Gas lift challenges in NS – TAQA's perspectives

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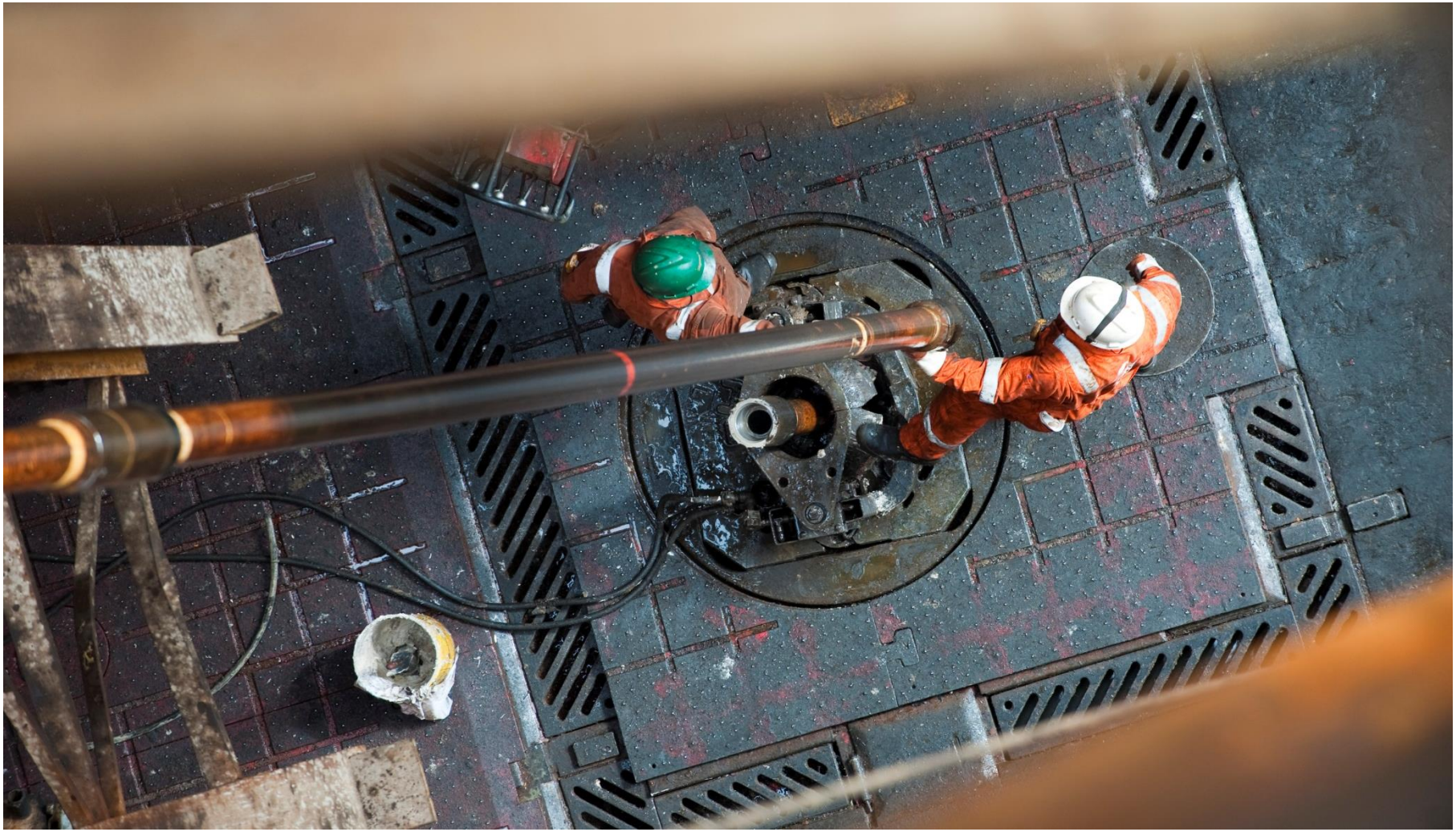
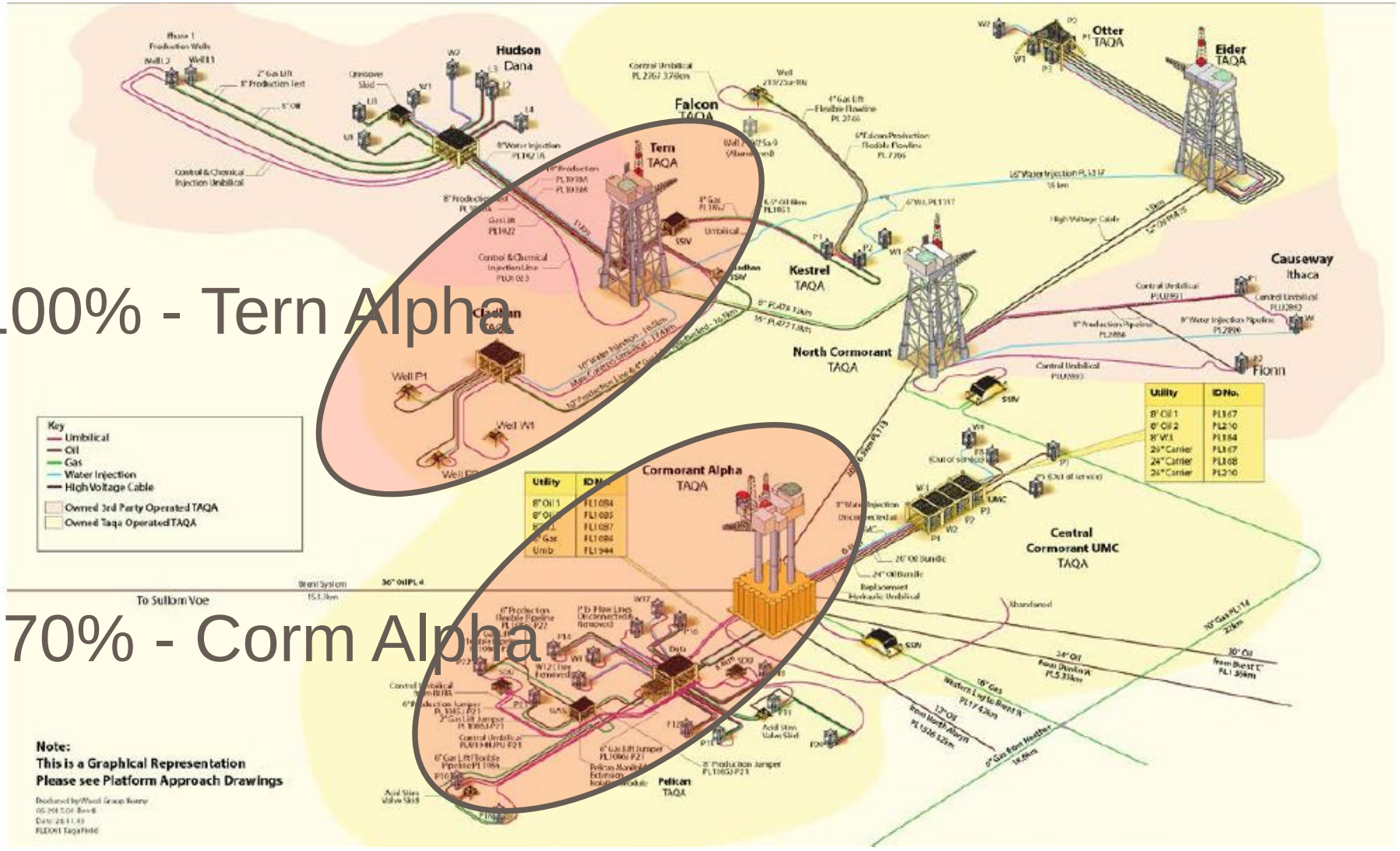


