Artificial Lift R&D Council

TAC's have been limiting production for too long

- *it's time for change!*

Jeff Saponja — Oilify

Furqan Chaudhry — Ovintiv

Corbin Coyes — Q2 Artificial Lift Services

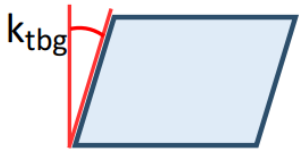
2023 International Sucker Rod Pumping Workshop
Aug 28-31, 2023. Midland TX

Anchoring Prevents Tubing Movement

1. **Controls casing / tubing wear**
2. **Controls tubing / rod wear**
3. **Controls damaging vibration**
4. **Maximizes pumping efficiency**

Interpreting Pump Card Shapes:

Ideal Card: fully anchored tbg, 100% liquid fillage, & pump in good condition.



Slanted: Unanchored tbg indicated by the card being slanted at the k_{tbg} (Tubing Spring Constant).

REFERENCE
www.downholediagnostic.com/_files/ugd/f8ee70_d4ba77a8b77e40d898037b28bebad23e.pdf

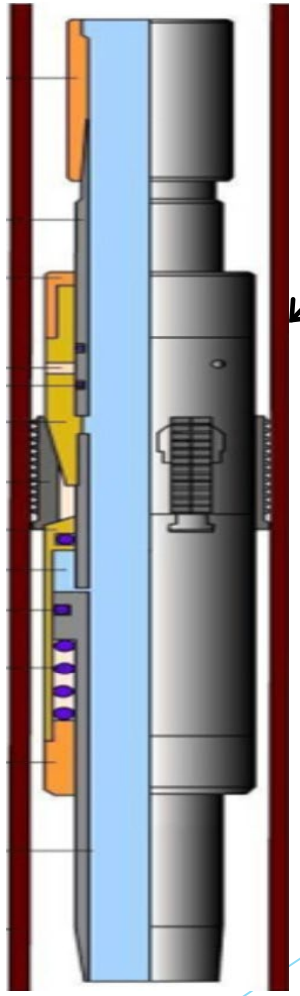
Why does a well need a CATCHER?

- **Reduce Operational Risk** – prevent tubing/BHA from falling down the well in the event tubing parts in half (from corrosion or erosion)
- Others ??
- Surveying multiple operators concluded tubing parts with L-80 tubing are a low likelihood; suggesting Catcher feature not required

Tubing Anchors can Limit Production

Any reduction in annular flowby cross-sectional area (relative to the tubing coupling OD) will:

- "choke the flow"
- increased pump intake pressure (PIP)
- create flow instabilities (excessive slugging) and erratic pump fillage



Restricted annular flow-by clearance

- need to include area slips take up when set!!

REFERENCE

Parametric design and application of fibreglass reinforced plastic tubing in beam pumping wells

Haiwen Wang[1,2], Feng Yang[3], Sixu Zheng[2] and Daoyong Yang[2]*

[1]College of Petroleum Engineering, China University of Petroleum, Dongying, 257061, China.
[2]Petroleum Systems Engineering, Faculty of Engineering and Applied Science, University of Regina, Regina, S4S 0A2, Canada.
[3]Shengli Oilfield Company, SINOPEC, Dongying, 257094, China.

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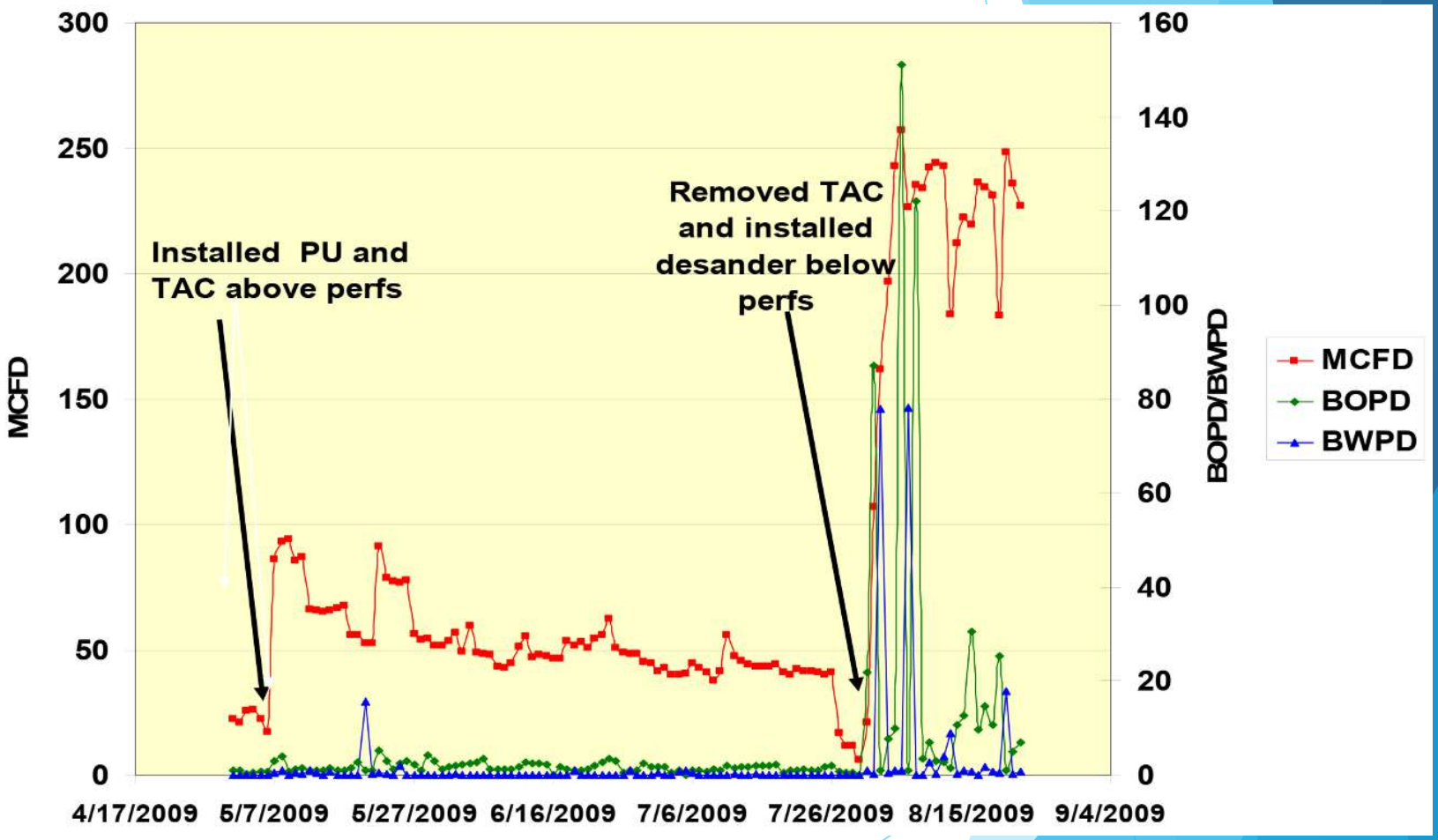
Tubing Anchors can Limit Production

