CONTROL VALVE SPECIFICATION

CONTRACT NO.: POGC-801-84/240

PROJECT: South Pars Gas Field Development Phases 15&16

COMPANY: Pars Oil and Gas Company

CONSORTIUM: GHORB,IOEC,ISOICO and SAFF

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1. SCOPE

This document covers the minimum requirements for the control valves for the SOUTH PARS FIELD DEVELOPMENT PHASES 15 & 16 ONSHORE FACILITIES. All instrumentation systems and components, as far as mechanical and electrical characteristics and performances are concerned, shall conform to the present general specification and to the specifications issued for each system and/or components. Any deviation from the present specification at any stage of the project shall be subject to COMPANY approval.

2. REFERENCE DOCUMENT

This document is completed by the others as specified below:

RP-1516-999-1300-002:	Piping Valves
RP-1516-999-1300-001:	Piping Material Classes
DW-1516-999-1538-001:	Typical Hook-up Drawings (valves)
DB-1516-999-P332-204:	Basic Engineering Design Data for Onshore Facilities
RP-1516-999-6600-001:	Painting
RP-1516-999-1511-032:	Instrument Design Specification

3. CODES AND STANDARDS

The control valve design, and materials shall comply with latest editions of codes, standards and recommended practices listed below:

- IEC Publications:
  - IEC 60-529 Electrical enclosures.
- ISA Publications:
  - ISA S75.01 Flow equation for sizing of control valves,
  - ISA S75.03 Uniform face-to-face dimensions for flanged globe style control valve bodies,
  - *ISA 75.19.01 Hydrostatic Testing of Control Valves*
- AMERICAN STANDARDS:
  - ASME B31.3 Code for pressure piping – Chemical plant and petroleum refinery piping.
  - *ASME B16.34 Valves Flanged, Threaded and Welding end,*
  - ANSI / FCI 70-2 Control valve seat leakage,
  - API STD 598 Valve inspection and testing,
  - API 2000 Venting of atmospheric and low pressure storage tanks.
- MISCELLANEOUS STANDARDS:
  - ISO 8501-1 Preparation of steel substrates before application of paints and related products.

- European Norms
  - EN-50102 Degrees of protection provided by enclosures for
  - Electrical equipment against external mechanical impacts.
  - EN-50014 Electrical apparatus for potentially explosive atmosphere general requirement
- MISCELLANEOUS STANDARD:
  - ISO15156-1 to 3: Material for Use in H_2S-Containing Environmental in Oil and Gas Production.

4. USE OF LANGUAGE AND ABBREVIATIONS

4.1 DEFINITIONS

Throughout this specification, the words "will", "may", "should", "shall" when used have meaning as follows:

- "may" is used where alternatives are equally acceptable,
- "Shall" is used where a provision is mandatory.
- "Should" is used where a solution is preferred,
- "Will" is used normally in conjunction with an action by COMPANY ,

And following definitions shall apply:

- Company: Shall be read PARS OIL & GAS COMPANY (POGC) or his nominated representative.
- Contractor: Shall be read GHORB-E-KHATAM.
- Vendor: Shall mean any person, firm or company which manufacture or supply equipment or services for the performance of any item of the work.
- Work: Shall mean works and / or services entrusted by GHORB-E-KHATAM under the contract with COMPANY.

4.2 ABBREVIATION

The following abbreviations are used throughout this Specification:
PCS: Process Control System
ESD: Emergency Shutdown System
TSO: Tight Shut Off

5. DEFINITIONS

In the context of this specification control valves are used with the following definitions:

- Throttling control: i.e. continuously manipulating the stem of a control valve in order to obtain a desired process condition.

- Depressurizing: i.e. reducing the pressure in process equipment at a controlled rate in an emergency condition or for operational purpose.
- On-Off: i.e. changing to an open, closed or predetermined state, when required by a control sequence.
- Shut-Off: i.e. shutting off a fluid flow in an abnormal condition when required by ESD/PCS system.

Stroking time:

The stroking time is the time required to move the valve over the full operational range in response to the command signal. For on-off commands, which include safety actions, the stroking time shall be taken as the time to travel between 100 % (fully open) and 0 % (fully closed) valve travel. For manipulating commands, the stroking time shall be taken as the time to travel between 5% and 95 % valve travel, or vice versa, in response to a control signal change from 100 % to 0 % or from 0% to 100 %.
Specifications for stroking time can be:

- minimum and/or maximum limitations,
- For valve opening and/or for valve closing,
- For control signal changes and/or for shut-off actions.

6. ENVIRONMENTAL CONDITIONS

The control valves shall be suitable for installation and operation outdoors under the prevailing environmental conditions as described in DB-1516-999-P332-204: "Basic Engineering design data for onshore facilities ".
The coastal environment and the presence of H2S in air in normal conditions involve a corrosive atmosphere.
For standardization purpose, the control valve shall be certified for gas group IIB class T3 according to IEC normalization (refer to RP-1516-999-1511-032: "Instrument Design Specification".
All pneumatic instruments shall have a degree of protection of IP 55 as a minimum, and all electric and electronic instruments located in field shall have a degree of protection IP 65 as a minimum.

7. CALCULATION REFERENCES AND CRITERIA

Sizing calculation sheets are required for control valve sizing. The calculations will be executed according to:

- Either ISA S75-1 Control valve sizing equation.
- Or standard method of valve Vendor that shall be approved by COMPANY.

