TR0038 - Valve Actuators

Process area:	Project development (PD)
Owner:	
Author:	
Revision no:	5.02
Revision date:	01/04/2020
System:	
Competence:	Mechanical technology
Validity area:	

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1 Objective, target group and provision

1.1 Objective

The objective of this document is to define the technical requirements for actuators, control circuits and accumulators for remotely operated on/off valves.

1.2 Target group

The main target group for this document is actuator and valve suppliers; however personnel and contractors involved in project development of new onshore and offshore facilities or modification of existing facilities should also be familiar with the requirements in this document.

1.3 Provision

Provision is made in Management System (TR3010 Mechanical, Technical Requirements and Standards).

2 General requirements

2.1 General

The technical requirements contained in this specification are in addition to those defined by Purchaser in TR2000 “Piping and Valve Material Specification” and other referred standards and specifications.

This specification excludes requirements for the following actuator locations:

- Non-conventional pressure protection systems (TR1956).
- Surface Wellhead and Christmas Tree System (TR3540).
- Subsea Wellhead, Tree and Completion/Workover Equipment (TR3541).
- Large Valves in Pipeline Transportation Systems (TR1236).
- Control & Choke Valves (TR2212).

The minimum requirements herein are still applicable for the above excluded systems if the actuated valve is given an additional safety function to its original function in the process plant.

Selection of actuator type is Purchaser responsibility and is described in TR3032 Field Instrumentation. Any information applicable for purchaser’s consideration to select mode of actuation, space requirements (maintenance, material handling etc.) and the effect on weight and equipment stability shall be highlighted by supplier.

Actuator suppliers shall be accepted for use according to the list of approved suppliers located in TR2000 Piping and Valve Material Specification:

www.tr2000.net → Document Space → Valve Technology and Requirements

http://www.tr2000.net/TR2000/document_space/list_documents.jsp?document_id=57&opn=

2.2 Environmental data

The design temperature range shall be based on the ambient temperature range defined in the design basis for the applicable project/installation/plant. Unless otherwise specified, the atmosphere shall be considered humid and corrosive.

Supplier will be responsible for supplying equipment suitable for the above conditions.

3 Functional requirements

3.1 General

The Purchase Order (PO) shall define the selected valve design and details, as well as the functional requirements by pre-selecting the control circuit function and thereby also define the selected actuator type (single/double acting, hydraulic/pneumatic/electric).

The valve supplier shall have full responsibility for the design, construction and functionality of the valve-actuator assembly including all accessories, local control circuits and accumulators. The valve supplier shall in close liaison with the actuator supplier calculate and select the most suitable actuator and control circuit capacity that will satisfy the requirements set forth in the PO's.

Actuator failure mode shall ensure the correct valve position required for the safe operating condition.

Service life shall be minimum 20 years unless otherwise specified.

3.2 Valve operating speed

All actuated valves shall be equipped with adjustable speed setting components. For detailed requirements reference is made to section 5.8.

Typical response times that shall be complied with unless other requirements are specified:

- Time from activation to start execution, e.g. de-energized solenoid valve, shall be less than 2 seconds.
- PSD/ESD valve travel time (in service) at minimum operating hydraulic/pneumatic supply pressure shall not exceed 1 sec/inch (valve size), or maximum 45 seconds to reach safe state. For valves 8 inch or less, a typical travel time may be set to 8 seconds. Travelling speed when travelling from the predefined safe position shall be agreed between buyer and supplier.

The PSD/ESD travel time limit for the actuator is specified taking into account possible future wear etc, and may not correlate directly with overall safety system time requirements.

For valves that by size or design fail to meet the required speed, the Supplier shall notify the Purchaser about the limitations and seek alternative solutions together with the Purchaser.

The actuator shall be equipped with a "maximum speed device" fitted in the actuator housing with sufficient mechanical strength to withstand breakage. There shall be no tubing between the device and the actuator piston chamber. Unless otherwise specified, the maximum speed shall be limited to 0.5 sec/inch (valve size) in case of a physical breakage of tubing connected to the actuator. The "maximum speed device" shall not influence the valve in reaching its predefined safe position on demand. For valves smaller than 4" this requirement may be discussed with Purchaser and may be waived based on a Company approved Concession Request (CR). The evaluation of such a CR shall take into account possible water hammer in liquid pipeline systems.

3.3 Actuator selection and sizing

3.3.1 General

The dimensioning of the actuator shall be valve supplier's responsibility in close cooperation with the actuator supplier. A description of the required service application will be submitted in a Process Data Sheet (PDS). In addition, an Instrument Data Sheet (IDS) and a Valve Data Sheet (VDS) with referred attachments will be presented in the PO.

Typical information provided by Purchaser will be:
- Type and size of valve
- Type of actuator
- Line pressure
- Maximum service media differential pressure
- Operating temperature
- Type of fluid in the line
- Ambient temperature
- Pneumatic/hydraulic/electric power supply
- Opening/closing times

In addition the valve supplier shall include (obtained from actuator supplier if relevant) experience data such as:
- Valve stem size and packing design/compression
- Valve wear and degradation
- Relaxation of springs
- Increase of valve torque and thrust when the valve is stationary in one position during a prolonged period of time

3.3.2 Actuator sizing

Actuator selection and sizing shall be based on:
- Maximum service media system operating conditions. When using differential pressure situations due attention shall be given to pressure combinations, such as up-stream, down-stream, pressure in valve cavity, static pressure, effects from media flow, etc. (special attention shall be given to valves with double piston effect seat design where cavity pressure can reach 133% of DP).
- Hydraulic actuators shall be able to withstand the maximum supply pressure as defined in 5.2 (static). I.e. all parts of the actuator shall be able to tolerate the loads resulting from the specified pressure also in any of the end positions.
- The valve and actuator drive chains shall be able to tolerate the loads generated by the nominal hydraulic or pneumatic supply pressure (dynamic) as defined in 5.2, including the safety factor as defined in 3.3.3, without exceeding 90% of the yielding capacity of any part of the drive chain.
- Where the pneumatic actuator output load capacity exceeds the output required to operate the valve (including safety factor) the air filter regulator, as described in 5.5, can be set to reduce the air pressure to limit the strain on the drive chain. The filter regulator including the relief set point shall be adjusted to avoid higher stresses than 90% of the yielding capacity on any part of the drive chain. For hydraulic actuators such scenarios shall be clarified with Company and approved by Company in a CR..
- If valve stem material is modified from material specified on the VDS, this shall be approved by Company in a Concession Request (CR).
- The sizing of the actuator shall account for forces from a situation where the valve's closing member is prevented from free movement during a valve stroke. The drive chain shall be able to tolerate maximum actuator output as defined in this chapter.

Pressure reduction features shall be in accordance with ISO 12490 section 9.2.

For slab gate valves of the reverse acting type, the contributing closing force from the media pressure shall not be accounted for when dimensioning actuators. Any deviation to this requirement shall be approved by Company in a CR.

This capacity shall be available in a dimensioning fire situation and as a minimum with a spring temperature up to 100 ^{0}C.

Purchaser shall be informed about any limitations on the equipment that may be relevant for each application. This can typically be an order with a remotely mounted control panel/cabinet with no reference to the distance between control panel and actuator/valve. In such case it shall be the Supplier's responsibility to request additional information from Purchaser to ensure that the required capacity will be met. Unless otherwise specified, an average tube run distance of 15 meters shall be assumed. For dimensioning of hydraulic oil systems, a back-pressure of ten (10) bar g in the return line shall be used unless otherwise agreed between Purchaser and Supplier.

3.3.3 Safety factors for actuator output

To account for potential future increases in frictional loads in the valve the actuator output shall be calculated with an additional safety factor.

In general actuators for ESV, BDV and XV valves shall be dimensioned to provide an output with a minimum safety factor of 2.0. It is permitted that the safety factor for the travel to the non-safe position may be reduced to a minimum of 1.5 (e.g. for a spring/piston operated valve where the fail-safe travel is operated by the spring, the minimum safety factor for the piston displacement/spring charging shall be 1.5, whilst the spring movement shall maintain a minimum safety factor of 2.0).

All other valve actuators shall use a minimum safety factor of 1.5.

Safety factors for actuator output shall be calculated using the nominal supply pressure/voltage values as provided by the Purchaser. The safety factor shall also apply for springs through the complete valve stroke.

Purchaser may, for individual valves, require a different safety factor. The Supplier might also recommend a different value based on experience at the given service conditions. This shall be approved by Company in a CR.

3.4 Sizing of accumulators

"Fail open" or "fail close" mode of spring-less double-acting piston actuators shall be accomplished by the use of accumulators and switching valves. The accumulator capacity shall normally be sized for at least three (3) strokes of valve operations within full operating temperature range (including minimum temperature), starting at nominal operating pressure as defined in 5.2.

One stroke is the movement of the valve from open position to closed position or from closed to open.

At the end of the third stroke, the remaining accumulator pressure shall not be less than the minimum operation pressure as defined in 5.2.

For non-safety critical valves larger than 20", the stored power capacity may be reduced to 1.5 strokes. For this case, the accumulator gas expansions temperature drop has to be taken into consideration. Normally the pre-charge gas isothermic behaviour, at the lowest ambient temperature, has to be assumed. If the calculation shows that, after one actuator stroke, there is not sufficient power immediately available

for another half stroke, additional gas volume has to be included. The requirement for the available 1.5 stroke power is that after a theoretical 150 % travel, with the actual accumulator piston, the minimum pressure for valve closure is still available (ref. isothermal expansion).

'Non-safety critical valves' will be defined in the PO based on an evaluation where current authority regulations are taken into consideration.

4 Material requirements

4.1 General

Unless otherwise specified, all equipment shall withstand humid and corrosive atmosphere. Special conditions like e.g. severe condensation, sea water, fire water spray, steam and AFFF may be specified in PO.

General accessories such as nuts, bolts, indicator pins, etc., assembled in direct contact with stainless steel equipment, shall be in AISI 316 SS.

For electric actuators, alternative use of aluminium material grades may be accepted if the aluminium grade(s) is documented as a corrosion resistant material grade in marine and saline atmosphere. If any aluminium grade is used, a proper specification shall be established as described in section 11.3.6.

All welding shall be continuous and welding of stressed components shall be full penetration welds. When welding is applied onto components specified as 316 SS material, the material grade shall be AISI 316L.

4.2 Manufacturing records and traceability

The Manufacturing Records represents the Supplier's computer system / reference to calculations together with the necessary drawings, manufacturing, testing and inspection procedures, certifications, and non-conformance reports required to demonstrate that the product (actuator / accumulators / control circuit as applicable) is in compliance with all specified requirements.

The Manufacturing Records shall include: material certificates, relevant welding procedure specification and qualification, repair weld maps, NDE reports together with lists of welder and NDE operator qualifications and NDE procedures. Relevant fabrication drawings and sketches must be included to facilitate the understanding of welding, heat treatment and NDE records. There shall be traceability from the applicable item to all documents in the Manufacturing Records.

Manufacturing Records shall be stored for at least 10 years following the commencement of the guarantee period. Supplier shall be able to provide information in the Manufacturing Records, as defined above, when required by Company. On written request, Manufacturing Records documentation shall be provided within 15 working days.

