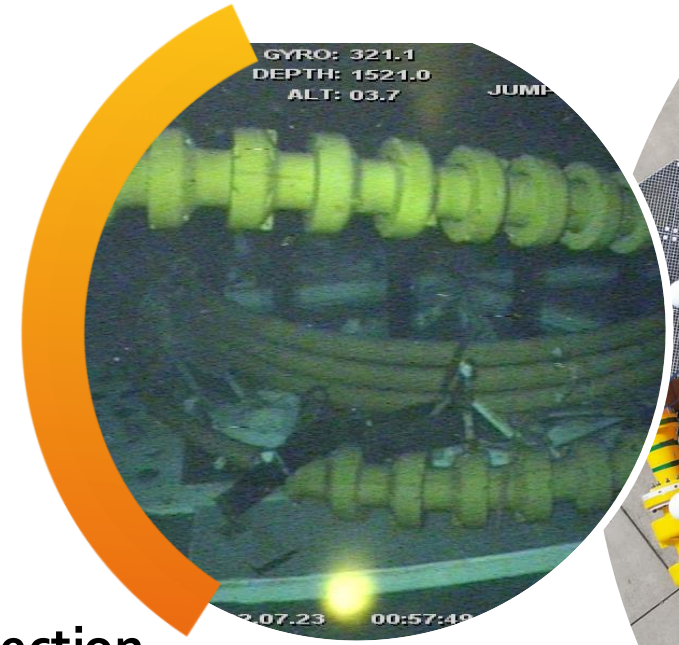
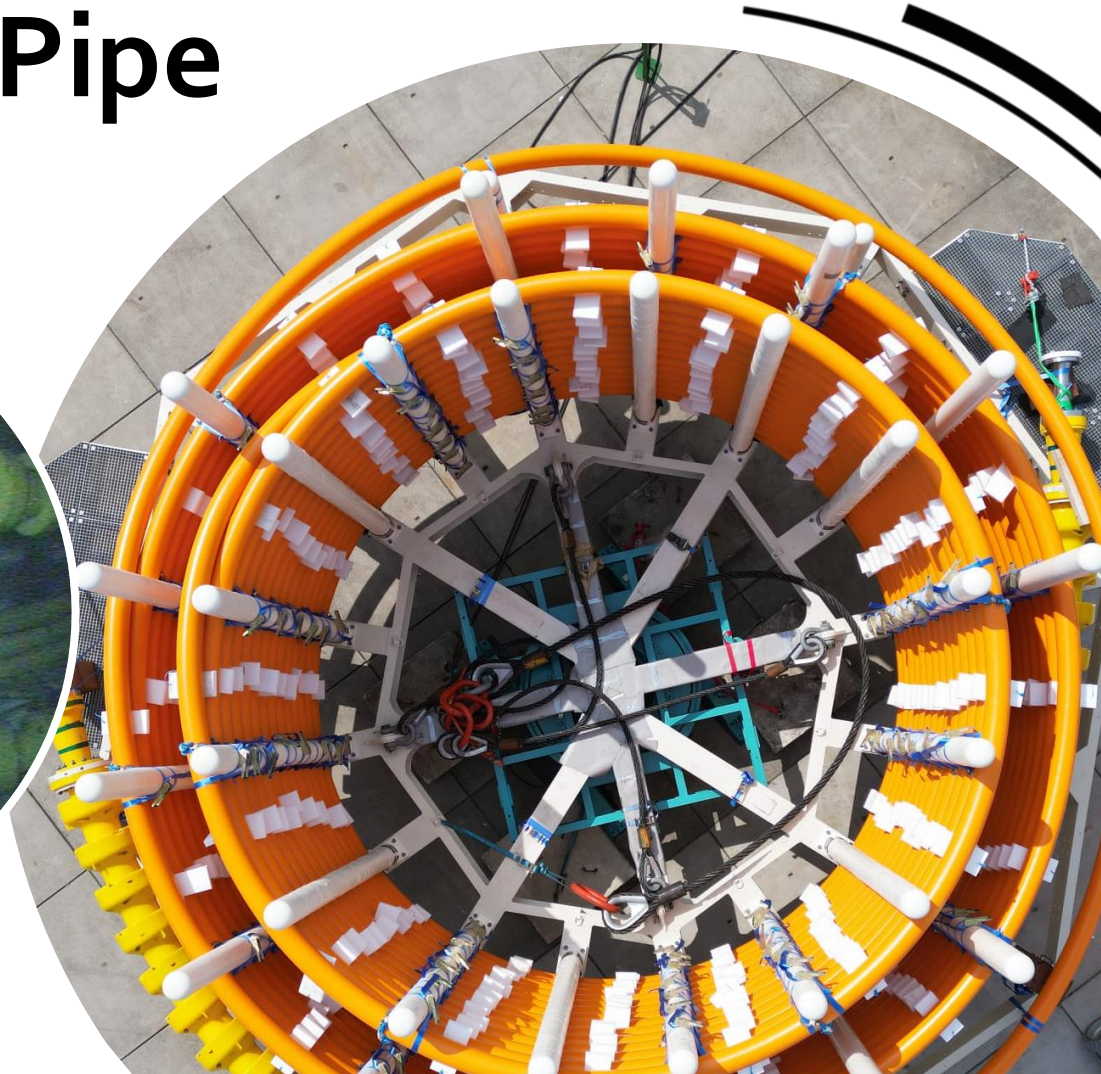
Thermoplastic Composite Pipe

