Open Water abandonment as standard approach for tubing retrieval

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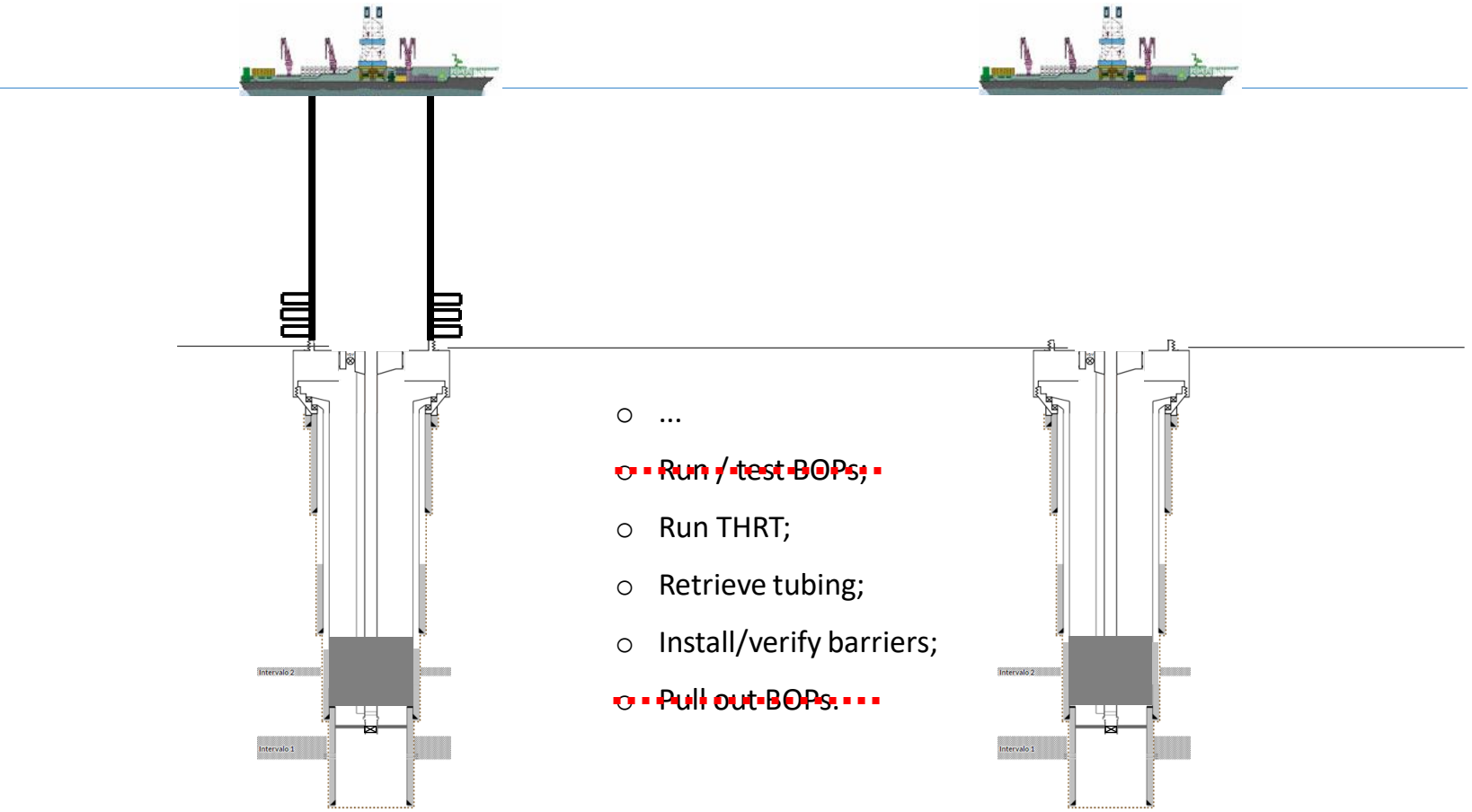
Paradigm shift: Rethinking the BOP approach to tubing retrieval

