# PCSB: Surface Sand Management Campaign

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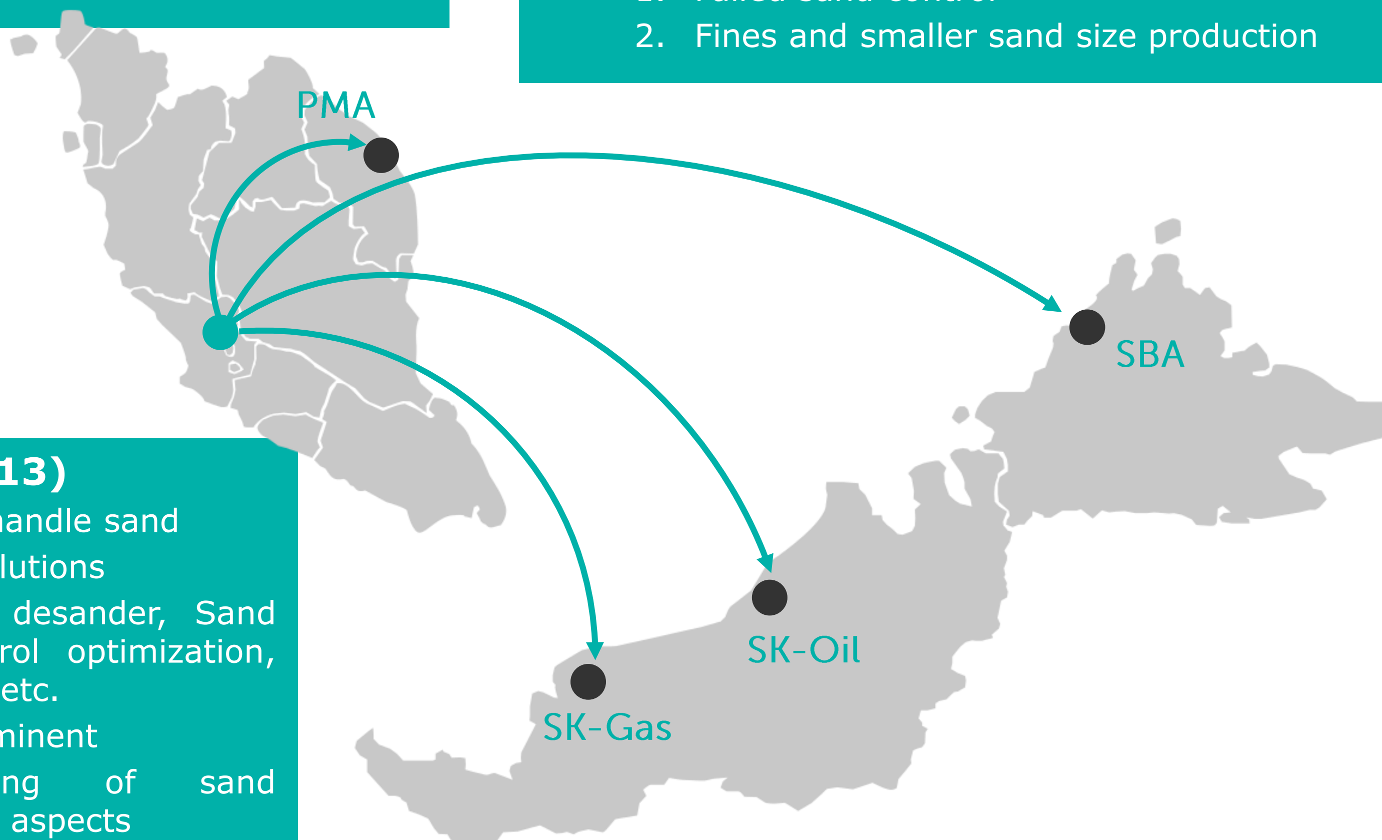
# BACKGROUND

1. PCSB structure is divided into 4 major assets
2. Fields > 30 years with few ~10 years old
3. With aquifer support not in all fields and depleted reservoirs, issues encountered from early 2000:
    1. Sand Production
    2. High Water Cut

1. Until 2010, down hole sand control – only means of sand management
2. OHSAS and OHGP > 80% of sand control completions
3. Post 2010, sand production observed at surface
    1. Failed sand control
    2. Fines and smaller sand size production




