



# STAY AHEAD STAY INFORMED



- ▶ SPE Live
- ▶ SPE Tech Talks
- ▶ Webinars
- ▶ SPE Podcast
- ▶ Online Training Courses
- ▶ On-Demand Videos

[STREAMING.SPE.ORG](https://streaming.spe.org)

# WELCOME

- ▶ The program will begin soon.
- ▶ You will not hear audio until we begin.

[STREAMING.SPE.ORG](https://streaming.spe.org)



# Effective Plugging

**Steven Allan Canny, Martial Burguieres, Jim Rairigh**

**September 30, 2026**



**SPE**  
**EnergyStream**

# ● Live Webinar **Effective Plugging**



**WEDNESDAY, 30 SEPTEMBER 2026**  
1100 CDT (UTC-5)



**MODERATOR**

**DEVI SUBRAMANIAM**  
HALLIBURTON



**MODERATOR**

**OLAMIDE EFOSA-AUSTIN**  
NNPC



**SPEAKER**

**STEVEN CANNY**  
ARCHER



**SPEAKER**

**JIM RAIRIGH**  
WT BELL INTERNATIONAL



**SPEAKER**

**MARTIAL BURGUIERES**  
STATICFLO



**REGULATORY  
RESPONDENT**

**GUNTHER HARMS**  
NORTH DAKOTA  
DEPARTMENT OF  
MINERAL RESOURCES

## SPE WEBINARS ARE SPONSORED BY:





# Dynamic Deepwater Decommissioning

Engineering P&A for Floating Production Systems

**Steven Allan Canny**  
September 30, 2026

**Archer**

# Dynamic Production Facilities



***DDTU***

*Dynamic Dry Tree Units*

***TLP***

*Tension Leg Platform*

***DDF***

*Dynamic Drilling Facility*

***SPAR***

***DDCV***

*Deep Draft Caisson Vessel*

# Production Facilities Overview

## References

[1] Barton, C., Hambling, H., Albaugh, E. K., Mahlstedt, B., & Davis, D. (2017)

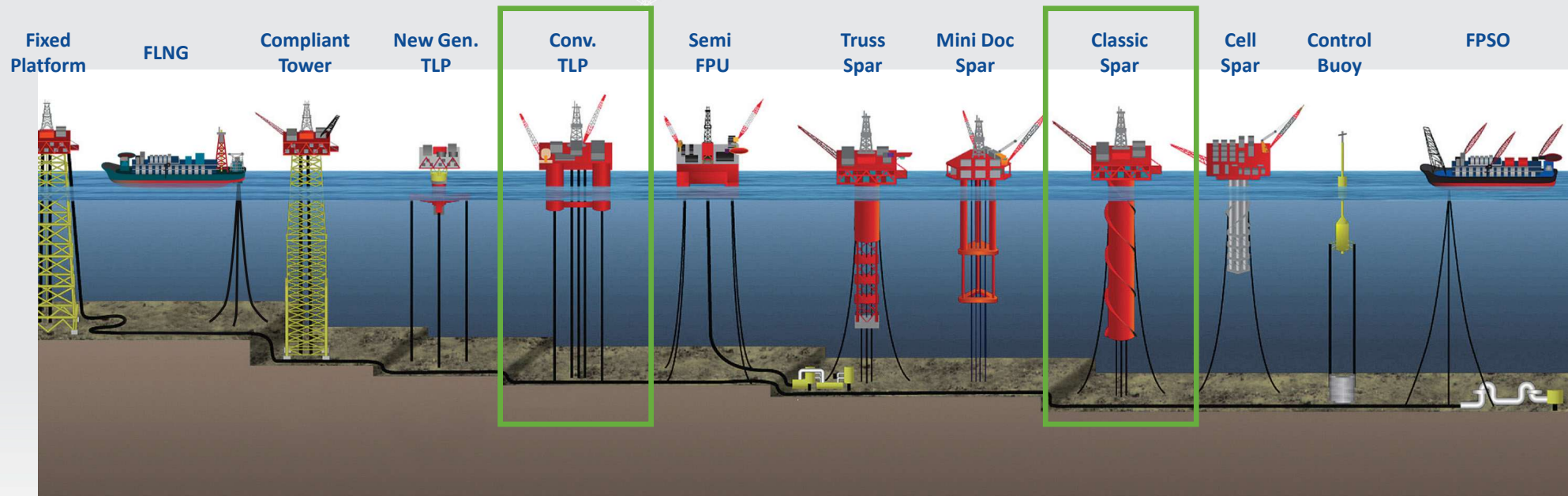


*Figure 1 – Example of Production Facilities [1]*

# Dynamic Dry Tree Units Overview

## References

[1] Barton, C., Hambling, H., Albaugh, E. K., Mahlstedt, B., & Davis, D. (2017)

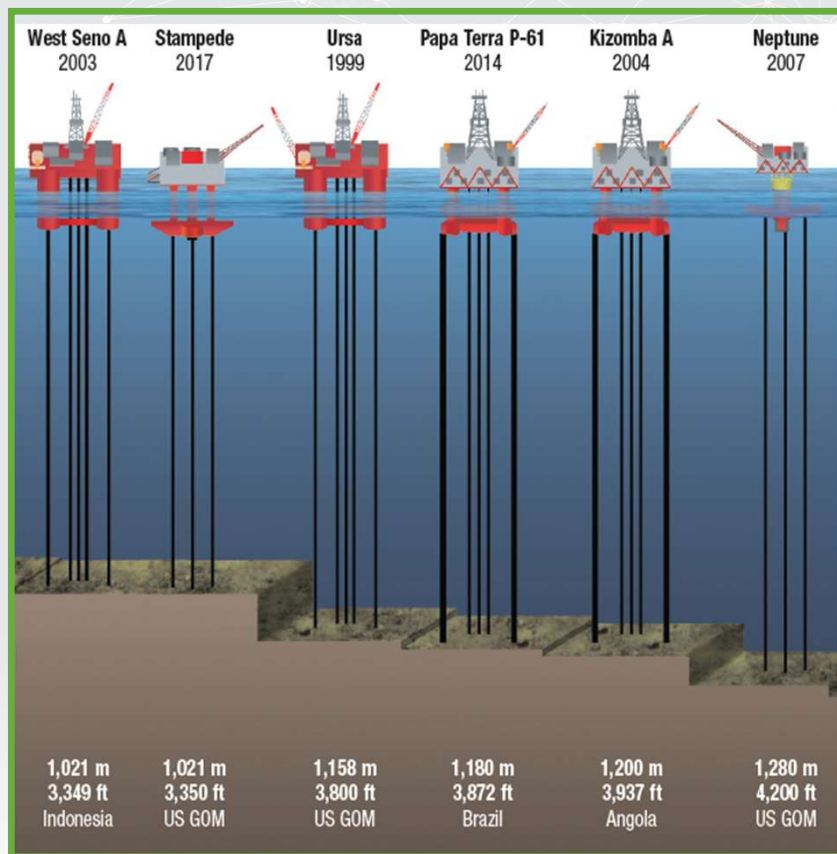


Figure 2 – Examples of Tension Leg Platforms [1]

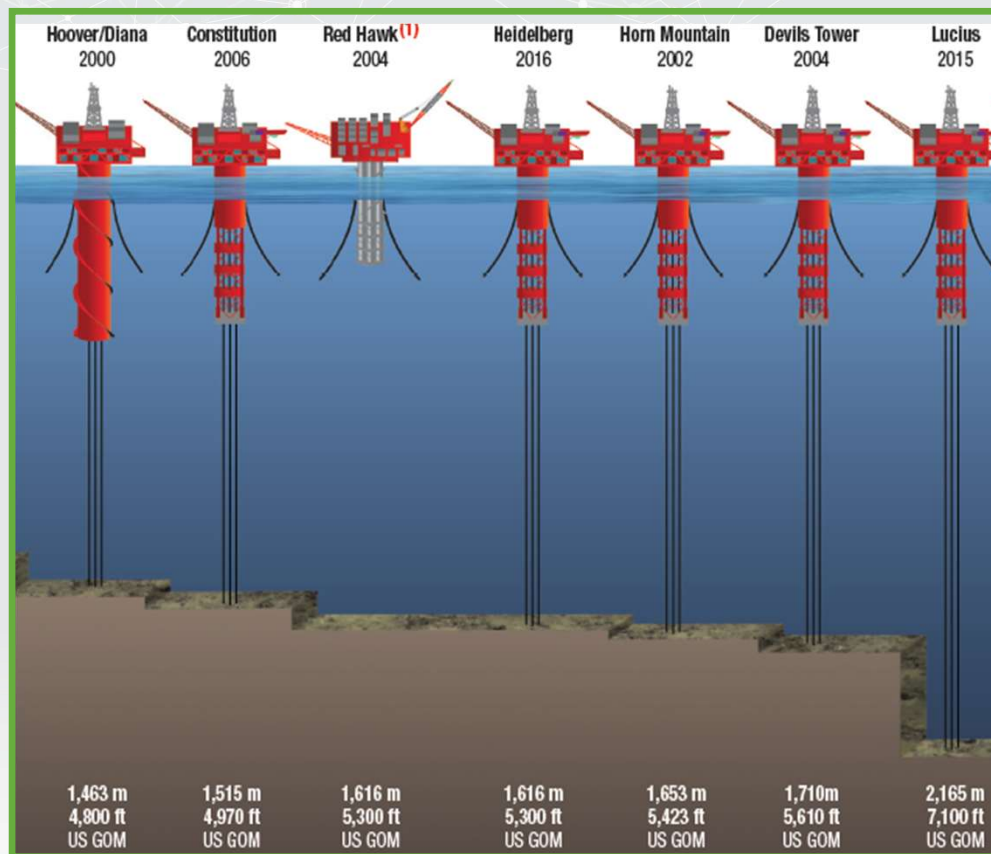


Figure 3 – Examples of Spars, DDFs & DDCVs [1]

# Dynamic Dry Tree Units Overview

## West Seno TLP Tension Leg Platform Indonesia

### Hull

- Year 2003 Installation
- 3,349ft water depth
- ~4,800 Tons hull
- 110 ft hull

### Production

- 28 wells
- Floating Production Unit for processing

### Riser Systems

Top tension drilling outer riser (13.375-in OD, cemented)

- 9.625-in inner string tied back to surface wellhead
- Single acting tension system

Flexible jumper to Floating Production Unit

**SPE**  
**EnergyStream**

STREAMING.SPE.ORG

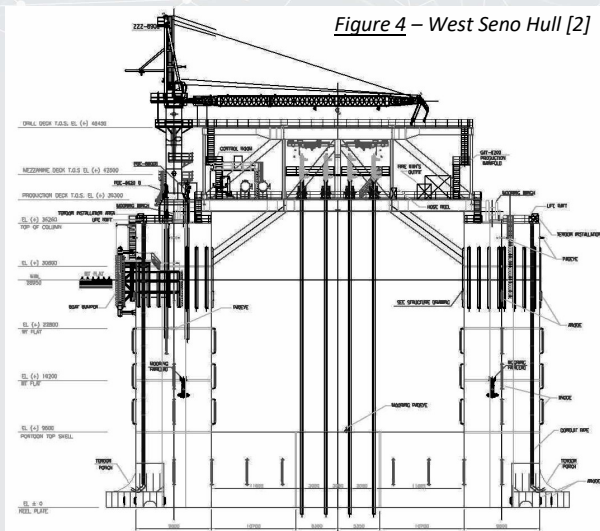


Figure 4 – West Seno Hull [2]

### References

- [2] Wetch, S. B., & Wybro, P. G. (2004, May 3–6)
- [3] Arthur, T. T., & Meier, J. K. (2001, April 30–May 3)



## Diana DDCV Dynamic Draft Caisson Vessel Gulf of America

### Hull

- Year 2000 Installation
- 4,850 ft water depth
- ~51,000 Tons hull
- 705 ft hull