Tubing retrieval with BOPs

Open Water tubing retrieval



- ...
- ~~Run / test BOPs;~~
- Run THRT;
- Retrieve tubing;
- Install/verify barriers;
- ~~Pull out BOPs.~~

OWTR – Open Water Tubing Retrieval
THRT – Tubing Hanger Retrieval Tool

THRT latched to TH in OWTR operation

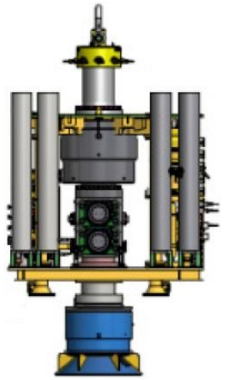
Source: authors (Petrobras)

Unseated TH in OWTR operation

Source: authors (Petrobras)

Comparative assessment: SSD x No SSD

Safety equipment over the wellhead:



Purpose / hability

- **Potential WBE** during operations
- Device to a **safe and controlled disconnection** by shearing the pipe

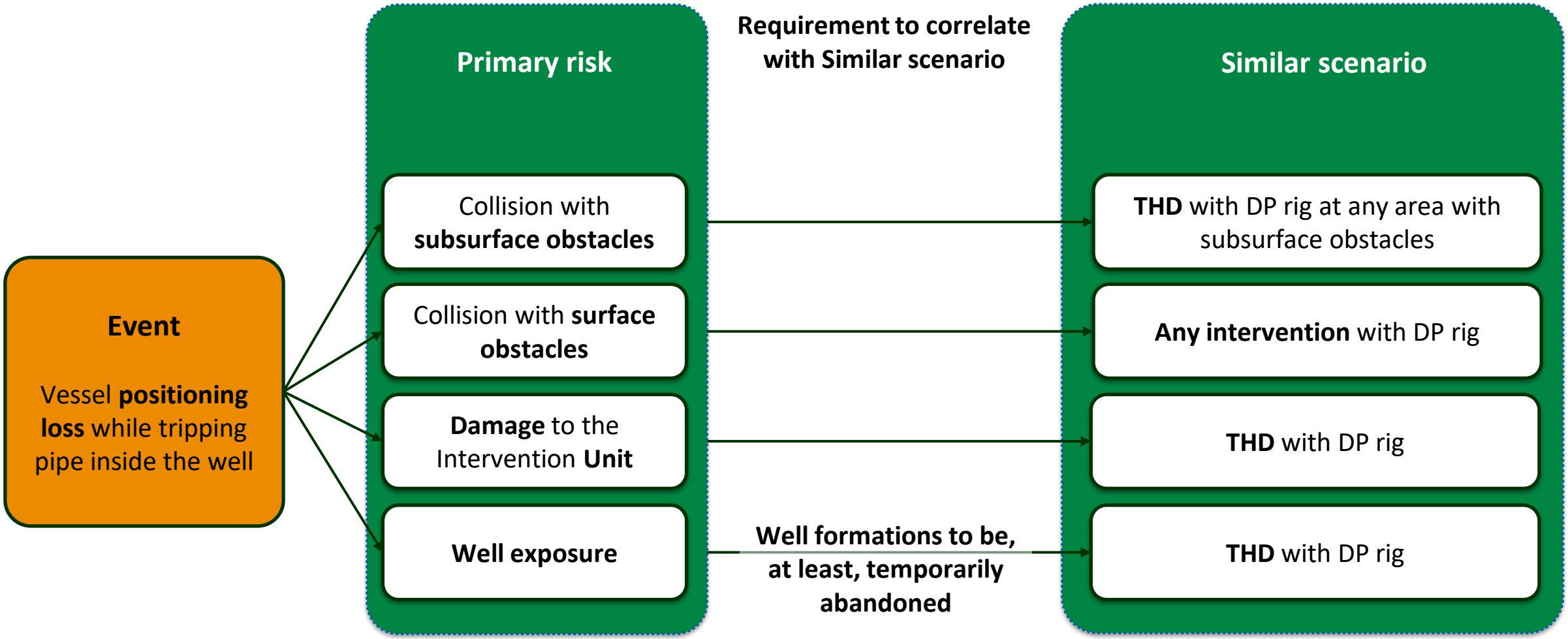
Aspects assessed[1] in the comparative analysis:

- **Number o WB´s** available during exposure time[2]
- Expected intervention **duration**
- **Technological risk**
- Intervention **Unit requirements**
- Unit **Positioning Loss** Issues / Risks
- **Operation risks**

[1]Assessment depends on the type of the Intervention Unit (DP or Moored)

[2]Exposure time refers to the timeframe between installing a WBE until the moment the WB (or WBE) is replaced by another WB. In the OWTR case, the temporary WBE installed to allow OWTR usually end their exposure time when the PWB is installed.

Risk of Unit Positioning loss

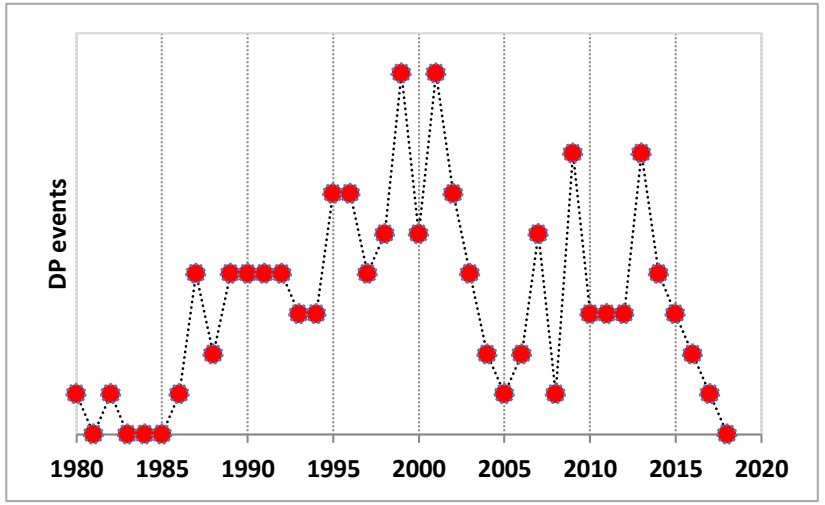


THD – Top Hole Drilling

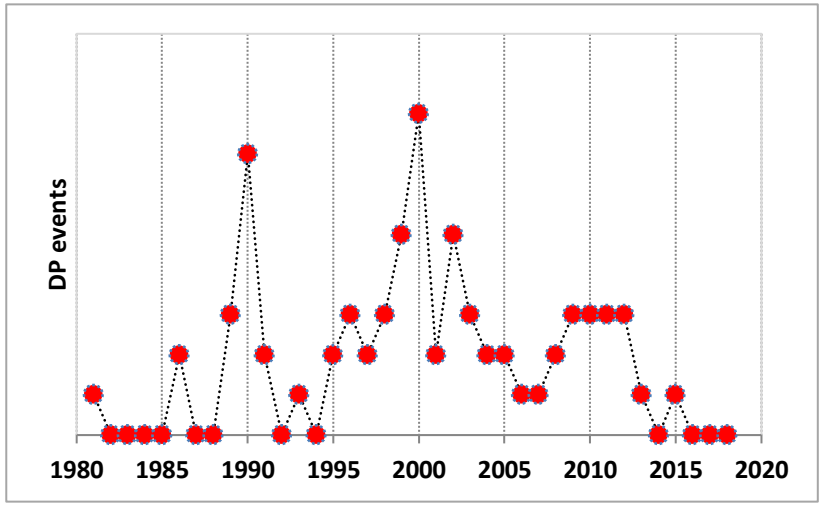
Risk of Unit Positioning loss

Historical data analysis:

- DP Yellow > Red Alert events
- DP **straight** Red Alert events;
- DP events during THD:
  - 2 wells (2003 and 2010);
  - **Damage restricted to the pipe across the wellhead**;
  - **No damage to the wellhead/well structure**.