Valve shall generally be selected, taking into account the minimum, normal, maximum operating conditions, to operate between 10% and 90% of its opening

stroke. Valves shall generally be selected to pass at least 110% of the maximum design flow rate (rated plant capacity) at normal pressure drop. Service such as venting, pump and compressor minimum flow, etc., should be considered as special exceptions to this sizing criteria.
The required maximum Cv value will be the basis to select the selected Cv value of the valve.
Butterfly-type valves shall normally be sized for a maximum travel of 60°, unless the valve characteristics allow control over a wider range of opening.
For fluid mixtures (gas/gas or liquid/liquid) the total composite density shall be used for the calculation of the Cv value. For 2-phase fluids (liquid and associated gas) or 2-phase mixtures (liquid and non-associated gas), the Cv value will be calculated for each phase separately and added up to determine the required maximum Cv.
Vendor shall advise where any fluid velocity for a specified valve would exceed the recommended limit and where cavitation, flashing, erosion or fouling may occur.
For all valves in gas, vapor, steam and flashing liquid services subject to a pressure drop equal to or above 0.4 time the upstream pressure, as well as for valves subject to cavitation, a noise calculation has to be supplied.

8. VALVE TYPE SELECTION CRITERIA

8.1 GENERAL

Unless otherwise required in the instrument data sheets or dictated by its application, the selection of a type of valve should be done under the following order of preference:

- eccentric rotary plug valve,
- globe valve,
- ball valve,
- butterfly valve,
- Other types.

Special body types such as angle, split body, “Y”, etc., may be considered when the process fluid may be erosive, viscous or carrying suspended solids.
Control valves on high-pressure steam reducing services with internal water injection for de superheating purpose are permitted.

8.2 ECCENTRIC ROTARY PLUG VALVES

When eccentric rotary plug valves are used for general-purpose control and shutoff, valve selection is limited to the obtainable valve size, the required pressure/- temperature rating and the required allowable leakage rate.
For specific shut-off purposes, special attention shall be paid to the valve TSO features.

8.3 GLOBE VALVES

Globe valves shall be used on all services, except on very low or very high-pressure drop, and/or high flow rates. Cage guided globe valves and balanced type valves, with the exception of double seated control valves, shall not be used on services with a tendency towards cocking. Cage guided globe valves shall not be used with fluids containing solid particles. Heavy duty plug guiding is acceptable for single seat valves.
Double seat globe valves shall have top and bottom guided construction preferably.
Split-body globe valves may only be applied after COMPANY approval.
Three ways globe valves are prohibited.

8.4 BALL VALVES

Ball valves may be considered for On-Off service and for large sizes on throttling service. Unless equipped with a special trim, i.e. anti-cavitation or low-noise design, ball valves should not be used on throttling services with a differential pressure of more than 10 bar. Ball valves should be considered as throttling valve for:

- Hydrocarbon services , having a tendency towards coking ,
- Erosive service , such as slurries ,
- Applications, where solid contaminants might settle in the body of a standard globe valve.

Use of ball valves on other throttling services requires the COMPANY approval.
Ball valves should be considered for On/Off services:

- In line sizes up to 6” when the required leakage rate cannot be met with a conventional globe body valve ,
- In fuel gas lines for shut-off purposes

8.5 BUTTERFLY VALVES

Butterfly valves should generally not be used for shut-off purposes.
Butterfly valves (60° or 90° opening) should be considered for throttling control functions as follows:

- When the required size (larger than 6”), with a low pressure drop, would make it economically attractive or when it is impossible to apply globe type valves.
- On corrosive services, where body lining in standard globe valves becomes economically unattractive.

Butterfly valves shall be of the heavy-pattern flangeless type. Butterfly valves drilling shall comply with the appropriate pipeline flange drilling.
Where a hand wheel is required, the shaft-mounted declutchable type shall be furnished. “Fishtail” disc, or equivalent, should be considered on all high torque requirements. Bronze “oilite” bushings shall be used for outboard bearing. In board bushings shall be manufacturer standard. Roller on needle bearings shall not be used.
Note: Spring-opening butterfly valves shall not have a valve body of the wafer type or lug type, this to be able to remove the valve from the piping system. Alternatively a spool piece up and down stream may be specified to permit removal of the valve.

8.6 ANGLE BODY VALVE

Angle type valves may be applied for:

- High noise level , where a conventional type globe valve is not suitable (special designed trims may be used) ,
- Liquid flows where cavitation in the valve may occurs (special uncavitation trims may be used) ,
- Hydrocarbon services , having a tendency towards coking ,
- Erosive services , e.g. slurries ,
- Applications, where solid contaminants might settle in the body of a standard globe valve.

Angle valves shall have full venturi throat.

8.7 SELF ACTING REGULATORS

Where applicable, for secondary services within capacity and service limitations, for low pressure padding systems, etc., self-acting valves may be used instead of externally actuated control valves.

8.7.1 SELF ACTING PRESSURE REDUCING REGULATORS

Direct operating pressure-reducing regulators shall only be applied on simple applications, such as for reducing instrument air supply pressure or for inert gas blanketing of storage tanks. Regulators on inert gas blanketing service shall be installed on the blanketing inlet connection of the relevant tank. External connection shall be used for pressure signal. For details of tank blanketing, refer to API-2000 Venting atmospheric and low-pressure storage tanks, non-refrigerated.