A credible, system-level alternative for deepwater injection service





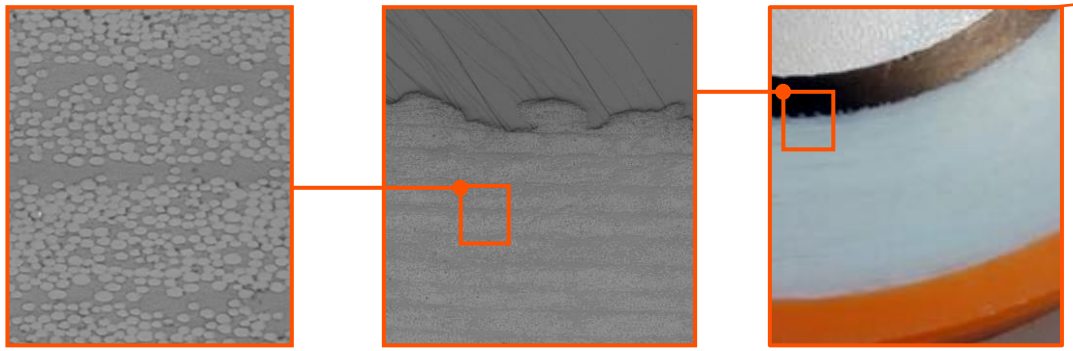
Screening TCP for water & gas injection

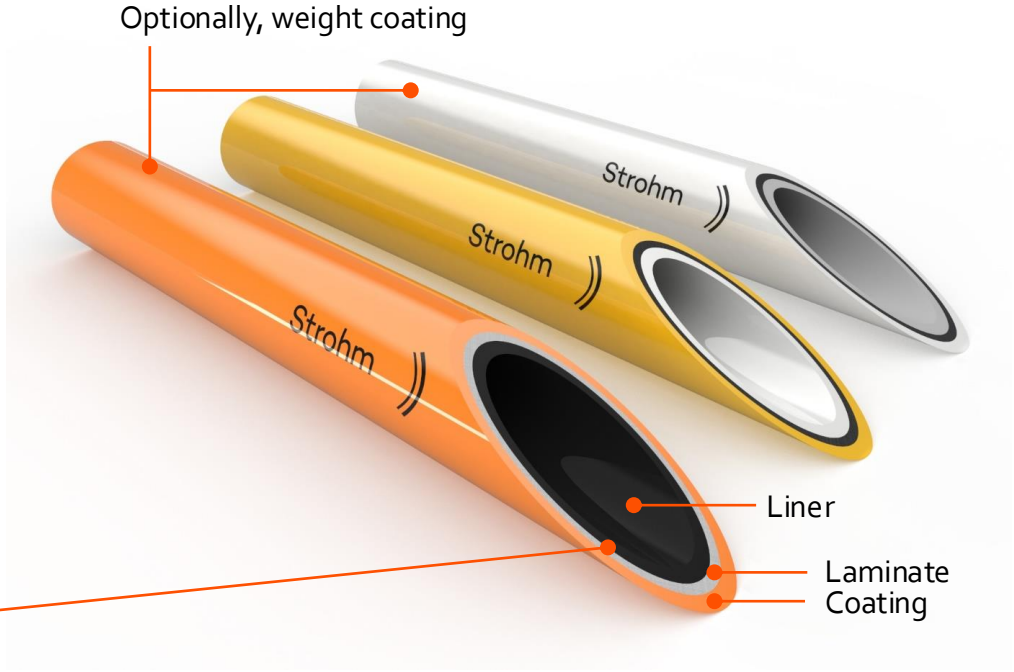
Namibia Oil and Gas Conference

Introduction to TCP Technology

Technology foundation

- Three-step fully bonded system: liner, composite, coating
- Composite layer: glass/carbon fibre in a thermoplastic matrix
- Non-corrosive, fully spoolable, continuous lengths
- Lightweight vs. equivalent steel or unbonded flexible pipe





