Case Studies in ‘flow access module’ applications providing multiple life of field solutions using standard Xmas trees and Manifolds

“Smart Standardisation”
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Enpro Subsea Background

Established 2011, headquartered in Aberdeen with office in Houston

Patented products for Flow Access Modules, Flow intervention services & Decom

Demonstrable record of delivering fast track projects

Field development group is a multi-discipline team with full suite of project execution capabilities in house, including technical assurance and analysis

Experience of executing projects in UK, GoM and West Africa with established supply chain to support

Integrated Management System to ISO accreditation, ISNet & FPAL
Enpro Subsea are production optimisation specialists

**fam**
- SMART Standardisation
- Retrievable Jumper Modules
- Provides Life of Field flexibility to standard subsea hardware
- Enable project specific technologies within FAM
- 35 wells in 18 months

**fis**
- Field Proven System for Low Cost Hydraulic Intervention
- Up to 3000m, 15ksi, 30 bbl./min
- Single or Dual Conduit
- Passive & Active disconnect

**fdecom**
- Decommissioning of GBS structures
- OSPAR Annex II Compliance
- Characterisation and removal of cell contents

**fdev**
- Field Development Engineering
- Integrated Support for opportunity ranking and decision-gate support
- Technical Assurance
- Project Execution, Management & Support

**Standardisation with Flexibility** delivering **ENhanced PROduction**
Provides Life of Field flexibility to standard subsea hardware

- **Retrievable Modules** located within the jumper (independently retrievable)
- Enables operator to locate project specific technologies within FAM supporting the use of **Standard Trees & Manifold**
- **Located at XT or Manifold / PLEM** end of rigid or flexible Jumpers
Operator Purpose:
- Understanding well performance in a cost effective manner is key to maximising asset value

FAM Vision:
- Enable Operator to effectively optimise well performance over field life

Value Drivers:
- improved project schedule
- improved well and reservoir management
- Transforms operational flexibility

Enabler:
- Flexibility, no need to design in on day one
- Be guided by the reservoir and change out FAM as conditions dictate
- Utilise “off the shelf” hardware
FAM: Multiple Locations

- Multiple locations (XT, Manifold, PLEM, Mudmat)
- Multiple OEM Connectors (Clamp or Collet)
- Rigid or Flexible Jumpers
- Vertical or Horizontal connections

- Manifold location
- Clamp connection
- Rigid jumper

- XT location
- Horizontal connection
- Flexible jumper

- XT location
- Vertical connection
- Flexible jumper
FAM: North Sea

- FAM Enabled DMAC Jumper
  - DMAC Greenfield Solution
  - Integral FAM Hub
  - DMAC Retro-fit Brownfield Solution
  - FAM Adaptor Hub
• Flanged Connection (Diver)
  • Diver removes existing flanged jumper (rigid or flexible)
  • Extended “over trawl” legs installed to provide protection to FAM (if required)
  • Diver installs FAM Dual Bore Access Hub
  • Diver re-connects existing jumper
  • Metering FAM installed - run on wire with integral passive soft land
  • Alignment funnel and land out plate omitted for clarity
FAM hub:
Multiple OEM Connection Types
Case Study 1 - GoM

Drivers

- Complete 4km tieback within 12 months
- Use existing stock tree
- No modifications to existing installed manifold
- Different OEM connector type at either end of tieback Jumper

- Multiphase Flow Meter (MPFM)
- Water Cut Meter
- Acoustic Sand Detector

- Flow Assurance Valve
- Chemical Injection
- PT Sensors
Delivered project enhanced production strategic objectives for:

- Multiphase metering
- Hydrate remediation & Flow Assurance
- Future tie in for Hydraulic Intervention

Delivered with benefits including:

- Fast track procurement; enabling earlier selection of standard architecture (XT)
- De-risk the project; use of standard hardware & undertaking concurrent project specific engineering
- Lower cost; taking advantage of material spec breaks
Drivers

- Operator wants existing technologies retrievable independently of rigid Jumpers
- Defer costs – no need to bolt in technologies on day one of production, can be installed after jumper
- Simplify Jumper fabrication and installation

Scope

- 10x Dual Bore FAM Hubs on Production Jumpers
- 5x Single Bore FAM Hubs on Injection Jumpers
- Brown & Green field
- Rigid (insulated) Jumpers
Case Study 3 - West Africa

- Dual Bore FAM hub on all production jumpers
- Single Bore FAM hub on all water injection jumpers
Case Study 3 - GoM

Drivers

• Operator wants MPFM retrievable independently of rigid Jumpers
• Standardised Hub design for both 10k and 15k manifolds (future proof)
• Flexibility to incorporate latest MPFM spec & integrate legacy MPFM types

Scope

• 11x FAM with MPM Meters
• 10k & 15k Modules
• Manifold Location
• Rigid Jumpers
Case Study 4 - GoM

Drivers

• Use proven successful ‘fast track’ model similar project
• By locating project specific technologies within the FAM modules operator was able to use an existing “stock” XT and tie back to an existing manifold slot with no modification
• FAM redeployed from similar project

Scope

• Metering FAM & Flow Assurance FAM
• 10k Modules
• XT & Tie In Skid Location
• Flexible Jumpers
GoM Operator used FAM to integrate 3 variants of MPFM with common standard interface.

