

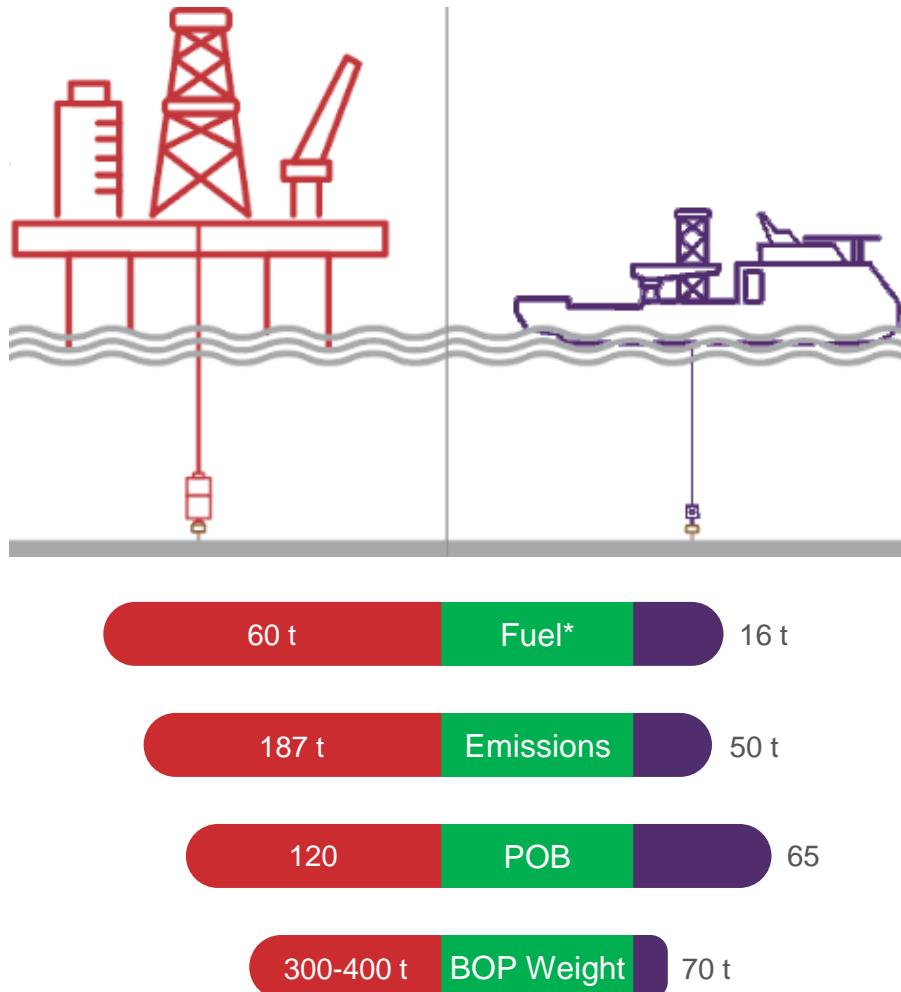
# Riserless Plug and Abandonment

## Success Stories and Recent Developments

7/11/2023



# Why Riserless P&A?



\*Fuel consumption per day on DP

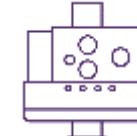


Simpler setup and operations

Unmatched efficiency

Reduced POB and personnel exposure

Reduced environmental impact



Reduction in wellhead stresses and fatigue



RLCT and additional Tooling expands the offering

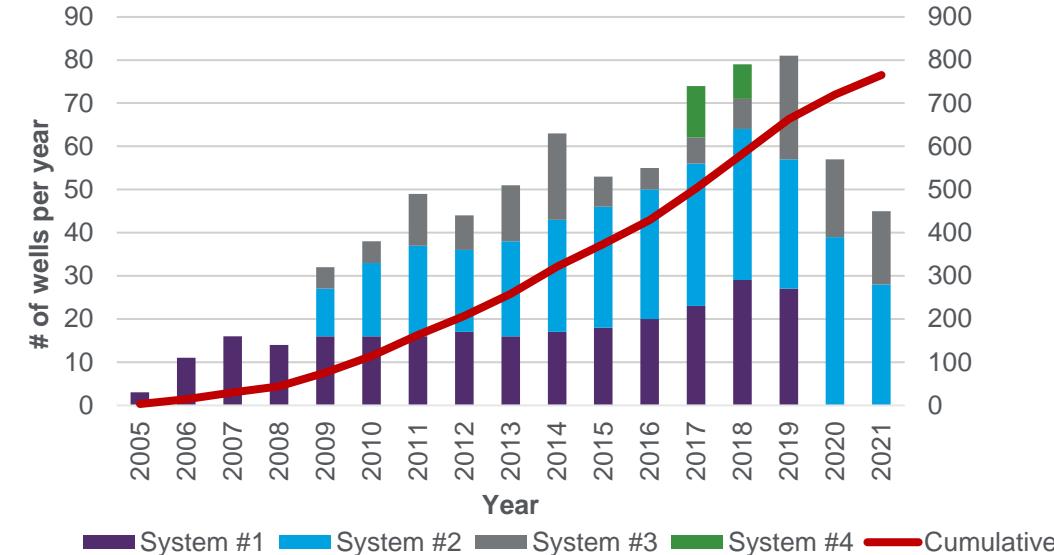


Reduced costs for P&A

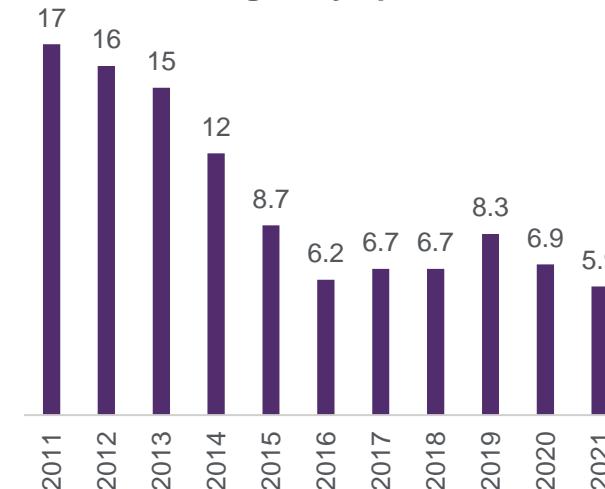
# TechnipFMC - RLWI Track Record

## Highlights

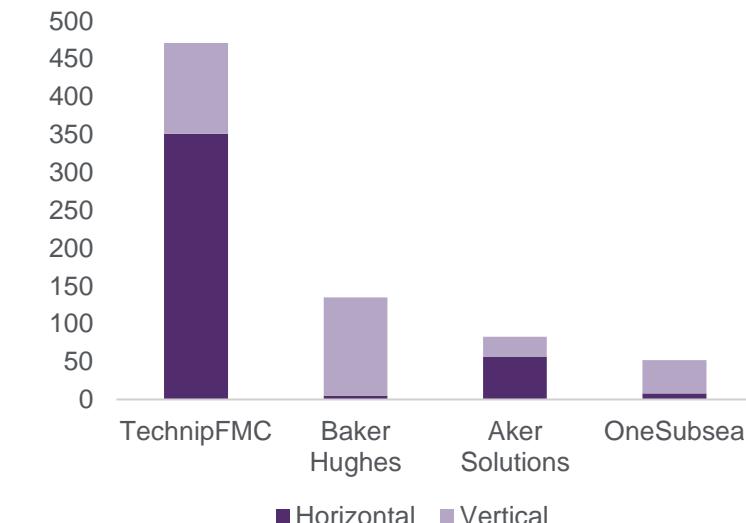
### RLWI Track Record



### Average Days per Well



### Subsea Tree Type and Manufacturer



## Takeaways

RLWI Track Record of >800 wells,  
>5000 runs in hole

Over 421 wells (56%) were Horizontal  
Trees with crown plugs

Average days per well has decreased  
by 65% in the past 10 years

# Why Riserless Coiled Tubing!

## Wireline

1. Production logging
2. Replacement of hardware, Shifting sleeves
3. Plug & perforation
4. Temporary P&A

## Coiled Tubing

1. All of the above +
2. Stimulation and circulation
3. Fracturing
4. Sand/scale removal
5. Permanent P&A



# Riserless Advantages in shallow water

**RLWI has multiple advantages versus riser-based Intervention, especially in shallow water:**

- Lower wellhead stresses and fatigue:**

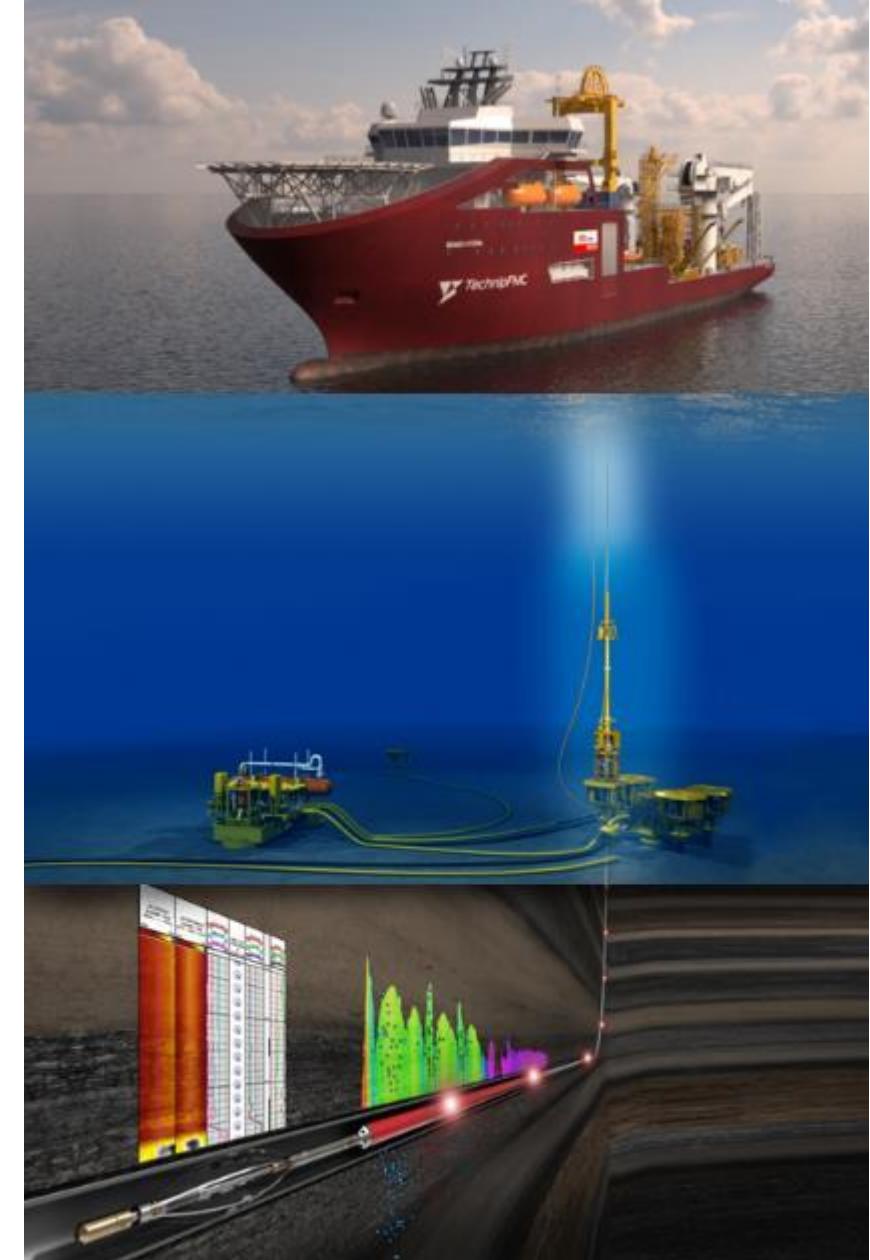
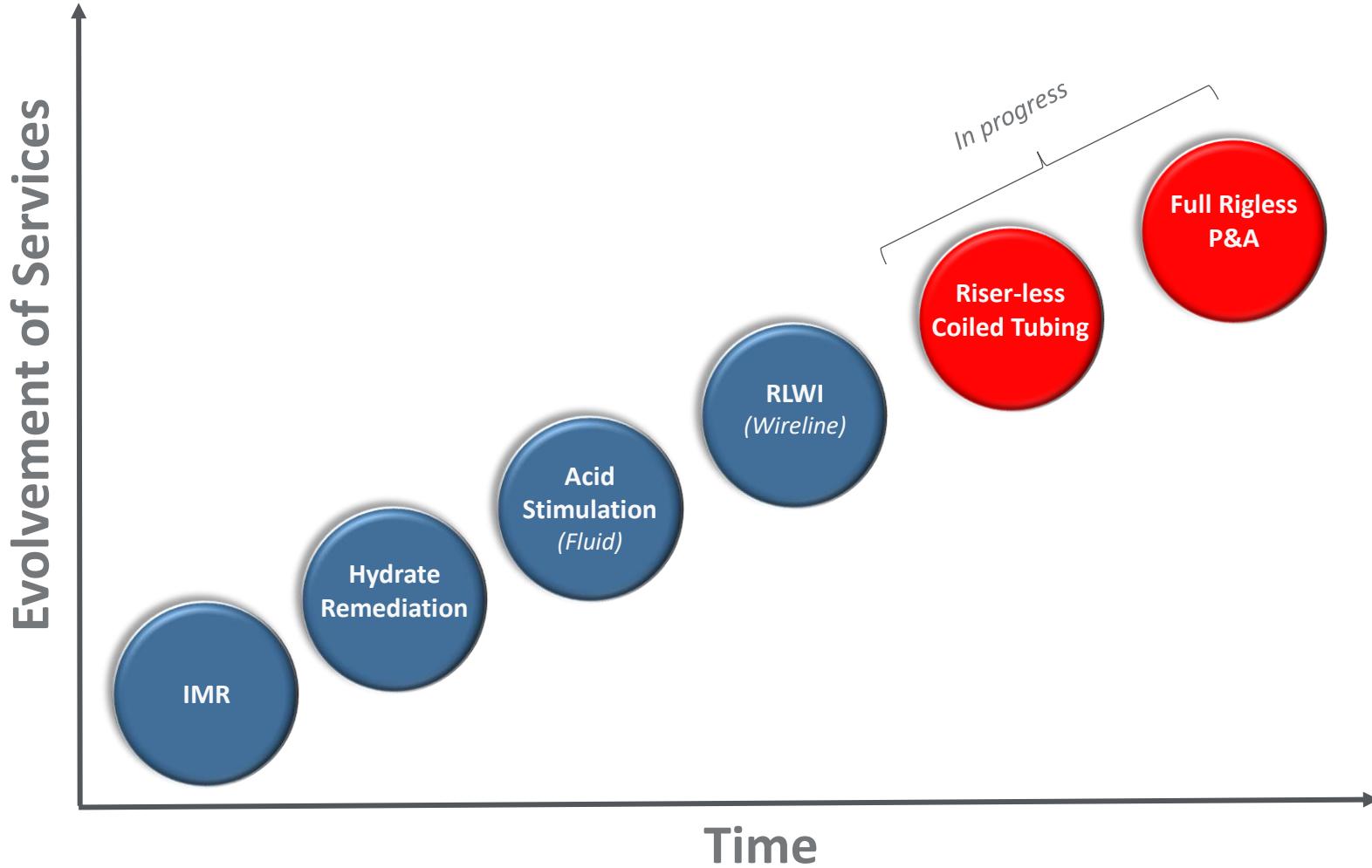
Typical Minimum water depth for DP operations:

- Riserless: 70-80 m
- Riser-based: 200-300 m

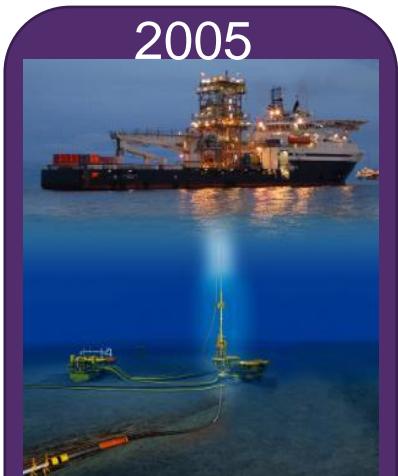
- No mooring needed**
- No BOP tethering needed**
- Larger watch circles, resulting in higher operating window and lower Waiting on Weather**



# Long Term Vision: From Rig to Vessel



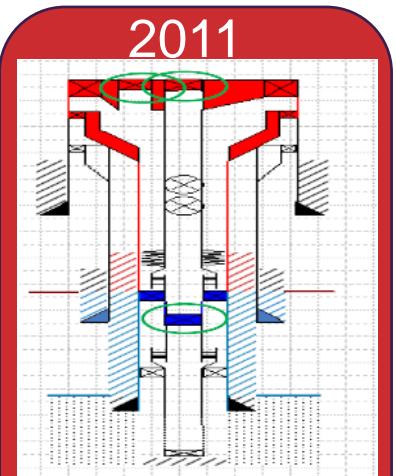
# Riserless P&A - Development Roadmap



2005

## RLWI

- 17 years continuous track record
- 800+ wells
- 5000+ runs in hole
- Well established and accepted, business as usual



2011

## Pre-P&A

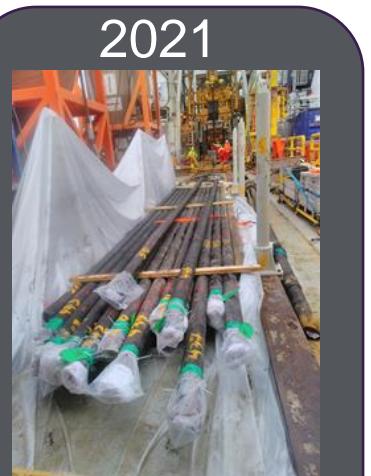
- 90+ wells
- Bullhead well
- Punch/cut tubing above production packer
- Bullhead/Circulate annulus
- Set Lower and Upper suspension plugs
- Set Annulus plug if needed
- Retrieve Vertical Tree



2020

## P&A incl. cementing

- Patented Subsea injection spool enables cement injection below WCP
- Reservoir cementing by bullheading
- Through Tubing Cementing



2021

## P&A incl. Tubing Hanger and Tubing Retrieval in Open Water

- Install Primary and Secondary cement barrier plugs
- Unlock and retrieve subsea tubing hanger
- Retrieval of tubing in open water



2022

## P&A incl. Gravity-Fed RLCT

- Subsea CT Stripper
- Riserless gravity-fed coiled tubing capabilities
- Can spot cement plugs
- Can set cement plugs in multi-packer completions

Waiting on first Well

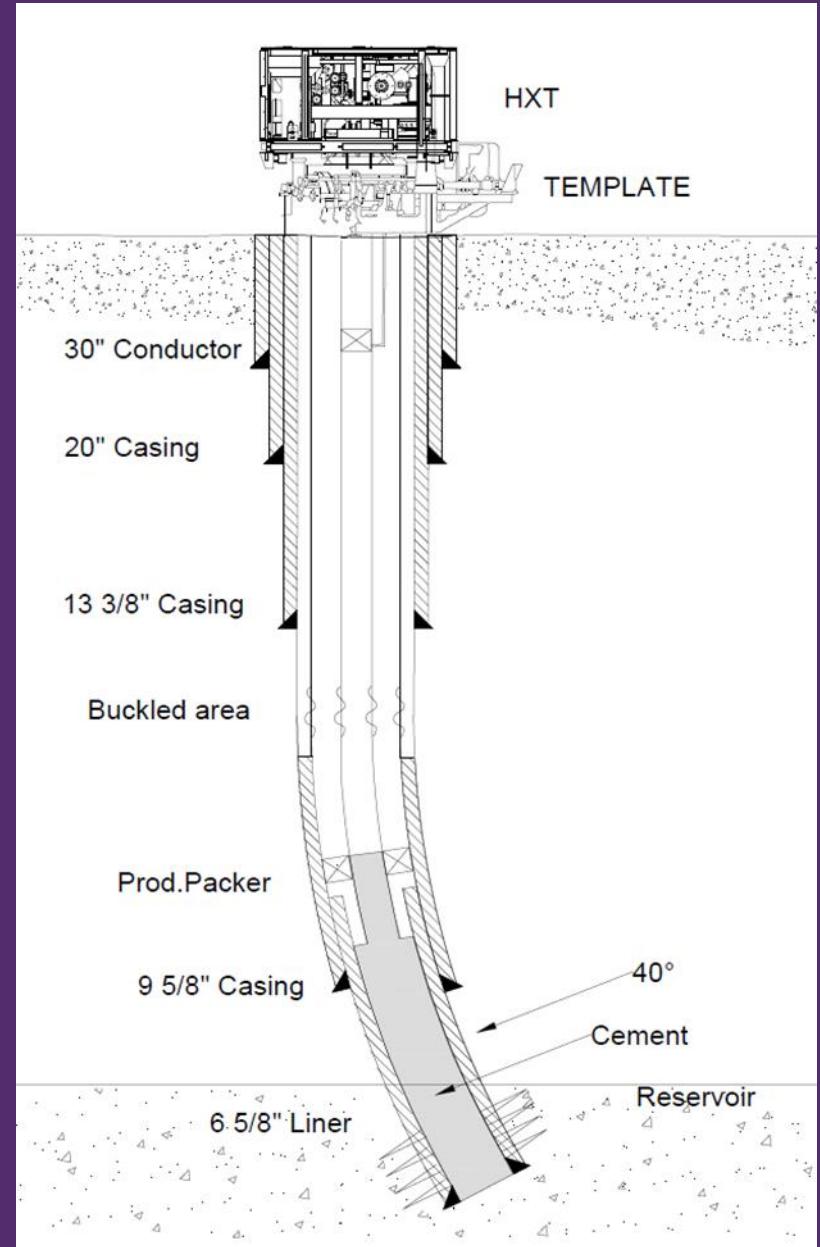
2023→



## P&A incl. Full RLCT

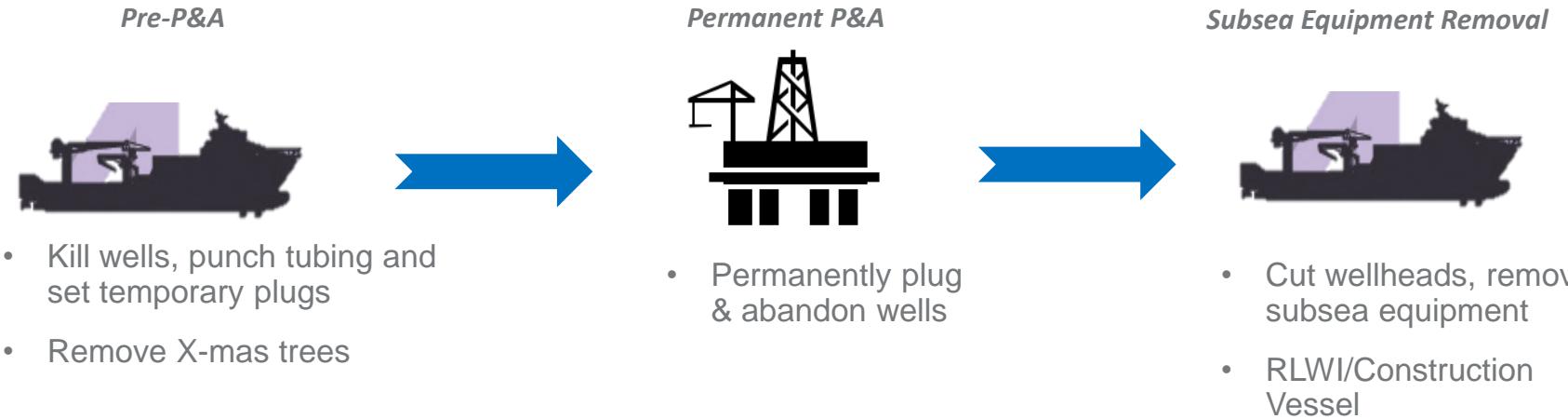
- Riserless coiled tubing with subsea injector available from 2023
- Full RLCT capabilities

