Namibia Oil and Gas Conference

3rd Edition

From exploration to action:
Positioning Namibia as the next energy frontier

ENDORSED BY

Ministry of Industries, Mines and Energy, Republic of Namibia

Strohm

Thermoplastic Composite Pipe

Enabling lean subsea development in ultra deepwater with Jumper on Demand solution

Introduction to Strohm

Wouter Spruijt

13-08-2025

HOST

economic association of namibia ean

IN PARTNERSHIP WITH

NIPDB Namibia Investment Promotion & Development Board Office of the President

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#NamibiaOGC25

We have come a long way

After years of development and piloting, Strohm created full breakthrough in 2021

Technology and product development | ***DNV & customer qualifications establish manufacturing*** | ***Pilots & portfolio build-up*** | ***Commercial breakthrough transition to H2 and CCS***

Significant barriers to entry:

1. *Certification (DNV)*
2. *Client qualifications*
3. *High cost of offshore installation*
4. *High impact in case of failure*

# of projects delivered

45
40
35
30
25
20
15
10
5
0

2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024

IJmuiden plant

Independent firm

First DNV qualification

First pilot installed

Last pilot pipe delivered

Commercial breakthrough

5 years on average from award to installation and acceptance

Strohm

DNV

ExxonMobil

woodside

TRIDENT ENERGY

PetroRio

AkerSolutions

TotalEnergies

ECONNECT Energy

BR

Allseas

Baker Hughes

Thermoplastic Composite Pipe

Flexible and spoolable in long lengths

- Non-metallic pipe body = no corrosion + high chemical resistance
- On-target weight – stable and light, reducing transportation and installation cost

Spoolable in long lengths.

Superior fatigue resistance.

No corrosion, resistant to H_2S, CO_2 and seawater.

Collapse resistant.

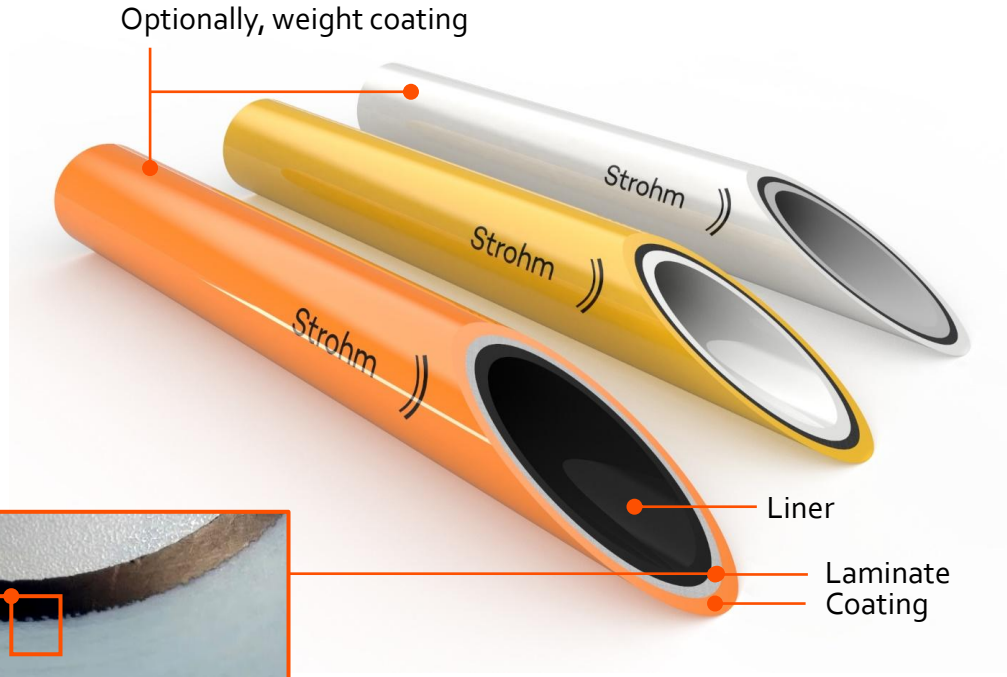
Strohm

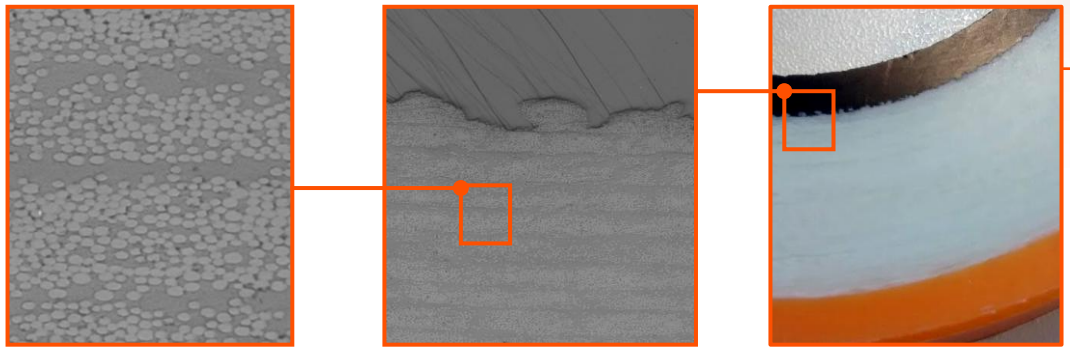
Thermoplastic Composite Pipe

Strohm developed and introduced TCP to the energy industry and is the market leader

Two Components: **1 Polymer + 1 Fibre**

- Two components, a fibre and polymer, selected and optimized for each application
- Liner and protective coating for robust offshore and subsea application
- Melt-fused composite laminate based on glass or carbon fibre with same polymer as liner & coating, to form a solid wall





Thermoplastic Composite Pipe

The right materials for every solution

- Fully qualified to 60°C , option to 65°C
- Large bore pressure up to 345Bar/ 5K psi
- Small bore pressure up to 690bar/ 10K psi
- Low permeation
- High chemical resistance
- Weight coating option
- Extensive Track record

- Up to 80°C Degrees C (180 F)
- High pressure (690bar / 10,000 psi)
- Low permeation
- Extensive Track record

- Weight coating under development

- Highest temperature up to 93°C *(later to 121 °C)*
- High pressure (690bar / 10,000 psi)
- Highest chemical resistance
- Weight coating option

- DNV qualification ongoing (*completion exp. 1H 2026*)