8.7.2 SELF ACTING BACK PRESSURE REGULATORS

Direct operating back pressure regulators shall only be considered for clean fluids and on simple applications, such as for maintaining a uniform back pressure on utility distribution systems, for example nitrogen systems. External connection shall be used for pressure signal.

8.7.3 SELF ACTING DIFFERENTIAL PRESSURE REGULATORS

Direct operating differential pressure regulators shall only be considered for clean fluids and on simple applications, such as for secured instrument air systems or for compressor bearing sealing services.

8.7.3 SELF ACTING TEMPERATURE PRESSURE REGULATORS

Self-acting temperature regulators shall only be considered for simple heating application, where instrument air supply is not available. Self-acting temperature regulators shall be supplied with 5 meters of 304 SS armored capillary tubing together with 1” 1/2 flanged thermowell and sensor bulb.

9. GENERAL REQUIREMENTS

9.1 DESIGN BASIS

Control valves are to be used for throttling or on-off service. They may be used also for shut shutoff purposes.

9.2 BODY SIZE

The body size of a control valve in throttling service should have the same size as the calculated trim size, however oversized bodies may be required up to the size of the adjacent piping (for example, to reduce the outlet velocity).
For shut-off valves where the pressure drop needs to be kept to a minimum, valve bodies shall be of line size.
The nominal sizes of control valve bodies shall be limited to the following series:

- 1”, 1 ½”, 2”, 3”, 4”, 6”, 8”, 10”, 12” and larger.

1" valve shall be used for line size smaller than 1", with reduced port when required. Valves smaller than 1" may be used only in special applications and requires the approval of COMPANY.

9.3 BODY CONNECTIONS

Control valves shall have flanged ends. Flangeless (wafer type) valves may be considered only for butterfly valves and for valve body requiring special and/or expensive body materials. Lap-joint flanges are not permitted.
Butt welding-end control valves shall be considered if mandatory by the Piping Specification. The flange rating for flanged control valves shall be in accordance with the piping class, with the minimum rating of 300 lbs. Authorized deviations to this requirement are:

- Valve bodies made out of special and/or expensive materials ,
- A flange rating of 150 lbs for carbon steel valves may be considered for systems having a large number of identical valves (e.g. control valves for automatic fire protection systems).

The COMPANY's approval for flange rating lower than 300 lbs is required.
Valve bonnet and bottom flange if any, shall be of bolted construction with fully retained gaskets.
Flushing connections shall be provided on slurry service.
Bottom drain plugs in control valve bodies are not allowed.

9.4 TRIM

The term TRIM covers all those parts of the valve assembly that are in contact with the line medium consisting of, but not limited to, the seat ring, plug, stem, plug guide bushing and cage.

9.4.1 FLOW CHARACTERISTIC

The flow characteristic shall be specified in order to obtain a linear characteristic over the operating range. To achieve this requirement the characteristic shall normally be:

- linear, when the major part of the energy loss in the system is across the control valve over its range of operation ,
- Equal percentage , ported or contoured , in the other case

This usually results in using:

a) Equal percentage characteristic on flow and temperature services.
b) Linear characteristic on level services.
c) Linear characteristic usually for pressure control application, however it requires consideration about energy loss as stated here above.

Linear characteristics shall be applied when specifically so required by the process and/or control application as follows:

- Compressor anti-surge control,
- Split range control,
- Control valves that are only operated via manual control,
- Minimum flow protection for pumps.

Quick opening characteristic shall only be used when the quick opening feature is considered to be necessary for process control reasons.

9.4.2 FLOW DIRECTION AND SEAT LEAKAGE

For throttling control application with unbalanced valves, the direction should be "flow tending to- open" to avoid a very large unstable force in the nearly closed position. For angle-body type, the direction should be "flow-tending-to-close" to avoid high velocity and turbulence in the valve body.
Unless otherwise required, On-Off and shut-off valves should be specified and installed as "flow-tending- to-close".
The requirements for "tight shut-off" (TSO) and the tight shut-off direction (one or both direction), shall be indicated on the relevant P&ID and GHORB-E-KHATAM control valves datasheets.

9.4.3 CONSTRUCTION

The trim and particularly the seat ring(s) shall be of the easy/quick replaceable type.
A bottom flange shall be provided for those valves that require access from the bottom, for trim removal. A bottom flange is not permitted on control valves on service below 0°C.
In butt welding-end control valves the entire assembly of trim and seat shall be removable from the top.
For valves that operate at high or low process temperatures, special attention shall be paid to the clearances between plug and guide bushing, and in addition for cage type trims to the clearance between plug and cage, in order to prevent the valve from sticking. For valves operating on fluids with a tendency towards coking, special attention shall be paid to the trim construction to prevent the valve from sticking. When ball valves are used on slurry services, they should be equipped with a scraper type of seat construction.
For trims that are not of the one-piece plug type and stem assembly, the plug/stem construction shall be provided with a locking device to prevent accidental separation. The locking device may be:

- Either a special fluted pin, driven through a hole that is simultaneously drilled in the plug guide section and stem.
- Or a welded construction

Screwed seat ring(s) shall be provided with a locking facility. The seat-ring(s) may be clamped or backed-up via a seat ring retainer. The locking of seat ring(s) with compounds such as "loctite" is not permitted.
Trim components shall not be screwed or welded to the valve body for globe or cage style trim. They shall not be welded for eccentric style trim.
The valve stem connection to the actuator stem shall be adjustable with positive locking of the adjustment.
The trim for butterfly valves should be of the balanced type, which can be used-up to the fully open position. The shaft and disc shall be capable of withstanding a pressure drop across the valve of at least 1.25 times the pressure drop in the closed position. For valve, operating on fluid that solidifies at ambient temperature, attention shall be paid that the fluid cannot penetrate the clearance between stem and bushing in order to prevent sticking of the stem after a plant shutdown.

