VALUE PROPOSITION SUBSEA ALL-ELECTRIC

Increasing Shareholder Value with Subsea Electric Actuation Systems

Mark Perry
Global Business Development
WITTENSTEIN motion control GmbH
Subsea Technology DRIVERS

- Environmental risk
- Deeper waters
- Longer step-outs
- Reducing Carbon Footprint
- Reduced HSE issues

- Increased Oil Recovery
- Standardization
- Operational Flexibility

CAPEX & OPEX REDUCTION
Subsea Electric Actuation Technology
SUBSEA ELECTRIC ACTUATION

Today’s ENABLER to Value Improvement
At low Oil price

The average oil price since 1900 is about $35/bbl (inflation adjusted)
Value Improvements

CAPEX SAVINGS
- Topside Space Reduced
- Project Schedule Improved
- Standardization
- Subsea Weight and Space Reduced
- Ultra-Deep Water
- FAST to Manufacture

OPEX SAVINGS
- No High Pressure Hydraulics
- Condition Monitoring
- Reduced Carbon Footprint
- Maintenance Reduced
- No Hydraulic Fluid
- Reduced Logistics
- Reliability

Environmental Sustainability
- High Availability
- Fast to Manufacture
- Reduced Logistics
- BROWNFIELD UPGRADES
- Long Step Outs
Benefits Outlined

SUSTAINABILITY

CAPEX Reduction

OPEX Improvements
ELECTRIC ACTUATION allows

ENVIRONMENTAL SAFETY
ZERO DISCHARGE

Carbon footprint reduced

HSE improved

Hi Safety & Redundancy available to the valve stem

ULTRA – DEEP & Long Step Outs enabled

For 150 wells spread over 300 miles with 19mm HP & LP lines
Hydraulic fluid volume “saved” would be over HALF a MILLION LITRES

source UT2 2007
ELECTRIC ACTUATION Delivers Reduction in CAPEX

6 P XT, 2 WI XT, 1 P Manifold

OPEX savings of 16MM over the life of the field

Source OSS
ELECTRIC ACTUATION Delivers Reduction in CAPEX

Offers average 8% reduction in umbilical $

Example of 6 P XT, 2 WI XT, 1 P Manifold

50 Km umbilical = $2.17 MM savings

✓ Topside HPU footprint gone
✓ Leaks eliminated
✓ HSE improved
✓ Carbon Footprint reduced

Image courtesy of Subsea 7
ELECTRIC ACTUATION Improves Project Schedules

NO HYDRAULIC PIPING

Over 100m of small bore tubing removed from XT with over 300 m reduced on a template

Providing an estimated 30% time improvement
(No: Flushing, Pressure testing, Weld testing, Weld documentation, Inspection)

Weight and Space reduced
ELECTRIC ACTUATION Reduces Downtime

HYDRAULIC failures identified on Production Umbilicals in Offshore Angola:

- **Unplanned** leak repair SPS to Umbilical 2011
  - 150 MUSD

- **Scheduled** critical Umbilicals update 2016
  - 85 MUSD
ELECTRIC ACTUATION Used in Enhanced Oil Recovery

Statoil Asgard subsea Gas compression & process facility is all electric.

All control is via electric actuated modulating valves
- Improved controllability
- Improved resolution
- Improved speed of operation

Will produce an extra 278 MMBOE Over the lifetime to 2050 (13,9B$)

Source Statoil 2011
ELECTRIC ACTUATION Improves Controllability

- **ELECTRIC ACTUATION 5 inch choke**
  - 65,300 position points
  - 16 turns

- **Hydraulic 5 inch choke**
  - 157 position points
  - 16 turns
ELECTRIC ACTUATION Improves Production and Reduces Sand Break Thru.

BROWNFIELD UPGRADES

Statoil Statfjord field in 2001

16 wells were retrofitted with electric actuators delivering a staggering

Increase of 1900b/d in production or

$35 MM per year @ $50perBOE

(Source UT2 Jan 2007)
ELECTRIC ACTUATION Provides Information and Enables Condition Monitoring on the Seabed

- **OPERATIONAL EFFICIENCY IMPROVEMENTS thru**
  - Flight Recorder
  - Finger Printing of valve
  - Partial Stroke Tests
  - Maintenance Diagnostics
  - Speed, Torque, Position

- Increased **UPTIME**
- Enhanced **SAFETY**
- Built to **SURVIVE**
- Environmental **PROTECTION**
- Commission **FASTER**
Integral Valve and Actuator FINGERPRINT

Drivers
Value Improvement
Benefits Outlined
Summary

- Speed
- Torque
- Position

Set point
**SSEAC® ELECTRIC ACTUATION from WITTENSTEIN**
HIGH AVAILABILITY - COMPACT - ACCURATE

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- **3000 m operation**
- **MTBF 400,000 hours**

- Retrofit or Integral mounted

- Vibration, Shock, EMC, Temperature & Pressure resistant ISO 13628-6
- Fail to Safety
- Powered from Surface or SCM (1000v AC to 24v DC)
Benefits

SUMMARY
## Deployments with Global clients since 2001 > 250 subsea units

### Some examples:

<table>
<thead>
<tr>
<th>Project</th>
<th>Units</th>
<th>Year</th>
<th>Application</th>
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</thead>
<tbody>
<tr>
<td>Statfjord</td>
<td>16</td>
<td>2001</td>
<td>Valve actuation</td>
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<tr>
<td>Elvis</td>
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<td>2002</td>
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<td>Orman Lange</td>
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<td>2011-13</td>
<td>Switch</td>
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<tr>
<td>Siemens</td>
<td>3</td>
<td>2012</td>
<td>HPU (Pump Drive)</td>
</tr>
</tbody>
</table>
The Sea Bed

Operator Benefits:

**RETROFIT & GREENFIELD**

**REDUCED MAINTENANCE**
CONDITION MONITORING

**OPERATIONAL EFFICIENCY**
MODULATING CONTROL

**SAFETY & RELIABILITY**
SIL available
Long MTBF

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**Processor / Compressor**
- Subsea Processing of oil/compression of gas enhances field economics by maximizing recovery, increasing production and reducing costs
- WITTENSTEIN delivers 80-100 valve system components for Aasgard

**Xmas Tree**
- Assembly of valves, spools, and fittings used for an oil, gas, water injection, water disposal, gas injection, condensate and other wells
- ~8-10 valves. Choke, Gates, Ball.

**Manifold**
- Structure consisting of pipes and valves and designed to transfer oil / gas from wellheads into a pipeline
- ~2-5% manifolds on the NCS are electrical
- ~18-20 valves per manifold
Increased Functionality:
Operational Efficiency:
Environmental Safety:

OPEX:
CAPEX:
RELIABILITY:
ENABLING:
OPERATIONAL EFFICIENCY:
SUSTAINABILITY:

No hydraulic fluids and maintenance of it.
Reduces overall project costs circa 20%
Facilitates condition monitoring
Longer step-outs and deeper water
Closer control of EOR and Production
Environmentally safe - zero discharge
QUESTIONS?

Sustainability!

ZERO HARM