Agenda

- Introduction
- GL operation, design envelope & optimisation
- GL operations out-with design envelope
- WH barrier envelope impact on GL Operation
- GL - production add & enhancement lever
- Summary

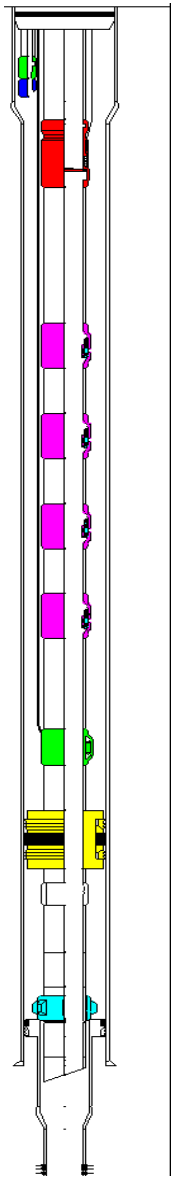
Introduction



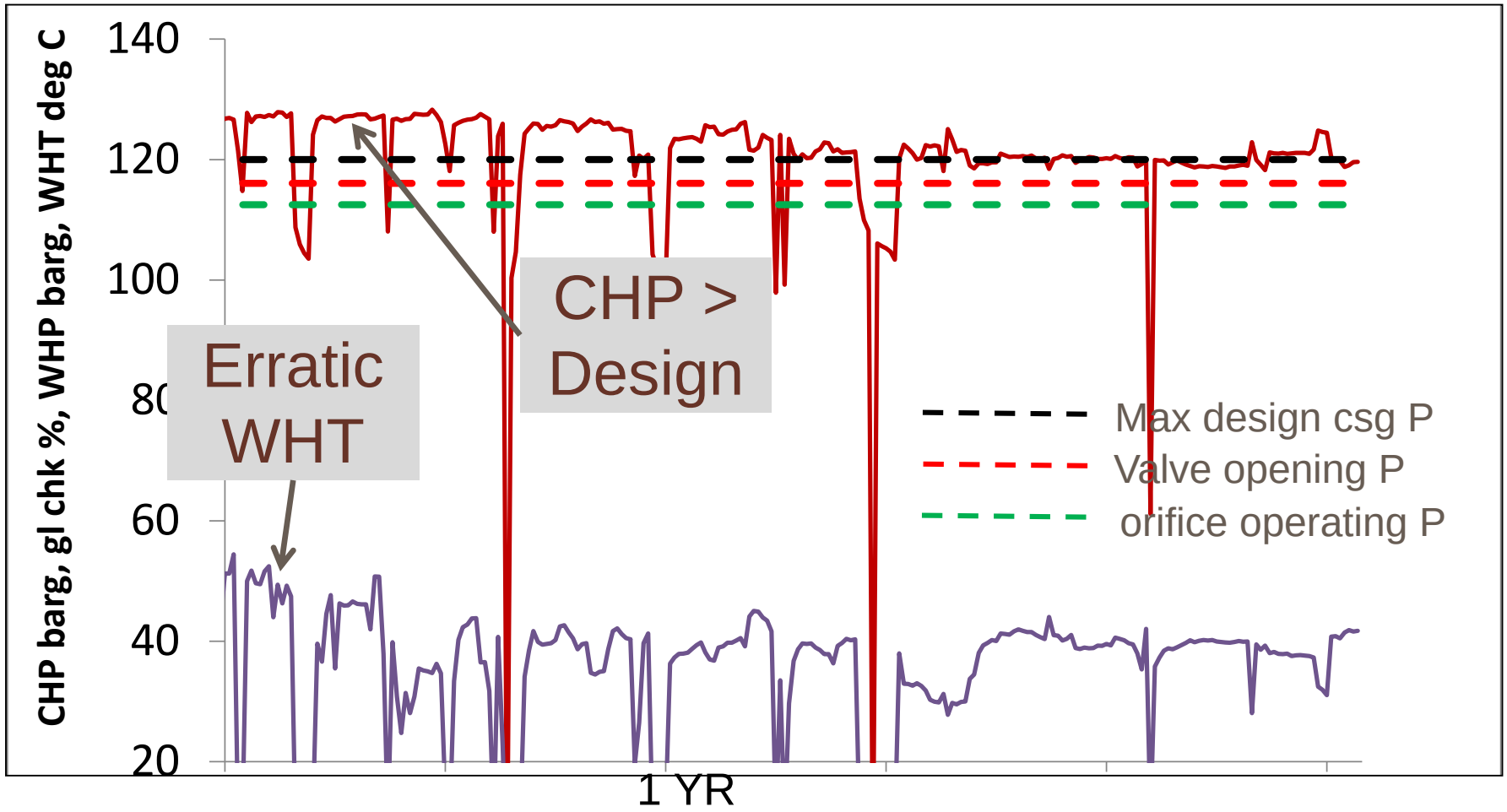
GL operation and design envelope 1

Cormorant Alpha Subsea well

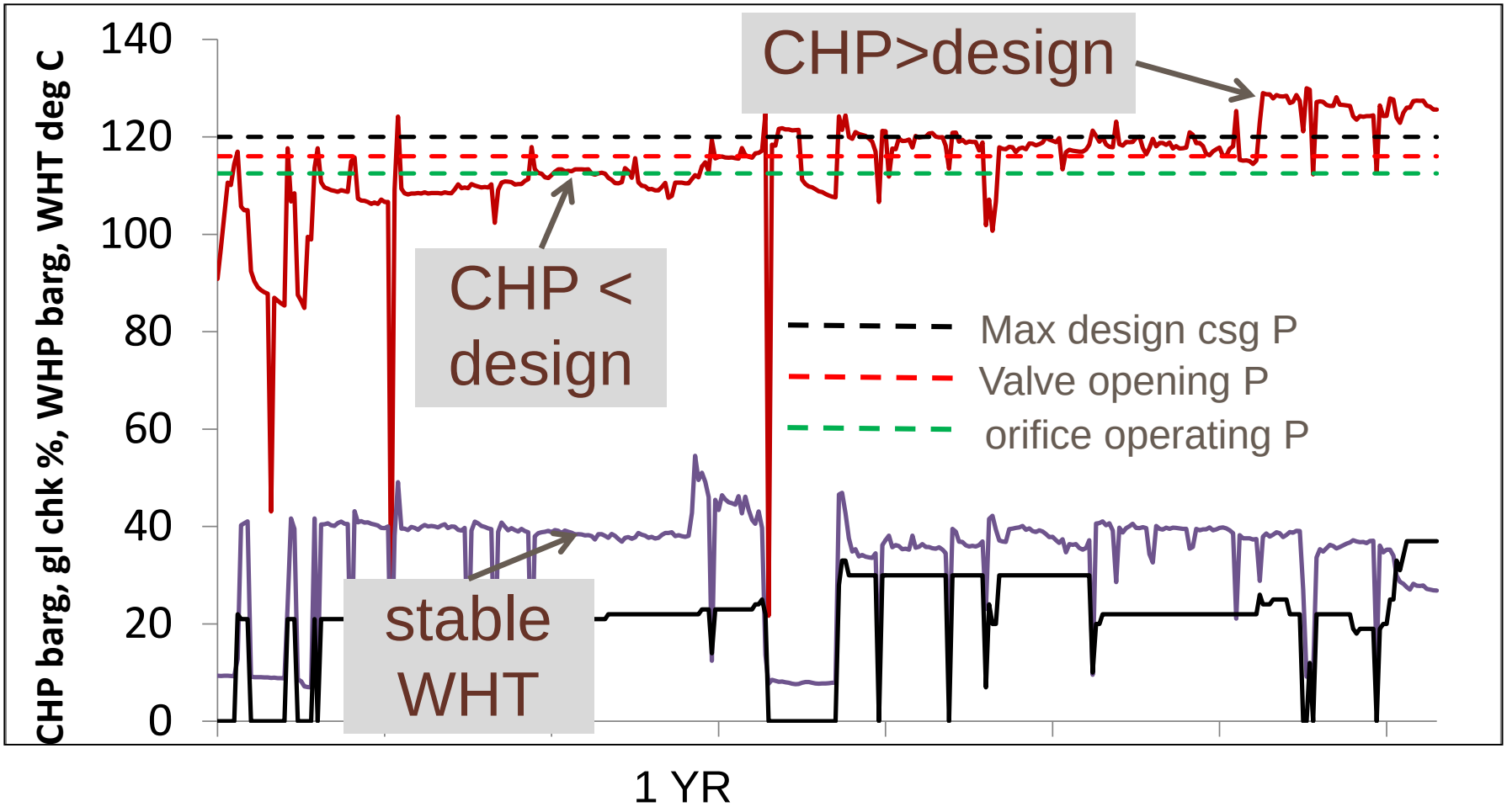
- Well completed and online Aug 11
- GL design parameters for the life cycle of well
  - Design CHP 120 bar
- Valve pressures = f(T)
- Gas Lift commissioned in Dec 11



GL operation and design envelope 1



GL operation and design envelope 1



GL operation and design envelope 1

Cormorant Alpha Subsea well

- Gas lift commissioned at CHP > design
- Well operated with CHP > design most of the time
- Tubing to A-annulus communication
- Well require regular A-annulus unloading