### Production

- 6 wells

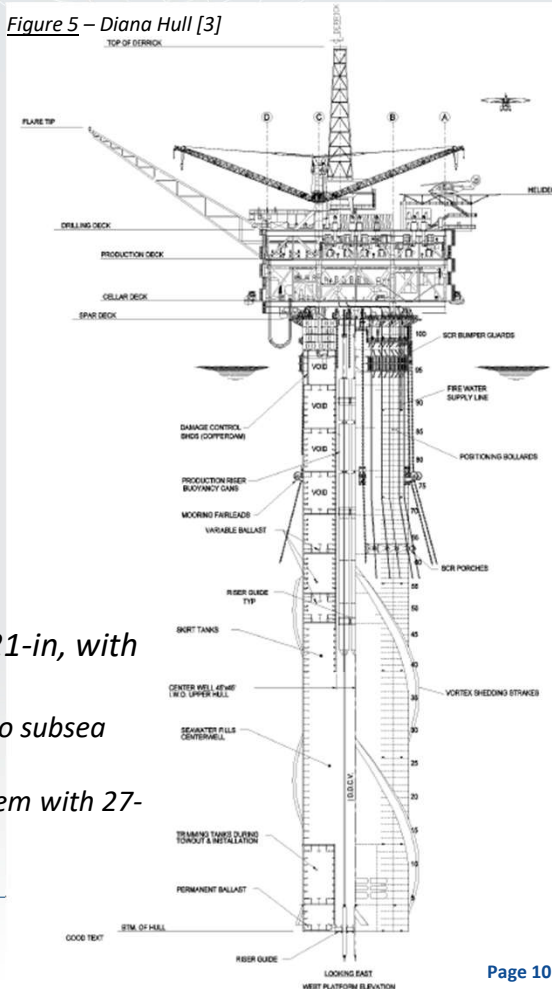
### Riser System

Top tension drilling outer riser (21-in, with wellhead connector)

- 13.425-in inner string tied back to subsea wellhead casing hanger
- Double acting Compensator system with 27-in stroke

Tieback steel catenary risers

Figure 5 – Diana Hull [3]





# Decommissioning DDTUs: Key Challenges

## Higher relative risk assets to Decommission

*Shelf fixed structure practices, approaches and assumptions don't transfer readily*

### Novel Assets with Specific Designs

- Localized to Deepwater Locations
- Specification and design are motion dependent
- Host type, riser design and well count all vary
- Non repeatable basis

### Weather Sensitivity

- Facility and riser response to waves, wind and currents
- Specific loop current eddies create multi-phase riser loads
- Hurricane events require shut in and evacuation
- Well operations weather windows drive scheduling

### Limited Sector Practice

- Little published P&A and Decommissioning history
- Asset Installation experience can be lost
- Adjacent decommissioning benchmarks are for shelf fixed structure and subsea facilities
- Cost estimation relies on analogy vs a base of actuals data

## Dynamic Dry Tree Units

# Motion and Characteristics

## References

[4] American Petroleum Institute. (2010).



## API Recommended Practice 2

- RP 2A – Fixed Structures
- RP 2T – Tension Leg Platforms
- RP 2FPS – Floating Production
- RP 2MET – Metocean Data

Table 1: Structure Motion Behaviour Characteristics

| Type                 | Facility             | Motion Profile                      | Riser Type                         | Water Depth             |
|----------------------|----------------------|-------------------------------------|------------------------------------|-------------------------|
| Fixed Structure      | Jacket               | Fixed:<br>Minimal X & Y             | Conductor &<br>Surface Casing      | Shallow-water<br>Shelf  |
|                      | Compliant<br>Tower   | Compliant Sway:<br>X & Y            | Conductor &<br>Surface Casing      | Midwater Shelf          |
| Dynamic<br>Tree Unit | TLP                  | Heave Restrained:<br>X & Y, minor Z | Top-Tensioned                      | Midwater -<br>Deepwater |
|                      | Spar / DDF /<br>DDCV | Heave Restrained:<br>X & Y, minor Z | Top-Tensioned or<br>Steel Catenary | Deepwater               |

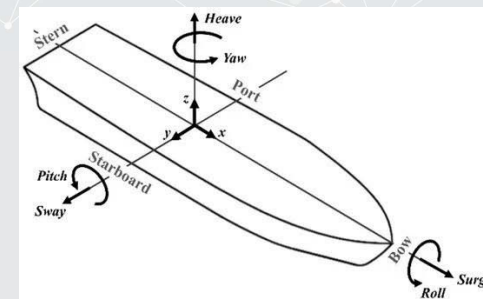


Figure 6 – Six-degrees of freedom of a vessel

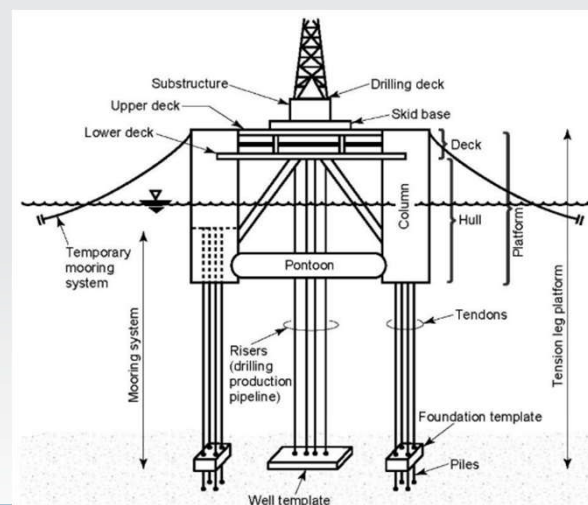


Figure 7 – Tension Leg Platform First Principal Force Application [4]

## Dynamic Dry Tree Units

# Motion and Characteristics

## References

[5] Leland, A. (2002, September 8–11)

[6] Ward, E. G., Gebara, J. M., Kim, M. H., &amp; Ghoneim, N. (2007, April 30–May 3).



Table 2: TLP and Spar modelling with 100-year storm data from Block 17, Angola. Ref [5]

| Environment    | Motion    | Accelerations @ Hull CG |             |
|----------------|-----------|-------------------------|-------------|
|                |           | TLP (g)                 | SPAR (g)    |
| 100-year storm | Surge (X) | 0.06                    | <b>0.11</b> |
|                | Sway (Y)  | 0.06                    | <b>0.11</b> |
|                | Heave (Z) | Negligible              | <b>0.02</b> |

Table 3: TLP and Spar modelling with 100-year storm data from Gulf of America, USA. Ref [6]

| Environment    | Motion        | Accelerations @ Hull CG |              |
|----------------|---------------|-------------------------|--------------|
|                |               | TLP (g)                 | SPAR (g)     |
| 10-year storm  | Horizontal    | <b>0.109</b>            | 0.083        |
|                | Rotational    | 0.004                   | <b>0.007</b> |
|                | Heel (static) | 0.001                   | <b>0.056</b> |
| 100-year storm | Horizontal    | <b>0.173</b>            | 0.124        |
|                | Rotational    | 0.005                   | <b>0.010</b> |
|                | Heel (static) | 0.002                   | <b>0.146</b> |
| Ivan           | Horizontal    | <b>0.220</b>            | 0.154        |
|                | Rotational    | 0.006                   | <b>0.013</b> |
|                | Heel (static) | 0.003                   | <b>0.187</b> |

## Dynamic Dry Tree Units

# Top Tension Riser Systems

### Surface Wellhead System

- Based to tension joint
- Dynamic movement independent of host facility
- BOP installed to this, and inherits riser motion

### Tension/ Compensation System

- Single (tension) or double acting (Tension & Compensation)

### Tension Joint

- Primary tension structural interface
- Interface to Compensation System

### Keel Joint / Centralizer Joint

- Largest diameter section
- Large diameter recovery handling risk

### Buoyancy

- Buoyancy Cans attached to open water riser sections
- Recovery handling risk

### Riser strakes

- Vortex induced vibration suppression
- Recovery handling risk

### Tapered Stress Joint

- Primary Compressive structural element
- Large diameter recovery handling risk

SPE  
EnergyStream

Well interface

Wellhead Connector

Riser or casing shoe

STREAMING.SPE.ORG

### References

[7] Bates, J. B., Kan, W. C., Allegra, A. P., & Yu, A. (2001, April 30–May 3)

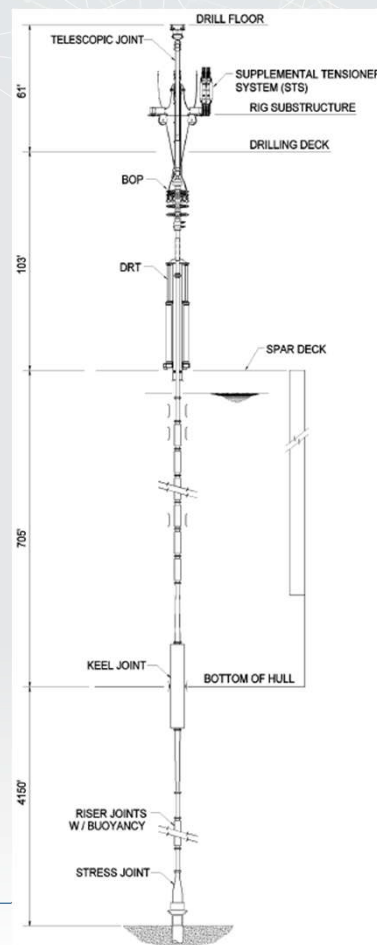


Figure 8 – TTR Drilling Configuration [7]

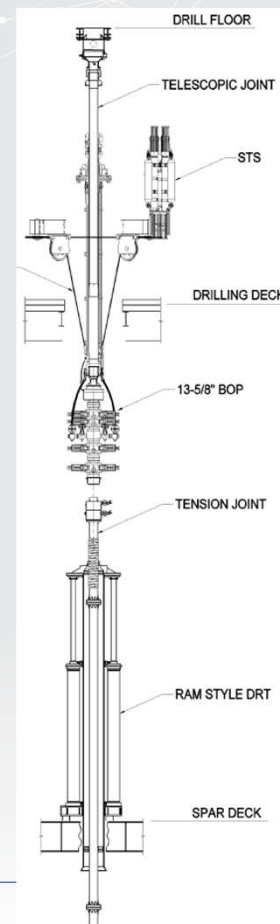


Figure 9 – TTR with BOP landing [7]

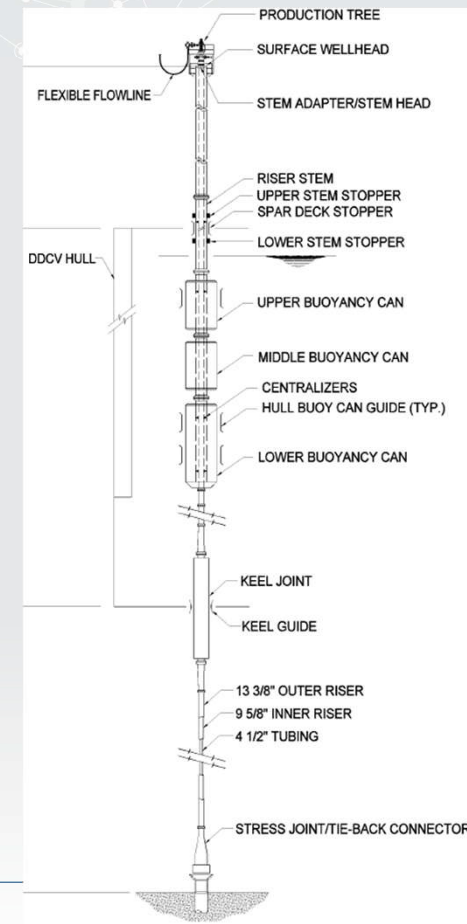


Figure 10 – TTR Pressure Envelope [7]

## Dynamic Dry Tree Units

# Top Tension Riser Systems

## Top Tension Riser Design

- Primary Failure Mode from exceeding excursion limits
- Axial cycling with combined non-geostrophic loading as a secondary failure mode