Coating — thermoplastic outer protective layer

Composite — fibre/thermoplastic matrix

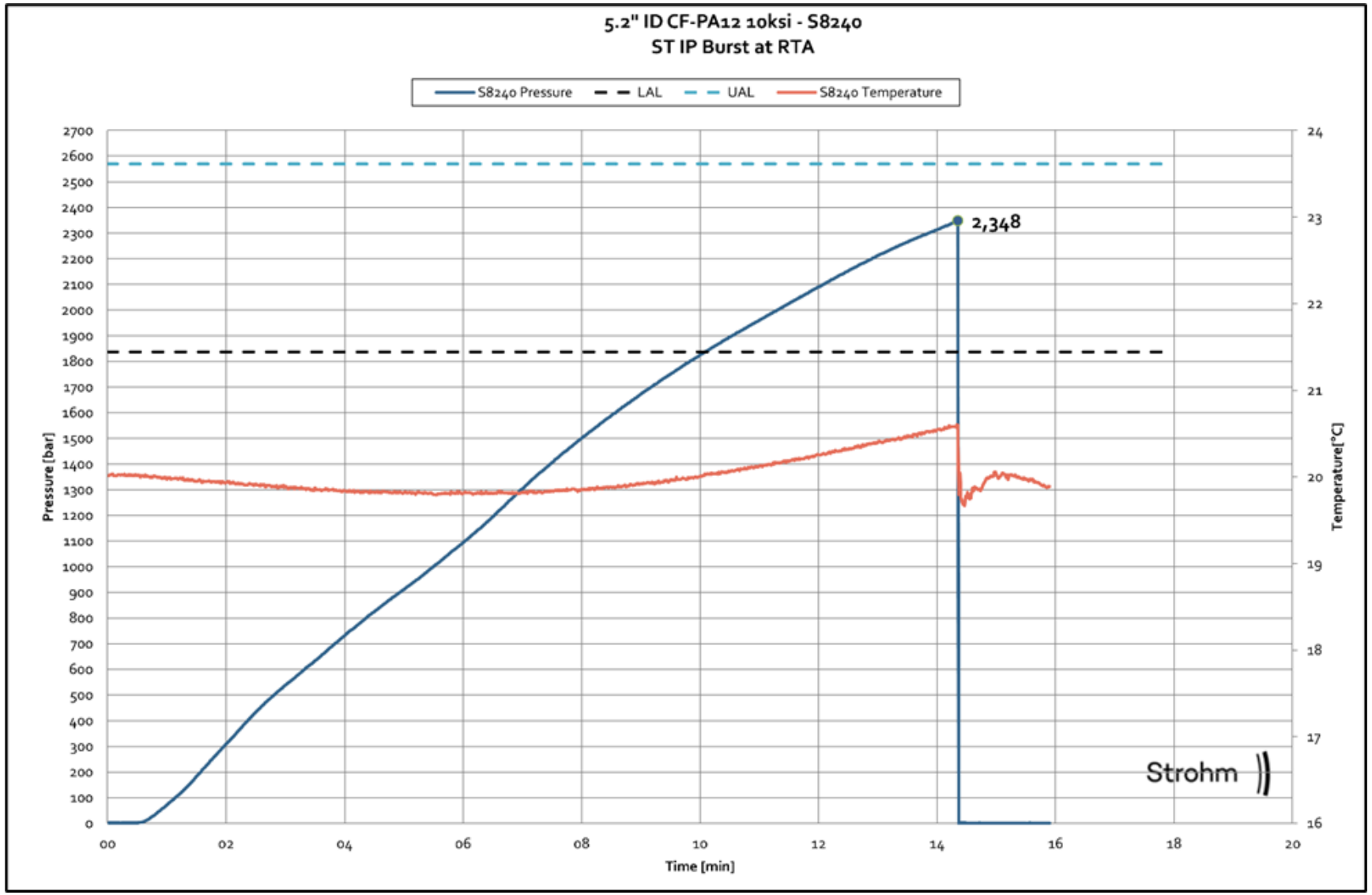
Liner — thermoplastic fluid barrier

5.2” CFPA12 Burst Test - RTA

before

Test Result - RTA

- Predicted failure
  - UAL 1837 bar
  - LAL 2570 bar
  - **Failure @ 2348 bar**

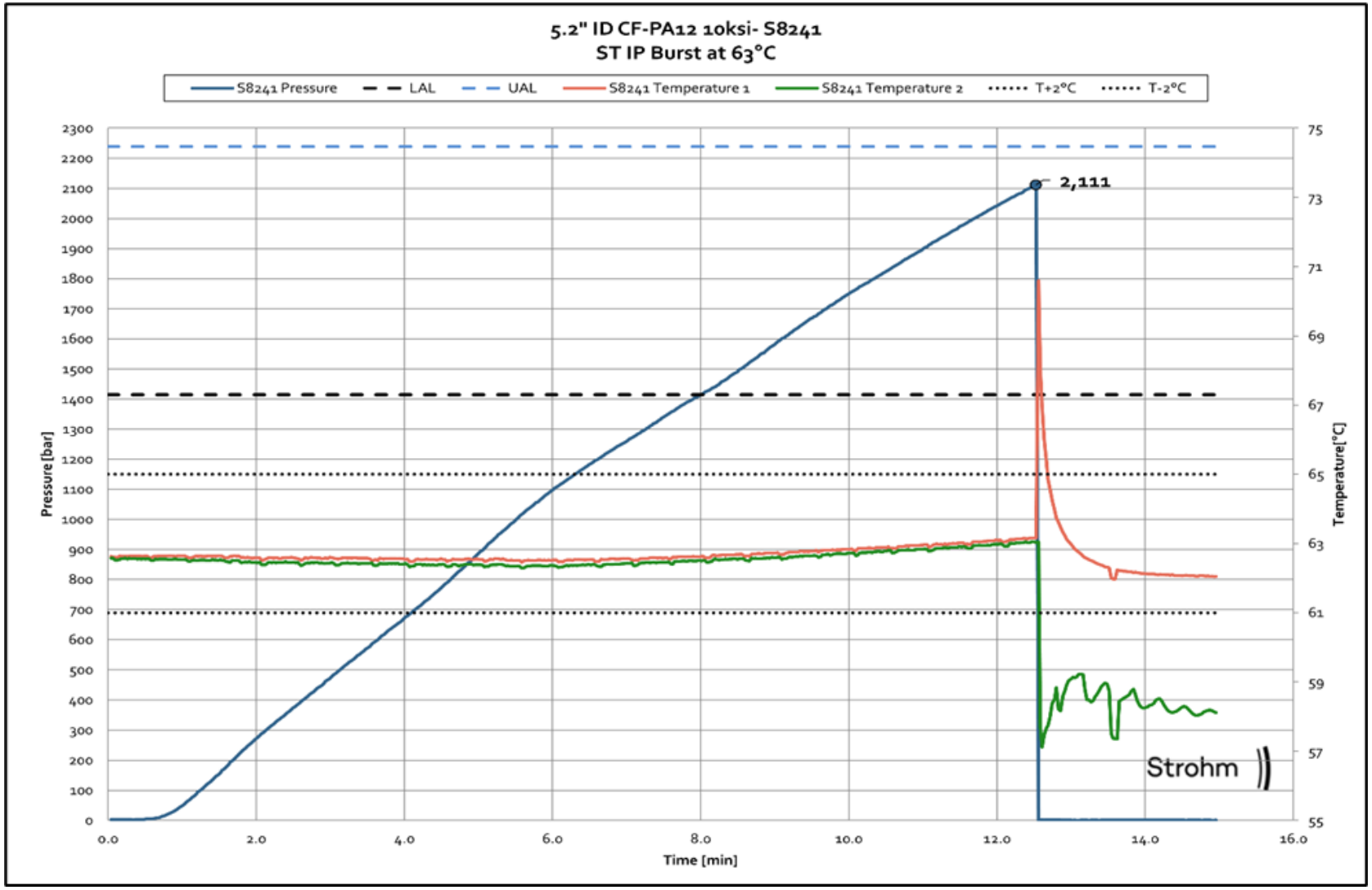


5.2” CFPA12 Burst Test - RTA

After

Test Result – 63°C

