

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

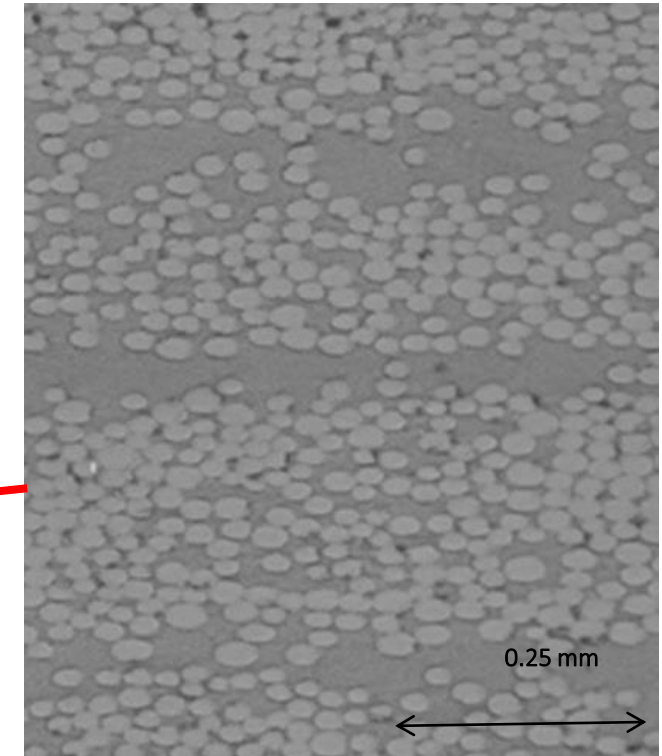
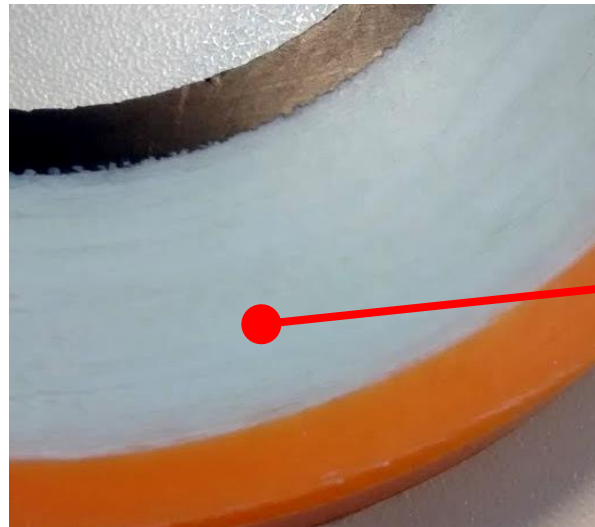
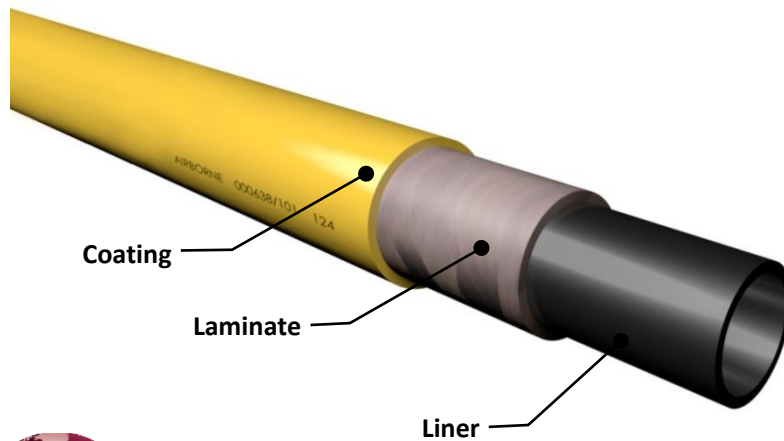
Bart Steuten

