’H’) rated insulation.

Hazardous area protection shall be by flameproof housings (Ex’d’) or encapsulation (Ex’m’) in accordance with IEC 60079 parts 1 or 18, respectively. Other protection types, such as intrinsic safety, may be applied in special circumstances, but shall only be applied if approved on a case-by-case basis by COMPANY. Valid solenoid coil certification shall be required over the full range of specified ambient temperature.

SOV coil housing shall be stainless steel and have minimum enclosure ratings of IP 65 for onshore application and IP 67 for offshore. Enclosure cable entries shall be threaded M20 x 1.5 to accept cable glands. Connection shall be made via fixed terminals within the housing. SOVs with flying leads or plug/socket connections shall not be used.

The entire assembly of SOV body and coil shall be rated for continuous operation over the full range of environmental conditions specified on the data sheets.

SOVs shall be reset remotely from the host system. Manual reset devices shall not be used.

Solenoid valves for use on valves in Emergency Service or Inventory Isolation service shall be certified by a body acceptable to COMPANY as being suitable for use (systematic capability) in applications up to SIL 3.

10.4.3 Additional Valves

Where the volume of fluid in a pneumatic or hydraulic actuator cylinder is too great to be emptied within the required time by the SOV alone, additional capacity can be provided by Quick-Exhaust Valves (QEVs) or volume boosters in the case of pneumatic actuators or by hydraulically operated pilot valves in the case of hydraulic operation.

QEVs may be used for increased outlet on pneumatic valves where there is no positioner-based PST. They shall not be used in cases where a valve ‘signature’ is required as they have non-linear characteristics.

Volume boosters shall be used on pneumatic valves where increased venting capacity is required on valves that use smart positioner PST. They may also be used in cases where no PST is required but there is a need for increased capacity.

Hydraulically operated pilot shall be use where capacity greater than the SOV Cv is required for valves with and without PST.

Body and trim materials for all of these components shall be 316 stainless steel. The entire device, including seals, shall be rated for continuous operation over the full range of environmental conditions specified on the data sheets.

10.4.4 Air Filter/Regulators

All on/off valves shall be provided with air filters.

Air filters shall be self-draining and have 316 stainless steel housings. Filter elements shall be rigid structure with a maximum mesh size of 40 µm. Connections shall be ½" or ¼" NPT, depending on flow requirement.

Air regulators shall be provided for all ESD and Inventory Isolation valves and for any General Service valve where consistent stroking time is required. Regulators shall be of stainless steel construction and 'bleedless' design.

Filter and regulator may be combined in a single filter/regulator assembly.

(Filter/)regulators shall be fitted with two stainless steel 50 mm dial pressure gauges, for inlet and outlet pressures, unless a PST positioner with gauges is present, in which case the regulator outlet gauge is not required.

10.4.5 Partial Stroke Testing

Where partial stroke testing has been identified as a requirement for valves in functions with SIL ratings greater than or equal to 1, additional components shall be provided on the actuator assembly.

Unless otherwise approved by COMPANY, the configuration of the pneumatic hook-up for valves with PST requirements shall be similar to the typical design shown in APPENDIX 1

Other configurations for PST may be used provided that the diagnostic capability is judged to be adequate and the configuration is approved by COMPANY for specific application.

The additional components required for this typical configuration are:

i. 'Smart' valve positioner (identified as '5' in A1.3)
ii. Test SOV (identified as '1' in A1.3)
iii. Pressure transmitter (identified as '7' in A1.3)
iv. Additional filter regulator

Positioner

While this section refers to smart positioners, the construction, environment and certification requirements apply to any alternative device proposed for the same duty.

Positioners for PST shall be smart devices that are capable of initiating a valve stroke from normal position to a predetermined value, returning the valve to its normal position and recording and time-stamping the resulting actuator pressure/valve position/time profiles for transmission to ICSS via HART communication. Valve position feedback to the positioner shall not rely on mechanical connection between the positioner and the valve stem (non-contact sensing).

Positioner interface to ICSS shall be 4 – 20mA +HART

Enclosure cable entries shall be threaded M20 x 1.5 to accept cable glands.

Positioner housing shall be 316 stainless steel and have minimum enclosure ratings of IP 65 for onshore application and IP 67 for offshore.

The positioner shall be fitted with two pressure gauges, for supply inlet pressure and control outlet pressure.

The positioner shall be certified as:

i. Suitable for use in safety applications up to SIL 3
ii. Designed to intrinsic safety Ex ib minimum in accordance with IEC 60079-11

Test SOV

Failure of the Test SOV in this configuration can prevent correct operation of the SIF in which the valve is installed (if it fails to return to 'Normal' position after test). The specification requirements are therefore the same as for the Trip SOV (see 10.4.2)

The partial stroke test sequence shall be designed such that failure of the Test SOV to return to de-energised position is checked.

Pressure transmitter

The pressure transmitter shall be specified in line with the Project/respective Operating Group standard specification for pressure transmitters in ESD service.

10.4.6 Manual Operation Override

Where specified, manual override provision shall be provided. This shall be provided either by handwheels or manual pumps.

Manual Override shall not be provided for ESD or Inventory Isolation valves.

For pneumatic actuators, override shall be provided by a handwheel, which shall meet the following requirements:

i. The operating force shall not exceed 360 N on the rim of the handwheel
ii. The transfer from actuator operation to handwheel operation shall be possible in all stem positions
iii. For quarter-turn valves the handwheel shall be shaft mounted and non-declutchable
iv. For rising stem valves, the handwheel should be yoke mounted non-declutchable
v. Shall be of fire safe design
vi. Be unaffected by vibration
vii. Neutral position shall be clearly indicated

Electric-motor actuators shall be fitted with handwheels. For quarter-turn valves actuators shall be side-mounted and declutchable. For rising stem valves handwheels may be either side mounted or top-mounted.

For Hydraulic/Electro-hydraulic actuators, override shall be provided by an integral hand-pump.

10.4.7 Visual Position Indication

All valves in On/Off service, including emergency valves, shall be fitted with external visual position indicators.

Quarter-turn valves, except for MOVs, shall be fitted with top-mounted beacon indicators with colour-change action. Colours shall be RED – Closed; GREEN – Open, unless otherwise specified.

10.4.8 Position Transmitter

Where specified, an independent position transmitter shall be provided.

The transmitter shall not rely on mechanical connection between the positioner and the valve stem (non-contact sensing).

Interface to the ICSS shall be 4 – 20mA +HART

Positioner housing shall be 316 stainless steel and have minimum enclosure ratings of IP 65 for onshore application and IP 67 for offshore unless the transmitter is enclosed in a top-works box that meets these requirements.

10.4.9 Limit Switches

Limit switches shall be provided on all valves in ESD or Inventory Isolation service and, where, specified, on other On/Off valves.

Limit switches shall be proximity types, using either inductive or magnetic detection principles. Output shall be either dry contact or meet NAMUR (IEC 60947-5-6) specifications.

Contact-type limit switches shall have contacts closed on detection of end-of-travel targets. NAMUR shall output higher current value when target is detected.