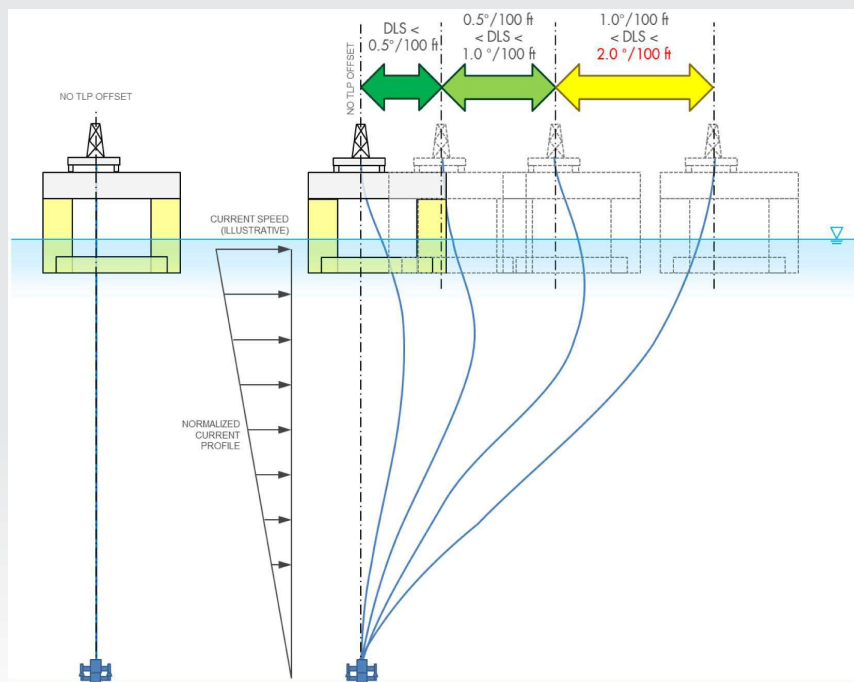


Figure 11 – Top Tension Riser excursions limits [8]

## References

- [8] Aramanadka, S. B., Yong, L., Kota, R., Jamal, S. A., & Yeap, F. (2018, April 30–May 3)  
 [9] Aramanadka, S. B., Hafernik, S., Power, T., & Tay, K. Y. (2018, April 30–May 3)

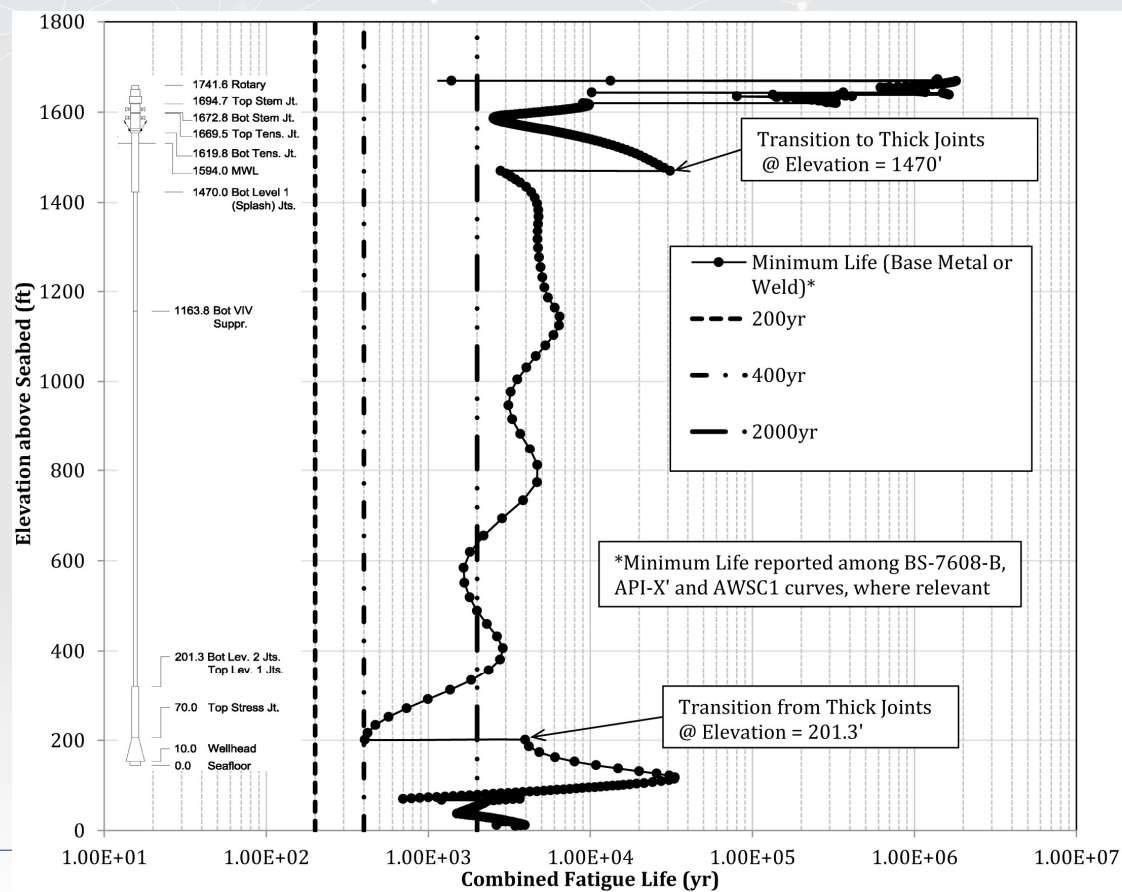


Figure 12 – Top Tension Combined Fatigue life vs Elevation above Seabed [9]

## Dynamic Dry Tree Units

# Well Operations (Outer Continental Shelf)



### Code of Federal Regulations, Title 30, Chapter 2, Part 250

- Subpart D – Oil and Gas Drilling Operations
- Subpart E – Oil and Gas Well-Completion Operations
- Subpart F – Oil and Gas Well-Workover Operations
- Subpart G – Well Operations and Equipment
- Subpart I – Platforms and Structures
- Subpart Q – Decommissioning Activities

### 30 CFR 250 Subpart G – Well Operations and Equipment

#### Blowout Preventor System

- Normative specification compliance to
  - API 6A, 16A, 16C, 16D, 17D, 20E, 20F and Standard 53
- 30 CFR 250.724 is applied to FPS cases and requires
  - (1) Real time monitoring of:
    - BOP System
    - High Pressure Fluids System
    - Low Pressure Fluids System
- 30 CFR 250.733(b) is applied to floating facility cases and requires
  - (a) Compliance to 250.734(a)(1)
    - 5 element BOP – A1 – R4 (2x BSRs, 2x PRs)
  - (2)(i) Outer to inner riser monitoring in operations
  - (2)(ii) qualified per 250.721 (Hydrostatic pressure test to 70% of material yield strength)

SPE  
Energy Stream

▪ No explicit DDTU Requirements

▪ Compensated frame functional requirement  
STREAMING.SPE.ORG

### Considerations in Well Engineering & Planning

#### Management of Axial Movement

- Managing BHA movement
- Engineered lifting

#### Management of Lateral Movement

- Managing material handling at surfaces
- Engineered lifting

#### Operating Limits

- Motion limits
- Shut in / hang off events
- Shutdown sequencing

#### Surface Hardware Selection

- Dynamic class units
- Temporary or Permanent Integration Designation
- Surface fluid systems and management

#### Surface Hardware System Integration

- Fire & explosion strategy
- Emergency shutdown logic and automation
- Hazardous area management

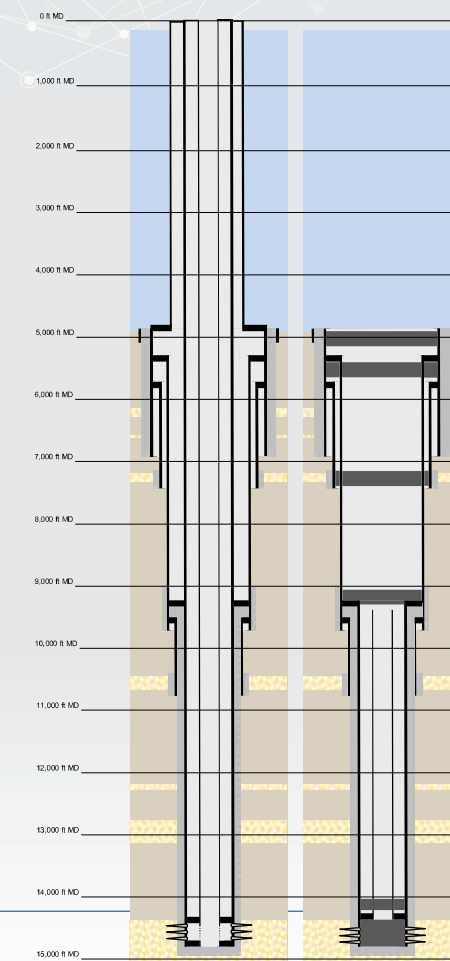


Figure 13 – Pre & Post Isolation Schematic

## Dynamic Dry Tree Units

## Engineering &amp; Integration

## References

[10] Canny, S. A. (2026, June 3–4)

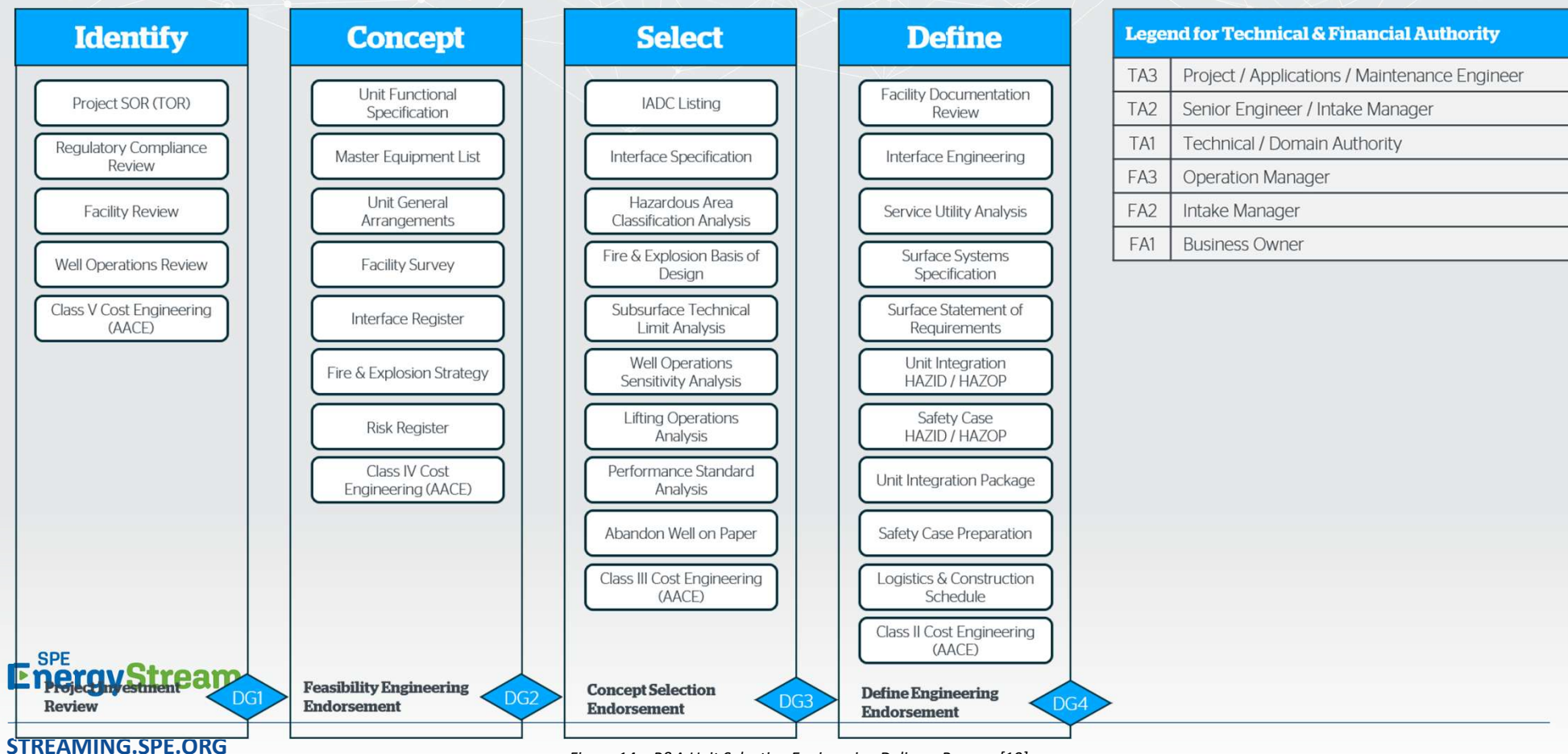


Figure 14 – P&amp;A Unit Selection Engineering Delivery Process [10]