Glass-PE

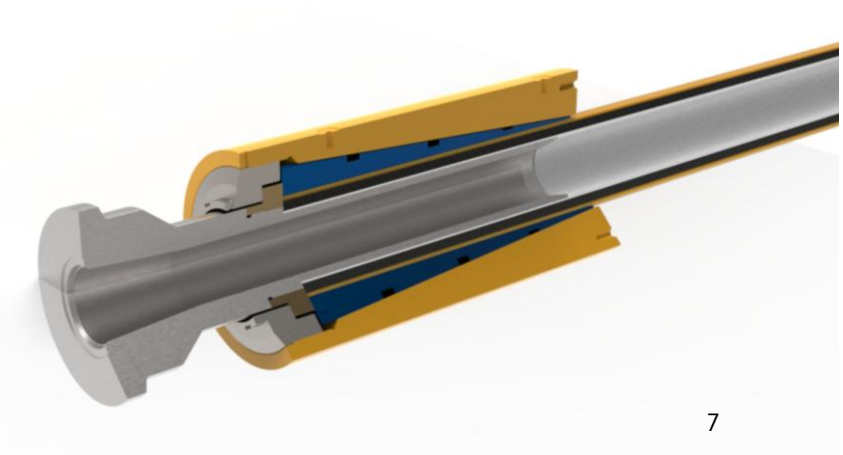
Carbon-PA12

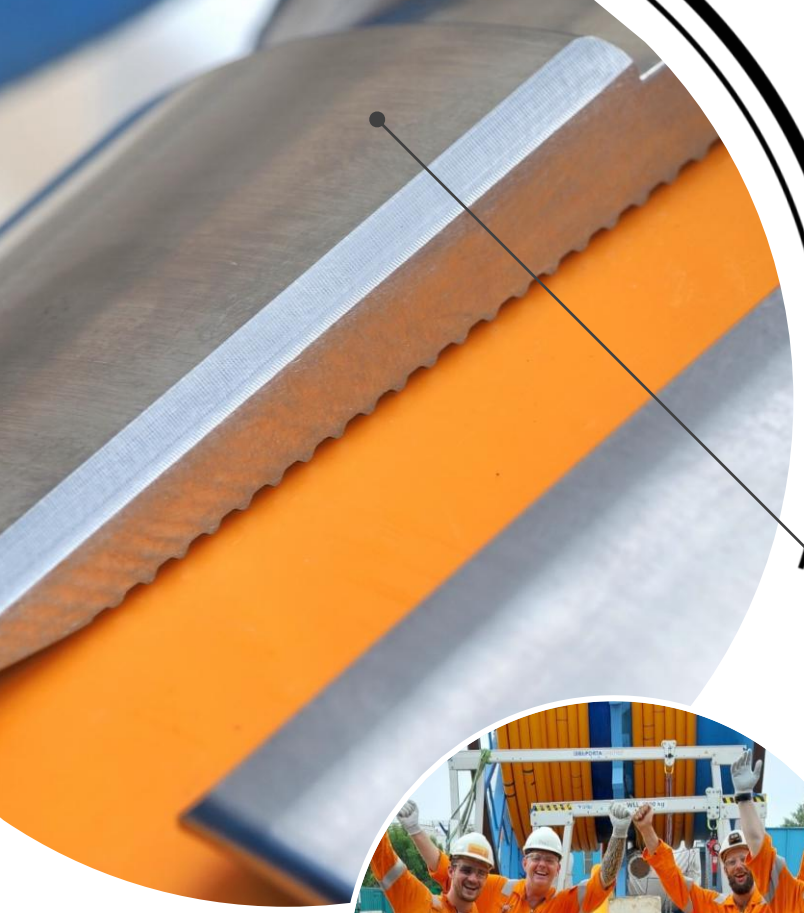
Carbon-PVDF

Key technical feature of TCP

TCP can be terminated at location; onshore & offshore.

- Pipe can be terminated in the field, incl. offshore
  - Allowing cutting pipe to length where required
  - Allowing quick repair, de-risking the project and schedule
  - Allowing J & I-tube pull throughs
- Flexible and provided in long lengths, transportation cost is optimized.
- Zero failures to date on installed pipe





TCP End Fitting

Versatility enabling optimized schedules

- Pipe can be terminated in the field, incl. offshore
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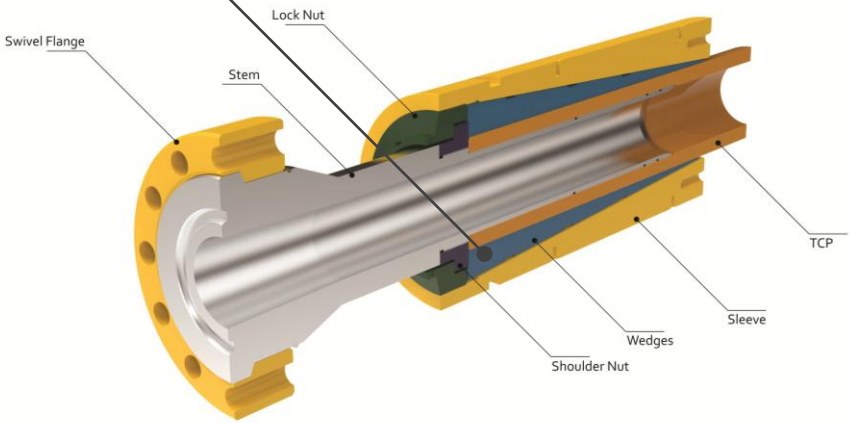