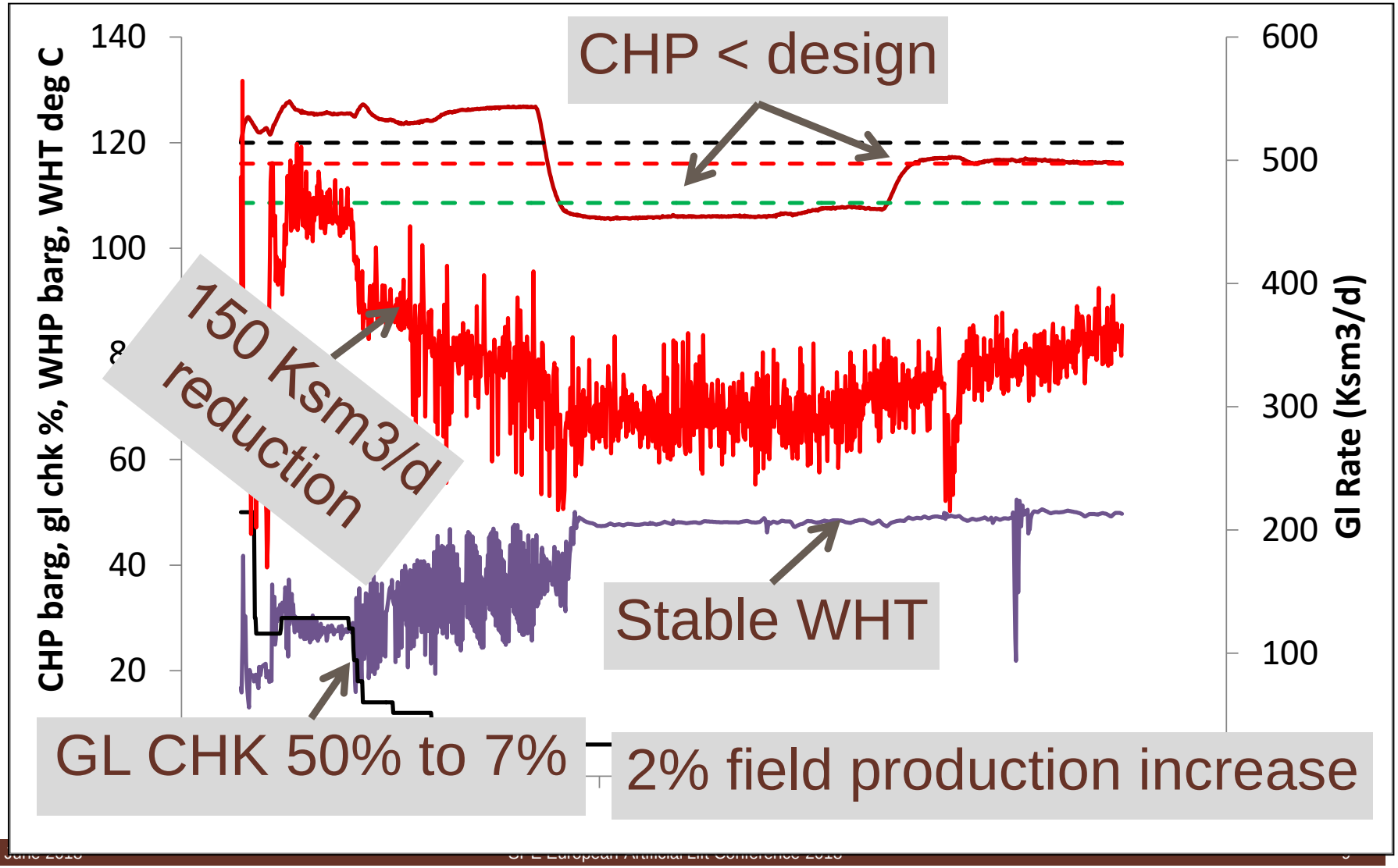
Lesson – It is poor operating practice to continuously operate the CHP above the valves opening pressures.