Contact-type limit switches shall be installed with end-of-line resistors to allow line fault detection.

Limit switches shall be as follows:

a) Directly activated by the valve stem or shaft position
b) Operate within 3% of valve travel from respective open and closed limits
c) Protected to prevent mechanical disturbance/malfunction
d) Failure mode leads to alarm condition
e) Adjustable so they operate at the correct point in the valve travel
f) Limit switches used on ESDV valves shall be minimum SIL 2 certified.

Limit switches shall be adjustable and autonomous to their function, e.g. one switch for the “fully open” position and a separate switch for the “fully closed” position.

The sensing face of limit switches in shall be hermetically sealed and, overall, limit switches shall have an ingress protection rating of IP 67 or higher unless installed within a housing that meets this requirement. Limit switch installation shall not have unprotected flying leads connecting the switches. Switches shall either be installed within a protective housing or leads shall be protected by armoured flexible conduits.

Enclosure cable entries shall be threaded M20 x 1.5 to accept cable glands.

10.4.10 Stroke Time Control

Where it is necessary to slow the stroke time of a pneumatic- or hydraulic- or gas-operated valve, a restriction in the motive fluid line may be required.

Use of restriction devices shall be avoided where practical, for example, by choice of suitable actuator ancillaries.

Flow restrictors used to slow the stroke to safe state of valves in emergency or other critical services shall be fixed orifices installed in the pressure outlet line from the actuator. Adjustable restrictors may be used in other applications. All adjustable restrictors shall be lockable.

10.4.11 Instrument Air Buffer Vessels

Instrument air buffer vessels shall only be used in exceptional circumstances and their use shall require case-by-case approval by COMPANY.

All valve where failure mode is safety-critical shall use spring-return actuators.

If buffer vessels are specified, they shall be provided in accordance with the Project/respective Operating Group Pressure Vessel Specification.

A pressure transmitter on the instrument air buffer vessel shall be provided as standard

10.5 Actuator Assembly (except Pipelines)

10.5.1 General

Materials used for fabrication shall be new, clean and free from rust, mill scale, pits and defects; and as specified in purchase data sheets.

Plastic / Perspex material shall not be used as enclosure material for any accessories and instruments mounted on actuator. All actuator ancillaries shall be suitable for continuous operation in all environmental conditions specified for the installation. Where the component is not suitable for the maximum solar surface temperature specified, either due to construction or certification, sunshades shall be provided to prevent insolation and maintain temperatures within acceptable limits.

Where actuator ancillaries are not suitable for the maximum solar surface temperature specified, either due to construction or certification, sunshades shall be provided to prevent insolation and maintain temperatures within acceptable limits.

All components and accessories directly mounted onto the actuator shall be protected from mechanical damage by means of SS316 protection plates or housing panel. Accessories housing panel shall be bolted and easily allow access to internal parts without necessitating complete disassembly or removing actuator from the valve.

In order to facilitate maintenance, the assembly of actuator components shall be such that any one item, should be easily removed from the assembly for repair or replacement without having to remove other items. Actuators shall not require regular maintenance and will have maintenance intervals based on plant turnaround every three to five years.

The actuator shall be suitable for mounting on the valve without excessive stress on the valve stem arrangement. Forces resulting from the actuator weight shall not be carried by the valve stem. Any requirement for additional supporting of the actuator other than that provided by the valve adapter shall be clearly identified. Support points for the actuators shall be provided by the VENDOR as necessary.

All tubing on actuators shall be SS 316 with SS 316L fittings. Tube size shall be based on valve stroke time requirements. Double ferrule type compression fittings shall be used. VENDOR shall only use the fitting manufacturer (Hoke, Swagelok, etc.) as specified on the data sheets. Fittings manufacturer shall be specified for consistency with the destination plant/project.

All external earths of all items on actuator such as solenoid coil enclosure, limit switches etc shall be connected to a common earth stud which in turn will be connected to the plant safety earth (by others). Valves shall have common 10mm earth boss for connection. Valves on pipeline with cathodic protection shall be bonded to the pipe, not to earth.

Actuator mounting on quarter-turn valves shall be in accordance with ISO 5211. The valve coupling shall match the standard actuator coupling so that any replacement of the actuator does not involve additional adjustment.

The valves and actuator assembly shall be suitable for mounting in the orientation specified in the data sheets (horizontal flow, valve stem horizontal or vertical; vertical flow).

If specified on data sheet, fire- proofing of the actuator assembly shall be provided. The fireproof enclosure shall be rated for 30-minute fire rating without increasing internal temperature above the maximum allowable limit for the actuator and accessories, assuming a continuous total exposure to fire with a flame temperature of 1100°C. The enclosure design shall have apertures to provide visibility and access to accessories. The aperture shall be designed in such a way that accessories can easily be removable through this without removing the enclosure. In particular, the valve travel indicator shall be extended outside enclosure.

The actuators shall be maintenance free and without need of periodic lubrication. All points on the actuator that require lubrication shall be fitted with grease or oil injection nipples with integral non-return valves. All bolting shall be pre-lubricated before assembly.

Mounting plates, bracket, nuts and bolts for mounting accessories shall be SS 316.

Required orientation for mounting of accessories, relative to pipe and valve, shall be specified in purchase order.

If a coating other than the manufacturer’s standard colour and paint specification is required, COMPANY shall specify the RAL colour and paint specification on the data sheet. For any additional requirements reference will be made to respective ADNOC group painting specification.

10.5.2 Pneumatic/Hydraulic/Electrohydraulic Actuator Common Requirements.

The actuator assembly shall comprise the actuator itself and ancillary components as described in 10.4.

Actuator and valve assembly for emergency or critical service shall be designed to move the valve to the safe failure position on failure of either the motive fluid supply (air or oil) or electrical signal.

Actuator cylinders and spring canisters shall be made of carbon steel or as specified in data sheet. The internal cylinder surface of piston type actuators shall have an adequate corrosion protection, such as Electroless Nickel Plated (ENP) coating, while the piston shall also be corrosion resistant. Use of aluminium shall not be permitted for any actuator part.

All actuator bolting shall be either AISI 316 or galvanized carbon steel, painted together with the actuator before assembling of accessories. All bolting for mounting the accessories and position indication shall be AISI 316. Cadmium plating of any component is not allowed. Stem connector assembly shall be SS 316.

The Actuator design pressure shall be such that all pressure retaining parts shall be capable of withstanding maximum air or hydraulic oil supply pressure. A pressure relief valve shall not be used to protect the actuator. However, for pneumatic ESD valves that require to maintain stroke time within critical limits, a relief valve shall be provided to prevent stroke time from being extended in case of regulator failure.

Spring actuation units shall be constructed and attached in such a way that it is not possible for them to be dismantled or removed without first releasing the spring to its fully extended position. Provision shall be made to allow internal inspection of the spring unit (e.g. by borescope), without dismantling.

The internal part of actuators shall be protected against corrosion from atmosphere and actuator power fluid and fully sealed to prevent corrosive fluid to enter.

