Step change in Wireline Subsea Intervention Lubricator Performance

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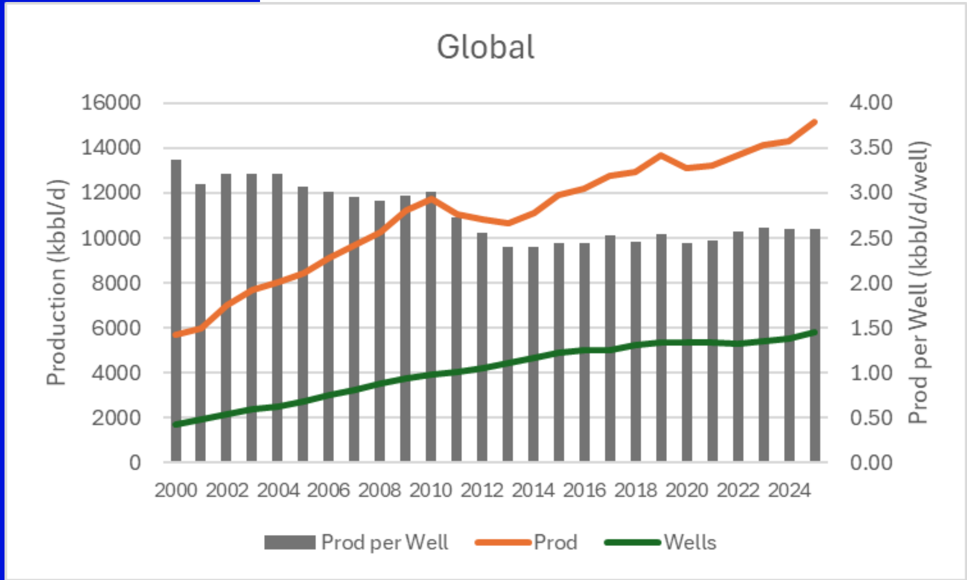
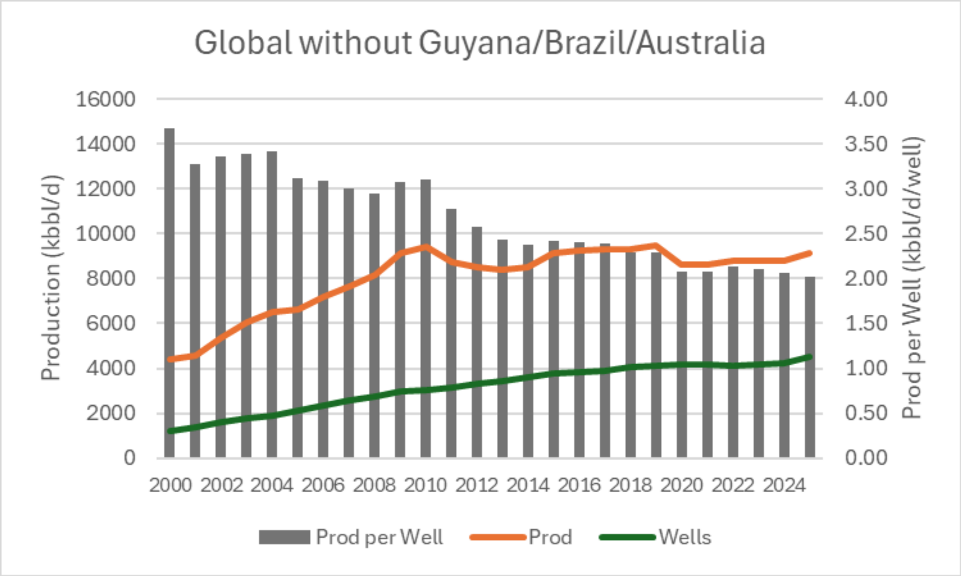
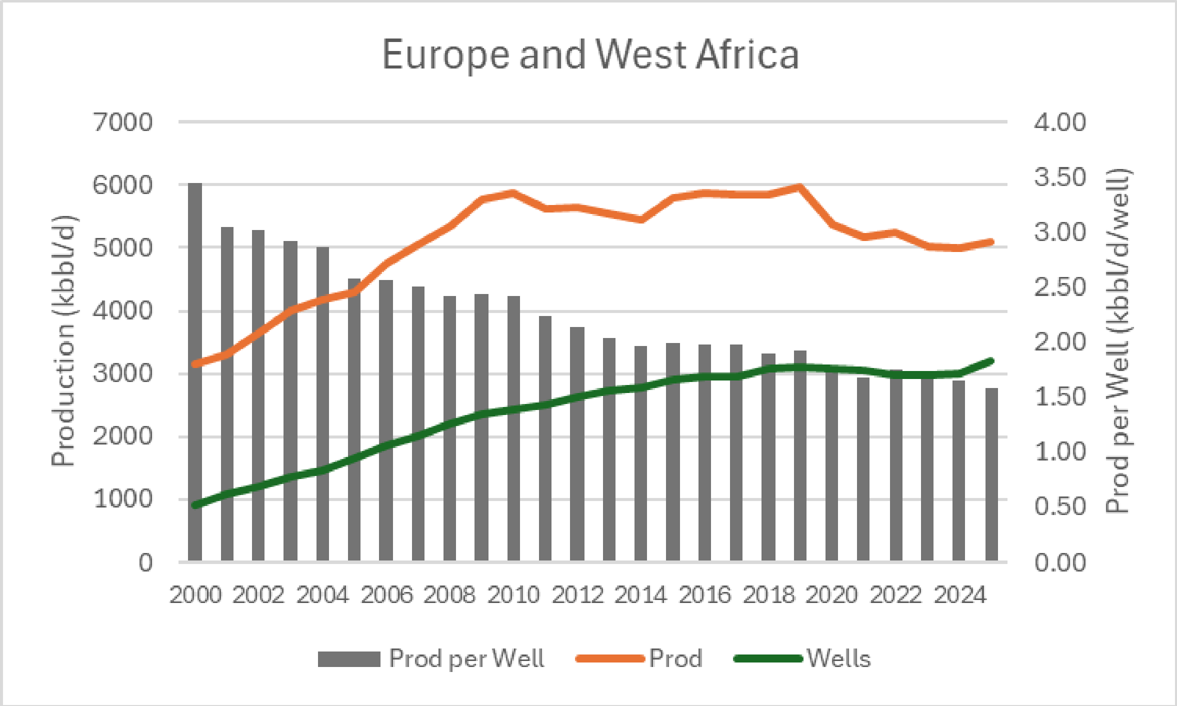
Subsea Production Macro