ABEX Profiles

# Shelf Fixed Structures vs Dynamic Dry Tree Units



**1.43 to  
1.47x**

**Longer duration**  
for deepwater dry tree wells vs  
shelf dry tree wells

**2.53x**

**Higher well unit rate**  
for deepwater dry tree wells vs shelf  
dry tree wells in **non-optimized**  
executions

**2.57x**

**Higher well unit rate**  
for deepwater dry tree wells vs shelf  
dry tree wells in **optimized**  
executions

## Fixed Structure - Shelf

### Shelf

Fixed Platform  
160 ft water depth

### Scope

18 Wells  
~21 days per well duration

### Financial Projection

**\$32.1M** USD Project Costs  
**\$1.7M** Averaged well unit rate

### Shelf

Fixed Platform  
160 ft water depth

### Scope

28 Wells  
~17 days per well duration with  
SIMOPS

### Financial Projection

**\$40.4M** USD Project Costs  
**\$1.4M** Averaged well unit rate

## Spar - Deepwater

### Deepwater

Spar  
4,200 ft water depth

### Scope

3 Wells  
~30 days per well duration

### Financial Projection

**\$13.0M** USD Project Costs  
**\$4.3M** Averaged well unit rate

### Deepwater

Spar  
4,200 ft water depth

### Scope

6 Wells  
~25 days per well duration with  
SIMOPS

### Financial Projection

**\$21.7M** USD Project Costs  
**\$3.6M** Averaged well unit rate



# Discussions

- How can we **accurately take provisions** for these facilities?
- In the case of asset reversion and returning liability to a prior operator – how can contracting **competence and capacity** be developed with the sector, to remove cost inflation?
- What pre-decom work can be standardized to enable facility status change from a **Floating Production System**, to a hydrocarbon free facility post well TA?
- Temporary equipment status is key, **expanding the capacity** of workover units to remove drilling hardware has significant cost benefit.
- With Limited sector track record, how can lessons be shared and **practice developed** to reduce risk, and increase contracting efficiency in liquidating the risk of these assets?



# Figures & References

## List of Figures

1. *Example of Production Facilities* [1]
2. *Examples of Tension Leg Platforms* [1]
3. *Examples of Spars, DDFs & DDCVs* [1]
4. *West Seno Hull* [2]
5. *Diana Hull* [3]
6. *Six-degrees of freedom of a vessel*
7. *Tension Leg Platform First Principal Force Application* [4]
8. *TTR Configuration* [7]
9. *TTR with BOP landing* [7]
10. *TTR Pressure Envelope* [7]
11. *Top Tension Riser excursions limits* [8]
12. *Top Tension Combined Fatigue life vs Elevation above Seabed* [9]
13. *Pre & Post Isolation Schematic*
14. *P&A Unit Selection Engineering Delivery Process* [10]

## References

1. Barton, C., Hambling, H., Albaugh, E. K., Mahlstedt, B., & Davis, D. (2017). *2017 deepwater solutions & records for concept selection: Enabling technologies for deepwater production* [Poster 129]. Offshore Magazine; Wood Group.
2. Wetch, S. B., & Wybrow, P. G. (2004, May 3–6). *West Seno: Facilities approach, innovations and benchmarking* [Conference paper OTC-16521-MS]. Offshore Technology Conference, Houston, TX, United States
3. Arthur, T. T., & Meier, J. K. (2001, April 30–May 3). *Diana/Hoover installation: Overview* [Conference paper OTC-13085-MS]. Offshore Technology Conference, Houston, TX, United States
4. American Petroleum Institute. (2010). *Planning, designing, and constructing tension leg platforms* (API Recommended Practice 2T, 3rd ed.). American Petroleum Institute.
5. Leland, A. (2002, September 8–11). *The use of self erecting tender rigs for improving the economics of marginal fields* [Conference paper IADC/SPE-77232-MS]. IADC/SPE Asia Pacific Drilling Technology Conference and Exhibition, Jakarta, Indonesia.
6. Ward, E. G., Gebara, J. M., Kim, M. H., & Ghoneim, N. (2007, April 30–May 3). *Performance of drilling-rig sea fastenings on floating production systems* [Conference paper OTC-18986-MS]. Offshore Technology Conference, Houston, TX, United States.
7. Bates, J. B., Kan, W. C., Allegra, A. P., & Yu, A. (2001, April 30–May 3). *Dry tree and drilling riser system for Hoover DDCV* [Conference paper OTC-13084-MS]. Offshore Technology Conference, Houston, TX, United States.
8. Aramanadka, S. B., Yong, L., Kota, R., Jamal, S. A., & Yeap, F. (2018, April 30–May 3). *Malikai tension leg platform – drilling tender vessel – top tension riser operations* [Conference paper OTC-28968-MS]. Offshore Technology Conference, Houston, TX, United States.
9. Aramanadka, S. B., Hafernik, S., Power, T., & Tay, K. Y. (2018, April 30–May 3). *Malikai TLP: Collaboration in design and delivery of the Malikai SCCTTR* [Conference paper OTC-28855-MS]. Offshore Technology Conference, Houston, TX, United States.
10. Canny, S. A. (2026, June 3–4). *Guesstimate, estimate or engineer? Accuracy in estimating ABEX performance in wells* [Conference presentation]. SPE Well Decommissioning 2026, Aberdeen, United Kingdom.



**THANK YOU**

---

[STREAMING.SPE.ORG](http://STREAMING.SPE.ORG)

# Bespoke Epoxy Application Equipment

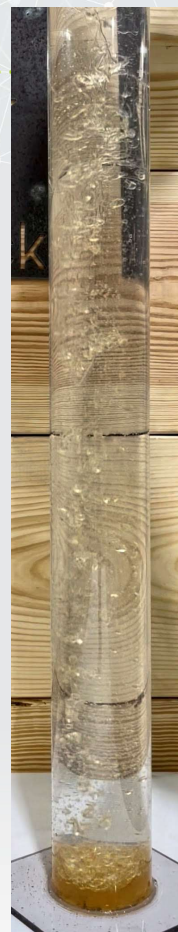
Martial Burguieres  
September 30, 2026

# Overview of Epoxy

Epoxyes have been used in wellbore applications since the 1960's with varying degrees of success.

## Pros of Epoxy:

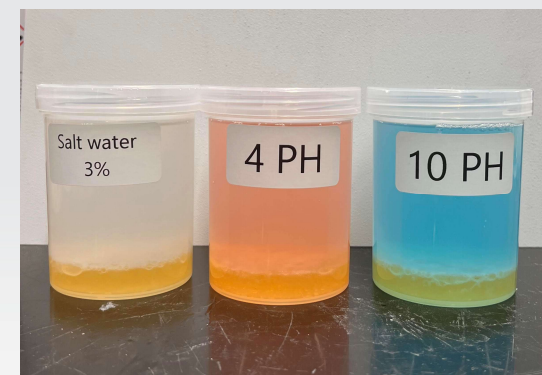
- Immiscible in water
- Extreme resistance to hydrocarbons, acids, chlorides, CO<sub>2</sub>, H<sub>2</sub>S...
- Stronger than cement in tension and compression
- Failure mode is "plastic" Ideal for seismic and vibration
- Chemically bonds, unlike cement
- Non-permeable
- Curing time and density can be adjusted
- Low to no solids... can be squeezed better than cement
- Highly resistant to channeling and micro-annuli



H<sub>2</sub>O immiscibility demonstration

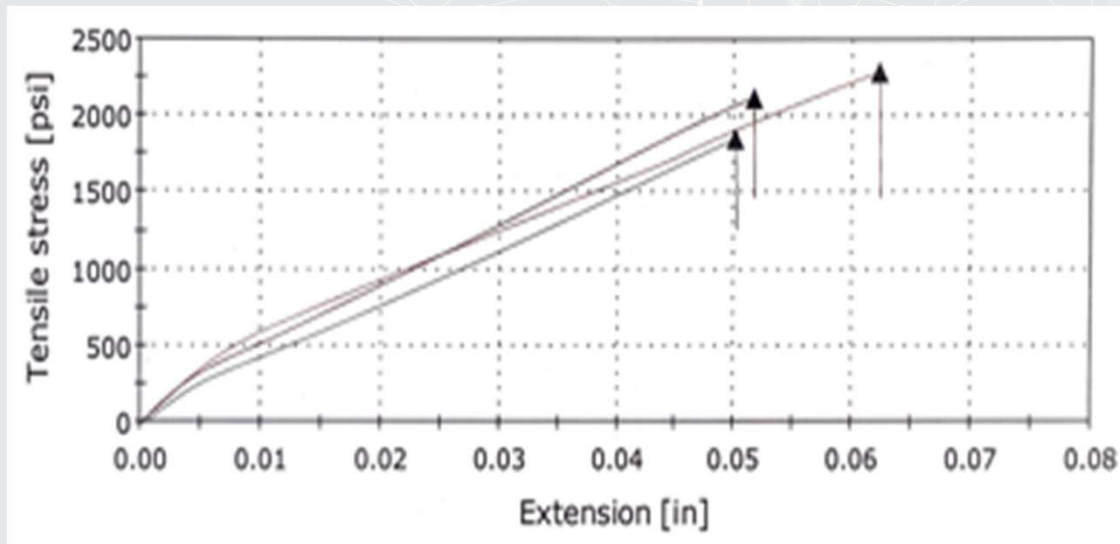


10,000# press test on 1.44" dia. cylinder

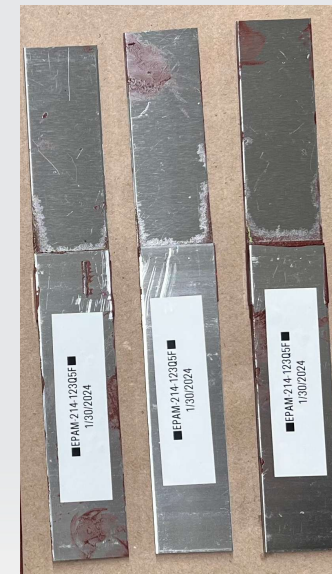


Epoxy Catalyzing in brine, acid and base

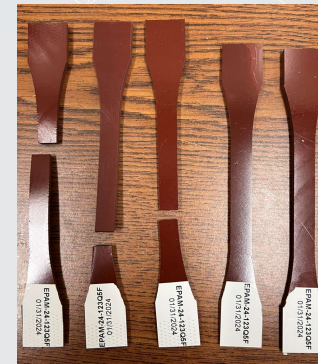
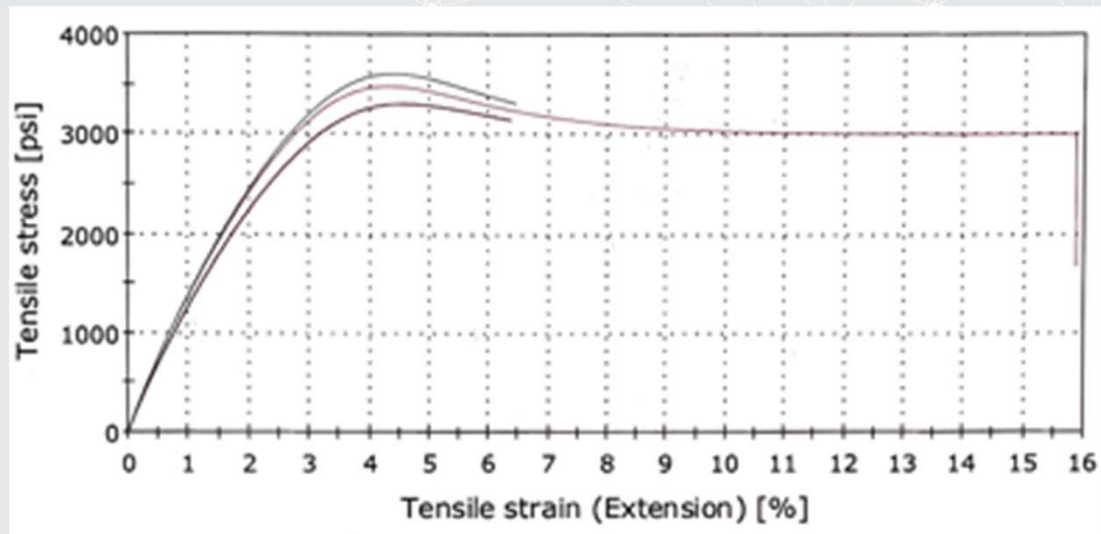
# Overview of Epoxy