Source: authors (Petrobras)



Source: authors (Petrobras)

Consequences (severity) of tubing/fish falling over remaining completion/WBE

What would happen to a mechanical WB in case of tubing falling over it?

Historical data analysis:

- **4 events** (non related to OWTR)
- Fluid environment: **brine**
- **All without major damage**

Year	Weight [klbf]	Remaining completion	Fall height (MD/VD) [m]	Consequence
1995	64	Lower completion (packer + TSR + STV)	154 / 154	No damage
1995	84		345 / 345	No damage
2009	14		2292 / 2244	No damage
2018	170	Lower completion (packer + TSR)	411 / 410	Minor ovalization at TSR top, packer still sealing

Concept of Main Well Barrier

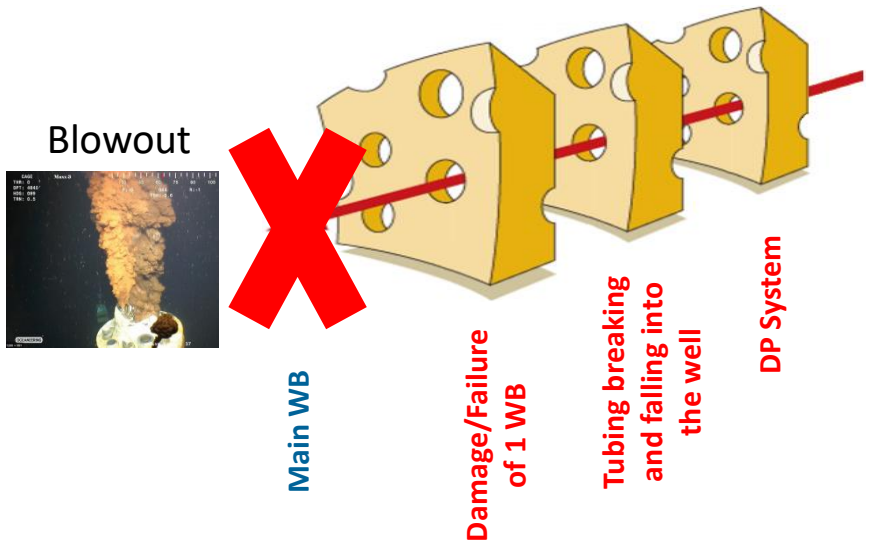
Requirements to Open Water operations:

- 2 independent WBs in place (as usual...);
- At least **1** WB classified as **Main WB**.

What is a *Main Well Barrier*?

- **Failure mode**: WB composed by WBE's that we do **not expect to be affected by a tubing falling over it** event;
- **Availability**: WB that has proven hability to avoid fluid flow from potential SoI without needing to be actuated (**no human intervention needed**).

Chain of events and Main WB concept



Source: adapted by the authors (Petrobras)

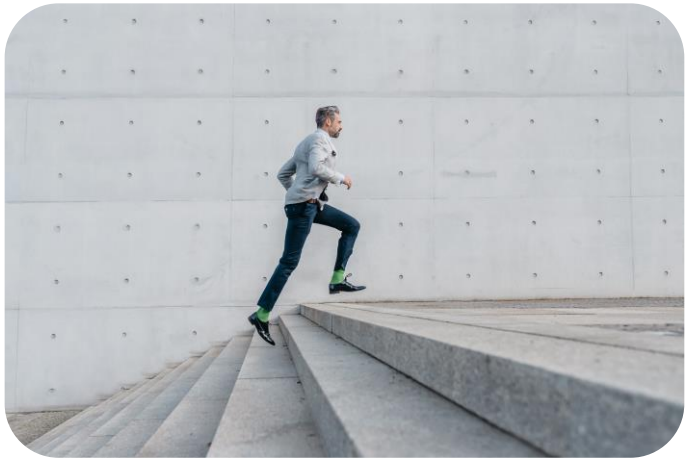
SoI – Source of Inflow

Was it really a paradigm?

