

New Deepwater Frontier Developments For Flexibles

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Flexible Technology



AGENDA

- TechnipFMC Ultra-Deep Water Track Record & Capability
- TechnipFMC Mapping Development Solutions
- 3, 500 m WD Project – Main Achievements
- Towards New Flexibles Generation : Hybrid Flexible Pipe
- Conclusion

Ultra-Deep Water Track-Records & Capabilities

- Successful Large Deep Water Track Record for Projects

- | | | | |
|-----------|------|-------------|-------------|
| ○ 1,886 m | 2003 | Brazil | 6" |
| ○ 2,100 m | 2009 | West Africa | up to 10" |
| ○ 2,250 m | 2011 | Brazil | up to 9.13" |
| ○ 3,048 m | 2013 | GoM | 7" |

- Deep Immersion Performance (DIP) Tests

- Current tested capability : ~ 90 000 feet.inch



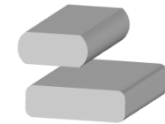
- Based on: Sour Service

Bottom risers / Jumpers

Collapse



Armours Buckling



Manufacturing & Installation

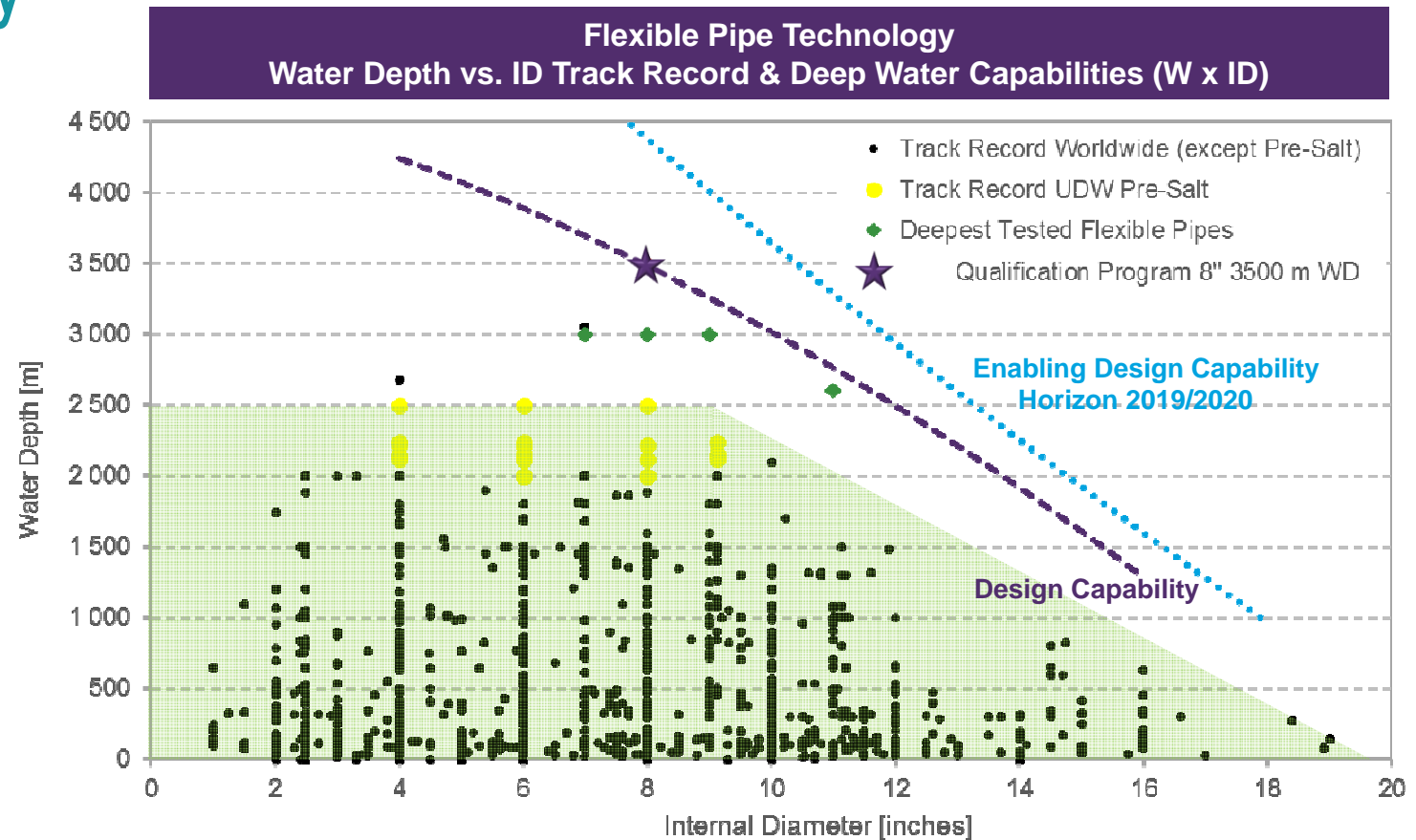


Deep Water Capability

