Compact Helical Slot Quarter Turn Actuators

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Actuators and Controls

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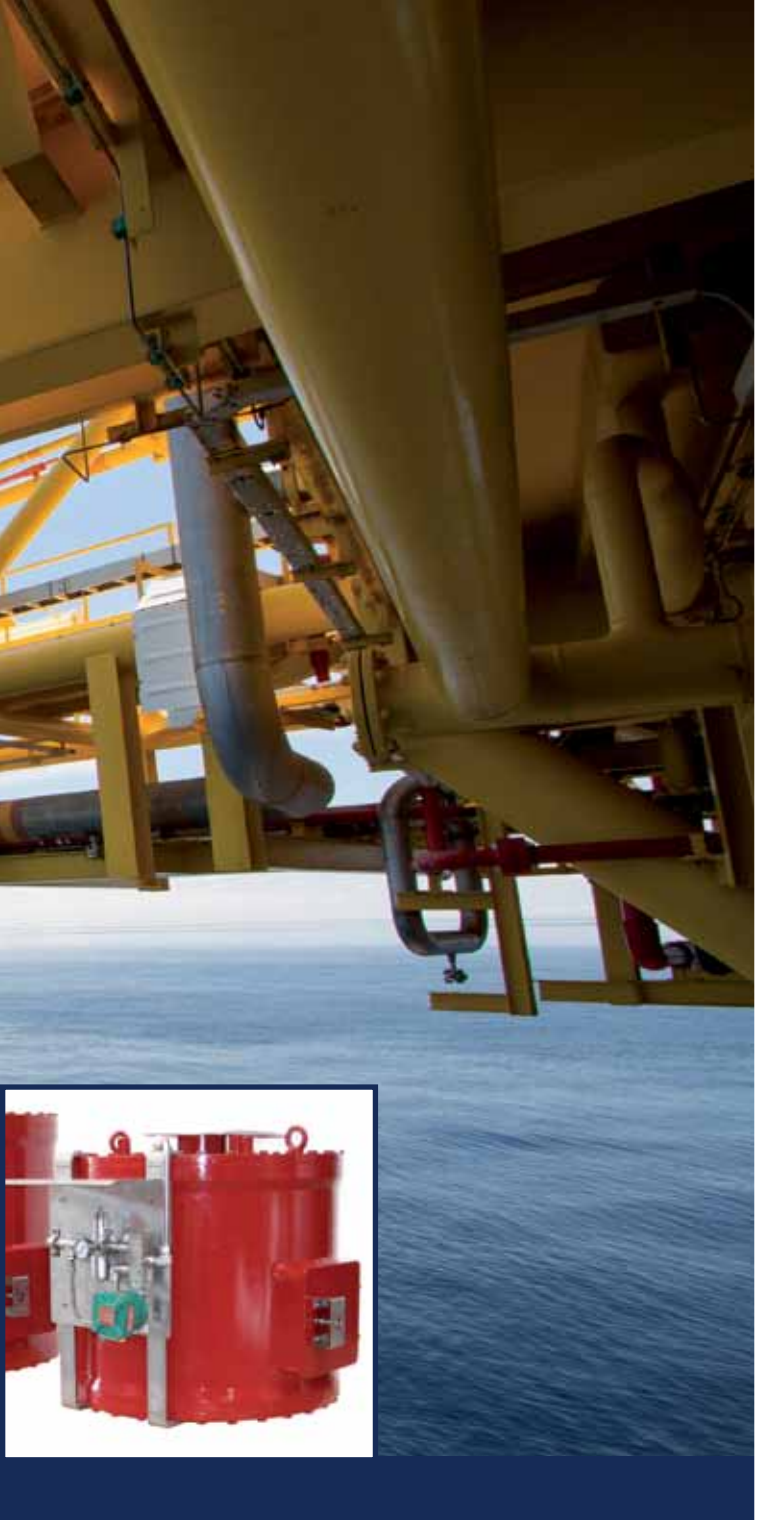
Increasing worldwide demand for Oil and Natural gas has pushed continuous developing and construction of offshore platforms, floating production storage and offloading (FPSO) units and floating liquid natural gas vessels (FLNG).
Nowadays and more in future Oil & Gas production and treatment will be developed in offshore sites and FPSOs or FLNG will be the preferred options for products treatment and transport due to their easy installation and flexibility, not requiring local pipeline infrastructure to export oil and gas.

