Production Enhancement Using Intelligent Completion

Case Studies West Delta Deep Marine (WDDM) Offshore Egypt

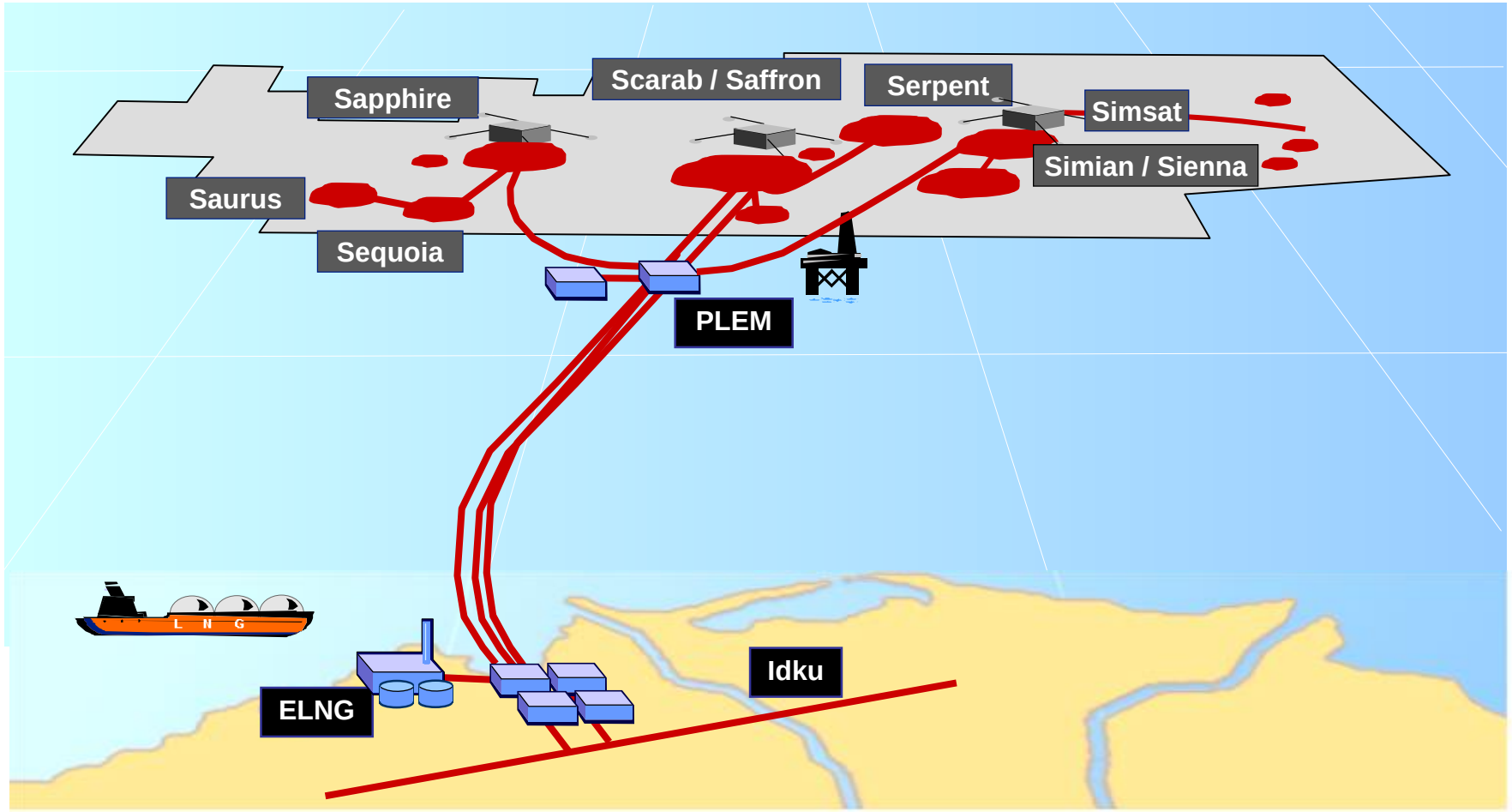
Agenda

1. Introduction
2. Smart Completion Value Drivers
3. Smart Completion Technology
4. Initial Implementation of SMART Completion in Rashpetco
5. Rashpetco Smart Completion Case Studies

Introduction

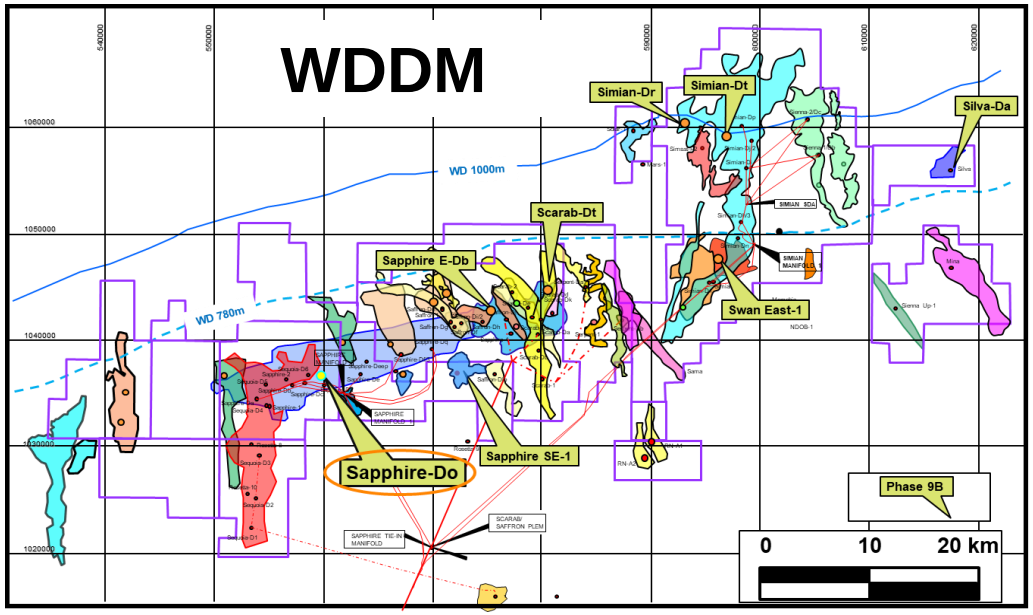
WDDM Concession – Development

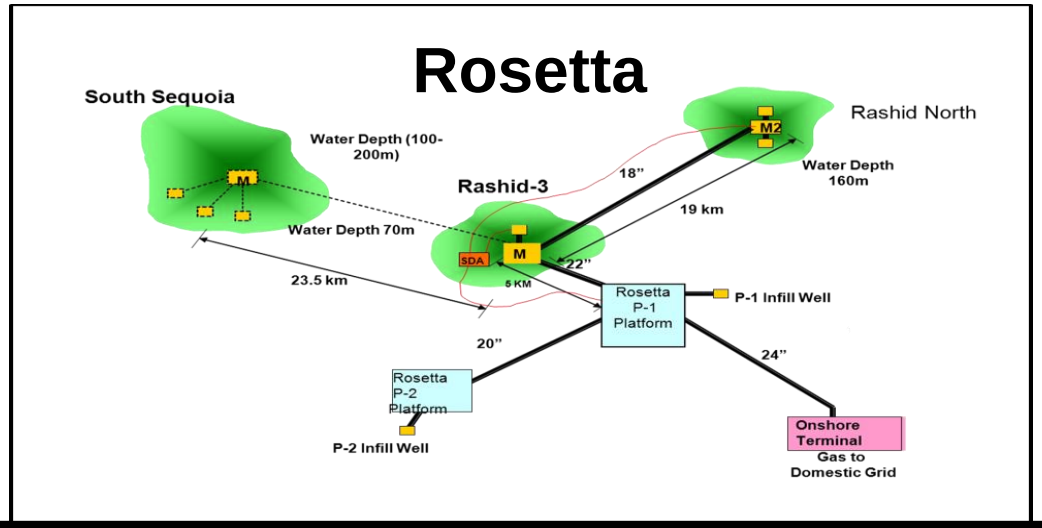
Phase 1 Drilling Campaign 2016/2018 Phase 2 2011- 2019



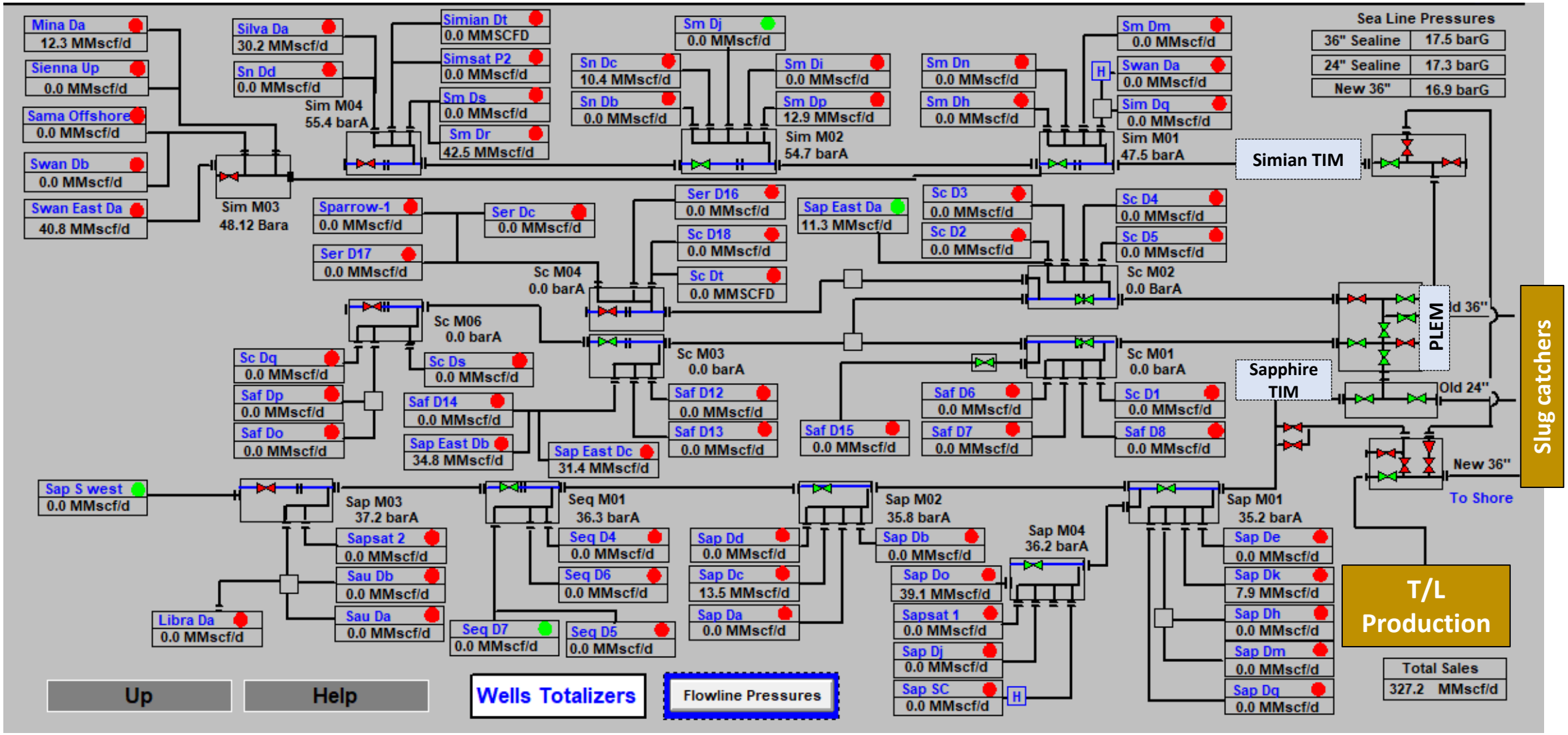
Rashpetco Overview

	WDDM	Rosetta
No of Fields	20	5
Total no. wells	68	18
Well types	Subsea	Platform and Subsea
Water depth, m	300 -1000	100- 200
Smart Completion Wells	19	7
Smart completion implementation results	Highest recovery factor. Reduce the No. of wells in the first implementation from 13 to 8 wells.	Highest recovery factor. Reduce the No of wells in the first implementation from 8 to 5 wells.