10.5.3 Pneumatic Actuator

For valves in emergency or critical service, the trip SOV shall be energised to open air supply to the actuator, allowing the valve to move from the fail-safe position. On de-energisation of the trip SOV, air shall be vented from the actuator to allow the valve to move to the fail-safe position. In general, this functional philosophy shall also be applied to valves in general service, except where a fail-in-last-position (FL) is required.

Actuators using instrument air shall be sized based on a minimum air pressure of 4.5 kg/cm2. Actuators requiring an instrument air supply pressure above 4.5 kg/cm2 shall not be used unless approved by COMPANY.

To achieve the required stroking speed on trip, first choice shall be use of a trip SOV with adequate capacity (Cv). If this is not practical, volume boosters or, where there is no PST facility, quick-exhaust valves shall be included in the hook-up assembly.

Ancillary pneumatic components, except for positioners, shall be mounted on a backing plate attached directly to the actuator, unless high vibration conditions require them to be separately mounted. If separate mounting is proposed, VENDOR shall specify the maximum distance (tubing length) that can be used while still maintaining specified performance. This tubing length shall be used for FAT.

10.5.4 Hydraulic Actuator

For valves in emergency or critical service, the trip SOV shall be energised to open the oil supply to the actuator, allowing the valve to move from the fail-safe position. On de-energisation of the trip SOV, oil shall be returned from the actuator to the reservoir to allow the valve to move to the fail-safe position.

Actuators shall be sized based on the minimum fluid supply pressure specified in the data sheets.

To achieve the required stroking speed on trip, first choice shall be use of a trip SOV with adequate capacity (Cv). If this is not practical, hydraulic pilot valves shall be included in the hook-up assembly.

Ancillary hydraulic components, except for positioners, shall be mounted on a backing plate attached directly to the actuator, unless high vibration conditions require them to be separately mounted. If separate mounting

is proposed, VENDOR shall specify the maximum distance (tubing length) that can be used while still maintaining specified performance. This tubing length shall be used for FAT.

10.5.5 Electro-Hydraulic Actuator

The Electro-Hydraulic Actuator package shall comprise a hydraulic actuator, as described in 10.5.1, 10.5.2, 10.5.4, and an electrically-powered Hydraulic Power Unit (HPU). The HPU may be integral with the actuator assembly or separately mounted local to the valve.

The HPU shall be a self-contained unit containing all the elements necessary to maintain a reliable supply of hydraulic fluid to the actuator, including filters, pumps, reservoir, accumulator, gauges and controls. For critical functions, dual-redundant pumps shall be supplied.

The hydraulic fluid shall be non-flammable hydraulic oil suitable for use over the entire temperature range specified for the installation.

Electro-hydraulic system and valve assembly shall be designed as mechanically and electrically failsafe.

The entire hydraulic system should be constructed of 316 stainless steel.

Unless specified otherwise, electrical power supply voltage for HPU shall be 415VAC, 50 Hz, 3 phase.

Each self-contained hydraulic unit shall include one or more accumulators with sufficient capacity to provide 3 cycles of the valve (i.e. 3 x (Open->Closed followed by Closed ->Open)). Accumulators shall be designed such that they can be recharged and maintained/removed online without shutdown.

Each E/H actuator shall have a manual hydraulic hand pump to operate the valve in case of loss of supply pressure.

Actuator/HPU package shall be capable of carrying out remotely-initiated PST, with valve signatures. Actuator oil pressure shall be available via 4-20 mA signal to ICSS and package shall communicate fault and status to ICSS via HART communication.

The operation switches, levers and push buttons on actuator local control panel shall have a protective cover with key locks to prevent unauthorised person access and operation switches accidental initiation.

10.5.6 Electric Motor Actuator

Electric motor actuators may be used for general service On/Off application where valve fail safe action is not required and slow stroking speed is acceptable.

The MOV actuator shall be supplied as a complete unit comprising of a motor, gearbox, integral reversible contactor starter, stall torque protection, integral control voltage transformer, over temperature protection, adjustable end of travel limiters, local valve position indication, torque switches, position switches and lockable local/off/remote selector. VENDOR shall be responsible for the mechanical compatibility and provision of the mechanical coupling between the valve and actuator.

Unless specified otherwise, MOV motor shall be reversible bi-directional and operate from 415V 50Hz three phase power supply. Control Voltage derived from main 415V power supply shall be available.

The drive from the motor to the valve shall be through a gear box which incorporates a clutch mechanism to allow manual operation of the valve via a handwheel.

All MOV shall have integral Starter with input power isolation functionality.

MOV shall provide following signals for interface with Station Control System:

i. Valve Open and Close Indication
ii. Valve Remote and Local Mode Indication
iii. Comprehensive Fault signal (inclusive of power failure)
iv. Ready Indication
v. Open, Close and Stop dry contact commands from Station Control System

If local controls (selector switch / push buttons) and local indication are not accessible due to the enclosure requirements, they shall be remote mounted. The remote panel shall be Ex-d / Ex-e in accordance with IEC 60079.

The motor shall be suitable for direct on-line starting and shall be capable of operating the valve under all specified conditions at 80% of the rated voltage on the terminals, without exceeding the permissible temperature rise in any part of the motor.

Protection against overheating of the motor must be an integral part of the motor. Actuators shall be suitable for S3 33%/S2 15 min duty (as defined in IEC 60034-1) at the maximum specified ambient temperature.

In the event of electrical failure, the valve/actuator shall 'stay put'. Correction of electrical fault shall not restore the motor drive without an operator reset.

The actuator, all equipment and components shall be easily accessible for maintenance and shall have facilities to permit replacement in situ.

Control electronics shall be segregated from the compartment containing power cables for the valve motor.

10.5.7 Gas Over Oil Hydraulic Actuator

Gas-Over-Oil actuators may be used for block valves on gas pipelines and for on/off valves inside compressor stations where instrument air is not available.

The gas supply to actuator shall be derived from gas pipeline on which valve is installed. A gas filter shall be provided on actuator at power gas supply inlet. Actuator power gas supply lines connections from upstream and downstream of the valve shall be provided. Selection of highest power gas supply pressure either from upstream or downstream supply line shall be selected automatically by necessary valving arrangement inside actuator control panel. Power gas supply connections on actuator control panel should be 1/2 inch NPT (F).

The remote opening and closing of the valve is achieved by actuation of solenoid valves on actuator, which in turn supply gas pressure to hydraulic system to operate the valve. The actuator control scheme shall be such that there will be no continuous gas bleeding when valve is stationary. The solenoid valves shall be provided with levers for local open and close manual operation. The solenoid valves and all control components shall be mounted in a padlocked enclosure. At site, the vent gas from solenoid valves shall be tubed to a minimum height of three meters away from the actuator.

The actuator shall be double acting type for gas pipeline valves and single acting spring return type for compressor station valves.

A gas accumulator vessel integral to valve actuator shall be provided to allow three valve strokes in case of power gas supply failure. Accumulator design shall be according to ASME Sec. VIII Div.1 and "U" stamped. Safety relief valve on accumulator shall be sized as per API RP 520.