Airborne
Oil & Gas



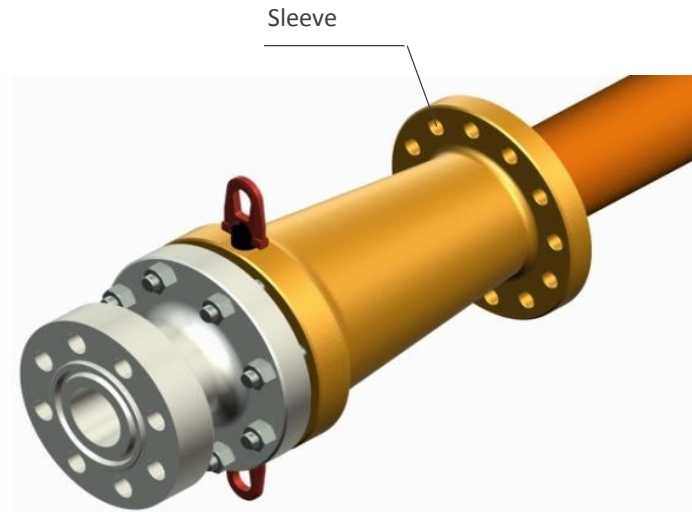
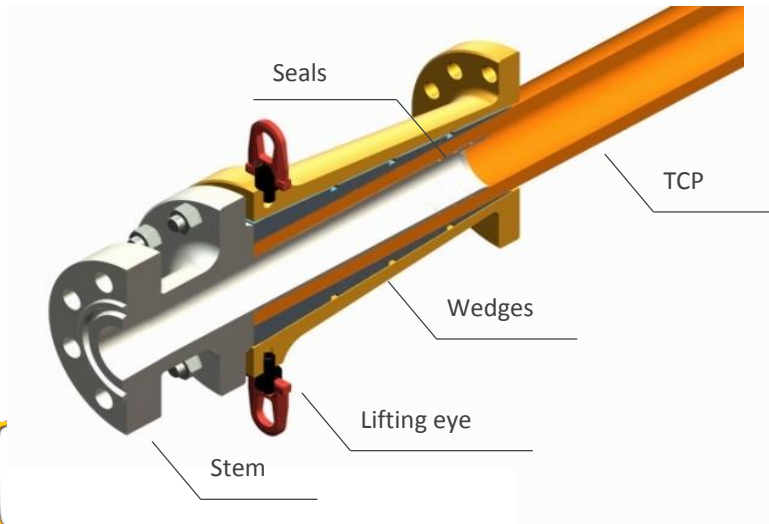
Thermoplastic Composite Pipe - TCP