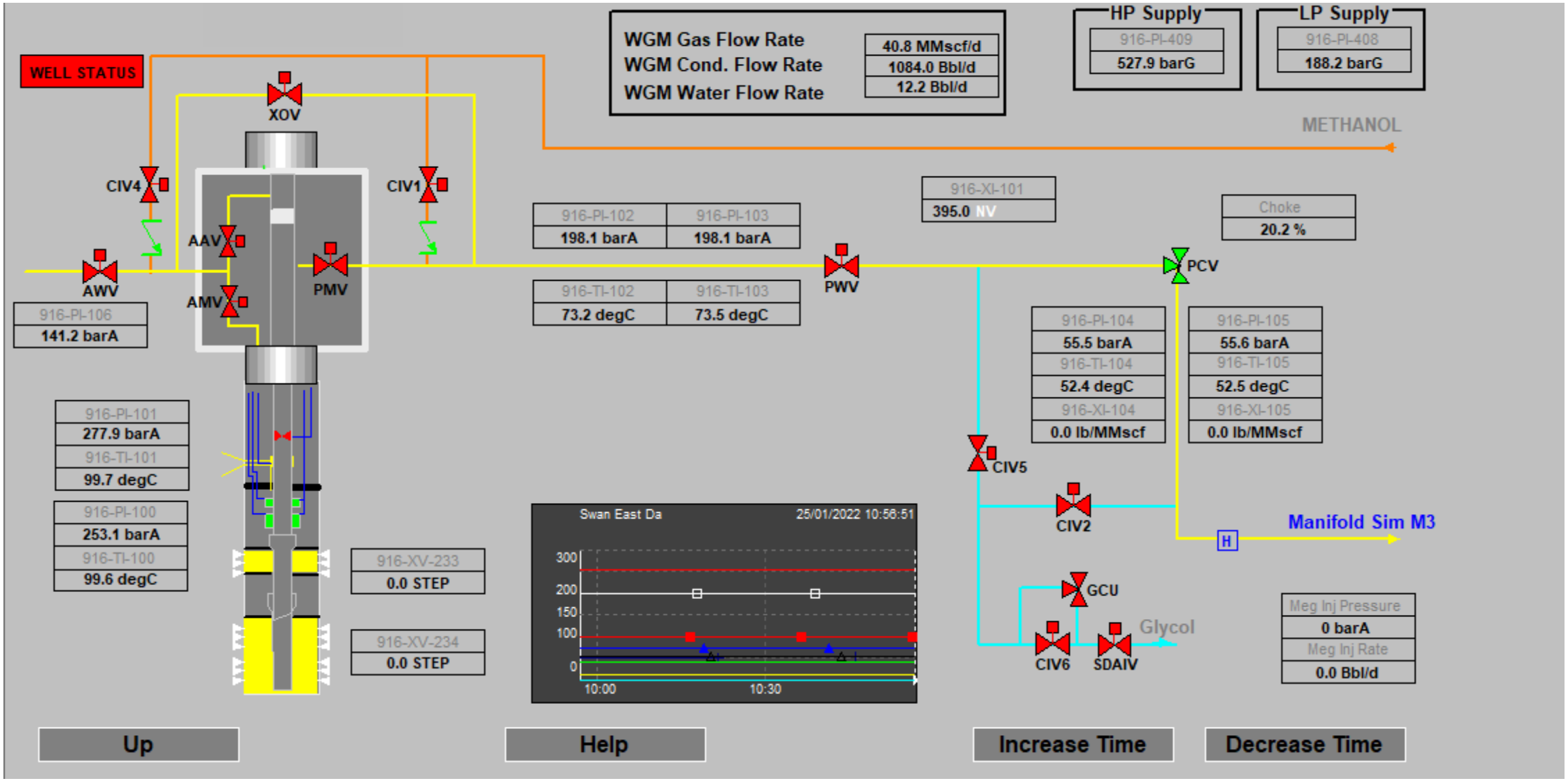


WDDM – Subsea Network Overview



WDDM subsea system: Total length > 567,924 m Total volume > 825,906 bbl.

Dual Zone Real time Data



Smart Completion Value Drivers

Smart Completion Value Drivers

Reducing CAPEX and OPEX & Maximize RF

Water Production Control & Management

Production Management

Reducing CAPEX and OPEX (No of wells & intervention).

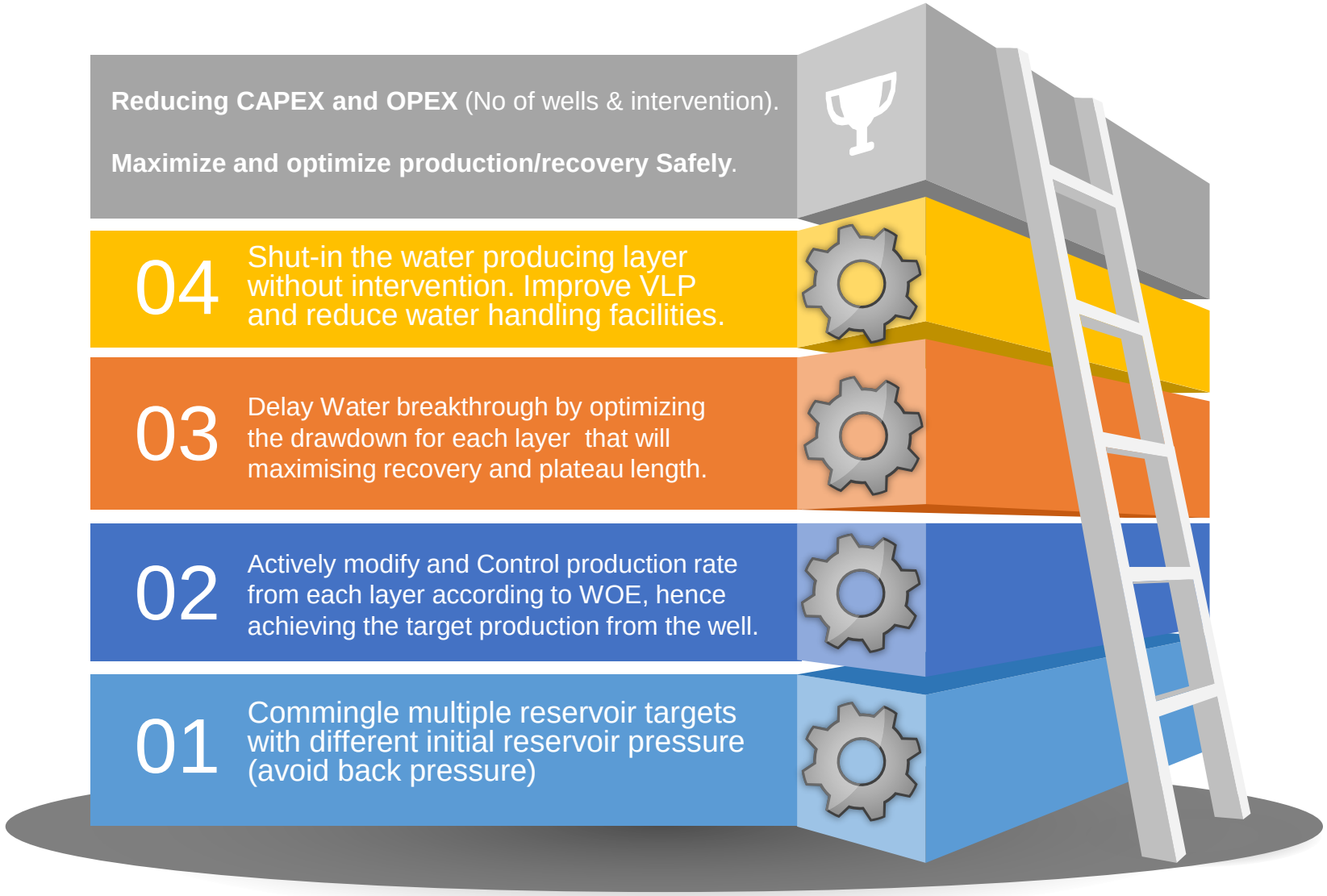
Maximize and optimize production/recovery Safely.