**MPFM Meter Types**
- **10k Op1 – 1,065mm**
  3.06” 10k API Studded Flange
- **10k Op2 – 1,150mm**
  3.06” 10k API Studded Flange
- **15k – 1,150mm**
  3.06” 15k API Studded Flange

Adaptor spool accommodates variance in Meter height / flange type.

- **15k FAM Hub interface**
  (common)
Extended version of the ESSI Flow Through Hub allows for one to all of the following:

- Water cut meters (shown below)
- Erosion detectors
- Corrosion detectors
- Pressure sensors
- Temperature sensors
- Salinity sensor
- pH sensor
FAM: Applications

Sampling FAM

- Full bore connector - no throttling of flow
- Easy retrieval for bottle change out etc.
- Gas Sampling 1000cc upwards capability
- Liquid Sampling 700 cc upwards capability
- Extracts liquid sample from well flows to 95% GVF
- Adjustable Sampling take-off across the Life of Field

Combined Metering & Sampling FAM

- Continued production during Sampling
- Adjacent wells can be sampled consecutively without retrieval to surface
- Consecutive Samples from a single well can be taken without retrieval to the surface.
Studies show that for a short tieback, the net savings in the material and fabrication of the lower rated flowline offset the incremental cost of incorporating a subsea HIPPS.

- SIL 3 Retrievable HIPPS module in accordance with API 17O
- Permits capture of high pressure wells using pre-existing low pressure infrastructure
- Retrievable / Re-deployable – after change in reservoir conditions
- Removes need for structure / foundations for manifold HIPPS
- HIPPS trip only shuts in single well
- Subsea safety system utilises a subsea safety PLC (HIMA F35) within the SCM
- HIPPS SCM communicates directly to the topside MCS via the subsea comms system.
**Pump - FAM**

- Single well pump solution
- 400m – 3,000m water depth
- Collaboration with pump vendor

**Sand KO - FAM**

- Compact Footprint
- Particle Separation to 150 micron (Solids Filter Separation)
- Holding Capacity limited by weight
Pre-commissioning / Decommissioning

Pig Launcher / Receiver
- FAM dewatering module, infield flowlines
- Launch and receipt of dewatering pigs
- Proven technology integrated within FAM

Hydrate Remediation Microbore coil tubing
- Mechanical reentry via 3D/5D bends
- Precision placement of chemical treatments
- Methanol placement for hydrate remediation

Pre-commissioning - Glycol Sampling

Objective: provide a subsea retrievable continuous sample of MEG slug during commissioning of subsea pipelines.

Uses differential pressure across the flow diverter valve to drive a small flow of Mono Ethylene Glycol into each sample bottles.

Benefits:
- Designed for average glycol sample in each pigging run
- Eliminates need for module retrieval between pigging runs
- Lightweight and ROV Operable
FAM: Applications

Dual Hub Jumper

- Enables make up of 2x Jumpers to 1x OEM Connector (at manifold)
- Option to consider composite jumper to reduce loads

- VCS Jumper with Destec FAM Hub installed
- FAM Jumper deployed
- Both jumpers made up
FAM: Catalogue

- **Applications**
  - Multiphase Metering
  - Hydraulic Intervention ✓
  - Water Cut Measurement
  - Erosion Detection
  - Solids Management
  - Fluid Sampling
  - Multiphase Pumping
  - HIPPS
  - P & T Instrumentation
  - Flow-thru (contingency)

- **Interface**
  - OEM Connector Type
    - Aker KVL8 ✓
    - FMC Taurus
    - OneSubsea CVC
    - DMAC
  - Connector Orientation
    - Vertical ✓
    - Horizontal
  - Nominal Bore Size
    - 3”
    - 4” ✓
    - 5”
    - 7”
  - Pressure Rating
    - 5ksi
    - 10ksi ✓
    - 15ksi

- **Location**
  - Infrastructure
    - Tree ✓
    - Manifold
    - PLEM / PLET
Field proven Intervention System for Low Cost Hydraulic Intervention

- Configurable to a range of operating criteria
  - Depth up to 3,000m / Pressure – up to 15k / Flow Rate – up to 30bbl/min (limited by conduit)
- Compact footprint, minimal deck space and ease of deployment
Enpro Subsea

... adding life of field strategic flexibility to standard subsea hardware

Future Proof
• USB for adapting technology, ensuring future proofed strategic agility throughout the life of field

Improve Capital Efficiency
• Provides flexibility and reusability to standard/stock subsea hardware without sacrificing functionality
• FAM transforms the capital efficiency of subsea tie backs
• Faster, lower cost projects delivering early first oil

Enhanced Production
• FIS delivers cost effective Hydraulic Intervention,
• Maximising production from existing subsea assets

Proven Track Record
• Track record of successfully delivering fast track projects globally
• Agile and responsive team, dedicated to delivering on our commitments
Case Studies in ‘flow access module’ applications providing multiple life of field solutions using standard Xmas trees and Manifolds

“Smart Standardisation”
Retrofit and New Field Development
Adopted for 35 wells in 24 months

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