Marathon Oil Corp. revealed:

- Removing TAC greatly increased production



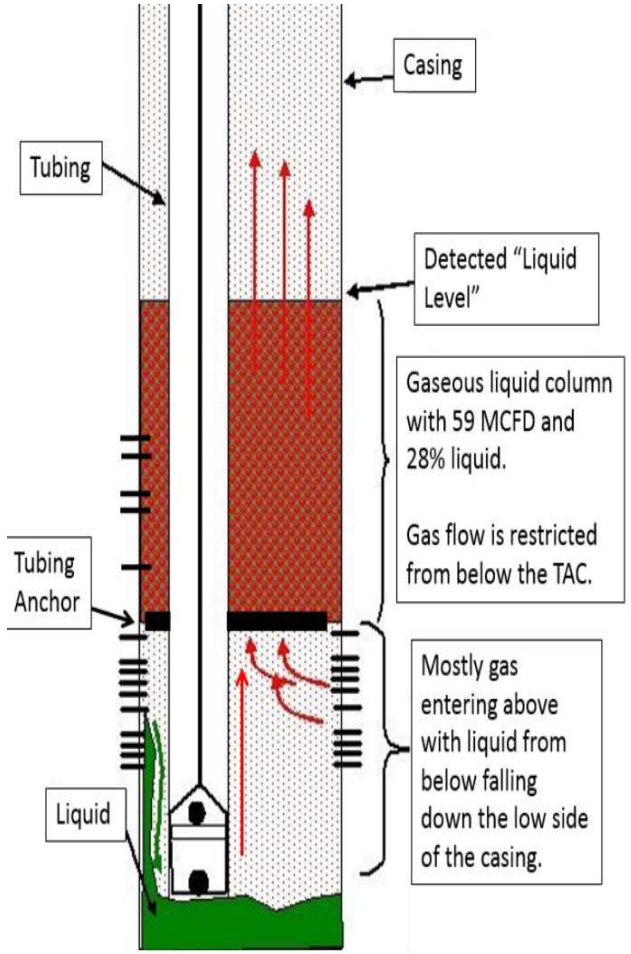
REFERENCE

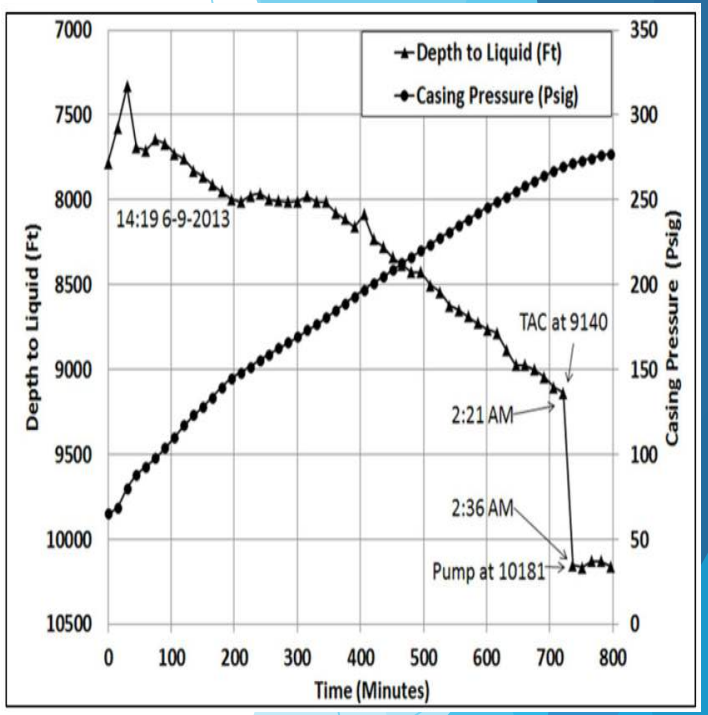
Roberts, W., Holmes, B., Pohler, S., "Tubing Anchor Effects in Gassy Wells", 5th Annual Sucker Rod Pumping Workshop, Wyndam Hotel, Dallas, Texas, Sept 15-18, 2009

Tubing Anchors can Limit Production

Echometer revealed:

- builds liquid level above
- higher and unstable PIP
- occurs at 6 feet/sec gas velocity
- Don't place anchor immediately above or below separator





