



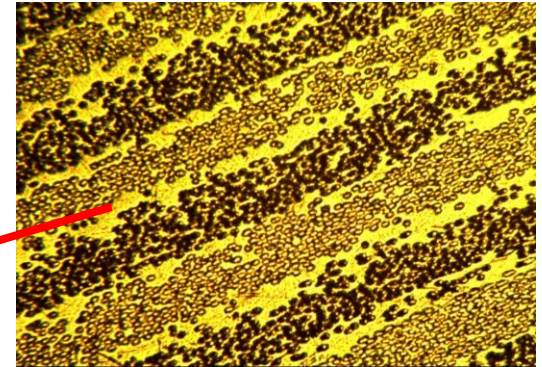
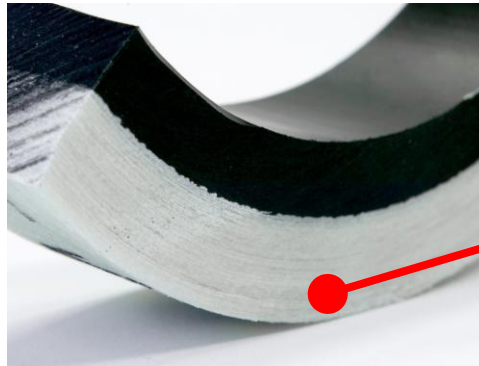
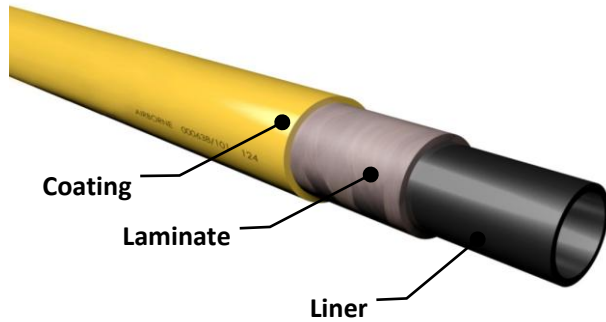
Industry adoption of game changing Thermoplastic Composite Pipe

Eric van der Meer

KIVI, Feb 2017, Den Haag

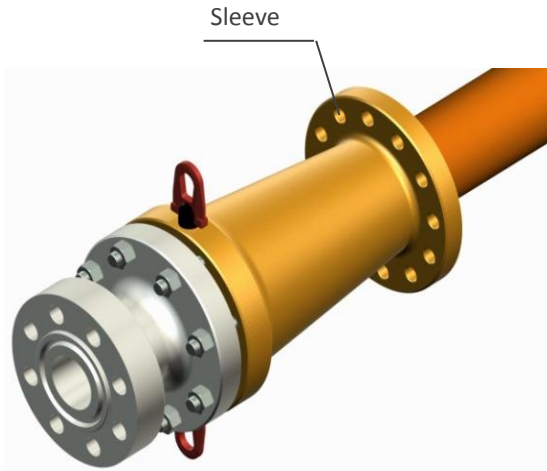
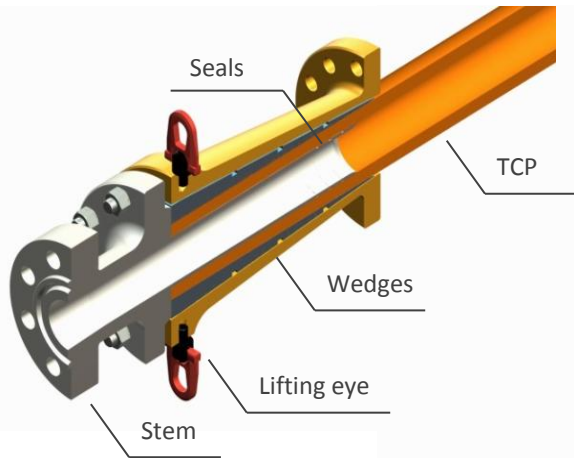
Thermoplastic Composite Pipe (TCP) - Concept