Supplier is obliged to:

- offer the Manufacturing Record documentation free of charge to Purchaser
- submit the Manufacturing Record documentation to Purchaser if for any reason the Supplier ceases to operate
- notify Company prior to destruction of any manufacturing records

4.3 Actuators

Table 1 – Material requirements for actuators

Description of actuator part	Material selection/design requirements
Valve actuator cylinder:	Nodular cast iron/Carbon steel/AISI 316 SS
Actuator yoke housing:	Nodular cast iron/Carbon steel/AISI 316 SS
Actuator end covers:	Nodular cast iron/Carbon steel/AISI 316 SS
Act. yoke fork, rack & pinion:	Nodular cast iron/Carbon steel/AISI 316 SS
Actuator spring housing:	Nodular cast iron/Carbon steel/AISI 316 SS
Piston rods and shafts exposed to atmosphere:	SS 316 or min. 13% Cr 4% Ni stainless steel.
External tie rods, nuts and bolts with dia. ≤10 mm, stroke adjustment components and washers:	AISI 316 SS, Duplex SS or in material with equal or better corrosion resistance.
External nuts and bolts dia. larger than 10 mm:	Hot-dipped galvanized carbon steel to ASTM A153, AISI 316 SS, or Duplex SS or a material with equal or better corrosion resistance.
Adapter stool (connector between actuator and valve):	AISI 316 SS, Duplex SS or in material with equal or better corrosion resistance. Adapter stool in carbon steel are acceptable with the following requirements: o The adaptor stool shall be galvanized and painted. o Machining is acceptable on flange faces towards actuator and valve after galvanizing. o Machined surfaces shall as a minimum be painted. o It is acceptable to drill and thread holes after galvanizing. o The flange faces between actuator and valve shall be preserved with rust and corrosion preventive product like e.g. a black bituminous spray during assembly to preserve potential paint damages coming from assembling or operational movement between the parts
Coupling (connection between valve and actuator shafts):	SS 316 or min. 13% Cr 4% Ni stainless steel.
Actuator/valve connection bolts:	Carbon steel according to ASTM A193 B7/2H, hot dip galvanised to ASTM A153, or material with better corrosion resistance.
Brackets for limit switches, junction boxes and other ancillaries, support structures between actuator and valve:	AISI 316 SS
Grease nipples:	AISI 316 SS
Hand wheel for manual override	Hand wheels and handles shall be in stainless steel (minimum SS304/316) or hot dip galvanized carbon steel according to ISO 1461. Hand wheels or handles galvanized according to ISO 1461 shall be painted in accordance with requirements in section 10. Hand wheels made from machine pressed tin is not permitted.

Note : Duplex SS means UNS S31803/UNS S32205 or equivalent grades.

4.4 Pressure vessels

Accumulators: AISI 316 SS or carbon steel
Nitrogen bottles: According to BS 5045, Part 7
Air reservoirs: AISI 316 SS or carbon steel

4.5 Tagged instruments

Table 2 – Material requirements for tagged instruments

Description of tagged instrument part	Material selection/design requirements
Hydraulic solenoid/control valve body & coil housing:	AISI 316 SS
Pneumatic solenoid/control valve housing:	AISI 316 SS
Pneumatic solenoid/control valve solenoid coils:	Glass-fibre reinforced plastic housing/ AISI 316 SS
Limit switches and position transmitters:	AISI 316 SS
Accumulator piston position indicator (if mechanical):	AISI 316 SS
Valve position indicator:	AISI 316 SS/plastic

4.6 Instrument commodity items

Table 3 – Material requirements for commodity items

Item	Indoor and dry atmosphere or external non-saliferious atmosphere		External and saliferious atmosphere	
	Material	MDS	Material	MDS
Air filter regulators:	AISI 316 SS			
Instrument fittings:	AISI 316 SS	SF312	6Mo 25Cr Duplex Alloy C-276	SF712 DF212 NF608
Instrument manifolds:	AISI 316 SS			
Instrument valves:	AISI 316 SS			
Rupture discs:	AISI 316 SS			
Small relief valves:	AISI 316 SS			
Tubing:	AISI 316 SS	ST301	6Mo 25Cr Duplex Alloy C-276	ST701 DT201 NT603
Pressure indicators:	AISI 316 SS			
Booster:	AISI 316 SS			

4.7 Framework, cabinets and junction boxes

Framework for control circuits, Control circuit plate (min. 3 mm thickness), Protection shield along control circuit top, Cabinets for control circuits and Junction boxes: AISI 316L SS.

4.8 Static environmental seals

Soft seal material shall be suitable for the specified service conditions. O-rings shall be according to MDS PG301.

5 Instrumentation

5.1 General

All equipment shall comply with the requirements of the specific hazardous area in which they will be installed.

The equipment shall be certified for Zone 1, Gas Group IIA, and temperature class T3 as a minimum unless specified otherwise by Purchaser in PO.

Preferred protection methods are Ex (e), Ex (i), and Ex (m) in accordance with IEC 60079.
For field instruments like limit switches Ex (i) shall be used in maximum extent possible.
For junction boxes and glands Ex (e) shall be used in maximum extent possible.
For solenoid valves Ex (m) shall be used in maximum extent possible.

The minimum degree of protection provided by enclosures shall be IP 56 in accordance with IEC 60529.

Pneumatic/control valve solenoid coils shall be with completely encapsulated coil, screw terminals within terminal box and cable connection to be ISO metric, pitch 1.5 mm.

5.2 Supply utilities

Air supply
Unless otherwise specified by Purchaser the on/off valve application shall be designed and sized for the following:

- Minimum operating pressure: 5,5 bar g
- Nominal supply pressure: 7 bar g
- Maximum supply pressure: 12 bar g

Hydraulic supply
Unless otherwise specified by Purchaser, the hydraulic actuators, control systems and accumulators shall be designed and sized for:

- Minimum operating pressure: 160 bar g
- Nominal supply pressure: 200 bar g
- Maximum supply pressure: 210 bar g

Electrical supply
Purchaser shall specify the type of power supply for field instruments and electric actuators, including voltage, AC/DC, phase and frequency:

- Voltage tolerances: +/- 10%
- Frequency tolerances: +/- 5%

5.3 Signal types

The following signal types shall be the preferred choice for electrically hardwired field devices:

Table 4 – Signal types

Signal	Type
Analogue input	4 – 20 mA with HART protocol
Analogue output	4 – 20 mA with HART protocol
Digital input	Potential free contact Proximity switches with NAMUR interface according to IEC60947-5-6
Digital output	24 VDC

5.4 Condition and performance monitoring

Based upon request and input given by Purchaser, the assets shown in table 5 are required as part of the valve/actuator assembly in order to facilitate valve condition and performance monitoring (CPM). Purchaser shall provide the required CPM level for specific actuator tags and other necessary information in the PO.

Table 5 – Condition monitoring

Valve condition and performance monitoring (CPM) levels	Condition monitoring functions							
	Total Valve/Actuator Operation Time	Response time	Travel Time	Actuator power use	Partial stroke test	Instrument Diagnosis	Valve power need (torque/force)	Valve leakage detection
	Assets							
	Manual or Automatic Recording	Limit Switches/ Actuator Power Sensor/ Positioner		Built-in function	Built-in function	Strain Gauges	Through Valve Leakage Sensors	
1	x	N/A		N/A	N/A	N/A	N/A	
2	N/A	x		x	x	N/A	N/A	
3	N/A	x		x	x	x	x	

- CPM level 1: Simple measurement of valve operation time
- CPM level 2: Valves with electrical actuator or positioner with built-in measurement of response time, operating time and power consumption
- CPM level 3: Same as for CPM level 2, but in addition with valve force and valve leakage measurements

5.5 Air filter regulator

Air filter regulators shall be provided with integral relief valve and micron filter.

5.6 Limit switches

Limit switches shall for European locations be of inductive type with NAMUR interface according to IEC60947-5-6, for other locations be in accordance with PO requirements.

When limit switches are specified they should be fitted inside a combined switch house/junction box, complete with terminals. This should be mounted to the actuator or valve body for termination of flying leads according to section 5.7.5. The limit switches shall be installed on rigid AISI 316 SS steel fixing plates or brackets and shall be easily adjustable.

Flying leads from limit switch to junction box shall be physically protected by the design. If no other options are possible 316 SST tubing shall be used.

The limit switches shall be activated by the movement of the valve shaft or stem and shall switch at less than 5% of the movement of the respective limit.

Limit switches should have integral LED indication.

5.7 Mechanical details and workmanship

5.7.1 Design considerations

The technical design and arrangement of all equipment shall carefully consider the following:

- Wear resistance
- Protection against damage
- Protection against vibration
- Operability and serviceability

5.7.2 Work with tubing and compression fittings

5.7.2.1 General

The installation shall be done by skilled personnel who have participated in the applicable fitting manufacturer's training course or general tubing and compression fittings training course before they are allowed to work with tubing and compression fittings. A successful performance of the course shall be documented by a qualification certificate, which shall be accessible on request.

The make and type of fittings will be specified in the PO.

Instrument ball valves shall only be used for on/off operation.

Fire resistant, braided flexible hose connection between the tube and the actuator final fitting may be considered when there is risk of high vibration and shall be approved by Company.

Any loose items shall be put in a small plastic bag and fastened with ”strips” onto the equipment close to the applicable mounting position.

5.7.2.2 Hydraulic & Nitrogen services

For hydraulic applications, and N_2 services for hydraulics, compression tube fittings shall be used.

Threaded end fittings (without adapters) shall be to ISO 1179-2 with BSPP threads to ISO 228-1, sealing surface to DIN 3852, form A, utilising a bonded seal packing in 316 SS/PTFE or 316 SS/NBR (Explosive decompression proof if used in Nitrogen service).

All interface tube fittings shall be included in the equipment units and shall be plugged with suitable AISI 316 SS caps prior to shipment.

All parts of the assembly shall be thoroughly cleaned by mechanical means before any washing or flushing is attempted. All tube ends, ports in solenoids etc. shall be de-burred on the outside and inside and blown through with air before assembly.

5.7.2.3 Pneumatic service

For pneumatic systems NPT threaded connections (ASME B1.20.1 or B1.20.2M) shall be used.

All interface tube fittings shall be included in the equipment units and shall be plugged with suitable AISI 316 SS caps prior to shipment.

On NPT-threaded compression fitting, the sealing compound for process services and instrument air services shall be recommended by purchaser. The use of PTFE tape can be used upon Company acceptance.

5.7.3 Actuator – valve interface

The actuator interface to the valves shall preferably be standardised accepting different valve sizes according to ISO 5210 or ISO 5211. Actuators, adapters, connections and valves must be sufficiently strong and rigid to comply with the requirements in section 7.

Rotary type actuators shall use dowel pins or key for securing fixed position between actuator and valve.

5.7.4 Cable installation

Cable installation, termination and earthing shall comply with statutory regulations and applicable specifications (ref. TR3023 Electrical, instrument and telecommunication installations, offshore units and TR3024 Electrical, instrument and telecommunication installations, onshore plants).

5.7.5 Junction boxes

Junction boxes shall be complete with terminals suitable for 2.5 mm^2 cross section copper conductors, mounting rails, endplates etc. and with suitable earth continuity plate for the cable glands and thus the cable armouring/lead sheathing where applicable.

All cable entries shall preferably be in the bottom of the junction box. If this is not practical the sides can be used, if approved by Company. No cable entries are permitted at the top of the junction box. Unused penetrations shall be carefully plugged before shipment.