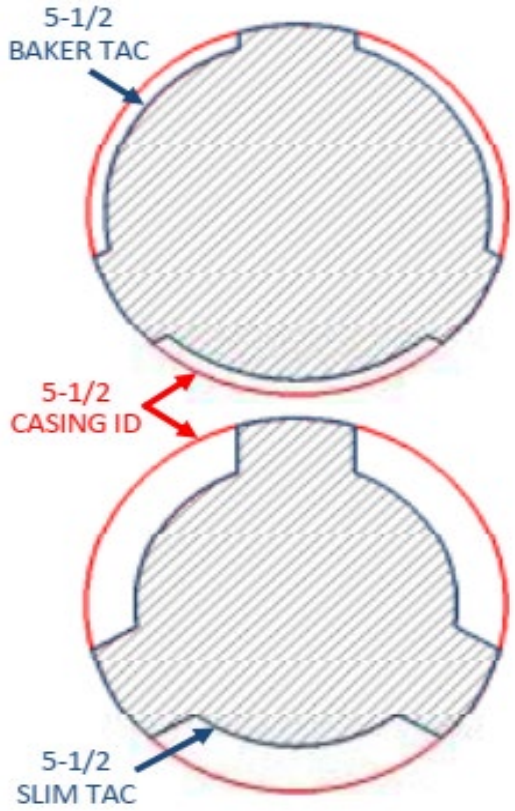
REFERENCE

James N. McCoy, O. Lynn Rowlan, Carrie A. Taylor*, Echometer Company, "Tubing Anchors Can Reduce Production Rates and Pump Fillage", 2014, paper URTeC: 1918491

Existing Options to Address Limitations

Higher annular flow-by or Slimhole Tubing Anchor Catchers

- Better, but none have flowby area equivalent to a 2-7/8” tubing coupling at 3.7” OD (i.e., still restrictive)
- 5.5” casing Slimhole Tubing Anchors have 1.9” ID mandrel, which limits pump size to 1.5” and BHA placement options



Existing Options Operational Risks

Increased Failure Frequency and Workover costs

- Rotational left turn to set, then right turn to unset
- Parting to reduced ID anchor mandrel due to rod wear
- Hydraulic anchors not able to achieve pre-set tubing hanger tension requirements
- Hydraulic anchor stuck in hole risk with shallow rod part and hole in tubing

Engineering an Improved Tubing Anchor

Wish List…….CHEAP, FAST and GOOD:

- Full 2-7/8” tubing ID for placement flexibility
- Annular flow-by area > than 2-7/8” tubing coupling
- No rotational turn set/unset (cap lines, setting in curve, etc)
- Low cost (as always)

