Case Study (GoM 2016):
Enhanced Production Strategies Throughout Field Life Using Standardised Flow Access Modules (FAM)

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Agenda

• Enpro Subsea background

• Flow Access Modules - FAM

• Case Study - GoM
  • Project Overview
  • Challenge
  • Solution
  • Execution

• Flow Intervention Services - FIS
  • Hydraulic Intervention
Enpro Subsea Overview

- Established 2011
- Patented products for Fluid intervention services & Flow Access Modules
- Integrated solutions provider
- 4 main business units
- Experienced team (worked together for 15 years)
- Track history of industry leading innovation
- Market acceptance; early adopters for each product group in NS, GOM and WA
The Four Business Lines

1. Flow Access Modules ("FAM")
   Multi-Service Hub, Production and Intervention Modules for Greenfield & Brownfield Applications

2. Flow Intervention Services ("FIS")
   Life-of-Field Liquid Intervention and Production Sampling Services

3. Decommissioning
   Attic Oil Recovery and Sampling

4. Project Management
   Project Management Services for Asset Optimisation
• Fluid Intervention – Enabled via FAM hub
• Multiphase Metering – for fiscal and production management
• Flow Assurance – for production injection and integrity
• Multiphase Pumping – for production boosting
• Integrated FAM – multiple services from a single hub
• Sampling – Adjustable Sampling take-off across the Life of Field
• HIPPS – Retrievable HIPPS system for early production and reuse
Flow Access Modules: Case Study

By taking the project specific technologies ‘off the tree’ other project benefits include:
- **Fast track procurement:** earlier procurement of standard architecture, such as, ordering the xmas tree immediately after preFEED
- **De-risk the projects:** enables the use of standard ‘off the shelf’ hardware with robust delivery timeframes
- **Manage the critical path:** undertake concurrent project specific engineering while standard hardware has already been ordered
- **Lower cost:** take advantage of material spec breaks where applicable (equipment located on flowline rather than tree)

**Metering FAM**
- Multiphase Flow Meter
- Water Cut Off Meter
- Acoustic Sand Detection

**Flow Assurance FAM**
- Fail Safe Close Valve
- Chemical Injection Valves
- PT & PTT

**Fluid Intervention FAM**
- Scale Squeeze
- Well Stimulation
- Well Control
Flow Access Modules: Case Study

Project Timeline:

- **Ordered:** October 2015
- **Delivered:** July 2016
- **Mobilised:** August 2016
- **Installed:** September 2016
- **First Oil:** October 2016

From PO to first oil in 12 months
Flow Access Modules: Case Study

Project Challenge:

- 4km tieback
- Project to be completed within 12 months
- Tie-in point was an existing spare slot on PLEM
- Different OEM connector type at either end of tieback flowline
- Production profile dictated enhanced production strategies required
Flow Access Modules: Case Study

Project Solution:

- Use patented Flow Access Module Solution
- Use existing stock tree
- Required no modification to installed manifold
- Locate project specific technologies within the flowline
Flow Access Modules: Case Study

**Project Scope:**

<table>
<thead>
<tr>
<th>item</th>
<th>Equipment</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dual bore gooseneck FAM hub - CVC</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Dual bore gooseneck FAM hub - Torus</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Retrievable Metering Flow Access Module</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Flow Assurance Flow Access Module</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Fluid Intervention Hub</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Associated Shipping &amp; Test Skids</td>
<td>set</td>
</tr>
</tbody>
</table>

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Flow Access Modules: Case Study

Project Engineering:

- Hand Calculation confirms both goosenecks benefit from the addition of bracing to support worst case loads that may be imparted from the flowline.

- FEA used to verify stresses throughout gooseneck remain within allowable.

- Design on N2 Gooseneck required telescoping action. Once landed and locked brace is energised and pinned to provide more rigid structure.
Flow Access Modules: Case Study

Multiphase Metering FAM

- Multiphase Flow Meter (MPFM)
- Water Cut Meter
- Acoustic Sand Detector
- Back seat seal test (dual bore connector)
- CVC connector
- 6” Isolation Valve
Flow Access Modules: Case Study

Flow Assurance FAM

- Flow Assurance Valve
- Chemical Injection (upstream/downstream of FAV)
- PT Sensors (upstream/downstream of FAV)
- Back seat seal test (dual bore connector)
- Torus connector
- 6” Isolation Valve

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Flow Access Modules: Case Study

Hydraulic Intervention FAM

• Acid Stimulation
• Scale Squeeze
• Well Kill
Flow Access Modules: Case Study

Project Manufacture:
Flow Access Modules: Case Study

Project Assembly & Test:
Flow Access Modules: Case Study

Project Mobilisation:
Flow Access Modules: Case Study
Flow Access Modules: Case Study

Project Timeline:

- Ordered: October 2015
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From PO to first oil in 12 months
Delivered project enhanced production strategic objectives for:

- Multiphase metering
- Hydrate remediation
- Future tie in for well stimulation

Delivered with benefits including:

- **Fast track procurement**; enabling earlier procurement of standard architecture
- **De-risk the projects**; enabling the use of standard ‘off the shelf’ hardware
- **De-risk the critical path**; undertaking concurrent project specific engineering
- **Lower cost**; taking advantage of material spec breaks
Flow Intervention Services (FIS)

Hydraulic Intervention

• Enpro personnel have previously been directly involved in the design, delivery and operation of Hydraulic Intervention Systems for operators in North Sea, West Africa & GoM

• Modular System design can be configured to suit a range of operating criteria (depth, pressure and flow rate)

• System can interface with new and existing subsea tie in points (ESSI hub, tree cap, MARS, Unitech etc.)

• Subsea Safety Module configurable to be compatible with range of conduits and deployment methods
Flow Intervention Services (FIS)

Hydraulic Intervention

• Modular System configured to suit a range of operating criteria (depth, pressure, flow rate)
• Subsea Safety Module configurable with range of conduits and deployment methods
• Suitable for Single vessel deployment, saving cost and improving uptime/efficiency

FAM Hub utilised as access point for Hydraulic Intervention
Flow Intervention Services (FIS)

Hydraulic Intervention

**Composite Conduit**
- Working Pressure: 15,000 psi
- Nominal Bore: 3"
- High Flow Rate

**Coiled Tubing Conduit**
- Working Pressure: 15,000 psi
- Nominal Bore: 2 x 2"
- Low-Mid Flow Rate
Thanks - Questions?

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