Threads for electrical glands shall be ISO metric; pitch 1.5 mm. Heat shrinking sleeves covering glands shall not be used. Glands of GRP shall not be used.

5.8 Actuator control circuits

5.8.1 General

The actuator control circuit represents the interface between different control/safety computer systems and the on/off valve. Schematic control circuits for hydraulic/pneumatic actuated valves are shown in App A and App B.
Control panels for the different circuit types shall be standardised in size, layout and mounting arrangement.

5.8.2 Design

5.8.2.1 General

Valve control panels for on/off valves should be of “compact” type, avoiding internal tubing and fittings. All accessories required for control of the actuator movement, such as hydraulic inlet filter, solenoid valves, manual valves, pressure gauges etc. shall be mounted on a control panel.

Hydraulic oil inlet and outlet ports shall be clearly marked "Oil Inlet" and "Oil Outlet", both on control panel and actuator. Isolation valves for supply and return lines shall be installed as close to the instrument as possible.

Hydraulic filter units to be used shall have a differential pressure indication without an automatic bypass function.

Pressure gauges shall indicate the internal pressure in the control unit.

5.8.2.2 Speed control

Devices for control of the speed in both directions shall be installed on the control unit as an integrated part. It shall not be possible to fully close the restrictors. The restrictors shall be easy to adjust during operation and shall include feasibility to car seal in any adjusted position.

5.8.2.3 Overpressure protection

Unless otherwise specified, a check valve shall be included in hydraulic circuit supply lines and pneumatic supply lines. For hydraulically operated valves this check valve will cause a trapped-in liquid volume in the actuator/control circuit. In case there will be a temperature rise in this liquid volume (due to external heat input) the pressure may exceed allowable limits. To avoid this, a combined check/pressure relief valve should be included. Alternatively, a small volume nitrogen accumulator (nitrogen cushion separated from the oil by a diaphragm) can be used.

5.8.2.4 Accumulator

Unless otherwise specified, accumulators and their protection devices shall be assembled as a part of the control circuit panel, to form a composite unit. If specified by Company they may also be required as independent units, depending on the space available. The vent outlets from bursting discs must be guided to a safe location.

5.8.2.5 Quick dump

Quick dump functionality may be considered when relevant to achieve necessary functional requirements, e.g. fast operating time. Such functionality involves assisting the control medium to be evacuated faster,

typically during fail-safe operation, and should be assessed in conjunction with the requirements for spring housing in section 7 as applicable.

5.8.2.6 Local reset function

All ESV actuators shall have a local mechanical or electrical reset function.

5.8.3 Mounting

Control circuits shall, unless otherwise specified, be fitted onto free-standing support structures or other fixed structures, i.e., with due attention made to conditions such as free line of sight to valve/actuator and vulnerability during major incidents (fire/explosion) and falling objects.

Control circuits that are fitted directly onto actuators shall only be selected when access and maintenance restrictions have been evaluated and concluded (by PO).

All mounting plates shall be protected by a shield along the top that completely covers all the control circuit components.

Nuts / bolts used for fastening components in the panel with fastening on the rear side of the panel shall be fixed to the mounting plate and not drop off the rear during removal of individual components for repair and maintenance.

Control circuits shall be mounted onto a plate (min. 3 mm thickness) supported by angle framework. All plate edges shall be rounded off to a minimum radius of 2 mm.

Control circuits for ESV valves and valves installed in saliferious atmospheres shall be mounted inside a cabinet with a quick-lock hinged door with door stop. The width of the door shall not exceed 800 mm. Drain plug(s) shall be provided in the cabinet base and plastic components shall not be used. When mounted directly onto valve/actuator it shall be prepared for subsequent fire insulation by others.

6 Electrical operation

6.1 Design

Each actuator shall have an individual performance test certificate stating the following recorded parameters: Maximum torque, maximum torque current, flash test voltage, output speed or operating time. The certificate shall also provide details of gear ratios and closing direction.

On/off valves with electrical actuators shall have the possibility for serial communication.

6.2 Electric motors

6.2.1 General

The electric motor shall be Class F insulated and rated for duty at an ambient temperature of + 40 deg C or specified maximum ambient, whichever is the highest, for a minimum of 15 minutes or twice the valve stroking time, whichever is the longest, and with an average load of 33 % of the maximum valve torque.

Electric motors shall be in accordance with the requirements in TR3122 Three phase cage induction motors, sections 2.1, 2.2, 3.3, and 3.5.

6.2.2 Testing

Testing of electric motors shall be performed in accordance with TR3122 section 5.2.

6.3 Torque and turns limitation

Torque shall at least be adjustable between the range 50% and 100% of rated torque. A torque sensing system shall allow sufficient torque during unseating and mid travel restarting. The number of turns shall be adjustable to suit the application.

6.4 Control facilities

The actuator shall have the possibility for the following modes of operation:
1. Remote electrically by signalling the actuator from the control system.
2. Local electrically by selecting local mode and operating pushbuttons on the actuator.
3. Local mechanically by releasing the electric motor via clutch and moving the actuator by a standard hand wheel installed on the gear.

The actuator shall have the following remote control modes with individual signal for each mode:
- Open, Close and Stop
- Open and closed position indication. Contacts shall be voltage free and possible to configure for Normally Open (NO) and Normally Closed (NC) mode.

6.5 Monitoring facilities

The following external monitoring shall be possible:
1) Local selector switch in Remote position
2) Actuator available for external control

Local position indicator shall be included.

6.6 Handwheels

Where handwheels are specified, they shall conform to the following:

- May be integral or attached by bolts or clamps
- Shall be of locking type with de-clutchable handwheel
- Engagement / disengagement shall be clearly indicated.

7 Mechanical requirements

7.1 General

The valve/actuator assembly shall be designed to avoid high component stresses, instability between valve and actuator, high deflections or other operational problems. The actuator shall be supported by the valve. Supporting shall not be by adjoining pipe or other external structures unless this is agreed between purchaser and supplier and included in the PO.

Junction- and limit-switch boxes, limit switches, position indicators and other ancillaries connected to actuators, adapters and accumulators shall use rugged and solid methods for attachment.

When the valve/actuator will be installed oriented horizontally the stem deflection shall be considered in the design and shall not be larger than 2% of the stem diameter, measured at the stem-coupling. Any spot check verification is to be agreed between purchaser and supplier and included in the PO.

All valve assemblies including the control circuits may be specified to withstand explosion loads and earthquake loads. Purchasers shall in the PO identify explosion load requirement by providing a Design Accidental Load Specification that will identify blast loads for the various areas of a plant.

Flexible hoses may be used subject to Company approval. Alternatively, hard tube shall be installed to allow safe operation due to relative movements of the actuator/accumulator during an explosion.

The actuator shall be provided with a local indicator showing the valve position at all times. Where fire protection shield is applicable, valve position shall be visible outside such protection. When a mechanical device/indicator is fitted, the Open and Closed position indication shall be permanent/engraved.

All components that will require adjustments (e.g. piston end-stops, limit switches) shall use threaded components for adjustment and locking.

Yoke and gear housings shall be completely weather proof. They shall be pre-lubricated for expected life and oil filled housings shall be filled to submerge all moving parts.

Whenever rotary or linear shafts enter into a closed compartment (e.g. piston rods, limit switch shafts) weather seals (lip-seal, O-ring) shall be fitted as flush as possible with the external surface. This is to avoid entry of water and dirt.

The equipment shall be designed so that water does not accumulate in pockets/depressions on the exterior, and is not trapped inside low-point volumes internally, causing corrosion. Drain facilities shall be included if this is not possible to avoid.

Spring housings and unpressurized parts of the piston cylinders shall be of closed design and not exposed to atmosphere internally. This can be achieved by sealing the housing or e.g. connecting to instrument air.

External tie-rods on cylinders and spring cartridges shall be arranged such that there will be a minimum distance between tie-rod and cylinder wall to enable adequate access for painting. The minimum distance shall be 3.5 mm for tie rods with a diameter smaller than 10mm and 5mm for tie rods with a diameter larger than 10mm.

The actuator shall be fitted with end stops that shall be adjusted so no damage is inflicted on the valve when it reaches its end stops.

7.2 Design of pressure retaining equipment

7.2.1 General

The specified design code shall be complied with fully, in addition to the requirements stated in regional requirements for applicable location.

Design, fabrication, inspection and testing of hydraulic and pneumatic accumulators (air reservoirs) and actuator cylinders shall be in accordance with EN 13445 and EN 14359.

The following alternative codes may be used if accepted by Company by CR:
- PD 5500 Unfired Fusion Welded Pressure Vessels
- ASME Boiler & Pressure Vessel Code, Section VIII, Division 1 or 2

Unless type approval exist, Supplier is responsible for obtaining the necessary verification from a recognised inspecting authority or organisation, for compliance with requirements in the applicable design code, with regard to:

- Design verification
- Construction and testing

Air reservoirs and nitrogen systems shall be equipped with a pressure indicator and a rupture disc overpressure safety device, designed according to ISO 4126-2 or equivalent. Rupture discs shall not face upwards and a safe gas outlet flow direction must be considered.

Multi-vessel accumulators shall be fitted with isolation valves to enable replacement of individual vessels without de-pressurising the complete unit.

Threaded connections shall be used and the wall thickness of piping/tubing shall conform to relevant maximum supply pressure and shall be calculated according to ASME B31.3

Hydraulic chambers shall have two ports located as far apart from each other as practicably possible (i.e. on opposing sides of the cylinder and towards the highest and lowest points) to allow for efficient flushing.

7.2.2 Hydraulic accumulator design

The hydraulic accumulators shall be of piston type, nitrogen charged, and mounted in vertical position. All accumulators shall be equipped with a directly mounted local piston position indicator of permanent magnet type. The upper and lower piston position limits, where proper function of the whole system is verified, shall be marked clearly on the accumulator/indicator.

When specified by Purchaser in PO for critical services etc., the accumulators shall be equipped with transmitters for continuous monitoring by the PCS system.

External nitrogen bottles, of standard size and material, according to design code BS 5045 Part 1, shall be included where applicable. The accumulator's nitrogen system shall be equipped with an easily operable nitrogen pre-charging arrangement. All valves in this service shall be of the soft seated type.

Multi-vessel accumulators shall be designed to allow 1/3 of the total number of accumulator units to be serviced with the remaining unit(s) in service.

For all accumulators pre-charge graphs shall be made showing the pre-charge pressure of nitrogen under different ambient temperatures. The graph shall cover the specified operating temperature range in steps of 5 ^{0}C. The graphs shall be a part of “Sizing and calculations” and a copy shall also be enclosed with the accumulators at delivery.

All nitrogen accumulators shall be delivered with wired-on AISI 316 SS tag plates giving information about pre-charge pressures at temperatures 0, 5, 10 & 15 ^{0}C.

Accumulators shall have max/min marking of piston position.

7.3 Springs

Spring and spring housing shall be designed paying careful attention to minimizing size and weight for each application.

The spring shall be designed to operate through design lifetime. A minimum of 70 % of the effective spring range shall be utilised.

Springs for fail safe actuators shall be designed for a 20 year life with a minimum of 2000 cycles with less than 5 % loss of output (extended position). Springs shall be able to be fully compressed for two weeks with the same output reduction.

Failure from fatigue shall not take place under the above conditions.

7.4 Adaptor stool

The adapter stool (connecting the actuator to the valve) shall be of a tubular design. Other designs may be accepted by Company subject to an approved CR.