The entire actuator assembly with accumulator shall be designed for pipeline maximum design pressure.

Actuators on pipeline valves shall be provided with three limit switches for open, intermediate and close valve position indication. Actuators on compressor station valves shall be provided with 2 limit switches for open

and close position indication. The limit switches shall be NAMUR inductive proximity type and intrinsically safe.

The actuator shall be provided with a mechanical locking arrangement to carry out testing at site (with the valves in the safe position). The locking arrangement shall be such that accidental actuation causing valve movement from its safe position is not possible. This locking device shall be clearly visible when installed. The locking device shall be designed to withstand the closing force of the actuator with the maximum specified hydraulic pressure applied.

A local/remote (2 positions) electrical selector switch shall be provided on actuator for maintenance purpose so that in the “local” position, remote operation shall be disabled. The “remote” position shall be padlocked.

In case of no pressure source available, manual operation of valve shall be possible by means hand operated hydraulic pump.

The actuator mounting on the valve shall be in accordance with ISO 12490.

Valve closing/opening stroking time shall be based on Pipeline surge analysis and safety requirements.

It shall be also possible to operate actuator by means of nitrogen bottles instead of pipeline gas. VENDOR shall furnish nitrogen bottles sizing based on actuator volume and number of stroke requirements.

10.6 Sour Service

If sour service is specified, NACE MR0175/ISO 15156 and NACE MR0103 sour service design and material shall apply to the valve (but not to the gaskets). Carbon steel flanges shall be normalized.

Pressure-retaining bolting (even if not directly exposed to the process fluid) shall comply with NACE MR0175. Tubing in the valve assembly shall be alloy 825 and all fittings shall be SS 316 double ferrule type compression fittings.

10.7 Functional Requirements

ESD and On/Off valve solenoid valves shall be designed as normally energised. Valve shutdown command shall de-energise solenoid to drive valve to fail safe position.

Pipeline Block Valve Open & Close solenoids shall be designed as normally de-energised. During block valve stroking (open to close or vice versa) the respective solenoid valve will be kept energised till valve reach fully open/ fully close position and then de-energised.

Reset for ESD and EBD valves will be from OWS. There will be no field reset.

Refer to Appendices for typical ESD and On/Off valves control schematics.

A summary of typical control functionality required for remotely actuated valves is as follows:

Causes	ESDV/ EBDV	Inventory Isolation Valves	MOV	Pipeline Block Valve
Control signal failure action (1)	Close	(5)	Stay last	Stay last
Actuator motive fluid failure action	Close	(5)	Stay last	Stay last
Reset after ESD (2)	Yes	No	No	No
Open remote control	Yes (3)	Yes	Yes	Yes

Close remote control	No	Yes	Yes	Yes
Open/Close local facility	No	(4)	Yes	Yes
Partial stroke facility	Yes	No	No	No
Solenoid signal test facility	Yes	(4)	No	Yes

Table notes:

(1) Control signal means electrical signal from control room.
(2) Reset from control room rather than locally.
(3) After Reset of ESD safety logic from OWS.
(4) If requirement specified in Purchase data sheet
(5) As per valve data sheet

10.8 Actuator Sizing

VENDOR shall be responsible for correctly sizing the actuators based on process conditions, open/close stroking time and valve torque requirements. The actuator type shall be as specified in valve data sheet.

The VENDOR shall size actuator for maximum torque required to operate the valve when subject to the conditions with full design pressure differential and the worst-case design temperature. Refer to the data sheet for the valve design data

Unless otherwise specified on the valve data sheet the actuator shall be capable of opening the valve with the maximum possible differential pressure across the valve at the maximum operating pressure and temperature and within opening time specified, and of closing the valve from the open position with maximum operating pressure in the valve within the closing time specified. Opening time is not generally critical relevant for ESD valves.

Vendor shall submit the torque calculations and torque tables detailing start/run/end torque value for the valves and actuators demonstrating compliance to the safety factor. Values of Stem shear torque and torque generated at maximum supply pressure shall also be included in the tabulation. Tensile stresses in the drive train components, including stem extensions, shall not exceed 67% of the specified minimum yield strength (SMYS) when delivering the design torque. Shear, torsion, and bearing stresses shall not exceed the limits specified in ASME Code Section VIII, Division 2. The drive train shall be designed such that the weakest component is outside the pressure boundary.

10.9 SIL Requirements

ESD valves are part of safety instrument system as defined in IEC 61511.

ESD/EBD valve, actuator and all ancillaries that form part of the trip chain to open/close the valves shall be certified, a minimum, to be suitable for use in functions up to the SIL rating specified in valve data sheet. VENDOR shall provide certificates from a certifying body acceptable to COMPANY (e,g TÜV, exida). Individual SIL certificates for valve, actuator, SOV and any additional components (volume boosters, QEVs, etc.) shall be provided.

Initial SIL Verification shall be based on assumptions specified by COMPANY (Test frequency, PST frequency, test procedures, Site Safety Index). If the target SIL, of the SIF, in which the valve is a component, is not achieved, CONTRACTOR shall propose alternatives to achieve the target SIL. The method adopted shall be subject to COMPANY approval.

11. PAINTING

Painting shall be to Project/respective Operating Group standard. VENDOR shall provide their painting procedure for in line with COMPANY standards for approval prior to painting. VENDOR shall ensure paint specification is suitable for the environment the valve shall be mounted. The paint colours for the valve and actuator shall be approved by COMPANY. VENDOR may be referred to ADNOC Group painting specification for alignment.

Corrosion due to condensation inside the actuator housing power unit and spring module shall be prevented by using protective coatings and compounds or corrosion resistant materials.

12. VALVE IDENTIFICATION

Each valve assembly shall bear corrosion resistant SS tag plate riveted to the instrument. Engraved lettering height shall be minimum 2 mm and location of the plate shall permit easy viewing.

The following minimum information shall be clearly and deeply stamped or engraved on the plate(s).

a) On the Valve:

i. Tag Number as per the data sheet
ii. Manufacturer's name and valve model number, Serial Number and the month and year of manufacture.
iii. Relevant codes and standards
iv. Body Size and End connection detail
v. Valve rating (MAWP)
vi. Port Size
vii. Material body and internals exposed to the process fluid)
viii. Relevant Purchaser process data
ix. Maximum Gross Weight
x. Action on air supply and/or signal failure

b) On the Actuator:

i. Actuator bench setting
ii. Maximum / minimum supply pressure
iii. Maximum travel
iv. Failure position

c) On Hydraulic Actuator systems.

SS tags & description on every item / component on the Hydraulic Panel / Assembly

i. Manufacturer's model number, Serial Number and the month and year of manufacture.
ii. Input Signal
iii. Output signal
iv. IP or NEMA class marking as well as hazardous area certification mark where applicable.
v. Supply pressure

All electrical accessories such as solenoid valves and limit switches shall be clearly identified with their electrical protection type.

