Lee Energy Systems

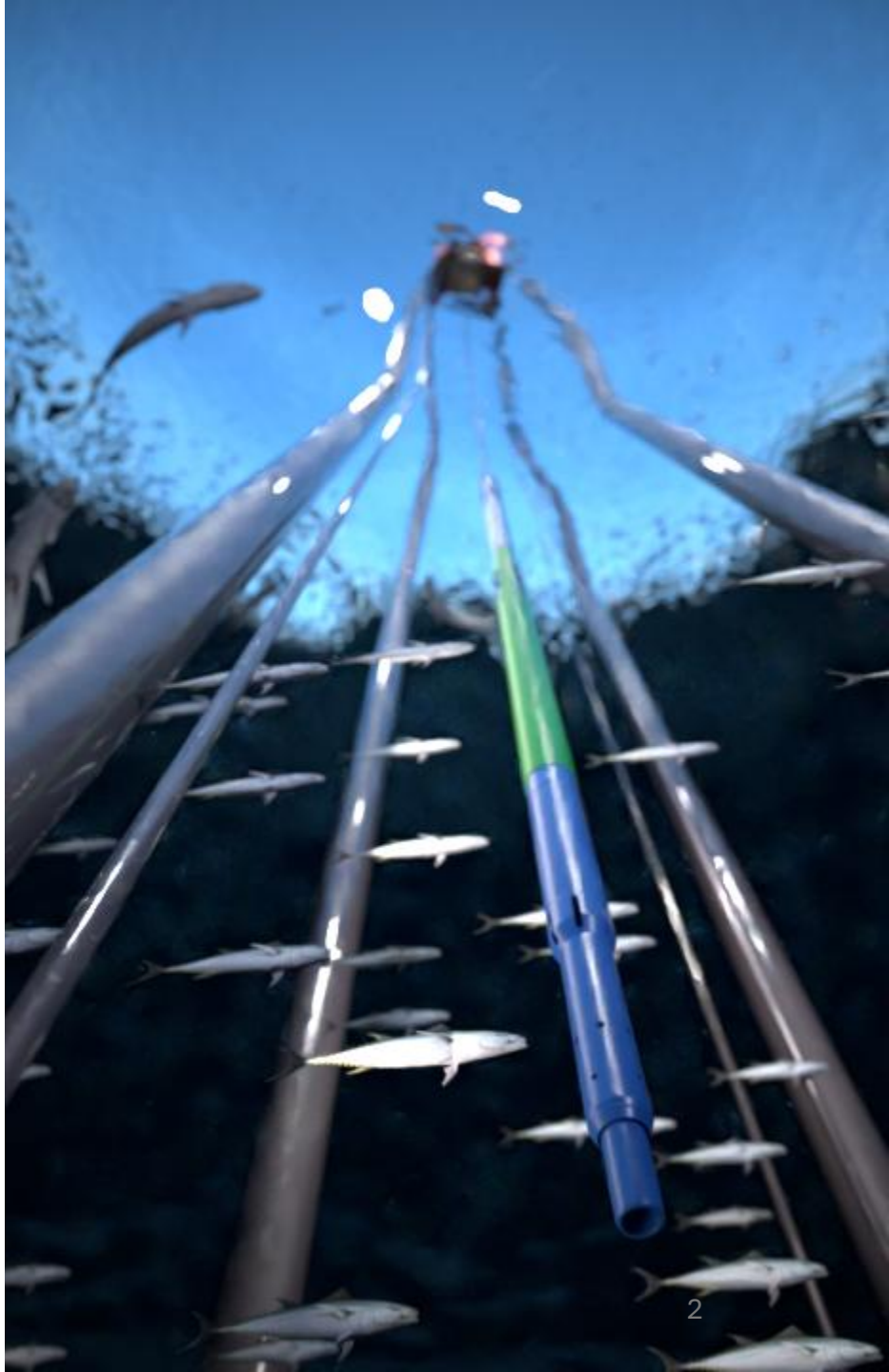
SPE Well Decommissioning Conference 2025