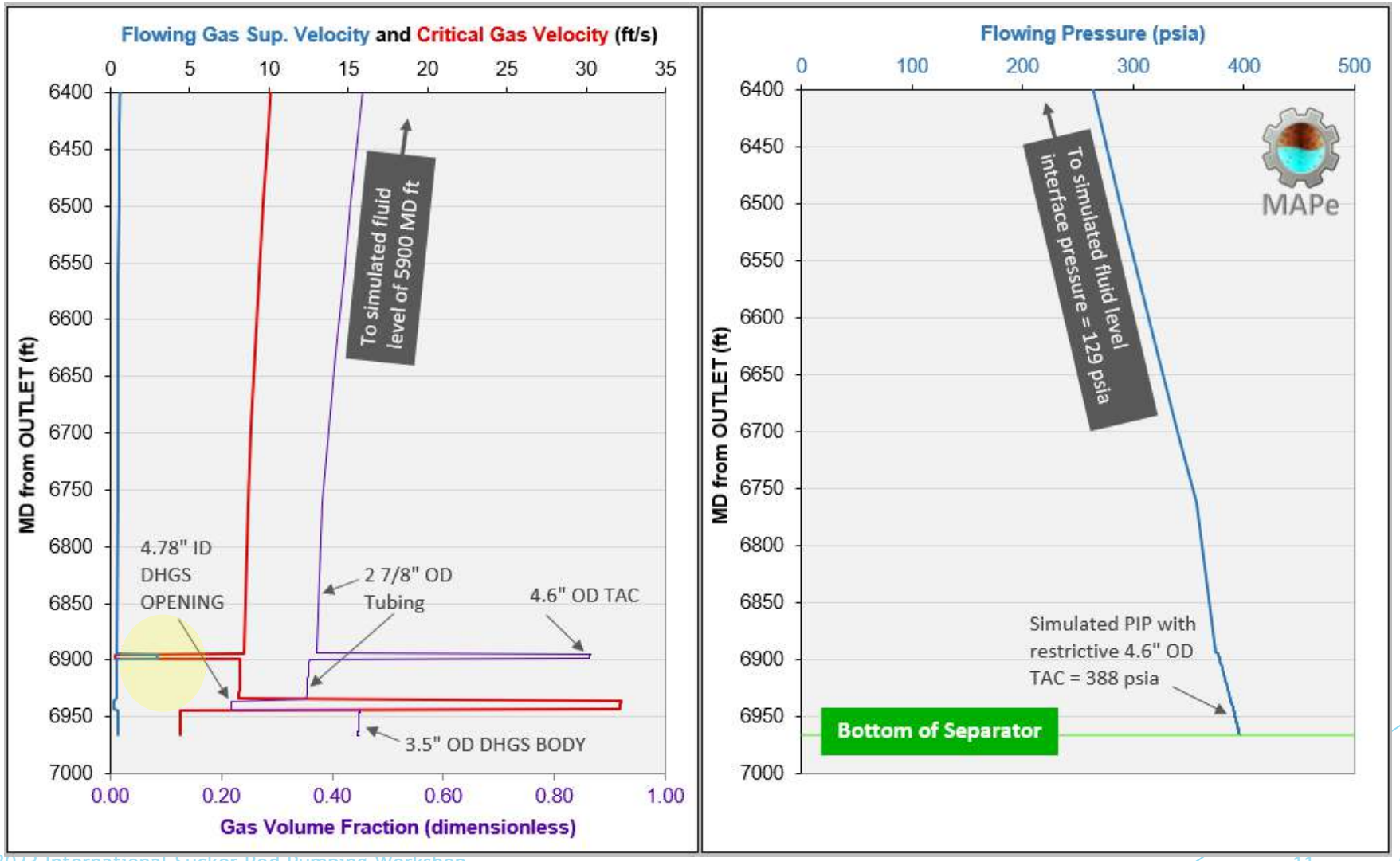
Engineering an Improved Tubing Anchor

Flow Modelled Comparison using

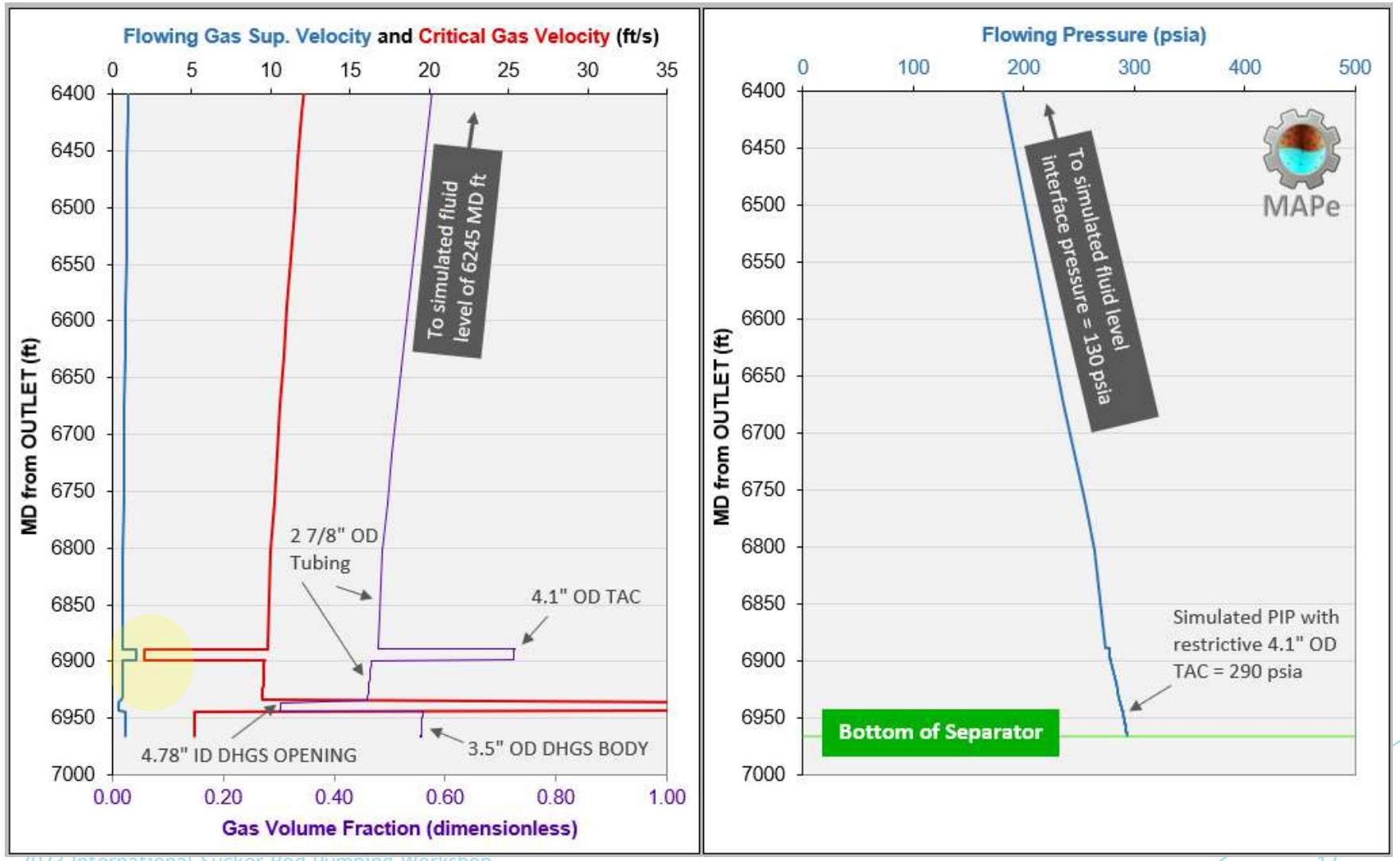
- 4.6” OD equivalent standard tubing anchor
- 4.1” OD equivalent slimhole tubing anchor
- No tubing anchor or 2-7/8” tubing coupling 3.7”