# P&A Case Histories



# Riserless Plug and Abandonment

RLWI in combination w/Rig (Pre-P&A) is a cost effective, proven method for P&A



## >120 Pre-P&A Projects

Typical Activities:

- Well Kill / Bullheading
- Tubing Punching and Cutting
- Circulating / Bleeding
- Setting and testing Mechanical Plugs
- XT Recovery



## 150+ Operations in UK, Norway & Denmark

- 60+ wells using SWAT and WASP technologies
- 90+ wellhead-severances and removal
- 35 mud-line suspended wells cleaned out and cut/removed, including pulling pieces of casing

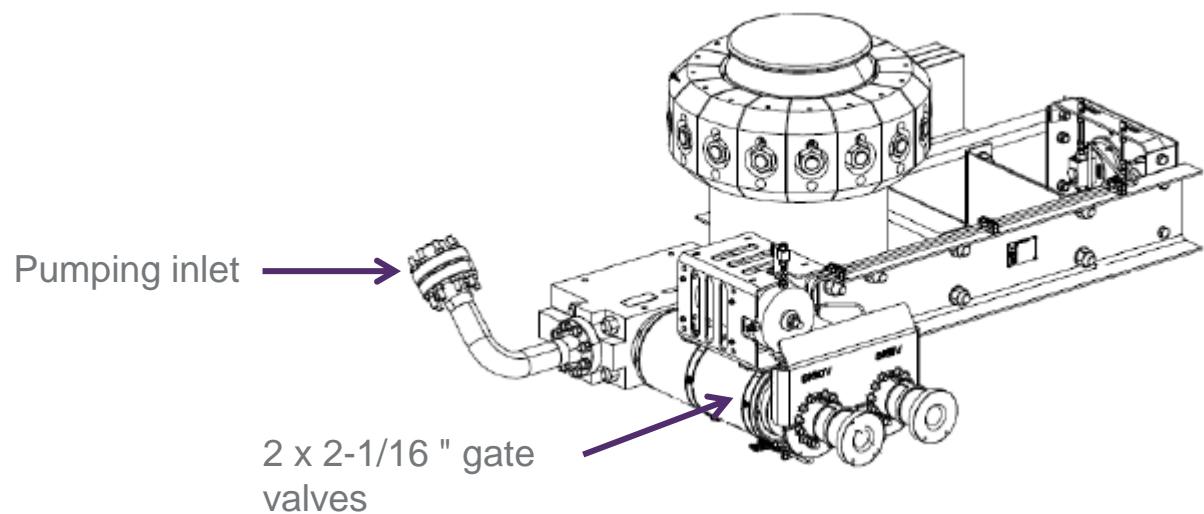
# Riser-Less Through Tubing Cementing

# SIS - Subsea Injection Spool

**Provides Hydraulic access below the stack valves**

**Equipped with dual barriers (2-1/16" gate valves)**

**Enables riserless through-tubing cementing without exposing the stack to cement**



Lower Lubricator Section, (LLS)

Well Control Package, (WCP)

Subsea Injection Spool (SIS)



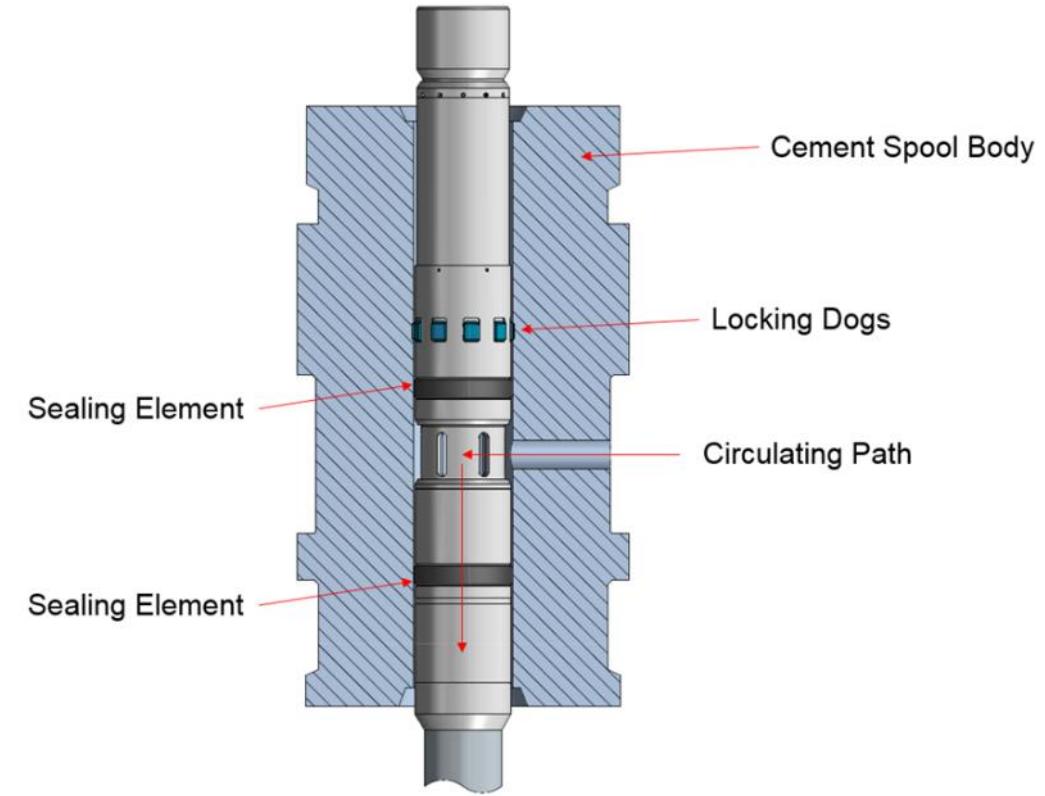
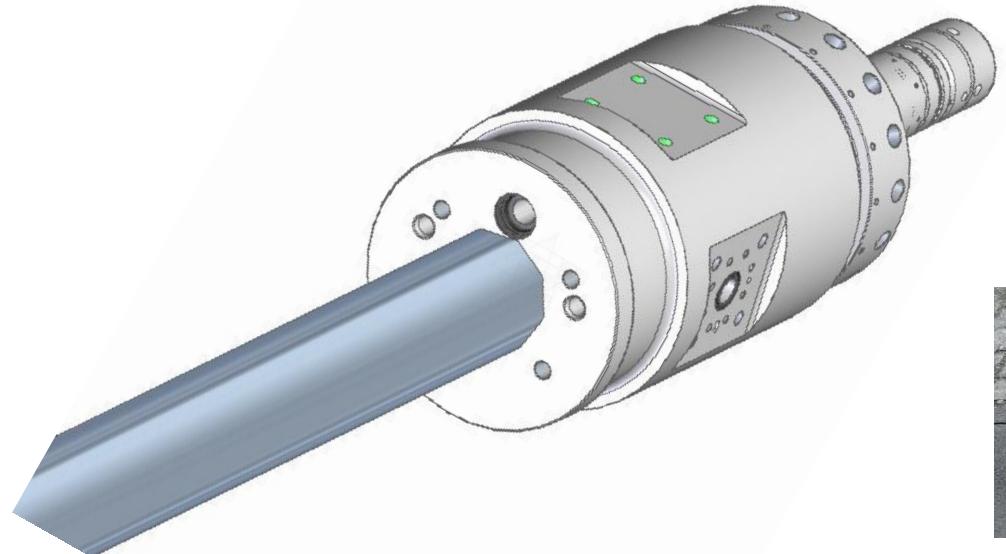
# Cement Straddle

**Enables riserless through-tubing cementing without exposing the stack and the tree to cement**

**Lands and seals in the SIS and in the tubing below the trees**

**TIOS proprietary system**

**Run and retrieved on slickline or e-line**



# Riserless Cementing Job Summary

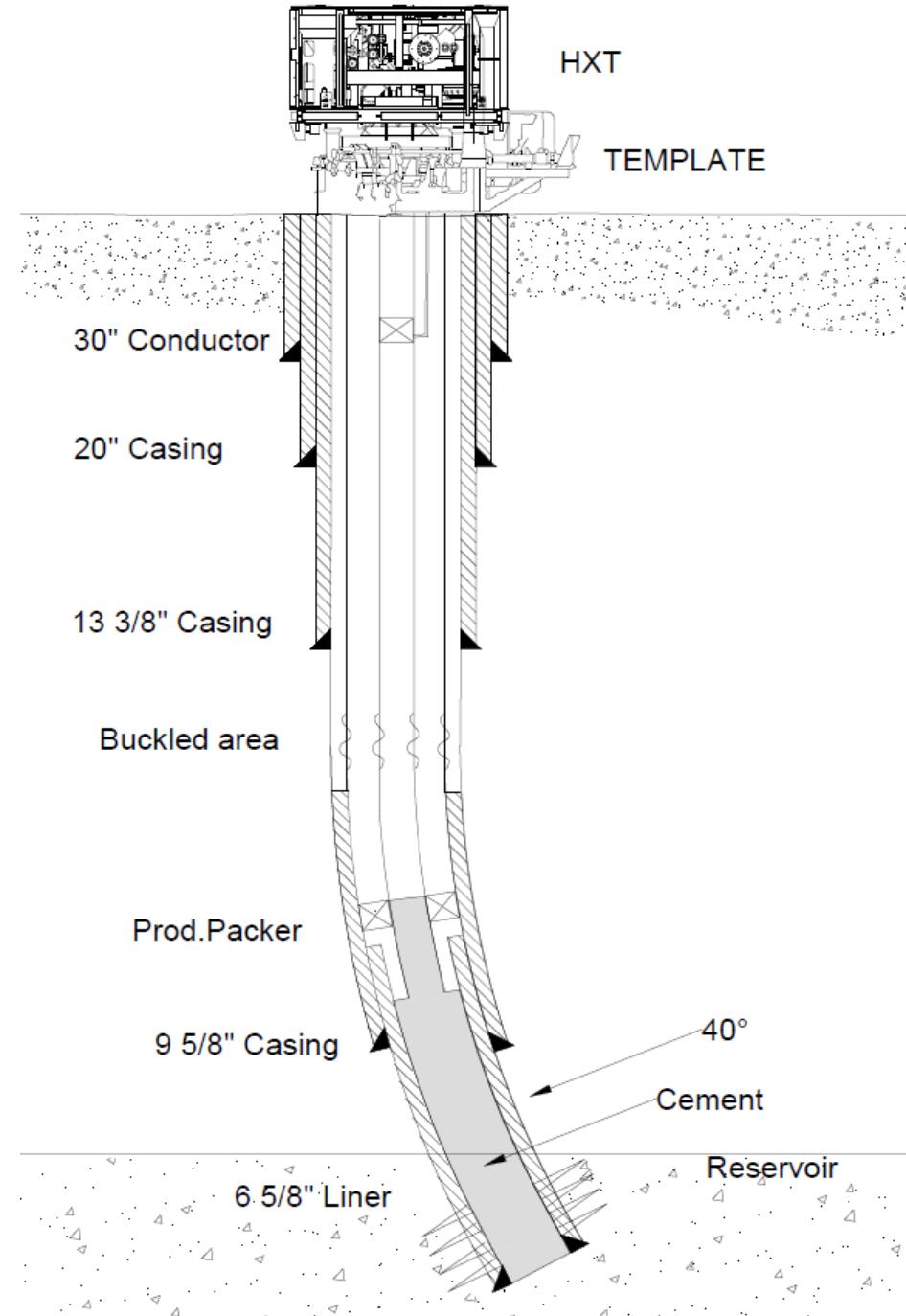
**Subsea well with damaged tubing and production-casing**