9.5 SPECIAL REQUIREMENT

9.5.1 ANTI CAVITATION VALVES

When, after proper selection of the control valve and its location, cavitation is unavoidable, preference should be given to hardened trim materials. For single seated valves, a change in flow direction through the valve may, however already be sufficient. Where hardened trim materials and/or a change in flow direction are not adequate or feasible, valves with special anti-cavitation trims should be considered.
For applications, where anti-cavitation trims are not available, two valves in series may also be considered. This solution requires the COMPANY approval.
The application of restriction orifice (s) downstream the control valve to reduce the pressure drop across the valve requires the COMPANY approval.

9.5.2 NOISE REDUCTION

The Vendor shall detail noise calculation.
If the predicted noise level exceeds 85 dBA at 1 meter far from control valve, noise attenuating device shall be provided such as special trim, diffusers, resistance plates, in-line silencer, etc.
Some alternatives or additional equipment are acceptable such as insulating the pipe, relocating the valve, reversing the flow direction through the valve, etc.
Special “low-noise” valve (multistage) may also be considered.
The noise level shall be reduced according World Bank Regulation.
The application of restriction orifice (s) downstream the control valve to reduce the pressure drop across the valve requires the COMPANY approval.

9.5.3 LEAKAGE

Valves in shut-off service shall be specified with the required tight shut-off class as per the GHORB-E-KHATAM Control Valve data sheet requirements. Tight shut-off classification shall be in accordance with ANSI / FCI 70-2, classes I through VI. If there is no more requirement than 'TSO' the class V is to be applied.
Unless otherwise specified, the leakage rate of a single seated control valve shall not exceed the requirements as per Class III. For a double seated control valve, the leakage rate shall not exceed the requirements as per Class II.
Where tight shut-off is required, metal to metal contact with single seated valves shall be used. If not applicable a soft-seated ring, for example Teflon or Viton A, may be provided if permitted by the process.

9.6 MATERIALS

9.6.1 BODY

GENERAL

Materials to be used shall be in accordance with the relevant particular specifications and Control Valve Data Sheets issued by GHORB-E-KHATAM and the following additional requirements.
The material selection of the body (including bonnet and/or bottom flange), external bolts, studs and nuts, etc., shall be in accordance with the requirements of the corresponding piping class specification.
Particularly on sour gas service, Vendor shall certify that his supply is fully in accordance with the NACE MR 01-75 requirements.
Bonnet, cooling fin and extension materials shall normally be the same as the valve body.

LINING

Where operational conditions require special materials, consideration should be given to a composite construction.
Internal lining of the fluid impact area may be required for:

- Fluids containing erosive particles (slurries) ,
- Ported plugs for wet gas or wet steam service with a pressure drop across the valve above 10 bars,
- Other services when the pressure drop is above 40 bar.

Internal lining of the whole body shall be considered for valves in seawater services.

COMPANY approval is required for the applications of internal metallic or non-metallic lining.

9.6.2 TRIM

The trim shall, as a minimum, be of AISI 316 type stainless steel, unless other material is required for the process conditions.
For fluids that become corrosive when in contact with the atmosphere, suitable trim materials shall be considered, or precautions to prevent contact with air shall be taken.
Where soft (resilient) inserts are required for meeting the specified leakage rate, the inserts should preferably be of glass-fiber filled or graphite filled PTFE. The selection shall be based on the suitability for the specified process conditions. The resilient insert shall be properly clamped between metal parts and/or locked in position to prevent blow out in the closed position.
Hardened stainless steel or stellited facing shall be supplied for valve plugs and guides with solid stellited seat rings for the following applications:

- erosive services,
- flashing, cavitation services,
- fluids above 315°C,
- wet gas or wet steam service with a pressure drop greater than 5 bar,
- When the pressure drop is greater than 10 bar at design conditions.

9.6.3 GASKETS

Body/bonnet and, if required, body/bottom flange gaskets shall be of the spiral wound type.
Material shall be AISI 316 stainless steel, graphite filled, unless otherwise dictated by the process conditions.

9.6.4 PACKING

Recommended packing materials:

- Teflon – chevron packing, suitable for operating temperatures less than 230°C, unless a specific valve construction permits higher limits. Vendor's standard may also be considered.
- High temperature packing, graphite - based metal re-enforced, for temperatures above the limit for Teflon.

Depending upon design of the valve, an extension bonnet may be required to keep the temperature at the stuffing box to an acceptable value for the applied packing. An extension bonnet may also be required, when the operating differential pressure across the valve may cause freezing of the stuffing box/packing and/or ice formation on the trim. This may be the case,

for instance, on compressor recycle (anti-surge) valves. For valves in vacuum service, the bonnet shall have an extended stuffing box, a lantern ring and a number of packing rings. Special attention shall be paid to the type of stem packing/sealing facilities as well as stem surface finish.
Packing lubricators with steel isolating control valve shall be provided if required.