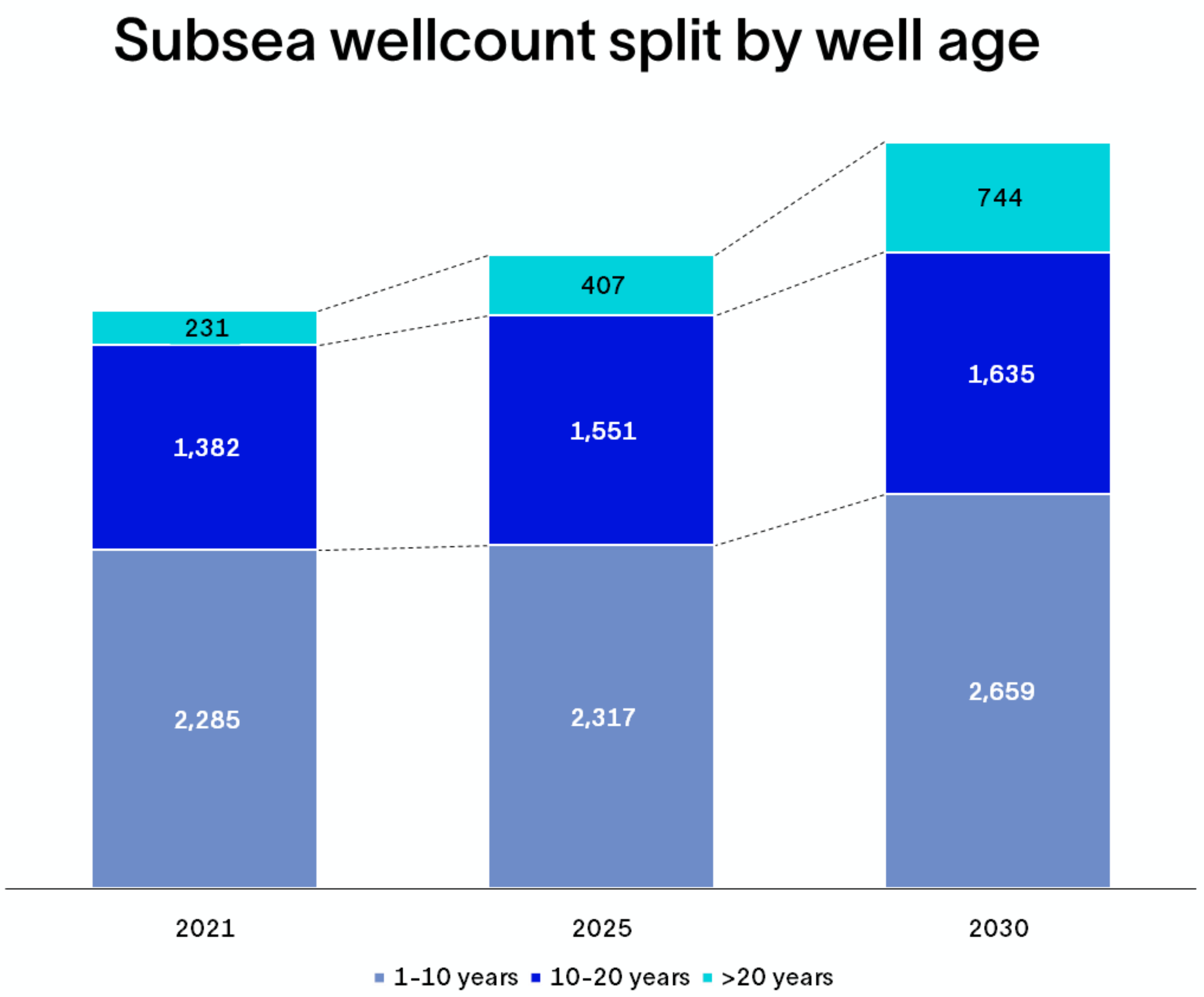


Data Rystad Subsea and Well Cubes, NSTA

The Need for Subsea Intervention

By 2030 ~48% of the active wells will be more than 10 years old and ~15% more than 20

Subsea intervention is costly (in UKCS in one year 11% of activity but 50% of spend on interventons)



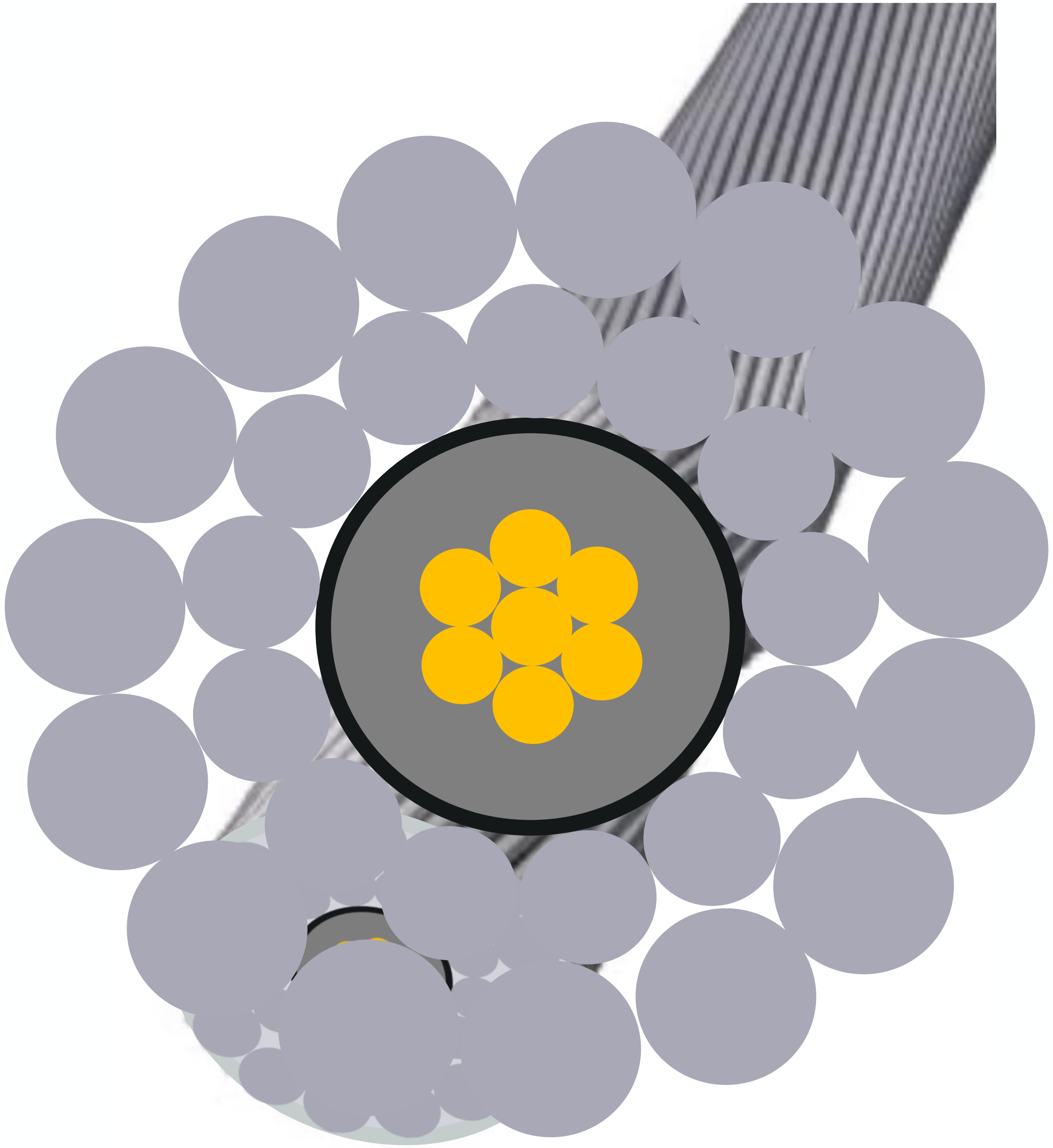
Subsea well – Offshore > 125m depth + Wellhead type: Wet and Producing/under development/to be discovered (future) Source: Rystad March 2025