04 Shut-in the water producing layer without intervention. Improve VLP and reduce water handling facilities.

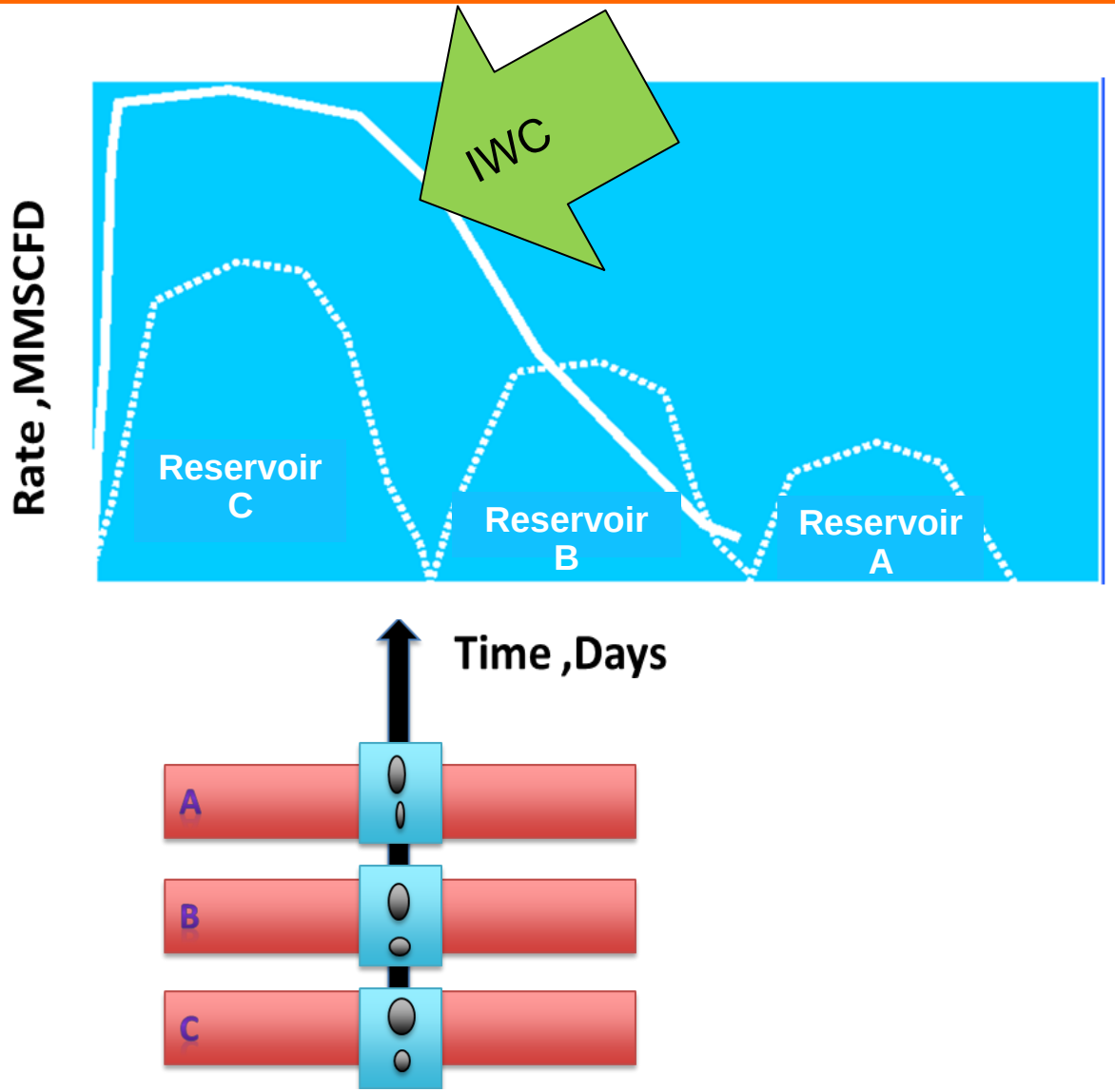
03 Delay Water breakthrough by optimizing the drawdown for each layer that will maximising recovery and plateau length.

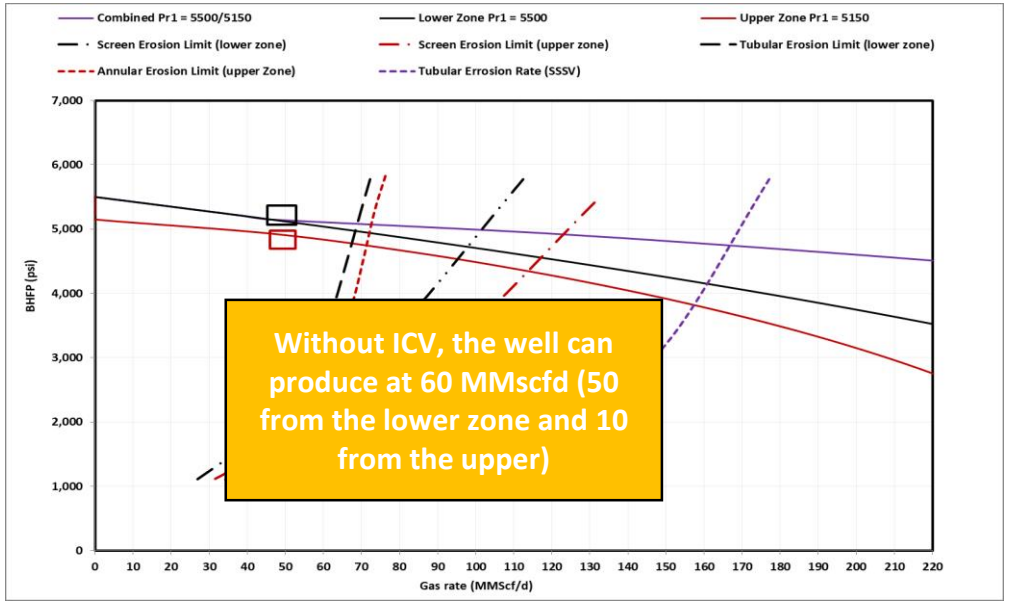
02 Actively modify and Control production rate from each layer according to WOE, hence achieving the target production from the well.

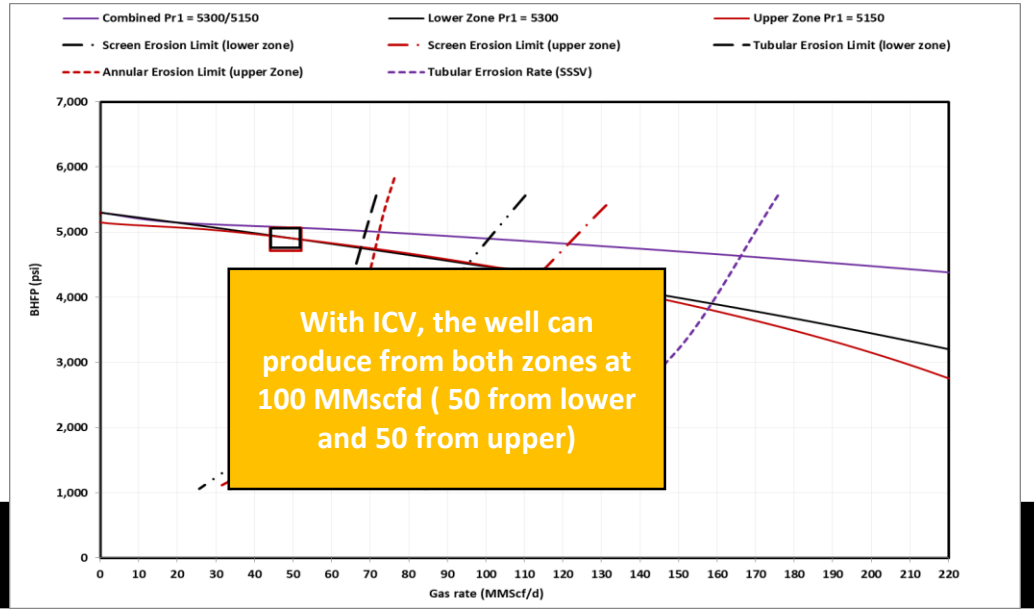
01 Commingle multiple reservoir targets with different initial reservoir pressure (avoid back pressure)