**Injectivity into reservoir still possible**

**Caliper log showed restriction which prevented access into tubing below damaged point**

**Intervention Plan: through-tubing cementing of reservoir and tubing up to production packer**

**Intervention Results: well successfully cemented**

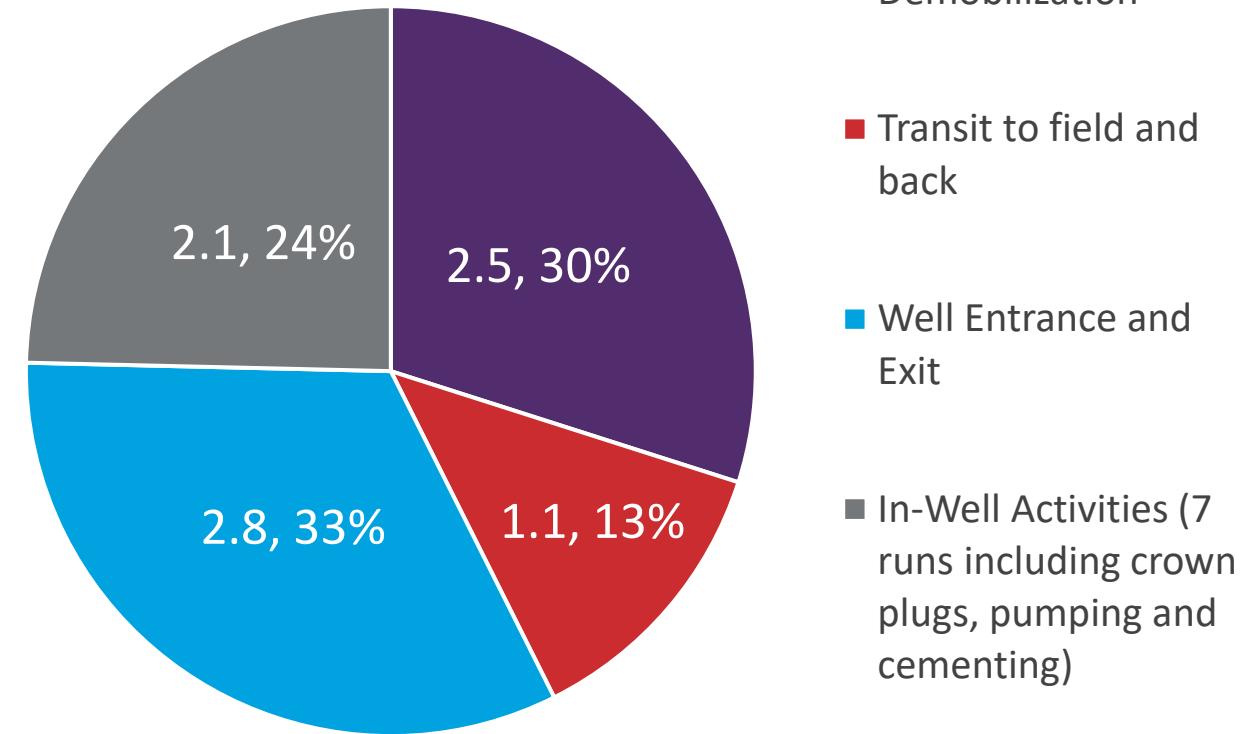


# Operational Summary

- 7 wireline runs + pumping and cementing in just 2.1 days
- Zero Waiting on Weather
- Minimal NPT (8 hours, 3.8%)
- 8.8 days total time including mob/demob and transit
- Innovative cementing methodology successfully field proven

Run #1	Retrieve Upper Crown Plug
Run #2	Retrieve Lower Crown Plug
Run #3	Install Cement Spool Straddle
Cementing	Injectivity test
	Mix cement on vessel
	Pump spacer
	Pump cement
	Pump displacement
Run #4	Retrieve Cement Spool Straddle
Run #5	Brush DHSV
Run #6	Install Lower Crown Plug
Run #7	Install Upper Crown Plug

Operational Summary [days, %]



Activity	Days
Mobilization and Demobilization	2.5
Transit to field and back	1.1
Well Entrance and Exit	2.8
In-Well Activities (7 runs including crown plugs, pumping and cementing)	2.1
Non-Productive Time	0.3
Waiting on Weather	0.0
<b>TOTAL</b>	<b>8.8</b>

On a vertical tree would need only 1.5 days inside the well (no crown plugs)

# Tubing Hanger and Tubing retrieval in Open Water

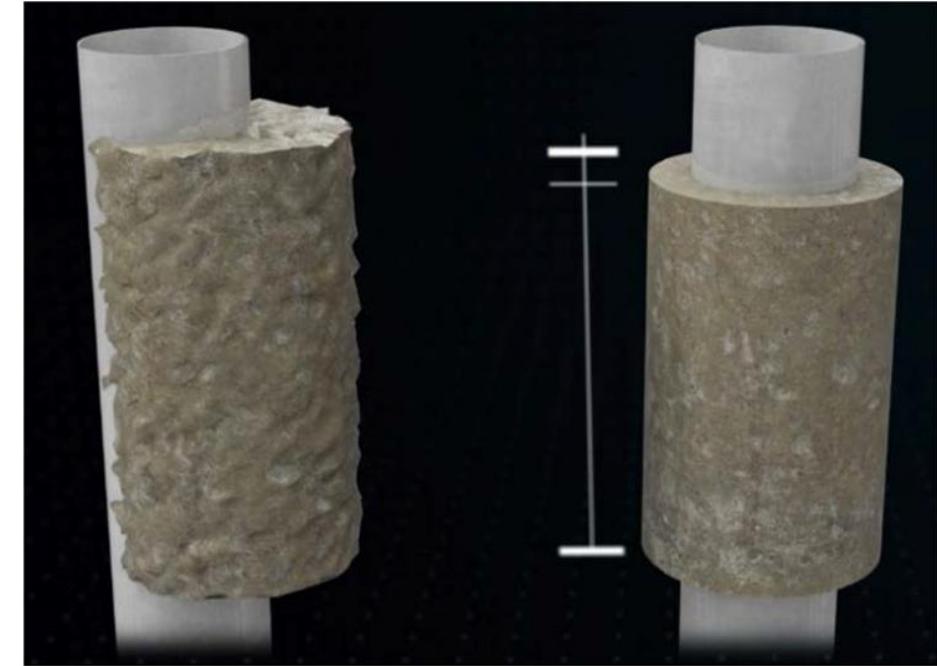
# Operations

- TCRT deployed, establish barriers and recover TC
- The LS/WCP including the Subsea Injection Spool (SIS) and 2" hoses run and connected to the XT and tested
- Tested and confirmed A-annulus, plug and production-packer integrity
- Drift to Deepset plug and deploy Hold Open Sleeve in TRSSSV
- Perforated A-annulus above production packer



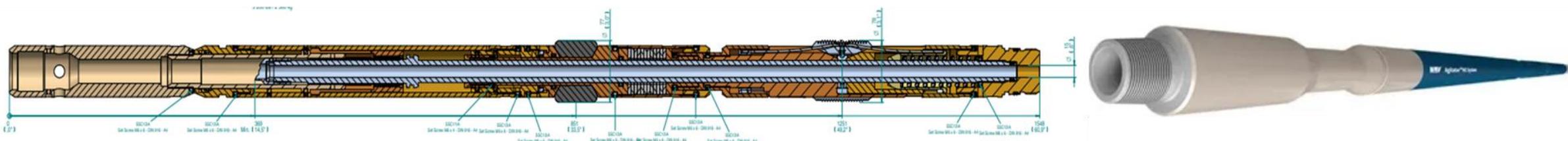
# Cementing

- Circulated 1.5 x well volume down tubing, took returns through A-annulus back to vessel
- Cut tubing at 9450 ft
- Installed an agitator-tool on a ME-packer just above the tubing cut, (see below). Better distribution and quality of cement, (see picture on right)
- Mixed cement and pumped 59 bbl cement down tubing using vessel's service-pumps
- WOC and pressure tested cement plug



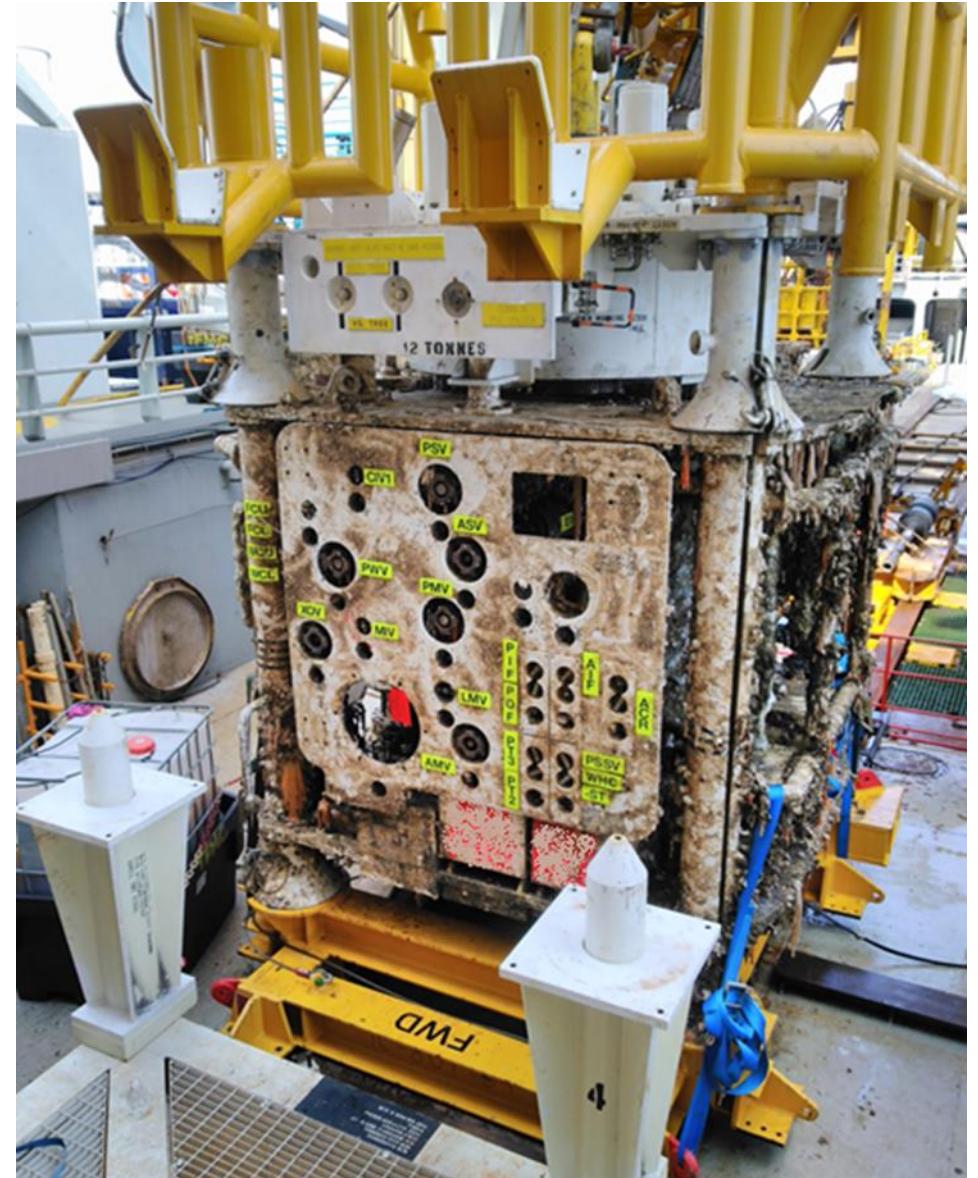
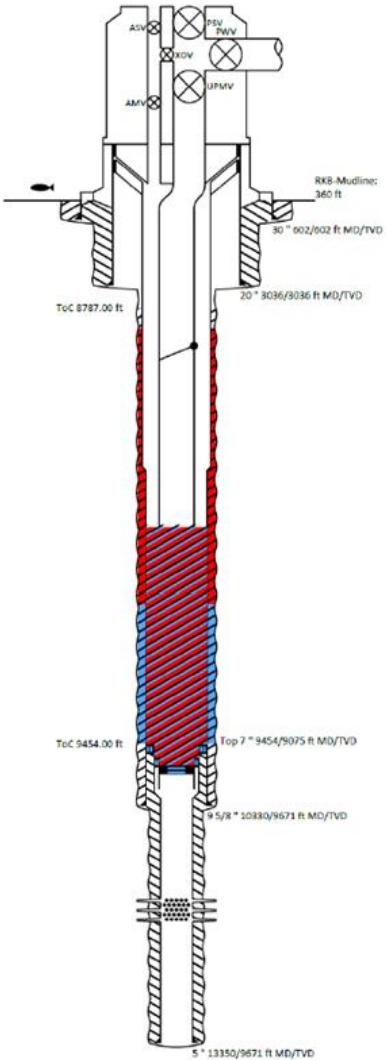
Traditional  
Method