Conventional Wireline Cable Construction

Cable Torque: The Good

The opposing wrap directions mean the cable binds up on itself and has mechanical strength

Cable Torque: The “Not so Good”



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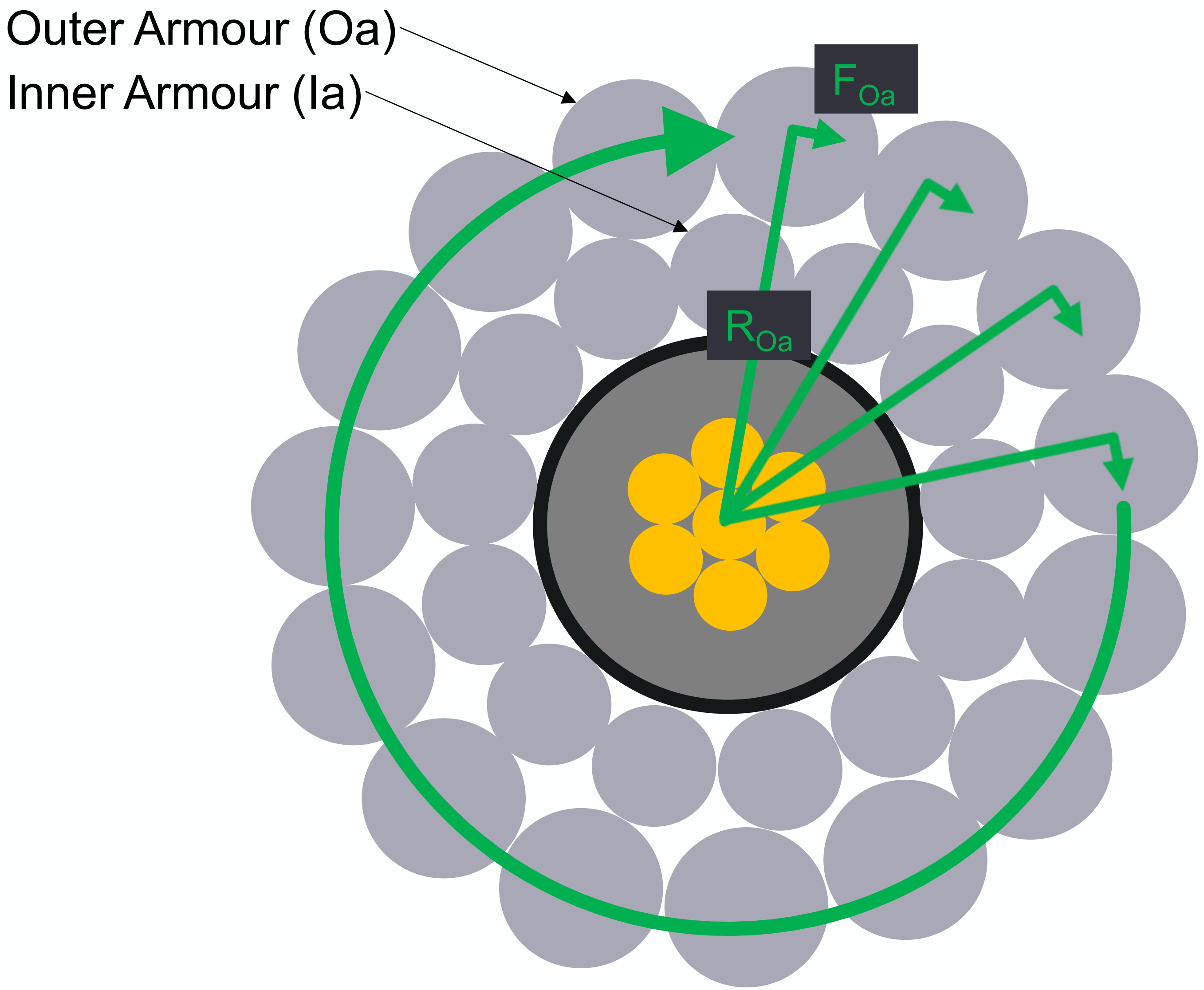