- 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

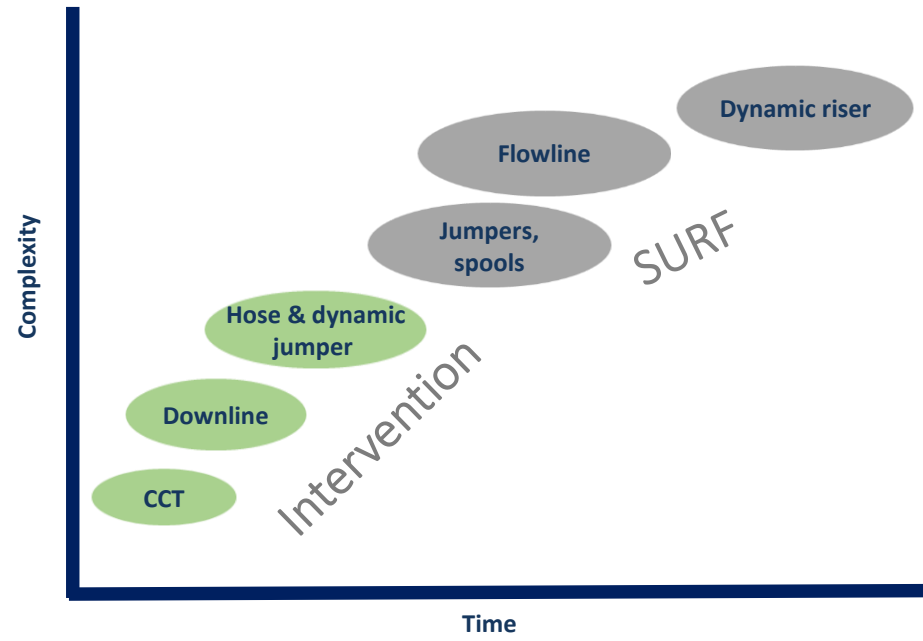


TCP End Fitting

- 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



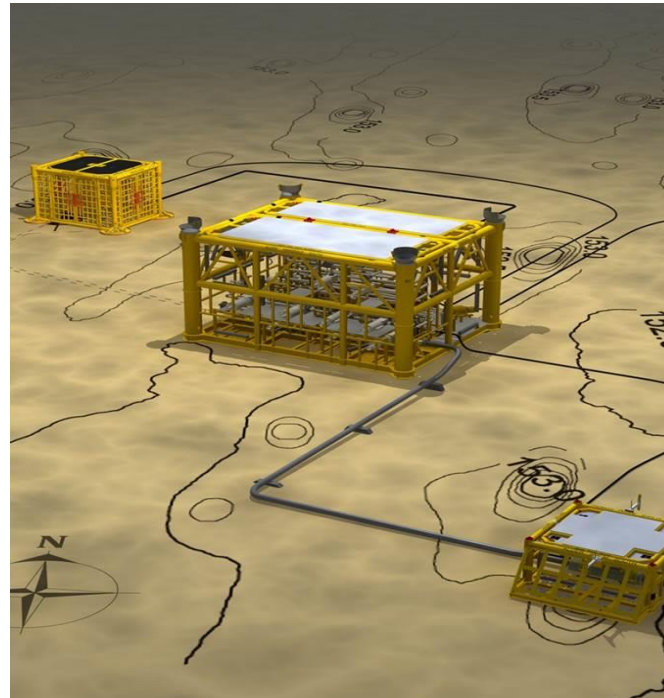
Source: Saipem



Source: Subsea 7 and IKM

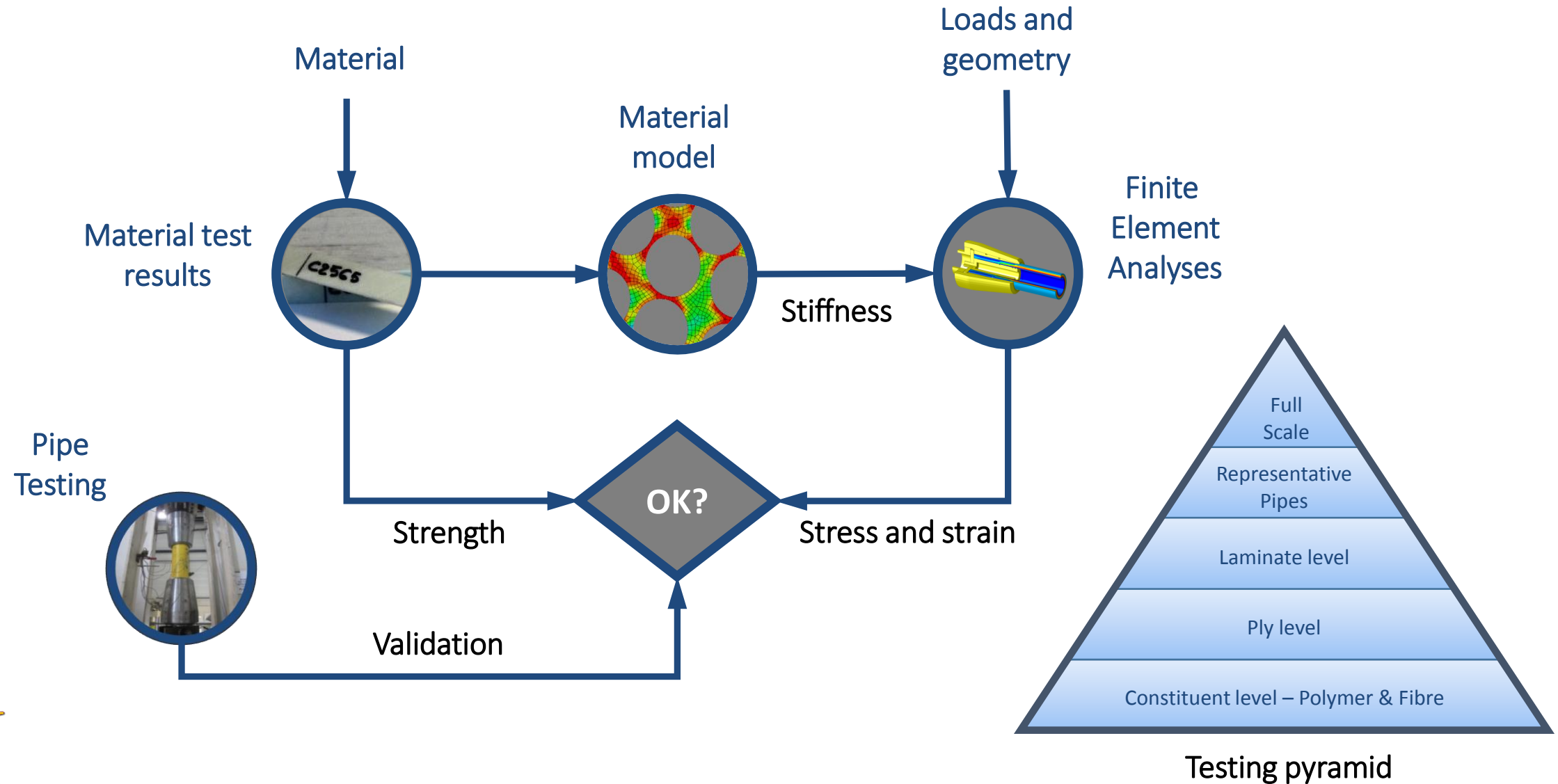
TCP Jumper Spools – Chevron Alder Jumper