9.7 BELLOWS SEAL

Bellows seal bonnets shall be applied for services with toxic fluids. The valve stem part, which is exposed to the surrounding atmosphere, shall be completely covered by the protection bellows. The bellows shall be of AISI 316 type stainless steel, unless otherwise demanded by the application. An additional stuffing box with the appropriate packing material shall be included. The seal extension shall be provided with a screwed connection between the bellows seal and the packed gland for leak detection and venting facilities.

9.8 BOLTING

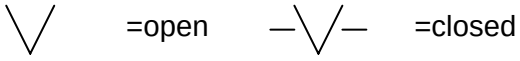
The Vendor shall indicate in the relevant manuals, the torque figures for bolting the body/bonnet and body/bottom connection for control valves on high-pressure service.

10. ACTUATOR

10.1 GENERAL

Valves shall be pneumatically operated, preferably by means of diaphragm and spring. Consideration of piston-type actuators, with or without helper springs and/or fail-safe capacity tanks, shall only be given if the force required falls beyond the normal range of diaphragm operators. The piston-type actuator should be of the spring-opposed short-stroke type. Long stroke springless piston actuators shall be opposed via a secured instrument air system or provided with lock-up valves to achieve the required action in the event of instrument air failure.
Control valves shall be such that on air failure the valve takes automatically a safe position either open, or close, or locked in position, depending upon the process requirements. Air failure position and control valve action in case of fail lock up device shall be specified on GHORB-E-KHATAM control valve datasheets.
Shut-off valves shall be kept in their normal operating position by means of a standard air supply signal (or control air signal). Interruption of that signal and venting of the valve actuator, by means of a solenoid valve mounted in the signal or supply air line, shall cause valve action to the safe position.
Safety shut-off valves shall be fitted with a fail-safe spring return mechanism.

For butterfly valves, the rotary intermediate linkages between valve and actuator shall be of the integral type and enclosed in a protected metal housing.
Cylinder actuators shall be provided with adjustable end-limit travel stops in both directions.
Bolt adjustment type limit stops shall be applied with a locking facility, by example a locking nut, to prevent tampering.
Piston and cylinder actuators shall have O-ring sealing and shall be designed for low shaft and piston friction.
Actuators shall be equipped with a direct-coupled adjustable travel or position indicator for local status indication. The position shall be indicated by a permanent mark on a reversible scale with the words 'open' and 'shut' at the travel limits or by unambiguous symbols, such as :



The valve closing time shall be in accordance with requirements for process operation.

10.2 ACTUATOR MATERIAL

The material of the actuator case/housing shall be metal, preferably steel. Aluminum actuators are not permitted on valves that are part of safety systems. The yoke material shall be high tensile strength cast or ductile iron, as a minimum. The yoke shall be of the open type to allow access for (re-) adjustment of packing gland follower. The diaphragm material shall be nylon reinforced neoprene or Buna N rubber. The actuator spring shall be fully enclosed in a metal housing and permanently treated to resist atmospheric corrosion. Cadmium plating of actuator housing and spring is not permitted.

10.3 ACTUATOR FORCE

The Vendor shall carry out actuator sizing calculations based on the data given in the requisition and in particular:

- Control valve actuators shall be sized to fully stroke the valve against the unbalanced force on the valve plug that results from a pressure drop across the valve equal to the upstream pressure.
- Actuators shall be sized for a minimum air pressure of 4.5 bar g. The normal operating pressure is 7.5 bar g and the maximum operating pressure is 9.0 bar g.
- When not specified on GHORB-E-KHATAM control valve data sheet, the stroking time shall be lower than 5 seconds for valve up to 4" and 1 second per inch diameter for bigger ones.

11. ACCESSORIES

All accessories specified with the valve will be supplied, installed, connected / wired, to the valve by the Vendor. Refer also to sub-paragraph "Tubing and Fitting" at the end of this paragraph. All accessories enclosures shall be dust and waterproof, to at least IP65 according to IEC 60529.

11.1 VALVE POSITIONERS

Electro-pneumatic valve positioners (input signal 4 - 20 mA) shall be provided, unless otherwise requested in the requisition for a specific application.
Positioners shall be force balance type, output signal 0.2 - 1 bar, with integral by-pass and output signal gauge. An electro-pneumatic converter with pneumatic booster shall be provided for special application when a positioner shall be avoided and when the signal to actuator is not standard.
The positioner shall have a weatherproof enclosure in accordance with IEC-60529, IP65 as a minimum.
Split range signals as well as reverse actions shall be implemented in the PCS in order to give a standard 4 - 20 mA input signal to the electro pneumatic positioners and to keep the fail safe action by signal failure.
Valve positioners with selectable characterizing cam shall be properly adjusted by the Vendor. The valve positioner shall be provided an identification plate, marked with air supply pressure and air signal.
The Vendor shall specify the air consumption.
They shall also be equipped with an auto-manual switch.

11.2 HANDWHEELS

Control valves shall be provided without a handwheel, unless otherwise indicated on the piping and instrument diagrams (P&ID).
Except for eccentric rotary plug valves, when a handwheel is required, it shall be of the declutchable side mounted type. Re-orientation of side-mounted handwheel should be possible in the field without the use of additional component.
The handwheel operating force shall not exceed 350 N on the trim.