Smart Completion (ICVs) Value Drivers



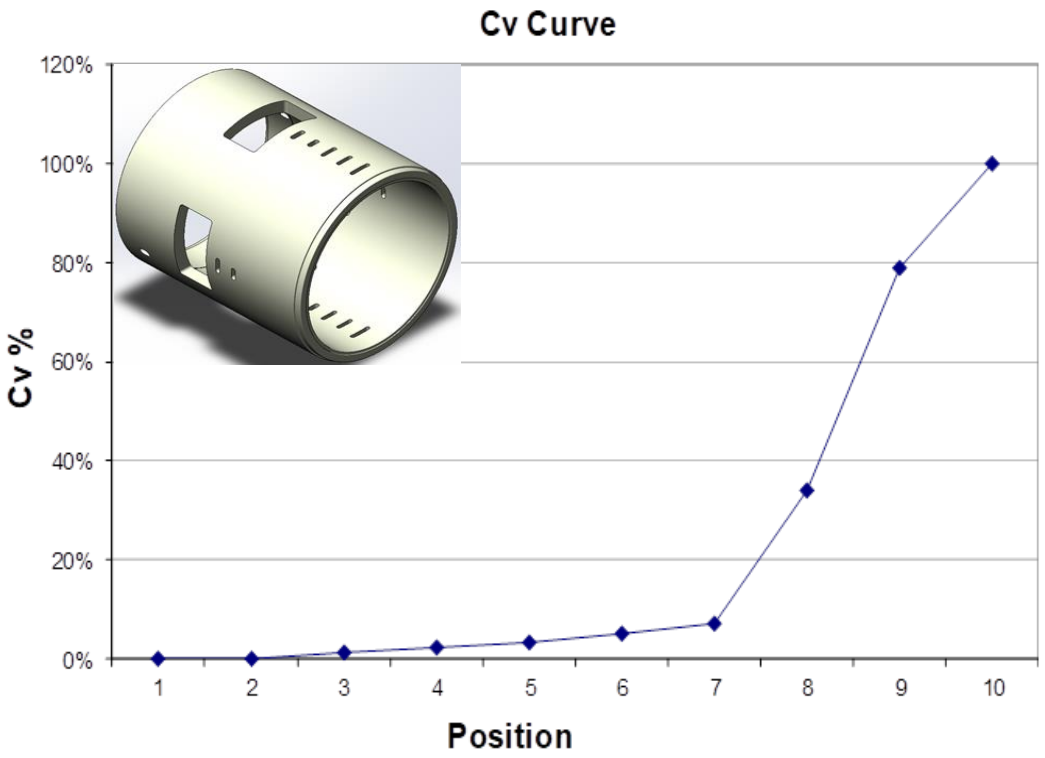


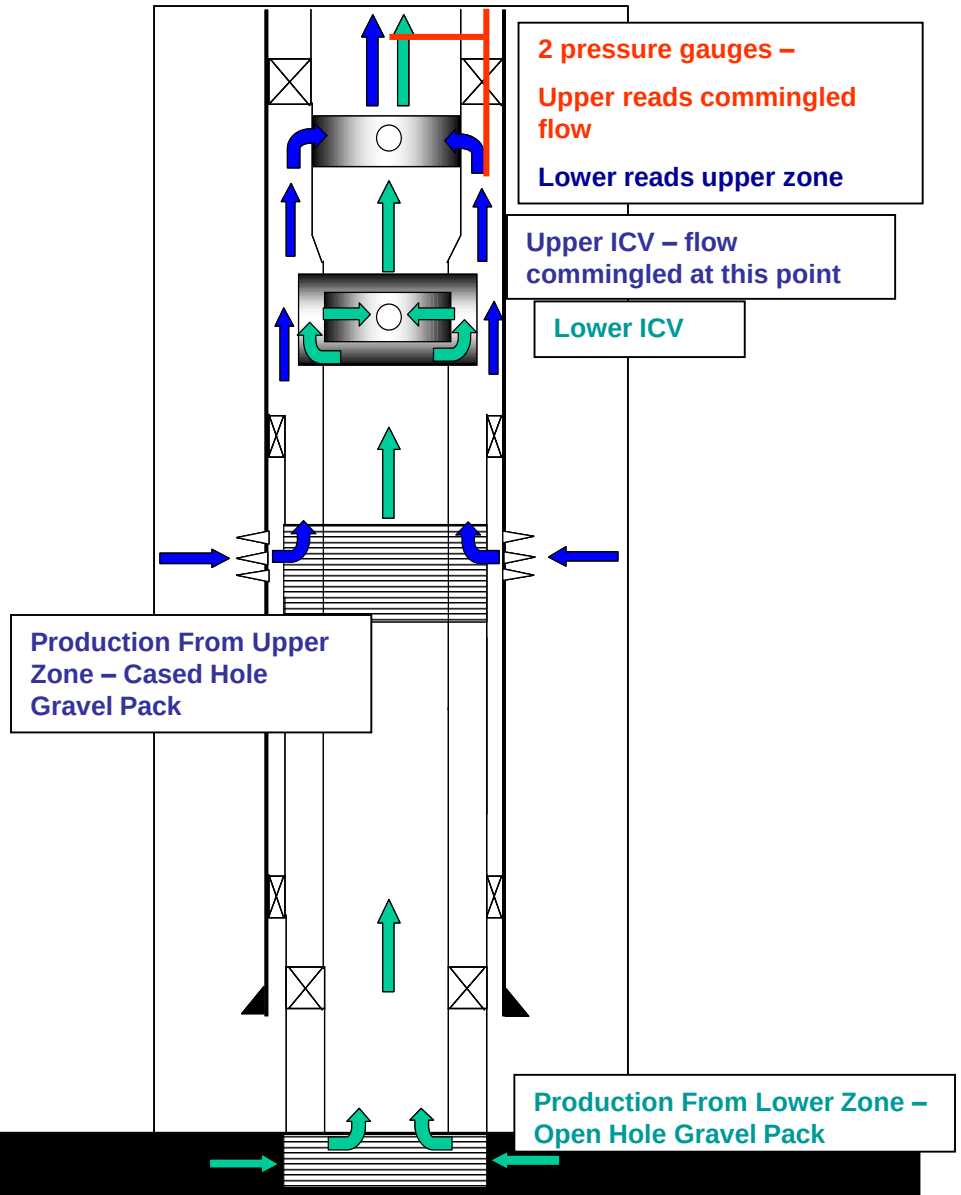


Smart Completion Technology

Smart Technology Component

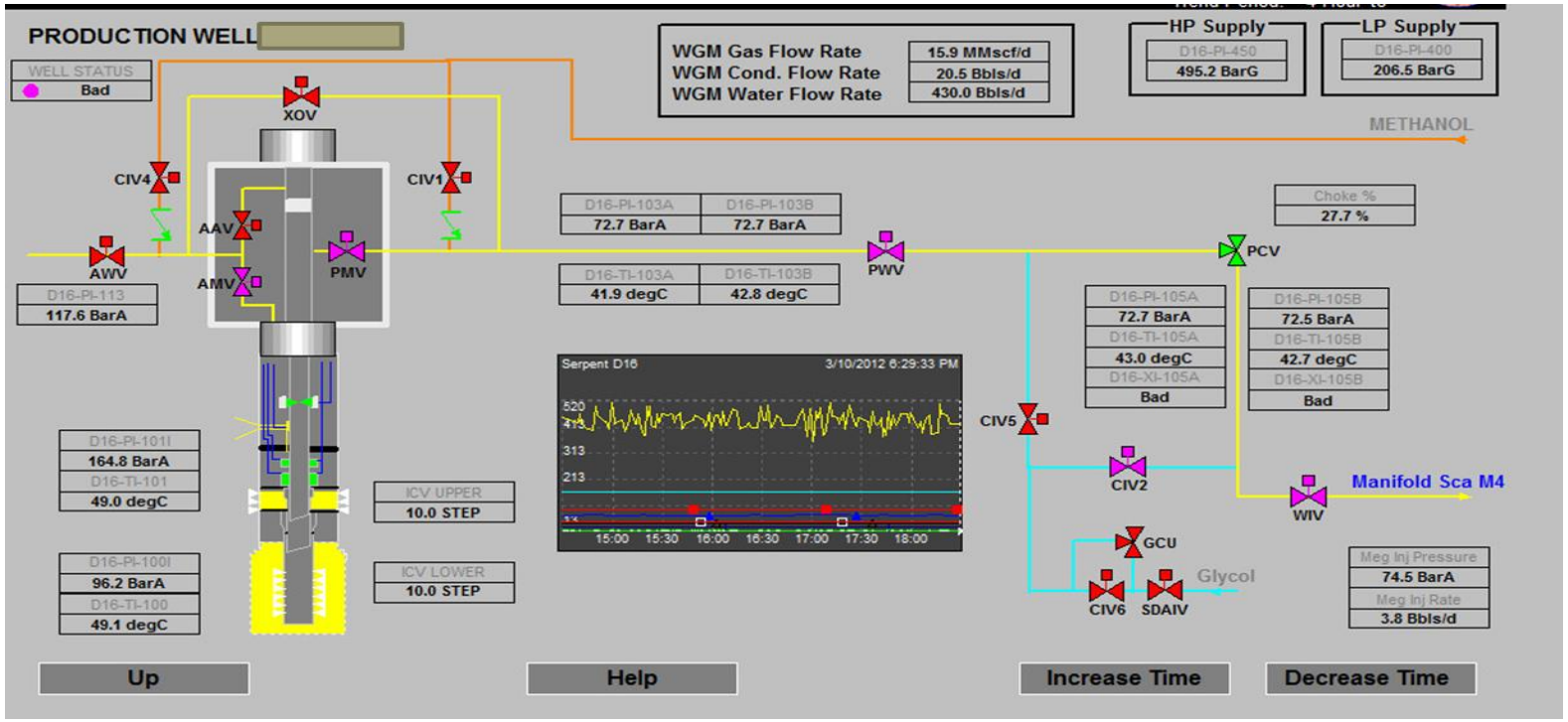
Interval control valve (ICV) Multi position valves Flow trim

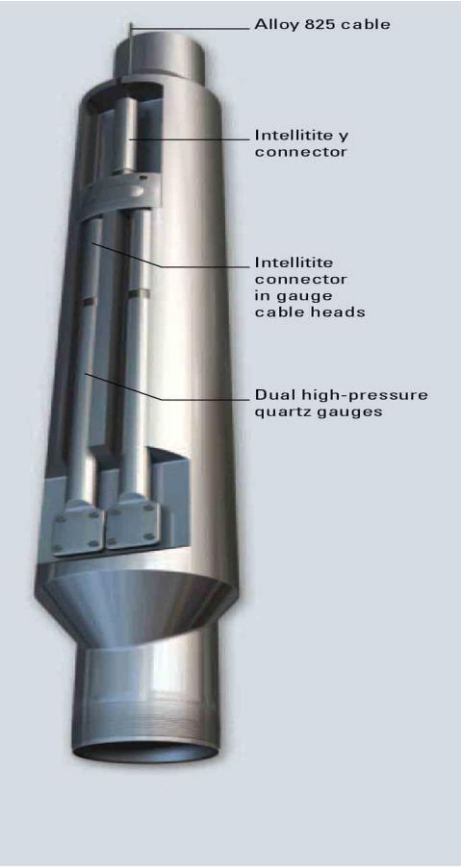




Improve Reservoir Knowledge

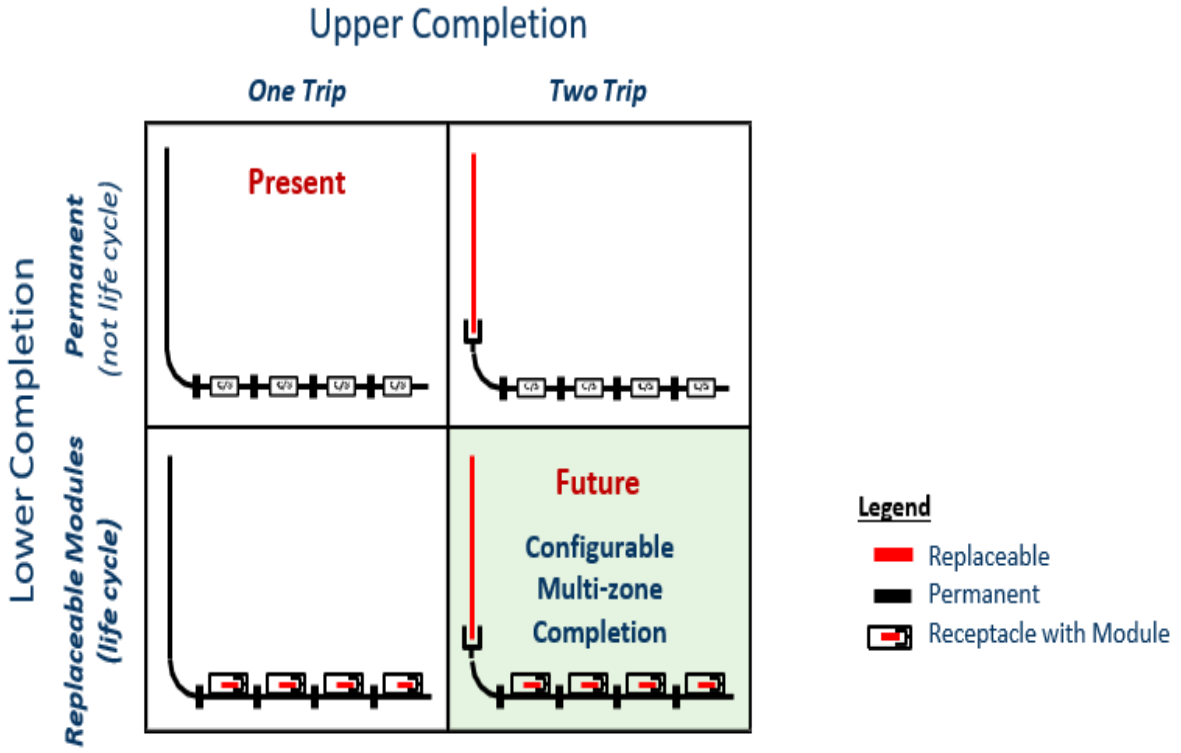
- Real time data Monitoring
- Minimizing the Impact of Reservoir Uncertainties



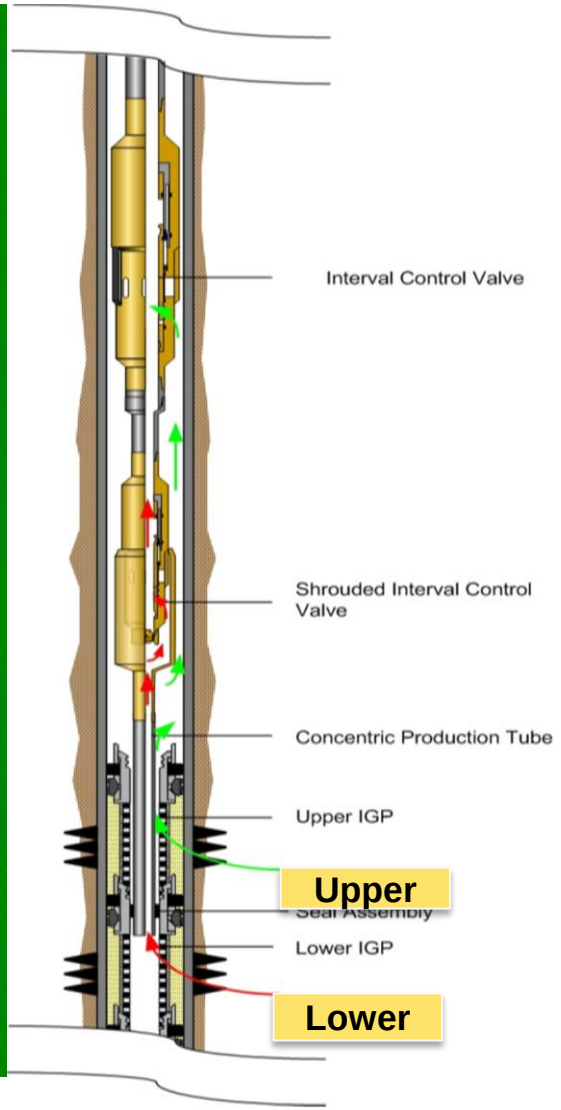


Multi-zone Completion Philosophy

- Permanent lower completions do not offer replaceability for the downhole component in the lower completion.
- This is significant because the lower completion includes components like electronics and valves which are the parts likely to need replacing or upgrading.
- The replaceable completion places these key components in a module that fits within a receptacle in the permanent completion.
- The receptacle is part of the permanent completion. The modules with the key components are replaceable and fit within the receptacle.
- Through-tubing replaceable modules can be installed into either a single-trip or a two-trip completion.