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



Thermoplastic Composite Pipe (TCP) - End-Fitting

- Easy to install within 2 hours, field terminated
- Several material & flange options
- Fully qualified



Thermoplastic Composite Pipe (TCP) - Manufacturing

Airborne Manufacturing plant

- World's first full scale thermoplastic composite pipe plant
- Sizes from 1 to 7.5 inch ID (equiv. to 8" nominal pipe size)
- Continuous length - 3000+ meters per spool
- Strategically located in Amsterdam Port Area



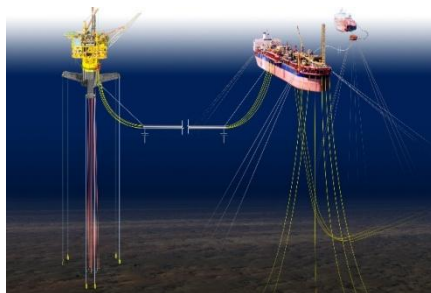
TCP: Products

Subsea Umbilicals Risers Flowlines

Flowlines & Spools



Risers



Subsea Light Well Intervention

Dynamic Jumpers & Hoses



Downlines



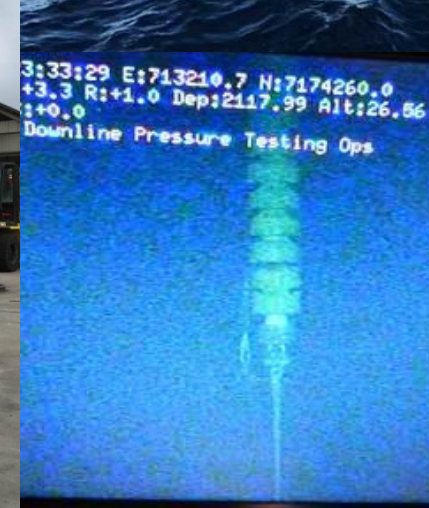
Key Proposition

- | | | | |
|--|---|--|--|
| <ul style="list-style-type: none"> ▪ No corrosion ▪ Lower total installed cost ▪ Lowest total cost of ownership | <ul style="list-style-type: none"> ▪ 50% weight reduction ▪ Lower riser cost ▪ Lower installation cost | <ul style="list-style-type: none"> ▪ Collapse resistant 3000 m ▪ Smooth bore ▪ Flexible | <ul style="list-style-type: none"> ▪ High flowrates ▪ Lower cost per intervention ▪ Long service life |
|--|---|--|--|

Key Applications

- | | | | |
|--|--|---|---|
| <ul style="list-style-type: none"> ▪ In-field flowlines ▪ Spools & well jumpers ▪ Gas, water & HC service | <ul style="list-style-type: none"> ▪ Deepwater ▪ Corrosive environments ▪ Gas, water & HC service | <ul style="list-style-type: none"> ▪ Light well intervention ▪ Plug & Abandonment ▪ Pipeline pre-commissioning | <ul style="list-style-type: none"> ▪ Light well intervention ▪ Plug & Abandonment ▪ Pipeline pre-commissioning |
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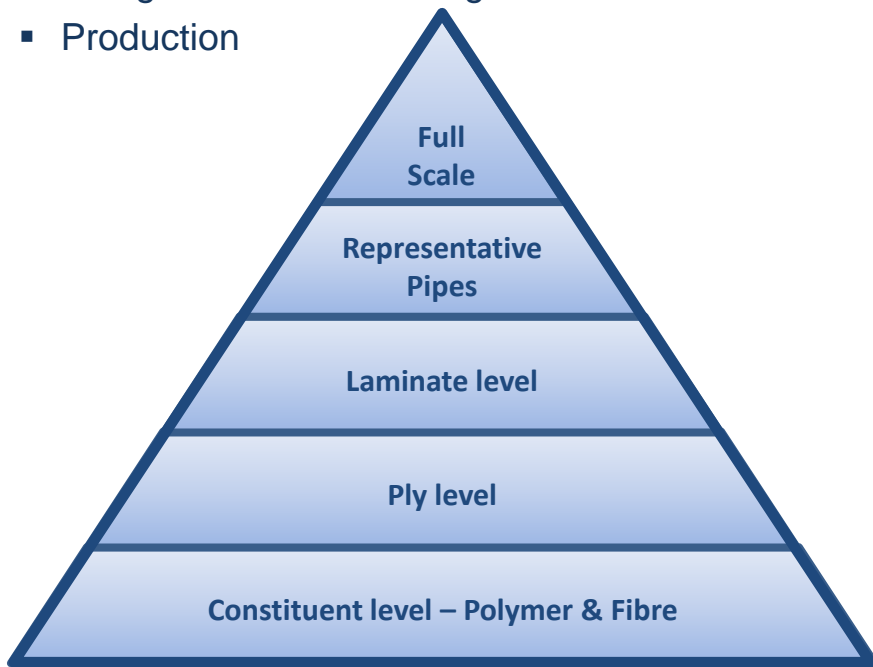
Proud of our Track Record