Valkyrie  
Method



# Tree Retrieval

- Cut tubing at +/- 1000ft below tubing-hanger below TRSSSV
- Recovered LS/WCP back to vessel
- Deployed TRT and retrieved XT back to vessel

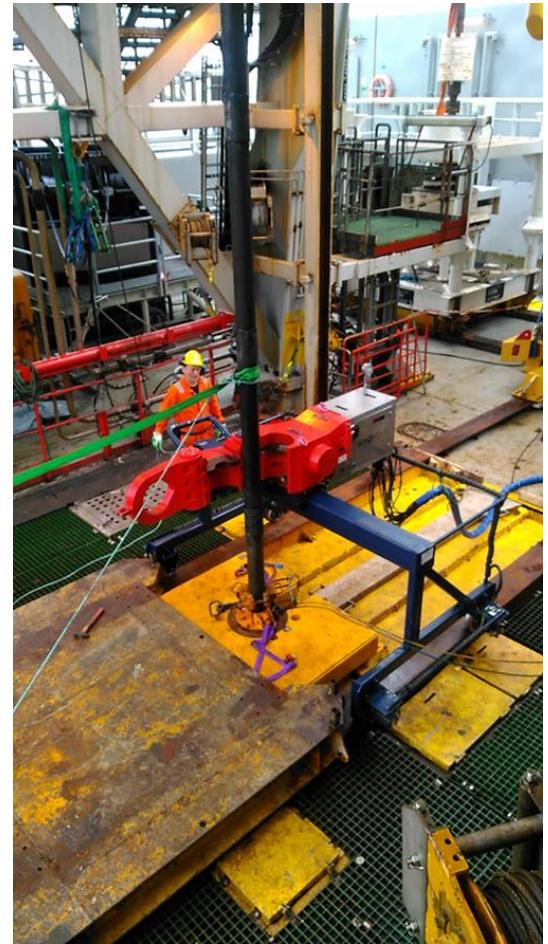


# Tubing Retrieval

- False rotary installed (after completion RLWI operations)
- Skid OWTHRT in to moonpool, Hook up main winch
- Open moonpool hatch, Deploy OWTHRT
- Lock OWTHRT on TH and Verify connection
- Release TH from WH and Retrieve TH and tubing
- Retrieve TH and tubing above hatch and Close moonpool hatch
- Install TH C-Plate and Land off TH string and OWTHRT
- Unlock OWTHRT and layout
- Install THERT to TH. Pick up TH string and lift string above tubing joint
- Remove TH C-plate, Hang off string in slips and Remove DH line clamp



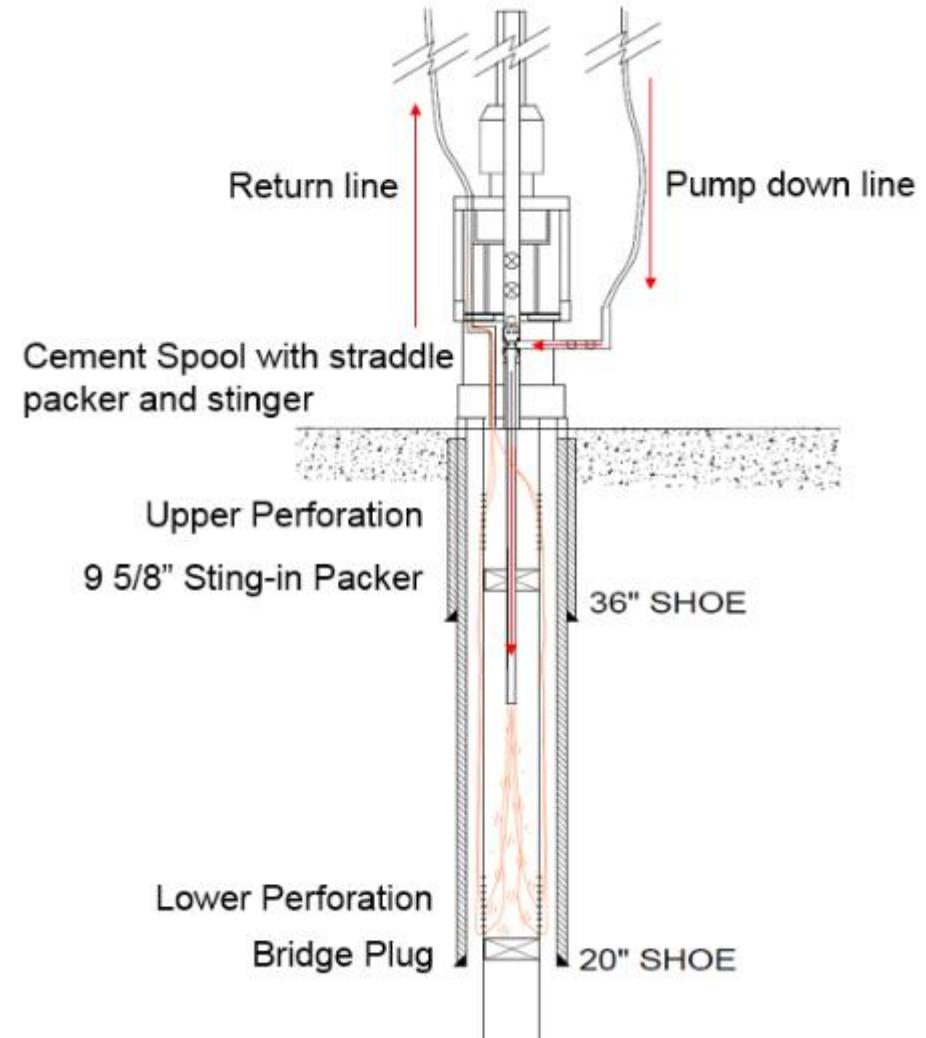
- Hook up gauge and control lines to waste drum and Secure tubing above cutter to reduce horizontal movement
- Cut tubing above joint and retract cutting tool
- Lay down TH string and Guide TH string out of tower
- Install bails on elevator shoulder
- Pick up Tubing and set in slips below next connection
- Secure tubing above cutter to reduce horizontal movement (guide lines)
- Remove control lines clamp
- Cut tubing above joint, retract cutting tool
- Lay down TH string and Guide TH string out of tower
- Repeat step until all tubing is removed



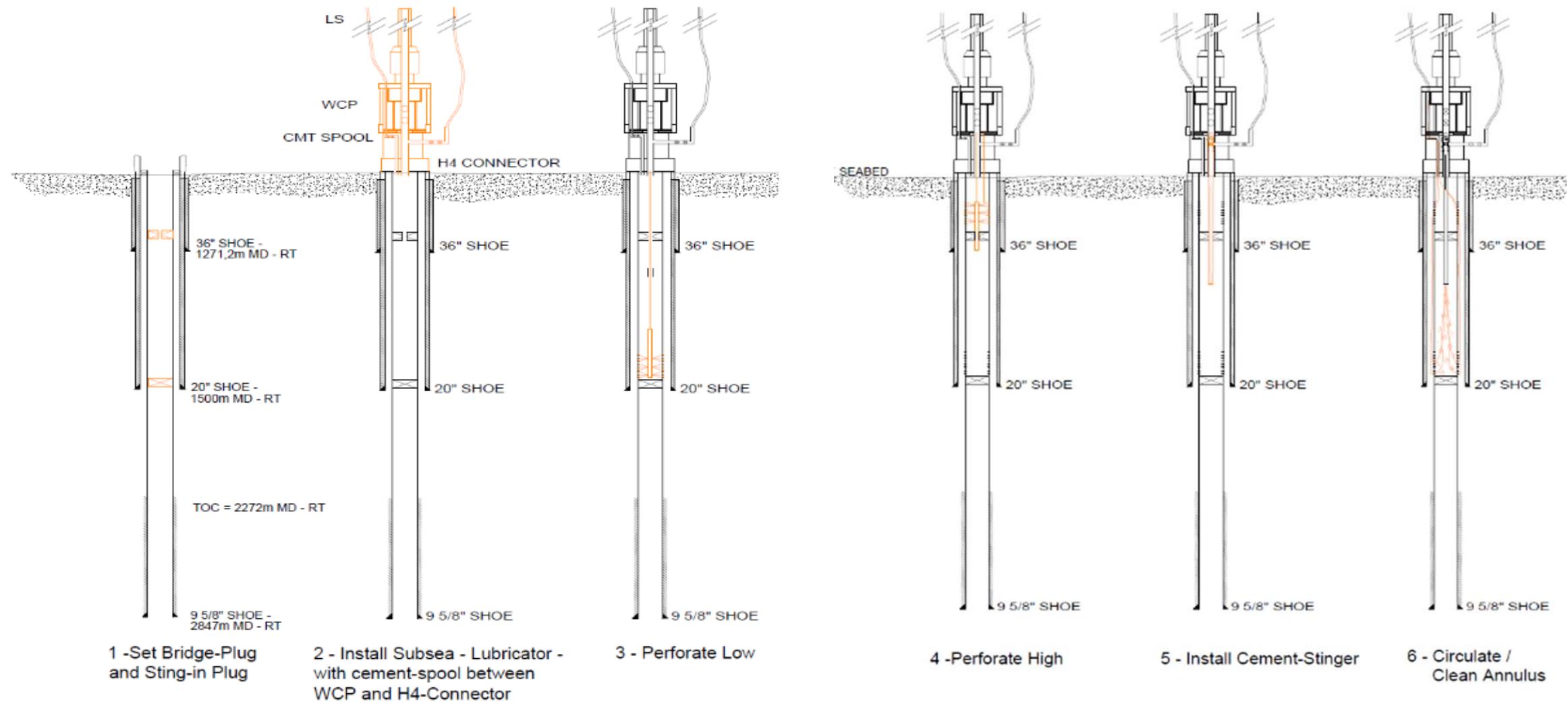
# Annulus Cementing and Wellhead Removal