11.3 LIMIT STOPS

Limit stops shall be specified, only when indicated on the P&ID. Limit stops shall be mechanical devices mounted on the actuator, screwed bolt-type on the control valve stem, adjustable over the full length of the stroke.
To prevent tampering, they shall be fitted with a locking facility, for example a locking nut.
To prevent unauthorized adjustments, the limit stops shall be provided with a protective cap.

The removal of the cap and (re-) adjustment of the limit stop shall require the use of a special tool, such as a triangle-shaped key. Too, such as a triangle-shaped key, supplied by the vendor.
The Vendor shall set the limit/travel stops at the required minimum or maximum valve opening.
Limit stop shall not form part of the handwheel mechanism.
Bolts screwed in the body are not authorized as limit stop.

11.4 LOCK-UP VALVES

Air lock-up valves shall be provided when the control valve shall remain in the last position in case of failure of the instrument air supply.
The lock-up valves shall have a bolt adjustment provided with a locking facility, for example a locking nut, to prevent tampering.
A separate nameplate shall be provided to indicate the set values.
The lock-up valves shall be set at 0.5 bar above the required control valve air supply pressure, unless some other set value is required for a particular actuator. The lock-up valves shall be properly adjusted by the Vendor.
For control valves with a valve positioner, the lock-up valve shall be installed between the positioner output and the actuator. Where lock-up valves are applied on valves operated by a solenoid valve, this solenoid valve shall be installed between the lock-up valve and the actuator.

11.5 LIMIT SWITCHES

“Open” and/or “close” limit switches shall be specified only, when indicated on the P&ID and GHORB-E-KHATAM Control Valve Data sheet.
Limit switches shall be hermetically sealed "REED" golden contacts, compatible for zone 2.
SPDT contact rating shall be 1 Amp/24 V DC.
Use of proximity switches shall be subject to COMPANY's approval
Mechanically operated switches and mercury switches are prohibited.
Limit switches with “flying leads”, shall be terminated in a junction box, part of the valve. The flying leads shall be armored or protected by a flexible conduit.
COMPANY's approval is required for the construction of the limit switch on the control valve.

11.6 AIR BUFFER

Secured instrument air shall be applied for springless actuators, to drive the control valve to a safe position, in the event of an air failure. The secured instrument air supply shall maintain sufficient air pressure in the buffer vessel for at least 30 minutes or 3 full valve strokes, whichever takes longer.
Unless otherwise specified in the GHORB-E-KHATAM Control Valve data sheet, the capacity of the secured instrument air buffer vessel shall be sized for a minimum instrument air supply pressure of 4.5 barg.

Buffer vessel shall be fabricated from carbon steel and painted according project painting specification. Buffer vessel shall be provided fully instrumented by the Vendor.

11.7 AIR LUBRICATORS

Air lubricators shall be considered for pneumatic long-stroke cylinder actuators.
Air lubricators shall be of the oil-mist type, suitable for installing on a mounting plate and shall have facilities for oil refilling under pressure. They shall be provided with oil level indication. The oil flow shall be externally adjustable. The oil buffer capacity shall be sufficient for one month continuous operation. Where air lubricators are applied for valves operated by a solenoid valve, the lubricator shall be installed upstream of the solenoid valve. Spherical glass (bowl type) air lubricators shall not be used.

11.8 SOLENOID VALVES

Solenoid valve may be installed:

- In the air supply line of On/Off valve. In that case, care will be taken that the trim of solenoid valve is adequately sized according to the air supply.
- In the air signal line of control valve, when required on the P&ID.

The solenoid valves shall be suitable for installing on a mounting plate. They shall be mounted as close as practicable from the valve actuator, always downstream of the control valve positioner.
Solenoid valves shall never be mounted directly in process or utility lines.
Three ways or four ways body shall be used.
Pilot operated solenoid valves shall not be used.
The valve body material shall be AISI 316 stainless steel.
The air passages in the solenoid valve shall be large enough to achieve the valve opening or closing in the required time. Exhaust port shall be provided with a piece of tubing bent downward with the end cut off at an angle of 45 degrees to prevent plugging. Solenoid valves shall be of the continuous type (continuously powered) and be equipped with capsular (potted) coils suitable for relevant hazardous area. Coil electric power supply shall be 48 V DC low consumption (~10 Watts max.).
Solenoid valves with “flying leads” shall be terminated in a junction box, part of the valve. The flying leads shall be armored or protected by a flexible conduit.
Solenoid valves may be equipped with an integrated manual reset feature when required or with a remote reset feature (by other).
Pneumatic connections shall be 1/4" NPTF minimum.
Electrical cable entries shall be 1/2" NPTF minimum

Solenoid valves shall be direct operated, use of pilot operated. Solenoid valves require the approval of COMPANY.

11.9 FILTER-REGULATORS

Separate air filter regulators shall be installed in the instrument air supply lines to the actuator or positioner.
They shall be of the reducing-relief valve type with automatic water drainage facility and bolt adjustment provided with a locking facility, for example locking nut, to prevent tampering. The air filter cartridges shall be of the rigid structure type to resist rupturing, shrinkage or distortion and shall have a maximum mesh size of 40 microns. When a control valve is used for shutdown function, an air set shall be provided with integral pressure safety valve to insure overpressure protection and increase the integrity of the system.