REFERENCE
www.nagoo-associates.com

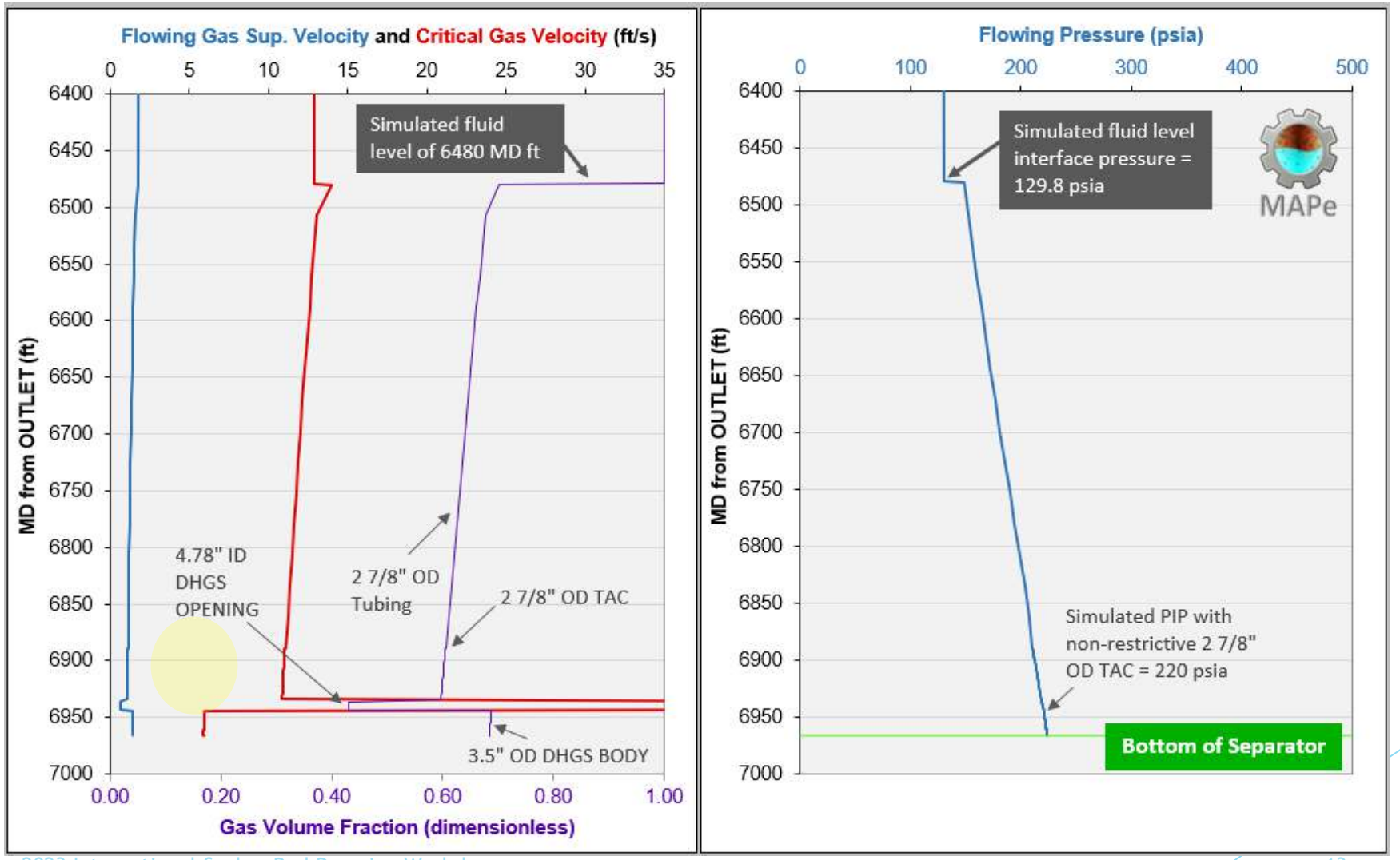
Flow Modelled Restrictive 4.6” OD TAC



Flow Modelled Restrictive 4.1” OD TAC

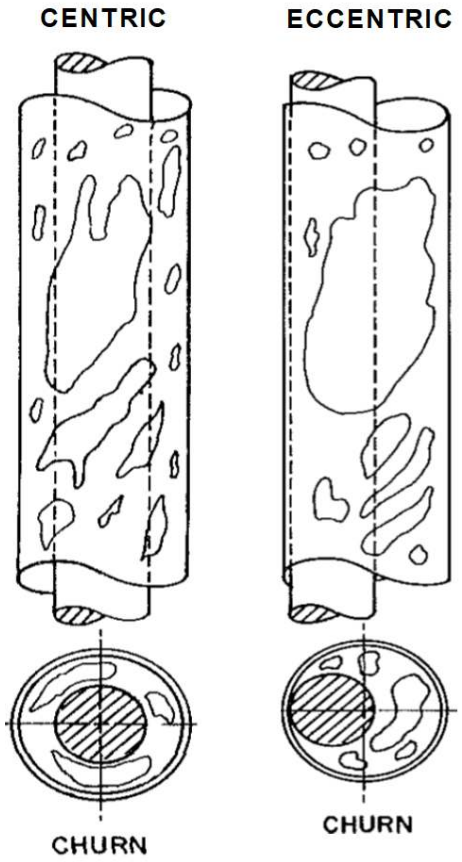


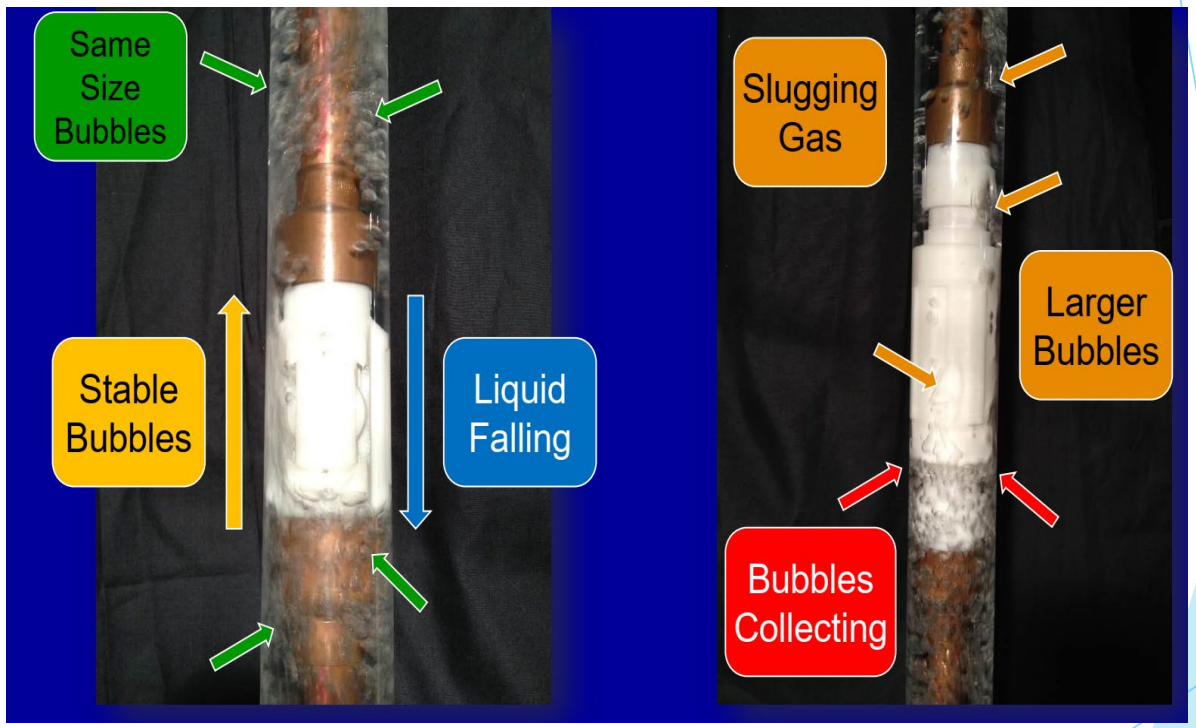
Flow Modelled 3.7” OD TAC



Engineering an Improved Tubing Anchor

