



# Pseudo Dry Gas System

Steady state and transient analysis

September 2019

**Advisian**  
Worley Group

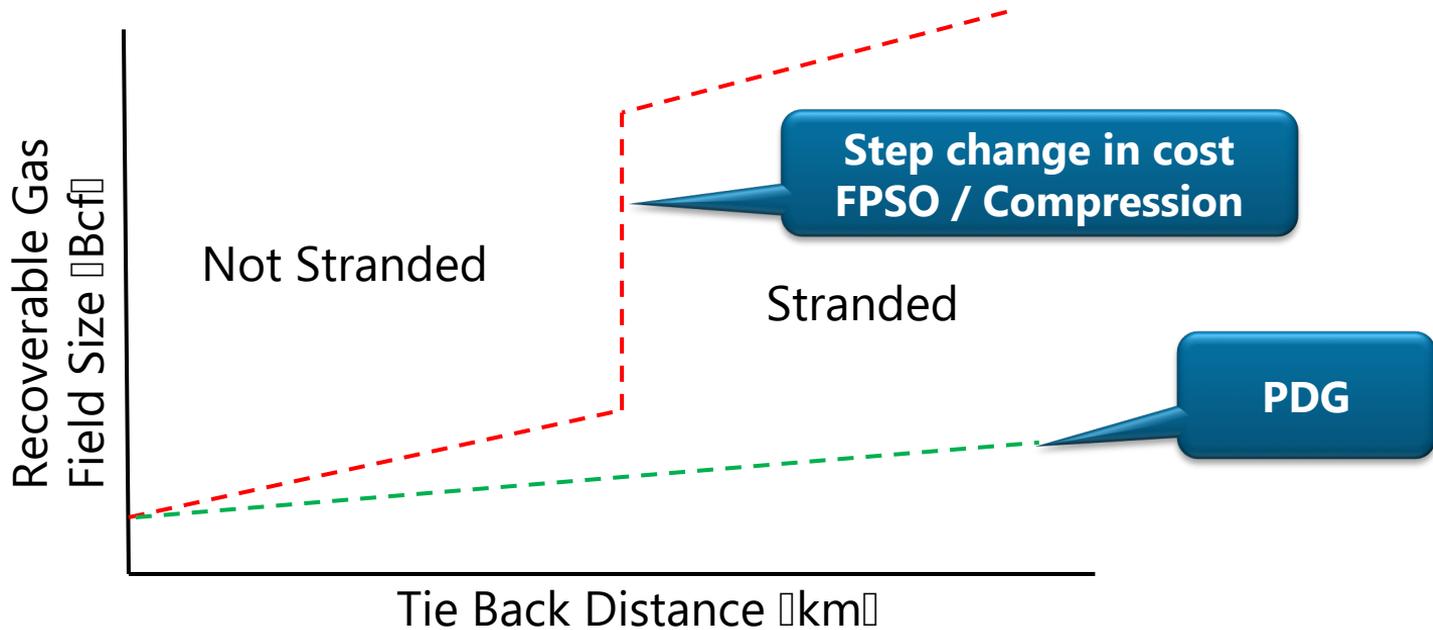
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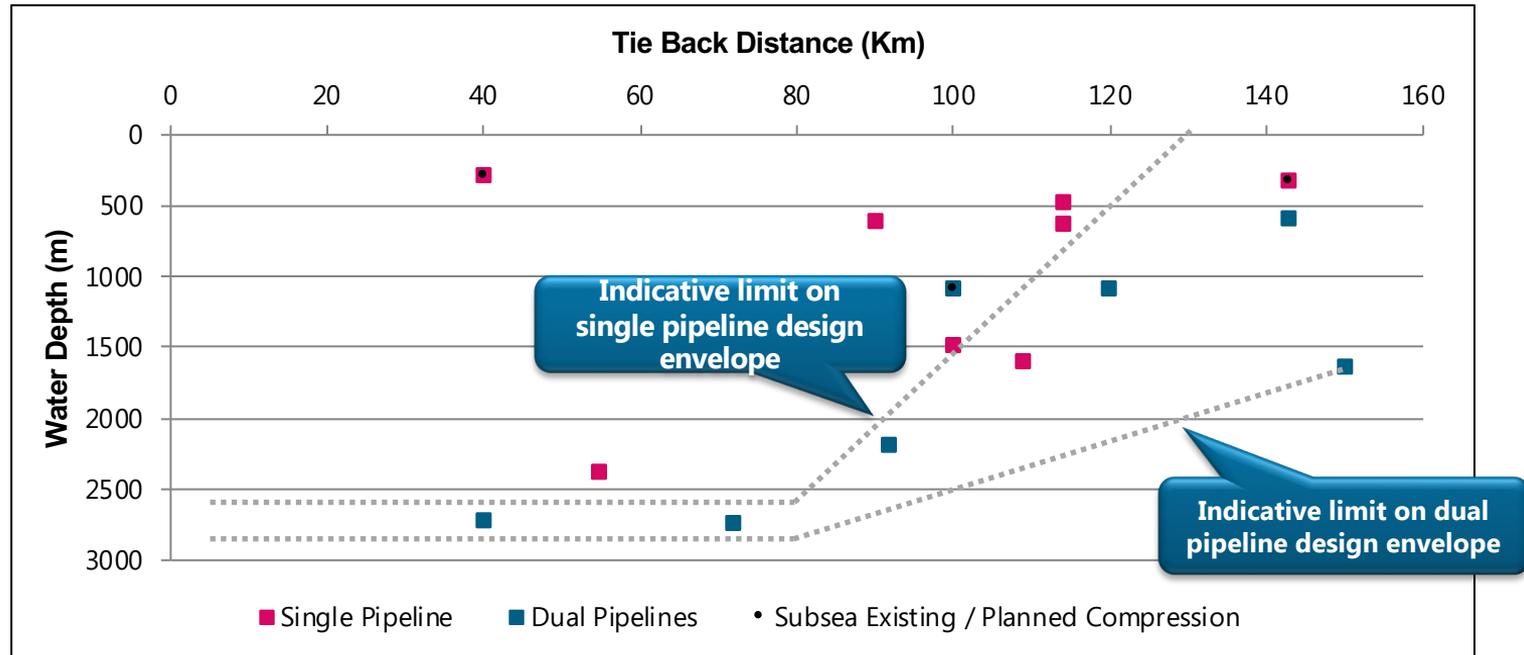
# Stranded Gas – Simplified Overview