- Predicted failure
  - LAL 1414 bar
  - UAL 2239 bar
  - **Failure @ 2111 bar**



5.2” CFPA12 Burst Test – 63°C

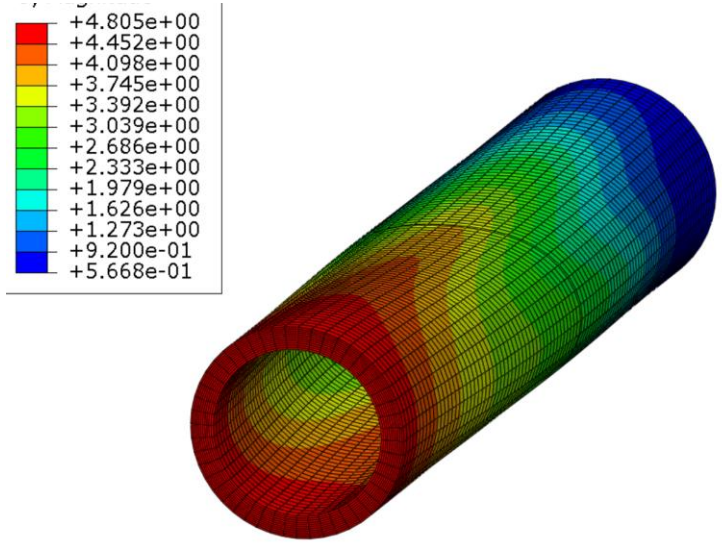
before

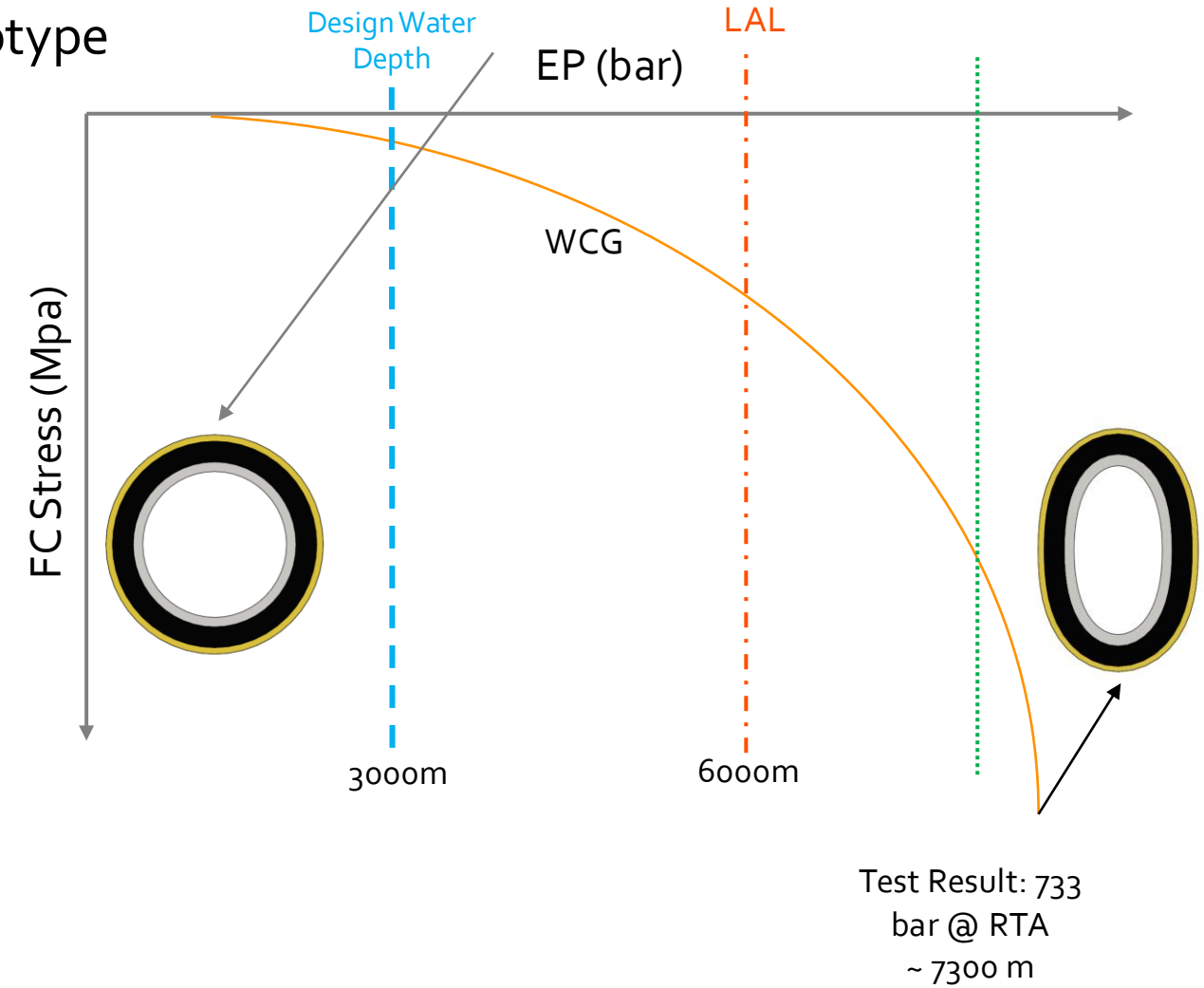
After

Validated performance at Pipe level

Collapse Analysis – 5.2" CF/PA12 – Digital Prototype

- Design the TCP based on DNV based safety factors on load offers safe collapse margins