# Riserless Through-Tubing Cementing

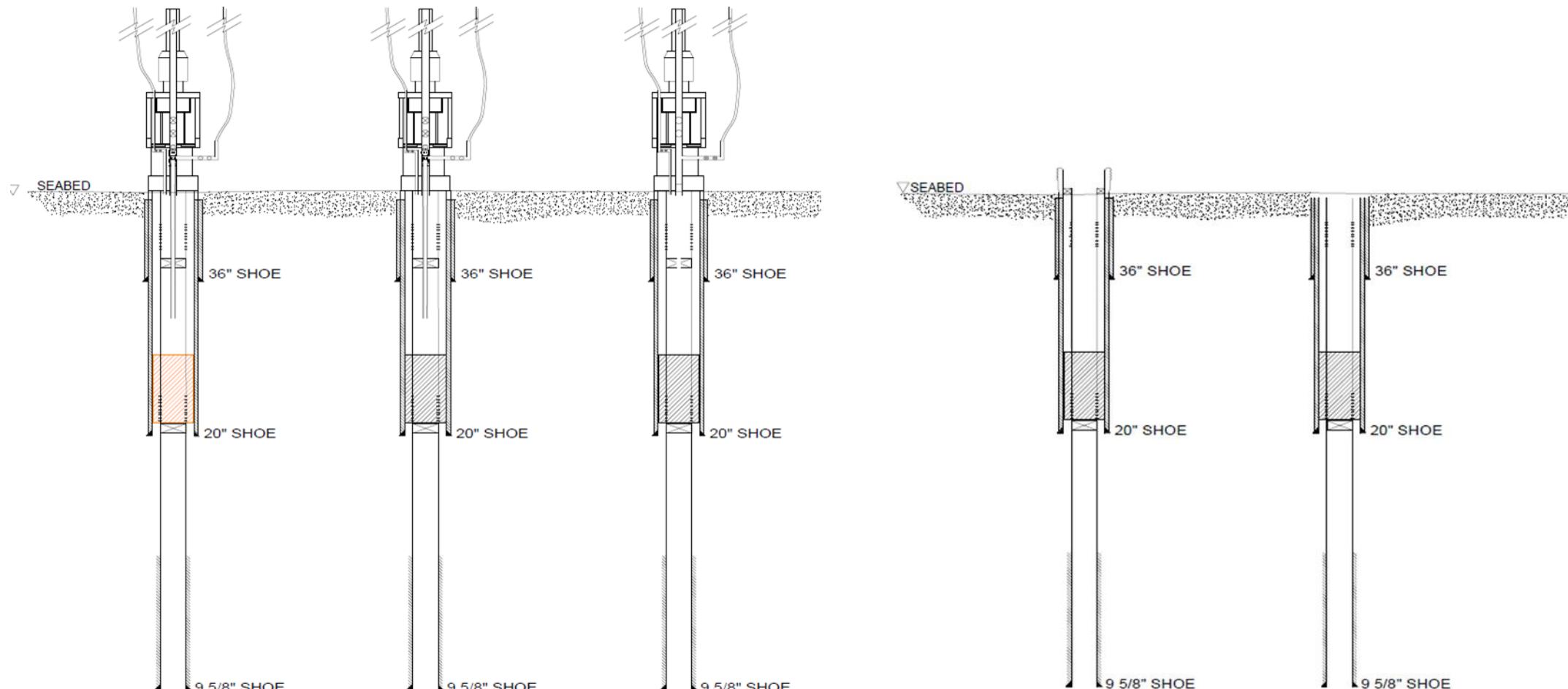
- A Subsea Injection Spool (SIS) connected below the RLWI Stack allows pumping cement into the well without passing through the stack
- A cement straddle is landed inside the SIS to establish the circulation path without having cement going up inside the stack or into the subsea tree
- The straddle is based on existing, field proven commercial straddle technology
- This solution can be used for setting lower cement plugs through-tubing but also for surface casing cementing through multiple annuli before wellhead cutting



# Annulus Cementing with Well Control



# Annulus Cementing with Well Control



7 - Pump and set Cement plug  
Wait on Cement

8 - Pressure test  
CMT from above in  
annulus and in Casing

9 - Retrieve Cement Stinger

10 - Retrieve LWI Stack  
and Sting-in plug

11 - Cut Casing & Wellhead  
and retrieve to vessel

# Wellhead Severing

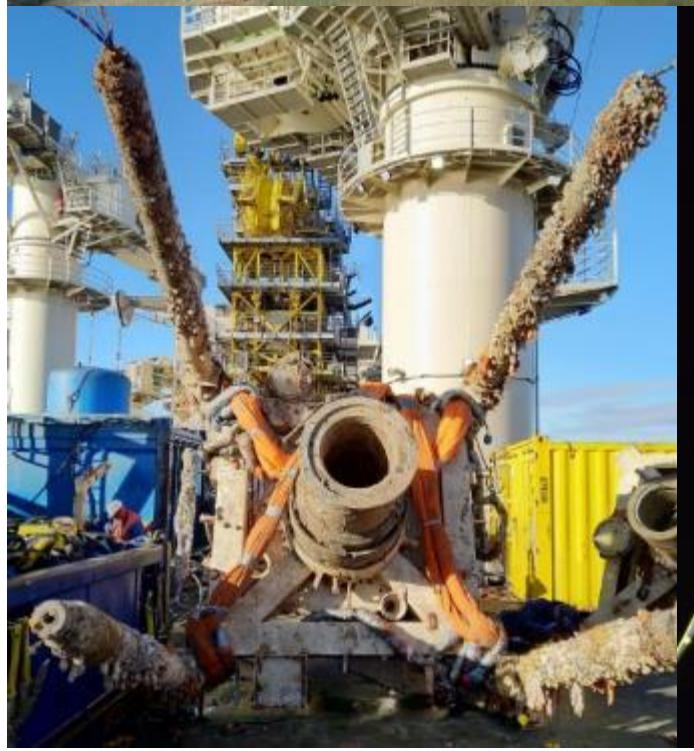
**Used technology: abrasive cutting, Explosives and Mechanical**

**Several 3<sup>rd</sup> party providers**

**Extensive track record**

**High success rate**





# Riser-Less Coiled Tubing

# RLCT Case Studies



## E39 Rogfast Drilling and Coring (2014)

Water Depth: up to 300 m.

Total Drilled Length: 537 m. (150 m. cores) in 3 wells

CT size: 2 7/8"

Number of CT runs: 52

Bit size/type: 5 7/8" rock bit

BHA size: 4 ¾"

Duration: 4 weeks

Subsea Injector: yes

Well Control Equipment: no

Coring: Granite, Quartz, Schist

Publications: SPE-179086



## Butch Pilot Hole Drilling, Centrica (2015)

Water Depth: 66 m.

Pilot Hole Depth: 351 m.

CT size: 2 7/8"

Number of CT runs: 2

Bit size/type: 5 7/8" tri-cone rock-bit

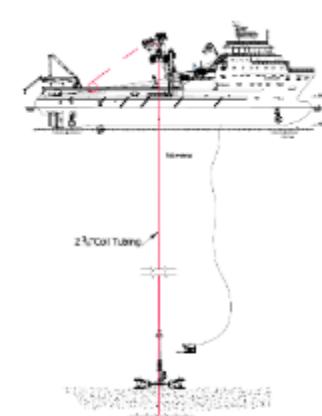
BHA size: 4 ¾"

Duration: 4.25 days on location

Subsea Injector: yes

Well Control Equipment: no

Logging-tools: GR, resistivity, pressure, direction, sonic. Abandoned the pilot-hole with cement.



## Seabed Coring Campaign, NPD (2020)

Water Depth: 2,780 - 3,085 m.

Drilled Length: confidential

CT size: 2 3/8"

Number of CT runs: 14

Bit size/type: 6-1/2" × 3-1/4" coring bit

BHA size: 4 ¾"

Duration: 26 days on location

Subsea Injector: no

Well Control Equipment: no

Publications: SPE-205828

# RLCT Achievements Summary

**Water Depth Range: 66 – 3085 m.**

**CT Size: 2 7/8" and 2 3/8"**

**Number of CT runs: 68**

- Gravity-Fed: 14 runs
- Subsea Injector: 54 runs

**CT Services:**

- Directional Drilling
- Logging
- Coring
- Cementing

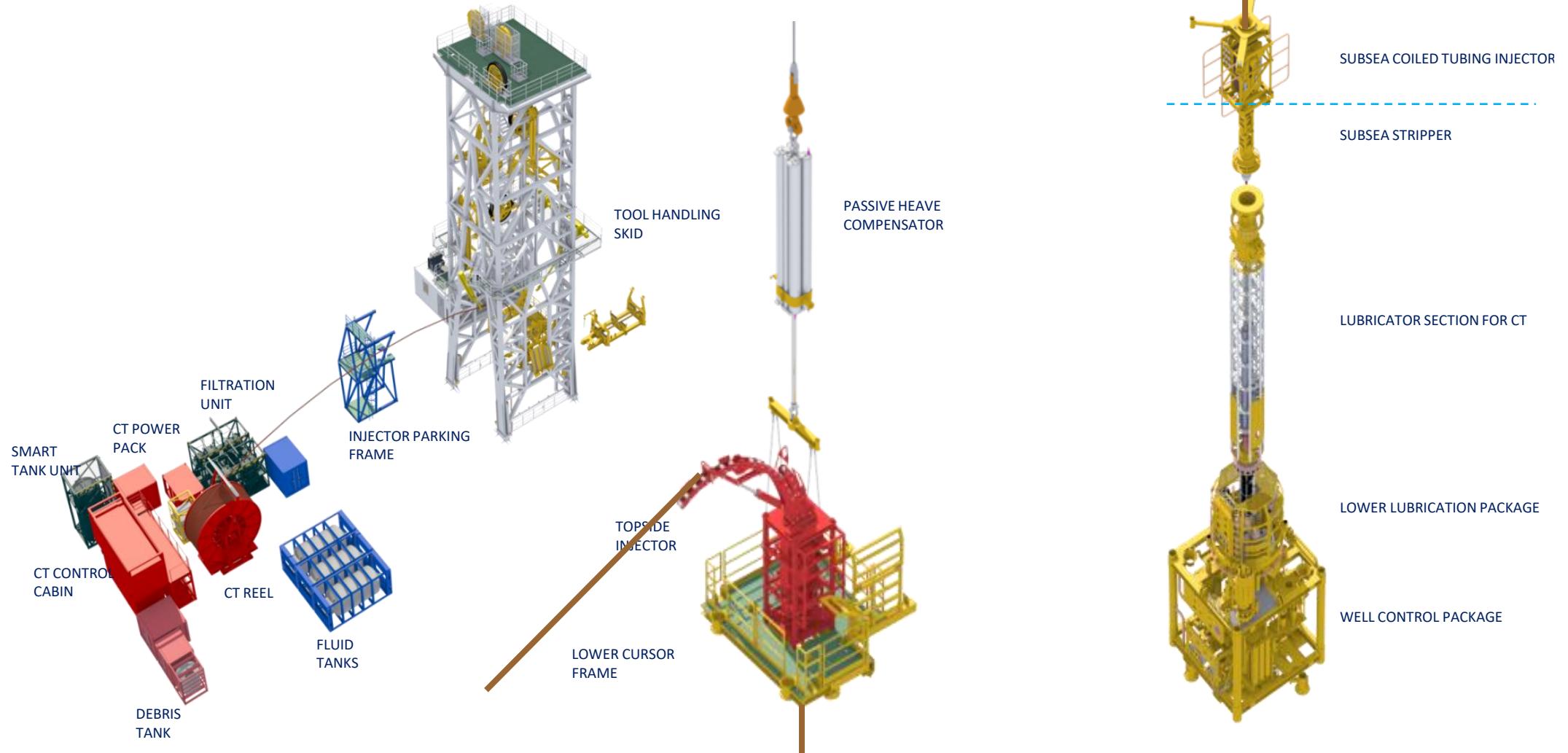
**Vessels:**

- Island Performer (RLWI vessel)
- Island Constructor (RLWI vessel)
- Island Valiant (AHTS vessel)