Smart Technology



Initial Implementation of SMART Completion in Rashpetco

Smart Completion Implementation in Rashpetco

Objectives

- The main objective was to have downhole equipment which allows each reservoir zone to be treated separately such that major problems in any single zone do not necessarily mean the shutting the well and losing production.
- This need to be considered in both platform and subsea developments.

Options Evaluation

Challenges

- The subsea wells to be designed for zero intervention to reduce the OPEX part of the budget.
- Selective SSD's carry high production
- The Rosetta Phase II Platform is Small platform. Hence, the philosophy was not that different from the subsea development and a reliable system had to be installed in all of these wells (i.e. no intervention).

Smart Completion Implementation in Rashpetco

Remotely operated duel zone completions. SMART™ wells.

- The increased cost of the SMART™ well is more than offset by the reduced well count. (Reduced CAPEX & OPEX)
- Cumulative water production over field life is significantly reduced, hence reducing the MEG injection cost.
- Maximize the Recovery.

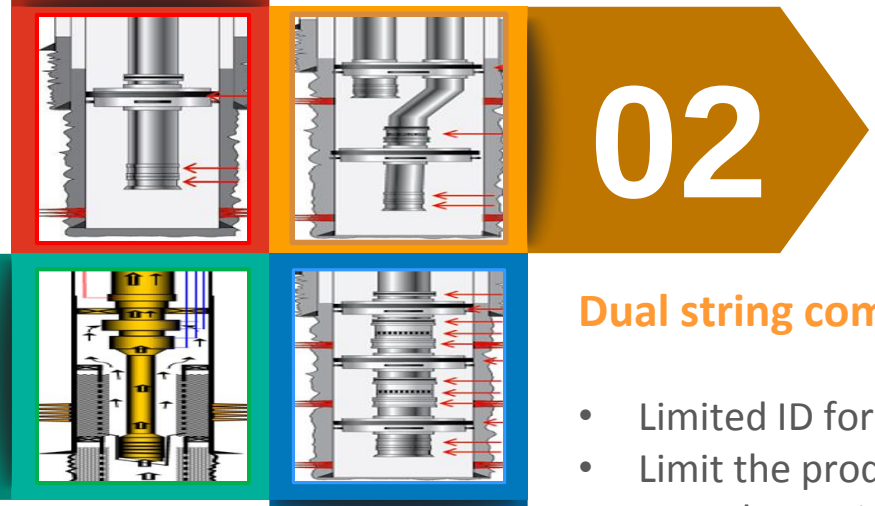
Commingling of zones (Single String)

- No water production control, cross flow, and back pressure, and formation damage.
- Integrity issue in case the SIBHP in front of the UZ higher than its Frac pressure.

01

Single zone completion

- Same recovery and plateau length will require almost double no. of wells.
- High CAPEX.



02

Dual string completions

- Limited ID for each string.
- Limit the production rate from each zone, hence increase the well count to achieve the production target.
- High CAPEX

04

03

The assessment concluded that a SMART™ well could fulfil all the requirements for the dual zone wells.

Smart Completion Implementation in Rashpetco

- Both Sapphire and Rosetta has been considered an ideal candidate for such technology due to the nature of the reservoir sands and potentially strong aquifer influx.

Platform Wells

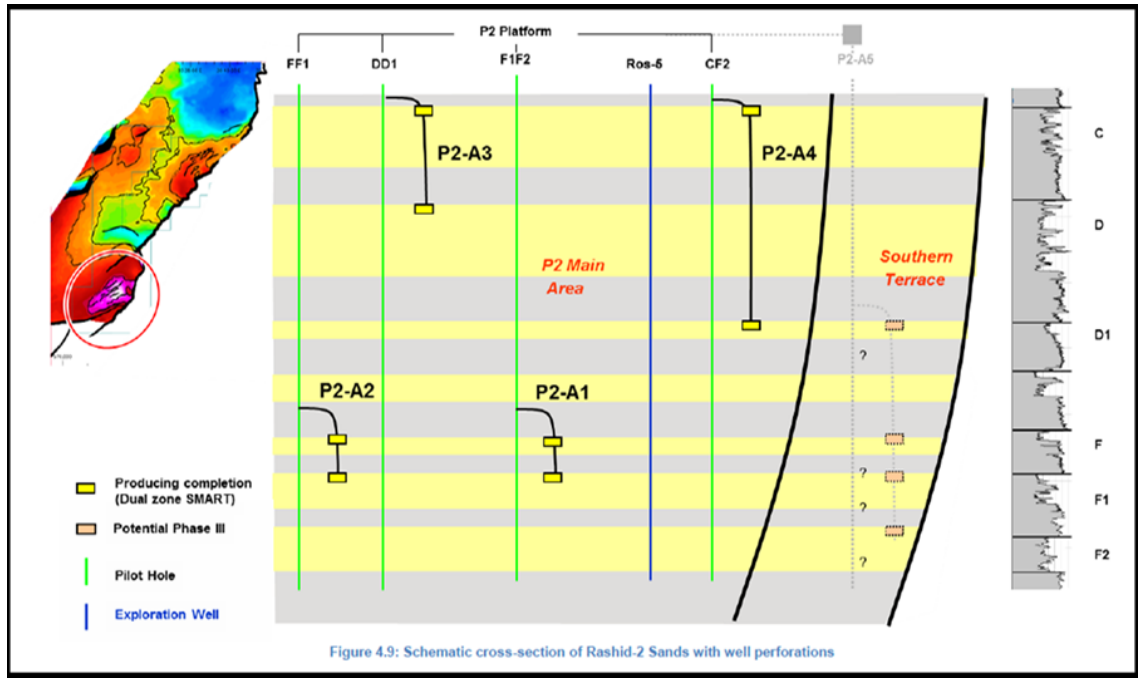
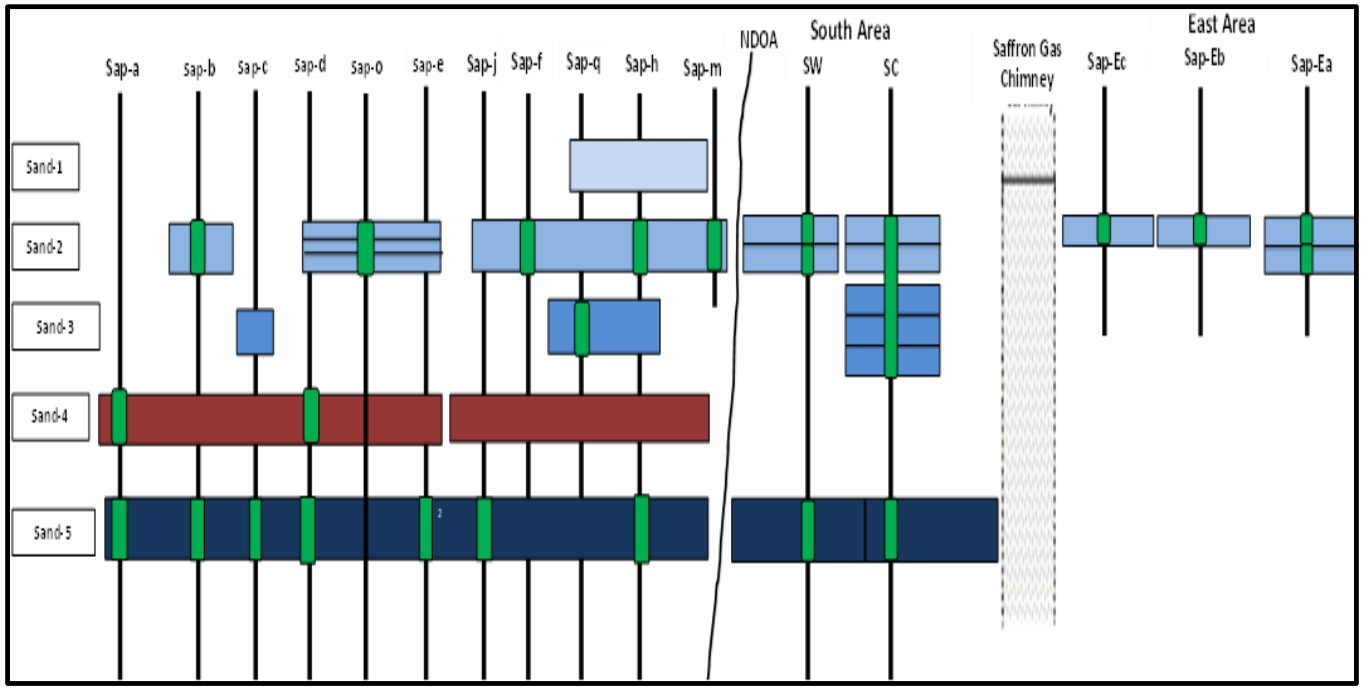


Figure 4.9: Schematic cross-section of Rashid-2 Sands with well perforations

Subsea Wells



Smart Completion Implementation in Rashpetco

Control System Selection Options

Hydraulic Control System

- Provide simple and reliable functionality, and currently have the widest industry use.
- Considered to be qualified for use with all the potential control system vendors.
- It has the least schedule impact and is considered to be more reliable due to its relative simplicity.

Electro-Hydraulic Control System

- Not that popular like Hydraulic one, and has been integrated into a version of the subsea control system, but only at a relatively shallow' water depth. 140 metres, and in the North Sea.
- The system has not been used with the other control system vendors, and thus integration qualification will be required.
- will require additional power at the subsea field for operation.