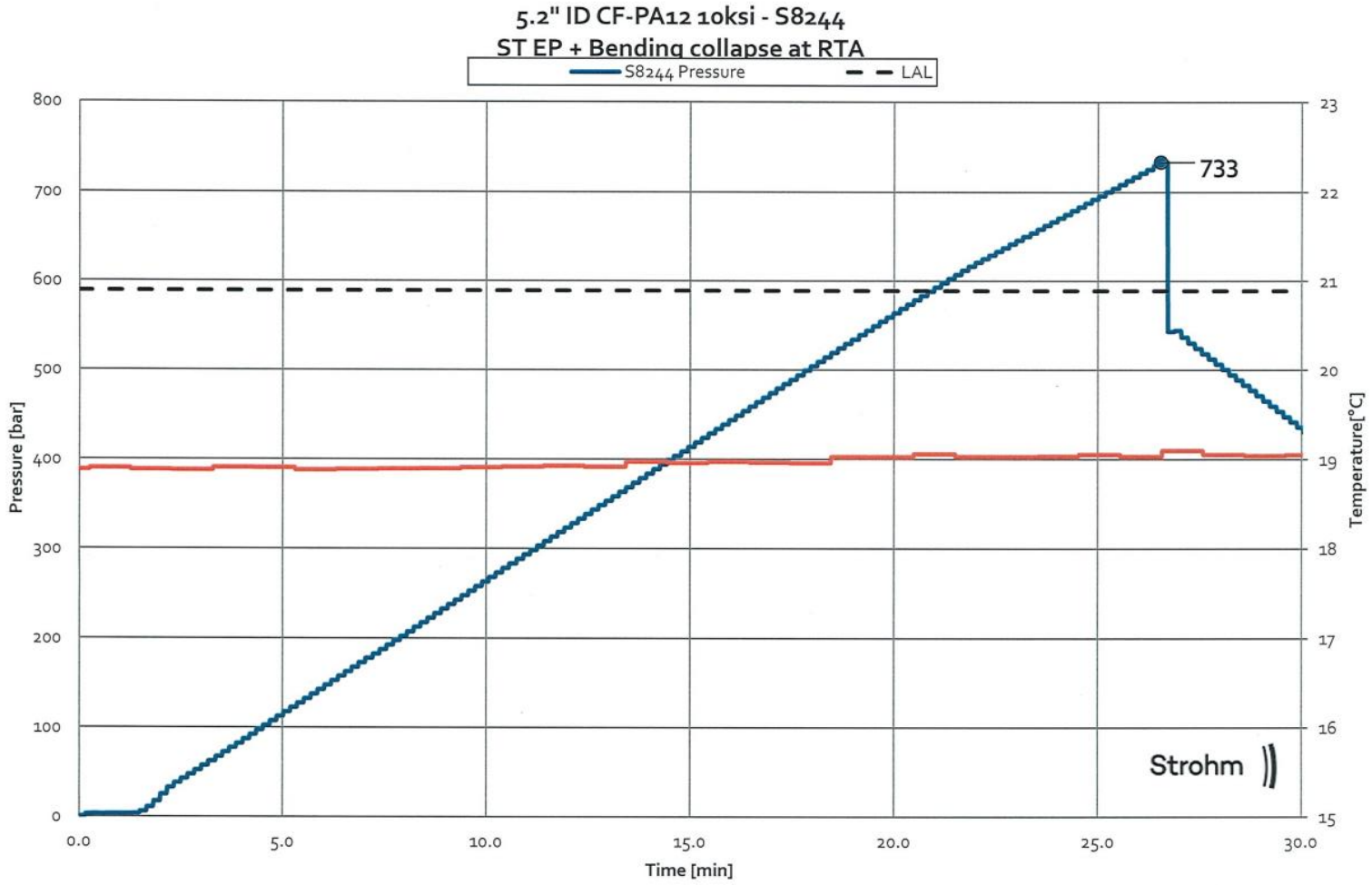


Test Result: 733 bar @ RTA ~ 7300 m

Validated performance at Pipe level

Collapse Analysis – 5.2" CF/PA

- Qualified for 3000m.
- Predicted LAL ~ 6000 m
- Test Result : 733 bar @ RTA ~ 7300 m