A ribbed design, e.g. T-ribs, with significantly unequal strength in longitudinal and transverse planes is not acceptable.

Enclosed adaptor stools, and yoke and gear housings that may be pressurised by malfunction (e.g. gas leaking through stem seals), shall be protected by a means to relieve over-pressure. The feature shall ensure that any overpressure is relieved while no moisture is trapped inside. For open adaptor stool designs all components (including actuator components) exposed to atmosphere shall be SS 316 or with better corrosion resistance.

7.5 Fire protection

Passive fire protection will generally be done by others, but Supplier shall provide requested information enabling detailing of the necessary fire protection.

When fire protection is specified by Purchaser, Supplier shall include for this in the design and will normally require the following:

- The equipment shall be prepared for fitting of the necessary clips etc. for attachment of fire insulation in accordance with agreement between Purchaser and Supplier.
- Fire protection shields must be designed to allow easy access to control units (hinged hatches are acceptable) without removing a major part of the insulation.
- Control panels will typically be bolted on steel profiles positioned about 2000 mm above deck level, therefore the bottom side of the panels must have necessary protection against jet fire and explosion loads.
- Supplier shall provide all details required to ensure that the equipment, including all penetrations, can be installed without degrading the integrity of the explosion- and fire proofing of the equipment.
- Supplier shall provide all necessary certification of the explosion- and fire proofing design (including any hatches and penetrations) from a recognised certifying authority e.g. Lloyds or DNV.

7.6 Mechanical valve locking

When requested by Purchaser, certain valves shall be fitted with a mechanical locking device. This applies to any type of valve where the closing member may travel when the actuator is removed or the power to the actuator is disconnected.

Example: Gate valves with the stem oriented vertically. Unwanted gate movement may occur due to the weight of the stem/gate assembly or pressure inside valve/pipe may cause an opposite movement of the gate.

7.7 Lifting lugs and eyebolts

All valves, actuators and valve assemblies with a weight ranging from 25 to 200 kg shall, as a minimum, have an engineered solution for strapping and lifting the equipment.

All valves, actuators and valve assemblies with a weight >200kg shall have a permanently fitted lifting device fit for purpose.

The lifting devices are regarded as a part of the equipment and not a lifting appliance. A safety factor of 4 shall be used when designing the lifting devices. Documentation of the calculations shall be kept by the Supplier.

7.8 Gears

All shafts penetrating the housing shall be furnished with seals (o-ring, lip-seals), this to avoid ingress of water and foreign particles. The protection class shall be minimum EN 60529 IP 66

All gearboxes shall be completely filled with grease (type EP or equal) or heavy-duty gear oil, all moving parts to be submerged. Gearboxes to be equipped with one or more easily accessible injection fittings and weather proof vent connection, permitting easy packing in situ, and lubrication of rotating shafts penetrating the gearbox.

Ambient temperature range: - 20 ºC / + 60 ºC unless other environmental data is specified on purchase order (ambient temperature is independent of temperatures stated on VDS).

Material in housing shall be cast or fabricated steel. 316 SS (unpainted) and nodular cast iron may be accepted. External shafts shall be from minimum 13 Cr. steel or other equivalent stainless qualities. Stem protectors for rising stem valves shall be made from 316 SS. All external bolts, nuts, fittings, end-stop screws etc. shall be from 316 SS. Hot dip galvanized carbon steel (painted or unpainted) bolting are accepted for sizes above 12 mm. Worm gears/gear wheels shall be hardened steel or ductile iron with strength and hardness suitable for the service.

7.9 Handwheels and levers

Lever and handwheel mounting shall be double secured by a nut and an additional locking (e.g. locknut, nut and pin, nut and tab washer, nut and Loctite, etc.). Additionally, the following applies for handwheels:

- The maximum force of operation shall not exceed 250 N on the rim of the handwheel
- Maximum diameter of handwheels shall be 750 mm
- Shall be permanently marked "Open/Closed" with an arrow to indicate direction of rotation

8 Marking

8.1 Identification plates

8.1.1 Permanent identification plates

All actuators, and the control panels if they are separate, shall be provided with a permanent identification plate made of a corrosion proof material. All metallic components shall be made from AISI 316. The permanent identification plate shall be suitable for UV, grease, applicable temperature, and shall be designed to be clearly legible for the actuator design life. The permanent identification plate shall be securely fastened after coating is completed, located so that it is easily accessible. Possible rivets shall be in stainless steel, and use of wire is not acceptable. Marking on the permanent identification plate shall be clearly legible, and shall at least include the following information.

- Manufacturers name or trademark
- Valve/actuator tag number
- Actuator serial number
- Operating pressure/Voltage

- Stroke (signal/range)
- Failure mode
- Operating medium

8.1.2 Temporary identification plates

Unless otherwise stated in the purchase order the actuator shall in addition be supplied with a temporary identification plate of rustproof material with the following information clearly legible:
- PO Number
- PO Item Number

8.2 Tags and labels

8.2.1 Tag numbers

Tagging of all equipment, with service/operation description, shall be in accordance with Purchaser's requirements and shall cover tagging for operation, maintenance and identification. The tag numbers will also be reflected on the data sheets supplied by Purchaser in PO's.

Purchaser shall issue a complete tag list covering all instruments and equipment items included in each valve/actuator assembly (loop).

8.2.2 Tag labels

All tagged items, shall be equipped with a tag label to properly identify each of the components.

Tag labels shall be of stainless steel (excluding labels for junction/switch boxes and cables), and shall have a rectangular shape. Minimum size shall be 50 x 20 mm x 0.4 mm. Letter- / figure size shall be at least 10 mm. Stainless steel drive screws or stainless steel wire shall be the method of fastening the plates. Adhesives shall not be used.

In addition to the tag label described above there shall be an identical tag label made from Traffolyte located adjacent (above) to each tagged item. This is to identify the location when the tagged item is removed from its position.

8.2.3 Language on signs

Signs and service designations on actuators shall for operational and maintenance purposes be provided in the official local language of the country where the facilities are located. Dual language (Native and English) shall be used if the information is vital to personnel safety, i.e. it relates to the use of emergency equipment, or it contains warnings about hazards.

Other language requirements may be requested by Purchaser.

Standard name plates required by codes shall be in the English language.

8.2.4 Identification of junction boxes, switch boxes and cables

The tag numbers for junction boxes shall be engraved on white Traffolyte labels. The letters shall be in black colour with a minimum size of 10 mm. The labels shall be pasted to the cover of the box using a suitable adhesive, after the surface has been cleaned properly.

Identification sleeves for cables shall be of non-corroding type and fitted to each end of the cable, and shall be labelled with instrument tag number / terminal number as appropriate and specified by Purchaser.

9 Testing and cleaning requirements

9.1 General testing requirements

All equipment and individual parts shall be delivered fully tested, in accordance with these technical requirements, codes and data sheets, to guarantee the performance of the equipment.

The technical condition/ranges of all test equipment used for the different tests shall be capable of verifying all requirements specified within this document.

All test equipment shall hold a valid calibration certificate. Hydraulic test rigs and pneumatic supplies shall have sufficient capacity to meet the required performance of the valve assemblies and control circuits as defined by purchaser.

The medium used in the main (piping) valve shall be potable water with chloride content less than 30 ppm with added corrosion inhibitor to protect the valve internals. The valve shall be cleaned and dried after testing. Water shall not be used for valves that will be used in cryogenic service. Test medium for such valves shall be agreed with purchaser.

Hydraulic test equipment shall be cleaned to ISO 4406, class -/14/10 prior to any test. An electronic particle counter, or equivalent, with printout shall be used for documentation of the cleanliness level.

No Teflon tape or equal sealing material shall be used on test equipment.

The various tests can be combined where found advantageous and agreed with the Purchaser.

9.2 Functional tests

9.2.1 General

All units shall be individually subjected to a function test in accordance with specified requirements. These may be manufacturers standard tests (subject to Purchaser's approval), but tests shall satisfy the requirements defined herein.

- **Valve test** to verify leak, pressure, thrust/torque, etc.
- **Actuator test** to verify performance, static pressure test, internal/external leak test, cleanliness, etc.
- **Control Circuit test** to verify capacity, internal/external leak test, pressure test, function test, cleanliness etc.
- **Accumulator tests** (third part verification, if applicable), leak and pressure tests, cleanliness, etc.

9.2.2 Documents present at test stand

The following documents and drawings shall be present at function/factory acceptance tests:

- Purchaser’s Process Data Sheet
- Valve, Actuator and Control Circuit Dimensional Drawing
- Operating Diagram/Hook-Up Guidance for Control Circuits
- Test Procedures

The following documents shall be made available upon request:

- Purchaser’s Valve Data Sheet
- Actuator Sizing Calculations
- Accumulator Sizing/Capacity Calculations

- Valve Test Records/Certificates, (Torque/Thrust Figures)
- Actuator Test Records/Certificates, (Torque/Thrust Figures)
- Control Circuit Test Records/Certificates, (Leak/Static Pressure Test)
- Wiring Diagram, Limit Switches, Solenoids
- Test Rig Certificates, Cleanliness, Instrument Calibration Certificates
- Agreed Deviations
- Purchaser's Instrument Data Sheet
- Documentation of conformance with IEC61511 and IEC61508 for the complete valve assembly (e.g., FMEA, failure data, type approvals etc.).

9.2.3 Leak test - hydraulic control equipment

All applicable units (actuators, control systems, accumulators) shall be leak tested for a period of minimum 15 minutes after pressure stabilisation. A recorder shall be used. Test pressure shall be 110 % of maximum supply pressure.

Test-medium: Reference is made to 9.4.2.

Acceptance criteria: The system shall be considered approved when test-pressure decreases less than 0.5 bar/15 min and there are no visible leaks or sweating.

9.2.4 Leak test - Pneumatic control equipment

All applicable units (actuators, control systems, accumulators) shall be leak tested with a soapy solution, checking all fittings and connections. Test pressure shall be 110 % of maximum supply pressure.

Test-medium: Clean air or nitrogen.

Acceptance criteria: The units shall be considered acceptable when no leaks are found (bubble-tight).

9.2.5 Assembly tests - Adjustment settings

Thrust/torque verification, limit switch settings, dimensions, function, and identity shall be verified against relevant documents and drawings.

The test shall include adjustment/control of stroke/alignment of valve, actuator and limit switches. Correct operation of limit switches shall be verified.

The following tests shall be done unless otherwise agreed:
1. In the actuator/valve open position, the ZSH signal shall be positive. No signal shall be indicated from ZSL. In the actuator/valve closed position, the ZSL signal shall be positive. No signal shall be indicated from ZSH. Record results.
2. The assembly shall be stroked a minimum of 3 strokes for valves 14" and above and a minimum of 5 strokes for 12" and below to verify repeatability. Travelling time to be monitored and shall be on a steady level for the specified no of cycles to be accepted. Record results.

9.3 Factory Acceptance Tests (FAT)

9.3.1 General

All completed and assembled combinations of valve/actuator/control circuit/accumulator shall be tested as described below.

9.3.2 Control circuit and valve assembly verification.

Check manufacturers individual test records for the control circuit, actuator and bare stem valve. All tests as defined for the function tests shall be performed, utilising the dedicated control circuit to operate the valve-assembly. The test shall verify the performance of the assembly, and confirm the performance recorded during the FAT tests of the individual parts. The test shall also verify that the selected actuator will operate the valve at minimum actuator supply pressure, with maximum differential pressure across the valve.