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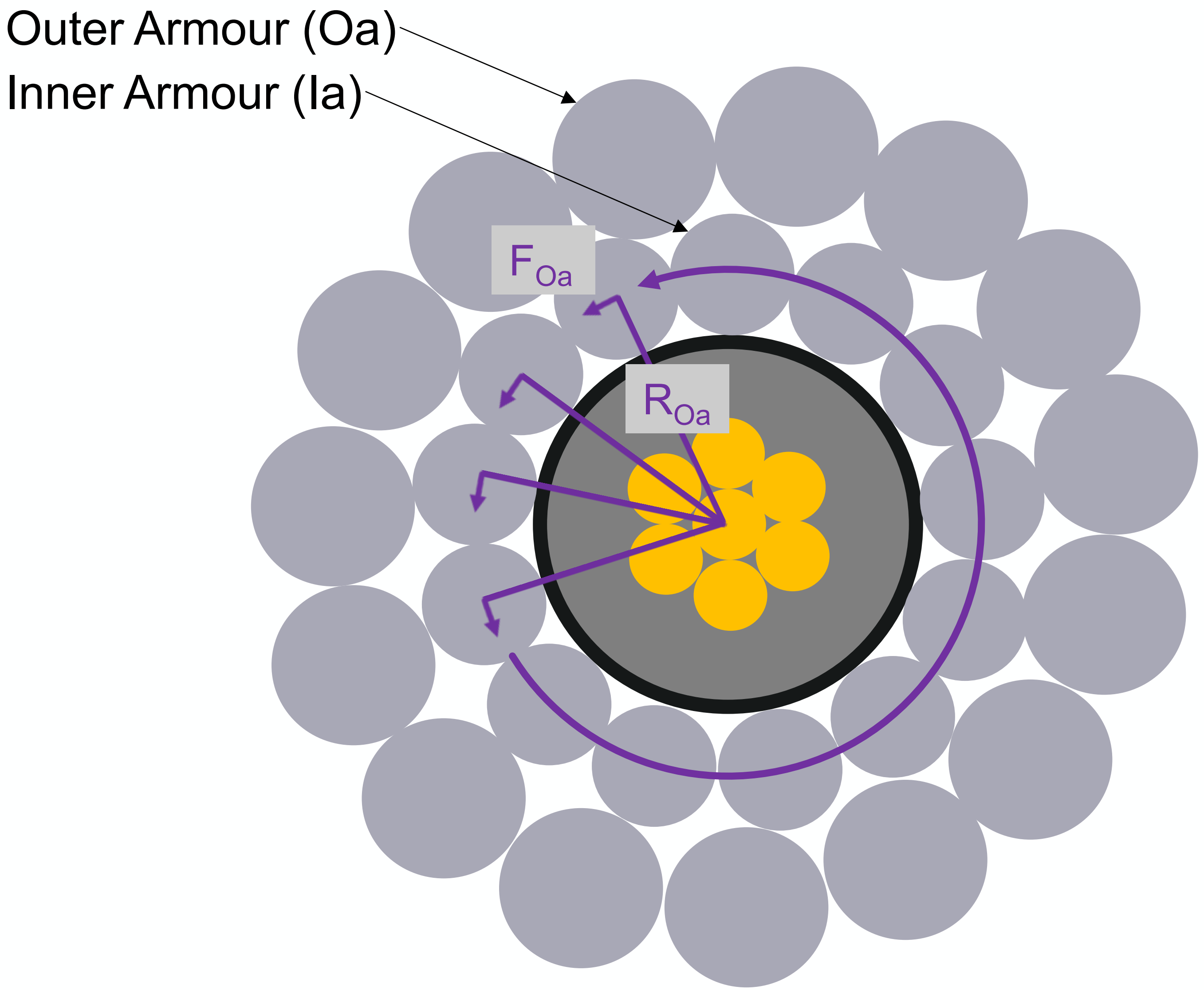


Cable Torque: The "Not so Good"

