Heavy Duty Actuation – How effective design can reduce maintenance and improve production uptime.

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IVS
INDUSTRIAL VALVE SUMMIT

Maintenance – why it matters

Half of production losses on the UKCS are due to unplanned outages from equipment failures, while one quarter more are due to planned maintenance shutdowns. (1)

Improper or insufficient maintenance was the underlying cause for **42% of incidents** of failure on ESD Riser Valves in the UKCS. (2)

Sources:

(1) "Tackling the Asset Production Efficiency Crisis in the North Sea"
McKinsey & Company - D.Cole, P. Graham, O. van der Molen, S. Tidewell – 2014

(2) "Investigation into the Immediate and Underlying Causes of Failures of Offshore Riser Emergency Shutdown Valves" – HSE UK - R. Goff, J. Kay - 2015

Maintenance in the real world

No Maintenance – corrective action in case of failure

- Low cost / impact in case of equipment failure
- High cost of preventive interventions
- Equipment with low failure rates or non-safety redundancy
- Non-critical equipment

55% of equipment in US energy industry facilities is not subject to any specific maintenance schedule
(source: US Department of Energy - Federal Energy Management Program – 2010)

Maintenance in the real world

Preventive Maintenance

- Time or cycle based periodic interventions
- Allows predictability and programmability of resource usage
- Reduces risk of sudden «catastrophic failure»
- Generally used for equipment with predictable wear or failure rates or under equipment manufacturer recommendation

Maintenance in the real world

Predictive, or Condition Based Maintenance

- Based on measurement or analysis to determine actual equipment degradation
- Maintenance interventions on as "as-needed" basis reduces downtime and un-necessary labour usage
- Increases complexity of system and initial capital costs
- Data management culture necessary
- Typically recommended for critical or safety related equipment, equipment with unpredictable failure patterns, or equipment not visibly subject to degradation.

Maintenance – what best approach?

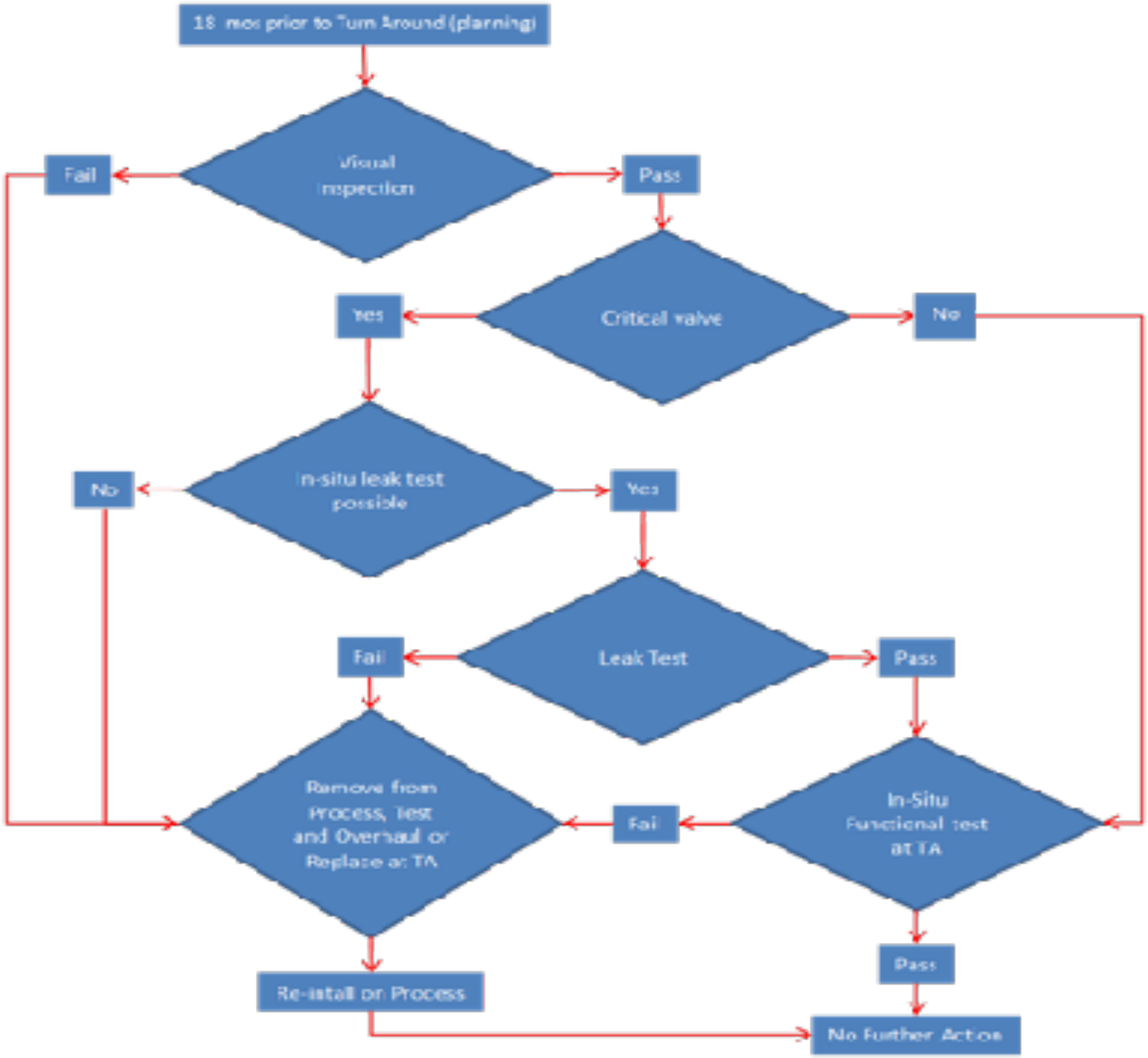
There is no single right answer.