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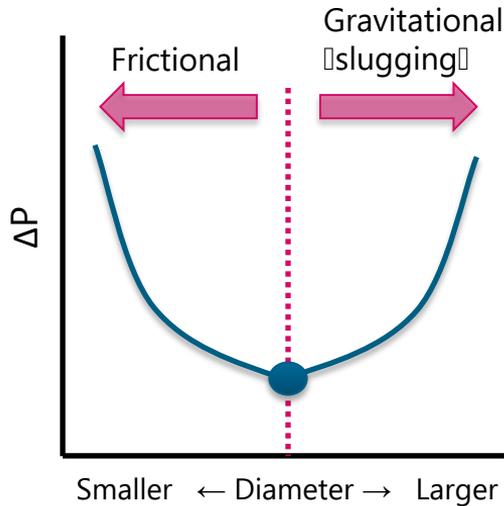
# Objective

- Present an innovative Pseudo Dry Gas (PDG) separation technology to demonstrate that tie backs far in excess of the current threshold distance can be achieved.

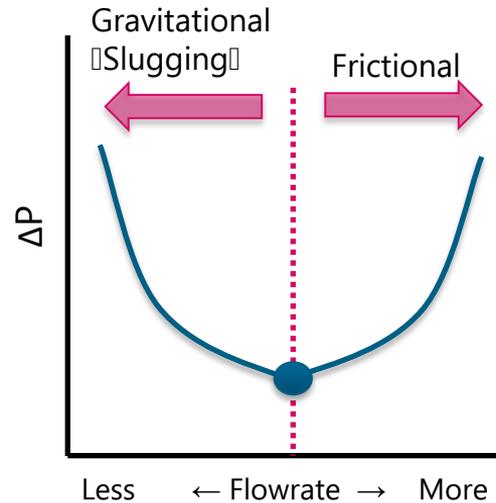


# Underlying Problem

## Fixed Flowrate



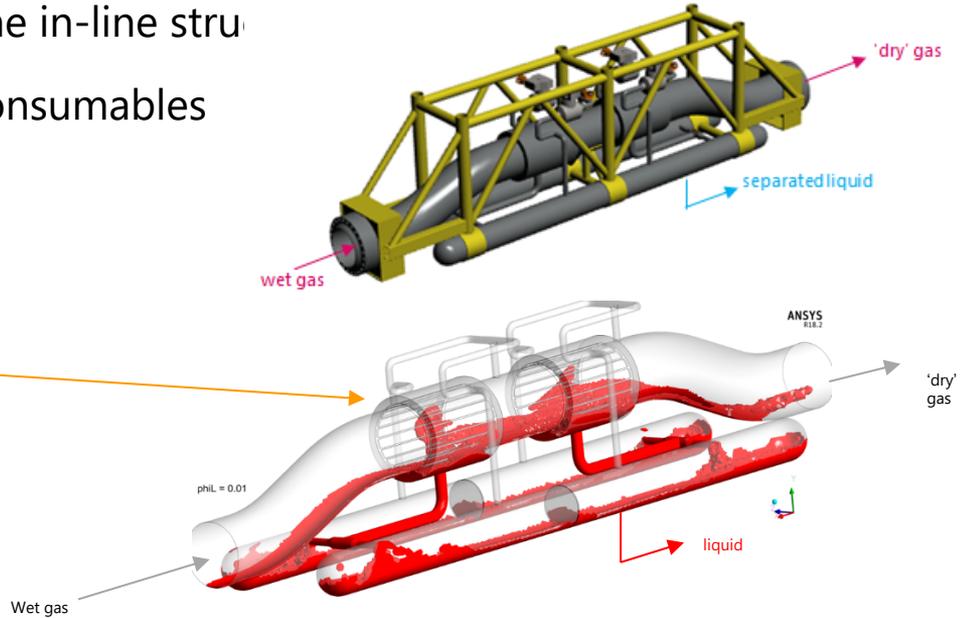
## Fixed Diameter



- Gas pipelines diameter choice is a compromise between lowest well back pressure Vs operability driven by liquids