**Challenges (2010-2013)**

1. Facilities not ready to handle sand
2. Ad-hoc and reactive solutions
3. Isolated initiatives – desander, Sand prediction, sand control optimization, remedial sand control, etc.
4. Leaks due to sand prominent
5. Limited understanding of sand management tools and aspects

# OVERVIEW OF SURFACE SAND MANAGEMENT SCOPE

01

## Offshore Site Survey

- To identify the requirement before job execution
- To gather all sand management related data at the platform
- To identify gaps and come out with sand management matrix

02

## Acoustic Sand Monitoring System

- To provide readings by measure the noise generated by collisions of sand particle on the pipe wall which indicate sand quantity.
- To perform 48 hours continuous monitoring for each string/locations
- To gather all related data and samples during online monitoring

03

## UT Wall Thickness Measurement

- To perform and analyze the wall thickness measurement to the entire area of targeted section/bend by providing 3D imaging of the wall loss thickness

04

## Onshore Data Collection, Interpretation & Report

- To gather all sand management related data in regional office that consist of multi-disciplines
- To analyze sand related data and come up with gaps in sand management matrix

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# SURFACE SAND MANAGEMENT - 2018

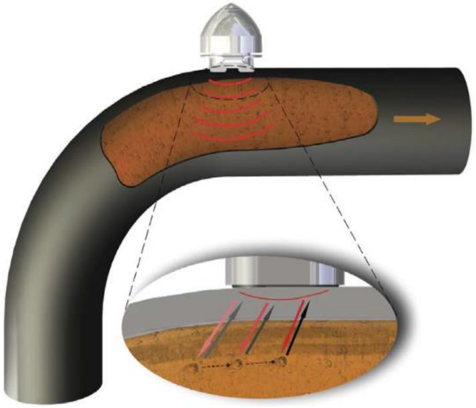
## Sarawak Field A

Acoustic (non-intrusive) Monitoring:

- Establish a base line of wells sand production, especially for ones without sand sampling point
- Confirm the absence of sand production from wells equipped with CSS
- Verify the absence of sand production after bean up for several key wells

3-D UT Measurement:

- Establish the loss of wall thickness on critical parts of the piping to adapt current UT point reading surveys



-Acoustic sensor measured energy hitting the pipe (depends to velocity and mass)

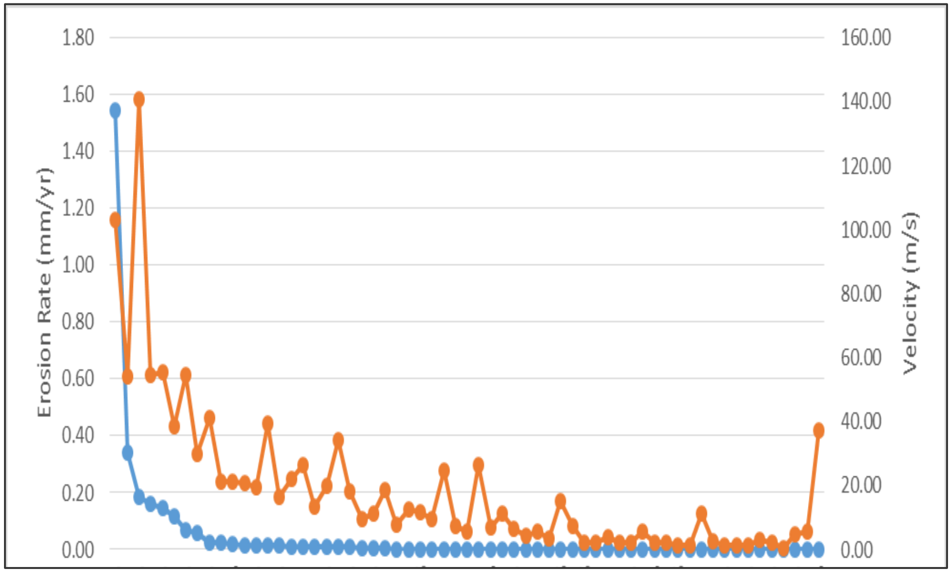
-Provides a qualitative measurement that requires interpretation with other data (FTHP, sand count, etc.)