Track Record W.ID (WDxID) ~ 70 000
ft.inch

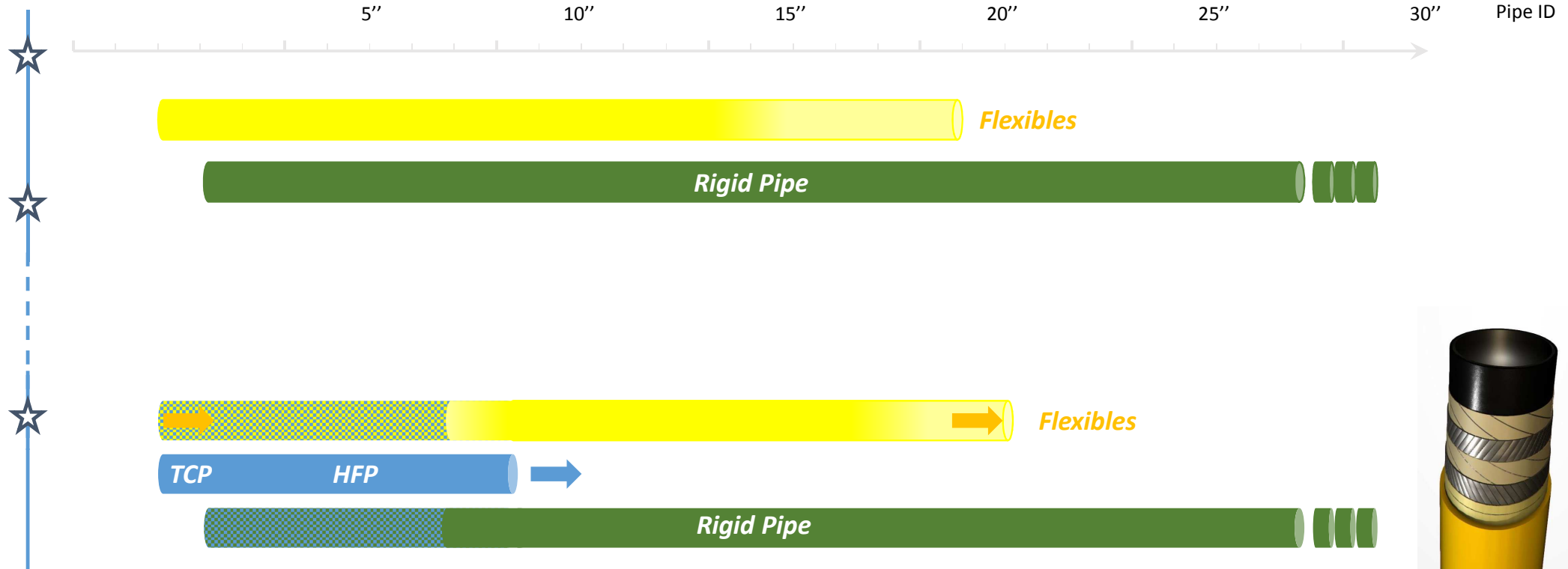
- 1700 km of flexibles delivered in WD >1000 m since 1993
- Incl. > 1000 km delivered in Pre-Salt

Qualification W.ID (WDxID)
Moving towards ~ 92 000 ft.inch



Sharing TechnipFMC capability with industry, enabling preliminary assessment of flexibles technology for FEED

TechnipFMC Mapping Development Solutions



Extension of TechnipFMC conventional flexibles portfolio to Hyper DeepWater & Larger diameters for Deeper Water

Introduce Hybrid Flexibles as Complementary solution to Conventional Flexibles

3, 500 m WD Project – Purposes & Project Value

- > 3, 000 m WD target
 - Requirement of flexibles technology / models capability extension
- Program to reach 3, 500 m WD (HyperDeepWater)
 - 8” sour flexible designed against main failure modes
 - Qualify flowlines & bottom risers / jumpers
 - Advanced assembly using most robust deep-water building blocks
- Engineer the full risers system
- Early Third Party engagement