- More distance = Greater Compromise = Greater Back Pressure = Less Revenue = Lower NPV = **Stranded Gas Reserves**

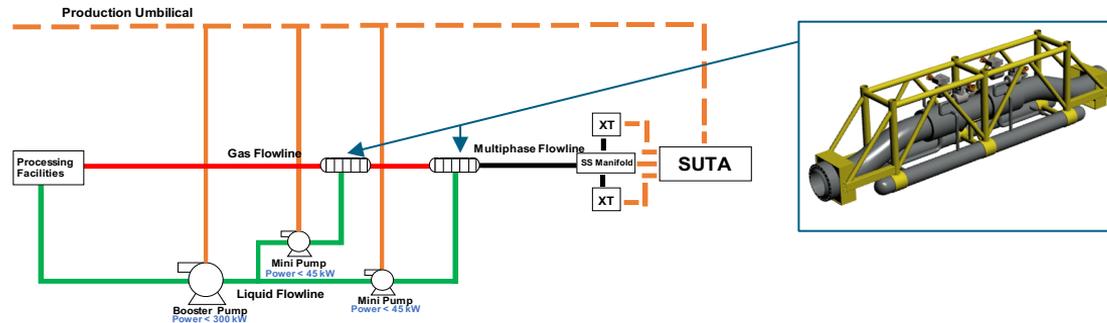
# Concept

- Compact - Installed as a pipeline in-line structure
- Passive - no moving parts or consumables
- Piggable



# Configuration

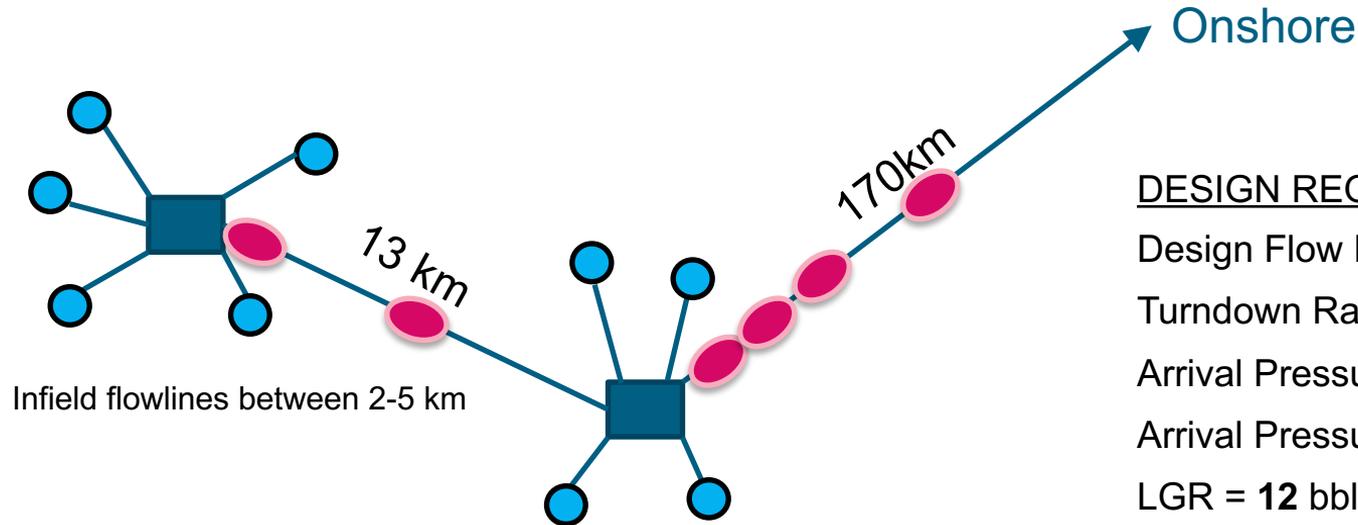
- Multiple PDG units are installed in-line and are piggable. Liquids are removed via small diameter pipe and small single phase centrifugal pumps  $\leq 45$  kW
- Power, telecommunications cables, hydrate inhibitor such as MEG and other service lines are deployed by means of an umbilical.