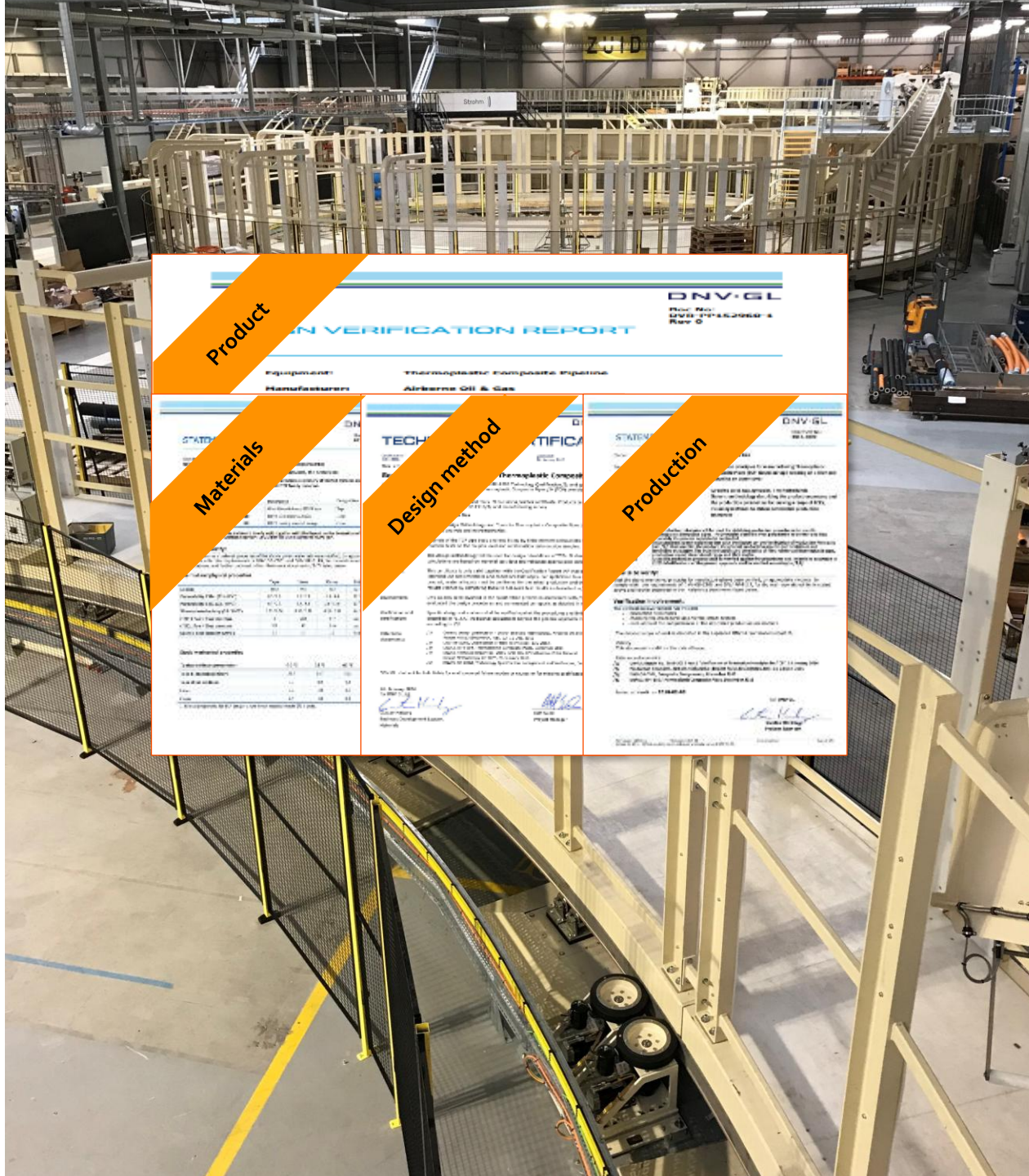
Adjustable TCP properties

Using design freedom of composites to achieve optimal solution

TCP Component	Design Parameter	Effect on Application
Liner	Choice of Polymer	Temperature rating, Service fluids, U-Value
	Thickness	Temperature profile, U-value
Laminate	Polymer	Minimum Bend Radius (MBR)
	Fibre and Fibre Content	Pressure rating, MBR, Stiffness
	Thickness (Layers)	Pressure and collapse rating, Crush resistance, Squeeze Load, tensile capacity, etc.
Coating	Polymer	Load transfer in End Fitting, UV resistance, Friction coefficient, etc.
	Thickness	Robustness, Protection, Load transfer EF, U-value, Temp. profile
Weight Coating	Polymer and filler content	Specific gravity and MBR, UV resistance
	Thickness	OBS, Stability in water column, MBR, U-Value, Temp. profile, tensile capacity

Qualification - DNVGl-ST F119

- Standard specifically meant for TCP and offshore use.
- Strohm is the world's first company qualified in accordance with it.

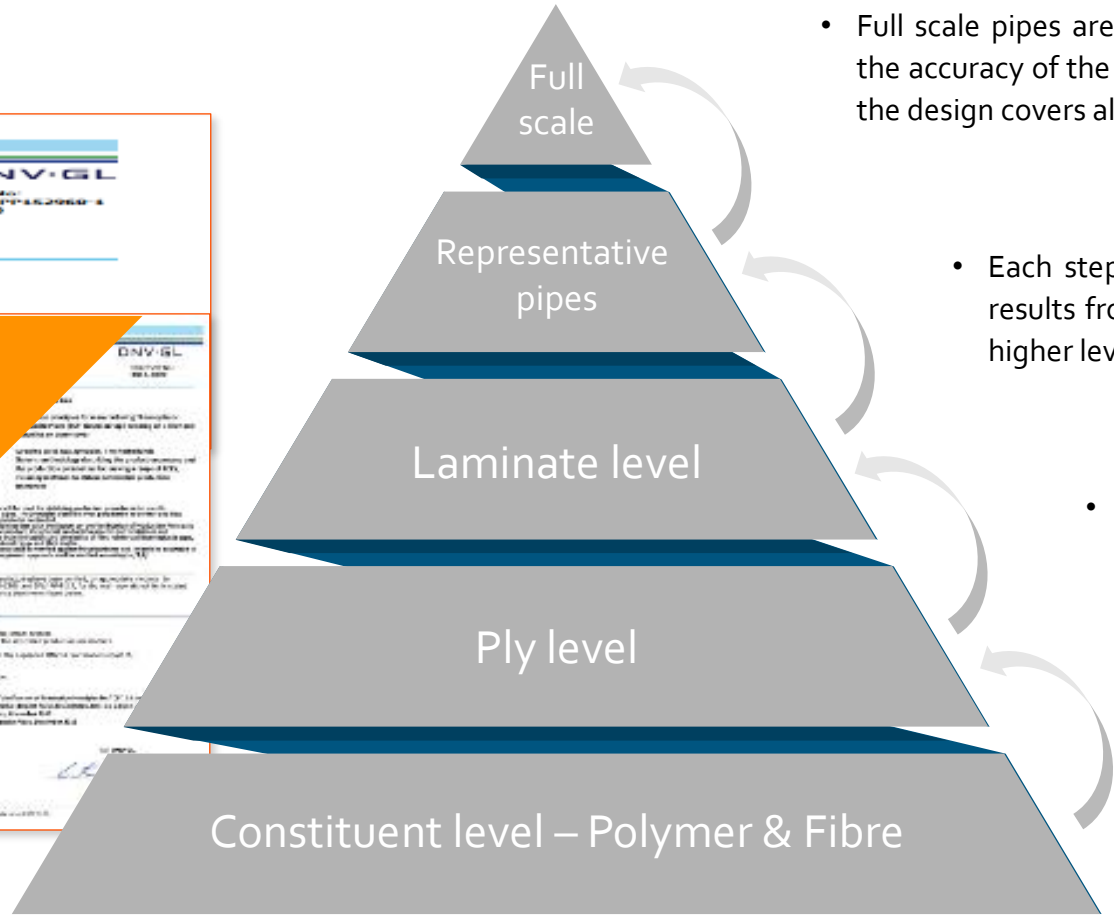


Qualification Approach

TCP is designed with the through life conditions included

DNVGL-ST F119 Qualification approach

- Full scale pipes are tested on critical load cases to prove the accuracy of the design predictions, hence proving that the design covers all single and combined load cases well