The challenge and the main concern in floating/offshore facilities design are space availability and weight reduction.

Scotch yoke actuators can provide an apparently standardized and economical option for valve automation, but if installed in offshore/FPSO site very often bring additional consequent problems and loss of efficiency in piping and plant design.



Actual growth in Oil & Gas production has increased also average flow and pressure of processed medium.
This means bigger and higher class valves with consequent need to assemble big size actuators, that in case of scotch yoke design can leadto complicated and heavy devices for their support and adoption of long pipes and considerable waste of space.
Servovalve UCR compact actuators are the ultimate technical solution for offshore design optimization.

UCR actuators have been designed to provide same perfomances of scotch yoke actuators but, due to their innovative helical slot mechanism, with a completely different result in overall dimensions.

Traditional scotch yoke mechanism include separate external cylinder and spring cartridge connected to a central link to obtain quarter turn rotation, with consequent development of longitudinal dimensions.

The new UCR' s innovative design allow to enclose in one single compact cylinder all the necessary components for quarter turn valve actuation: pneumatic/hydraulic cylinder, spring and helical slot mechanism to transform the linear piston movement into a 90° degrees rotation, all in one cylindrical envelope, usually with an external diameter that do not exceed the face-to-face valve flange dimension.
Resulting design is extremely flexible providing the requested output torques but keeping a customized design, optimizing the valve/actuator assembly and minimizing the overall dimensions, allowing the possibility of changing actuator output torque diagram depending on internal slot design.

The design, engineering and materials used ensure optimum performances in the heaviest work condition in every environment according to the international standard specifications.
In particular the extreme compact design has various benefits in corrosion resistance and protection of internal parts, with a final result of actuators particularly suitable for offshore, splash area and submerged application.

Cost saving and benefits of UCR actuator

A correct cost/benefits analysis for adoption of compact actuators against standard scotch yoke actuators, cannot be limited to the only actuator itself, but must include the complete system actuator-control system-valve-piping and space availability.

From this global point of view main features and advantages of compact actuators can be resumed as:

Extremely reduced dimensions: typically actuator dimensions are contained inside valve flange face-to-face.
This can allow a dramatic reduction in pipeline and allow the possibility of assemble valves very closed to each other compressing space and allowing wide use of vertical pipes.

Weight balance: actuator symmetric design respect to valve axis assure a perfect weight balance that brings to a greater facility for assembly/disassembly to/from valve. This also avoid the necessity of special supports or pedestals to balance and sustain eccentric loads as in case of scotch yoke actuators.

Direct valve assembling: due to his shape compact actuator allow a direct coupling on valve flange reducing overall dimensions and avoiding cost for additional intermediate adapting parts.

Fireproof protection: due to reduced dimension, cost for Passive Fire Protection for actuator is dramatically reduced. In case of big size and high class valve, the considerable cost saving in actuator PFP lead the choice of compact actuator to a mandatory option.

Center of Gravity: center of gravity is aligned with valve stem , so in presence of high vibrations ensure the best mass distribution, avoid necessity of complicated supporting system for unbalanced loads.

Simple construction - high efficiency: actuator design assure a considerable reduction of moving parts which are forced to perfectly aligned positions. This brings to an extremely high efficiency with reduction of frictions and transversal unproductive efforts in torque conversion maximizing actuator performance.

Sealed construction: totally enclosed design to assure optimum corrosion resistance to internal parts from dust and saline water.

Weight reduction: Simple and compact construction reduce the number of parts composing actuator with a consequent total weight reduction against equivalent traditional actuator.

Air/Oil displacement: reduction of hydraulic/pneumatic cylinder displacement allowing cost saving in customer medium power supply network (size reduction for hydraulic power unit or air compressor) and improvement in operating stroke time with benefits on control circuit components with consequent size reduction.

Customized torque diagram: the particular design of internal helical slot allow a considerable flexibility in actuator output torque diagram. Shape of slot during the 90° rotation can be differently machined obtaining dedicated output performance suitable for any kind of valve or particular torque diagram requirement or presence of high dynamic torques.

Flexibility in dimensions: in absence of a fixed standard, compact actuators design can be easily modified and adapted to specific space limitation.