The direction of flow, the valve body rating, the body material and, flow direction shall be clearly indicated by a permanent mark cast in or stamped on the valve body, not painted.

13. ADDITIONAL SPECIFIC REQUIREMENTS

None

SECTION C

14. SCOPE OF SUPPLY

The VENDOR will supply valves and accessories as stated in the purchase order and detailed in the data sheets. The equipment provided shall meet the technical requirements of this specification.

The VENDOR's scope of supply will include and not be limited to:

i. Valves and accessories as stated in the purchase order.
ii. Data sheets and sizing calculations
iii. SIL Certificates
iv. Hazardous area certificates
v. Fugitive emissions testing
vi. Actuator functional test
vii. Valve stroking time test
viii. List of exceptions and non-compliance
ix. Catalogue details of provided equipment
x. Manufactures Record Book and material certificates
xi. Operation and Maintenance manuals
xii. Safety Manual
xiii. Inspection and Test plan
xiv. FAT and all required inspection and test services at VENDOR's facility
xv. Valve signatures for benchmarking valve performance
xvi. Spare parts as detailed in the purchase order
xvii. Special test equipment such as HART communicator
xviii. Packing and preservation
xix. Weights and dimensions of cases for shipping
xx. Warranty and guarantee

15. QUALITY CONTROL AND ASSURANCE

Equipment shall only be purchased from VENDOR'S approved by ADNOC Category Management. This approval indicates that the VENDOR has an approved Quality management system and a proven track record in supply of this equipment type.

VENDOR shall submit a quality plan for approval by COMPANY.

16. CERTIFICATIONS

Material test certification requirement shall be as per EN 10204, 3.2 for valve wetted parts and inspection documents type shall be in accordance with EN 10204 class I. Bolting shall be certified to level 2.2

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VENDOR shall provide all hazardous area certificates and SIL certificates for ESD and EBD Valves.

17. INSPECTION & TESTING REQUIREMENTS

17.1 General

Prior to the start of valve manufacture, an Inspection and Test Plan) ITP shall be submitted for approval by COMPANY.

The ITP shall include all inspection and test activities to be performed, including those at SUBVENDORS works.

All valves shall be tested as per ADNOC specification AGES-SP-09-003 Piping & Pipeline Valves Specification as a minimum.

17.2 Materials

Material test certificates in accordance with EN 10204 shall be provided as follows:

Components	Certificate Type
Other wetted parts and bolting	2.2
Body, Bonnet, Stem and Closure Members for General Service valves	3.1
Body, Bonnet, Stem and Closure Members for Critical Service valves (Note 1)	3.2

Note 1: Critical Service is defined as: ESD, EBD, Inventory Isolation, Pipeline Block, and any general service valves that have been rated functionally critical.

Documents shall be validated in accordance with EN 10204.

17.3 Shop Inspection Access

COMPANY and COMPANY/CONTRACTOR appointed TPI shall at all times have access to the VENDOR and any SUBVENDOR facility engaged in providing material or supplying equipment in the scope of this purchase order for the purpose of inspecting the materials and equipment.

17.4 Factory Acceptance Test

The FAT will evaluate each fully assembled valve to verify that it is built and operating as per the technical requirements of this specification. The FAT procedure will be provided by VENDOR and approved by COMPANY.

All valves together with accessories shall be subjected to the following checks and tests as a minimum:

i. Dimensional and flange face finish check

ii. Visual inspection
iii. Hydrostatic test
iv. Performance and mechanical operation test

The following tests will be executed if specified in the purchase order.

i. Seat leakage test
ii. Capacity test
iii. Low temperature or cryogenic test
iv. Fugitive emissions leakage test

17.5 Dimensional and Flange Face Finish Check

The face-to-face dimensions of flanged valves shall be as given in the relevant standard cited in AGES-SP-09-003

All dimensions (including overall height) shall be as shown on the VENDOR'S drawings.

The flange face finish shall be in accordance with ASME B16.5 or as specified by COMPANY.

17.6 Visual Inspection

The visual inspection is a mandatory test which shall be performed on all valves. It is intended to ensure that all accessories are assembled and identified correctly. The paint finish is also checked.

17.7 Hydrostatic Test

Valves shall be hydrostatically tested in accordance with IEC 60534-4. Valves shall be flushed and drained immediately after testing and thoroughly dried with compressed air immediately after draining.

The water quality shall be clean potable water of a natural pH value, clear and free of sulphides. Water containing up to 200 mg/kg chlorides, temperature not to exceed 50ºC, may be used for the pressure test with the following exceptions:

The valves shall be flushed with condensate or demineralised water (chloride content of < 2 mg/kg (2 ppmw)) immediately after the hydro test.

The duration of the hydrostatic test shall be based on Table 2 in IEC 60534-4 unless alternative durations are advised by COMPANY.

17.8 Seat Leakage

The seat leakage test shall be in accordance with the requirements set out in 10.2

The seat leakage test procedures shall be executed for all ESD, EBD, Inventory Isolation and critical service valves.

Testing shall be carried out in accordance with ISO 5208

For each valve tested, the VENDOR will state the following data:

i. Flow direction;
ii. Test medium;
iii. Test differential pressure;

iv. Duration of test;
v. Seat leakage flow rate measured;
vi. Allowable seat leakage flow rate; and
vii. Seat leakage class, ISO 5208 (if applicable).

During the seat leakage test no adjustments shall be made to the actuator/body/bonnet. After the seat leakage test no adjustments shall be made to the actuator/body/bonnet unless the valve is to be retested.

17.9 Fugitive Emission Test

Fugitive emissions seal leakage for valves in hydrocarbon service shall be certified as per ISO 15848. Where fugitive emission tests are specified in the data sheets, valves shall be subjected to type tests and production tests in accordance with ISO 15848 Part 1 and Part 2 respectively and test reports shall be provided for all valves and shall meet:

i. Class BM for quarter turn valves
ii. Class CM for rising stem valves

For hydrogen service these requirements shall be:

i. Class BH for quarter turn valves
ii. Class CH for rising stem valves

Fugitive emission test procedure shall be submitted for COMPANY review/approval.

COMPANY can specify different fugitive emissions specification depending on local UAE regulations.

17.10 Performance and Mechanical Operation

The valve shall be completely assembled and fitted with all accessories. The packing box shall be correctly packed to the tightness as needed for the hydrostatic test (if necessary, packing shall be renewed after testing).

The performance and mechanical test shall include a stroking time test.

The actuating medium for the tests shall be clean, dry air or nitrogen at a supply pressure of 4.5 kg/cm^2, unless otherwise specified. Where filter regulator is included in the assembly, the test shall be repeated with a supply pressure of 8 kg/cm^2 to the regulator.

For each valve the stroking time at the specified air pressures shall comply with the requirement specified in the data sheets.

If the valve is equipped with a handwheel, the fully open and closed position of the valve shall be achieved with handwheel operation, taking over from actuator starting at mid-position.

If the valve is equipped with limit switches, they shall be checked for functional operation.

The Inspection and test plan shall be developed and agreed with COMPANY prior to inspection and testing activities and subsequent notification and approving authorities are decided.