GL operation and optimisation 1

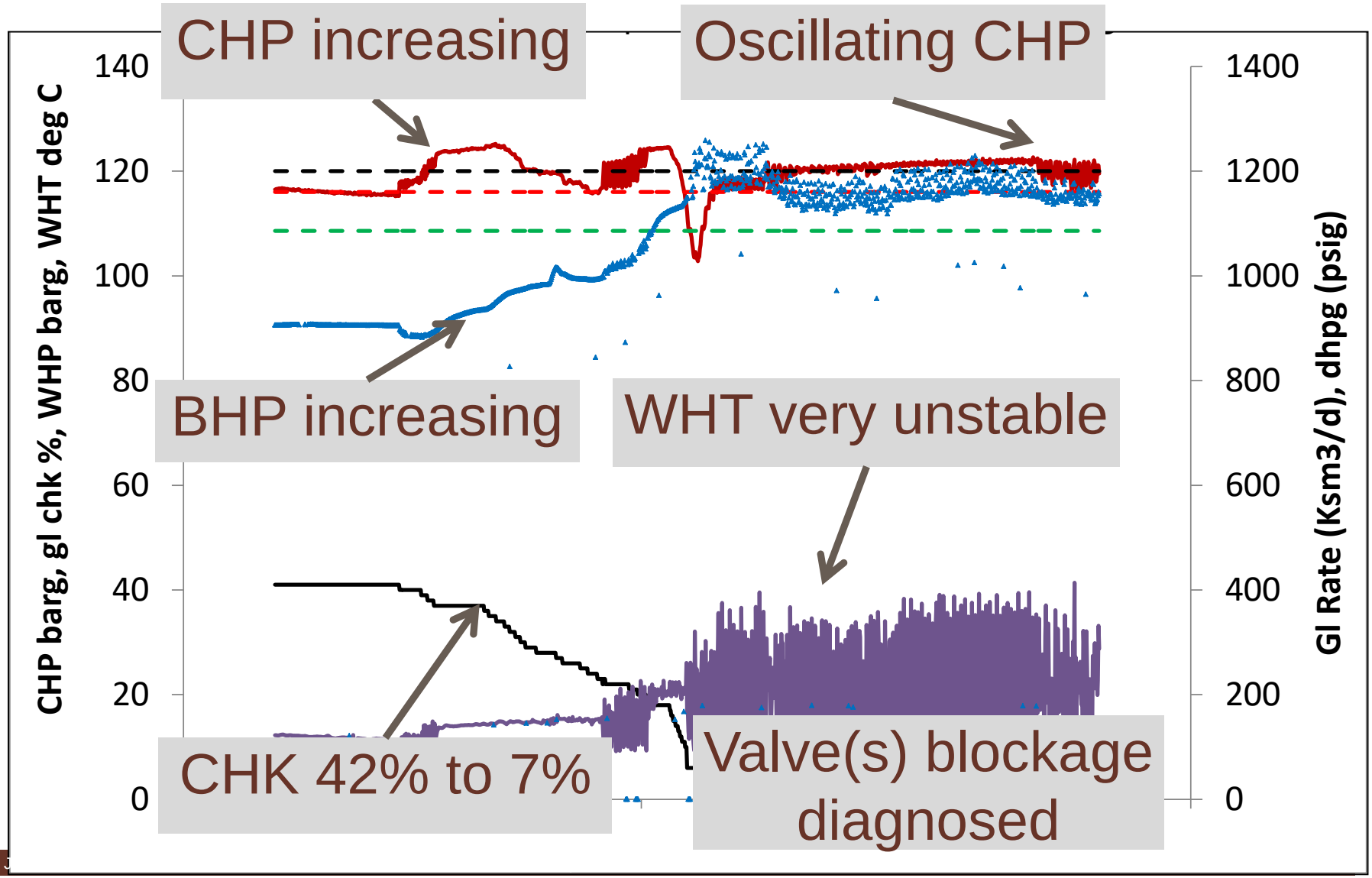
Cormorant Alpha Subsea well

- DHPG and gas lift meter on well had failed
- Reducing CHP was recommended using WHT proxy
- This is challenging previously entrained practice