Maintenance: helical slot mechanism is life lubricated and the extremely high efficiency of actuator ensure a long life free from particular maintenance requirement.

FEED Project phase: knowing that typical actuator dimension would remain in valve face-to-face, allow Project Engineers to anticipate their preliminary piping design and layout and relevant optimization already since early FEED stage, without necessity of waiting for final actuators sizing from the selected supplier and without waiting to receive from actuator manufacturer relevant dimensional drawings. Detailed early stage plant design can so be conducted in independent way by Design Institute with considerable cost reduction for engineering man-hours.

Special execution

Fast acting ESD execution (up to 0,3 sec stroke time).
Servovalve has a wide reference and long experience in manufacture of very fast stroking ESD actuators in both hydraulic or pneumatic execution.
Transfert of this technology to compact actuators bring some additional benefit compared to traditional scotch yoke ESD actuators.
In case of fast acting shutdown, than can be typically up to 0.2 sec., an extremely big inertial moment is transferred in a very reduced time to the actuator end stop, generating a considerable stress on valve/actuator connection and consequently on the entire piping. Even if actuators are usually equipped with damping systems, in case of big size actuators the stress on the entire structure is considerable.
Selection of compact actuators for fast acting service can bring additional relevant benefits due to the fact that the actuator center of gravity is aligned to valve stem and that also the piston movement is vertical on the same axis.
In this way during the emergency stroke mechanical parts in movement do not generate any bending moment on valve and stress is safely discharged on actuator damper and stop screw.
Any special support or elastic hanger system would be required for stress and vibration adsorption and no additional stress would be added to piping.

Special material execution
Compact and fully enclosed design allow realization of execution with out of standard materials for external parts so to comply to particular Project Specification or extremely corrosive environmental.
Execution of compact actuator in fully external stainless steel material is available upon request.

Main Technical Features

Operating Medium
UCR actuators are available for different medium supply:
- Instrument air: UCRP pneumatic cylinder actuators
- Mineral oil or water based fluid: UCRH hydraulic actuators
- Pipeline or natural gas: UCRG gas operated actuators

Angular stroke
Standard angular rotation: 90° +/- 4°
On request different torque rotation (180° or different)

Environmental Temperature Range
Standard execution: minimum -20°C / maximum +80°C
Low temperature execution: minimum -40°C / maximum +60°C
High temperature execution: minimum -20°C / max 150°C
Special executions for lower or higher temperature range available on request.

Design&Research

UCR compact actuator, as all Servovalve products, are the final result of the most accurate process developed to satisfy Customer requirement and expectation for the best technical solution to their problems in valve automation.

All actuators parts are designed with 3D modeling software and submitted to accurate Finite Elements mechanical stress analysis, while motion simulating is currently used for the assembled machine check.

Designed is realized in Servovalve technical department that takes also advantage from the experience coming from nearly 40 years of production of highly customized actuators worldwide supplied.

Actuators design and performance are verified and tested in severe working conditions and cycling load test sessions realized in Servovalve Research&Development department.

Several performance test are currently realized as acceptance criteria for new actuator development, including UCR actuators.

Servovalve testing area can rely on the following devices:

Various size of torque measurement test bench controlled by dedicated software that allow possibility of:

- Static torque measurement
- Dynamic torque measurement
- Simulation of valve resistant torque diagram
- Cycling endurance actuator test under load condition
- Dedicated software for measurement and record of stoke time and pressure diagrams,in particular for fast acting and ESD actuators.
- Hydraulic power units for hydraulic actuator pressure testing.
- Hydraulic power units for flushing test, complete of oil cleanless level measurement electronic devices according to NAS or ISO standard

Certification

UCR actuators are produced and tested in accordance to Servovalve quality management system in compliance with:

EN ISO 9001:2008 Quality System - cert. Det Norske Veritas (DNV).

EN ISO 14001-2004 Environmental Management System - cert. Det Norske Veritas (DNV).

BS OHSAS 18001:2007 Occupational Health and Safety Assesment Series - cert. Det Norske Veritas (DNV).

Actuators can be provided complete of following certificates:

European pressure equipment directive 97/23/CE (PED) - cert. Det Norske Veritas (DNV).

ATEX Directive 95/9/CE

SIL according to IEC 61508:2008 - cert. TUV Rheinland

GOST-R certificate

Rostechnadzor certificate

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