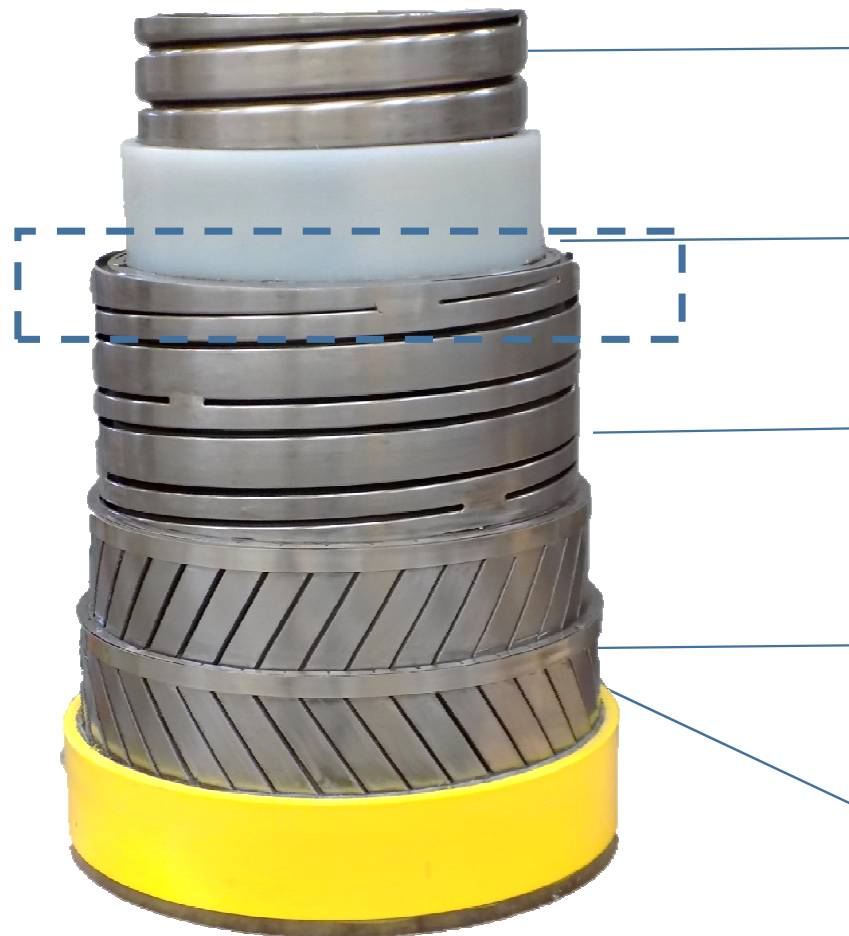


Demonstrate complete suitability of flexibles in HyperDeepWater

3, 500 m WD Project – 8” Flexible Structure – Building Blocks

- Designed for

- Production system : sour, max diff. P \leq 450 Bar, T \leq 150°C
- 3500 m WD
- Dynamic Applications
- SL=30 years
- Compatible with our installation vessels



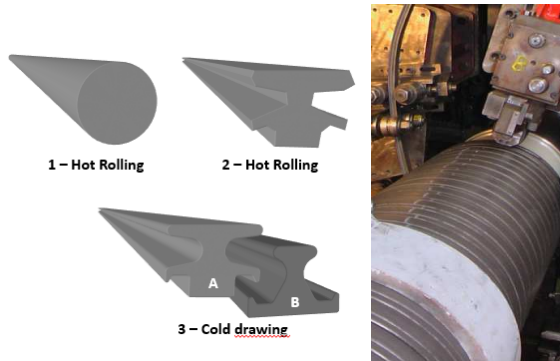
- Interlocked Carcass
- Material : Duplex 2205
- Size : 12,5 mm thick

- Standard Polymer sheath
- PVDF, PA, PE

- High Inertia Pressure Armour Wires
- Material : Sour service steel grade
- Size : 21 mm

- Wide Tensile Armour Wires
- Material : Sour service steel grade
- Size : 20x6 mm
- Anti-Buckling Tapes
- Material : High performance Aramides (Technora®)

3, 500 m WD Project – PSI 21 : A key technology building block



- Supply Chain & manufacturing process qualified
- Large ID range tested



BUREAU
VERITAS



- Qualified for Sour service & Dynamic applications



- Full Scale tests (collapse / fatigue/burst)