Validated performance at Pipe level

Collapse Analysis – 5.2" CF/PA12

- Qualified for 3000m.
- Test Result : 733 bar – RTA ~ 7330 m

Structural Integrity & Qualified Envelope

Qualified for deepwater pressure and temperature envelopes

Collapse resistance through composite structure

Strong fatigue performance under cyclic loading

Composite layer engineered per project-specific loads

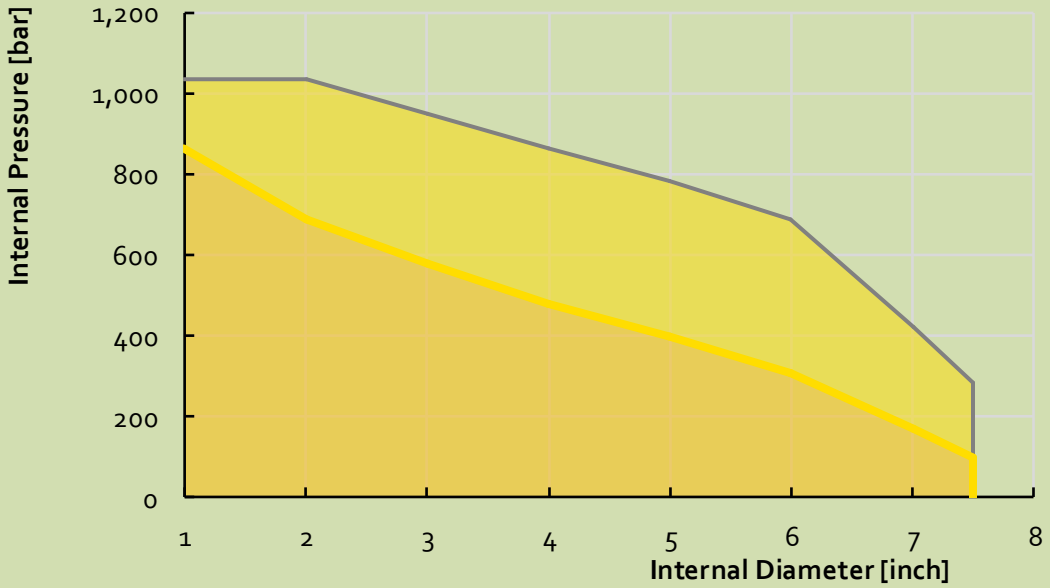

DNV·GL

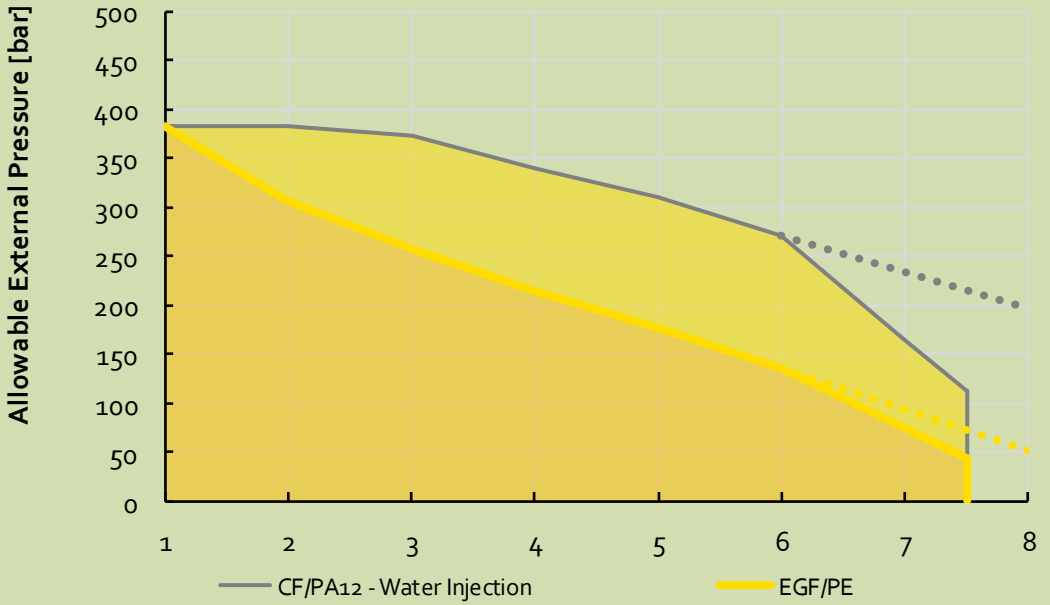
TECHNOLOGY CERTIFICATE

General Design Methodology for Thermoplastic Composite Pipes


DNV·GL

STATEMENT OF CONFORMITY





Strohm: worldwide activity and track record

Subsea Applications Overview

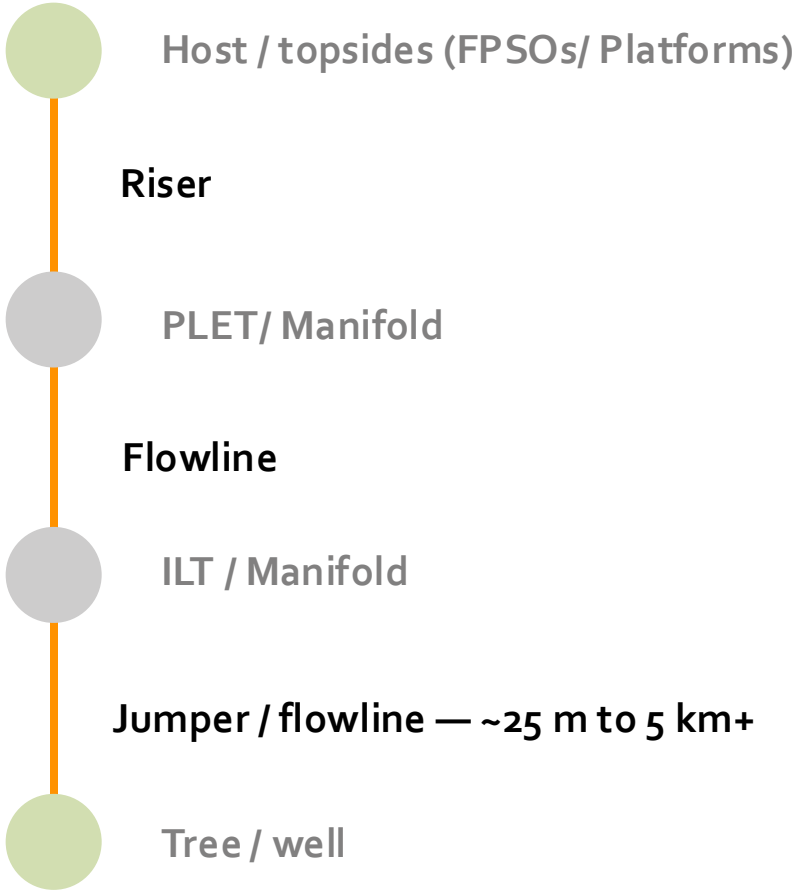
Where TCP applies

Applications: jumpers, flowlines, and risers, and jumpers.