1. Test 1 shall be performed with speed control valves in the fully open position. Apply maximum differential pressure across the valve (as agreed with purchaser to be dimensioning for the actuator sizing). The test shall include verification of the required valve torque/thrust with the maximum differential pressure across the valve. This may be done by recording the necessary pressure to operate the actuator and calculation of torque/trust (actuator internal friction to be considered). The obtained value shall be compared with the torque/thrust result from the bare stem valve test. No increase in torque/thrust shall be accepted. (If no bare stem test record is available, the test result shall be compared with the theoretical valve requirements used for actuator sizing). Record results and confirm the safety factor requirements as specified in 3.3.3.
2. Test 2 shall be performed with speed control valves in the fully open position. Repeat test 1 at minimum, normal and maximum supply pressure to control circuit/actuator. Record travelling times.
3. Close speed control valves fully and operate the valve open/close at normal actuator supply pressure. The valve shall complete the open/close stroke fully. Record travelling times.
4. Apply normal supply pressure to the control circuit and set speed control to suit travelling time requirements as defined in the Purchaser's IDS/PDS.
5. Verify fail safe operation of the valve/control circuit by simulating electric signal loss with the maximum differential pressure applied across the valve. This step is meant to verify the capability of the actuator to operate the valve to fail-safe position under the most onerous condition. For fail-safe close valves the obturator can be placed in the “start-to-close” (i.e. the point of travel where the obturator first starts to seal off the bore) position prior to the pressurization and subsequent signal loss.

9.3.3 Accumulators/reservoirs verification

Ensure the correct nitrogen pre-charge pressure (related to actual temperature) in the hydraulic accumulator prior to tests.

1. Set the valve in the "normal operating position" by pressurising the actuator/control circuit using normal supply pressure.
2. Isolate and disconnect the hydraulic/pneumatic supply.
3. Cycle the valve 3 or 1.5 strokes, depending on the valve type (ref. section 3.4), by energizing/de-energizing the control circuits solenoid valves as intended in the control circuit functional design. Record actuator/control circuit supply pressure at start and end of test as well as travelling times. All opening strokes shall be done with the specified maximum differential pressure across the valve.
4. Verify fail safe operation of the valve/control circuit as per 9.3.2 step 5 if applicable.

Acceptance criteria: Accumulator/reservoir pressure shall not fall below the stipulated minimum pressure after completion of the required test stroke cycles.

9.3.4 Electrical actuators

Electrical actuators shall be tested in accordance with ISO 12490 section 13.5. Verification of the power requirement and consumption shall be performed and documented.

9.4 Cleaning and flushing

9.4.1 General

All surfaces in contact with hydraulic oil shall be machined. Raw as-cast or forged surfaces are not permitted (cylinder end covers, pistons etc.).

Before shipment (after painting) all hydraulic equipment described in this document, including valve actuators, shall be flushed to a cleanliness level according to ISO 4406 class -/14/10 or better. Flushing shall be performed in accordance with a written flushing-procedure, conforming to requirements specified in NS 5910. Supplier shall purchase all hydraulic main components with a documented cleanliness level according to this standard. These components shall be by-passed during assembly system flushing, so as not to contaminate already cleaned components.

Storage, handling and assembly of the actuator parts shall be such to prevent any ingress of foreign material and pollution. The specified hydraulic oil shall be the only lubricant used during assembly of the hydraulic cylinder, piston, rod and seals.

An electronic particle counter, or equivalent, with printout shall be used for documentation of the cleanliness level.

Maximum allowed water content shall be less than 50 % of the relative saturation at + 20 ^{0}C.

The interface fittings between flushing equipment and equipment to be flushed shall conform to the specified project instrument tube-fittings for the control system. After completed flushing these fittings shall not be removed, but plugged by nominated instrument fittings, to maintain the cleanliness requirements. Labels shall be attached to these sealing fittings with the following text: "System flushed to ISO 4406, class -/14/10. Only to be removed by authorised personnel".

9.4.2 Hydraulic oil

Hydraulic oil type HYDRAWAY HVXA-15 LT, or equivalent compatible Company approved hydraulic oil shall be used for all tests and flushing.

In some applications synthetic hydraulic oil will be used. This will be specified by Purchaser in the PO.

10 Surface protection

10.1 General

All carbon steel components and surfaces exposed to the atmosphere shall be coated. All surface protection shall be according to TR0042.

10.2 Colours

The color codes for valves and actuators shall be according to TR0042.

Nitrogen bottles shall have the color green.

11 Documentation including Life Cycle Information (LCI)

11.1 General

Documentation shall be supplied in accordance with TR2381, TR0052 (applicable for project specific documentation) and additional requirements specified herein.

Documentation comprises Life Cycle Information (LCI) specified in TR2381 and Project Documentation specified herein. Project Documentation is documentation needed in the project phase in order to ensure correct quality of delivered valve assemblies. Project Documentation shall not be stored in SAP, and may be disposed by Purchaser when the valve assemblies have been taken into use.

The Supplier shall incorporate details of sub-supplier scope in their own documentation.

Company's acceptance of Supplier's documentation does not constitute approval in the sense that Company assumes responsibility for the correctness of the contents.

Documentation from actuator supplier shall not be modified or added new or different drawing frames as this will reduce readability of the documentation. If required, valve supplier logo, contractor logo and document numbering other than the numbering given by the actuator supplier shall be added on the original document format located on available free space or as an additional front page. Page numbering shall not be revised.

11.2 General requirements for all procedures

All procedures shall in a condensed and concise manner:

- Include the scope and purpose of the document.
- Include all Company specific requirements.
- Detail all relevant operations, checks and tests.
- Describe all precautions to be observed.
- Include relevant health warnings related to chemicals used etc.
- Include sub-suppliers data sheets.

Procedures shall be self-explanatory, avoid making reference to other support documents.

11.3 Supplier Information Requirement List (SIRL)

The Supplier Information Requirements List (SIRL) given below comprises documentation requirements additional to TR2381, and defines the scope of Project Documentation.

Submittal time shall be agreed with project.

Table 6 - Supplier Information Requirements List (SIRL)

Document description	**Project Documentaiton**
Supplier Master Information Register – (SMIR)	Y
Preliminary envelope dimensions	Y
Production Plan	Y
Quality Control Plans	Y
Tag – Document information	Y
Aluminium Specification	Y
Painting Procedure(s)	Y
Performance / functional test procedures and reports	Y
Mechanical Completion / Commissioning Dossier	Y

11.3.1 Supplier Master Information Register (SMIR)

SMIR shall give a detailed listing of indexes, drawings and documents with schedule for submittal. The SMIR should be in Excel format and shall be used and maintained by the Supplier. A different format may be used as long as all the columns in the template above are used.

11.3.2 Preliminary envelope dimensions

The document shall specify guaranteed maximum dimensions (tolerances typically + 0mm / - 50 mm). These dimensions will be used for space allocation in the piping 3D model design. Exact dimensions shall be confirmed on detail / cross sectional drawings (ref. TR2381 §5.248). Preliminary envelope dimensions may be provided in a tabulated manner or by issuing preliminary GA drawings containing maximum outer dimensions.

11.3.3 Production plan

The production plan shall contain the main production activities and shall include actual dates.

11.3.4 Quality Control Plans (QCP)

A separate Quality Control Plan (QCP) shall be made for each equipment design, but the various plans may be compiled into one document. The QCP shall include references to relevant documents including MDS. All applicable tests and inspections shall be included in the plan. The QCP shall make reference to acceptance criteria, and include witness (W), review (R) and hold (H) points.

11.3.5 Performance / functional test procedures and reports

The following performance / functional test procedures and reports are required:

- FAT including pressure testing

Test procedures shall include, but not be limited to:
- Description and sequence of tests to be conducted
- Responsibilities
- Equipment used (clamping, instrumentation, etc.)
- Test pressures
- Test duration
- Acceptance criteria
- Description of test documentation

For intelligent positioners with 4-20 mA input and HART or Fieldbus communication and diagnostic possibilities, a documented footprint/valve signature from the FAT shall be delivered electronically in a readable file format.

All performed tests shall be recorded, indicating the actual results/figures, and the records shall be presented upon request by Purchaser.

11.3.6 Aluminium specification

The specification shall include standard and grade, manufacturing and delivery condition, testing, NDT, certification, manufacturer(s), etc. The connection details to other components, to avoid possible galvanic corrosion, shall be described.

11.3.7 Painting procedure(s)

Coating Procedure Specification (CPS) shall be in accordance with TR0042, and shall cover all applicable coating systems.

11.4 Mechanical Completion / Commissioning Dossier

The mechanical completion (MC) dossier consists of a variety of documents presenting and verifying the hook-up and assembly of the actuated valves. Use of ProCoSys for data recording may be specified by Purchaser, compensation to be agreed.

11.5 Safety Integrity and Reliability Requirements

Safety Integrity and Reliability Requirements shall be as per TR2381 section 5.166.

12 Additional requirements

12.1 Definitions and abbreviations

12.1.1 Definitions

Prescribing definitions:

Shall (requirement)	Requirement strictly to be followed in order to conform to the document and from which no deviation is permitted, unless a deviation permit is approved.
Should (recommendation)	Indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

May	Indicates a course of action permissible within the limits of the document.
Can	Statements of possibility and capability, whether material, physical or causal.

Role definitions:

Company	ASA. Owner and the final recipient of the equipment who may delegate another agent as the purchaser of the equipment.
Purchaser	Owner or owner's agent, who issues the order and specification to vendor.
Manufacturer	Original manufacturer of the equipment.
Vendor/Supplier	Manufacturer or manufacturer's agent that supplies the equipment and is normally responsible for service support.

Other:

"Drive chain"	means all parts and components of a valve drive between the actuator and the valve's closing member, including the closing member and the actuator

12.1.2 Abbreviations

AFFF	Aqueous Film Forming Foam
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BDV	Blow Down Valve
BS	British Standard
BSPP	British Standard Pipe Parallel thread
CCR	Central Control Room
CPS	Coating Procedure Specification
CSDS	Coating System Data Sheet
CSO	Car Seal Open
CSC	Car Seal Close
CR	Concession Request
DNV	Det Norske Veritas
DP	Differential Pressure
ESD	Emergency Shut Down
ESV	Emergency Shutdown Valve
EPMS	Engineering Procurement Manufacturing Schedule
FAT	Factory Acceptance Test
FMEA	Failure Modes and Effects Analysis
GA	General Arrangement
GRP	Glass-Reinforced Plastic
HIPPS	High Integrity Pressure Protection System
HV	Hand Valve, actuated, controlled by PCS
HP	High Pressure
IDS	Instrument Data Sheet
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Organization for Standardization
LCI	Life Cycle Information

LED	Light-Emitting Diode
NACE	National Association of Corrosion Engineers
NDE	Non Destructive Examination
NEK	Norwegian Electrotechnical Committee
NPT	National Pipe Thread
NS	Norwegian Standard Association
OLF	The Norwegian Oil Industry Association
PED	Pressure Equipment Directive
PO	Purchase Order
PCS	Process Control System
PDS	Process Data Sheet
PSA	The Petroleum Safety Authority Norway
PSD	Process Shut Down
PQR	Procedure Qualification Report
QCP	Quality Control Plan
SAS	Safety and Automation System
SMIR	Supplier Master Information Register
SIRL	Supplier Information Requirement List
SPV	Simple Pressure Vessels
VDS	Valve Data Sheet
WPS	Welding Procedure Specification
XV	Process Shutdown Valve, controlled by PSD
ZSH	Position switch high
ZSL	Position switch low

12.2 Changes from previous version

Previous version (TR0038 ver. 5)		**New version (TR0038 ver. 5.01)**	
Sec.	**Affected text** ~~Removed text from previous version~~ Added text to previous version	**Sec.**	**Modification, reasoning and effect**
App G	Applicable for valves supplied to Mongstad	App G	Section numbers of App G are adjusted in compliance with section numbers of the main document. Requirements in App G are unchanged.