17.11 Functional Tests (tests where applicable per valve type)

Functional testing of the valve and actuator shall include, but not be limited to, the following:

i. Actuator operation: cycle (open/close) each valve with its actuator at least five times.
ii. Verify: opening and closing times; that valve position coincides with position indicator, and limit switches.
iii. Buffer Vessel capacity: cycle (open/close) each valve with its actuator three times.
iv. Operate valve using resets / overrides on solenoid valve (if such has been specified).
v. Simulate Partial Stroke Test (PST) by operating the valve utilizing the Partial Stroke Testing functionality and verify a subsequent ESD signal will override the PST and drive the valve to the fail-safe position.
vi. Hydraulic test of valve, at test pressure as per API 6D
vii. Air Seat test per C.3 of API 6D

The Inspection and Testing requirements for a Shutdown Valves shall include a witness test & inspection with a Factory Acceptance Test (FAT) and Site Acceptance Test (SAT) by Purchaser and/or Third Party Inspector. 100% of valves shall be inspected.

17.12 Test Procedures and Pre-test Documents

FAT and SAT procedures shall be submitted for Purchaser's approval, prior to witness inspection and tests.

Review of all Factory test certificates and test reports for Shutdown Valves shall be carried out for each unique type or model number.

The VENDOR shall submit the following Factory test certificates/ reports for Purchaser's review, prior to shipment or FAT, as applicable.

17.13 Material test certificates (all valves)

Testing and certification for valves shall be as per AGES-SP-09-003 Piping & Pipeline Valves Specification.

17.14 Actuator Tests (all valves)

Actuator tests shall include Differential Pressure Test, Rated Valve Travel and Stroking time tests. Actuator tests shall be performed with Instrument air or Nitrogen only for Pneumatic actuators.

17.15 Dimensional verification (all valves)

Face-to-Face and other Dimensional verification for each type and size shall be carried out using approved for construction drawings and relevant project documents (latest revisions) for reference. Flange face finish shall also be carried out.

18. SUBCONTRACTORS/SUBVENDORS

The list of SUB-CONTRACTORS, must be approved by COMPANY

The VENDOR shall assume unit responsibility and overall guarantee for the equipment package and associated equipment.

The VENDOR shall transmit all relevant purchase order documents including specifications to his SUBVENDORS and SUBCONTRACTORS.

It is the VENDOR'S responsibility to enforce all Purchase Order and Specification requirements on his SUBVENDORS and SUBCONTRACTORS.

The VENDOR shall submit all relevant SUBVENDOR and SUBCONTRACTOR drawings and engineering data to the CONTRACTOR.

The VENDOR shall obtain and transmit all SUBVENDOR and SUBCONTRACTORS warranties to the CONTRACTOR/COMPANY, in addition to the system warranty.

19. SPARE PARTS

A listing of recommended spare parts for Construction, Start-up/Commissioning and for two years operations shall be provided by the VENDOR and will be detailed in the purchase order.

Any spare parts for the valves used during the Warranty Period shall be replenished at the VENDOR'S expense.

The time scale and procedure for repair and/or replacement of parts shall be stated in the bid.

The VENDOR shall provide a priced listing of recommended special tools and spare parts for Start-Up, Construction and Commissioning and for two years operations.

The spare part lists shall detail:

i. Identifying model and/or figure number of the main equipment being quoted
ii. Part number and identification name
iii. Drawing or sketch number
iv. Source of the part. When a part is not manufactured by the VENDOR the original supplier's identification must be given
v. Price of spare parts
vi. The lead time for supplying additional spares shall be quoted, (e.g., ex. stock, 30 days, subject to quotation, etc.).
vii. SPIR (Spare parts Interchangeability record)

All spare parts shall be clearly marked and identified using a concise tag number.

Original spare parts shall be guaranteed available for a period of 15 years from the date of delivery.

VENDOR shall provide a list of all required testing and calibration equipment. COMPANY will decide which items shall be supplied to avoid duplication.

Spare parts shall be adequately protected and packaged to prevent deterioration of components during prolonged storage. See Painting Preservation & Shipment section.

20. PRESERVATION & SHIPMENT

20.1 Packing and Shipment

Preparation for shipment shall be in accordance with purchase order Preservation and Export Packing requirements. VENDOR shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and application, and to provide equipment at the destination in ex-works condition when handled by commercial carriers. Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite. Preparation for shipment and packing will be subject to inspection and rejection by COMPANY'S inspectors. All costs occasioned by such rejection shall be to the account of the VENDOR. Equipment shall be packed and securely anchored Bracing, supports, and rigging connections shall be provided to prevent damage during transit, lifting, or unloading. Separate, loose, and spare parts shall be completely boxed. Pieces of equipment and spare parts shall be identified by item number and service and marked with CONTRACTOR'S order number, tag number, and weight, both inside and outside of each individual package or container. A bill of material shall be enclosed in each package or

container of parts. One complete set of the installation, operation, and maintenance instructions shall be packed in the boxes or crates with equipment. This is in addition to the number called for in the Purchase Order.

20.2 Preservation and Storage

Equipment and materials shall be protected to withstand ocean transit and extended period of storage at the jobsite for a minimum period of 18 months. Equipment shall be protected to safeguard against all adverse environments, such as humidity, moisture, rain, dust, dirt, sand, mud, salt air, salt spray, and seawater. All equipment and material shall be preserved, and export packed in accordance with project specifications.

21. COMMISSIONING

21.1 Installation

If specified in purchase order VENDOR shall provide supervision assistance for installation and commissioning of valves at site.

21.2 Long Term Support

VENDOR must provide assurances that supplied equipment will not be obsolete in the next 15 years. In the belief that equipment will eventually be withdrawn from sale, a firm commitment by the VENDOR that for his standard products there will be either repair capability or equivalent parts and/or products available for a minimum of 15 years from the withdrawal date is required. VENDOR may be requested to provide a “roadmap” of equipment obsolescence.

VENDOR shall include comprehensive details of his support facilities for Abu Dhabi as part of the proposal. This shall include the location of support facilities, number and capabilities of service personnel, quantities and types of spare parts kept in inventory and the approximate turnaround time for repair of defective parts together with call out options.

22. TRAINING

VENDOR shall offer training courses covering installation, operation and maintenance of the subject valves. Requirement for these courses shall be defined in the purchase orders.

23. DOCUMENTATION/MANUFACTURER DATA RECORDS

The VENDOR shall submit proposed actuator control schematics and installation details as part of the tender process.

The VENDOR shall submit general arrangement drawings of valves along with actuator to the COMPANY/CONTRACTOR approval prior to assembly.