What is usually done in case of TH not released?

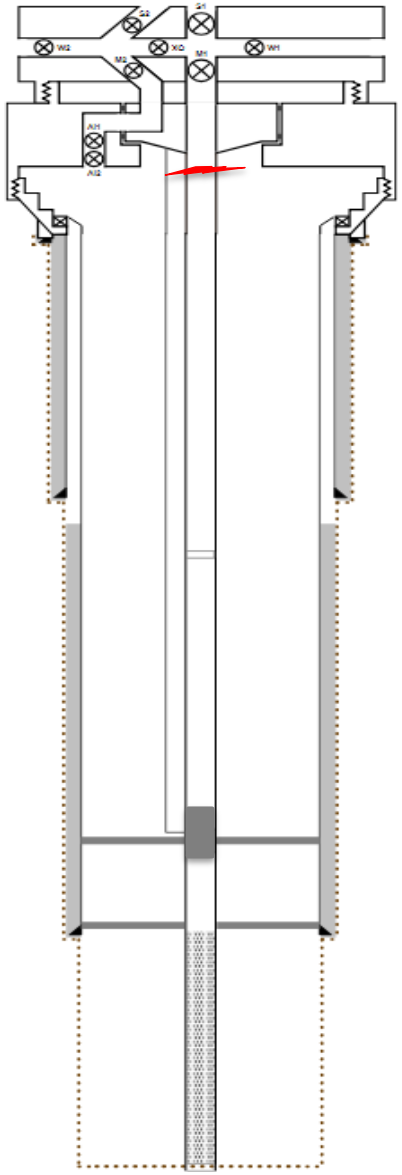
1. Cut tubing below TH;
2. Retrieve PAB + TH (**Open Water TH pull**);
3. Run BOP´s;
4. ...