11.10 FILTERS

Air filters may be considered instead of air filter regulators, in the instrument air supply lines to those long-stroke cylinder actuators that can withstand the maximum air pressure.
If applied, the air filter shall be provided with a manual drainage facility and a filter cartridge of the rigid structure type, to resist to rupture, shrinkage or distortion, having a maximum mesh size of 40 micron.

11.11 QUICK EXHAUST VALVES

Quick exhaust valves shall be provided for service that requires a non-standard opening or closing time.
The quick exhaust valves shall be of the non-spring return type. Pilot operated quick exhaust
Valves shall not be used.
Quick exhaust valves shall be installed on the actuator.

11.12 VOLUME BOOSTERS

Volume boosters shall be provided for service that requires a non-standard stroking time.
Volume boosters for pneumatic actuators shall be of the high capacity type with fast throttling facilities to control the required capacity.
Volume boosters shall be installed on the actuator.

11.13 RESTRICTORS

Instrument air flow restrictor shall be provided for service requiring a slow opening and/or slow closing time.

The flow restrictor shall be provided with a lockable, variable restriction adjustment facility. The direction(s) of restricted flow shall be indicated by a permanent mark on the body.
The capacity of the flow restrictor shall be sized (and tested) for a normal air supply pressure.

11.14 TUBING AND FITTINGS FOR ACCESSORIES

The tubing material will be AISI 904L, 1/4" NPT connection for outside diameter tubing = 1/4" OD (as a minimum).
The fittings for air piping will be of the AISI 316 compression type, with double ferrule and complete with coupling nuts.
All control valves shall be equipped with a mechanical position indicator.

12. PAINTING

Refer to the project painting specification RP-1516-999-6600-01.
Surfaces to be painted or coated shall be dry and free from burrs, weld spatters, flux, dust, grease, oil and other foreign matter before any paint is applied.
All carbon steel or low/intermediate alloy steel parts of the control valve, not in contact with the medium shall be blast cleaned or chemically cleaned according to Vendor's standard. Thereafter one coat of primer shall be applied. Two coats of oil resistant paint shall be applied as final finishing. Unless otherwise specified in the requisition, priming and coating shall be in accordance with the Vendor's standard.
The color of the final finish shall be as per COMPANY's requirements unless otherwise specified in the requisition.
The valve stem or spindle and gasket contact surface of flanges shall not be painted but protected against corrosion.

13. VALVE IDENTIFICATION

The control valve shall be provided with a stainless steel identification plate, with following information, clearly and deeply stamped on to the plate:

- Vendor's name or trade mark,
- Vendor's model/type number (valve and actuator),
- Vendor's serial number
- Body and flange rating
- Size (body and trim)
- Material (body and trim)
- Type of plug (characteristic)
- Installed Cv value
- Bench setting/spring range
- Action on air supply and/or signal failure

- Limit stop setting in % travel and between brackets the related Cv value
- Hazardous area classification for electrical part
- Ingress Protection class for electrical parts
- Operating range
- Stroking time
- Signal range
- Instrument air supply pressure

In addition, each control valve shall be provided with a stainless steel tag plate that shall be fixed with a stainless steel wire in a prominent position to the control valve. This plate shall be marked with the COMPANY's tag number as stated in the requisition. Control valve body/bonnet, flanges, etc., shall be marked in accordance with ANSI/ASME B.16.34.
The direction of flow shall be clearly indicated by a permanent mark cast or stamped on the valve body. Painted markings are not permitted. Three-way globe valves shall clearly indicate the fixed open port by a permanent mark "COMMON" stamped on the flange.
The control valve tag number shall be stamped on the body/flange, when the identification plate is attached to the actuator.
Body flange rating and body material may be indicated by a permanent mark cast.
Process fluid direction (arrow) shall be clearly and permanently indicated on body.

14. INSPECTION AND TESTING

14.1 GENERAL

Unless otherwise specified in the requisition, inspection of control valves should be carried out "at random" with a minimum of one valve per type/size. FAT procedure shall be submitted to COMPANY at least 30 working days before date of inspection.
Any valve with a specification more stringent than the standard requirements, for example low noise valves, depressurizing valve, anti-surge valve, emergency shut-off valve, etc., shall be individually inspected/tested and the results recorded.
All control valves together with all related accessories, when part of supply, shall be subjected to the following checks/tests as a minimum:

- Dimensional check
- Hydrostatic test
- Performance and mechanical operation test

Following tests should be executed on a selection of control valves, as indicated by the GHORB-E-KHATAM:

- Seat leakage test,
- Capacity test,
- Low-temperature test,
- Helium test,
- Vacuum test

The Vendor shall make the test results available as part of the package of final certified document and drawings.

14.2 DIMENSIONAL CHECK

The face-to-face dimensions of flanged globe-body control valves shall be as given in the relevant standard.
Other dimension such as overall height, etc., face-to-face dimensions of other valve types and of other ratings, for which standards are not available, shall be as shown on Vendor's drawings within the given tolerances.
The flange face finish shall be checked in accordance with ANSI B 46.1.

14.3 HYDROSTATIC TEST

Control valves shall be hydrostatically tested in accordance with the requirements of ANSI/ASME B16.34 or in accordance with the standards, as applied for the particular type of valve.

