



Sustainable Sand Management Control and Solutions - Balancing Performance, Costs, and Environment

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Facilities Sand Impact Assessment: Using Published Correlations for Sand Transport to Identify Focus Areas

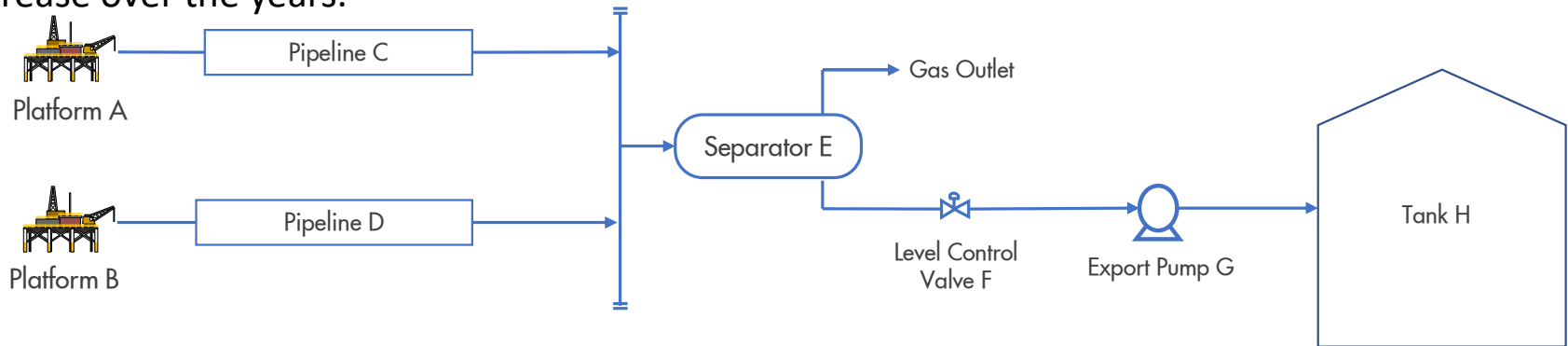
Muizz Rabaha

Brunei Shell Petroleum Co. Sdn. Bhd.



Introduction

- BSP Topsides largely not designed to monitor or handle sand or fines.
- Two offshore assets, One onshore asset: ~8XX well strings. Risk of sand production likely to increase over the years.



	Well	Pipeline	Separator	Valve	Pump	Tank
Monitoring	<ul style="list-style-type: none"> • No real time monitoring • Sand sampling ineffective 	<ul style="list-style-type: none"> • Report debris during pigging 	<ul style="list-style-type: none"> • Report debris during cleaning 		<ul style="list-style-type: none"> • Pressure drop across strainer • Operating Envelope 	
Management	<ul style="list-style-type: none"> • Reactive on leaks 	<ul style="list-style-type: none"> • Pigging 	<ul style="list-style-type: none"> • Vessel Cleaning (offline) 	<ul style="list-style-type: none"> • Reactive replacement 		<ul style="list-style-type: none"> • Tank Cleaning (offline)



Overall Improvement Strategy

- Sand Management is key for improving WRFM Performance and Reliability.
 - Sand Management Improvement Strategy released early 2024:
 - Short-term actions will be OPEX-heavy
 - Long-term actions consider CAPEX investments to...
 - Manage future OPEX and reliability goals, considering the approach towards late-life production.
 - Move from excluding sand from surface, to including and managing sand at surface.
 - Prediction on both wells (sand production) and topsides (sand transport) to help identify high-risk areas and guide prioritisation of efforts.
 - Monitoring / surveillance across the system to collect data and trigger actions to prevent escalation.
 - Manage maintenance activities, especially when sand is allowed to be produced.