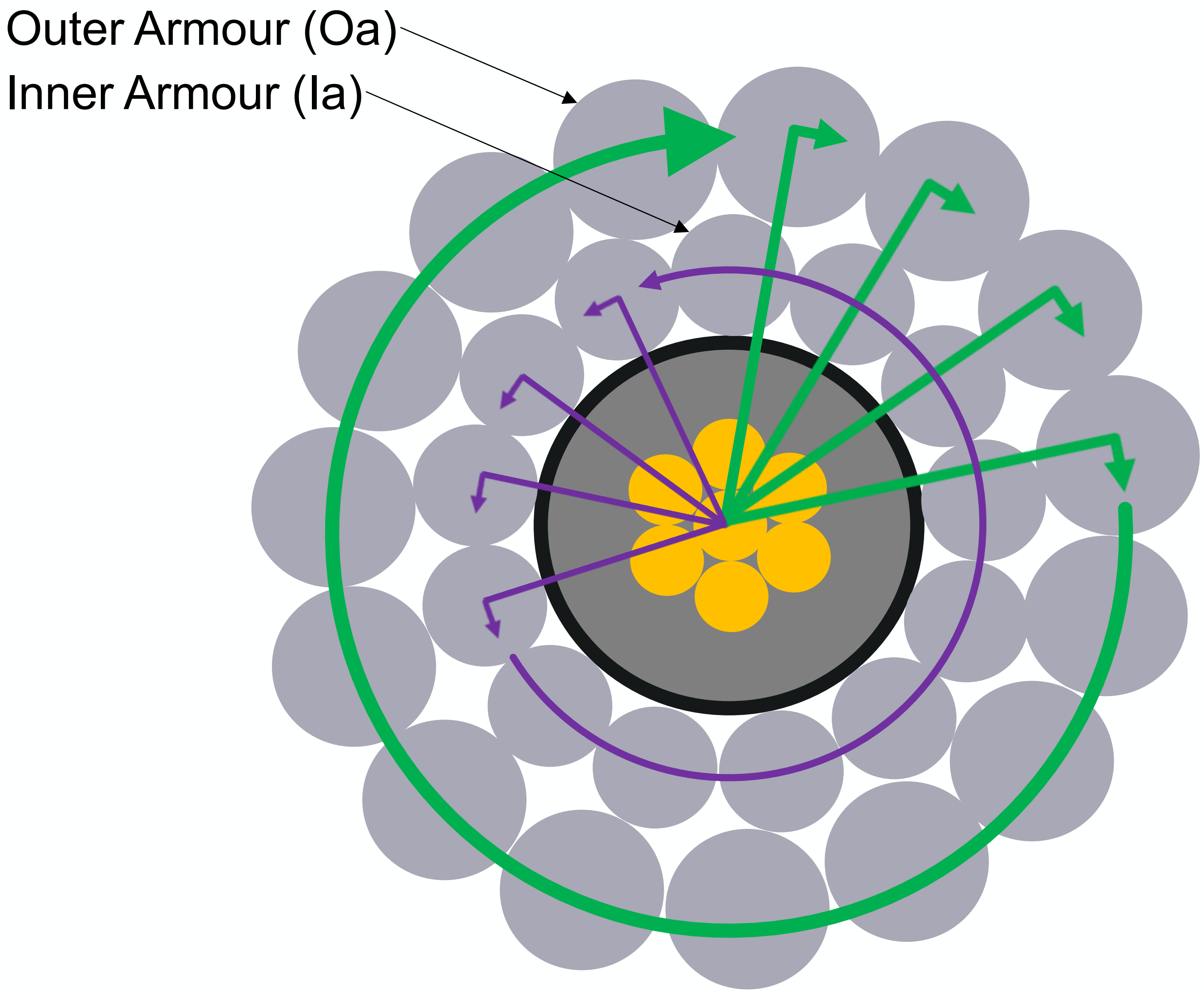
Outer Armour Torque

$\mathbf{T}_{Oa}$= Fn (F_{Oa} X R_{Oa})

Inner Armour Torque

$\mathbf{T}_{Ia}$ = Fn (F_{Ia} X R_{Ia})

$\mathbf{T}_{Oa}$ > $\mathbf{T}_{Ia}$ = Unbalanced

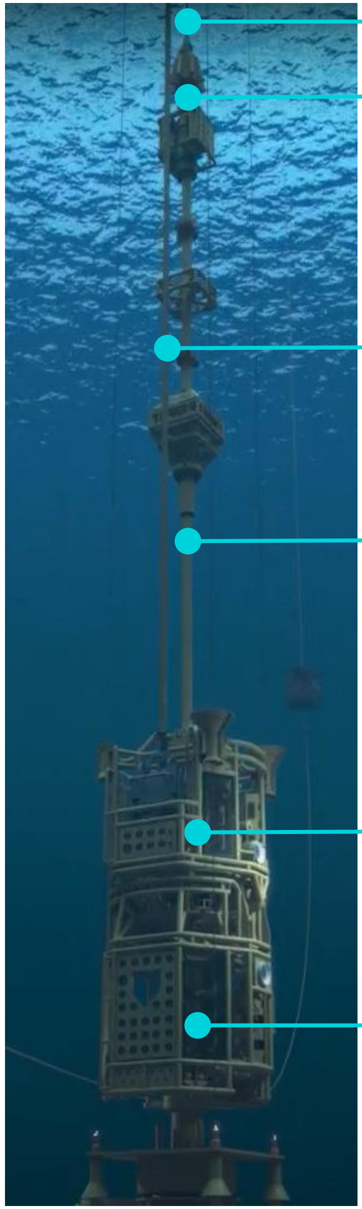


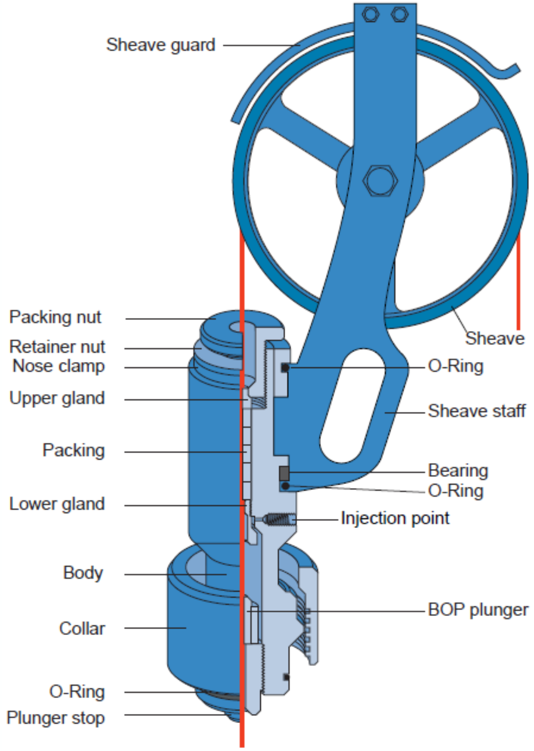
The Real Consequences of Unbalanced Cable Torque

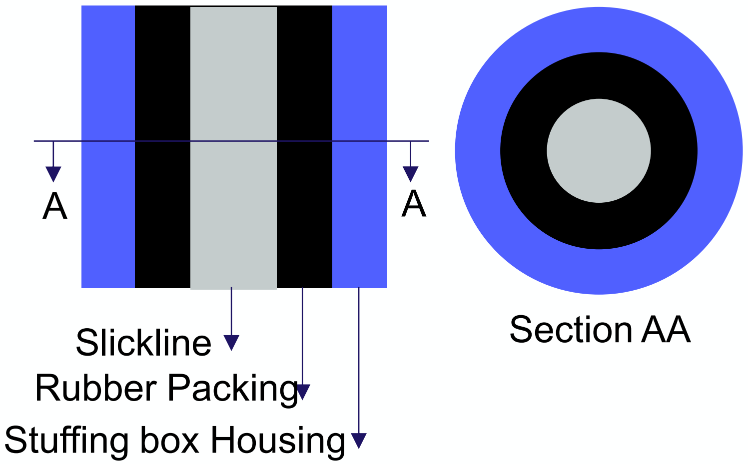
UK North Sea 2002

Cable cut at seabed to recover

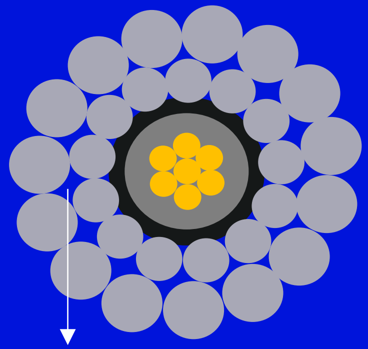
Sealing Against Wirelines in Live Wellbore