Eccentric annular conduit shape offered opportunity: 30% increase in efficiency

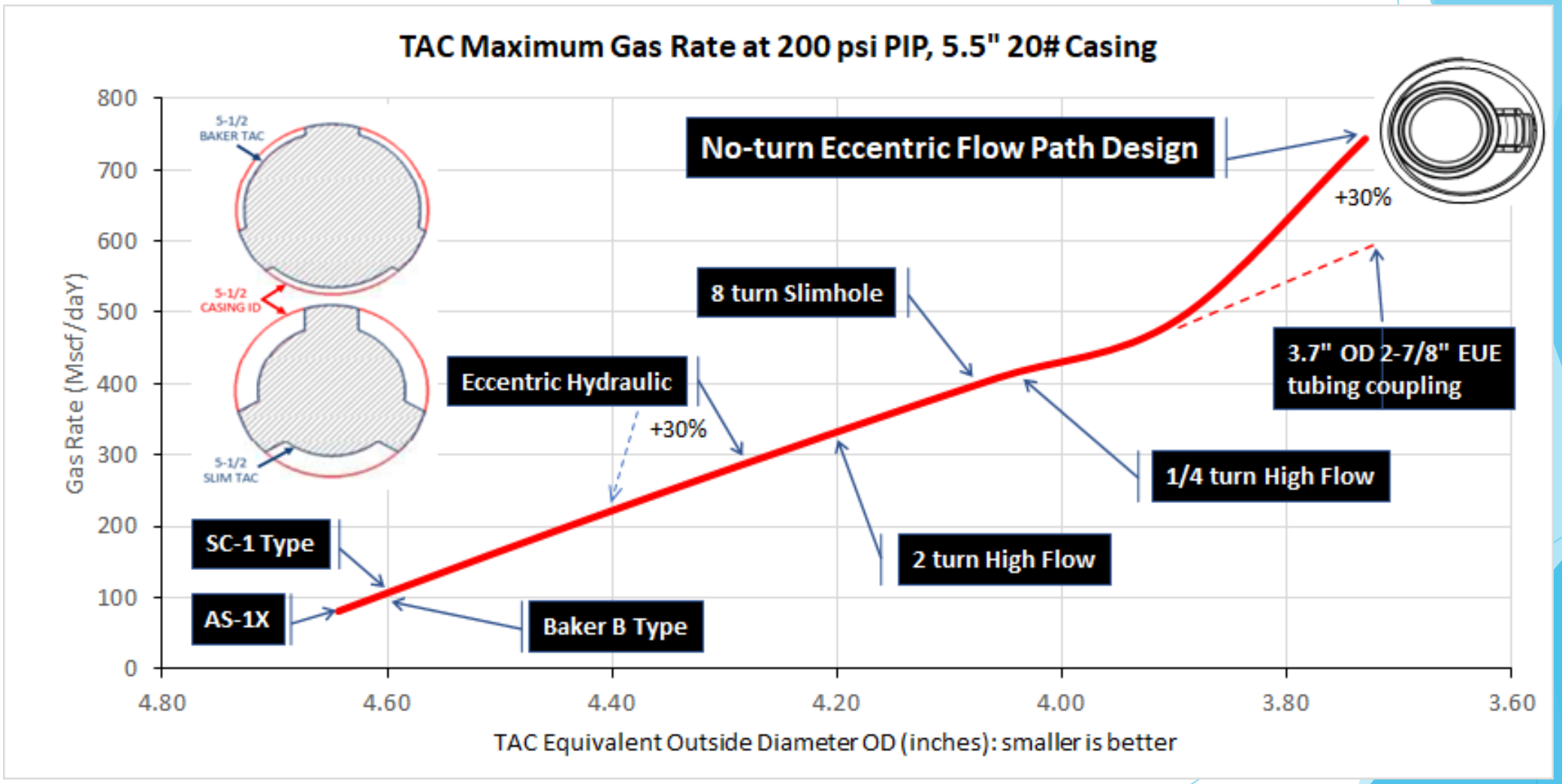




REFERENCE

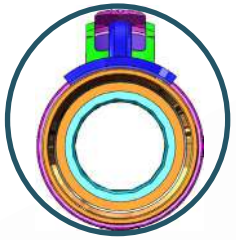
Phillips, W., "Comparing Annular Flows Through Tubing Anchors", presentation at the ALRDC Gas Well Deliquification Conference, Denver Co., Feb 23-25, 2015