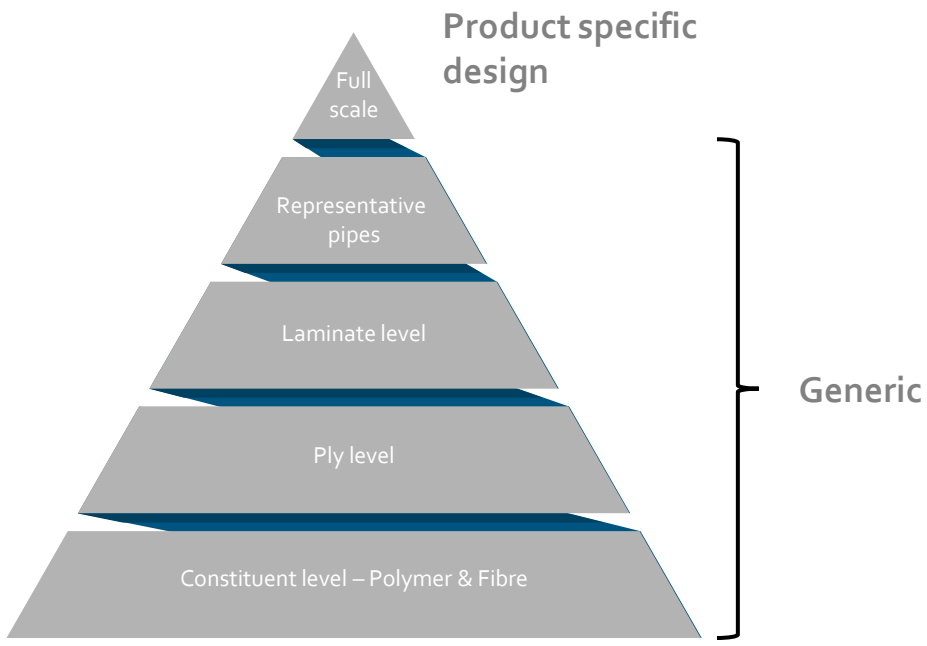


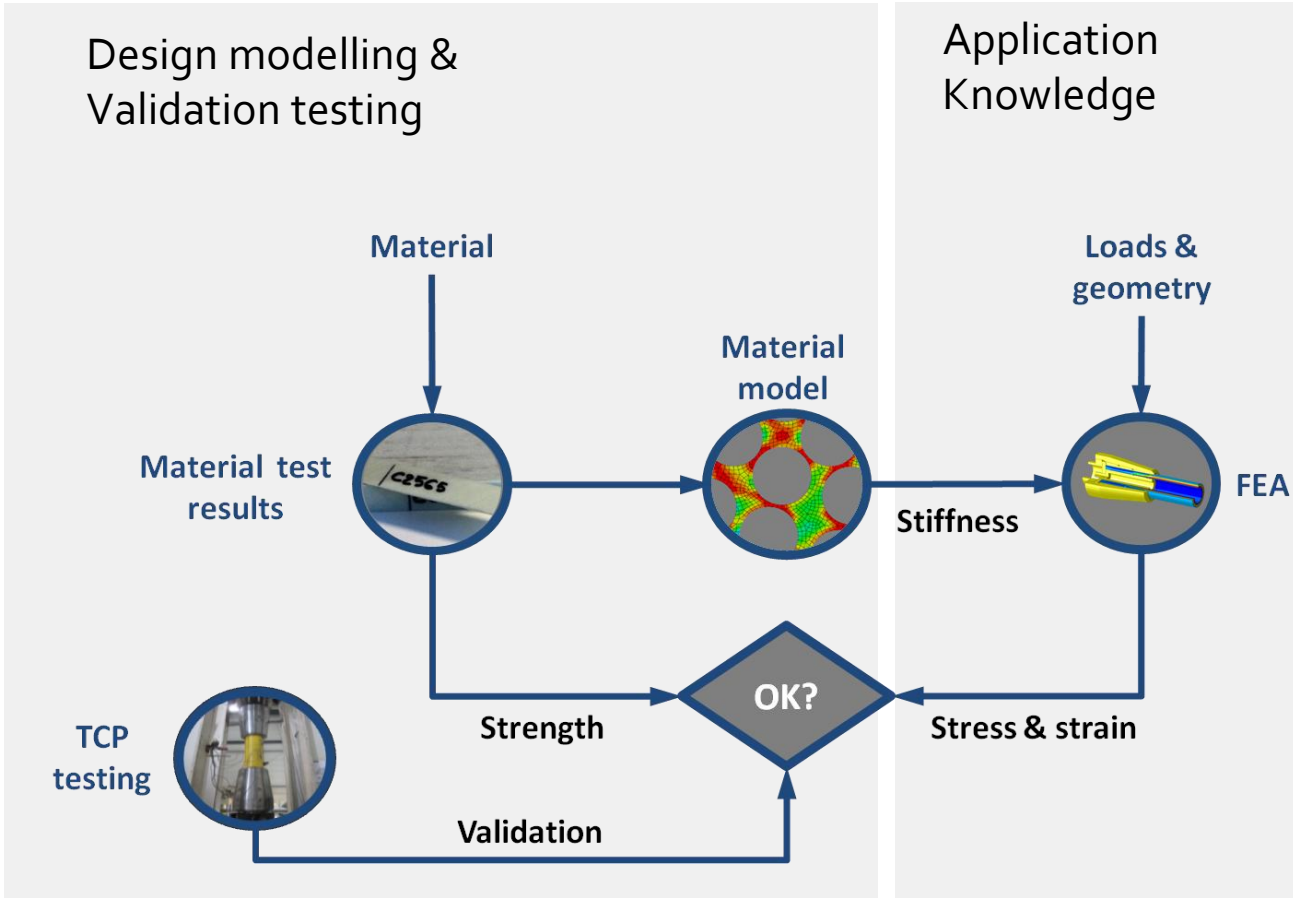
- Each step includes validation, proving that the results from the lower level can be used for the higher level
- Material performance is measured and tested with infield conditions of fluid, temperature etc
- Tested material performance is translated to validate a model based on fibre and polymer

Design and Qualification for Application

Strohm's design approach combines deep application knowledge with a superior understanding of the TCP and the effect of time, temperature and fluid on the materials: Predictive Engineering

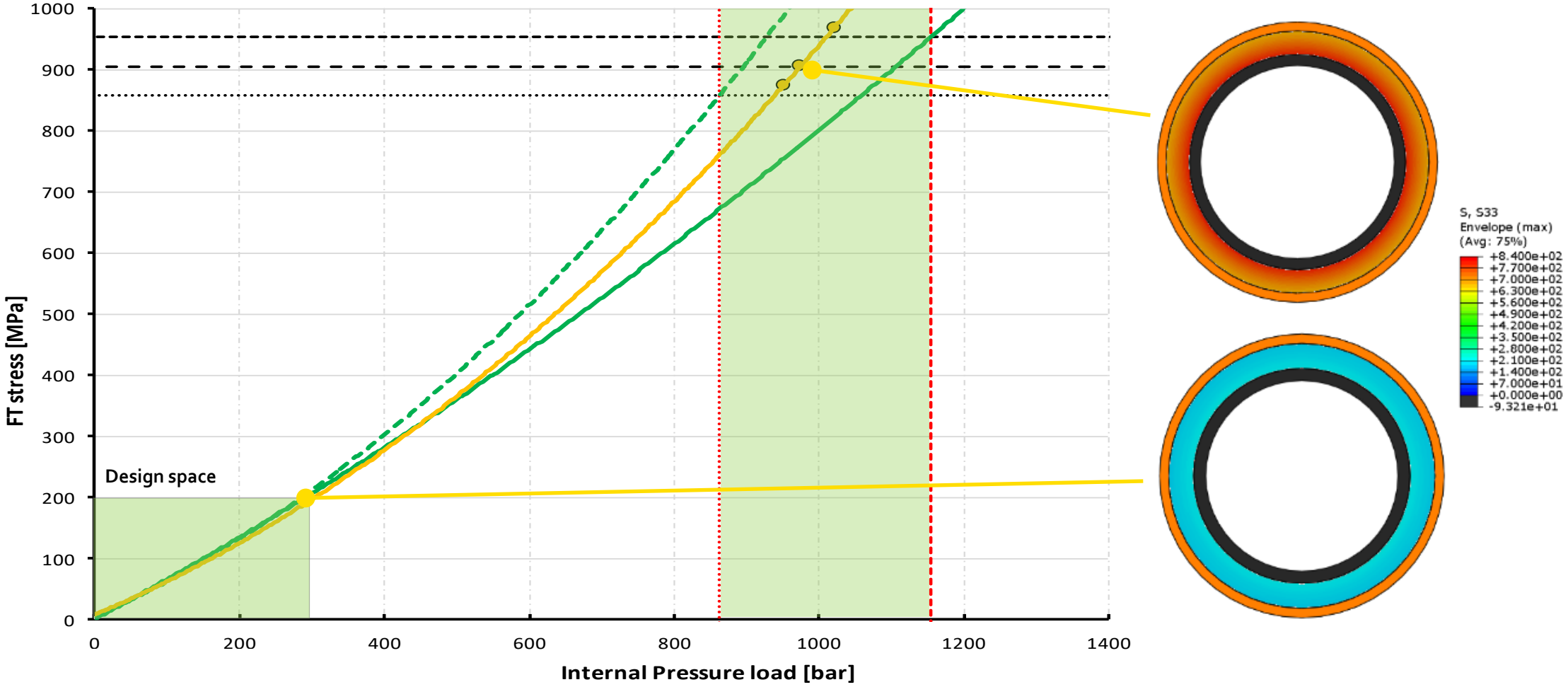
Qualification approach
- Extensive material testing and modeling
- Limited full-scale validation tests





