ELECTRIC VALVE
Integrated solution

JV between ATV S.p.A and INNOVA A/S.

Subsea Controls Down Under, Perth, Oct. 2018
Eirik Ravnås
Goal

• Provide the best solutions for the customer
  • Cost
  • Reliability
  • Ease of integration
  • Predictability
  • Control
Why Electric?

• Marked exist
  • Extend range of subsea production systems (deeper, longer step-out)
  • All-electric subsea systems have the potential to reduce CAPEX and OPEX
  • Case studies report CAPEX saving in the range of 10-30%
  • Environmental benefits

• Electric systems are maturing
  • Ormen Lange Subsea Compression Pilot
  • Åsgard Subsea Compression
  • K5F All-electric tree

• Electric actuators are reliable
  • Equinor reports 8M running hours accumulated
  • No retrievals due to failures in actuator
Why Electric?

• Better regulation
  • Smooth, controlled motion
  • Position accuracy
  • Feedback

• Condition monitoring
  • Predictive / Planned maintenance
Challenges

• Concern of the unknown
• Standards written around existing solutions
• Need for system understanding across different disciplines
Challenges

Power infrastructure

EVERY WATT COUNTS!
Challenges

Local energy storage

Central energy storage

Direct powered
Challenges

• Power management raises “new” questions
  • Valve torque profile (Energy)
  • Operation time (Power)
  • Frequency of operation (Recharge time)

• Valve actuation times are high
  • Fail-safe (XT, HIPPS)
  • Gate valves
  • Large Ball valves
Challenges

• Transitional phase from hydraulic -> electric
  • Incremental approach (Risk reduction)

• Not taking advantage of new functionality
  • Valves and their configuration selected for hydraulic system
  • Valve forces and energy demand are high
  • Fail-safe functions sometimes specified due to removal of one hydraulic control line
Integrated electric valve

- Unique possibility for close integration of actuator and valve.
  - Power efficiency
  - One qualification
  - Targeted condition monitoring
  - Smaller physical size
  - Less weight
  - Less cost
Condition monitoring

• Actuator as a platform
  • Valve signature
  • Vibration
  • Valve internal leakage monitoring
  • Hydrate jamming
  • External load
  • Shutter position
  • Other pipeline parameters can be conveyed through electric actuator
Building blocks - modularity

- Battery/BMS
- Charger
- Motor drive
- Motor
- Gearbox/Screw

- Electric actuators
- Subsea HPUs
Case Study I
Example 5 1/8” - 15ksi Gate valve

Forces:
- Gate drag
- Ejection force
- Hydrostatic force
- Friction force stem seal

Spring failsafe:
- Springs are difficult to produce to required quality
- Springs are big
- Balanced valve cannot be used with spring failsafe! (XT’s)
Size/weight T.C Slab Gate 5 1/8” – 15ksi (3000m)

T.C. Gate Valve 5 1/8”-15k
Hydraulic Actuated
Spring Return Fail to Close
Weight = 4550 kg

T.C. Gate Valve 5 1/8”-15k
Mechanical Operated
Suitable for drop-in Electric Actuator
Fail As Is
Weight = 1400 kg

T.C. Gate Valve 5 1/8”-15k Mechanical Operated Double stem
Suitable for drop-in Electric Actuator for configuration Fail as Is, Fail Close and Fail Open (with battery)
Weight = 1850 kg
## Energy efficiency

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Balanced</th>
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<tbody>
<tr>
<td>Actuator</td>
<td>2.7 kNm</td>
<td>2.7kNm</td>
</tr>
<tr>
<td>Max torque</td>
<td>1900 Nm</td>
<td>1200 Nm</td>
</tr>
<tr>
<td>No. turns</td>
<td>26</td>
<td>8</td>
</tr>
<tr>
<td>Time to open</td>
<td>13 min 25 s</td>
<td>2 min 27 s</td>
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<tr>
<td>Time to close</td>
<td>7 min 28 s</td>
<td>1 min 49 s</td>
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<tr>
<td>Energy to open</td>
<td>266 kJ</td>
<td>20 kJ</td>
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<tr>
<td>Energy to close</td>
<td>92 kJ</td>
<td>10 kJ</td>
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<tr>
<td>Time to recharge (open)</td>
<td>2h 15 min</td>
<td>10 min</td>
</tr>
<tr>
<td>Time to recharge (close)</td>
<td>47 min</td>
<td>5 min</td>
</tr>
</tbody>
</table>

- **Implications:**
  - Less power demand
  - Frequent operation/ testing
Case Study II
22” ball valve

Standard (Worm gear):
- 62 turns

Alternative (Spur gear):
- 19 turns

SAME TORQUE!
## Energy efficiency

<table>
<thead>
<tr>
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<th>Standard</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuator</td>
<td>2.7 kNm</td>
<td>2.7 kNm</td>
</tr>
<tr>
<td>Max torque</td>
<td>1477 Nm</td>
<td>1477 Nm</td>
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<tr>
<td>No. turns</td>
<td>62</td>
<td>19</td>
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<tr>
<td>Time to open</td>
<td>23 min</td>
<td>7 min 8 s</td>
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<tr>
<td>Time to close</td>
<td>19 min</td>
<td>5 min 44 s</td>
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<tr>
<td>Energy to open</td>
<td>352 kJ</td>
<td>108 kJ</td>
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<tr>
<td>Energy to close</td>
<td>262 kJ</td>
<td>80 kJ</td>
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<tr>
<td>Time to recharge (open)</td>
<td>2h 58 min</td>
<td>54 min</td>
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<tr>
<td>Time to recharge (close)</td>
<td>2h 12 min</td>
<td>40 min</td>
</tr>
</tbody>
</table>

- **Implications:**
  - Less power demand
  - Frequent operation/ testing
Integrated electric actuator

• Power interfaces:
  • SIIS L2/L3
  • 400 VAC
  • 400 VDC

• Communication interfaces:
  • SIIS L2
  • Modbus RTU
  • SIIS L3

• Control system redundancy
  • Single
  • Dual
Conclusion

• Energy efficiency is essential

• “Smart Valve” enables predictive maintenance
• Integrated electric valve is the way to accomplish this
Questions?