Document Title	Weeks after award	Required with Bid
Master Data and Document Register	2	N
Dimensional Outline Drawing	4	Y
Actuator Sizing Calculation	4	Y
Manufacturing Schedule	2	N

Document Title	Weeks after award	Required with Bid
Weld Map	6	N
General Catalog Information	4	Y
Instrument Data Sheet	4	N
Electrical Schematic Diagram	4	N
Wiring Diagram	8	N
Installation Operation & Maintenance Manual	8	N
Recommended Spare Parts List	16	Y
Performance Test Report	16	N
Electrical Certification	4	Y
Fire Safety Certification	12	N
SIL Certificate & Reliability Data	Included in Bid	Y
Material and Mill Certificate	16	N
Pneumatic - Hydraulic Schematic	8	N
Inspection Test Plan	4	Y
Factory Acceptance Test - FAT - Procedure	8	N
Fugitive Emission Test Procedure	8	N
Liquid Penetrant Test Procedure	8	N
Magnetic Particle Inspection Procedure	8	N
Positive Material Identification - PMI - Procedure	8	N
Pressure and Leak Test Procedure	8	N
Radiography Test Procedure	8	N
Seat Leak Test Procedure	8	N
Ultrasonic Test Procedure	8	N

Document Title	Weeks after award	Required with Bid
Weld Procedure Including Qualification (WPS - PQR)	4	N
Certificate of Compliance - Conformity	12	N
Instrument Certification	12	N
Factory Acceptance Test - FAT - Report	16	N
Fugitive Emission Test Report	16	N
Functional Test Report	16	N
Heat Treatment Test Report	16	N
Liquid Penetrant Test Report	16	N
Magnetic Particle Inspection Report	16	N
Material Test Report - MTR	16	N
Positive Material Identification - PMI Record	16	N
Pressure - Leak Test Record	16	N
Radiography Test Report	16	N
Seat Leak Test Report	16	N
Ultrasonic Test Report	16	N
3D Model File	4	N
Name Plate Detail	12	N
Progress Report	4	N
Bill of Materials	16	N
Manufacturing Data Book	When shipped	N
Product Safety Manual	8	N
Transport and Storage Instructions	8	N
Assembly and Disassembly procedures	With O&M Manual	N

Document Title	Weeks after award	Required with Bid
Lubrication requirements	With O&M Manual	N
Packaged weight	16	N

VENDOR shall submit the type of drawings and documentation for CONTRACTOR'S authorization or information as listed above.

Mutual agreement on scheduled submittal of drawings and engineering data shall be an integral part of any formal Purchase Order.

Comments made by CONTRACTOR on drawing submittal shall not relieve VENDOR or SUBVENDORS of any responsibility in meeting the requirements of the specifications. Such comments shall not be construed as permission to deviate from requirements of the Purchase Order unless specific and mutual agreement is reached and confirmed in writing.

Each drawing shall be provided with a block in the bottom right-hand corner incorporating the following information:

a. Official trade name of the VENDOR.

b. VENDOR'S drawing number.

c. Drawing title giving the description of contents whereby the drawing can be identified.

d. A symbol or letter indicating the latest issue or revision.

e. PO number and item tag numbers.

Revisions to drawing shall be identified with symbols adjacent to the alterations, a brief description in tabular form of each revision shall be given, and if applicable, the authority and date of the revision shall be listed. The term "Latest Revision" shall not be used.

In addition to the instruction in standard forms, the MANUFACTURER shall comply with the following additional requirements for Installations, Operating and Maintenance Manuals.

a. The front cover, spine and inside page shall state the purchase order number and MANUFACTURER'S reference number.

b. The inside front page shall carry an index listing the contents of each section of the manual.

c. Individual sections shall be completed and shall refer to the equipment actually supplied.

d. Published data shall also be included, including published data for bought-in items.

e. A punch list of "do's" and "don'ts" shall be included.

f. Full detail for installation setting up shall be included.

g. Recommended test data shall be stated, covering initial and also regular testing.

h. Items requiring regular inspection, checking, testing and maintenance shall be listed, and the time scale clearly indicated.

i. Important items shall be cross referenced to other part of the manual as necessary.

j. Fault finding/trouble shooting chapter shall be included

24. GUARANTEES AND WARRANTY

The VENDOR shall guarantee, in accordance with the general conditions, that the provided equipment shall meet the performance conditions specified in this specification, the purchase order, associated documents and Data Sheets.

The VENDOR will provide warranty services for a minimum period of 18 months from purchase date or 12 months after has been installed, whichever is later. The warranty services shall comprise any diagnostic services, on-site repairs or replacements, and technical support required to ensure that the control valves operate as specified during the defined warranty period and shall be provided at no additional cost to COMPANY

SECTION D

25. DATA SHEETS TEMPLATES

Valve Data Sheet to IEC 60534-7 Control Valve Data Sheet

26. STANDARD DRAWINGS

None

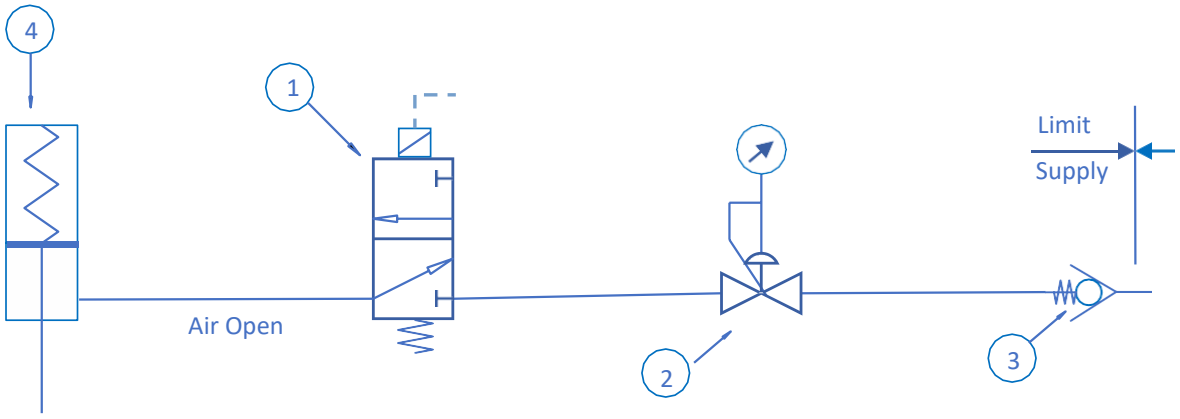
SECTION E - APPENDICES

APPENDIX 1 TYPICAL PNEUMATIC EMERGENCY AND CRITICAL VALVES

A1.1 ON/OFF & EMERGENCY VALVES 'TYPE 1' – 'FAIL CLOSED'

Single acting piston actuator

Electrical signal to open, fail close on loss of signal or loss of air pressure, no PST