Validate predicted performance at Pipe level

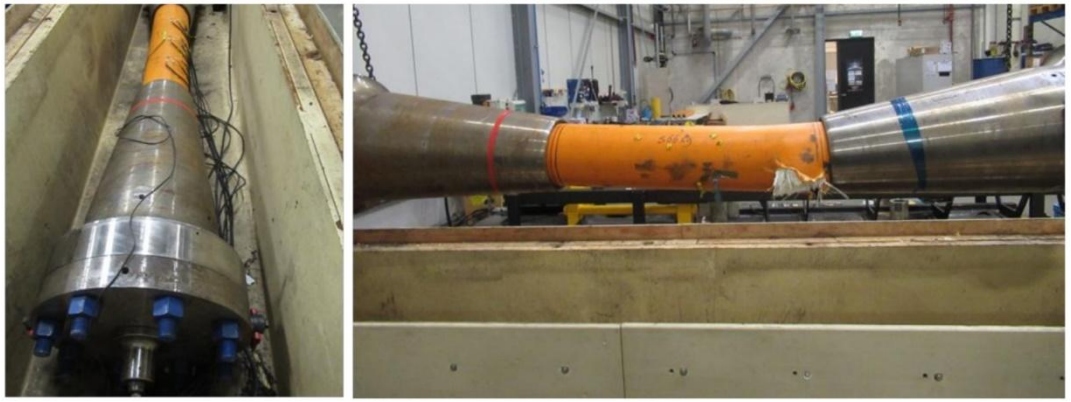
All application load cases analysed for Digital Prototype, verification by few full-scale tests



From design model to validation test

Virtual testing is validated by full scale testing, confirming that Strohm's predictive engineering approach yields accurate results – done for all critical load cases

Qualification testing – internal pressure burst

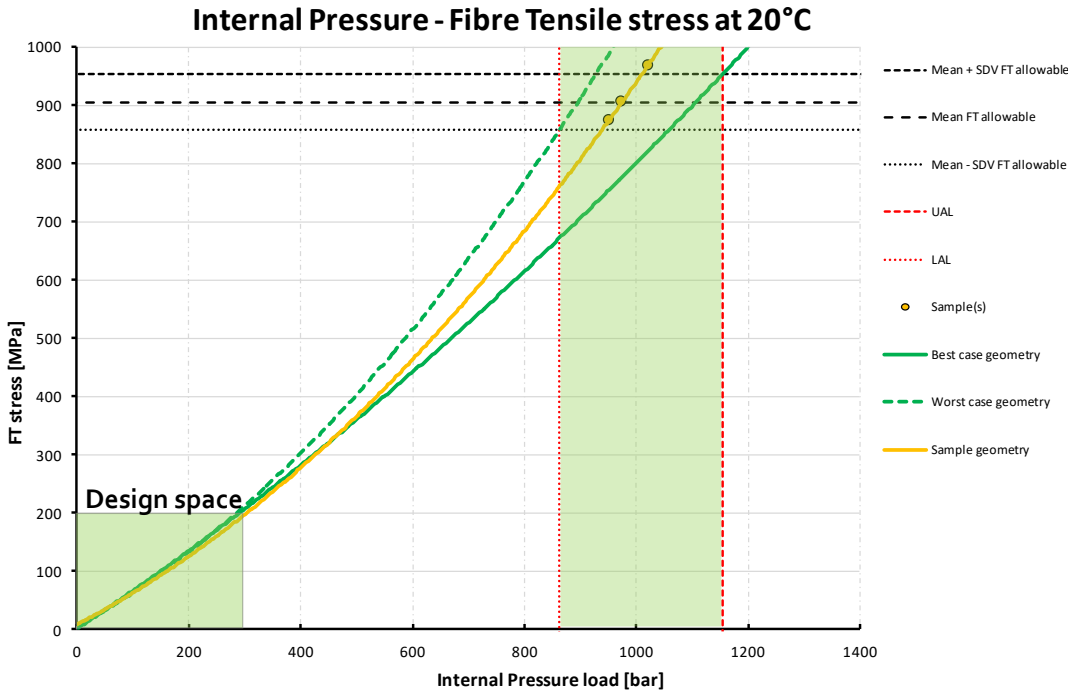


Failed sample after the IP test, where the failure is caused by fiber failure in tension leading to burst of the pipe sample.

Sample nr.	Failure pressure [bar]	Failure mode	Test Temperature [°C]	Acceptance	Result
S6220	1020	Burst	RT	863 (LAL) ≤ P [bar] ≤ 1154 (UAL)	PASS
S6656	972	Burst			
S6657	950	Burst			

1000 bar = 14,500 psi

Predictive engineering



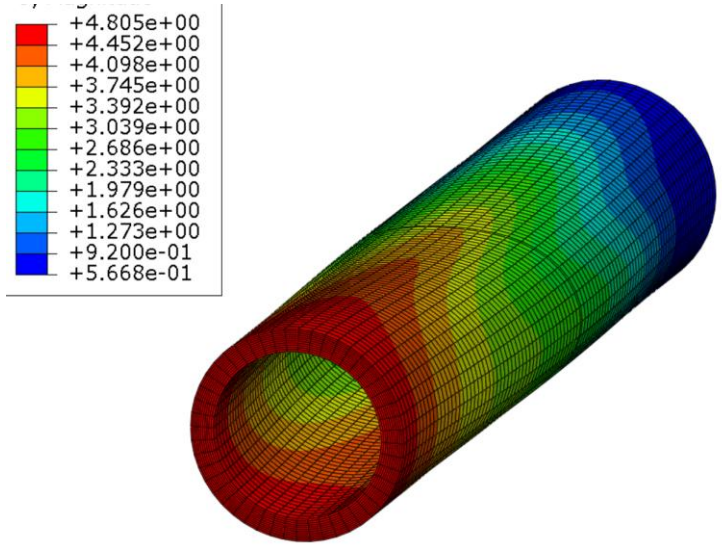
✓Failure governed by the fiber tensile strength

