Thermoplastic Composite Pipe
First Permanent Subsea Jumper Installation and Qualification for Deep Water
Thermoplastic Composite Pipe - TCP

• Flexible pipe (reelable), non-corrosive, light weight
• Solid wall pipe: melt-fused liner, composite laminate and coating
• Fit for purpose material selection:
  • Glass or carbon reinforcement fibres
  • Polymers include PP, PE, PA, PVDF, PEEK
TCP End Fitting

- Simple and robust mechanically clamped design
- Easy and quick to install
- Assembly and FAT at factory OR termination in field
- Material & flange options to client specification
Building Track Record – Staircase Approach
TCP Jumper Spools – Chevron Alder Jumper

• High pressure methanol service, design pressure 12,500 psi
• 1 inch ID, length 120m (manifold to well)
• Installed September 2016
• Now sitting at 622 bar lock-in pressure

Source: Chevron
Qualification – TCP Design Methodology

Material test results → Material → Material model → Stiffness → Loads and geometry → Finite Element Analyses

Material test results → Validation → OK? → Strength → OK? → Stress and strain

Testing pyramid:
- Full Scale
- Representative Pipes
- Laminate level
- Ply level
- Constituent level – Polymer & Fibre
Qualification – Full Scale Testing

• Burst, collapse, long term, etc
• Failure prediction based on coupon strength
• Failure mechanism and failure load must be in line with predictions (as per DNVGL RP-F119)

Source: Chevron
Chevron Alder - Interface Testing

Wellhead/Tree Interface

Pipe Spool

Manifold Interface

Source: Chevron
Chevron Alder - Offshore installation

- Installation vessel - Technip DSV
- Jumper installation – 13 hrs
  (Overboarding, Layout, Hook-up)
- Concrete mattressing – 13hrs
TCP Jumper Spools – General Benefits

• **Flexibility !!**
  - Large absorption of tolerances & pipeline movement
  - No critical path metrology and fabrication required
  - No loss of flexibility under pressure
  - Low interface loads (on connectors and structures)

• **Procurement & fabrication**
  - No complex geometries, pre-manufactured
  - No expensive buoyancy
  - Shorter lengths/configurations compared to flexibles
  - Local end-fitting termination

• **Transport & installation**
  - Various installation methods possible incl. flex lay method (VLS/HLS), ‘rigid’ method (spreader bar) and subsea carousel/coil
  - Low spec installation vessel requirements
Ongoing Client Qualifications for TCP Jumper

• Qualification projects ongoing with Total and Shell
• Application: deepwater well jumpers
• Materials EGF/PE and CF/PA12
• Diameter upto 6 inch, design pressure upto 10,000 psi
• Qualification according *DNVGL RP-F119 for TCP* and client specific requirements
• Both projects will be completed mid-2017
Under development – TCP Riser (Deepwater)

• Technical feasibility demonstrated for Free Hanging Catenary TCP Riser on Libra
• High cost savings per riser! – no buoyancy needed, quicker installation
• Working with EPC contractors on cost effective configurations utilizing low weight of TCP
• CF/PVDF material qualification ongoing

Source: Saipem
Summary

• TCP intervention track record paved the way for SURF applications
• Increasing acceptance of TCP by major operators
• First SURF applications for TCP are now reality – in operation since 2016 on Chevron Alder
• Strong business case for jumpers and risers - 60% cost reduction compared to steel jumpers
• Scalable, design based qualification method allows for efficient project implementation