14.4 SEAT LEAKAGE TEST

The seat leakage test shall be executed for all control valves specified as tight shut- off.
The Vendor shall perform for each control valve in the shut-off position a leakage calculation, at the test conditions as defined in the test procedure, and at operating conditions with the specified fluid.
The control valve shall be tested under the thrust or torque applied by the actuator with the signal pressure that will be available to close the valve, for example 0.2 bar or 0.2 to 1.0 bar bench setting as required.
For each valve tested, the Vendor will state the following data:

- Flow direction,
- Test medium,
- Test differential pressure,
- Duration of test,
- Seat leakage flow rate measured,
- Allowable seat leakage flow rate,
- Seat leakage class (if applicable).

14.5 PERFORMANCE AND MECHANICAL TEST

The control valve shall be completely assembled and fitted with all accessories such as positioner, solenoid valve (s), etc. The packing box shall be correctly packed to the tightness as needed for the hydrostatic test (when necessary packing shall be renewed after testing). The valve stem may be lightly lubricated.
The performance and mechanical test shall, as a minimum, consist of a hysteresis, dead band test and a stroking time test.
The hysteresis test shall consist of measuring valve stem position for the following sequence of input signals:

- 50%, 75%, 100%, 75%, 50%, 25%, 0%, 25% and 50% approx.

Hysteresis shall not exceed 0.5% of maximum valve stroke.
The dead band test is expressed in percentage of the input span and shall be measured at approximately 5%, 50% and 95% of the input span. The maximum dead band found shall not exceed 1% of rated input signal.
In case of special requirement the stroking time shall comply with the time stated in the requisition.
Testing shall be performed under ambient temperature and with the minimum specified air supply pressure.
If the control valve is equipped with a handwheel, the fully open and closed position of the valve shall be tested with handwheel operation.
If the control valve is equipped with limit switches, they shall be checked for functional operation with a proximity tester.

14.6 VACUUM TEST

A vacuum test shall be made on selected control valves, as indicated by the GHORB-E-KHATAM.

14.7 HELIUM TEST

As indicated by the GHORB-E-KHATAM, helium test shall be made on selected control valves used on hydrogen service, vinyl chloride service and on other services, as specified in the requisition.

14.8 MATERIAL TEST

14.8.1 TOUGHNESS TEST

The toughness tests to be carried-out on the valves (if required) are normally shown on the data sheets or in the requisition.

When these tests are required, they shall be carried out in conformity with the requirements of ASTM standard A 370 and at the temperature required for the grade of material.

14.8.2 HARDNESS TEST

If specified in the requisition, hardness tests shall be carried out on each valve body.

14.8.3 SPECIAL EXAMINATIONS

For valves 6" and larger in class 600 and higher, castings shall be examined in accordance with ANSI B 16.34 (Requirements for special class valves, examination of steel castings) and MSS SP 55.
For ferrous materials, Magnetic Particle examination shall be used in preference to Dye Penetrant.
A full radiographic inspection shall be carried out on 100 % of the beveled areas of all weldend valves of sizes 2" and above, and on all butt-welded joints, to prove that these areas are free from any defects.
Additionally, any weld (including fillet welds) on valve bodies, regardless of size or rating, shall be 100 % examined by dye penetrant testing.
Radiographic defect acceptance levels on welds shall be in accordance with the following:

- Welds in forged or other wrought materials:
  - ANSI B31.3 Table 341.3 2A, for normal fluid service (although the inspection level must be 100%, and not "spot or random").
- Welds in castings :
  - ASTM E446:
    - Up to 25 mm wall: level 1,
    - Above 25 mm wall: level 2.

Cracks or crack-like defects are not acceptable.

14.9 DOCUMENTATION

The test results from the factory test shall be made available to the COMPANY as part of a package of final certified documents and drawings.

15. PRESERVATION AND PACKAGING

All necessary precautions shall be taken for adequate protection of the valve, including accessories, during shipment and outdoor storage at their destination. These precautions shall comprise, but not necessarily be limited to the following:

- Before leaving the factory, all openings in the valve body shall be provided with temporary closures to prevent entry of dirt.
- During transport and storage, the valve ends shall be protected with suitable close fitting protector (e.g. plastic caps) or covers of at least 3 mm thick and securely fastened by an adequate number of bolts.
- Air connections of actuators, positioners and accessories shall be protected by thread protectors.
- The stuffing box of valves with a graphite based packing shall be protected against the ingress of water.

16. DOCUMENTATION

Vendor shall provide documentation for approval as follows:

- Detail drawing of the control valve assembly, including :
  - Overall dimensions,
  - Face to face dimensions, rating and facing ,
  - Actuator type and size,
  - Accessories, and in particular :
    - Electro-pneumatic positioner with the instrument air line arrangement,
    - Solenoid, installation, tubing and wiring.
    - limit switch arrangement, wiring
  - Material of body, trim, etc…,
  - Weight.
- Drawing of the buffer capacity, including :
  - Overall dimension, accessories ,
  - Capacity calculation.
- Control valve noise calculations.
- Control valve and actuator sizing calculation
- Test procedure
- Material certification
- Hazardous area certification

- Installation, operation and maintenance manuals
- Part list
- Material and other parts certificates
- Maintain schedule

17. SPARE PARTS

The Vendor shall provide:

- The special tools required for correct operation and for maintenance,
- The spare parts for commissioning and start up for all equipment supplied.
- The price list of spare parts for two years operation shall be issued by VENDOR at bidding stage for COMPANY approval.