Previous version (TR0038 ver. 4)		**New version (TR0038 ver. 5)**	
Sec.	**Affected text** ~~Removed text from previous version~~ Added text to previous version	**Sec.**	**Modification, reasoning and effect**
2.2	Unless otherwise specified, the atmosphere shall be considered humid and corrosive. ~~Unless otherwise specified,~~ Supplier will be responsible	2.2	Moved to avoid over-specification. Potentially cost saving.

	for supplying equipment suitable for the above conditions.		
3.2	For valves 8 inch or less, a typical travel time may be set to ~~15~~ 8 seconds.	3.2	Changed to align with requirement for maximum travel time of 1 sec/inch (valve size).
3.3.2	Unless otherwise specified, an average tube run distance of 15 meters shall be assumed.	3.3.2	Added to avoid over-specification. Potentially cost saving.
3.4	~~Air reservoirs shall be able to be charged to the maximum air supply pressure requirement a leak free non-return valve.~~	3.4	Removed due to misalignment with control schematics.
4.1	~~Generally,~~ Unless otherwise specified, all equipment shall withstand humid and corrosive atmosphere.	4.1	Modified to avoid over-specification as per section 2.2.
4.1	~~Components in plastic (non-metallic) materials shall not be used (except solenoid coil and limit switch housings).~~	4.1	Removed due to discrepancy with Table 2 and to open up to use of plastic. Potentially cost saving.
4.1	~~All carbon steel components and surfaces exposed to the atmosphere shall be coated to the referred surface treatment standard in this document.~~	4.1	Moved to chapter 10 and modified to refer to TR0042.
4.3	External tie rods	4.3	Added to distinguish between internal and external tie rods. Potentially cost saving.
4.3	Carbon steel according to ASTM A193 B7/2H, hot dip galvanized to ASTM A153, or material with better corrosion resistance.	4.3	Added to open up for other acceptable bolt materials. Potentially cost saving.
4.4	Accumulators: AISI 316SS or carbon steel Air reservoirs: AISI 316SS or carbon steel	4.4	Added alternative material in open for cost saving.
4.6	Entire section - Table 3	4.6	Text re-arranged for clarity. Base case SS316 for all components. MDS added for alignment with other COMPANY documentation. Temperature requirements removed because not relevant.
5.4	New section.	5.4	Section added to include requirements for CPM in line with COMPANY maintenance policy.

5.4	Air filter regulators shall be provided with integral relief valve and micron filter. ~~If regulator supply pressure is lost, downstream air pressure shall be relieved.~~	5.5	Sentence removed because the necessary functionality is covered elsewhere.
5.6.2.1	~~Instrument valves shall be mounted in accordance with supplier recommendations where mounting position and contamination can affect the valve function.~~ Instrument ball valves shall only be used for on/off operation. ~~All instrument tubing shall be in metric size. The Supplier shall use preferred standard size but shall evaluate and advise if other outside diameters are required for any reason. The following instrument tubing outside diameters are preferred:~~ ~~10 mm, 16 mm, 20 mm and 25 mm~~	5.7.2.1	Text removed because of lack of value and covered by need for Purchaser specification.
5.6.2.2	~~Thread sizes shall be 1/4", 3/8", ½", ¾" or 1" unless there are specific requirements in PO's.~~ … ~~NPT threaded connections may be used when specifically requested by Purchaser. This may be inside plants where the same types of connections have been previously used.~~	5.7.2.2	Text removed because of lack of value and covered by need for Purchaser specification.
5.6.4	~~Purchaser will detail the requirements for cables in the PO.~~ … ~~Intrinsically safe (IS) circuits shall be coloured light blue and have Ex (i) type terminals. Ex (e) type terminals shall be used for all other circuits. All terminals shall accept conductors with 2.5 mm^2 cross section and be made using crimping pins.~~	5.7.4	Removed because of lack of value and outdated requirements.
5.7.1	~~The type of circuit design will be decided by Purchaser and specified in the PO. The control circuits shall be designed for easy maintenance at location.~~	5.8.1	Removed because it needs to be specified by Purchaser.
5.7.2.1	~~Constant internal leakage shall not be designed into a control system, especially solenoid- and hydraulic/pneumatic valves.~~	5.8.2.1	Removed because it has no value or is irrelevant.

	~~Oil-mist lubrication systems shall not be used unless required for special applications (gear motors etc.).~~ ~~Final layout arrangements proposed shall be confirmed and agreed by Company before fabrication.~~		
5.7.2.3	Quick dump functionality may be considered when relevant to achieve necessary functional requirements, e.g. fast operating time. Such functionality involves assisting the control medium to be evacuated faster, typically during fail-safe operation, and should be assessed in conjunction with the requirements for spring housing in section 7 as applicable. ~~For saline and corrosive atmosphere conditions the project/installation/plant shall consider features to recycle air/hydraulic fluid from the spring chamber back to the control system, or otherwise prevent humid air and moisture from moving in and out of the spring housing. Such features should be considered in conjunction with "quick dump" functionality of the actuator, and shall be specified in the PO.~~	5.8.2.5	Modified to align with policy for closed spring housings and avoid potential internal corrosion.
5.8.2.6	New section.	5.8.2.6	Requirement for local reset function added to align with Field Instrument policy.
5.7.3	~~All components required for controlling the movement of the hydraulic/pneumatic operated valves, such as solenoid valves, pilot valves, manual valves, pressure indicators, air filter regulators, junction boxes etc.,~~ Control circuits shall be mounted onto a plate (min. 3 mm thickness) supported by angle framework.	5.8.3	Modified for simplicity.
5.7.3	Control circuits for ESV valves and valves installed in ~~exposed areas~~ saliferious atmospheres shall be mounted inside a cabinet with a quick-lock hinged door with door stop.	5.8.3	Modified for clarity.
5.7.3	~~Direct access shall be provided for calibration and maintenance of all instruments. It shall be possible to remove individual components without~~	5.8.3	Removed because of lack of value.

	having to remove inter-connected components (N/A for “compact type”).		
6.1	**6.1 General** Requirements specified for electrical operation is default requirements. Other or additional requirements may be specified in the PO. The electric actuators may be considered used for "fail safe" applications based on final user evaluations. This shall then be stated in the PO.		Removed because of lack of value.
6.2	**6.2 Design** The electric actuator shall be one integrated unit comprising an electric motor, gearbox, hand wheel, reversing starter, local on/off control facilities, and local on/off/remote selector switch with padlock facility. Hand wheel for manual operation shall be included as standard for electric actuators.	6.1	Removed because functionality is covered elsewhere.
6.2	An option for fieldbus operation from the PCS system is required.	6.1	Modified for alignment and clarity.
6.3	Electric motors shall be in accordance with the requirements as specified in TR3122 sections 2.1, 2.2, 3.3, and 3.4, 3.5. and 3.10.	6.2.1	Modified to make suitable in accordance with electrical actuator requirements.
6.3.1	Testing of electric motors shall be performed in accordance with TR3122 section 5.2.	6.2.2	Modified to refer to test requirements relevant to electrical actuators.
6.3.2			Entire section removed because the required functions are covered elsewhere in the electrical system.
6.5	On/off valves with electrical actuators shall have the possibility for serial communication. Control of non-safety on/off valves (HV) with electrical actuators should be done with serial communication links preferably using Foundation Fieldbus or profibus communication protocols. Other	6.4	Removed because requirements are covered elsewhere.

	~~communication protocols like modbus may also be considered but shall be evaluated by Company.~~		
6.6	The following external monitoring shall be possible: 3) Local selector switch in Remote position ~~using individual signal cabling.~~ 4) Actuator available for external control ~~5)~~ ~~Motor tripped~~	6.5	Removed because requirements are covered elsewhere. Individual cabling not needed.
7.1	Spring housings and unpressurized parts of the piston cylinders shall be of closed design and not exposed to atmosphere internally. This can be achieved by sealing the housing or e.g. connecting to instrument air.	7.1	Requirement added to avoid internal corrosion.
7.2	~~BS 2915~~ISO 4126-2	7.2.1	Changed standard because of superseding.
7.2.1	For all accumulators pre-charge graphs shall be made showing the pre-charge pressure of nitrogen under different ambient temperatures. The graph shall cover the specified operating temperature range in steps of 5 ^{0}C. The graphs shall be a part of “Sizing and calculations” and a copy shall also be enclosed with the accumulators at delivery. ~~For all accumulators pre-charge graphs shall be made in accordance with requirements specified in 11.6.21 “Sizing and calculations”.~~	7.2.2	Text reintroduced due to previous wrongful removal. Text removed because requirement is located in TR2381.
7.2.1	Accumulators shall have max/min marking of piston position.	7.2.2	Text moved from chapter 8.
7.3	~~The spring and spring housing shall be produced of materials resistant to corrosion and/or be surface treated to minimize corrosion due to humid and corrosive atmosphere. Where the actuator design is such that the volume inside the spring chamber varies as the valve is operated, the spring housing shall be fitted with two ports located as far apart from each other as practicably possible (i.e. on opposing sides of the cylinder and towards the highest and lowest points) to allow for efficient flushing.~~	7.3	Text removed because of added requirement for closed spring chamber and coverage in chapter 4.

7.4	The adapter stool (connecting the actuator to the valve) shall be of a tubular ~~design having the same moment of inertia in the longitudinal plane as in the transverse plane (planes intersecting through valve stem). The tube diameter shall not be less than 40 % of the valve bonnet diameter~~. ~~A fabricated~~Other designs ~~of equal strength~~ may be accepted by Company ~~by~~ subject to an approved CR.	7.4	Modified for clarity.
7.4	For open adaptor stool designs all components (including actuator components) exposed to atmosphere shall be SS 316 or with better corrosion resistance.	7.4	Added to avoid corrosion.
8.1	~~Identification plates shall be of stainless steel and have a rectangular shape. Stainless steel drive screws or stainless steel wire shall be the method of fastening the plates. Adhesives shall not be used.~~	8.1.1	Aligned with TR2000 and moved.
8.1	~~Accumulators shall have max/min marking of piston position.~~		Moved to chapter 7.2.2.
8.1.1	All actuators, and the control panels if they are separate, shall be provided with a permanent identification plate made of a rustproof material. All metallic components shall be made from AISI 316. The permanent identification plate shall be suitable for UV, grease, applicable temperature, and shall be designed to be clearly legible for the actuator design life. The permanent identification plate shall be securely fastened after coating is completed, located so that it is easily accessible. Possible rivets shall be in stainless steel, and use of wire is not acceptable. Marking on the permanent identification plate shall be clearly legible, and shall at least include the following information. ~~Actuators, and the control panels if they are separate, shall be furnished with permanent identification plates, and the following information shall be shown as a minimum:~~ • Manufacturers name or trademark	8.1.1	Requirements aligned with TR2000.