Facilities Impact Assessment

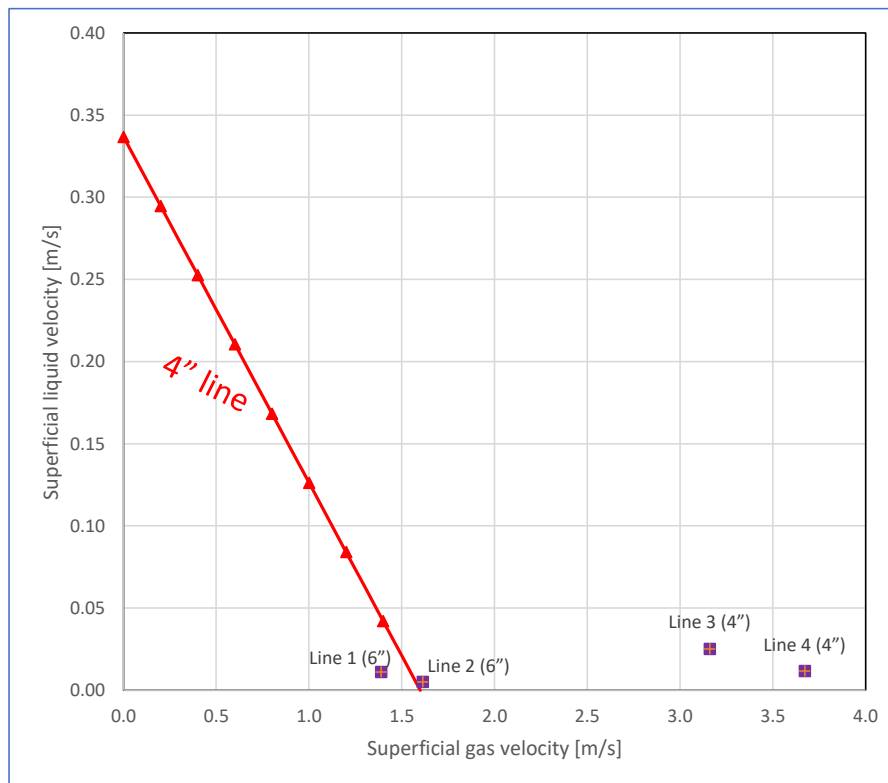
	Well	Pipeline	Separator	Valve	Pump	Tank
Data	<ul style="list-style-type: none"> Sand risk assessments Sand samples Flowline Inspection 	<ul style="list-style-type: none"> Debris collected during pigging activities 	<ul style="list-style-type: none"> Solids collected during vessel cleaning activities 	<ul style="list-style-type: none"> Analyse performance of control valve against design Frequency of equipment failure 	<ul style="list-style-type: none"> Analyse performance of pump against design Frequency of equipment failure 	<ul style="list-style-type: none"> Solids collected during vessel cleaning activities
Prediction	<ul style="list-style-type: none"> Likelihood of sand production Erosion assessment 	<ul style="list-style-type: none"> Likelihood of sand deposition 	<ul style="list-style-type: none"> Cut-off size of particle deposition (Stoke's law) 	<ul style="list-style-type: none"> Predict when a valve will be plugged or eroded beyond a limit 	<ul style="list-style-type: none"> Predict when a pump requires to be replaced 	
Monitoring	<ul style="list-style-type: none"> Prevent vs limit? Real-time vs frequency? 		<ul style="list-style-type: none"> Manage limit Trigger vessel cleaning 	<ul style="list-style-type: none"> Proactive replacement 	<ul style="list-style-type: none"> Proactive replacement 	<ul style="list-style-type: none"> Manage limit Trigger vessel cleaning
Prevention	<ul style="list-style-type: none"> Value: unlock Locked-In potential, Maintain Reliability (no gains) and Manage Performance (no gains) Cost: OPEX vs CAPEX 					
Correction	<ul style="list-style-type: none"> Timeline: When will OPEX be too much to handle sand? 					



Sand Transport Prediction in Pipelines

- Stevenson & Thorpe 1999:
 - Predict critical velocity in intermittent (slug) multiphase flow regime
 - $$j_f = 0.34\sqrt{gD} - \frac{j_g}{4.75}$$
 - j_f = superficial fluid velocity (m/s)
 - j_g = superficial gas velocity (m/s)
 - g = acceleration due to gravity (m/s²)
 - D = pipe diameter (m)
 - Correlation is independent of particle size and liquid viscosity

Stevenson & Thorpe 1999



- Validate Correlation with Pigging:
 - Lines 3 & 4: expect no debris during pigging
 - Lines 1 & 2: expect debris, pigging should be designed accordingly
- Use the prediction to:
 - Design pigging program
 - Use to shortlist piping that has potential for erosion due to sand



Potential Scale-up

- Digitalisation & Visualisation
 - Integrate with real-time field data to estimate build-up inside pipeline.
 - Integrate with piping inspection data as a means to “monitor” for sand where direct sand monitoring is poor.
 - Visualise the hotspots, together with the value the lines carry.
 - Anticipate which equipment will be affected due to changes in sand production, pre-empt actions to manage performance and reliability.
 - Focus OPEX on safety- & production-critical lines, as well as lines with high production value.
 - Anticipate OPEX demand vs CAPEX investment (lifecycle sand management assessment)



END

Thank You