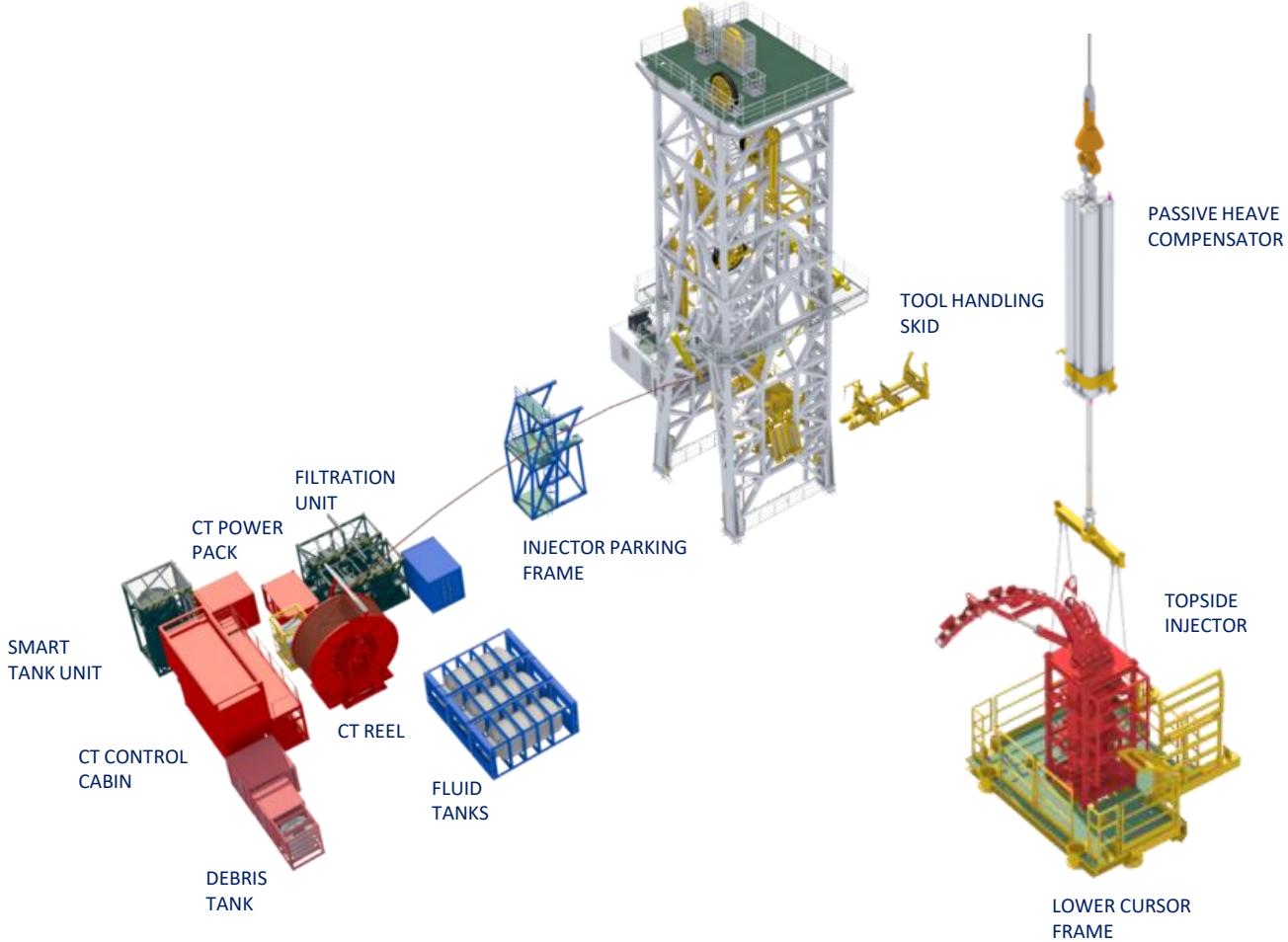


# System Overview – dual injector setup

Riserless CT with surface injector and subsea injector



# CT equipment setup



Surface setup

1. Conventional CT unit c/w conventional CT injector
2. Passive heave compensator
  - used several times for open water CT operations
3. Injector Parking Frame
  - designed and manufactured by TIOS to interface with existing hardware on vessel – skidding beams, MHT, LCF as well as subsea stripper and subsea and topside injector



Subsea setup

- Subsea Injector – Equipment for Riserless CT operations, standard Injector marinized for subsea operations has been used on riserless openwater CT operations
- Subsea Stripper – New Equipment for Riserless CT operations
- 22m lubricator - Existing equipment used in Riserless Wireline Operations
- Lower lubricator package- Existing equipment used in Riserless Wireline Operations
- Well Control package- Existing equipment used in Riserless Wireline Operations

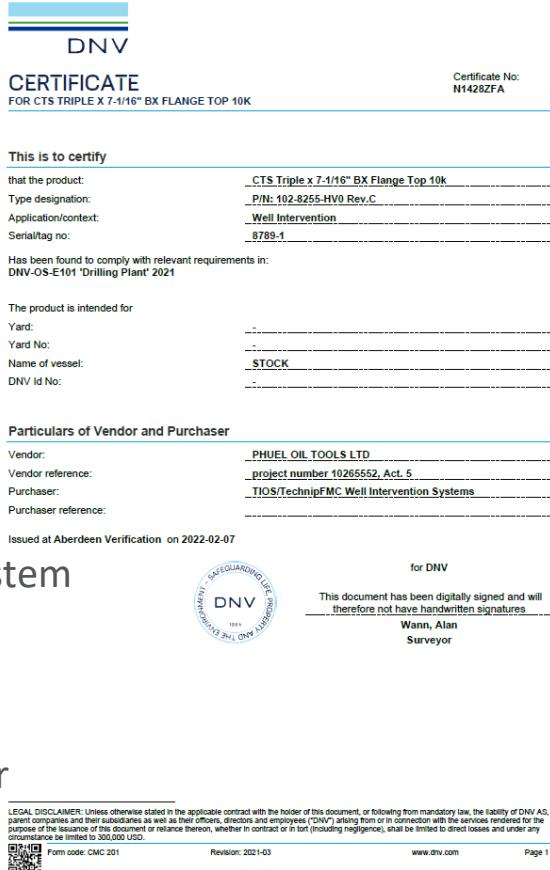
# Status Subsea Stripper

Subsea Stripper including control system built and qualified.

- CT size ¾ inch to 2 3/8 inch.
- Max wellhead pressure 10 000 psi
- Max water depth 2500 meter.

3rd party DNV approved.

- Subsea Stripper from Phuel subject to DnV approved FMECA
- Testing and qualification of subsea stripper performed by Phuel Oil Tools, witnessed and approved by DnV
- Product certificate issued by DnV
- Stripper delivered from Phuel to Envirex for assembly of Control system
- DNV facilitated FMECA on Subsea Stripper Control system
- Control system for Subsea Stripper assembled on Subsea Stripper
- DNV witnessed FAT of Control System integrated on Subsea Stripper week 38
- DnV defines this to TRL 6 minimum

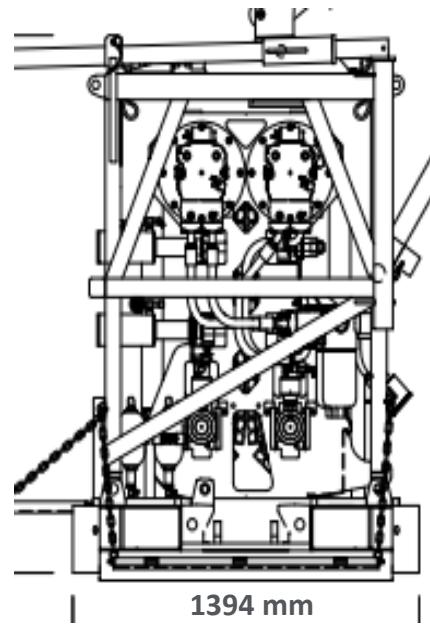


## Status New Injector:

- PO issued for new Subsea Injector.
- Quote received and PO to be issued for Subsea Injector control system
- RLCT Parking frame extension to be fabricated.

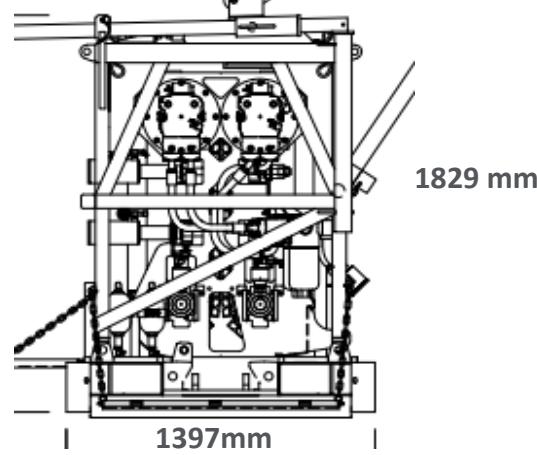
## Main changes on Subsea Injector

HR 680 (Old)



Total weight 4 400 kg

HR 635 (New)

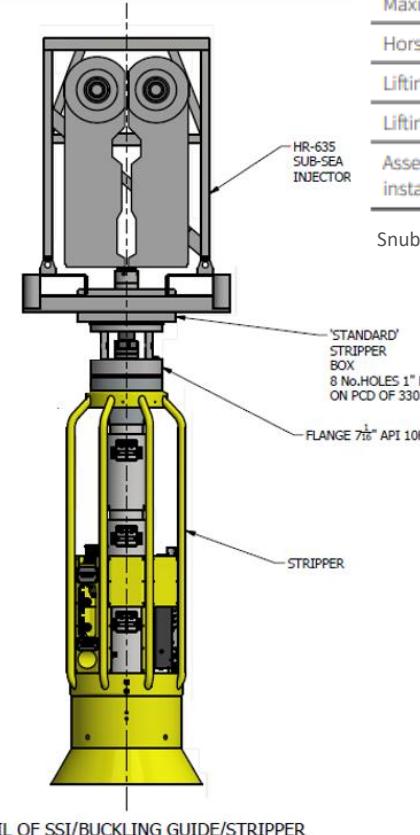


Total weight 2500 kg

## HR-635 Coiled Tubing Injector

### Specifications

Maximum speed (min. displacement)	265 ft/min
Maximum speed (max. displacement)	115 ft/min
Horsepower	100-hp continuous at 120° F
Lifting capacity through outer frame	41,000 lb
Lifting capacity from stripper	35,000 lb
Assembled weight: 60-in. gooseneck installed, no stripper	5,500 lb
Snubbing Force	15,000 lb