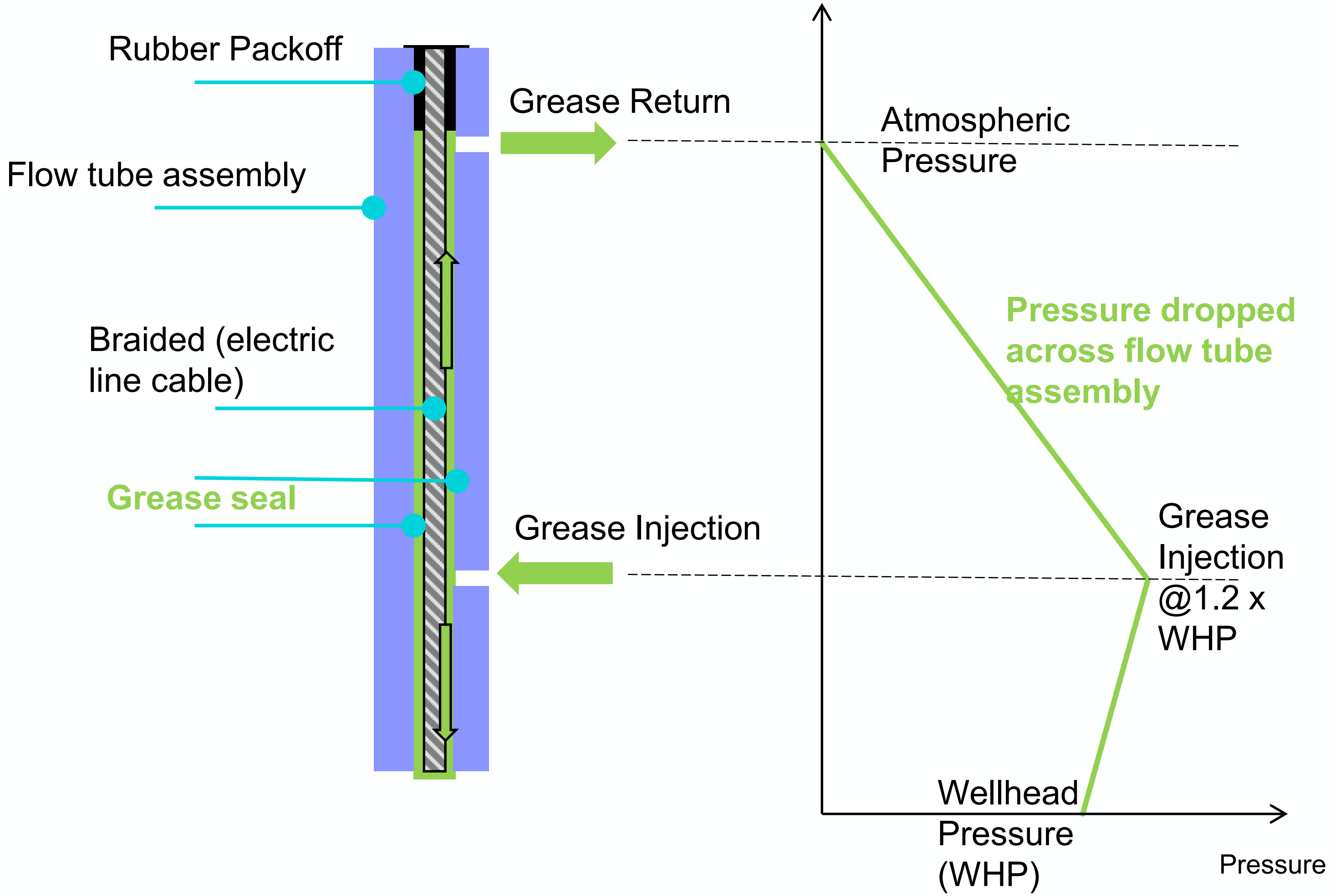




Sealing Against Wirelines in Live Wellbore



Interstitial void or leak path

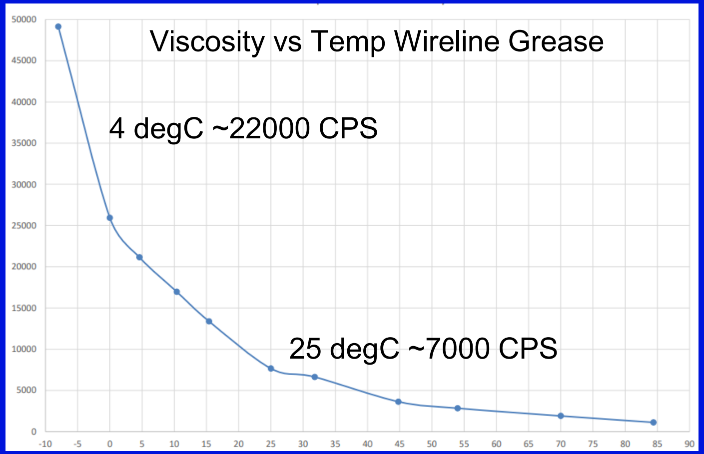


COUETTE'S EQUATION

$$P2 - P1 \; (\Delta P) = \frac{6\,L\,u\,Q}{Rc\,h^3}$$

P2 = grease injection pressure @ flow tube
P1 = grease outlet pressure @ flow tube
L = Length of flow tube
u = grease viscosity
h = clearance between Flowtube & cable
Rc = cable radius
Q = quantity of grease injected

Wireline Grease Supply to Subsea Lubricator



Many variables to control:

- Water depth
- Temperature profile
- Wellhead pressure
- Cable running speed

Surface pumping of wireline grease limited to approx. 600/800m

Deeper requires subsea grease storage with own limitations

Pressure loss pumping along a hose – Darcy Weisbach

$$\Delta P = f \times (L/D) \times (\rho v^2/2)$$

- ΔP = pressure loss
- f = friction factor (dimensionless) = fn(Re)
- **L = length of the hose**
- D = internal diameter of the hose
- ρ = fluid density
- v = average fluid velocity

Highly viscous fluid, laminar flow, use Hagen Poiseuille's law

$$\Delta P = 8\boldsymbol{\mu}\mathbf{L}Q/\pi\mathbf{R}^4$$

- Q = volumetric flow rate
- R = pipe radius (m)
- **μ** = dynamic viscosity

A challenge at 2000m+ water depth where considerable length is at low temperatures with a large volume of grease with a high viscosity