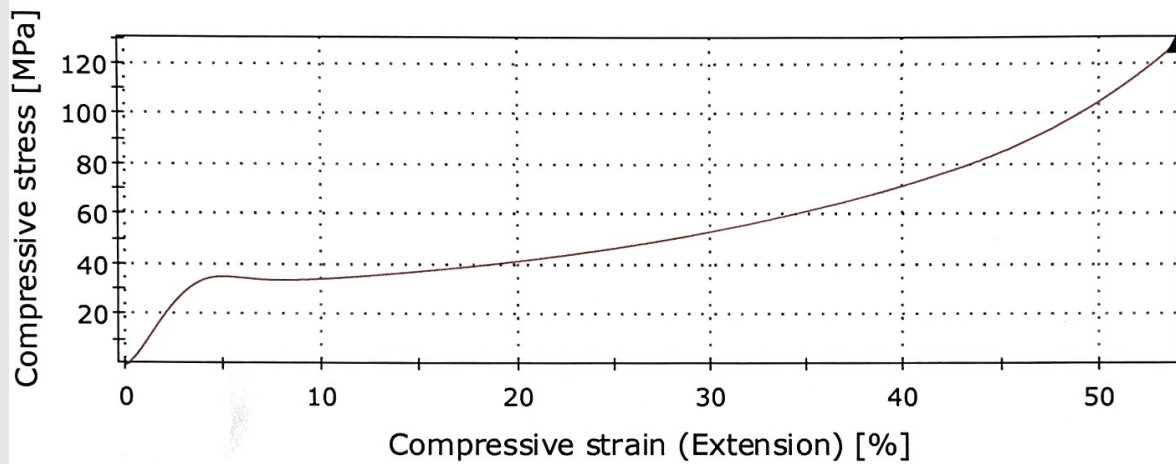
\*No equivalent available for cement



# Overview of Epoxy

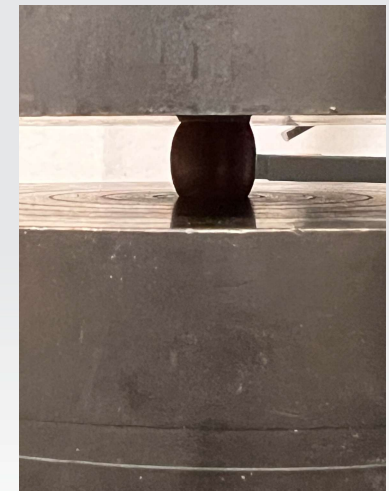
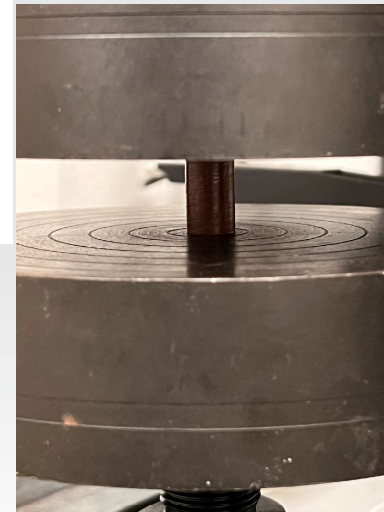


# Overview of Epoxy

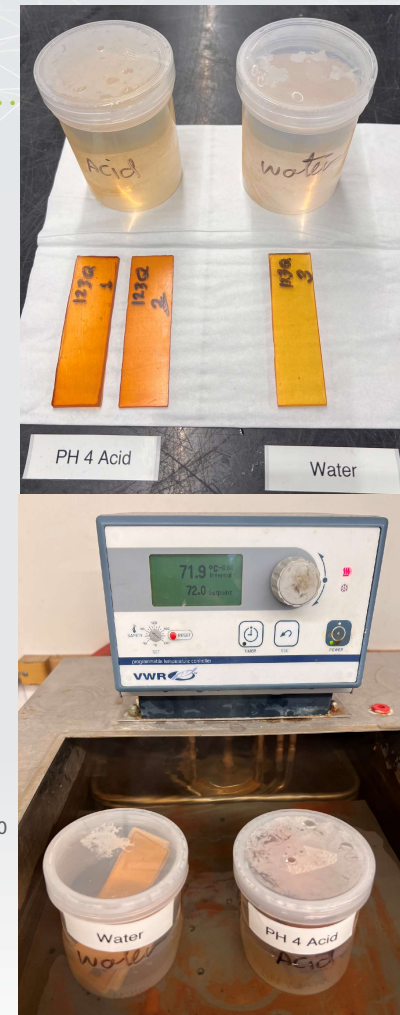
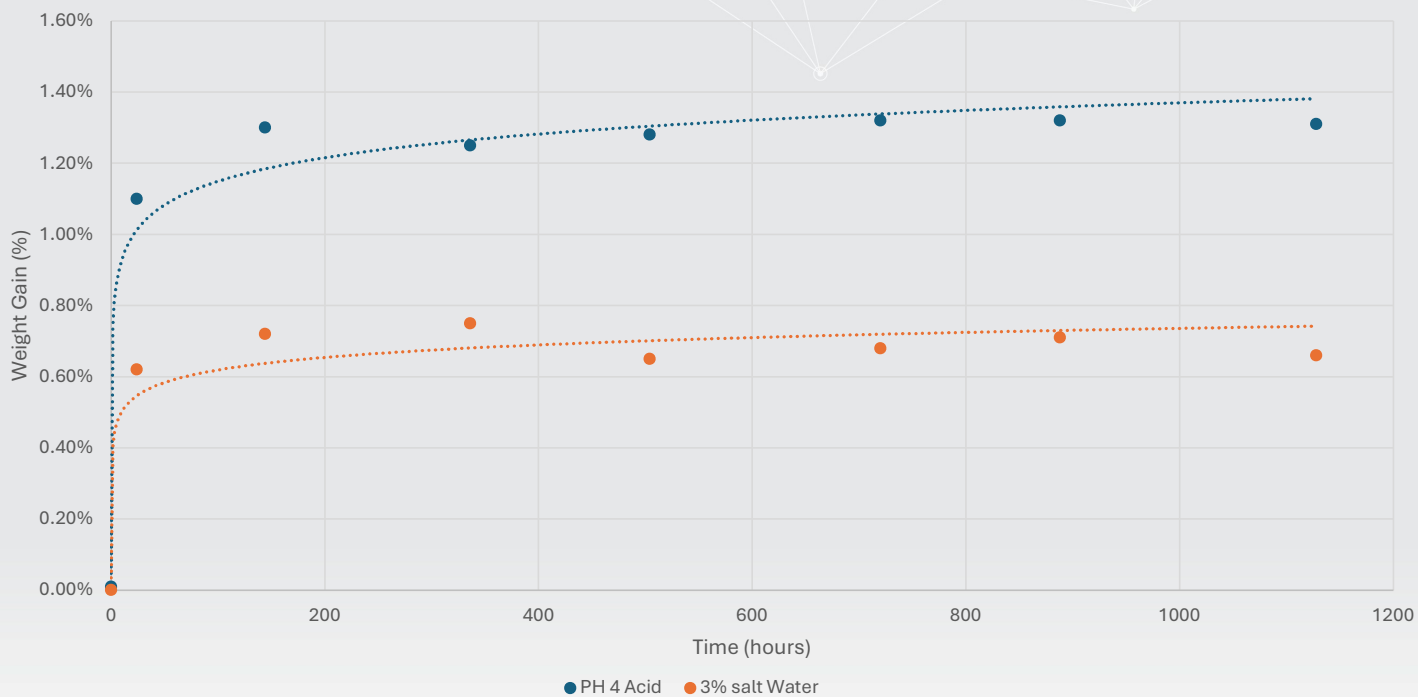


\*Compression for cement ranges from 2,500-4,000 psi

\*Failure mode of epoxy is more favorable than cement



# Overview of Epoxy



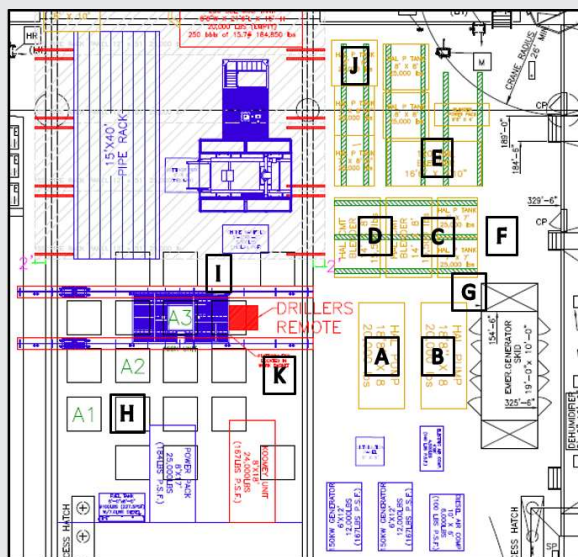
# So Why Doesn't Everyone Use Epoxy?



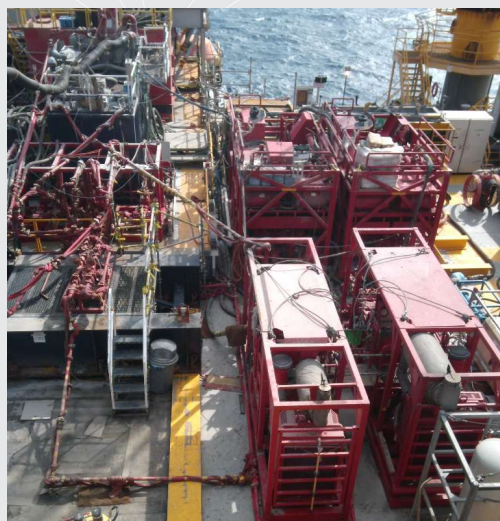
- Epoxy is difficult to handle in field situations
  - temperature affects viscosity/cure times
  - large quantities of epoxy produce equally large amount of heat (could flash cure)
  - epoxy requires extensive cleanup and use of solvents
  - epoxy curing where it shouldn't is a serious problem

The solution is less in the chemistry and more in the handling and disposition...