8.1.2	Unless otherwise stated in the purchase order the actuator shall in addition be supplied with a temporary identification plate of rustproof material with the following information clearly legible: ~~Unless otherwise stated in the purchase order the valve shall additionally be supplied with a temporary identification plate with the following information:~~	8.1.2	Requirements aligned with TR2000.
8.2.3	Signs and service designations on actuators shall for operational and maintenance purposes be provided in the official local language of the country where the facilities are located~~Native language~~.	8.2.3	Requirement clarified.
9.1	~~Company reserves the right to carry out inspections and witness tests at any time during manufacture. The Supplier shall notify the Purchaser two weeks in advance of any scheduled inspections and tests.~~ ~~The Purchaser's representative shall have entry to all those parts of the Supplier's works, which are concerned with the manufacture of equipment included in these technical requirements. They shall be afforded all reasonable facilities to be satisfied that the work and goods are being supplied in accordance with these technical requirements. This shall include all items of equipment subcontracted by Supplier.~~		Section removed from this document because the scope of inspections shall be agreed with purchaser case-by-case.
9.2	~~All performed tests shall be recorded, indicating the actual results/figures.~~	9.1	Moved to chapter 11.
9.3.1	~~All performed tests shall be recorded with their results, and records shall be presented upon request by Purchaser.~~	9.2.1	Moved to chapter 11.
	Electrical actuators shall be tested in accordance with ISO 12490 section 13.5. Verification of the power requirement and consumption shall be performed and documented.	9.3.4	Section added to specify requirements for testing of electrical actuators.
9.5	~~The procedure shall be submitted to Company for review.~~	9.4.1	Removed because not necessary for Company review.
10.1	All carbon steel components and surfaces exposed to the atmosphere shall be coated.	10.1	Moved from chapter 4.

10.1	~~When coating is specified, all external surfaces shall be coated. An external surface is a surface that will be exposed to the atmosphere after the valve/actuator/gear box is assembled.~~ ~~In the event that coating inspectors qualified to NACE, FROSIO or ICorr as specified are not available, Company can consider accepting alternative qualification of inspectors from the painting shops. The acceptance shall be formalized by a CR including documentation of alternative qualification. The approval of the CR may require a verification of the paint shop and will be agreed from case to case. The quality of the coating work will be followed closely and any failure to meet quality requirements following alternative inspector qualification acceptance may lead to withdrawal of the concession.~~	10.1	Removed because covered by TR0042.
11	Entire chapter modified and aligned with other MEC TRs.		
12.1.1	~~"Company" means or The Group for projects with more than one owner.~~ ~~"Purchaser" means any other party issuing the PO to Supplier.~~ ~~"Supplier" means the party who supplies or manufactures equipment against the PO from Purchaser.~~	12.1.1	Not required in this document.
E.2	~~Signal Types:~~ ~~Solenoid valves EX(m), End connection EExi 24VDC~~		Removed by Snorre A.
E.2	~~Typical schematic control circuits for hydraulic and pneumatic actuated valves for Snorre A shown in section E.7.~~		Removed due to lack of value.
E.3	Table slightly modified		Modified by Snorre A.
E.4	For project procurement the sizing requirements of section 3.3 shall apply. The following sizing factors shall be		Section added to avoid over-dimensioning in connection with historical equipment.

	used for replacement of existing actuators and complete valve/actuator units due to valve design (stem capacity), layout constraints and/or accumulator size: • Hydraulic/electrical actuators shall have a break-out torque/force with a minimum sizing factor of 1.25. • End torque/force for a spring return actuator shall have a minimum sizing factor of 1.25. Nominal hydraulic supply pressure used for sizing shall be 200 barg.		
E.5	Section added.		Added by Snorre A.
E.4	~~Air filter regulator, Fairchild, 316SS~~	E.6	Removed by Snorre A.
E.4	Local control panel – hydraulic Oceaneering Rotator Norway AS	E.6	Added by Snorre A.
E.6	S1-AA-PAT-0009 S1-AA-PAT-0010	E.8	Added by Snorre A.
App G	Appendix added to document		Added by Mongstad.

12.3 References

All work specified, shall where referred be strictly in the accordance with applicable sections of the latest editions of the following general or regional codes, standards and regulations (and their current amendments):

Referred std.	**Description**
APOS DW-T10-01	Surface Wellhead and Christmas Tree System
ASME VIII	Boiler & Pressure Vessel Code, Section VIII, Division 1 and 2
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B1.20.2M	Pipe Threads, 60 deg. General Purpose (Metric)
ASME B31.3	Process Piping
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
BS 5045	Part 1. Spec. for seamless steel gas containers above 0,5 litre water capacity
DIN 3852	Ports and stud ends with metric fine pitch thread, for use with compression couplings, valves and screw plugs; Dimensions
EN 286-1	Simple unfired pressure vessels designed to contain air or nitrogen - Part 1: Pressure vessels for general purposes
EN 13445	Unfired Fusion Welded Pressure Vessels
EN 14359	Gas Loaded Accumulator for Fluid Power Applications
EU Directive	Pressure Equipment Directive (PED)
EU Directive	ATEX, concerning equipment and protective systems, intended for use in potentially explosive atmospheres, shall apply
EU Directive	Simple Pressure Vessel Directive (SPV)
EU Directive	EN 292-1 and EN 292-2 Safety of Machinery
IEC 60079	Explosive atmospheres
IEC 60529	Classification of degrees of protection provided by enclosures

Referred std.	Description
IEC 60947-5-6	Low-voltage switchgear and control gear
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety related systems
IEC 61511	Functional safety – Safety instrumented systems for the process industry sector
ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation
ISO 1179-2	Connections for general use and fluid power - Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing - Part 2: Heavy-duty (S series) and light-duty (L series) stud ends with elastomeric sealing (type E)
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
ISO 4126-2	Safety devices for protection against excessive pressure. Bursting disc safety devices
ISO 4406	Cleanliness Requirements of Parts Used in Hydraulic Systems
ISO 5210	Industrial Valves – Multiturn valve actuator attachments
ISO 5211	Part 1/2/3 Part turn valve actuator attachment
ISO 12490	Petroleum and natural gas industries – Mechanical integrity and sizing of actuator and mounting kits for pipeline valves
NEK 606	Cable for Offshore Installation
NORSOK M-650	Qualification of Manufacturers of Special Materials
NS 5910	Cleaning of Hydraulic Pipe Systems
OLF 070	Guidelines for the Application of IEC 61508 and IEC 61511 in the petroleum activities on the continental shelf
PS	Regulations concerning process and auxiliary facilities in petroleum activities Regulation concerning safety and communication systems on installations in the petroleum activities
PSA	Regulations concerning explosion and fire protection of installations in the petroleum activities
PD 5500	Unfired Fusion Welded Pressure Vessels
TR0042	Surface preparation and protective coating
TR0052	engineering numbering system (ENS)
TR1236	Large Valves in Pipeline Transportation Systems
TR1956	Non-conventional pressure protection systems
TR2000	Piping and Valve Material Specification (internal specification)
TR2212	Control & Choke Valves
TR2381	LCI Requirements
TR3023	Electrical, instrument and telecommunication installations, offshore units
TR3024	Electrical, instrument and telecommunication installation, onshore plants
TR3032	Field Instrumentation
TR3122	Three phase cage induction motors
TR3540	Surface Wellhead and Christmas Tree System
TR3541	Subsea Wellhead, Tree and Completion/Workover Equipment

App A Control circuits (Normative)

Table 7 – Control circuits (normative)

Link to: Control units

Type No.	Control Circuit Description	Drawing No.	Drawing Rev.
1	Pneumatic Single Action, PSD or PCS Service	mser1300-cc01.tif	B
2	Pneumatic Single Action, ESD and PSD or PCS Service	mser1400-cc02.tif	B
9	Electr./hydr. Single Action, PSD or PCS Service	mser2100-cc09.tif	D
10	Electr./hydr. Single Action, ESD and PSD or PCS Service	mser2200-cc10.tif	D
11	Electr./hydr. Double Action, PCS Service	mser2300-cc11.tif	D
12	Electr./hydr. Double Action, PSD or PCS Service	mser2400-cc12.tif	C
13	Electr./hydr. Double Action, ESD and PSD or PCS Service	mser2500-13.tif	C
14	Pneumatic Single Action, ESD (blowdown) and PCS Service	mser2600-cc14.tif	B
17	Electr./hydr. Single Action, ESD (blowdown) and PCS Service	mser2900-cc17.tif	D
18	Electr./hydr. Double Action, ESD (blowdown) and PCS Service	mser3000-cc18.tif	C
24	Elec./hydr. Double Action, PCS service(inching for pig launcher control)	mser1400-cc24.tif	0

Note:
Optional circuits as listed in App. B or alternative functions might be required. Selected control circuit will be defined by Purchaser in PO.

Legends:

Pumps, Compressors, Filters, Control Mechanisms:	C999-ST-R-LF-0001-01
Connectors and Joints Control Valves, Miscellaneous:	C999-ST-R-LF-0001-02
Actuators, Equiment, Signals Function Blocks:	C999-ST-J-LF-0001-03
Line Symbols, Signals and Line Styles:	C999-ST-P-LF-0001-07

App B Optional control circuits (Informative)

Table 8 – Optional control circuits (informative)

Link to: Control units

Type No.	Control Circuit Description	Drawing No.	Drawing Rev.
3	Pneum./hydr. Single Action, PSD or PCS Service	mser1500-cc03.tif	D
4	Pneum./hydr. Single Action, ESD and PSD or PCS Service	mser1600-cc04.tif	D
5	Pneum./hydr. Double Action, PCS Service	mser1700-cc05.tif	D
6	Pneum./hydr. Double Action, PSD and/or PCS Service	mser1800-cc06.tif	D
7	Pneum./hydr. Double Action, ESD and PSD or PCS Service	mser1900-cc07.tif	D
8	Hydr. Manual Operation, PCS Service	mser2000-cc08.tif	C
15	Pneum./hydr. Single Action, ESD (blowdown) and PCS Service	mser2700-cc15.tif	D
16	Pneum./hydr. Double Action, ESD (blowdown) and PCS Service	mser2800-cc16.tif	D
20	Pneumatic Double Action, ESD or PSD or PCS service	mser1400-cc20.tif	0
21	Pneumatic Double Action, ESD and PSD or PCS service	mser1400-cc21.tif	0
22	Elec./hydr. Double Action, ESD or PSD or PCS service(high volume/capacity for large gate valves)	mser1400-cc22.tif	0
23	Elec./hydr. Double Action, ESD and PSD or PCS service(high volume/capacity for large gate valves)	mser1400-cc23.tif	0

Note:
Optional control circuits, selection will be defined by Purchaser in PO.

Legends:

Pumps, Compressors, Filters, Control Mechanisms:	C999-ST-R-LF-0001-01
Connectors and Joints Control Valves, Miscellaneous:	C999-ST-R-LF-0001-02
Actuators, Equiment, Signals Function Blocks:	C999-ST-J-LF-0001-03
Line Symbols, Signals and Line Styles:	C999-ST-P-LF-0001-07

App C Applicable for valves supplied to the European Community (Normative for applicable area)

C.1 Design of Equipment

The specified design codes shall be complied with fully, in addition to the requirements stated in relevant EU Directives (PED, ATEX, SPV, Safety of Machinery, Etc.).