Reducing Risk in Subsea Interventions

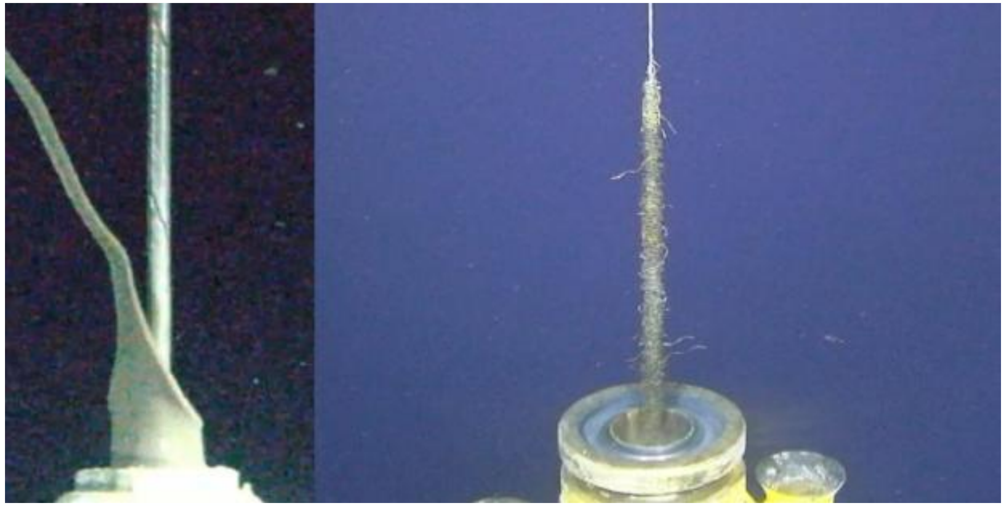
SPE-228275-MS

The Evolution of Riserless Wireline Subsea Intervention in Deepwater Gulfof Mexico, Doing More with Less

S. E. Townsend, J. Duenas, and L. W. Ramnath, BP America Inc 2025

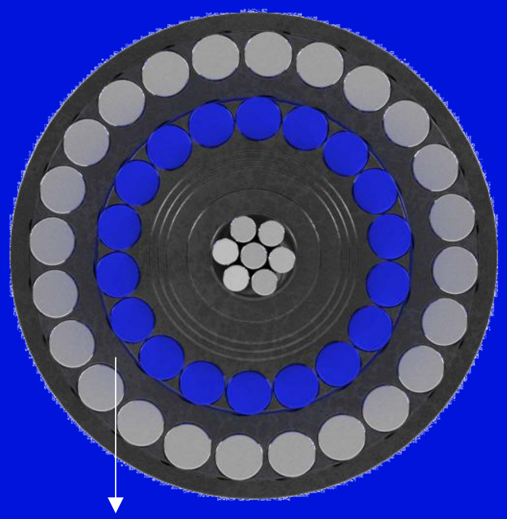
Key Challenges Observed

1. Loss of grease seal primarily related to grease supply
2. Stranded Wireline



Use of a polymer encapsulated wireline can eliminate need for a grease seal and eliminate stranded wires

Polymer locked electric line cable technology



Cable armours are locked together with a polymer coating

Brings the following benefits:

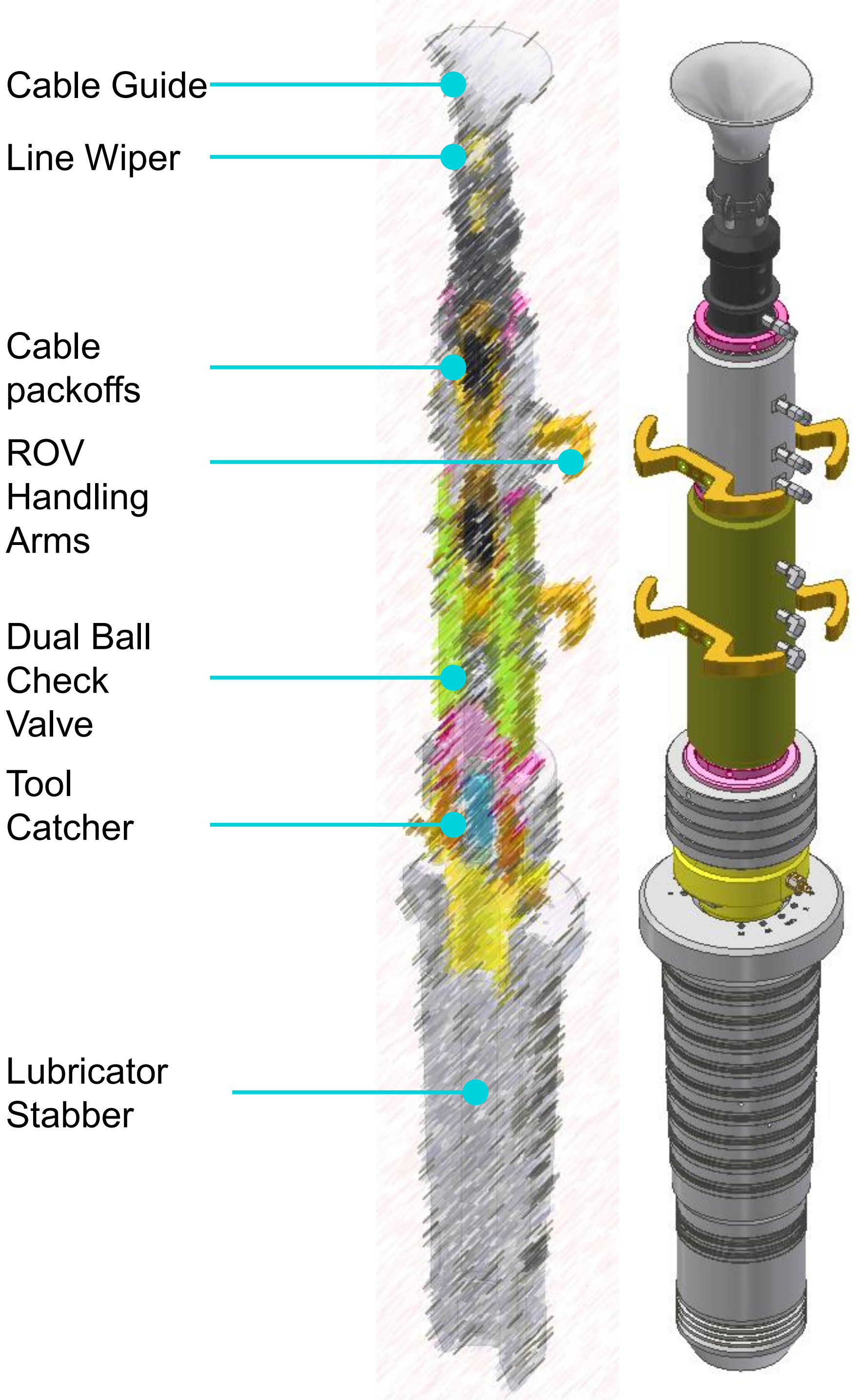
- No need for grease injection to seal against well bore pressure
  - Shorter pressure control head
  - Simpler pressure control
- Cable torque eliminated as armours locked togethar meaning no stranded lines
- Lower friction between cable and wellbore
- Lower weight meaning higher effective pull on BHA