Jumper lengths now range from ~25 m to 5 km+

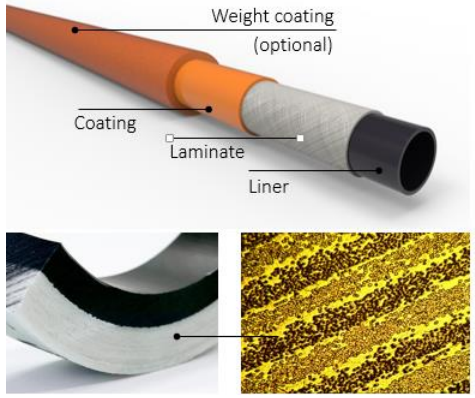
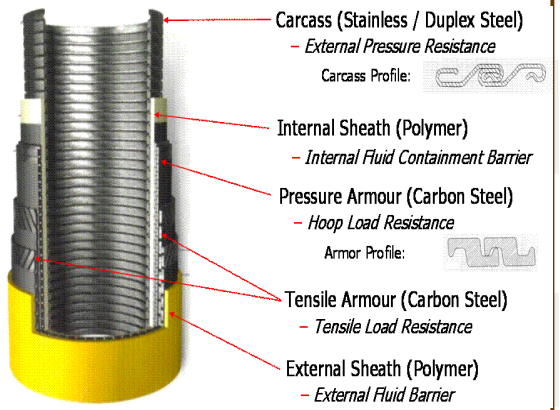
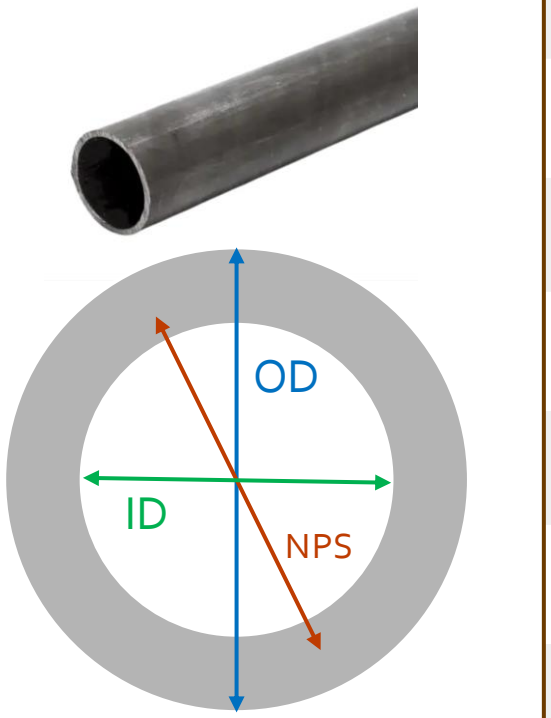
Longer jumpers approach flowline-scale distances