Fully Qualified & Available for commercial projects

3, 500 m WD Project – Main Qualification Results

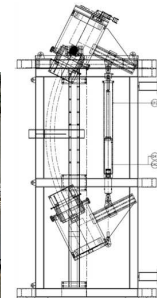
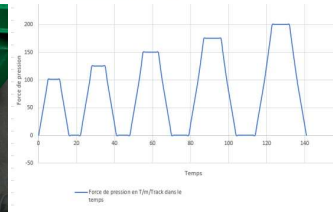
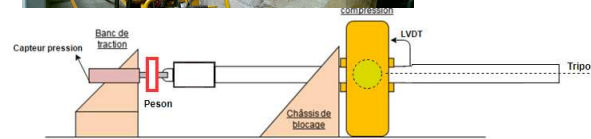
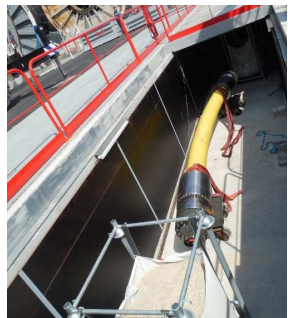


BUREAU
VERITAS

- Qualification program endorsed by Third Party
- 100 m long flexible sample industrially manufactured
- Burst test
 - Validate the manufacturing (incl. weld) & EF mounting
 - Burst Pressure > Minimum guaranteed burst pressure
- Crushing Tests
 - Simulate 3500m WD installation loads prior the hyperbaric chamber tests

Hyperbaric Chamber Tests

- Characterize the full flexible & its EF in a static & dynamic curved configuration
- Static Configuration validated



SUMMARY

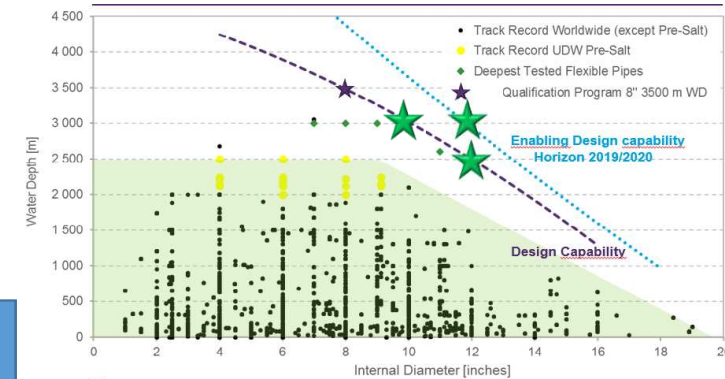
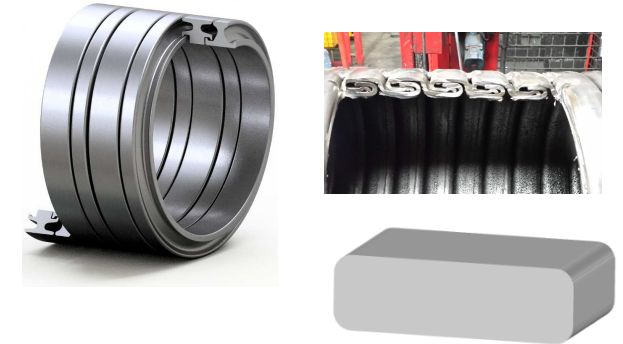
Large Track Records at ~ 70 000 ft.inch

Building Blocks for
larger ID extension

NEW NEEDS FOR UDW



Towards ~ 92 000 ft.inch



Towards new Flexibles generation : Hybrid Flexible Pipe

Conventional Flexible Pipe



Hybrid Flexible Pipe (HFP)

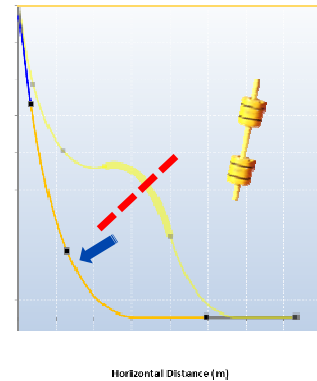


- Thermoplastic Composite Pipe (TCP)
 - Carbon Fiber + high performance polymer PEEK
 - Replaces **3 layers** – Smooth Bore
 - **100** x less permeable (High CO₂/H₂S)
 - High Pressure / High Temperature

- Conventional Armor
 - Sustain axial load
 - Protected from corrosion by TCP
 - External Sheath




-60% Weight saving



Free hanging

Towards new Flexibles generation : Hybrid Flexible Pipe

- Introduce Solutions Complementary to Conventional Flexible Pipe
- Create a new Composite product line based on TechnipFMC proprietary HFP concept
-  **magma**[®] composite technology accelerates development of next generation Hybrid Flexible Pipe (HFP)

[Ready to Market 2021



Conclusion

- Enabling technology building blocks available for larger ID development in Ultra Deep Water
- HFP cost effective solution for UDW (4''-8'')
 - Qualification on-going
 - Ready for market 2021