GL operation and optimisation 1



GL operation and optimisation 2

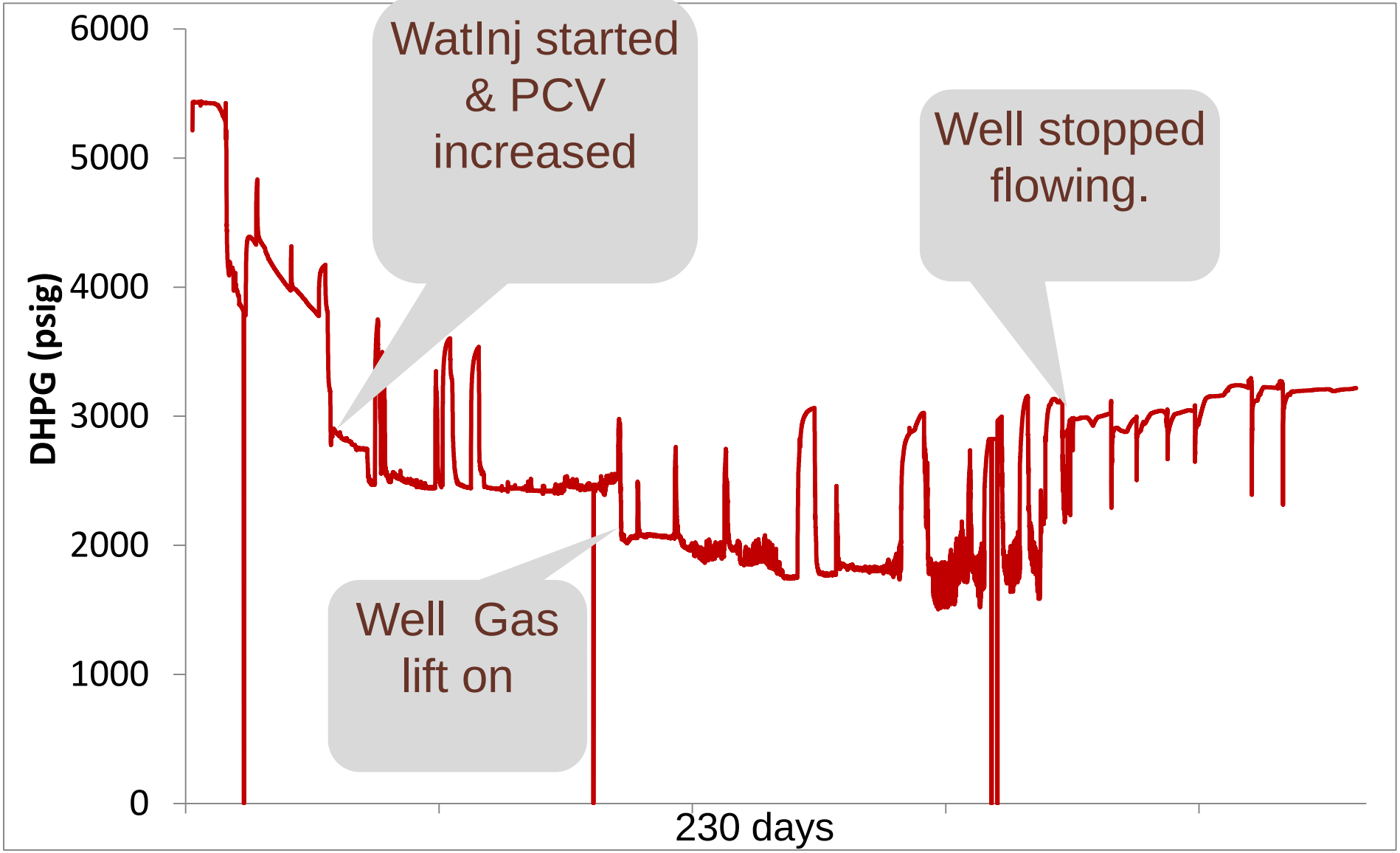


Gas lift out-with design envelope

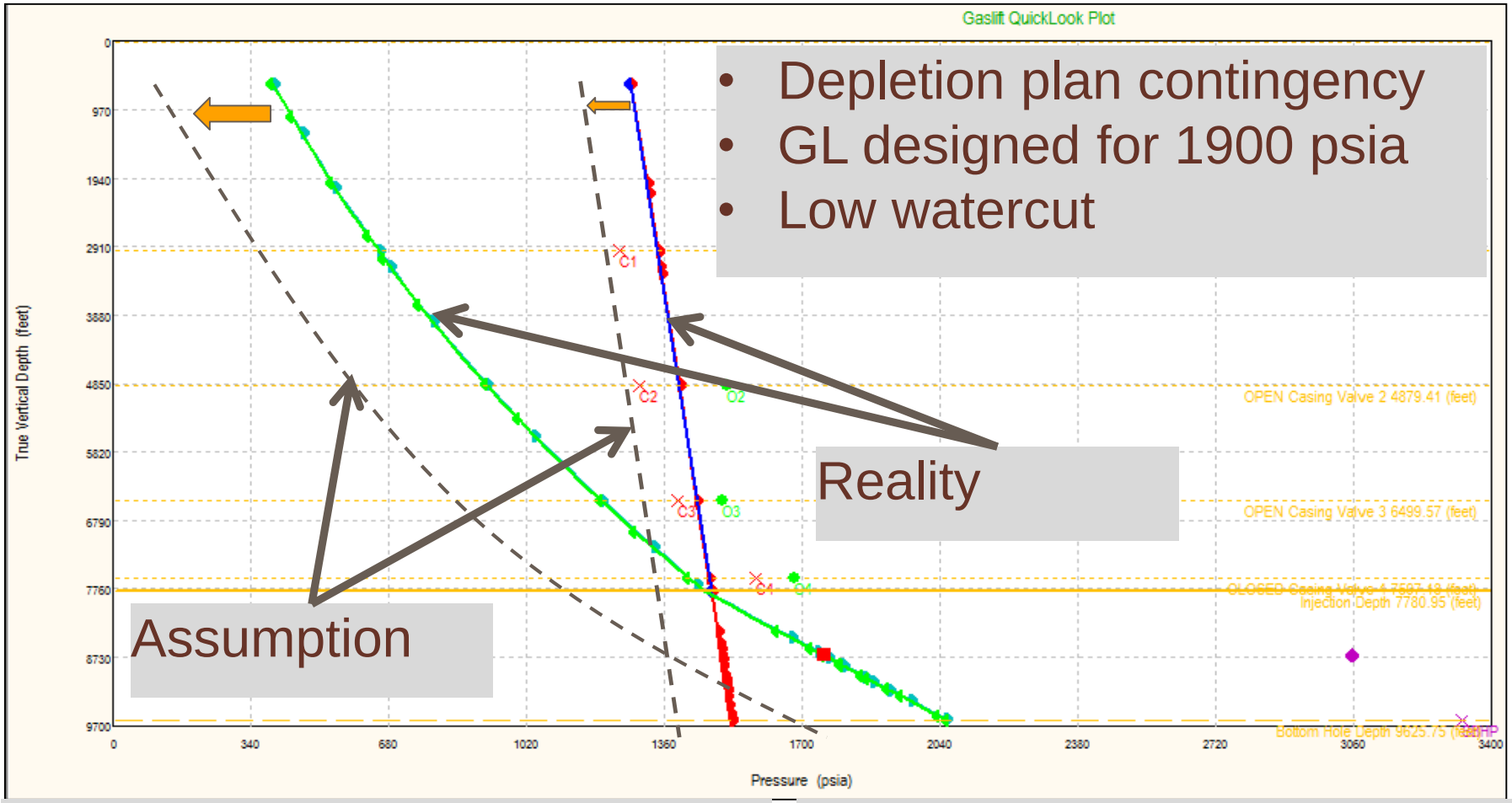
Tern Alpha (Subsea well)

- Well completed and online Mar 2015
- 5.5 x 4.5 inch tubing c/w DHPG
- The initial reservoir pressure 5600 psia
- Subsea field consisted of 2 producers & 1 injector
- **Depletion strategy** was to maintained natural flow above bubble point through waterflood with gas lift as contingency for poor waterflood performance