# Traditional Epoxy Setup



Complex Deck Layout



Mixers, Pumps, Manifolds and Flow Iron



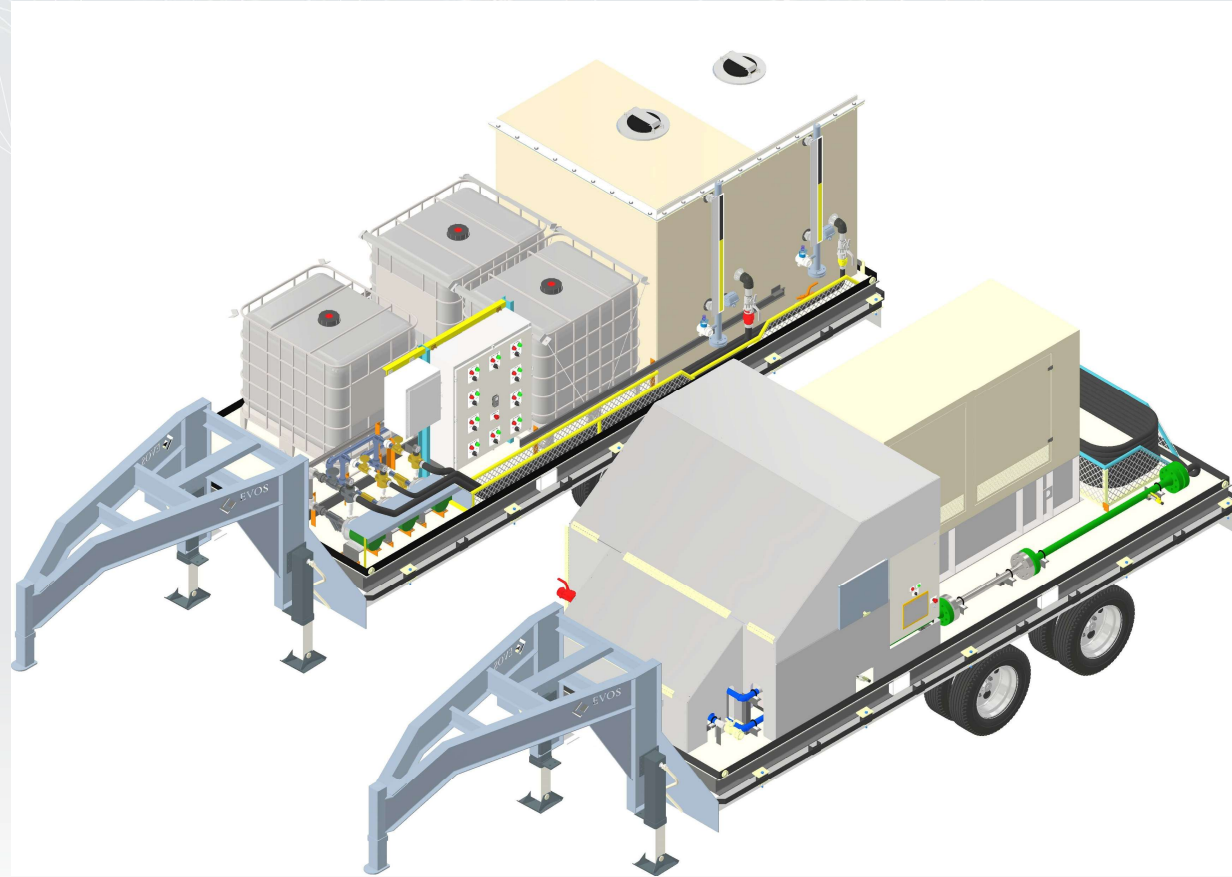
Mixer with Field Mixed Additives



Rented, Ragged out Triplex Pumps

# Mix on the Fly Pumping Systems

- 24 gpm @ 3,500psi
- Self Contained w/ 2 man crew
- HMI panel, auto limits, dataloggers and Coriolis flow meters
- Rig up time 10 minutes
- 10 minute flush cycle  $\approx$  25 gallons of waste
- Skid mounted, offshore capable



# Mix on the Fly Pumping Systems



- Eliminates need for any additional mixing or pumping equipment
  - no rental equipment necessary
  - no “convincing” vendors to handle/pump epoxy
- Like a mobile “batch plant” for epoxy
  - ability to change requested volumes at will
  - ability to STOP mixing epoxy if an issue arises
- Quick cleanup cycle allows for a “follow up” epoxy job within 20 minutes
- “Closed Loop” enables tremendous reduction in cleanup time and cost
- Heated and insulated tanks allow for operations in any climate
  - consistent viscosities provide known pumping pressures
  - provides consistent gel times and cure times



# Non-Pumping Solutions



If the volumes required for a well operation don't require "bullheaded" volumes. Proper application of bailing and thru-tubing equipment can make application of epoxy quick and reliable.

# Epoxy Bailers

## Two issues with bailing surface mixed epoxy...

1. Bailing sufficient volume to ensure long enough plug length/volume
2. Ensuring volume of epoxy doesn't over exotherm and compromise plug (thermal mass effect)

This well required the following:

- pull tubing and rods
- set a tested plug across the perforations
- DRILL OUT the plug and test perforations



**STREAMING.SPE.ORG**

|        |              |  |     |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--------|--------------|--|-----|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Static | GROUND LEVEL |  | 905 | FT |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--------|--------------|--|-----|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|



# Epoxy Bailers

## Two issues with bailing surface mixed epoxy...

1. Bailing sufficient volume to ensure long enough plug length/volume
2. Ensuring volume of epoxy doesn't over exotherm and compromise plug (thermal mass effect)

This well required the following:

- pull tubing and rods
- set a tested plug across the perforations
- DRILL OUT the plug and test perforations

[illegible]

# Epoxy Bailer (Pre Cure)

- Catalyzing epoxy bonds robustly to cure epoxy
  - produces no “cold seam” like cement
  - results in a monolithic plug
- Can be sized to requirements and centralized in any casing
- Reduces the volume required to be bailed
- Ensures all loads of epoxy are still liquid and able to be “squeezed”



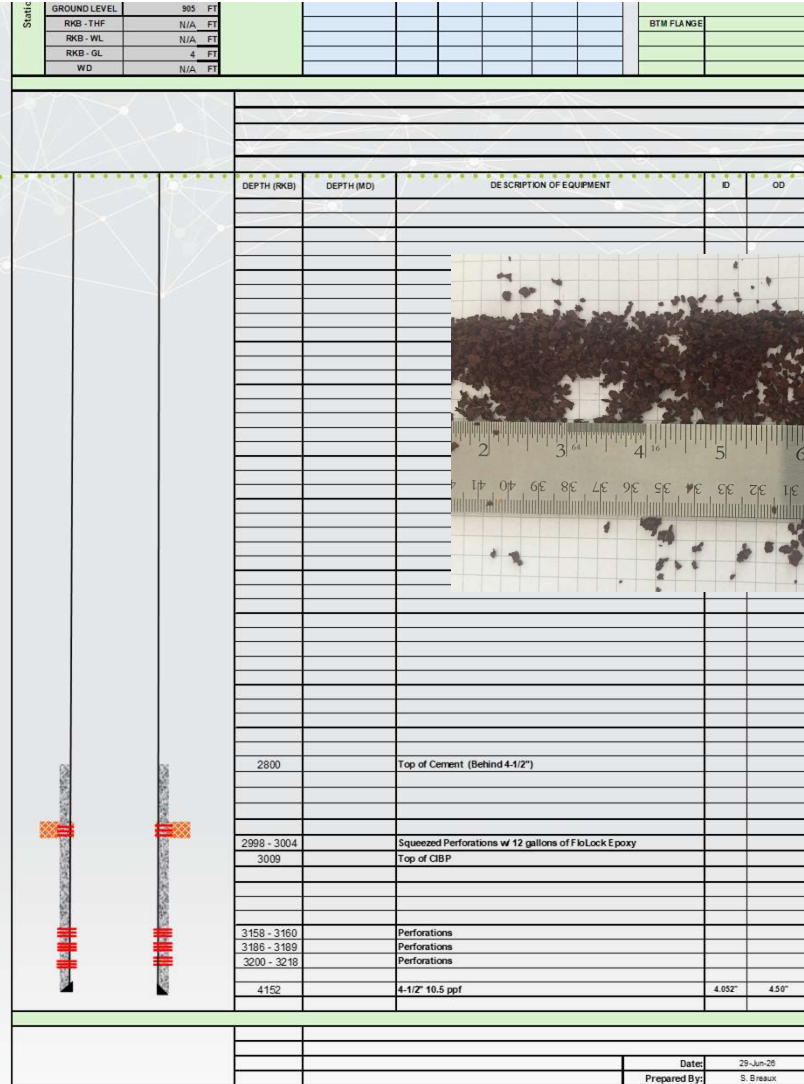
# Epoxy Bailers

## Two issues with bailing surface mixed epoxy...

1. Bailing sufficient volume to ensure long enough plug length/volume
2. Ensuring volume of epoxy doesn't over exotherm and compromise plug (thermal mass effect)

This well required the following:

- pull tubing and rods
- set a tested plug across the perforations
- DRILL OUT the plug and test perforations



## Epoxy Cuttings

# Conclusions



Exotherm Epoxy is an excellent permanent plugging material that offers extreme resilience, bonding and chemical resistance.

Learning how to handle a relatively complex chemical compound in real world field/wellbore conditions ensures reliable performance and consistent results.

- Mix on the Fly pumping unit
- Surface Bailer w/ pre-cure articles



**THANK YOU**

---

[STREAMING.SPE.ORG](http://streaming.spe.org)

# Expansion Charge Technology for Leak Remediation

The Rigless Intervention Pipe Expansion Method to Seal Gas or Fluid Leaks



**Jim Rairigh**

September 30, 2026

**W. T. Bell International**  
an explosives specialty group

# Energetic expansion charge technology seals leaks



Safe maximum expansion of pipe to remediate casing seepages

- Reduces risk → Less crew on-site vs squeeze jobs & section milling
- Cuts greenhouse gas emissions vs other methods
- Lowers costs up to 82%



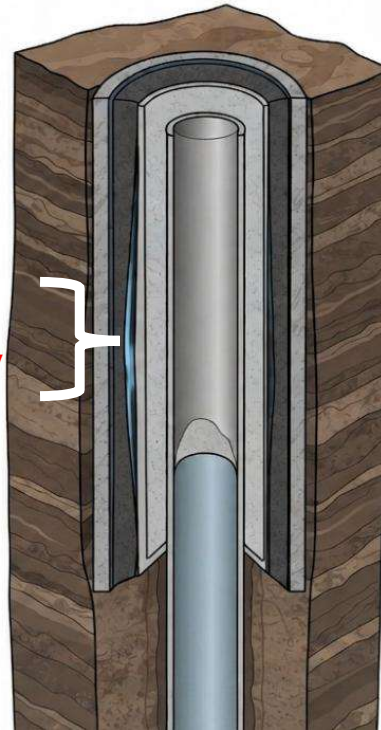
[STREAMING.SPE.ORG](http://STREAMING.SPE.ORG)

## Example challenge: Annular gas seepages in producing wells or P&A well candidates

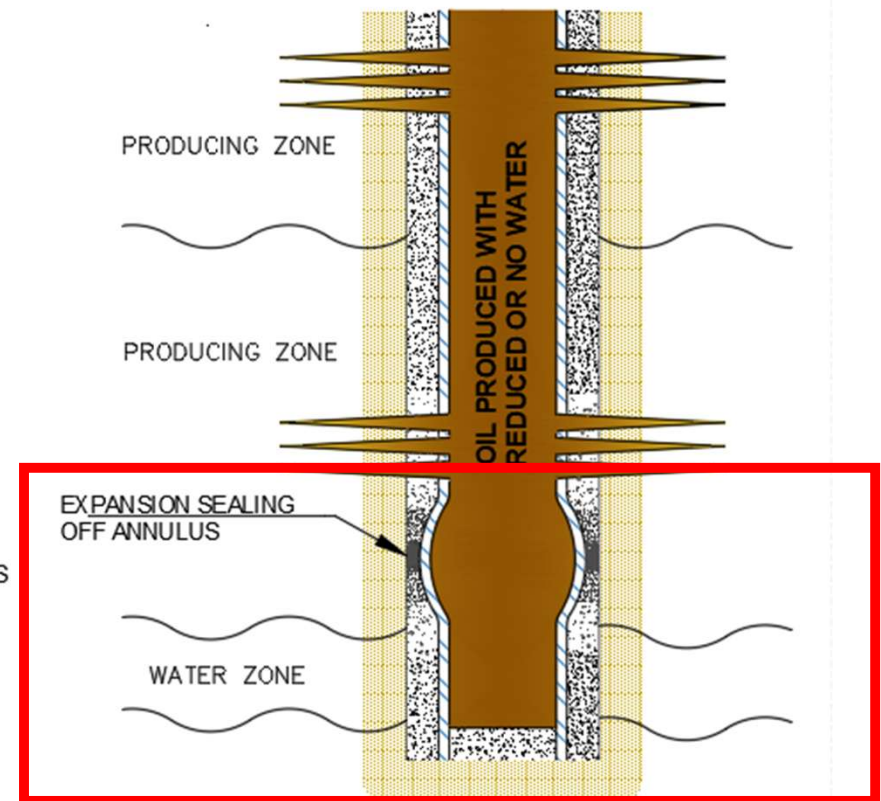
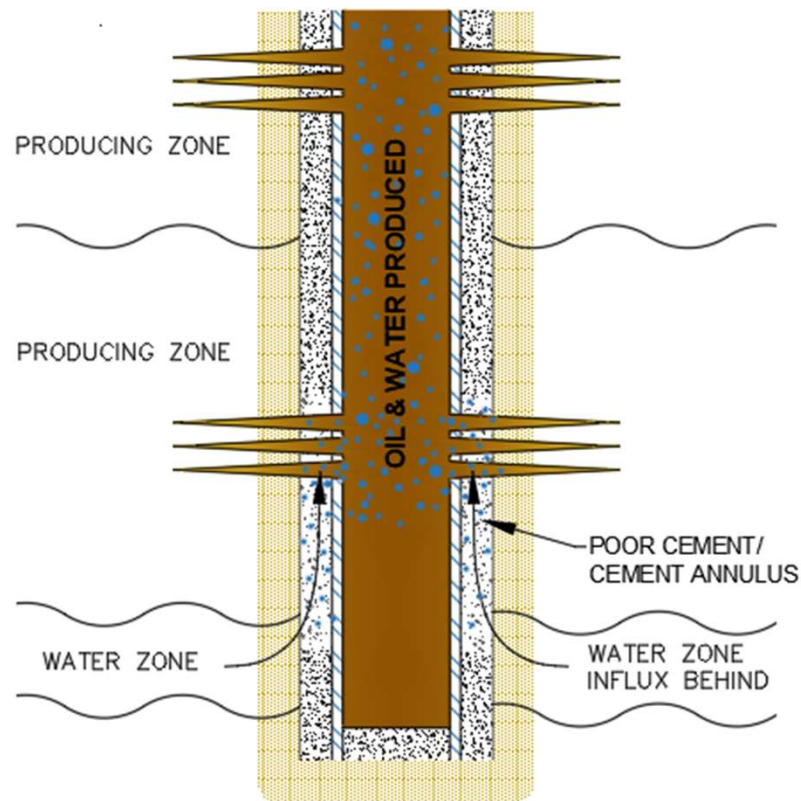