➔ **Less risk exposure time**... **But not risk free!**

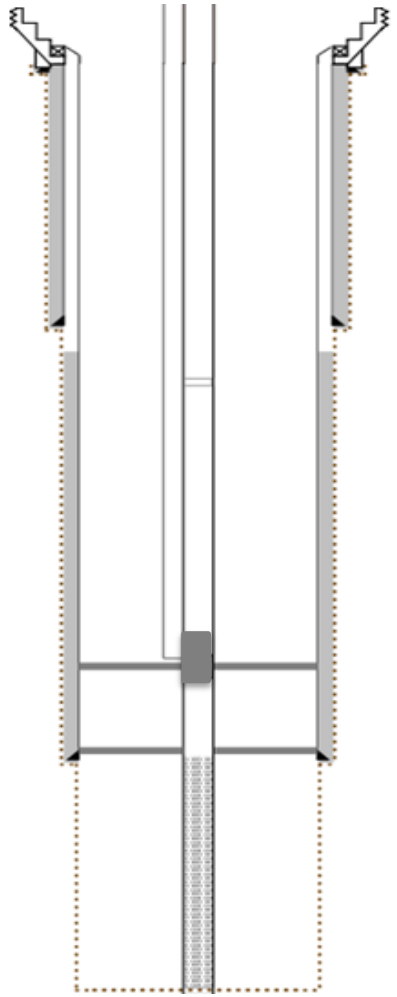


Source: Microsoft 365

Well schematics prior to XT retrieval



Well schematics prior to BOP run



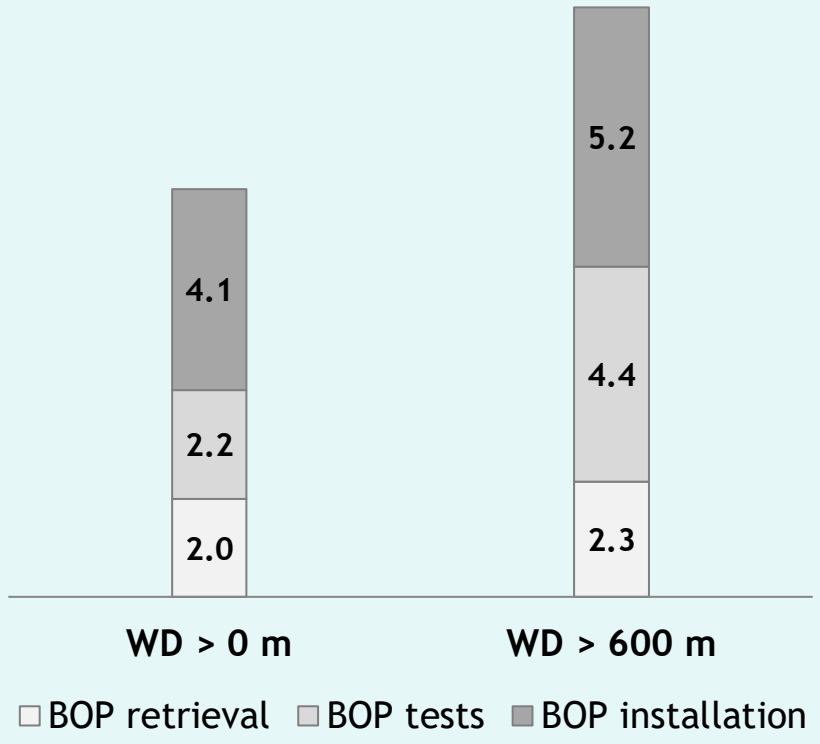
Source: authors (Petrobras)

Concerns on well cleaning?

Well ID	Water Depth	Well type	BSW	Tubing x A-annulus communication	Result
Well 1	828 m	Water injector	NA	No	No HC escape
Well 2	970 m	Water injector	NA	No	No HC escape
Well 3	770 m	Producer	72%	Yes	No HC escape
Well 4	674 m	Producer	52%	Inconclusive (No)	No HC escape
Well 5	1376 m	Gas injector	NA	Yes	No HC escape
Well 6	1250 m	Gas injector	NA	Inconclusive (Yes)	No HC escape
Well 7	1340 m	Producer	64%	Yes	No HC escape
Well 8	531 m	Producer	79%	Yes	No HC escape
Well 9	1697 m	Producer	94%	No	No HC escape
Well 10	1483 m	Producer	8%	Inconclusive (No)	No HC escape

Source: authors (Petrobras)

Key benefits



Source: authors (Petrobras)