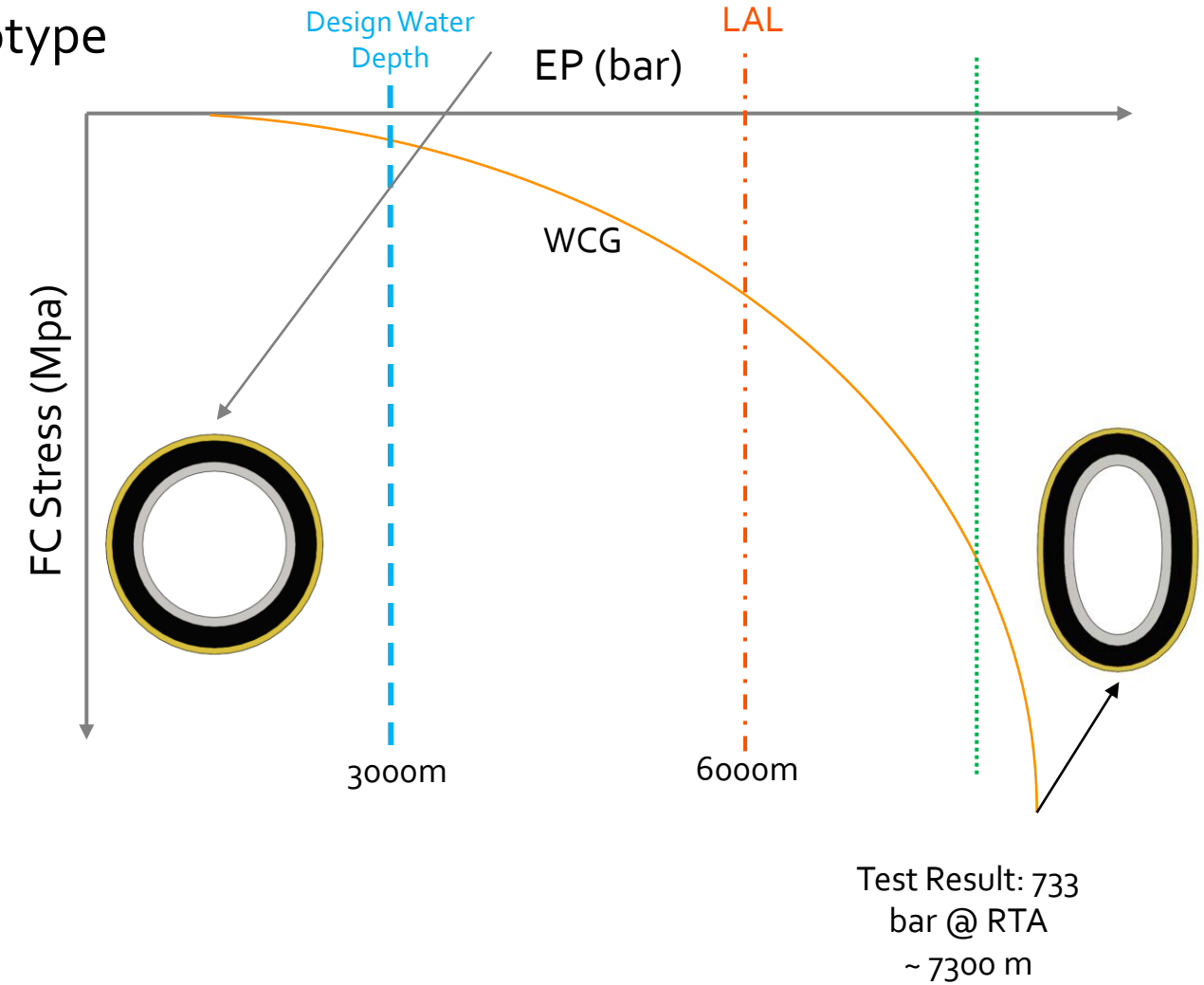
✓Good correlation between the finite-element predictions and experimental observations

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/PA12

- Qualified for 3000m+
- Test Result : 516 bar – 63 degC
  ~ 5200 m

TCP Jumper on demand

TCP Jumper on Demand concept

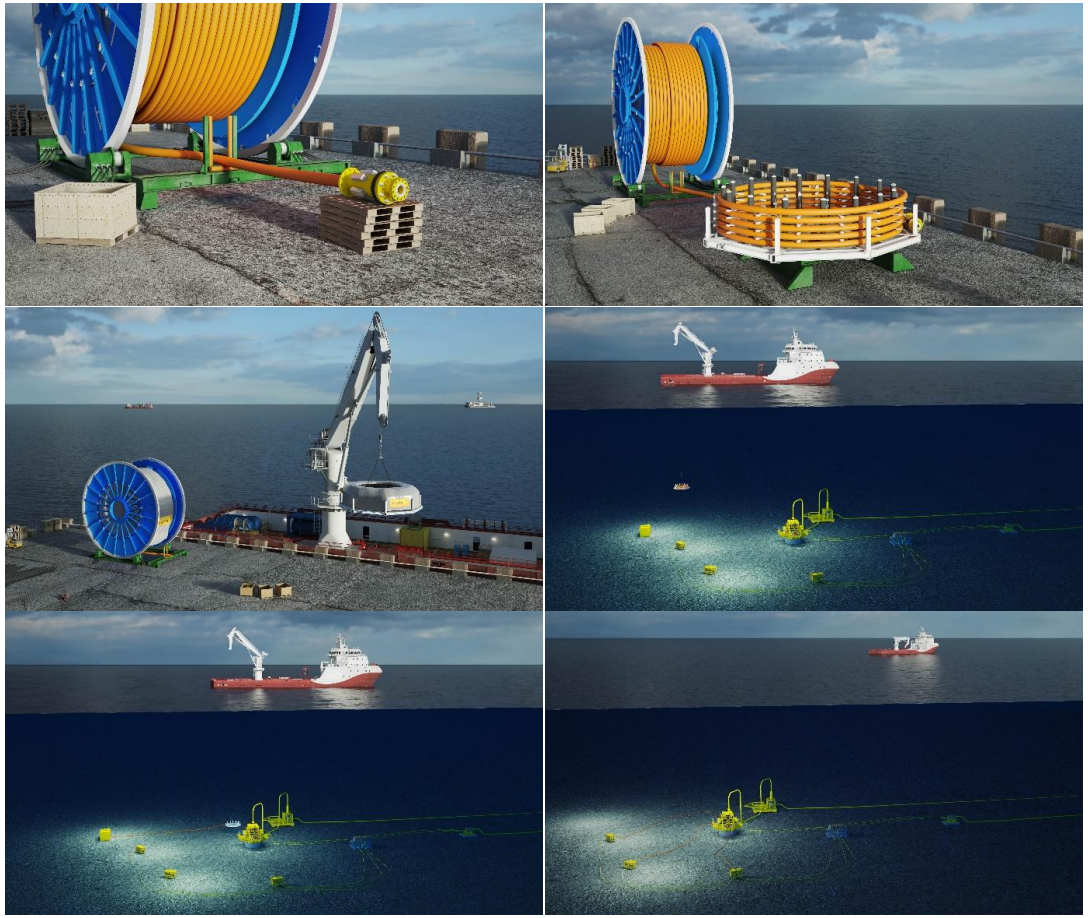
The concept for ultimate flexibility combined with lowest cost and local content