Gas lift out-with design envelope



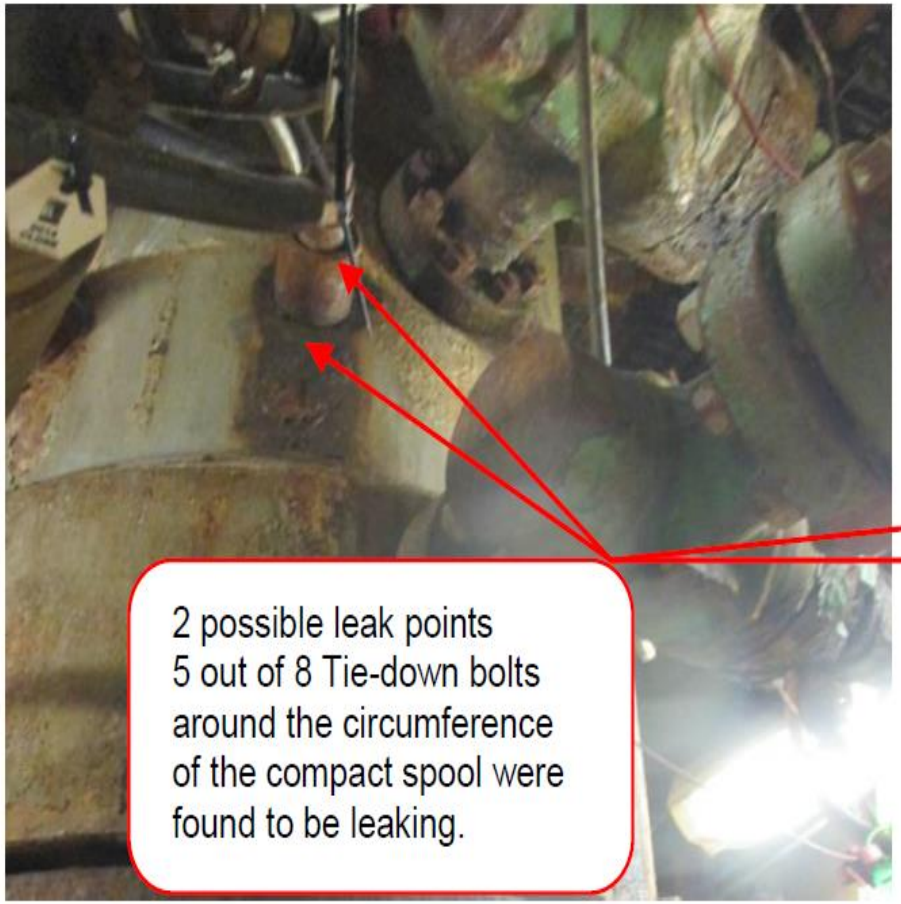
Gas lift out-with design envelope



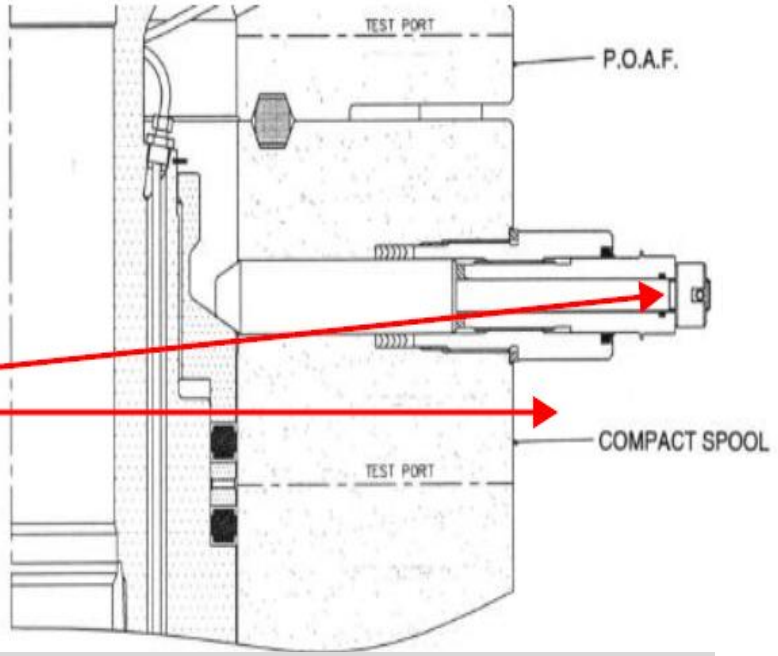
Actual field performance
- High watercut
- Lower pressure support

Orifice injection impossible
Unloading valves failed close
Well remain S/I

Gas lift operations barrier envelope



Leak from WH tie down bolt



10% of SC potential S/I

60% of SC potential at threat

SAFETY

GL–production add & enhancement lever1

Tern Alpha (platform well)

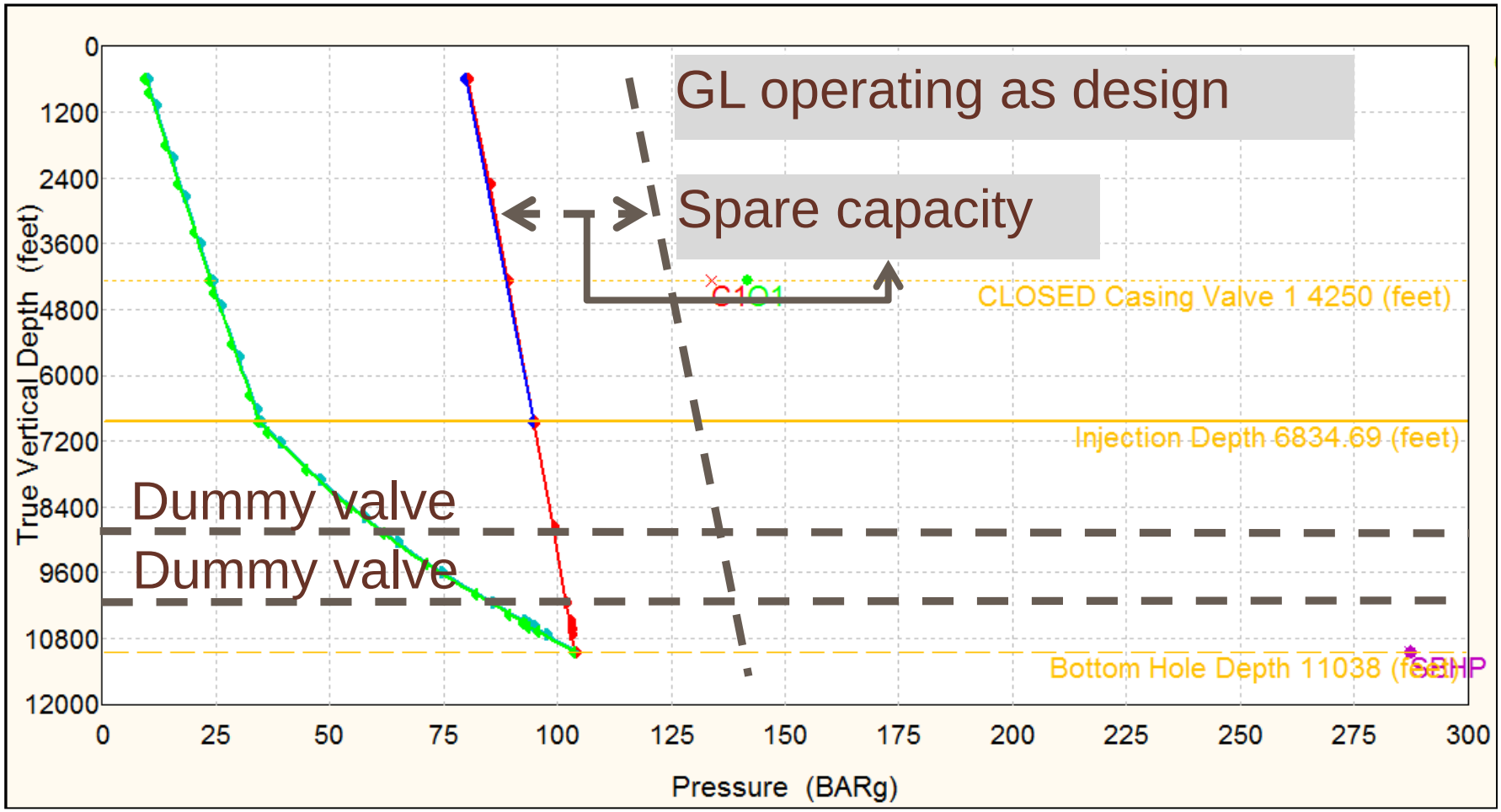
- Well completed and online in May 1997
- Surveillance data (2009 & 2014) confirmed gas lift via 2nd out of 4 valves
- 2nd valve could not be consistently operated (2016) and the well died in mid 2017
- Reservoir pressure was determined - input to gas lift design
- A gas lift orifice shallowing was designed and executed (1 unloading + 1 orifice)