-Quantitative correlation is possible but difficult to maintain (many variables)

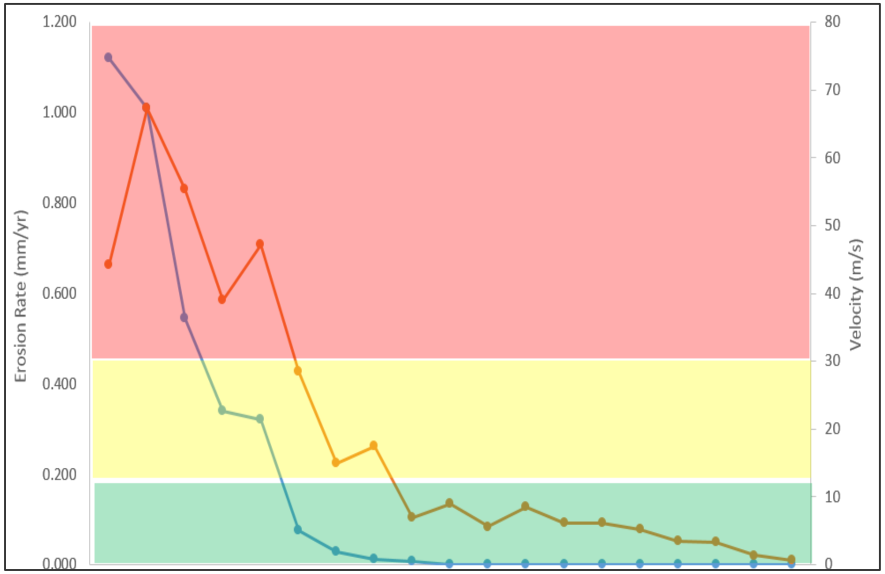
-Clamp-on sensors can be easily relocated, and require low maintenance

# WELL RANKING/CANDIDATE SELECTION

- Initial study was conducted prior to the campaign to understand the wells limit and risk based on current production data.
- Erosion risk for each well and flowline was identified using in-house erosion tool, SET




Well ranking based on erosion rate




Flowline ranking based on erosion rate

- Further well ranking (priority) was established for the acoustic monitoring based on:
  1. Oil rate
  2. Potential bean up gain
  3. CSS wells and downhole sand control wells
  4. Surface readiness – availability of wells transmitters (FTHP and FTHT)

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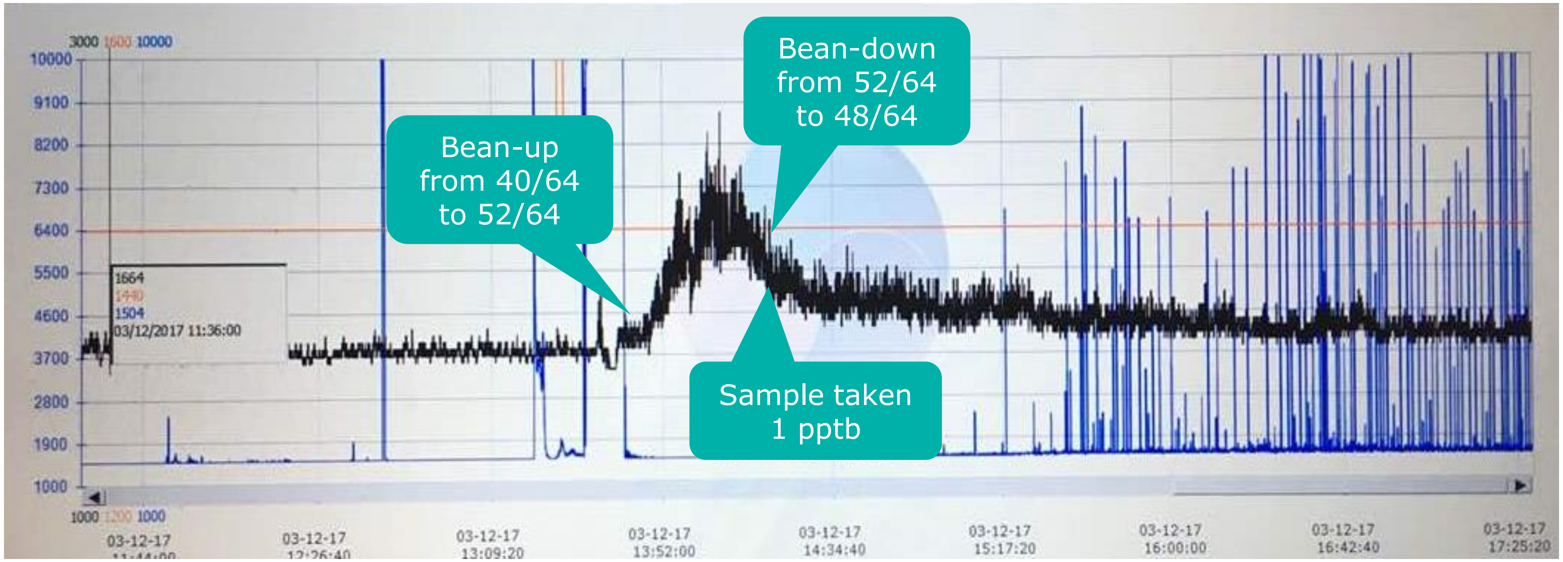
# BEAN UP MANAGEMENT