Preparation:

- TCP is manufactured in long length and shipped to near location
- TCP is cut to length and terminated onsite
- TCP is spooled onto subsea pallet
- Local content opportunities in end-fitting and ancillary supply and termination

Installation:

- Installation through MSV
- De-risking of project schedule
- Lowest cost



> “Strohm’s first Jumper on Demand contract in 2021 for 26x TCP Jumpers was the company’s main breakthrough”
>
> Martin van Onna, CCO - Strohm

TCP Jumper

A quick connection solution for short to medium distance for all service requirements

Service:

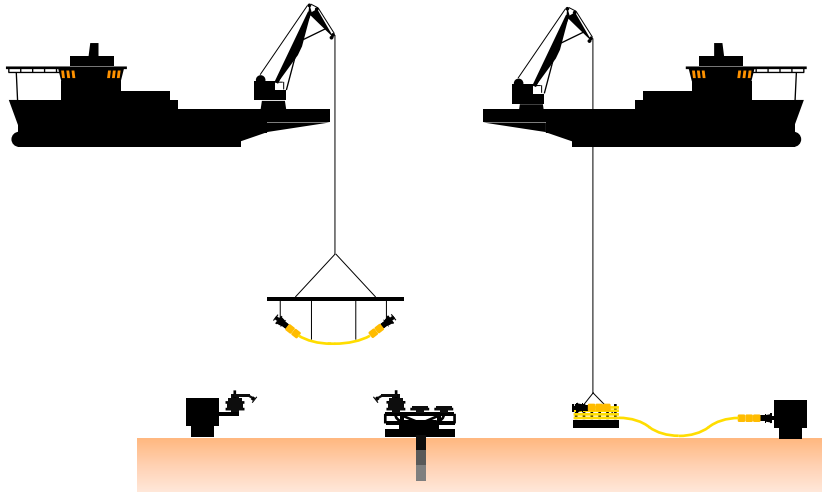
- Qualified and track record, fully TRL-9

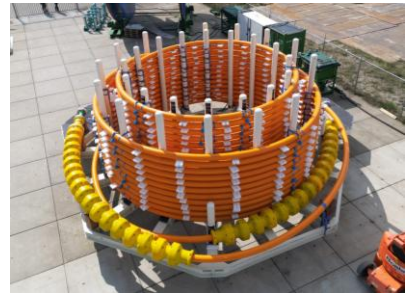
Subsea infrastructure flexibility:

- Bridging any distance from 20 to 500 meters
- Ability to navigate difficult seabed conditions, existing pipeline infrastructure
- Reducing overall infrastructure cost

As-installed:

- TCP does not become stiffer with internal pressure as flexible pipe does
- Lower loading on connectors
- TCP is non-conductive





TCP Jumper: fast & flexible connection

No metrology and ease of installation reduce total installed cost and de-risks the project schedule.

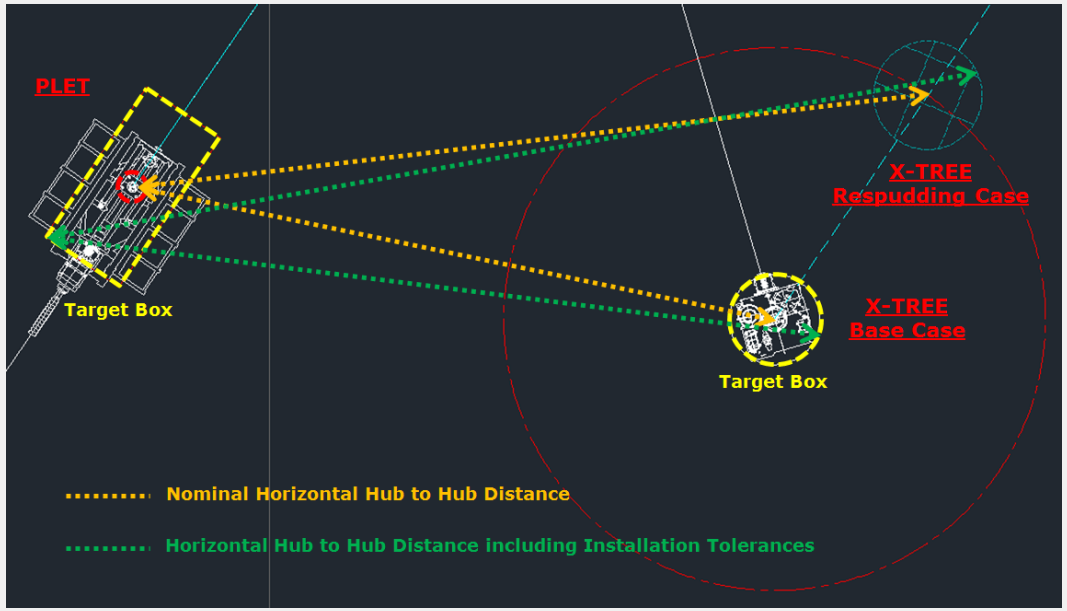
Lower Capex:

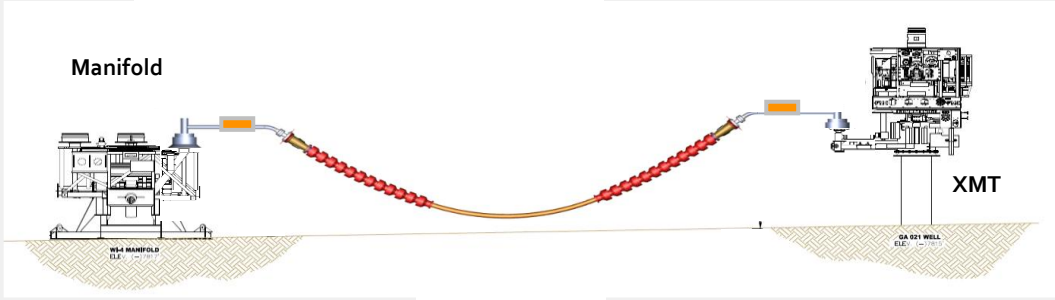
- No metrology
- More economic installation (time & vessel req.)
- Larger x-tree target box and installation tolerances
- Reducing infield flowline infrastructure cost
- Lighter manifolds and PLET foundations, no anchoring