Same product family across static and semi-dynamic service

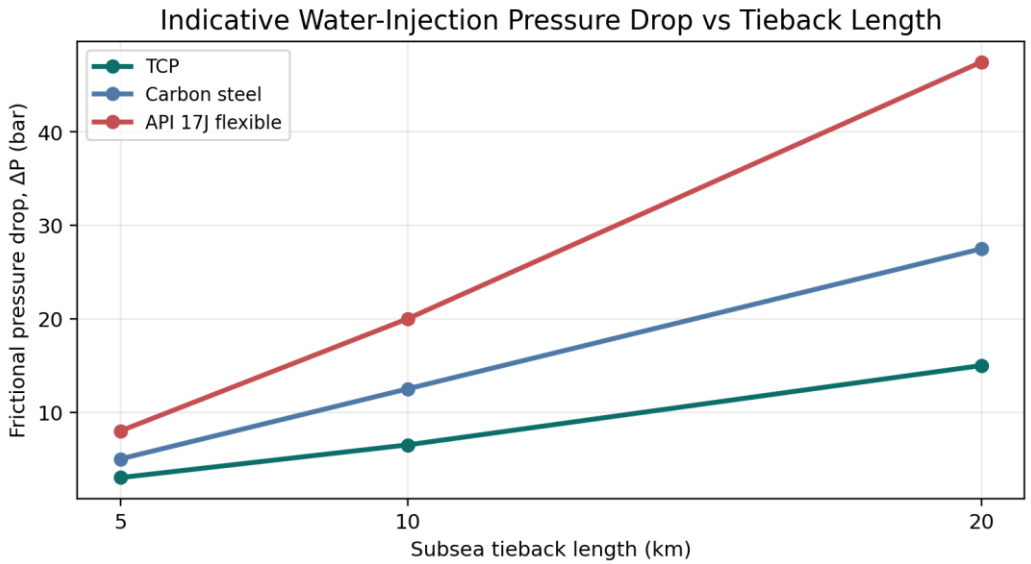


Subsea Pipe Technology Comparison Matrix

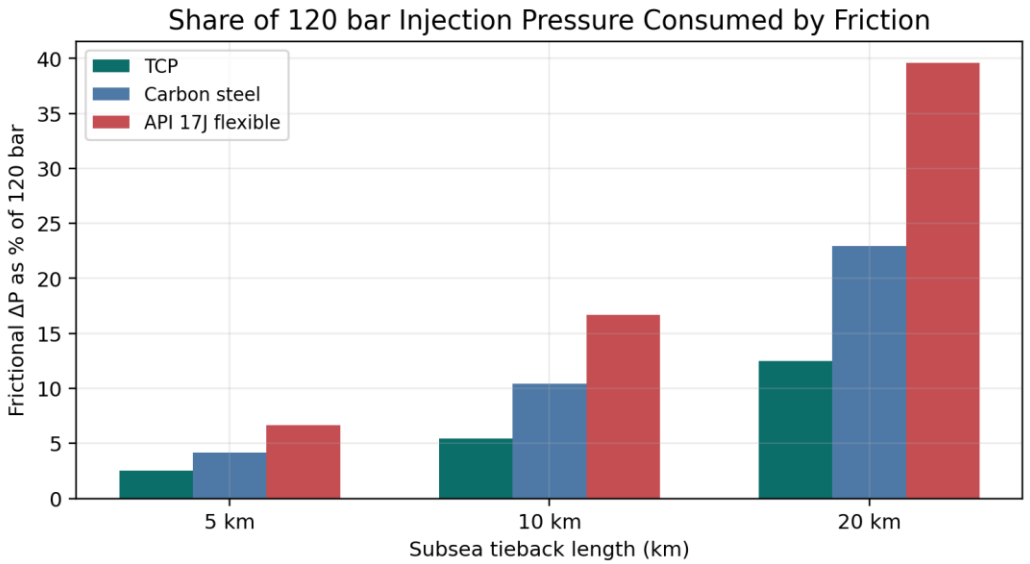
Screening basis

Attribute	TCP	API 17J Flexible	Rigid Carbon Steel
Internal profile (absolute roughness)			
Corrosion allowance			
System weight			
Sizing philosophy			
Installation Speed			
Installation Vessel			
Pipe Cost / Meter			

Pressure Drop Comparison



Basis: client-provided indicative ΔP ranges at ~0.07 m³/s; plotted values are range mid-points.



Basis: mid-point ΔP values divided by lower end of operating injection-pressure range (120 bar).

Flow assurance pressure drop effects from surface roughness due corrosion or design have a different effect on the type of fluid. Heavy Oil has less of a pressure drop than light oil, and gas has a greater pressure drop than oil. Generally the lighter the fluid the greater the effect.

Hydraulic Efficiency & Sizing Optimization

TCP true bore	Length	Steel / flexible equivalent	
		Water	Gas
6 in	1 km	8 in class	8 in class
6 in	5 km	8 in class	8 in class
7.5 in	1 km	8 in class	10 in class
7.5 in	5 km	10 in class	10 in class

**depending on flowline length*

1 size class smaller
for equivalent hydraulic performance

Smooth true bore preserves pressure budget over short-to-mid tiebacks

Flow assurance can size TCP smaller for equivalent performance

Steel/flexible must step up a size class to match TCP

Consistent at 1 km and 5 km, across water and gas service

Installation Philosophy & Vessel Logistics

Execution model

No heavy flex-lay, carousel, or specialized S/J/reel-lay vessel

Light-to-medium MPSV/CSV with modular horizontal lay

Broader vessel market, lower day rates

Improved schedule and mobilization flexibility

vs.

Broader vessel pool

Lower day rates

More flexible scheduling

Case Study — Deepwater TCP Installation, Egypt

West Delta Deep Marine — a delivered outcome, not a screening estimate

Replaced an existing (corroded) steel flowline — first TCP of this type in the country.

TIC (Total Installed Cost) reduction driven primarily by installation and vessel selection

Shorter manufacturing lead time vs. flex-pipe slot availability

Horizontal lay from an MPSV; synergies allowed umbilical installed in the same campaign

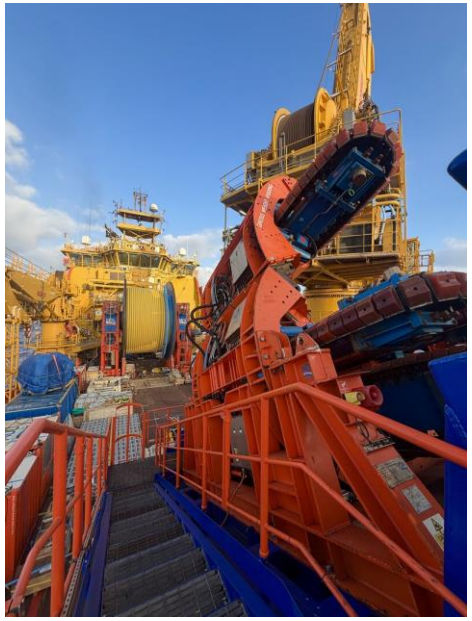
~30%
Total installed cost reduction

6 mo
Faster to first gas

Field	**West Delta Deep Marine (WDDM)**
Operator	Burullus Gas Co. / Rashpetco/ EGAS / Shell / Petronas
Installation Contractor	Oceaneering International
Product	6" ID TCP — carbon fibre / PA12
Length	1,700 m flowline
Design pressure	5,000 psi
Water depth	Up to 700 m
Qualification	DNV-ST-F119

Energy Savanah — TCP Installation Offshore Egypt

MSV/CSV with a horizontal lay spread (HLS) on deck



HLS spread
Deck-mounted lay system

TCP installation
Reel, Reel Drive System, tensioner and chute on deck

Energy Savanah
MSV/CSV

Screen TCP on a Full System Basis

Summary & takeaway — West Africa / Namibia

TCP is a credible option — not a universal replacement

Evaluate as a full system: FA - hydraulics, weight, installation, TIC, life of field

Bring TCP into **early concept** and **Pre-FEED** screening

West Africa vessel market amplifies the installation advantage

TCP screened in at the earliest stage