Commercial for many years **but a subsea pressure control device to enable well access had not been developed**

Subsea Wireline Packoff

Intensive Field Input to Design

- 12.5kpsi working pressure rating
- Grease injection for pressure control eliminated
- Polymer locked cables only
- Redundant packoffs with 3 total
- Dual ball check valves
- Low friction due to low actuation pressure
- Split packers, inserts, & bushings for quick and easy line redress
- Can be configured with different stabbers/SIL connections

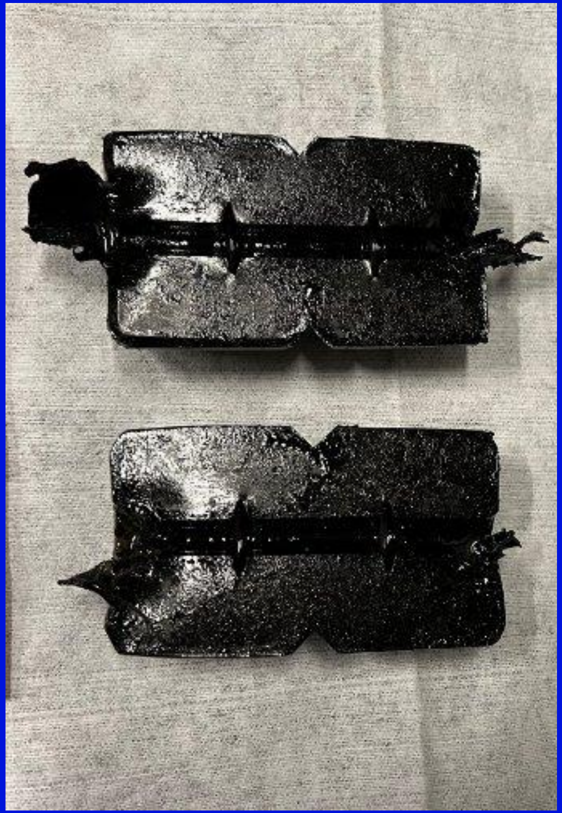


Engineering Qualification Plan

Huge focus on engineering qualification testing prior to going to field

Guidelines reference including API 16A, API 6A, API17D, API 17G

Look ahead to API 17G4 and API 16B



Photos from pack off testing – 200K ft over wheel at 8000 psi

FIELD EXPERIENCE

Riser-Less Light Well Intervention 2025

Objective: Acquire Wellbore Acoustic and Temperature Data for Well Integrity Assessment

Success Factors

- Effective **collaboration** between TotalEnergies, SLB & field teams.
- Extensive **pre-job planning,** preparation covering; **risk assessment**, training, execution monitoring, and post job analysis.
- Equipment **inspected** after every run – minimal pack-off wear observed.
- Deployment and operational **lessons learned**.

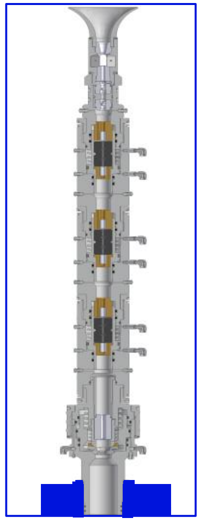
Operations Overview:

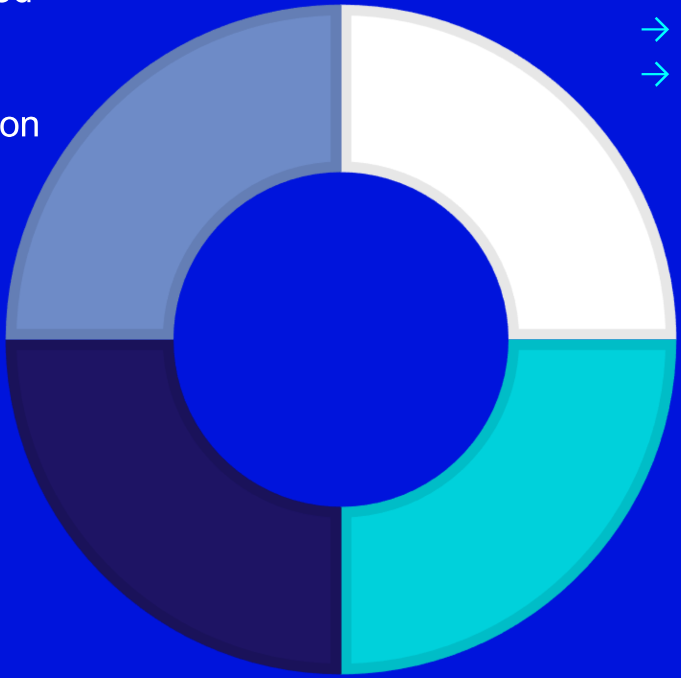
- Deployed via LWI vessel in a riser-less configuration
- 1st operation: WD = 112m, TH = 136mMD
  - Planned in a low-risk well context.
  - 1st deployment: Camera investigation at HXT (LCP in place)
- 2nd operation: THP of 850 psi; WD = 112m , MD ~3350m
  - 1st deployment: Multi-finger caliper and corrosion survey
  - 2nd deployment: Noise survey
- Dual pack-off configuration on both operations.

Successfully deployed in 2 x wells

Greaseless Wireline Subsea Intervention System

- Subsea pressure control packoff
- Enables polymer locked cable operations on riserless light well intervention vessels





Efficiency increase
- → Single conveyance method
- → Avoid grease tank refill
- → Increased tripping speed
  - → 40% friction reduction

Reduced operational risk
- → Eliminate stranded armor
- → Reduced risk of pressure leaks

Operational flexibility
- → Agnostic connection
- → Single conveyance unit
- → Reduced crew size
- → Greater depth capability

Environmental stewardship
- → No grease injection
- → Overall lowered CO2 emissions with interventions

12,500psi

pressure rating

-50%

footprint reduction (single winch)

+50%

CO2e reduction LWIV vs MODU

Thank you to TotalEnergies, SLB and Helix for enabling these first field tests

Questions?