Operators with the highest productivity returns limited planned maintenance exclusively to what could not be executed during with facility running, and carried out checks and routine maintenance during normal operation.

But what about:

- Unmanned facilities?
- Hazardous or inaccessible areas?
- Remote or extreme environment locations?
- Long stand-still applications?
- Fast acting / High cycle applications?

Maintenance approach - Shut-Off Valves
Customer case



Actuator Design for Maintenance

Design for Maintenance: Objectives

- Actuator maintenance is driven by valve performance and revision cycle.
- Actuator manufacturers should accommodate user "neglect" into the structural and design features of the actuator.

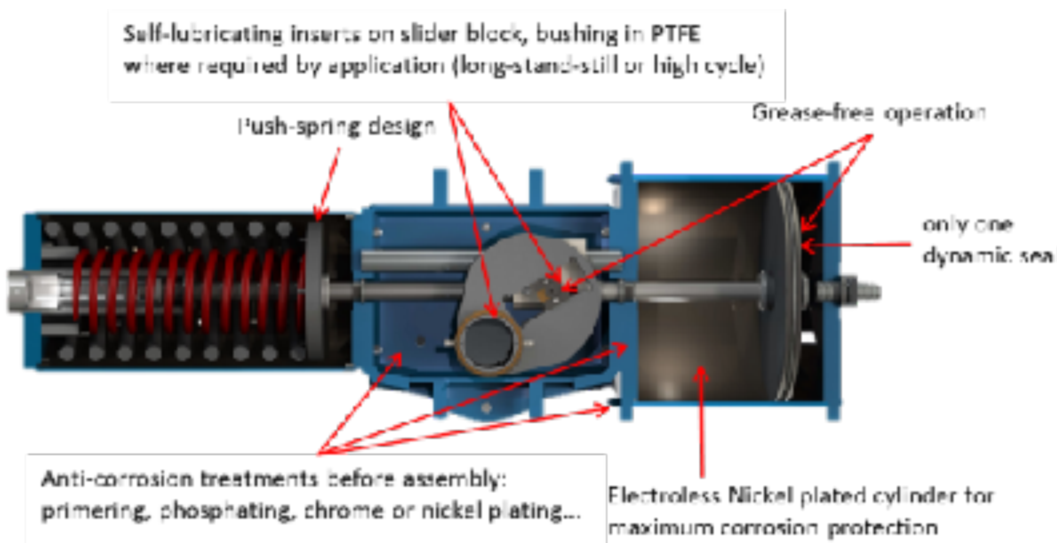
This means:

- Limit maintenance requirements through good design
- Facilitate access to maintainable parts and design for ease of operator handling during revision.

Actuator Design for Maintenance – Limit the need for intervention

The fewer parts needing upkeep or replacement the better. The longer the interval between maintenance interventions the better. There are several ways to achieve this first goal:

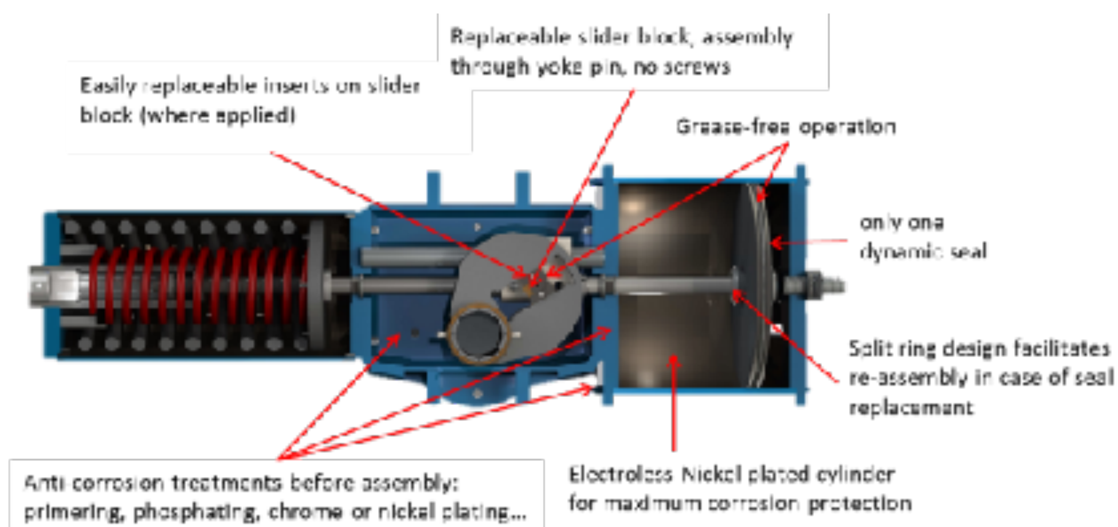
- Reduce the number of dynamic seals.
- Improved materials for long standstill applications, avoiding metal-to-metal sliding parts
- Optimized contact between load bearing surfaces for parts subjected to high cycling.
- No spring load loss, guaranteed by proper design and application of standards such as EN 13906.
- Suitable surface treatments on internal and external surfaces to protect against the effects of corrosion.
- Minimum use of grease and lubricants (limit use to facilitate assembly or protect against corrosion, but not for friction reduction)



Actuator Design for Maintenance – Facilitate operator intervention

Operators need to work safely, and with ease and speed in carrying out all necessary interventions.

- Increase scope of interventions possible without removing the actuator from the valve
- No special tools. Actuator parts should be designed to be handled by one person, with common tools readily available on any industrial site.
- Lifting arrangements should give due consideration to balance, centre-of-gravity, potential actuator orientation with respect to lifting equipment position.
- Parts connection through pins, clips or mechanical locking – limited use of screwed parts.
- Components not reversible or interchangeable should have only one possible mounting position.
- Actuator parts should be primered, or subjected to other anti-corrosion treatments before assembly. Screws and fasteners should be in corrosion resistant materials.