TCP - Qualification

Generic

- Airborne Oil & Gas is the world's first company qualified in accordance to DNV RP F119
- Materials: E-glass PE (others in progress)
- Design: TCP & End-fitting
- Production



Product

Dynamic Jumpers



Spools



Flowlines

PETRONAS



In progress

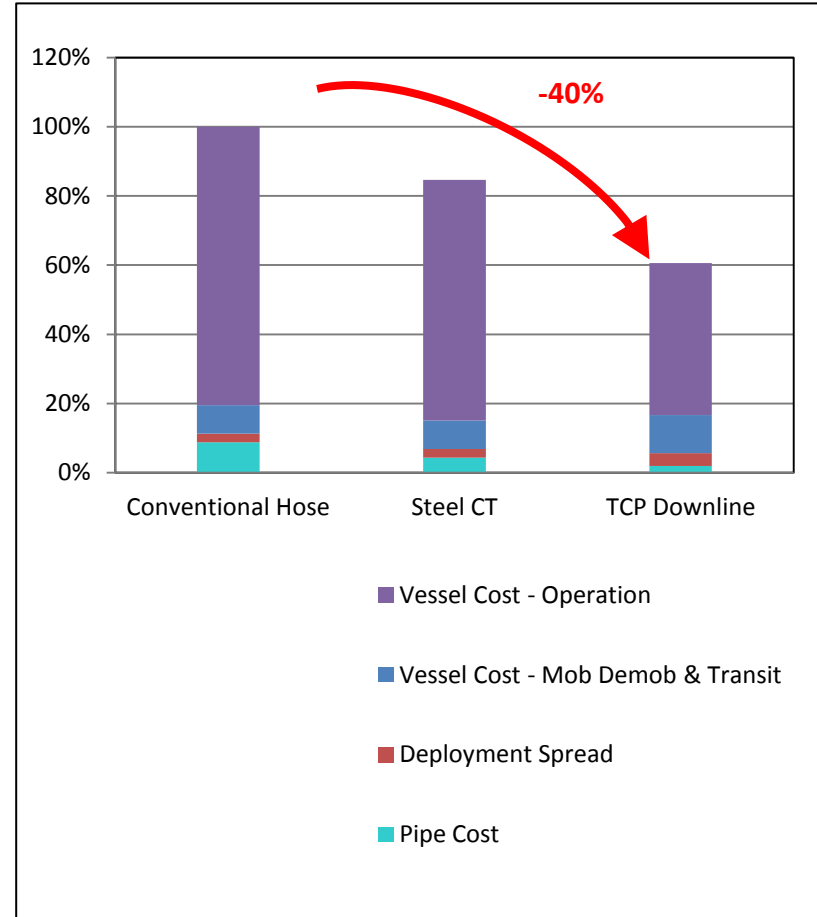
TCP Downline

- **Field proven:** 65+ deployments to date
- **High flowrates:** one 3" ID coil = 25 BPM
- **Lower cost per intervention:** Multiple operations per year, for years, with one downline
- **Easy and safe to operate:** light-weight, no spring effect, no weight requirements, one single length no midline connections
- **Fast running:** 2,5 hrs to 2100 meters water depth, no clamping of ballast or buoyancy during deployment