Project schedule de-risking:

- On-site cutting to length and termination
- Quick turnaround and installation
- Flexible, allowing for larger tolerances

> Strohm's TCP Jumper removes the need for metrology and provides us with great flexibility
>
> Strohm client South America, supermajor



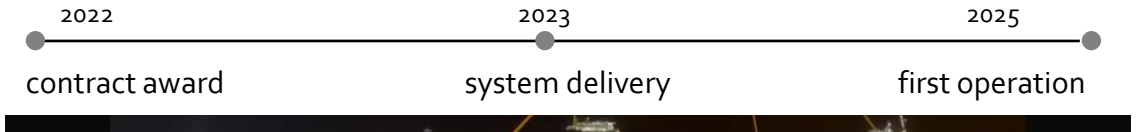


Case Study: ExxonMobil – Yellowtail Jumpers

Project description

After completing the pilot for Liza in 2021, ExxonMobil awarded Strohm with all the WAG (water alternating gas) jumpers for Yellowtail, Uaru and Whiptail projects in Guyana. The Yellowtail jumpers are all short jumpers installed through spreader bar, the Uaru and Whiptail jumpers are all longer, installed using subsea deployable pallets.

All jumpers are terminated and prepared in country, Guyana, using the Jumper on Demand concept whereby the TCP jumpers are cut to length on site and terminated and prepared for installation.

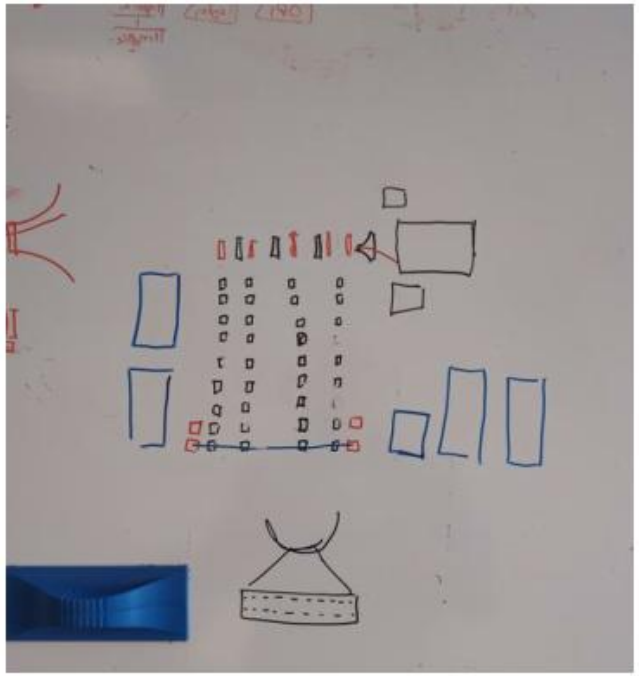


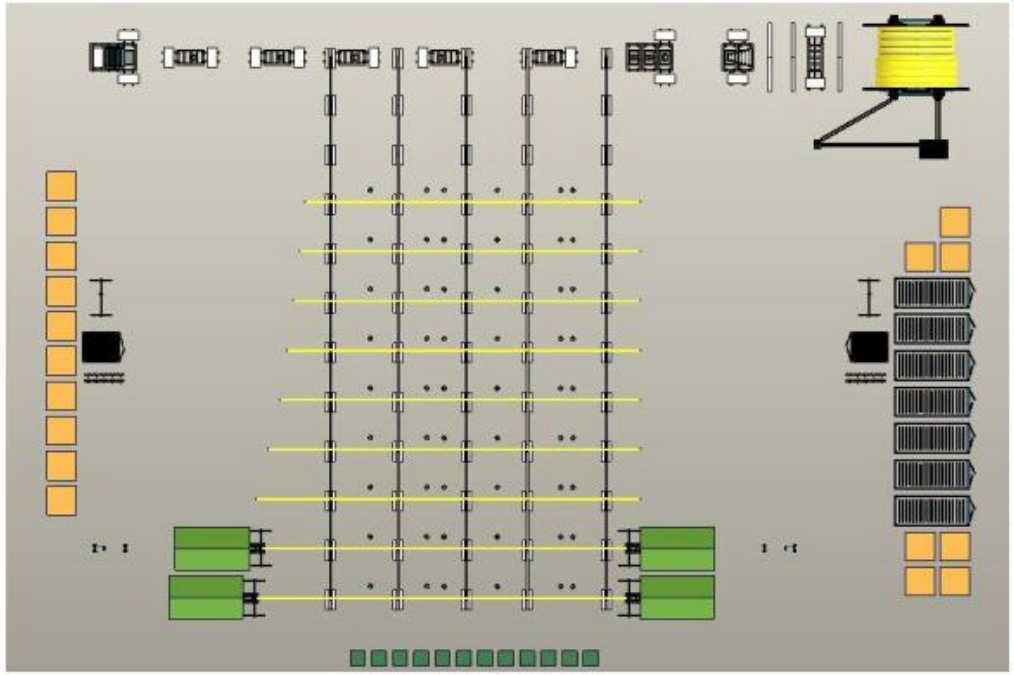
Specifications Yellowtail

Inner Diameter:	**5.2”**
Pressure rating:	**689 bar**
Water depth:	**1700 -2000 m**
Length:	**25 x 20 m**

Strohm

Case Study: From Idea, To Plan, To Reality





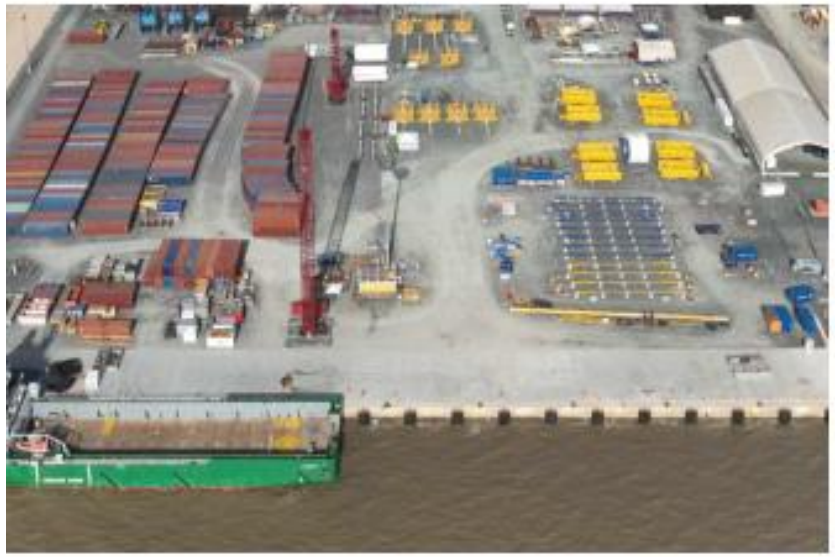
Case Study: Spooling Pipe Out/ Firing Line

Case Study: Completed TCP Jumpers

Case Study: Gooseneck/ Subsea Connector Installation (not STROHM)





Strohm

Case Study: Upending Jumpers and positioning on Test Stands






Thank you!

Strohm