# Case Study

- Trunkline; 170km long
- WD 0-1800m, no escarpment
- Two manifolds and 9 satellite wells

- 6 PDG units required
- Efficiency linked to fluid conditions
- Last PDG 80km from shore



## DESIGN REQUIREMENTS

Design Flow Rate = **880** MMscfd

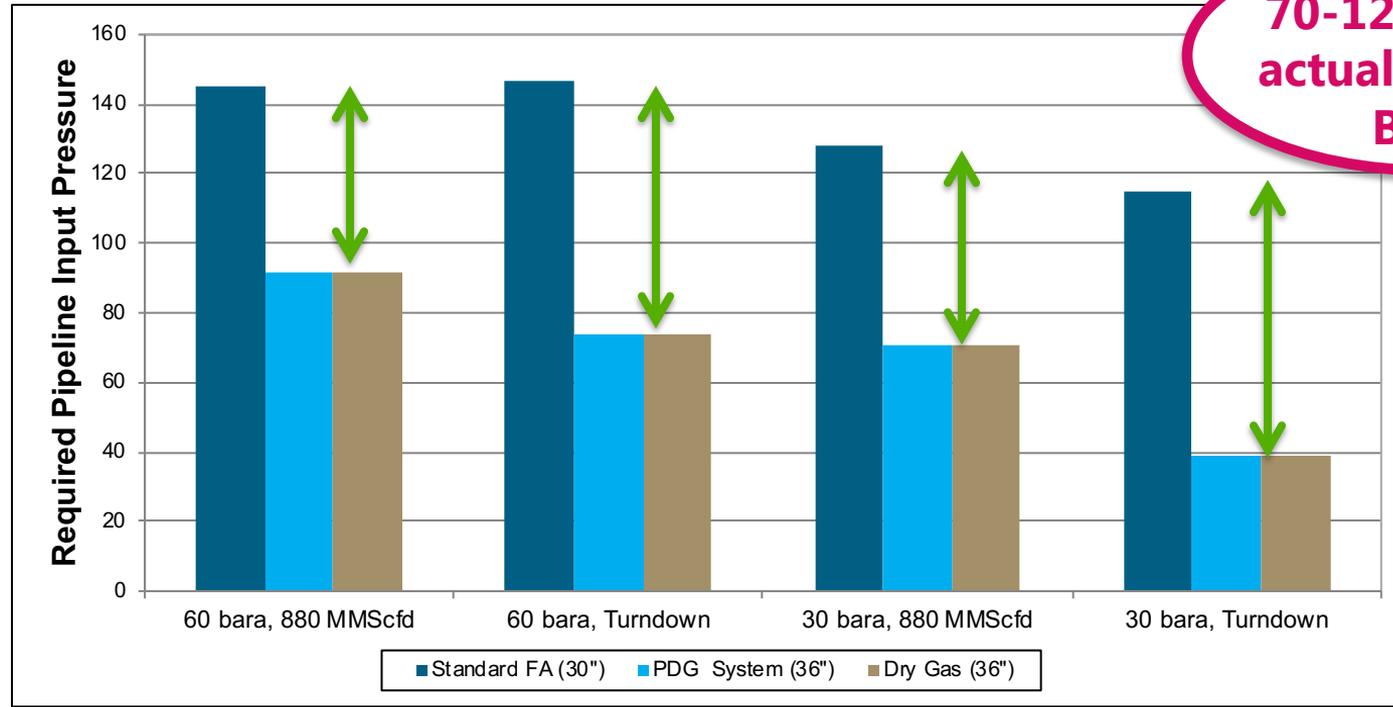
Turndown Rate = **380** MMscfd

Arrival Pressure Early Life = **60** bara

Arrival Pressure Late Life = **30** bara

LGR = **12** bbl/MMscf

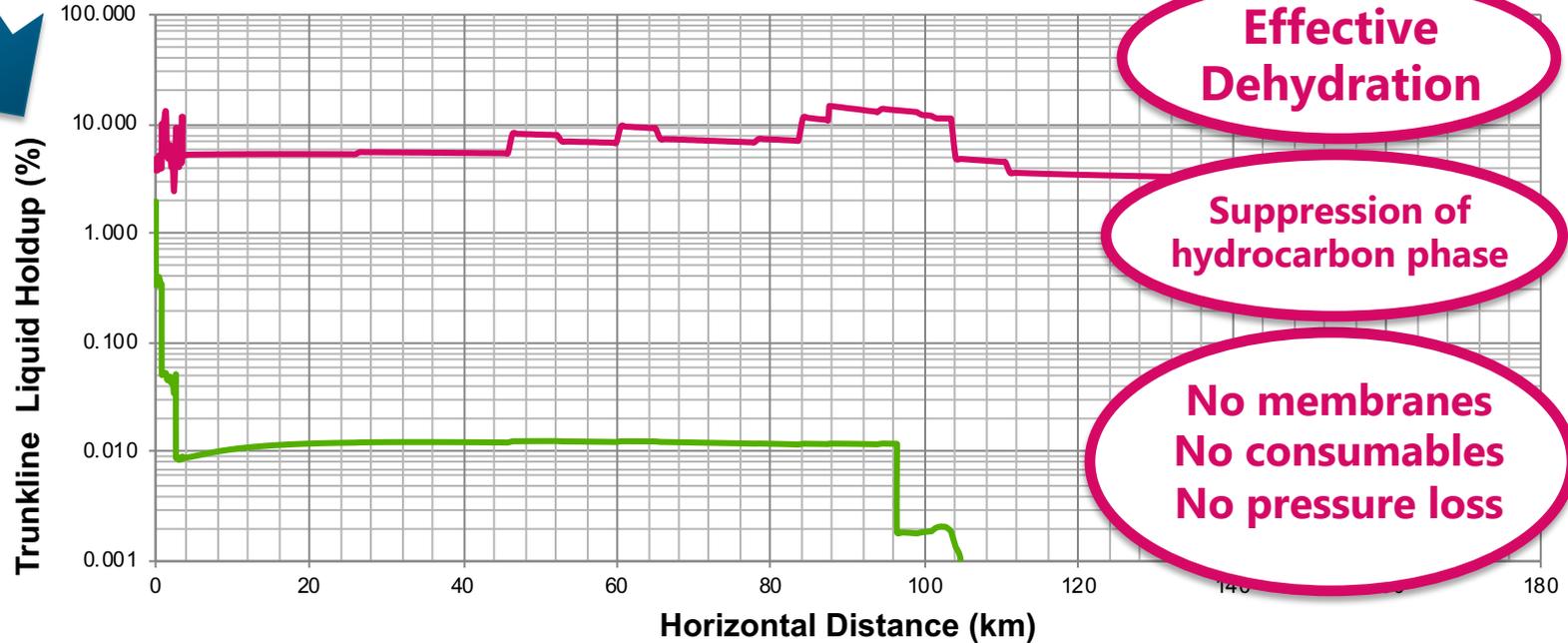
# PDGS Enabled Tie-back Hydraulics



- **55 to 80 bar** reduction in wellhead back pressure across design cases

# PDGS Enabled Tie-back Hydraulics

**% on log scale**



**Effective Dehydration**

**Suppression of hydrocarbon phase**

**No membranes  
No consumables  