TCP Downline – Reducing Cost per Intervention

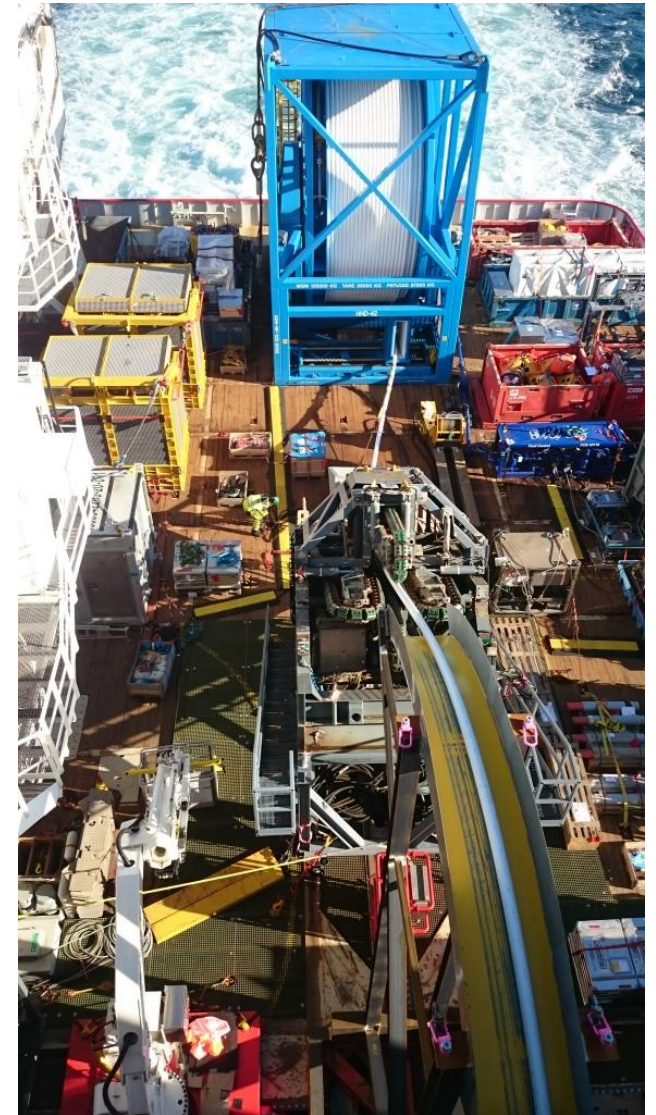
- Fastest deployment, reducing vessel time
- One single conduit, fast hook up and short pressure testing
- 200+ deployments per pipe, superior fatigue performance



TCP Downline

Latest project :

- Statoil - Asta Hansteen
- Client - Subsea 7/IKM testing
- Pipeline precomm - 19 deployments completed to date



TCP Jumper

- **World's only smooth bore, non-collapsible flexible jumper**
- 1" to 3" ID
- 10 ksi & 15 ksi
- Vacuum capability
- Can pump cement (smooth bore)
- High flowrates
- Field terminated
- Coating repair



TCP Jumper - deployment



TCP Flowline & Jumper Spools

- Up to 7.5 inch ID
- Up to 690 bar/10ksi
- 2500-5000m in one length
- Fit-for-purpose material selection
- No corrosion
- Flexible
 - Simplifying configuration
 - Simplifying installation
 - Allowing reel lay