- Few wells were identified for bean-up to unlock the potential, however it has to be done in a safe production to ensure no LOPC occur.

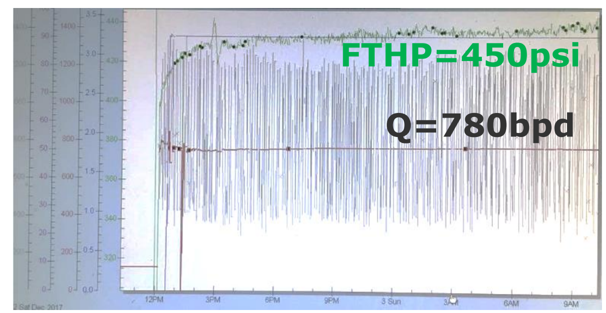
- The decision to maintain or bean-up well will be based on:
  1. Current choke size vs. target choke size (based on maximum historical choke size)
  2. Presence of sand control (or remedial sand control)
  3. Fluid velocity at current choke size
  4. History of LOPC
  5. Clamp on reading giving confidence that sand is measurable (e.g. no high noise due to high gas velocity)
  6. Constant dP across the choke during the WT (i.e. choke not eroding)

# CAMPAIGN: UNLOCKING PRODUCTION

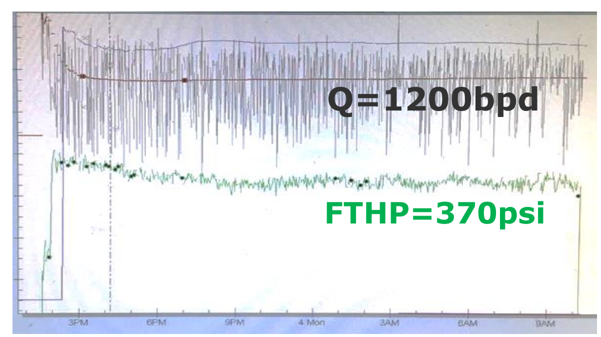



**WELL A**

- Sensor was installed for 4 days continuously at T-Bend location (90 degrees bend was not available)
- Original choke size was 40/64, commenced bean-up to 52/64. Raw signal amplitude increased, bean-down choke size to 48/64.
- At 48/64 choke size, well was stable with no high spike. The raw signal increase from original reading interpreted as an increase in flow noise.