No pressure loss**

— Std FA - 880MMscfd - 30in TL

— PDGS - 880MMScfd - 36in TL

# PDGS Gas Condensate Behaviour

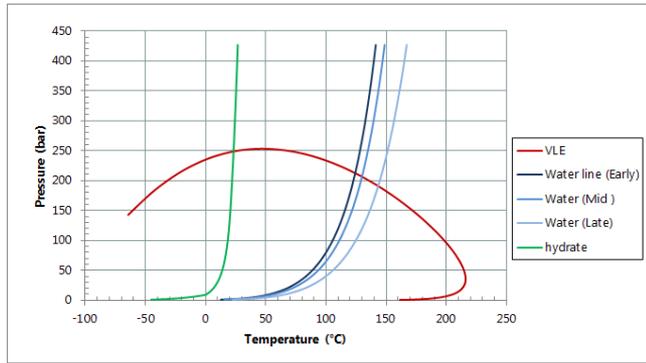


Figure – Typical phase envelope

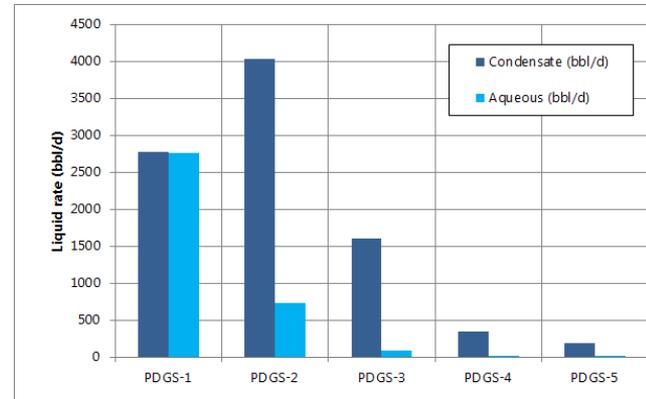


Figure – Typical Liquid drop out behaviour

- Analogues of subsea gas systems have shown that the condensates continue to drop out of the gas after it reaches ambient temperatures due to pressure loss
- The drop out slows down / stops once the ambient temperature increases due to pipeline moving into shallower waters

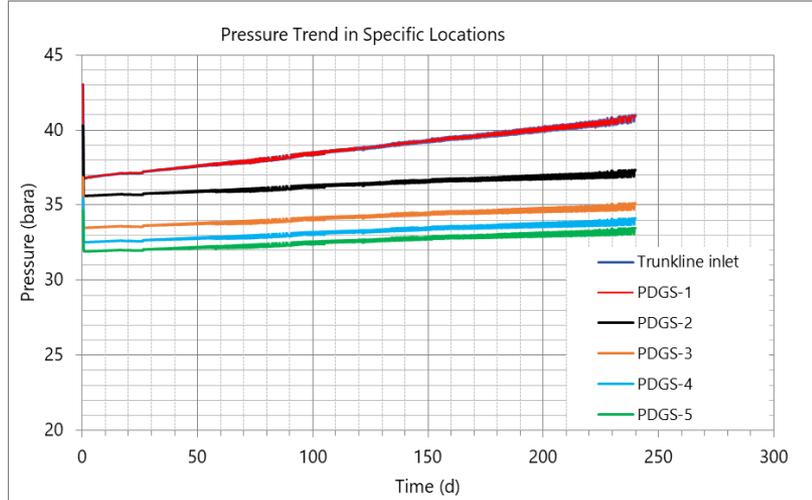