→ *Lower Total Installed Cost*

→ *Lower Total Cost of Ownership*

TCP Flowlines – Life Cycle Cost

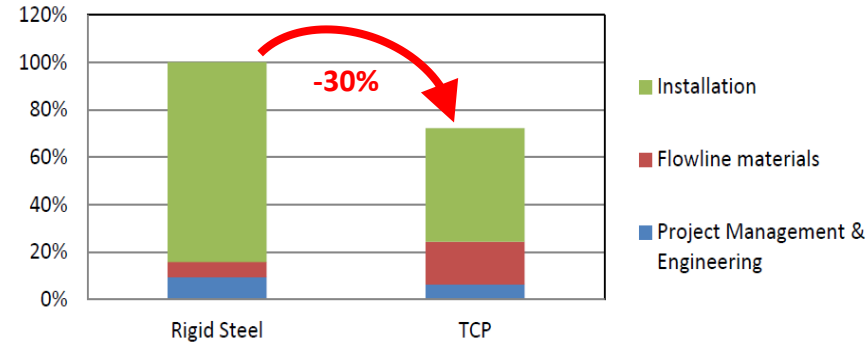
Comparison with steel:

- **Lower Total Installed cost (CAPEX)**
 - ✓ Less seabed intervention works
 - ✓ No PLET, no spools, no metrology
 - ✓ No diving
 - ✓ Low installation vessel day rates

- **Lower Operating Cost (OPEX)**
 - ✓ No corrosion, no corrosion mitigation
 - ✓ Smooth bore, better flow
 - ✓ Less inspection, less pigging
 - ✓ Long design life

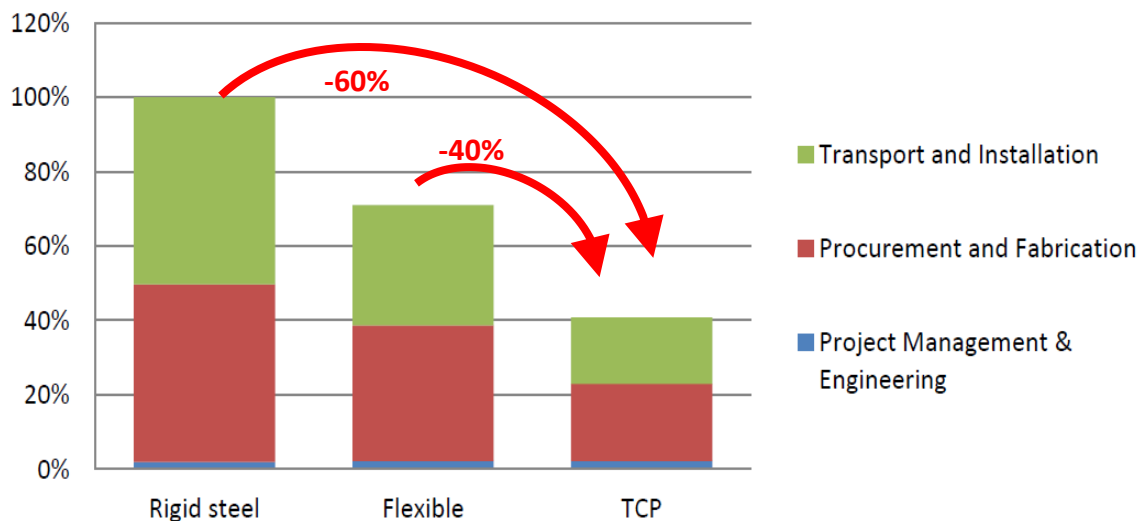
Comparison Total Installed Cost

Rigid Steel - TCP



TCP Jumpers Spools – Total Installed Cost

- **Lower Total Installed Cost with TCP**
- ✓ 60% cost reduction compared to steel*
- ✓ 40% cost reduction compared to unbonded flexibles*



*Overall as-installed cost based on 5 well jumpers

Ready for business