- 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



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

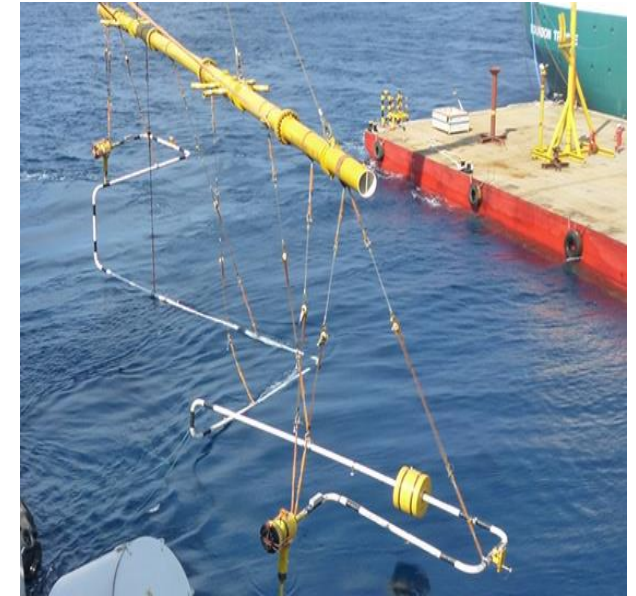
- Installation vessel - Technip DSV
- Jumper installation – 13 hrs
(Overboarding, Layout, Hook-up)
- Concrete mattressing – 13hrs



Source: Chevron

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

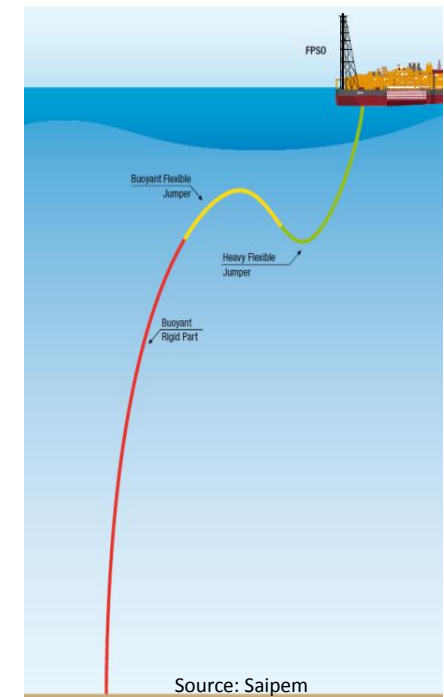
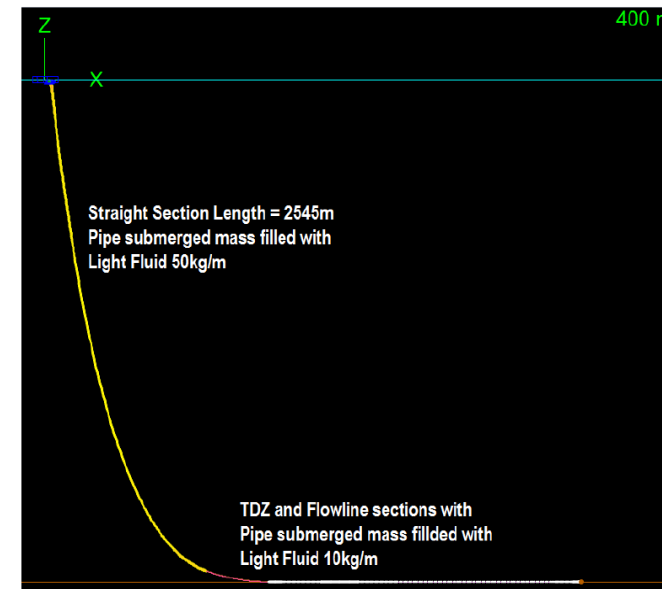


Ongoing Client Qualifications for TCP Jumper

- 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



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