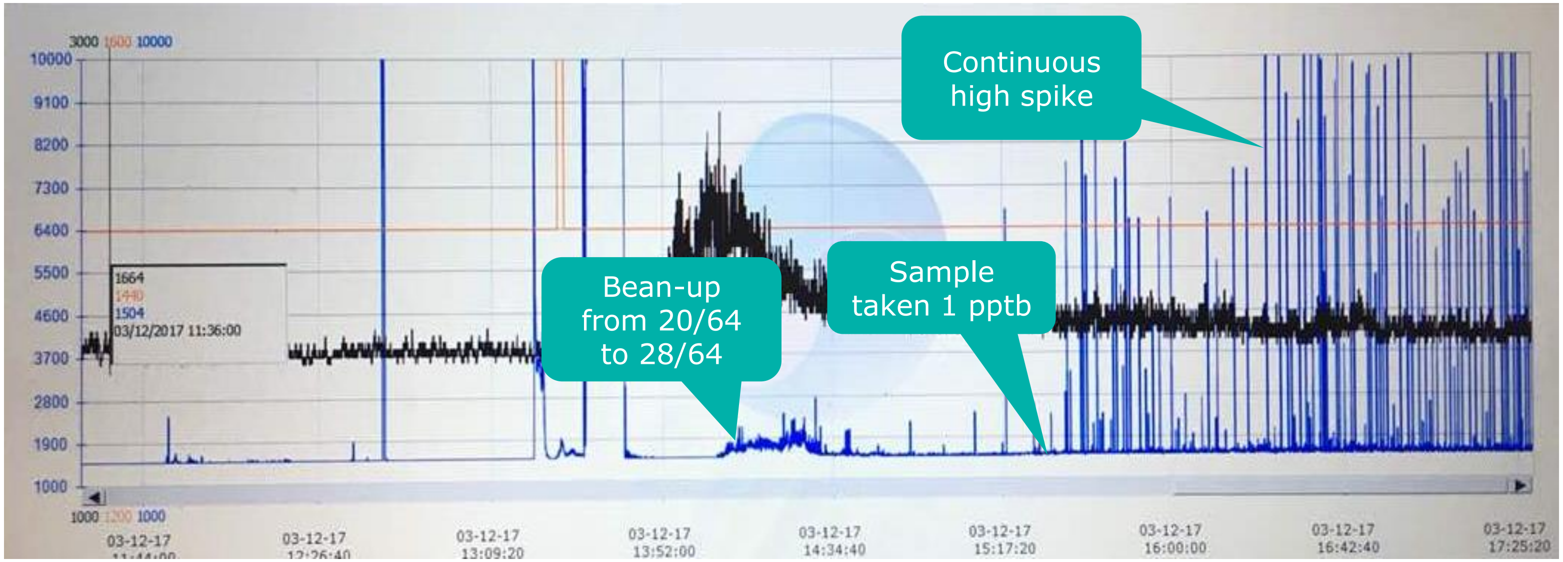



Well A: Well test pre-bean up




Well A: Well test post-bean up

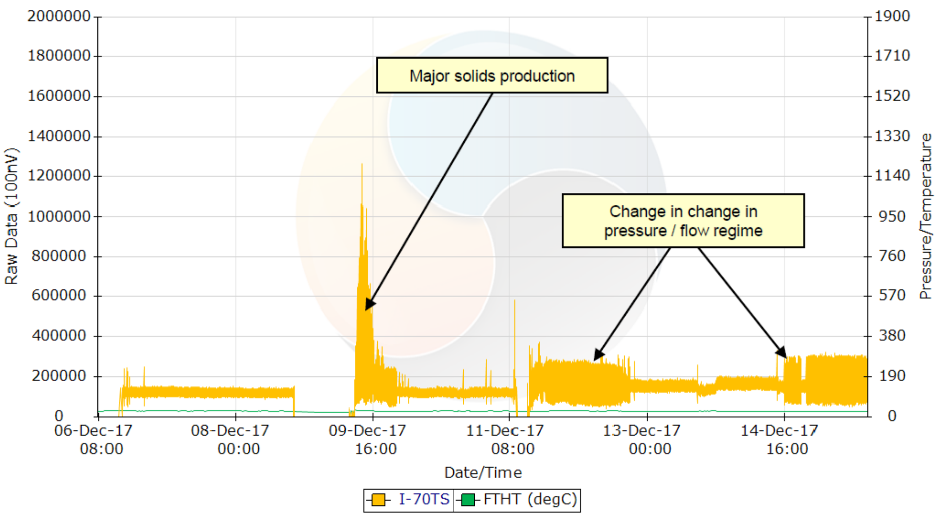
# CAMPAIGN: ESTABLISHING PRODUCTION

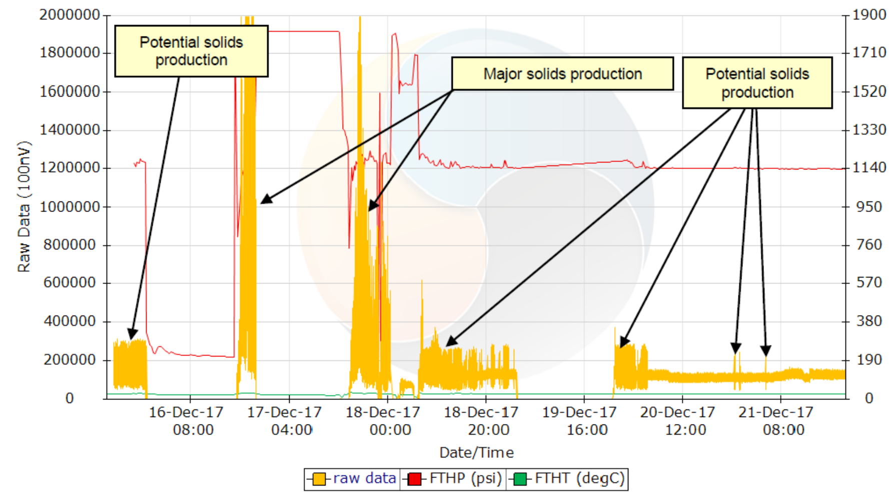


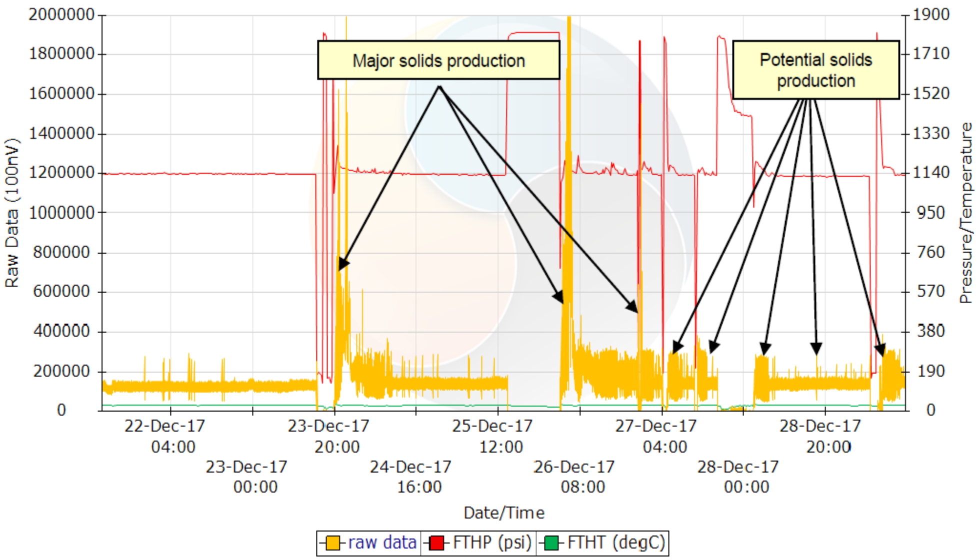

**WELL B**

- Sensor was installed for 5 days continuously at T-Bend location (90 degrees bend was not available)
- Original choke size was 20/64, commenced bean-up to 28/64. Raw signal amplitude increased, suspected increase in gas flow rate
- Intermittent and regular spikes were recorded at 28/64 choke size, team decided to bean back to original 20/64 choke size. Suspected solid production on surface and increase gas production may cause high erosion.

# CAMPAIGN: AVOIDING LOPC




## WELL C

- Sensor was installed for 3 months
- The raw signal show major sand production and slugging.
- FTHP: stable
- Fluid sampling always show no sand production
- Well C has history of sand production and CSS was installed
- Mitigation: bean-down, revise opening procedure, trigger choke inspection and frequent RT survey

# VALUE CREATION

- **Unlock production potential**: demonstrated absence of sand production after bean-up (Well A ~300 bopd) and onset of sand production in Well B at higher choke
- **Avoid LOPC** by providing continuous measurement to detect sand production during transient events: Well C
- **Improve operational limits** for each well by enabling trending during well test

# REPLICATION

- 4 fields in PM region and 1 in SK Gas undergoing a similar campaign
- The campaigns have become our initial step of understanding the sand, behavior and health check of the system

# FUTURE IMPROVEMENT

- Installation of permanent acoustic sensors especially on the critical and high potential wells:
  - Avoid LOPC
  - Determine safe operating envelope

- Tie the acoustic sensors into the IO system for continuous data monitoring for better response and mitigation plan

- Update and tie the analysis into in-house tool, SET for better erosion evaluation.

- Regular RT survey to inspect flowline condition and choke inspection

# Thank you