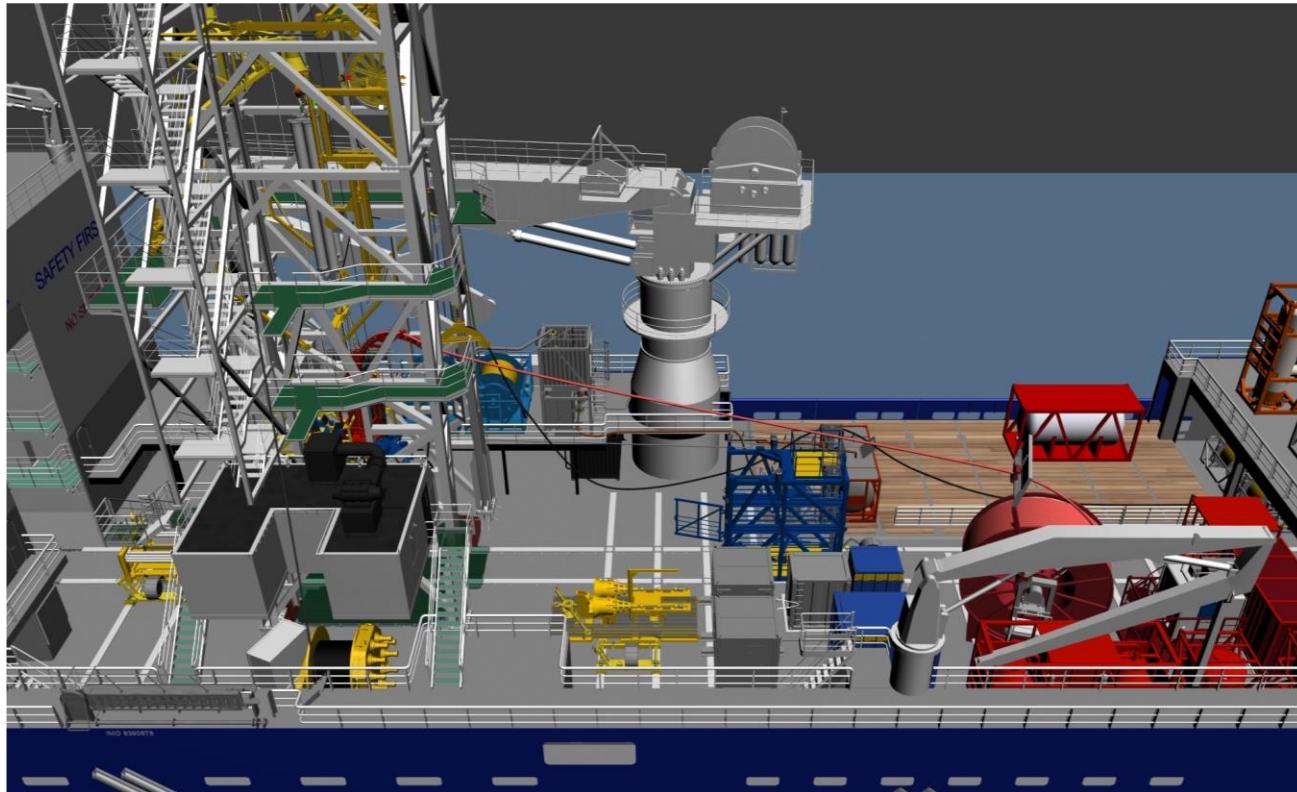


# Efficient Change of Mode

WL Mode



CT Mode

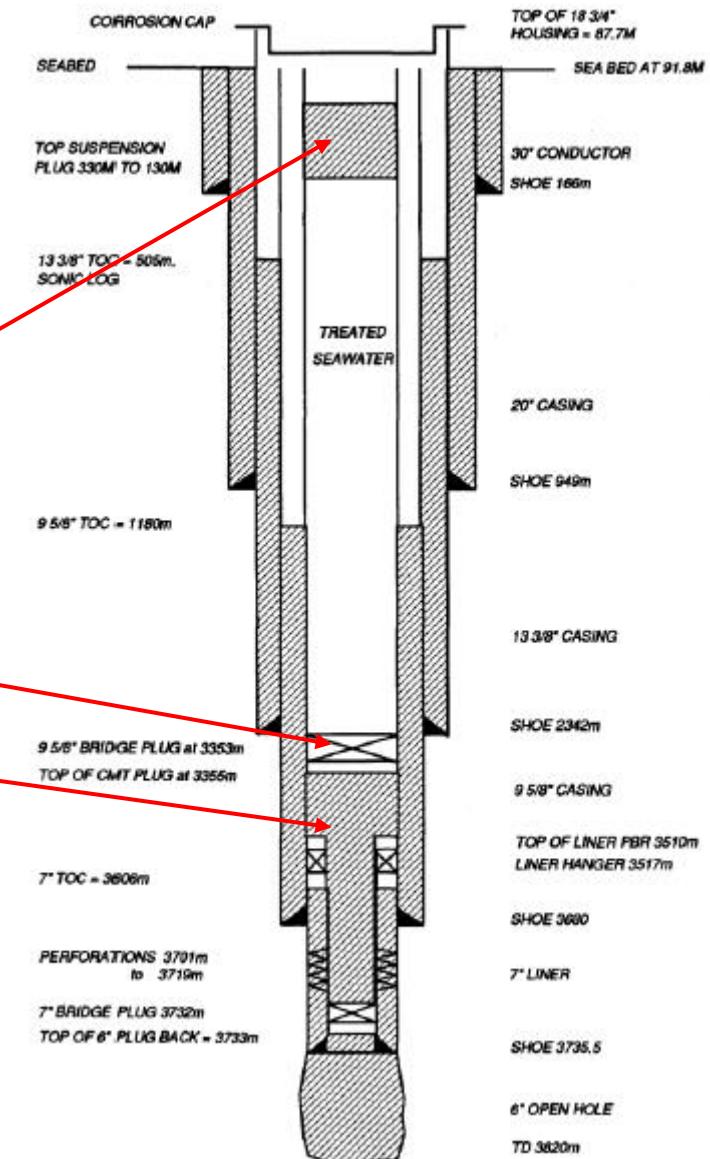


Will take less than 8 hours to change between WL and CT mode  
System is also modular and can be used on any RLWI vessel (pending tower interface)

# Current Projects

# E&A Wells "as they are"

- Upper cement-plug set to shallow, and needs to be drilled out
- Bridge-plug set @ 3353 mMD
- Primary cement-barrier is in place



# High-level plan as being worked on in the feasibility-study

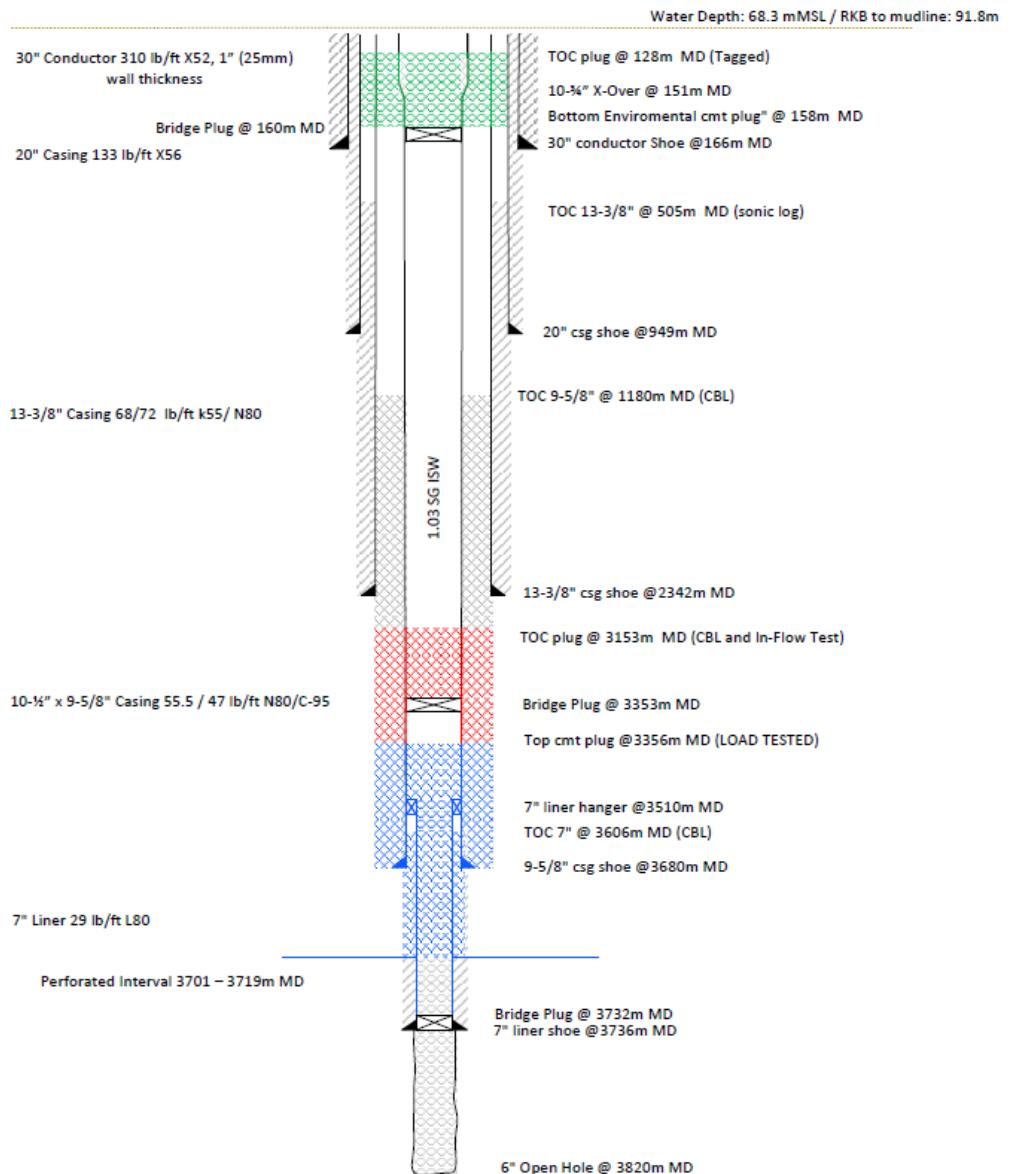
- Drill out shallow cement-plug with coil tubing with 7" bit or 7" mill
- Log cement behind 9 5/8" casing where secondary cement-barrier shall be placed\*
- Set secondary cement-barrier on top of bridge-plug, using coil tubing
- Perforate through 9 5/8" casing @ 100 meter below wellhead
- Perforate 10 ¾" casing @ 8 - 10 meter below wellhead
- Circulate clean and set cement-plug in annulus between 9 5/8" & 13 3/8" casings
- Perforate through 9 5/8" casing and 13 3/8" casing @ 100 meter below wellhead
- Perforate 10 ¾" and 13 3/8" casings @ 8 - 10 meter below wellhead
- Circulate clean and set cement-plug in annulus between 13 3/8" and 20" casings and inside 9 5/8" casing
- Cut casings and wellhead 5 meter below seabed and retrieve to surface

\*If CBL shows poor cement-bonding behind 9 5/8" casing, evaluate contingencies:

1. Placing cement higher across good cement bonding shown by CBL
2. coil tubing PWC-technology
3. Installing Mechanical plug and leave for Rig

# Wells as “shall be” when permanent P&A is completed

- Primary and secondary cement-barriers in place
- Surface plug set across well/casings “rock-to-rock” from 60 – 100 meter below wellhead
- Wellhead and casings will be cut and retrieved from 5 meter below seabed



# Ongoing / coming projects

- Slot-recovery and Pre-P&A projects
- Slim-hole exploration-drilling for CO2-storage
- Pilot-hole drilling with coil tubing
- Light exploration-drilling with casing-drilling and coil tubing drilling
- Drilling out scale with coil tubing
- Several ITT's coming for RLWI including PP&A

# Riserless Coiled Tubing – This is the Way



Thank You!

