Deepwater riserless (RLWI) enablers for increased oil recovery.
Bringing shallow water experience to deepwater.
Deepwater RLWI success criteria

RLWI history

Technology Focus

Deepwater Operational Focus

Service enablers
Well operations from various vessel types

- Production logging
- Replacement of in-tubing hardware
- Shifting sleeves
- Well stimulations
- Plug & perforation
- Limited scale and sand removal

- Cement squeeze
- Stimulation, circulation, scale/sand removal
- Fracturing and acidizing
- Sand and scale removal
- Sidetrack drilling

- All of light well intervention & coiled tubing
- Pull tubing, full bore hardware access
- Drilling and milling
- Full P&A scope

Future focus; Develop P&A solutions from more cost optimized vessel solutions
Impact of well intervention; One example from NCS field

![Bar chart showing monthly oil production for different activities: No activity, Drill New, Maintenance.](chart.png)
Successful operations at Statfjord, Visund and Åsgard fields in the North Sea
Riserless Light Well Intervention
Achievements - Examples

Well NCS May 2008

- The well was partly clogged with 1.5” scale layers below the tubing hanger
- Milled out 30 m of scale using tractor and milling tools; speed 0.5 m/hour
- Reperforated and flowed the well

Results:
- Production increased by 8450 bbl/day
- NPV of increased production estimated at 200 MUSD (at 100 USD/bbl)
- Cost of operation = 9 MUSD
Deep water RLWI success criteria

RLWI history

Technology focus

Operational focus

Service enablers
Anticipated RLWI deepwater issues

• Wireline operations:
  – Cable conveyance
  – Jarring operations

• Well access:
  – Line entanglement
  – Difficult running/retrieval
  – Running time
  – Hydrates
  – Response time

RLWI stack 4 umbilical (61 mm OD)
- MEG injection
- Power and coms to the stack
- Power and coms to the XT

Only connection between stack and vessel
RLWI will work in deepwater

- Hydrate prevention
  Studies and extensive tests by third party confirms that FMC has a robust strategy for hydrate prevention
  - Hydrates will not form on the wire
  - The grease itself is an efficient mean for hydrate prevention
  - MEG provides additional protection
- Recent development in wireline tools removes the need for jarring operations
- Surface Read-out Tools knows exact location in well
Capabilities at 2000 m WD

- Fast hydraulic response due to closed loop circuits subsea
  - Significant reduced umbilical size without hydraulic supply from surface
- The flushing speed is maintained compared to a shallow water case
- No spill of hydraulic fluid to the environment
- Communication speed is maintained
- Maintained cutting capabilities
Riserless stack designed to meet deepwater challenges

- Main focus on
  - Deepwater challenges
  - Operational Safety & efficiency
  - Ease of Adaption to Wells
  - Open interfaces towards Vessel

- Operational envelope
  - Main components qualified for 3000 m WD
  - WD down to 2000 m Main bore 7-1/16”
  - System pressures 690 bar

Available for operations Q1 2015
Deep water RLWI success criteria

RLWI history
Technology focus
Operational focus
Service enablers
The West of Shetland experience

The challenge is current, not water depth!
Current Velocity and Drag force

<table>
<thead>
<tr>
<th></th>
<th>Standard Umbilical</th>
<th>West of Shetland</th>
<th>North Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbilical OD</td>
<td>120</td>
<td>51</td>
<td>51 mm</td>
</tr>
<tr>
<td>Current V</td>
<td>3,23</td>
<td>3,23</td>
<td>1,08 Knots</td>
</tr>
<tr>
<td>(V^2)</td>
<td>2,92</td>
<td>2,92</td>
<td>0,31 ((m/S)^2)</td>
</tr>
<tr>
<td>Depth</td>
<td>470</td>
<td>470</td>
<td>121 meter</td>
</tr>
<tr>
<td>(D^*V^2)</td>
<td>1374</td>
<td>1374</td>
<td>38</td>
</tr>
<tr>
<td>Drag*</td>
<td>8,6</td>
<td>3,50</td>
<td>0,1 Tonnes</td>
</tr>
</tbody>
</table>

![Image of Standard Umbilical](image_url)

![Diagram of Drag force](image_url)
Static Finite Element Analyses

- Input: Weight, stiffness, line tension, current
- Calculates drag forces and offset angle
- Conditions
  - Water depth 470m
  - Current 1 year profile applied in 5 steps (similar to what we experienced)

<table>
<thead>
<tr>
<th>Interval</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20 %</td>
<td>47 %</td>
</tr>
<tr>
<td>20 - 40%</td>
<td>41 %</td>
</tr>
<tr>
<td>40 - 60%</td>
<td>6 %</td>
</tr>
<tr>
<td>60 - 80 %</td>
<td>3 %</td>
</tr>
<tr>
<td>80 - 100%</td>
<td>2 %</td>
</tr>
</tbody>
</table>

- Umbilicals plotted for each current velocity interval for clamp tensions 4t and 7t (sum for both lines)
- During operation, the tension is adjusted as required to stay with top angle below 15deg
Handling & weight issue
Deep water RLWI success criteria

RLWI history

Technology issues

Operational issues

Service enablers
Deepwater Service Enablers

A: Dedicated service team consisting of
- Experienced operators and management
- Onshore technical support
- Subsea engineers with operational experience
- Local support

B: Access to world class subsea technology

C: Best in class vessels and crews
FMC Well Intervention Services

Capabilities:
- Riserless Well Intervention (RLWI) Services.
- Riser-based Through Tubing Rotary Drilling (TTRD).
- Deepwater Intervention Services.
- Installation of trees and manifolds.
- Riserless P&A & Completion.

Operations:
- Operating 3 RLWI vessels.
- Operating 1 TTRD system on Songa Dee rig.
- 3 more deepwater RLWI vessels ready for operation late 2015.

Experience:
- Performed well intervention on more than 250 wells since 2003

People:
- Dedicated well intervention group of 250 people with extensive knowledge of well operations.

Established joint company, FMC Technologies Offshore (FTO Services), with Edison Chouest Offshore to take on main contracts as integrated subsea services provider
Riserless Light Well Intervention (RLWI) - a safe and cost-effective method to increase recovery from deepwater subsea wells

Riserless intervention is ready for deepwater
✓ Well access systems ready
✓ Down hole tools already in the market
✓ Vessels available

Thank you!