# Operational Performance

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OLGA 2017 – HD module

- Dynamic Steady State
- Turndown
- Ramp-up
- Shutdown
- Restart

# Turndown



Lower Minimum Stable Flow

Wet Gas Pipeline Minimum Stable Flow – 380 MMscfd

Flow Rate [MMscfd]	Wet Gas Total Liquid Content [m <sup>3</sup> ]	PDG Total Liquid Content [m <sup>3</sup> ]
880	2053	264
250	10857	258
100	42579	5183*

\* after 8 months operation

# Shutdown

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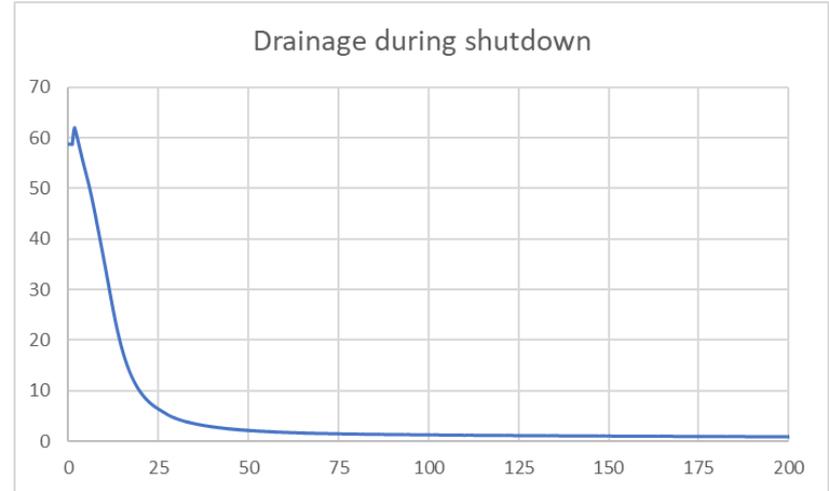
Liquid drains back to the separators

Liquid pumped back to shore

Extreme shutdown  $\sim 5000\text{m}^3$  can be drained

But time dependent:

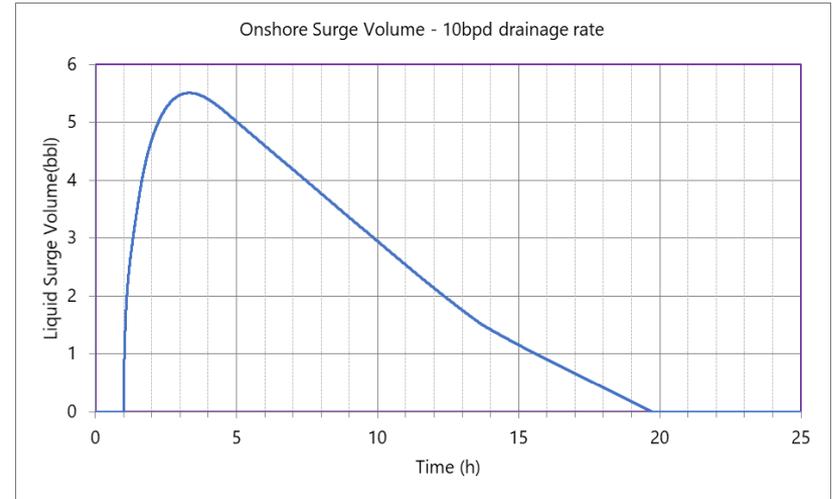
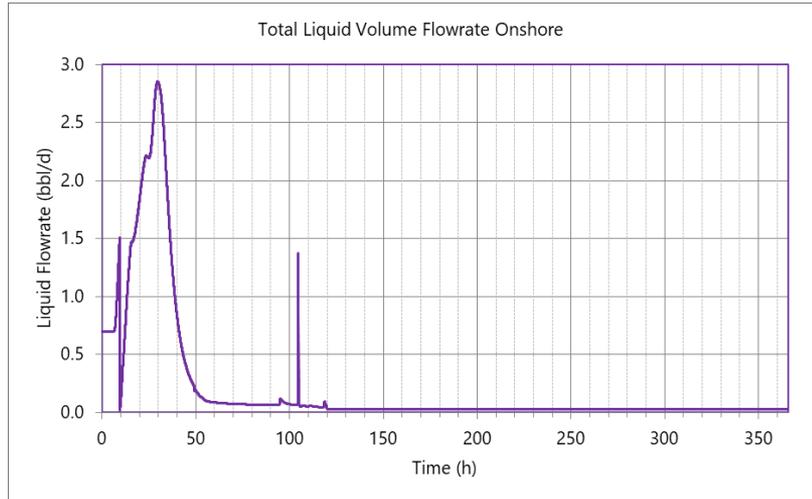
- Pump size
- Liquid drainage to separator
- Gas sweeping to speed up drainage