**Sustained casing pressure**

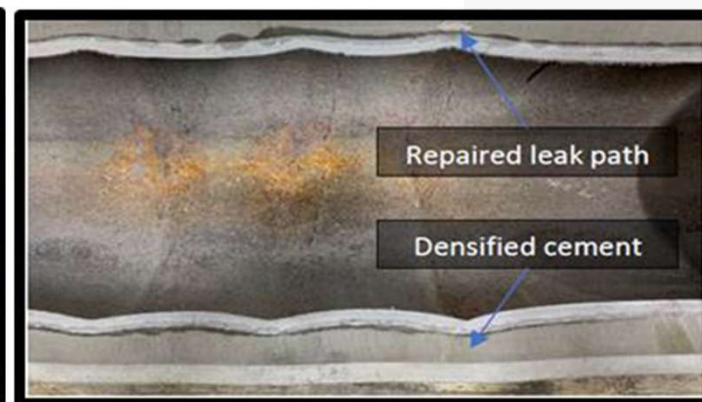
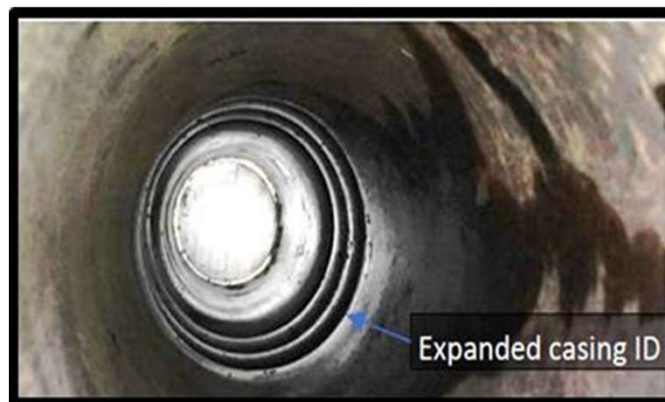
**Compromised  
annular integrity**



## Example challenge: Resolves water leakages through small channels in the cement or micro-annuli



# Expansions



1

Softer post  
compaction

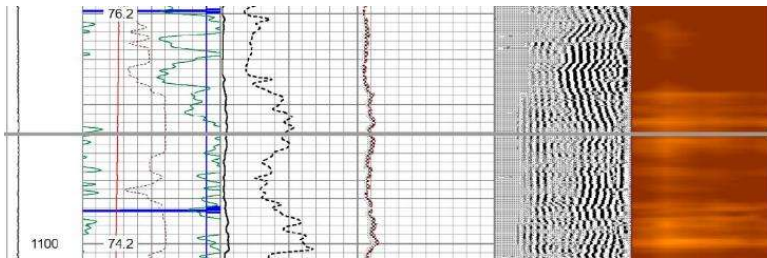
2

Rehydration

## 2-step cement densification



## 4-step solution: Log, test, shoot, validate



**1** Radial cement bond and integrity logs identify integrity issues

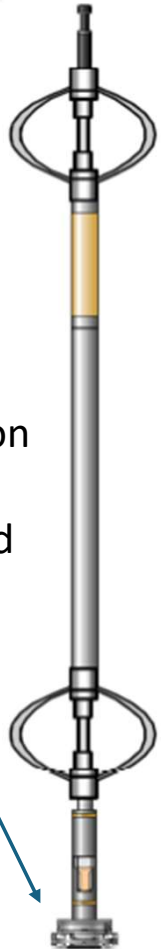
**2** Thousands of tests optimize explosive weight for reliable expansion in many grades, types and sizes



SPE  
**EnergyStream**

[STREAMING.SPE.ORG](http://STREAMING.SPE.ORG)

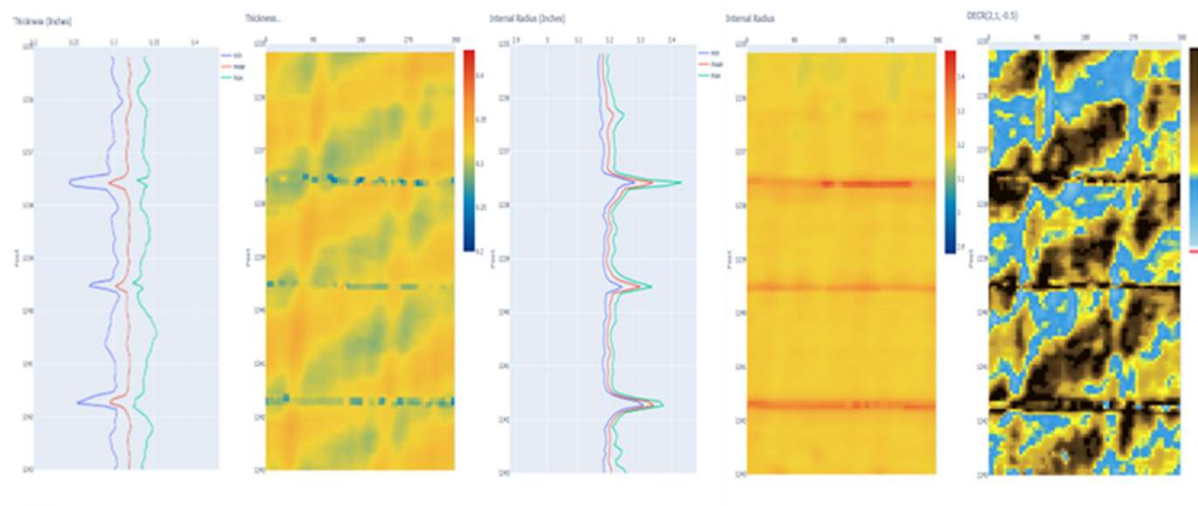
**3** Expansion charges deployed



## 4-step solution: Log, test, shoot, validate



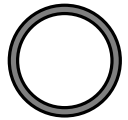
### 4 Ultrasonic casing integrity and cement evaluation logs



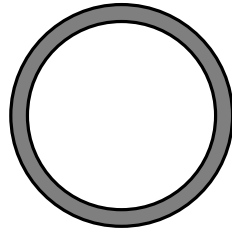
Wide variety of tubular sizes tested and proven to remediate gas and water leaks



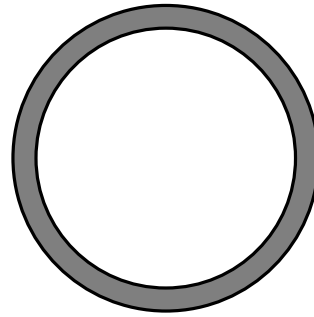
3.5 in.



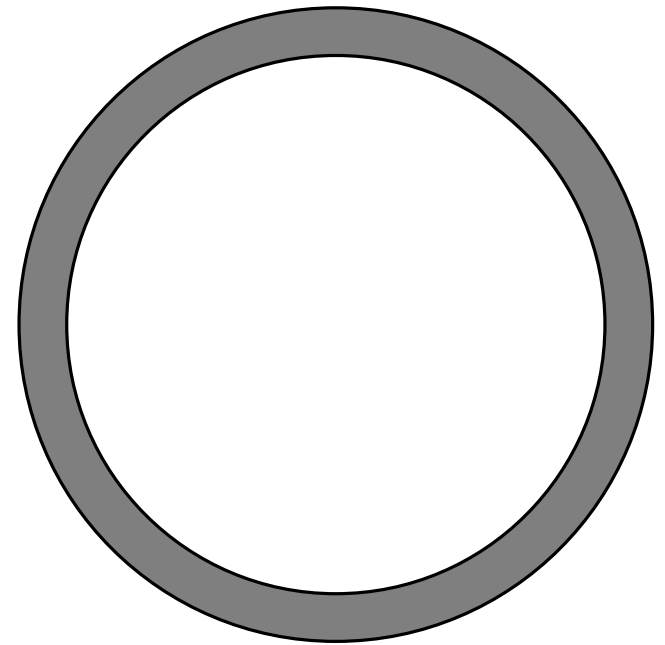
7 in.



9.625 in.



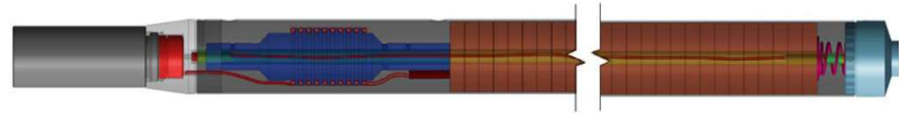
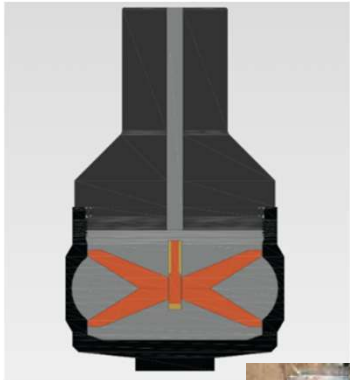
20 in.



**Expansion Charge  
Technology**

**Dual End Fired Expansion Charge Technology**

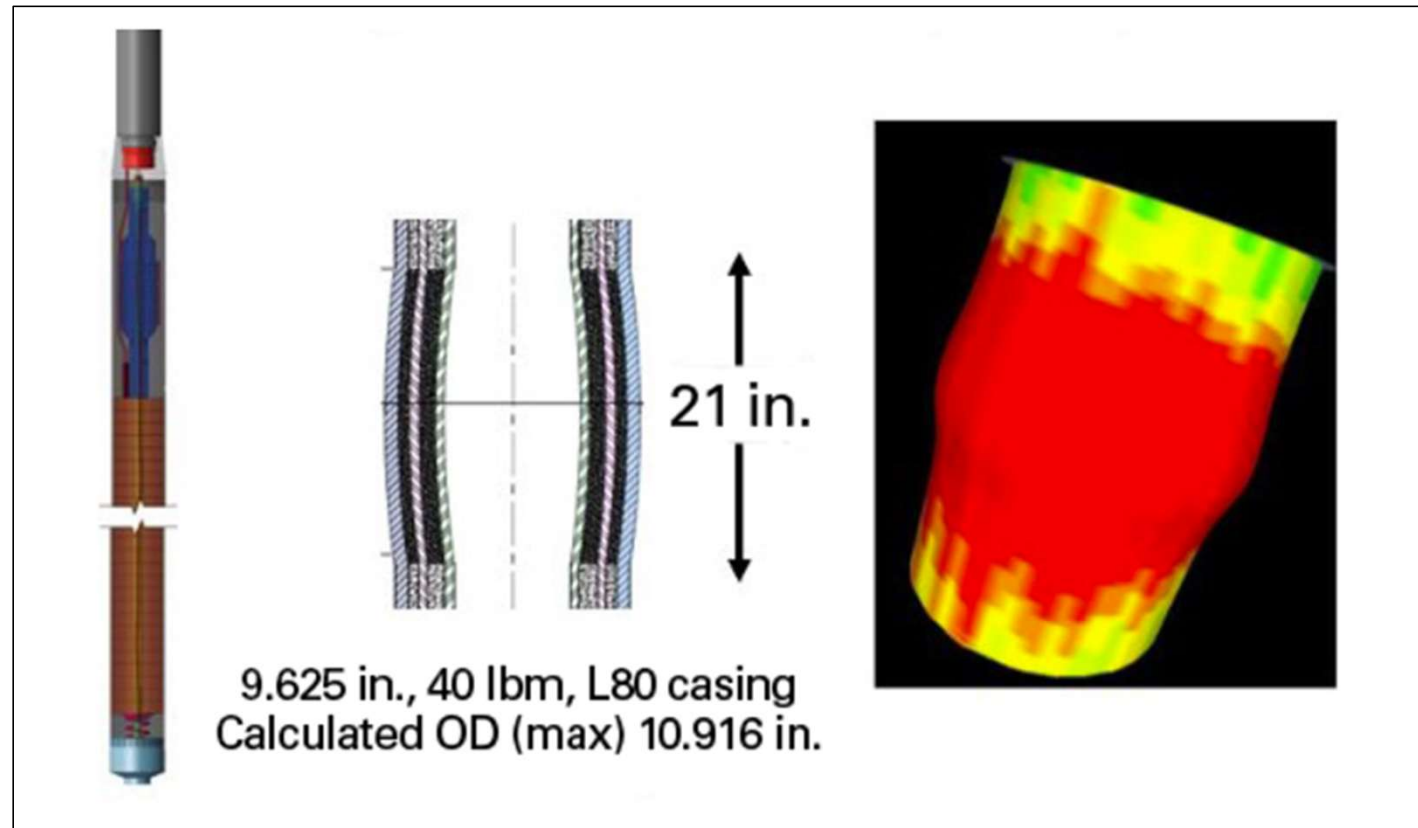
## Smaller and larger diameter solutions