All-Electric Control System

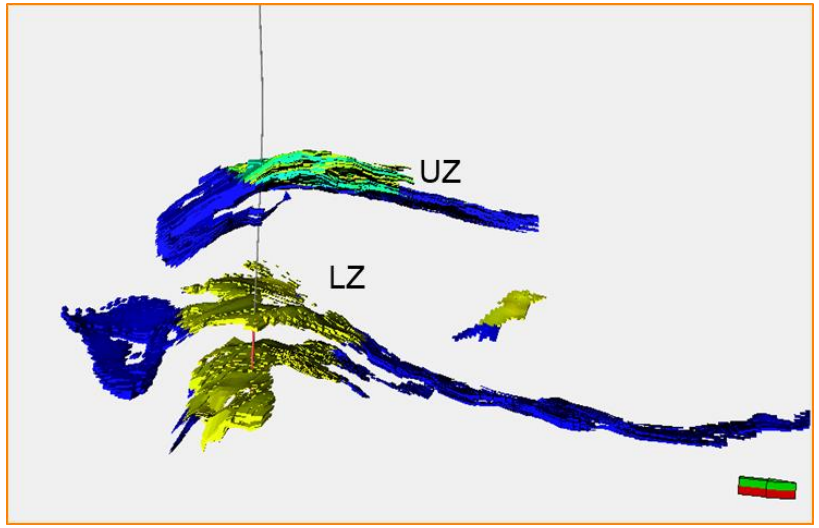
- Each vendor has its own communications protocol, thus the SMART™ would have to be selected before any integration and qualification programme can commence.
- Will require qualification of the transparent communications and additional power at the subsea.

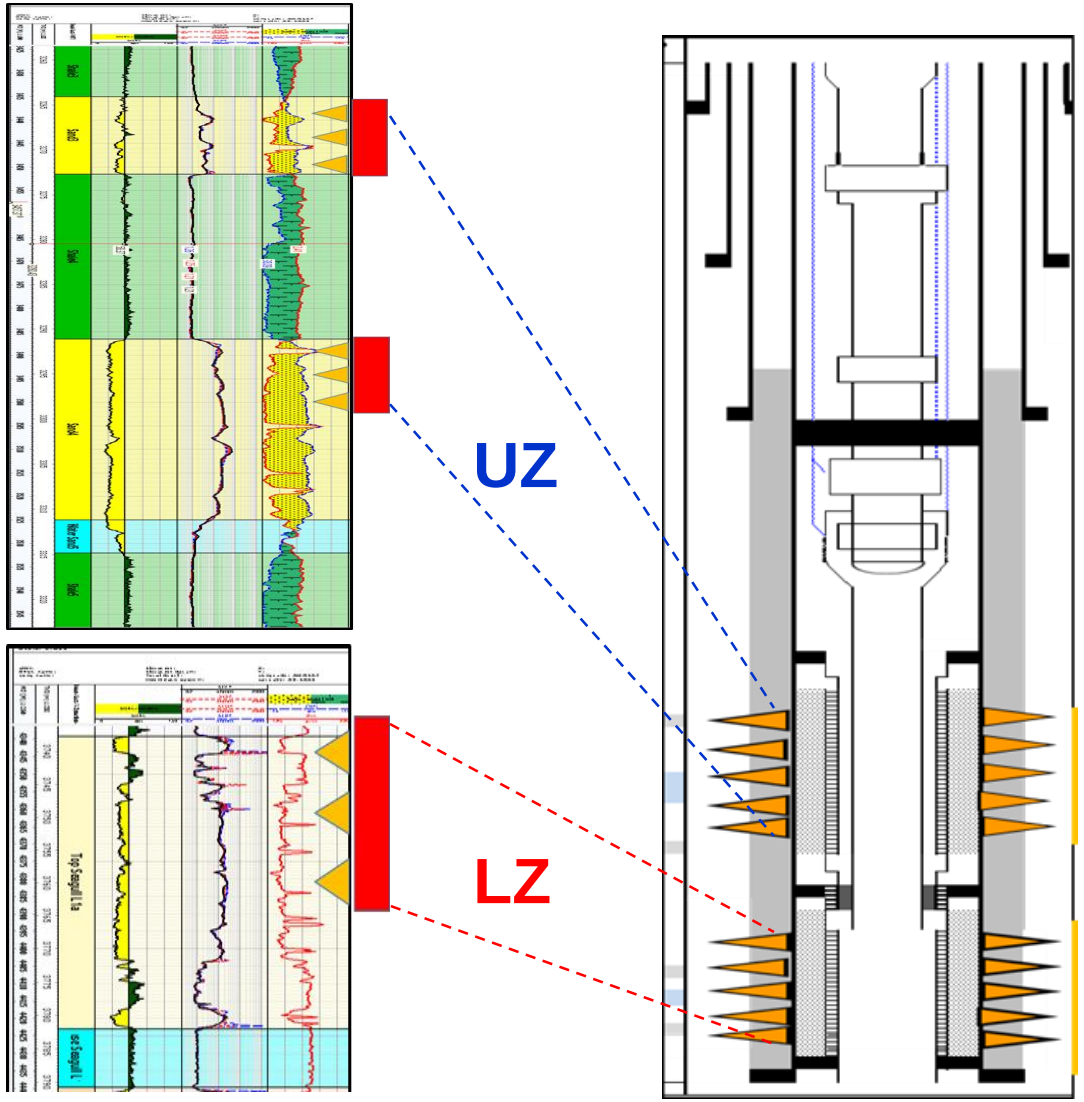
Rashpetco Smart Completion Case Studies

Case Study I Dual zone Completion

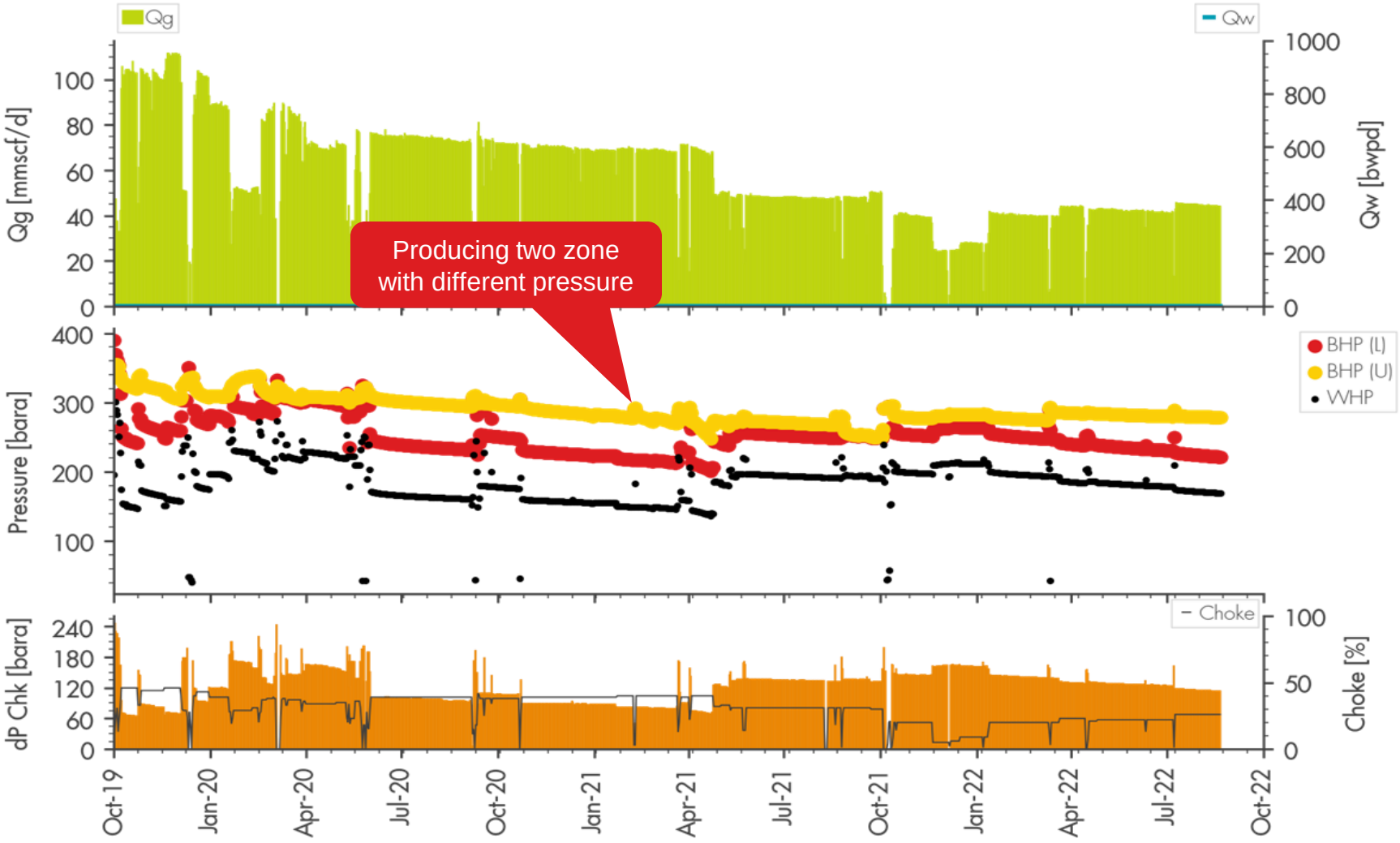
Key Challenges

- Zonal Production Management
- Cross Flow
- Production Allocation
- Water production Management