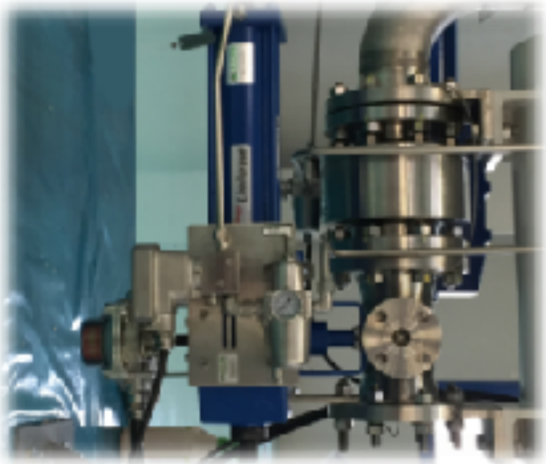


Predictive monitoring

Sophisticated instrumentation is not always necessary. Elements of essential diagnostic information can be collected through operator observation and simple mechanical tests.

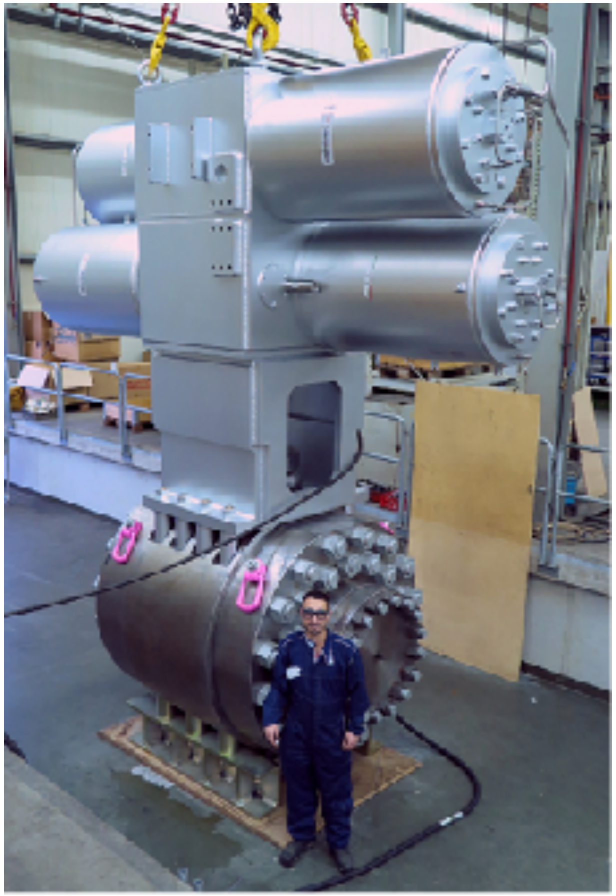
- Safety factor: Verify the actuator holding pressure and compare against known values provided at time of valve installation.
- IP tightness. Lightly pressurize the actuator housing and spring container.
- Readiness to stroke. This is typically verified through a partial stroke test, which can be carried out with mechanical, electric, electro-pneumatic or electronically controlled devices*, with varying degrees of diagnostic feedback.
- Full stroke test / full functional test (often not possible outside of planned maintenance intervals). The operator will observe for anomalous behaviour such as vibrations, jerking, noise, as well as achievement of expected functional performance.

**Electronic and automated partial stroke test systems allow collection of a much more extensive range of data, but this must also be collected, analysed, stored and transformed into meaningfull intervention criteria.*



Actuator design for maintenance – a real world approach

- Partner with users to understand application and operational context
- Test and validate design criteria as well as individual performance
- Balance standardization and optimization
- Avoid «defensive» prescriptions
- Make it easy to manage
- Build to last



In conclusion:

Effective design can reduce maintenance requirements and improve production uptime and plant profitability.