GL–production add & enhancement lever1

- 9% oil production increase via S/I well reinstatement
- 4th valve (orifice) could not be pulled
- Significant embrittlement from valves packings
- Dome pressure lost in one of the valve

Lesson – understanding of reservoir and well performance changes can identify the correct lever for adding production.

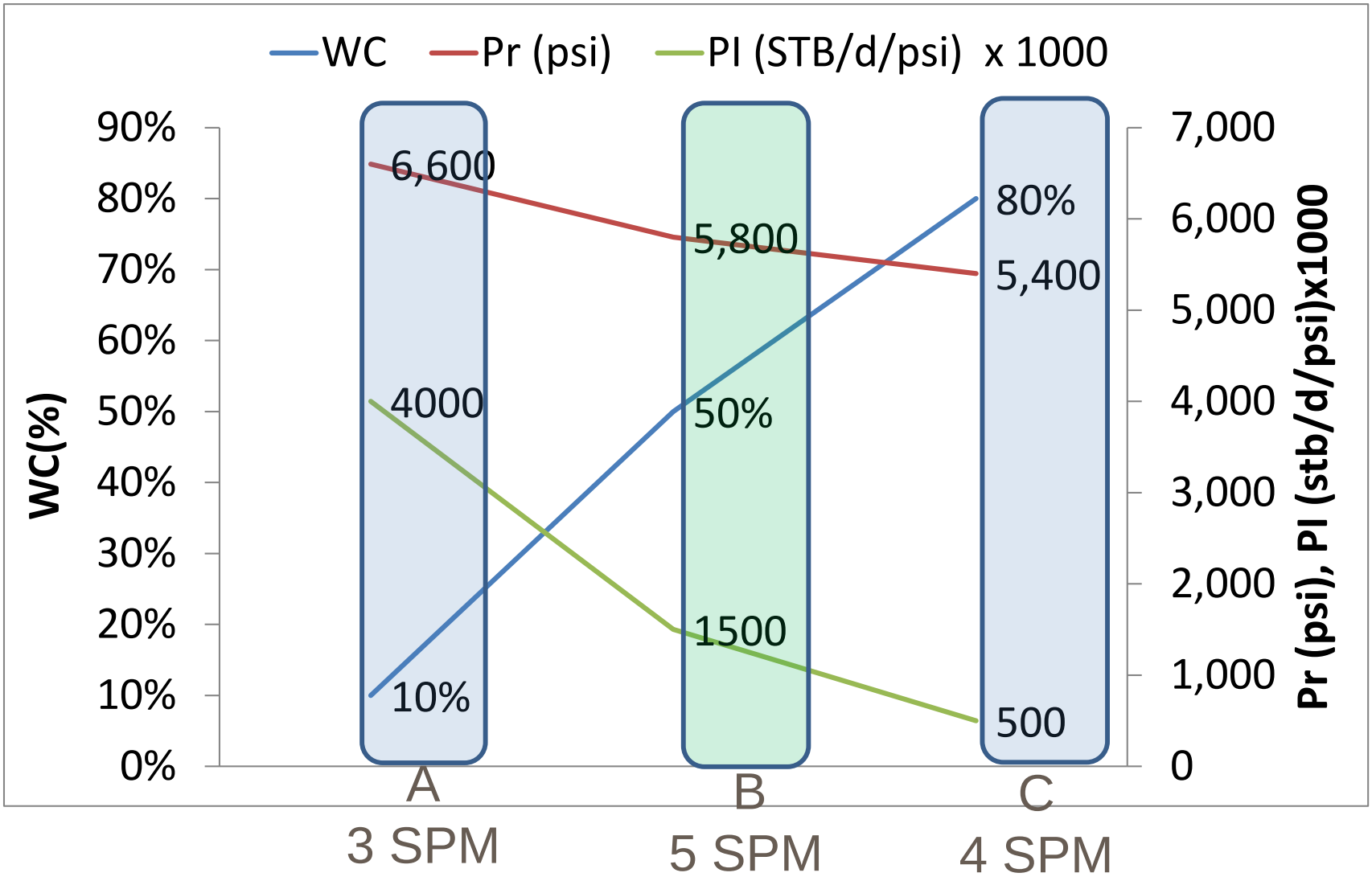
GL–production add & enhancement lever2



Future opportunity to increase production potential

Deepened orifice – 17% well production increase

GL–production add & enhancement lever3



1.5-in barrier valves selected

Summary

- Operating gas lift as per design is important
  - optimising /stable production and maintain well integrity
  - diagnosing valve problems
- It is important to understand performance change vs. depletion strategy assumptions for GL design / operation
- Understanding the WH barrier envelope in older wells is important for safety and well integrity
- Regular review of reservoir and well performance KEY for identifying gas lift production add / enhancement


TAQA