For small industrial standard pressure vessels with design pressure (PS, bar) less than 10 bar g and having a product of PS and V (volume, litre) less than 25 for gas and 200 for liquids, and having an approved type examination according to PED, any of the referred codes may be used without additional requirements.

For small standard pressure vessels for air and nitrogen, EN 286-1 Simple Unfired Pressure Vessel Designed to Contain Air and Nitrogen, may be used without any additional requirements.

ATEX – Directive 94/9/EC
For electrical equipment (e.g. electrical actuators and control circuits) conformance to the Directive shall be issued by a Notified Body in accordance with 94/9/EC Annex III. However, for hydraulic actuators, pneumatic actuators and assembled units (e.g. actuated valves) the manufacturer can affix the CE marking and draw up a written declaration of conformity according to Annex VIII of the Directive.
As stated in ATEX Guidelines section 5.2.1 the Directive is not applicable for pressure relief valves and hand operated valves.

C.2 Marking

The name plate shall in addition to specified marking be marked with:

- CE approval

App D Applicable for valves supplied to Norway or Norwegian part of continental shelf (Normative for applicable area)

D.1 Design of equipment

The specified design codes shall be complied with fully, in addition to the requirements stated in relevant EU Directives and national regulations.

The following is relevant but others may be identified in PO:

- NEK 606 Cable for Offshore Installation
- OLF 070 Guidelines for the Application of IEC 61508 and IEC 61511 in the petroleum activities on the continental shelf
- PS
  - Regulations concerning process and auxiliary facilities in petroleum activities
  - Regulation concerning safety and communication systems on installations in the petroleum activities
- PSA Regulations concerning explosion and fire protection of installations in the petroleum activities

App E Applicable for valves supplied to Snorre A

E.1 Environmental data

Ambient temperature: +23 °C / -8 °C

E.2 Instrumentation

Air Supply:

Min. oper. pressure:	4 bar g
Nominal oper. pressure:	7 bar g
Maximum oper. pressure:	10 bar g
Design pressure:	10 bar g

Electrical Supply:

230V AC / 3-phase / 60Hz
660V AC / 3-phase /60Hz (Note: Vigdis)

Actuator control circuits:

The control panel is not part of the valve supplier scope of work, but the valve supplier is responsible for informing the project of all necessary interface data relevant to the control panel manufacturer. This data shall include flow rates, max. and min. pressure conditions, interface connection sizes, and mounting details to allow for mounting and control panel on the actuated valve unit.

E.3 Actuator selection

Selection no.	Tag / action	Actuator type	Remarks
1	ESV, XV, BDV, HV Fail safe action	Hydraulic actuator with spring return	
2	ESV, XV, BDV, HV Fail safe action	Hydraulic actuator, double acting incl. accumulator	'Old' SNA philosophy
X	XV Fail Safe action	Pneumatic actuator with spring return	
1	HV Fail lock action	Electrical actuator	
2	HV Fail lock action	Hydraulic/pneumatic actuator excluding accumulator	If favourable vs electrical actuator due to signal infrastructure, size, price etc.

E.4 Actuator sizing

For project procurement the sizing requirements of section 3.3 shall apply. The following sizing factors shall be used for replacement of existing actuators and complete valve/actuator units due to valve design (stem capacity), layout constraints and/or accumulator size:

- Hydraulic/electrical actuators shall have a break-out torque/force with a minimum sizing factor of 1.25.
- End torque/force for a spring return actuator shall have a minimum sizing factor of 1.25.
- Nominal hydraulic supply pressure used for sizing shall be 200 barg.

E.5 Hydraulic oil

Tag HPU	Location	Oil
65A-CT01	Snorre topside HPU	HydraWay HMA 32
65B-CT01 A/B	Snorre topside HPU/Wellhead Area (W23,W33,W43)	HydraWay HVXA 15
65C-CT01 A/B/C/D	HPU in Column 1,2,3,4	HydraWay HMA 32
65A-CT60	Vigdis HPU (Modul P88)	HydraWay HVXA 15

E.6 Nominated manufacturers

Actuators:

Hydraulic actuators – spring return	Rotork Oceaneering Rotator AS / Scana Skarpenord
Hydraulic actuators – double acting	Rotork Oceaneering Rotator AS / Scana Skarpenord
Pneumatic actuators	Rotork Oceaneering Rotator AS / Scana Skarpenord
Electrical actuators	Rotork

Tagged instruments:

Solenoid valves – hydraulic	Oceaneering Rotator Norway AS	316 SS
Solenoid valves – pneumatic	Lucifer UK	316 SS

Instrument commodity items:

Instrument fittings	Swagelok	316 SS
Instrument manifolds	Swagelok	316 SS
Instrument valves	Swagelok	316 SS
Tubing		316 SS

Note: No mix of material for ferrule/tubing or fitting manufacturers is acceptable.

Other:

Local control panel – hydraulic	Oceaneering Rotator Norway AS

E.7 References

/1/	WR1246 Testing of Emergency – Shutdown and Blow Down Valves
/2/	WR1759 Testing and Inspection of Safety Instrumented Systems

E.8 Typical control circuits

S1-AA-PAT-0006 P&ID diagram legend instrumentation typical detail valves I
S1-AA-PAT-0007 P&ID diagram legend instrumentation typical detail valves II
S1-AA-PAT-0008 P&ID diagram legend instrumentation typical detail valves III
S1-AA-PAT-0009 P&ID diagram legend instrumentation typical detail valves IV
S1-AA-PAT-0010 P&ID diagram legend instrumentation typical detail valves

App F Applicable for valves supplied to Gullfaks

F.1 Environmental data

Field material and equipment shall be designed for the following weather conditions, unless otherwise specified:

	Summer	**Winter**
Ambient air temperature:	+20 °C max	-3 °C min
Ambient air humidity:	90% R.H. max	90% R.H. max

Wind conditions

Predominant wind direction:	WSW
Wind speed:	20 m/sec

F.2 Instrumentation

General:

Equipment installed in non-hazardous naturally ventilated areas shall comply with a level of explosion protection according to hazardous area zone 2 requirements as a minimum.

Preferred Ex protection methods shall to maximum extent possible be:

- Ex I for field instruments and solenoid valves

Ex m for solenoid valves may be used.

Limit switches:

When replacing an existing valve, the new limit switches shall have equal electrical signal interface to the control system as the old switches to prevent modifications to the SAS.

Mechanical details and workmanship:

Work with tubing and compression fittings:

Field instrument hydraulic connections shall as a minimum be ½" NPT female connections.

If accumulators cannot be supplied with NPT ports, accumulators with BSPP ports are allowed limited to first process connection.

Actuator control circuits:

Schematic control circuits for hydraulic/pneumatic actuated valves shall be as defined in STIDDoc GFX-1-000-JT-101-01 to GFX-1-000-JT-118-01.

Valve control panels for on/off valves of compact type shall not be used.

The need for installing control circuits into a cabinet shall be approved by Company prior to purchase.

Hydraulic operated valves with a check valve in the circuit supply line shall have a small volume nitrogen accumulator included to allow for thermal expansion in trapped volume.

F.3 Mechanical requirements

Mechanical valve locking:

SO0501 “Bruk av aktuatorstyrte ventiler som barrierer” Section 2.2 gives guideline to which valve type that should have a mechanical valve locking device installed.

App G Applicable for valves supplied to Mongstad

G.1 Objective

This appendix must be read in conjunction with the main document TR0038. In case of conflicts between the requirements in the main document and this appendix, the appendix shall have precedence.

This appendix replaces TR2064 – 'Quarter-turn actuators for on/off valves'.

G.2 General requirements

The pneumatic/hydraulic/mechanical arrangement of the ESV shall be designed and built so that the ESD action is never prevented, i.e. to bring the ESV to the safe state. The PSD related arrangement (PSD solenoid etc.) of the ESV shall be designed and built such as to never prevent the ESD action, which is to bring the ESV to the safe state.

Actuators for safety valves shall generally be pneumatic single acting with spring return. Areas without instrument air should have electrical actuators. Where valve/actuator service exceeds the spring return design, hydraulic double acting actuator with accumulator shall be utilized.
Double acting pneumatic actuators shall be avoided.

G.3 Functional requirements – Valve operating speed

Pneumatically actuated valves shall normally not be equipped with adjustable speed setting components. Valve and actuators datasheet will specify relevant requirements.

G.4 Material requirements – Instrument commodity items

Tubing shall be imperial size, ref TR1900.
Fittings shall be Gyroloc 316ss imperial size.

G.5 Instrumentation

G.5.1 General

All equipment shall as a minimum comply with following requirements:

- The equipment shall be certified for Zone 1, Gas Group IIB, and temperature class T3, unless specified otherwise by Purchaser in PO.
- Solenoid valves shall as a standard be Ex(i). Ex(m) solenoids can be evaluated where Ex(i) is not practical (no Exi cables installed), or additional power is required.
- All ESVs and PSD valves shall have local reset.
- All on/off valves shall have CCR (Central Control Room) and local end position indication.

G.5.2 Supply utilities

Air supply:

Unless otherwise specified by Purchaser the on/off valve application shall be designed and sized for the following:

- Minimum operating pressure: 5.0 bar g
- Nominal operating pressure: 6.9 bar g
- Maximum operating pressure: 9.6 bar g

G.5.3 Mechanical details and workmanship

G.5.7.2 Work with Tubing and Compression Fittings

All instrument tubing shall be in imperial size.
Tubing outside diameter should be, ½“, ¾“ and 1“.

G.5.7.4 Cable installation

Cable installation, termination and earthling shall comply with statutory regulations and applicable specifications (ref. TR1908 and TR1871).

G.5.8.2 Design

G.5.8.2.2 Speed control

Devices for control of the speed shall not be installed if not specified by the Purchaser.

G.6 Electrical operation

G.6.1 Design

The drive from the motor to the valve shall be through a gearbox which incorporates a clutch mechanism to allow manual operation of the valve via a handwheel. A local, mechanical valve position indicator shall be provided within the actuator body. The clutch mechanism shall be key lockable in hand or auto position.

The gearbox shall incorporate hammer blow feature to assist unseating of valve.

G.6.2 Electric motors

Electrical actuators shall include:
- Auto-phase correction
- Anti-hammer protection (foreign body intrusion)
- Internal anti-condensate heaters

G.6.5 Monitoring facilities

Remote indication in CCR shall be included.

G.7 Surface protection

All surface protection shall be according to NORSOK M-501 System 1.

Mongstad has not implemented color code for determining actuator “fail in” position. Existing actuators on plant has color combination generally based on vendor standard colors. Unless otherwise specified by Purchaser, vendor standard color shall be used.

G.8 References

TR1911 Technical Requirements for Mongstad Refinery
TR1926 Supply of valves
TR1900 Instrument Piping Design
TR1908 Instrument Cabling Design
TR1871 Instrument installation requirements

G.9 Control Circuits

Additional requirements for control circuit drawings listed in Appendix A, Table 6 and Appendix B, Table 7:

Pneumatic actuated valves shall not be equipped with adjustable speed setting components if not specified by Purchaser.

Solenoid valves for ESD and PSD functions shall have local manual reset.

Optional control circuits may be selected by Purchaser.