**1 to 3 Expansion charges  
up to 7 in.**

**Dual End Fired Expansion Charge Technology  
>7 in. to 20 in. tested and proven**

Dual End Fired Expansion (DEFEC) charge assembly works through tubing to deliver an expansion 2.5X the charge length



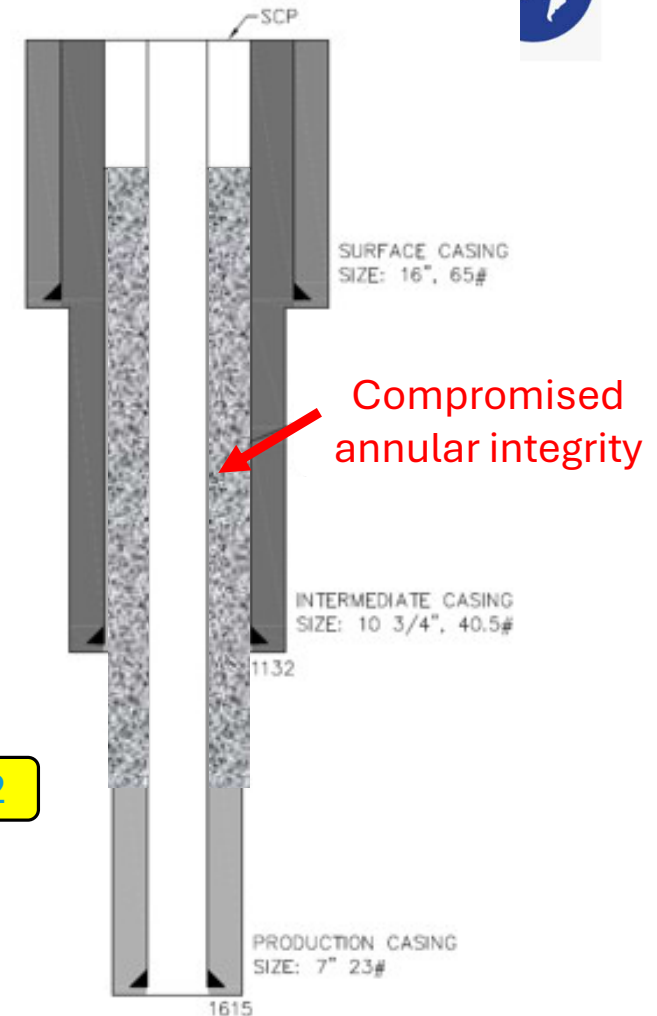
**Can also remediate B and C annuli**

## Case study: Annular seepages in gas storage wells 100% success with integrity maintained >2 years



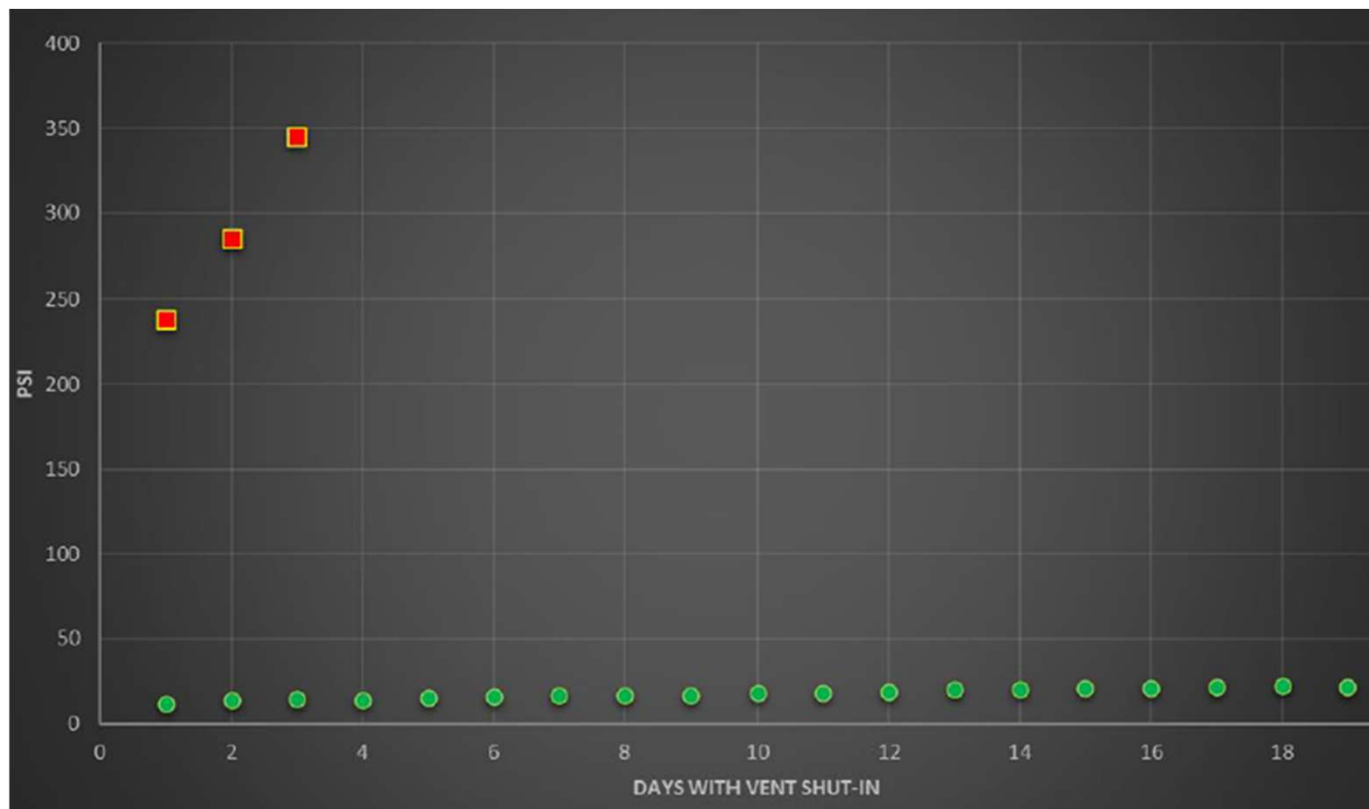
9 wells drilled and completed in 1960s

**Sustained casing pressure**



**SPE 224082**

## Illinois Basin gas storage well typical outcome: Pre-job (red) vs post-job (green) wellhead pressure





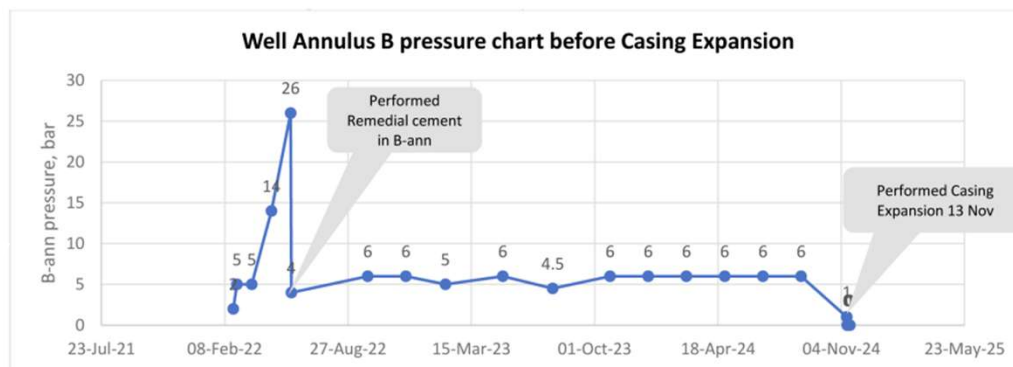
## Case study: Sealing leak paths in the B annulus from sustained casing pressure for a P&A well

**Fully eliminated B-annulus SCP from 3–6 bar to zero, enabling regulatory approval for final abandonment.**

- Controlled plastic deformation of 5.5-in. casing with 3 shots w/o inducing splits, cracks, or loss of ID.
- Confirmed uniform radial expansion by multifinger log, with ID change from 4.58 in. to 4.87 in.
- Densified annular cement with CBL bond index improving from approximately 60% to 100%.
- Sealed leak path after multiple failed perforation/squeeze attempts.
- Proven method to regain casing integrity prior to P&A'ing wells.



STREAMING.SPE.ORG

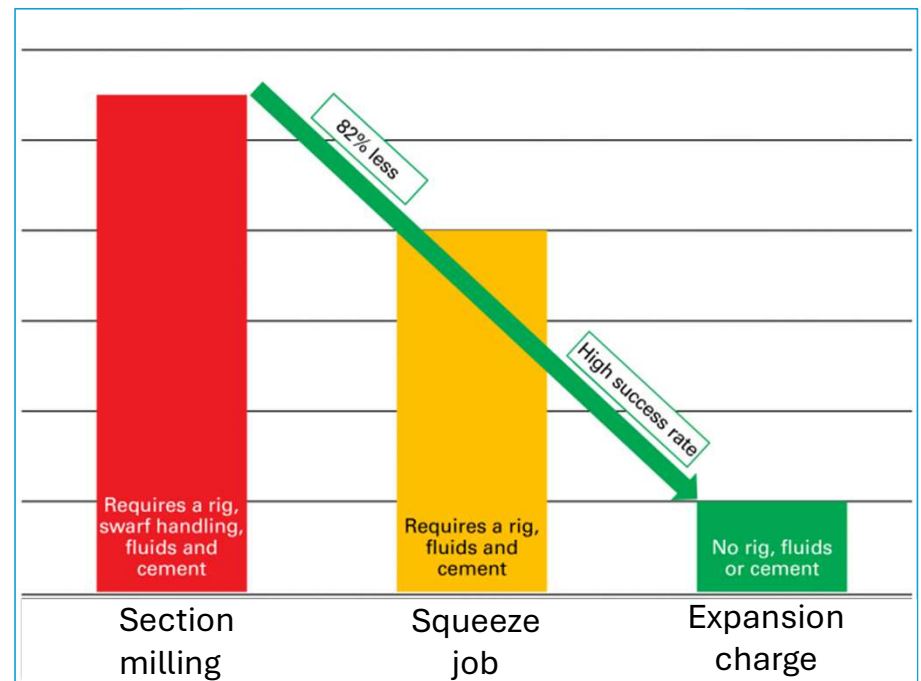


# Energetic expansion track record



- Extensive lab testing and modeling by a large international operator
- 94% annular integrity remediation success rate onshore and offshore
- Fewer POB → reduced risk
- Less diesel burn → lower GHG emissions

*Rigless, wireline operation*  
*Low-cost operation*  
*82% avg cost reduction*



# Expansion Charge Technology for Leak Remediation

The rigless intervention pipe expansion method  
to seal gas or fluid leaks

Jim Rairigh

**THANK YOU**