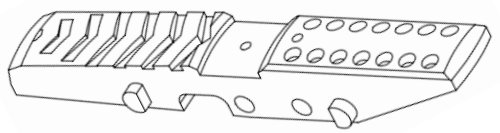
Engineering an Improved Tubing Anchor

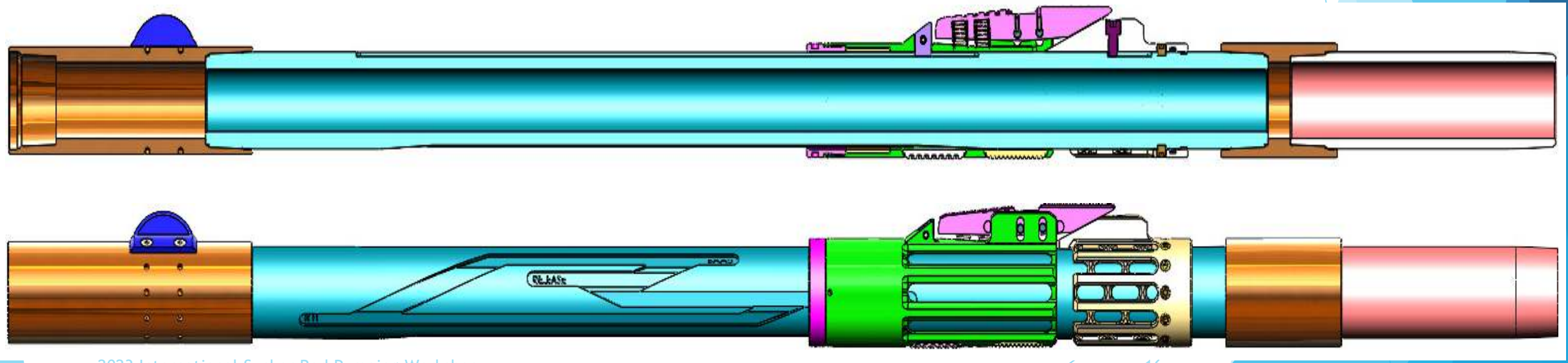


Engineering an Improved Tubing Anchor

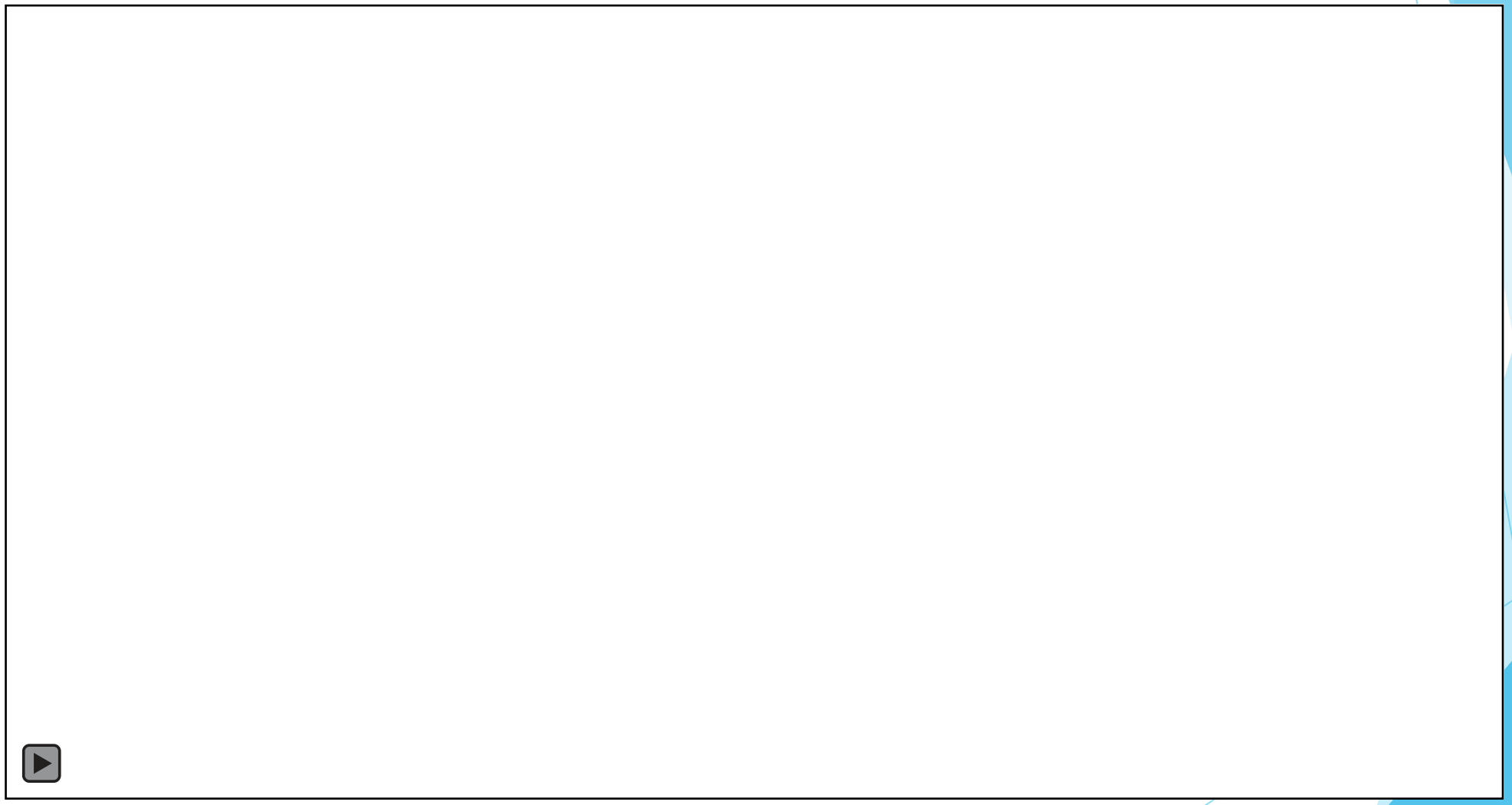
- Eccentric annular flow-by path
- Full 2-7/8” tubing ID
- Integrated casing scraper / drag / slip
- Auto-J, no rotation required for set/unset