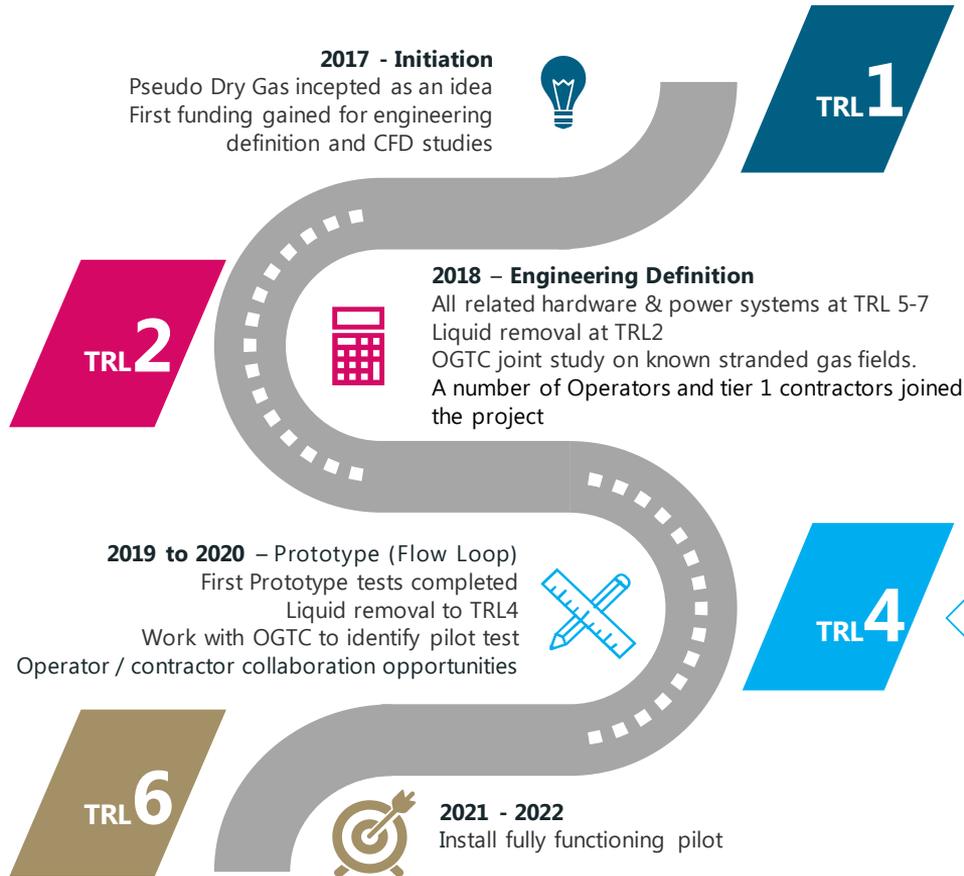
# Ramp-Up & Restart

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Low liquid arrival rates onshore – no slug catcher needed

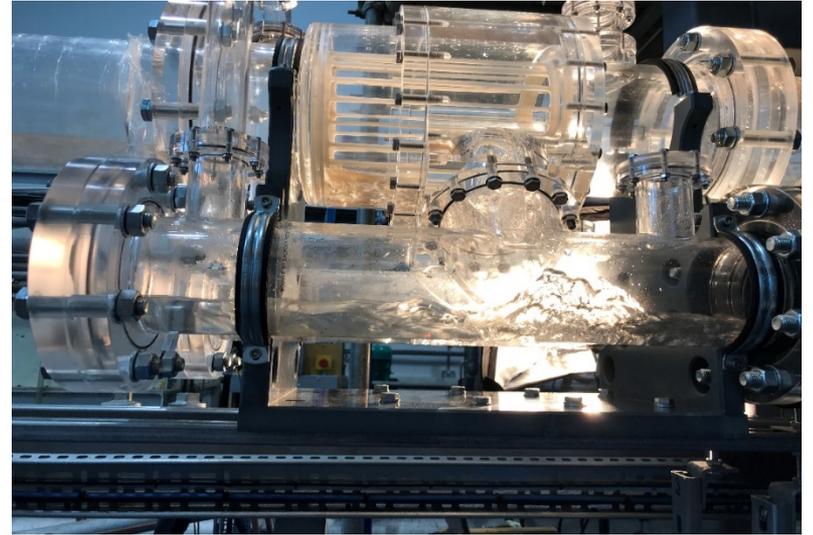
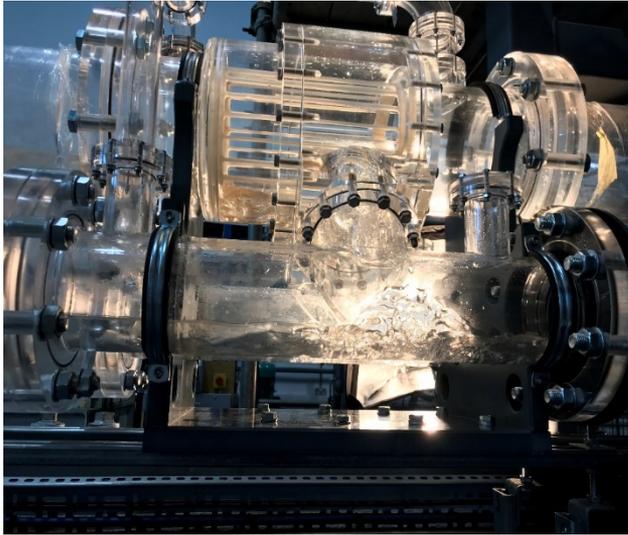


# Development Plan



## 2018 / 19

- Kicked off a techno-economic study for the Oil and Gas Technology Centre (OGTC) to assess the potential benefits of the PDG technology; within their portfolio of subsea initiatives (marginal, long distance, deep water)
- Testing of a prototype in lab conditions (Cranfield University (UK))
- **Open to work with other Operators/ Organisations**
  - Proof of concept studies
  - Invitations to participate in peer reviews



# Questions

**Advisian**  
Worley Group

**IntecSea**  
Worley Group

[lee.thomas@intecsea.com](mailto:lee.thomas@intecsea.com)  
[terry.wood@intecsea.com](mailto:terry.wood@intecsea.com)

**OGIC**  
Oil & Gas Innovation Centre

  
University of  
**Strathclyde**

  
**The  
Oil & Gas  
Technology  
Centre**  
Your Innovation Partner

  
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