① 3-way solenoid valve normally energised (de-energised to shutdown) 24V DC

② Filter regulator with pressure gauge

③ Check valve

④ Single acting actuator

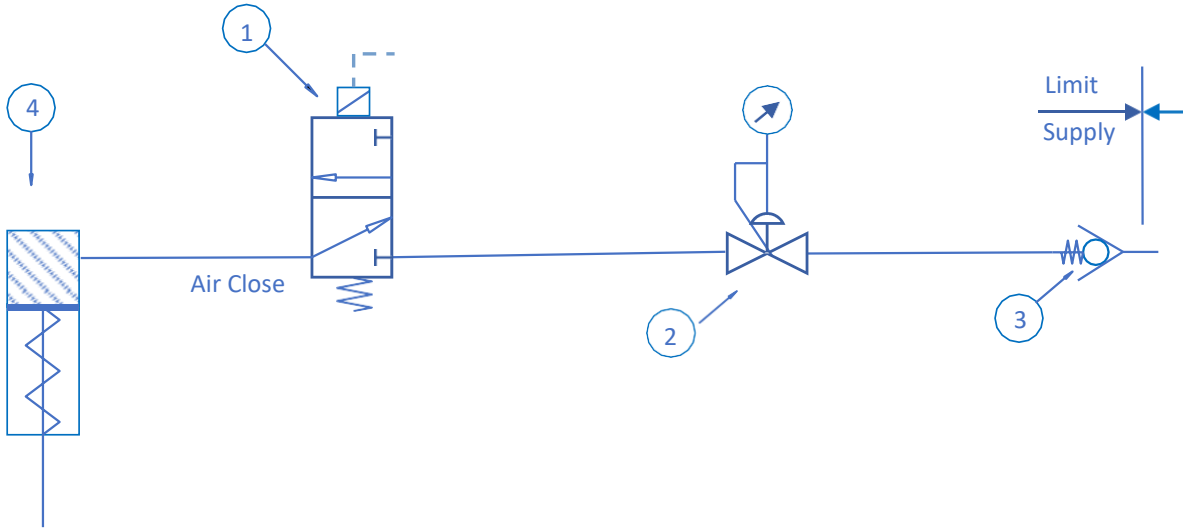
- - - Electrical

— Pneumatic

A1.2 ON/OFF & EMERGENCY VALVES 'TYPE2' – 'FAIL OPEN'

Single acting piston actuator

Electrical signal to close, fail open on loss of signal or loss of air pressure, no PST



① 3-way solenoid valve normally energised (de-energised to shutdown) 24V DC

② Filter regulator with pressure gauge

③ Check valve

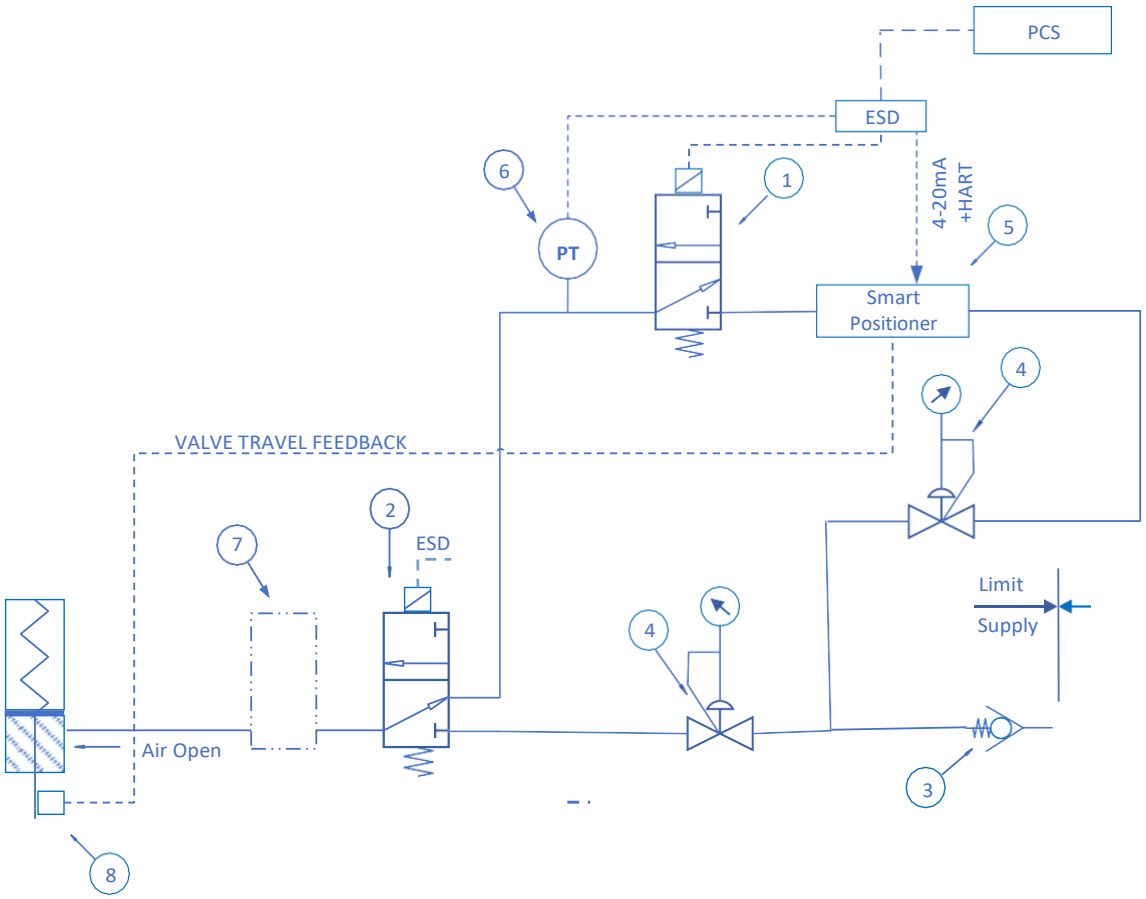
④ Single acting actuator

- - - Electrical

—— Pneumatic

A1.3 ON/OFF & EMERGENCY VALVES 'TYPE 3' – 'FAIL CLOSED' – WITH PST

A1.3.1 Hook-up Configuration



(1) 3 –port, 2-position SOV. Activated from ESD system; Normally de-energised, enables PST when energised

(2) 3 –port, 2-position SOV. Activated/tripped from ESD system ; Normally energised, trips ESD valve when de-energised

(3) Check valve

(4) Filter regulator with gauge(s)

(5) Smart valve positioner; controls PST testing

(6) Pressure Transmitter; used to confirm PST line-up before de-energising trip SOV (2)

(7) Volume booster (if required); provides increased air flow capacity

(8) Valve position feedback sensor.

A1.3.2 PST Interface Signals to ICSS

Component	Signal Function	Signal Type
SOV (1)	Energise to switch Trip SOV (2) vent connection from atmosphere to PST positioner	ESD SOV Digital Output
SOV (2)	De-energise to vent actuator and move valve to fail-safe position	ESD SOV Digital Output
Posiitioner (5)	Controls Initiation of PST	ESD Analogue Output (4-20 mA + HART)
Pressure Transmitter (6)	Pressure measurement to confirm line-up for start and end of PST	ESD Analogue Input (4-20 mA + HART)
'Open' Limit Switch (not shown on diagram)	Confirmation of valve 'Open' status	ESD Discrete Digital Input NAMUR Input
'Closed' Limit Switch (not shown on diagram)	Confirmation of valve 'Closed' status	ESD Discrete Digital Input NAMUR Input