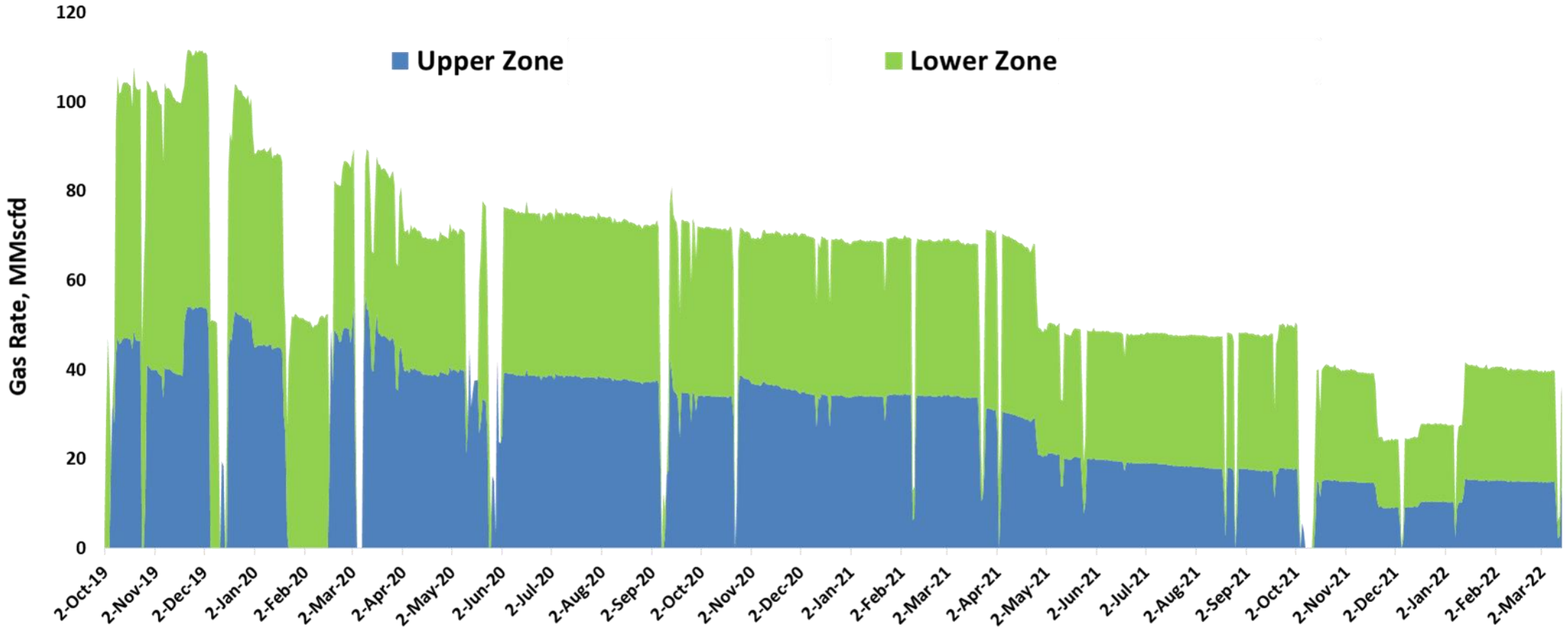




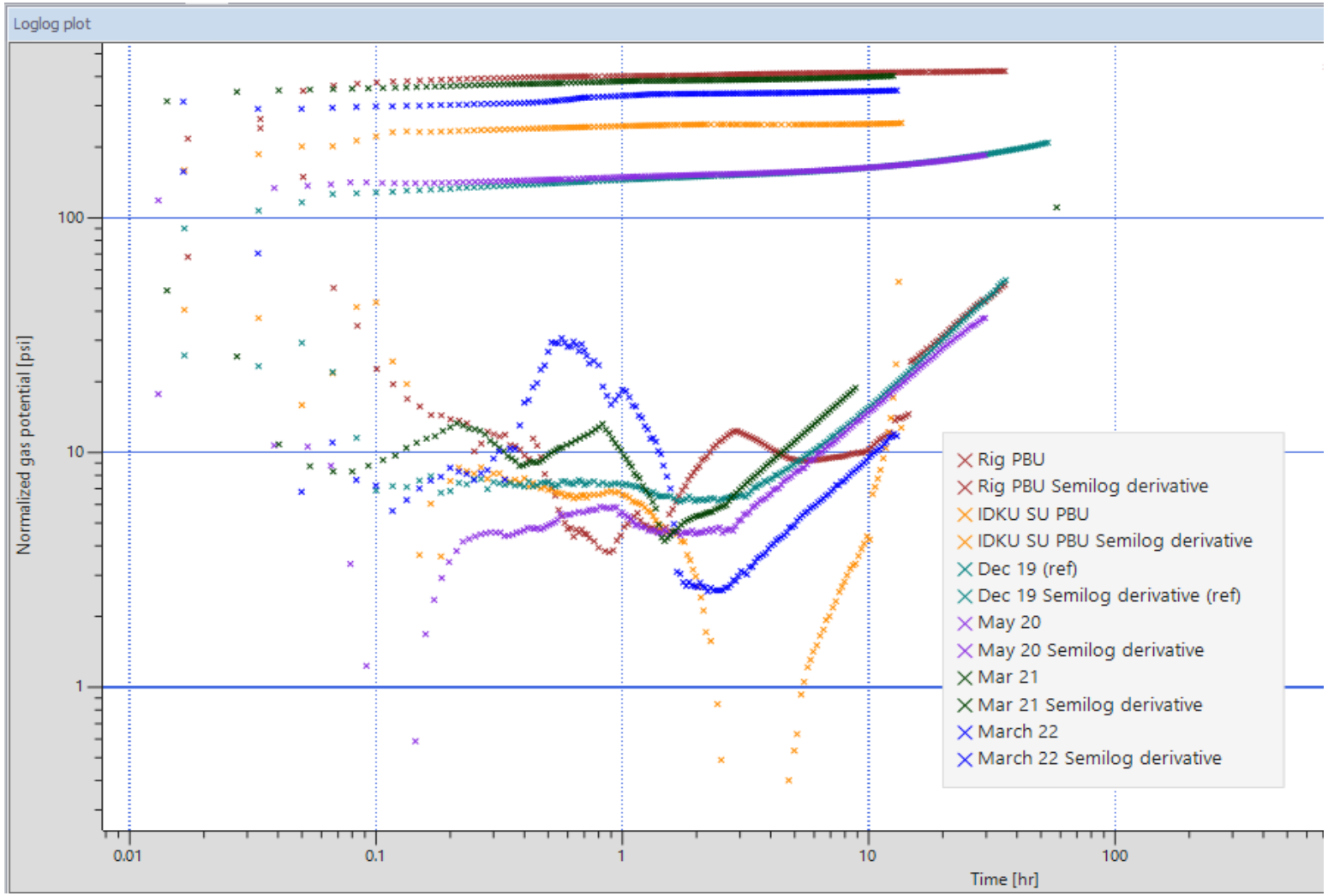
Well Production Performance



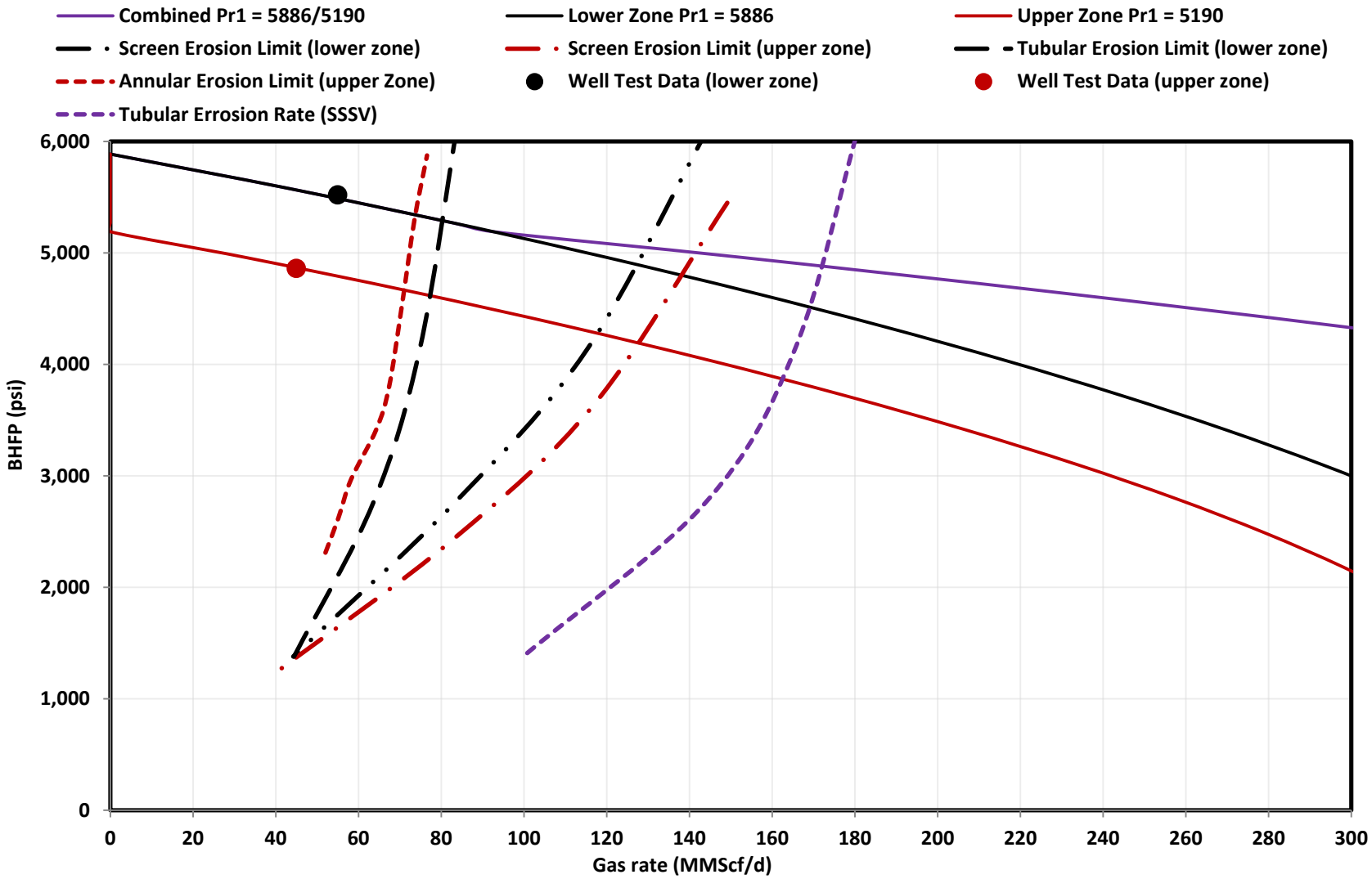
Production Allocation



Well Test Tracking for Each Zone

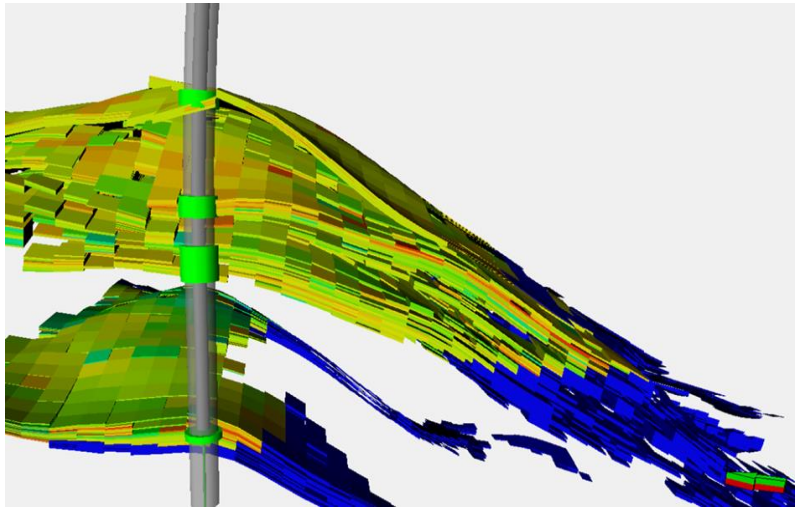


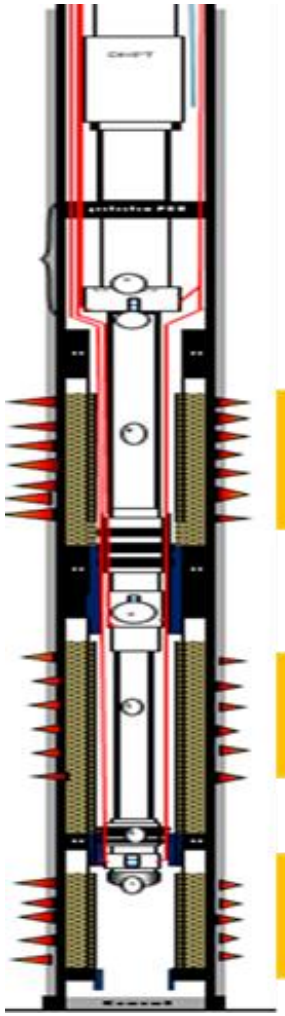
Managing well Production

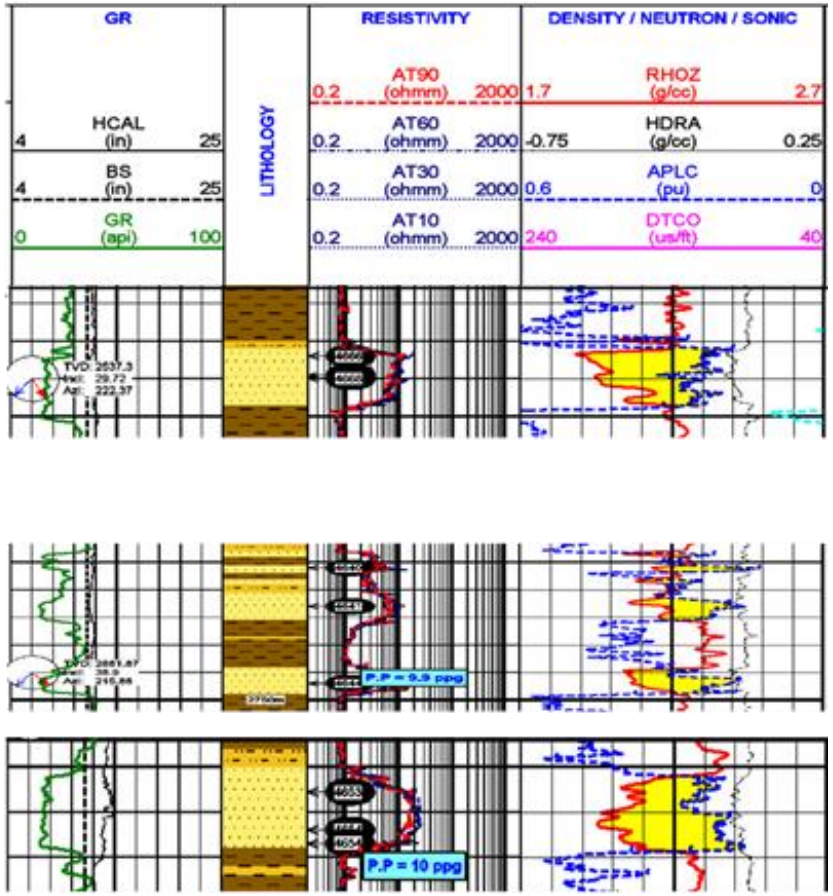


Case Study II (Triple Zone Completion)

- Key Challenges
- Water Management
- Production Management
- Production Allocation
- Cross Flow

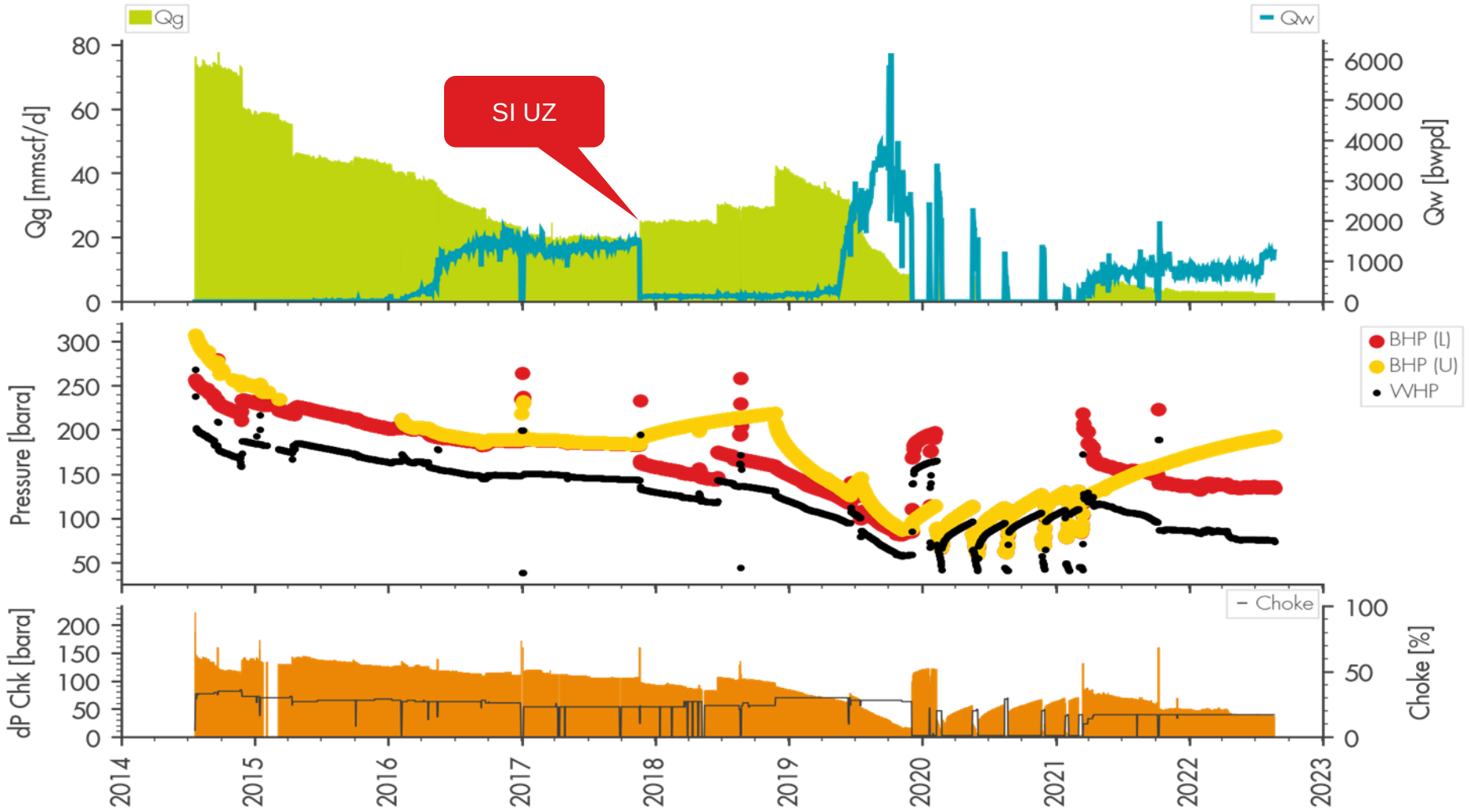






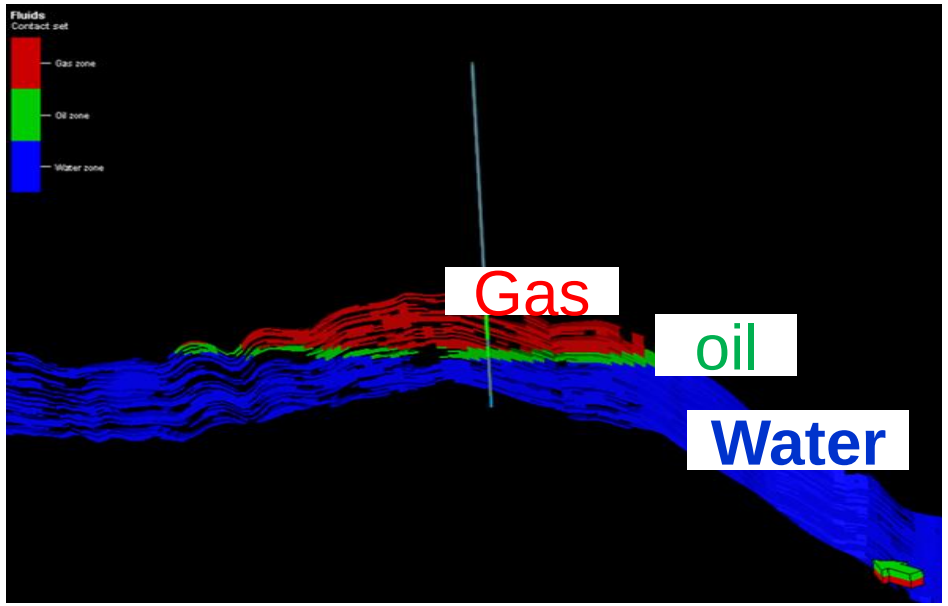
SW is 1st Subsea well completed in Mediterranean as a triple zone over Sand-2 Upper , Sand-2 lower and Sand-5

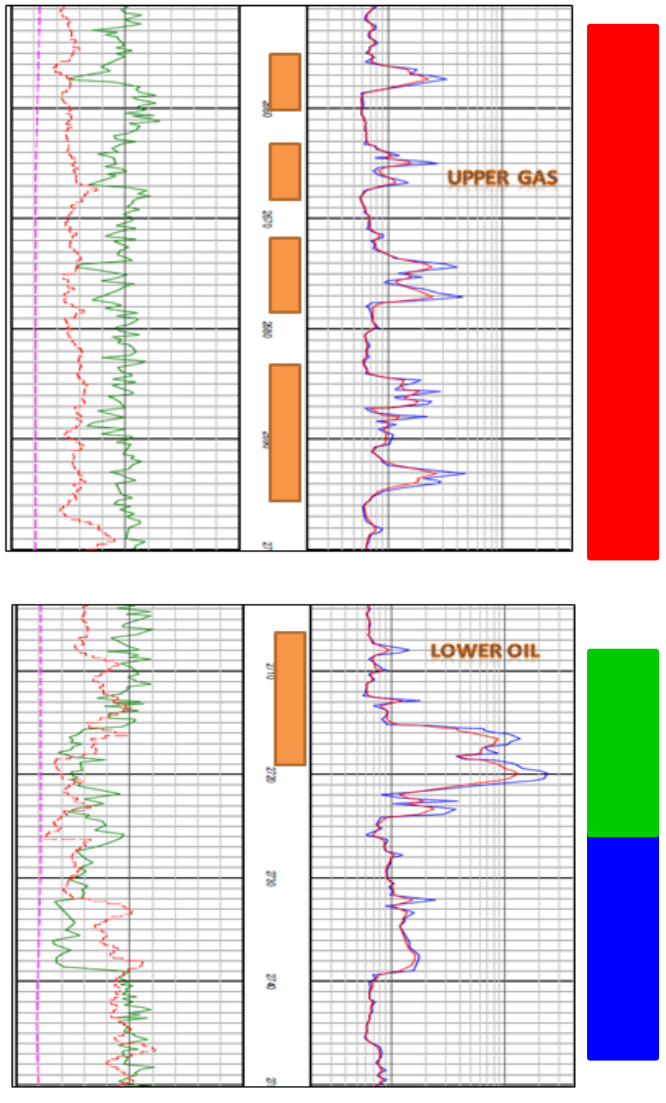
SW Production Management



Case study III (Auto gas lift)

- Key Challenges
- Artificial lifting Oil in Subsea Environment
- Water Production Management





The well was completed as dual zone completion over gas zone(upper layer) and oil zone (lower layer).

Conclusion and Recommendation

The SMART™ completion is a very good tool to achieve the following:

- Reduce CAPEX & OPEX and Accelerate revenue (No. of wells, MEG injection, water handling, No intervention).
- Successfully comingled production from dual and triple zones completions .
- Smart completion used successfully in water control.
- Smart completion configured to auto-gas lifting oil zone.
- Real time data monitors helps a lot in tracking zonal performance and production allocation and will give better reservoir management, early and better reserve estimate.

Thank you

2022