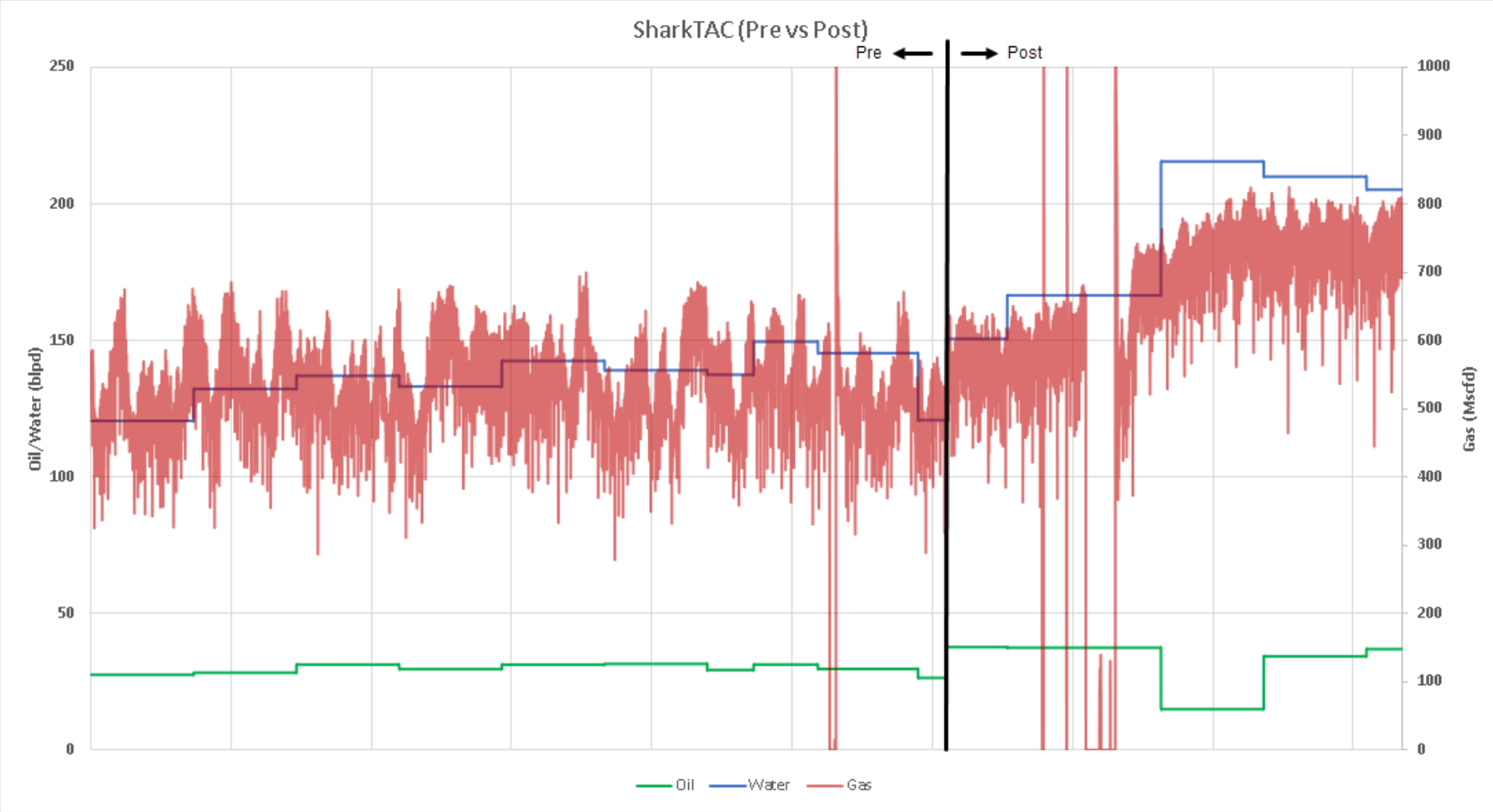




Engineering an Improved Tubing Anchor

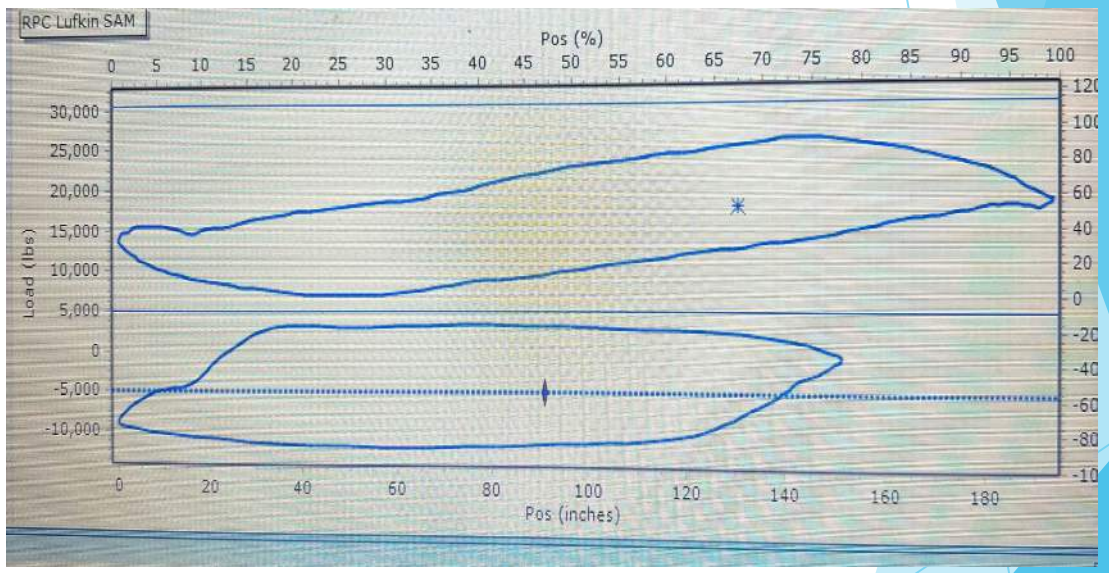


First Well Trial Results: 40% Uplift



First Well Trial Results: Anchor Unset

- Drag block / slip spring issue (spring could not compress far enough)
- Tong damage on mandrel increased slip cage drag
- 20 more well trials immanent



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