P&A duration reduced up to 12 days/well

Avoided handling 10,9 km of drilling riser, avg 1,1 km/well

Source: http://www.perenyi.com.br

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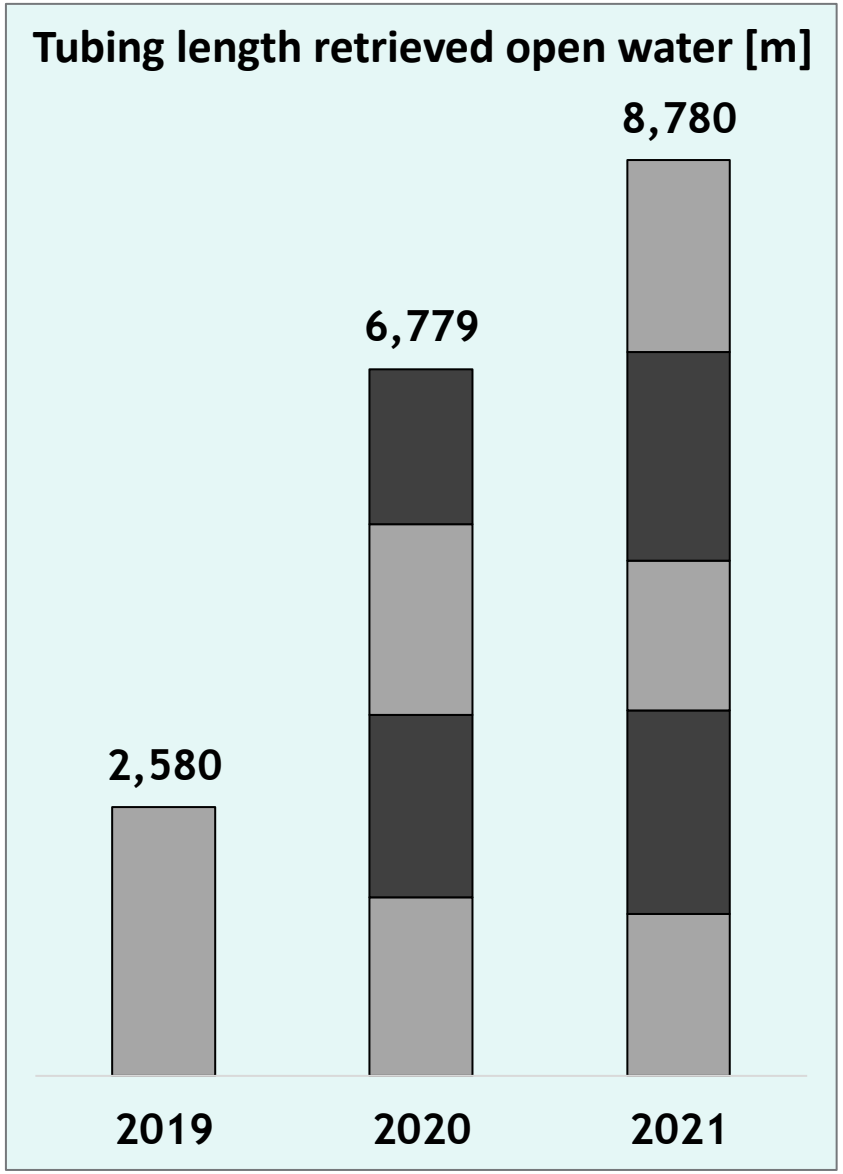

Source: authors (Petrobras)

Key benefits

Could be to be applied to:

- Old wells with **structural restriction**;
- Wells with difficulty to get **riser analysis** approved;
- **Shallow water** wells with DP vessels;
- Intervention with **LWIV**.

Well ID	Water Depth	Rig type
Well 1	828 m	DP MODU
Well 2	970 m	DP LWIV
Well 3	770 m	DP MODU
Well 4	674 m	DP MODU
Well 5	1376 m	DP LWIV
Well 6	1250 m	DP LWIV
Well 7	1340 m	DP LWIV
Well 8	531 m	Moored
Well 9	1697 m	DP MODU
Well 10	1483 m	DP LWIV

Source: authors (Petrobras)

	P&A Distribution						
	2015	2016	2017	2018	2019	2020	2021
Through Tubing	10%	7%	30%	30%	0%	36%	60%
OWTR Conventional	0%	0%	0%	0%	14%	29%	20%
BOP Conventional	59%	53%	30%	70%	71%	21%	12%
BOP + fishing/B-Annulus cement	31%	40%	30%	0%	14%	14%	8%
Complex	0%	0%	10%	0%	0%	0%	0%

Source: authors (Petrobras), considering all subsea P&A´s concluded (not considering P&A Phase 1)

Summary

- **Proven successful and useful strategy** when the *main barrier* concept can be applied to the project;
- Attested feasibility of **LWIV for tubing retrieval**;
- Significant **costs savings**;
- Significant reduction on **logistics and CO_2 emissions**;
- Potential to enable DP Units on **shallow water wells & old wells**;
- **Well cleaning challenges** to avoid environmental impacts were **successfully overcame**;
- There is **opportunity to develop / improve *main well barrier* materials**/configuration.

THANK YOU

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