Installation of world's 1st subsea thermoplastic composite pipe jumper on Alder

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Presentation overview

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**Thermoplastic Composite Pipe (TCP)**

**TCP concept**
- Solid pipe structure: bonded
- Fit for purpose polymer: liner, matrix and coating
- Glass or carbon fibres fully embedded (true composite)
- Protective coating

Source: Airborne
Thermoplastic Composite Pipe (TCP)

End fitting
- Easy to install (within 2 hours)
- Can be field terminated
- Several material and flange options
- Fully qualified

Source: Airborne
Alder – a challenging project

- Chevron equity 73.7 percent
- Chevron operated
- Subsea tie-back to Britannia Platform
- North Sea (United Kingdom Continental Shelf)
- High pressure reservoir – 12500psi
- 7+ technology firsts in the project for Chevron

Source: Chevron
Alder – Thermoplastic Composite Pipe (TCP) jumper

TCP application
• Methanol injection jumper
• 126 meters long
• 1” inside diameter
• 0°C to 20°C operating temperature
• Material E-glass / polyethylene
• 12500 psi maximum design working pressure
• 150 meters water depth
• 1 meter minimum bend radius

Main TCP benefit
Flexibility / lightweight enabling remotely operated vehicle manipulation subsea

Source: Chevron
Thermoplastic Composite Pipe (TCP) jumper – design

Standard based on DNVGL-OS-C501 and -A203
- Predecessor of DNVGL-RP-F119 TCP for subsea use

Design methodology following load and resistance factored design: L<R
- Resistance – strength, adjusted for variability in strength and failure criterion
- Load – stress, adjusted for uncertainties in load effects and modelling

Safety class ‘high’ leading to highest safety factors
- Default as used by Airborne Oil & Gas for this application

Finite element modelling in combination with full scale testing
- All relevant single and combined load cases in all phases of life
Qualification - approach
Qualification – design methodology

Material test results → Material → Material model → Stiffness

Thermoplastic Composite Pipe testing

Strength → OK? → Validation

Stress and strain → Finite Element Analysis → Loads and geometry

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Qualification – loads

Loads assessed with finite element analysis

Through life loading considered:
• Factory acceptance test
• Transport
• Installation
• Operation
• Maintenance

Interactions with environment included:
• Seabed
• Mattresses
• Currents
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

Source: Chevron
Offshore installation preparation
interface testing

Unitech Connector Interface
Pipe Spool
Manifold Interface

Source: Chevron
Offshore installation – preparation transpooling

Source: Chevron
Offshore installation

Installation vessel
• Technip Dive Support Vessel

Jumper installation
• 13 hours (overboard, layout and hook-up)

Concrete mattressing
• 13 hours

Source: Chevron
Conclusions and lessons learned

• Successful installation of first Thermoplastic Composite Pipe (TCP) in a permanent installation subsea worldwide
• Pipe in operation since 1 November 2016
• Successful joint effort involving Chevron, Airborne Oil & Gas, Technip and Flowline Specialists
• Product more robust in handling than expected
• Installation from subsea carousel worked well
• Product weight vs stiffness managed during installation
• Involvement and input of Airborne Oil & Gas at interface trials and transpooling key for success
• Concrete protection mattresses worked well for short length of TCP on seabed
Thank you

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