10th June 2025

Casing Expansion and Mechanical Perforation for North Sea P&A campaign

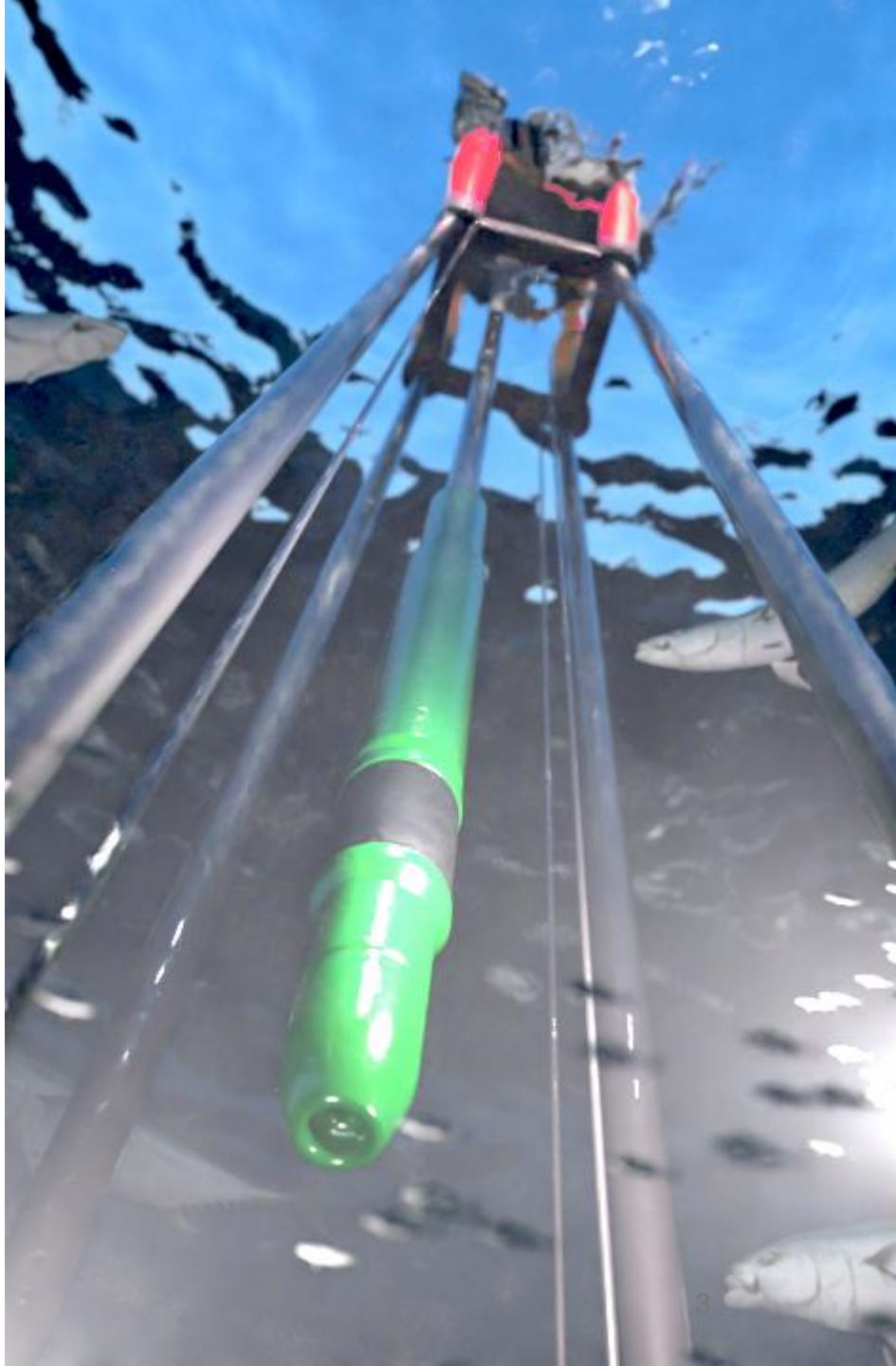
Campaign Background

- 12 well campaign.
- Initially the operators original plan was to utilise TCP to create perforations for circulation of the annulus and cement placement on the wells.
- OPRED pushed back the operators original plan for using TCP so close to the seabed, and a marine licence was almost not granted for the P&A work, so they required a different solution.
- After reviewing previous wells completed in conjunction with the Lee Energy Solutions equipment globally, they decided the Gator Mechanical Perforator would be the best fit for the campaigns due to its success record, of over 1900 runs and wells completed, and its flexibility and compatibility with other BHA components, enabling multiple operations to be completed on the same run.
- Lee Energy's latest casing expander technology was also chosen; to provide a base in the A & B annulus this allowed the operator to prove the cement would not slump in the annulus.



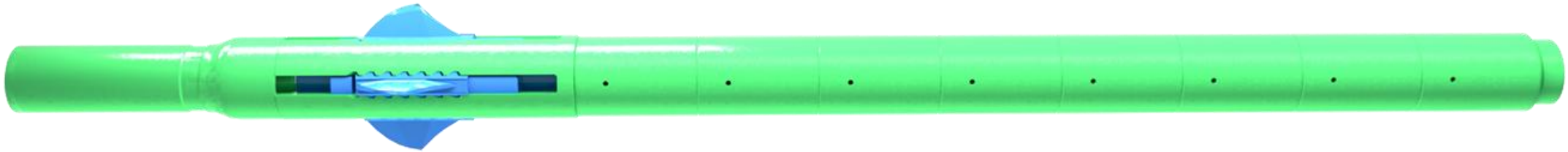
Solution and Flexibility

- The early engagement from the operator, allowed us to work collaboratively to plan the best solutions for their wells, utilising technology from Lee Energy and our Agent Coretrax “an Expro Company”
- This collaboration of over 3 years gives operators one point of contact and one company for their P&A requirements for tools such as casing perforators, plugs, packers, and circulation tools.
- After a period of planning, a selection of proposed BHA’s were given for approval the different well scenarios.
- Initially the main BHA proposed to the operator included a Test Packer, Gator mechanical perforator, circulation sub and bridge plug in one dedicated BHA. This BHA allows for a mechanical base to be set for cement and multiple perforations and circulations to be completed should the annulus be packed off with debris all in one trip.
- With the introduction and first successful runs of the Mega Packer casing expander it was decided the bridge plug was no longer needed as the Mega Packer creates a base in the A&B annulus.



Tools Utilised on the Campaign

GATOR Mechanical Perforator



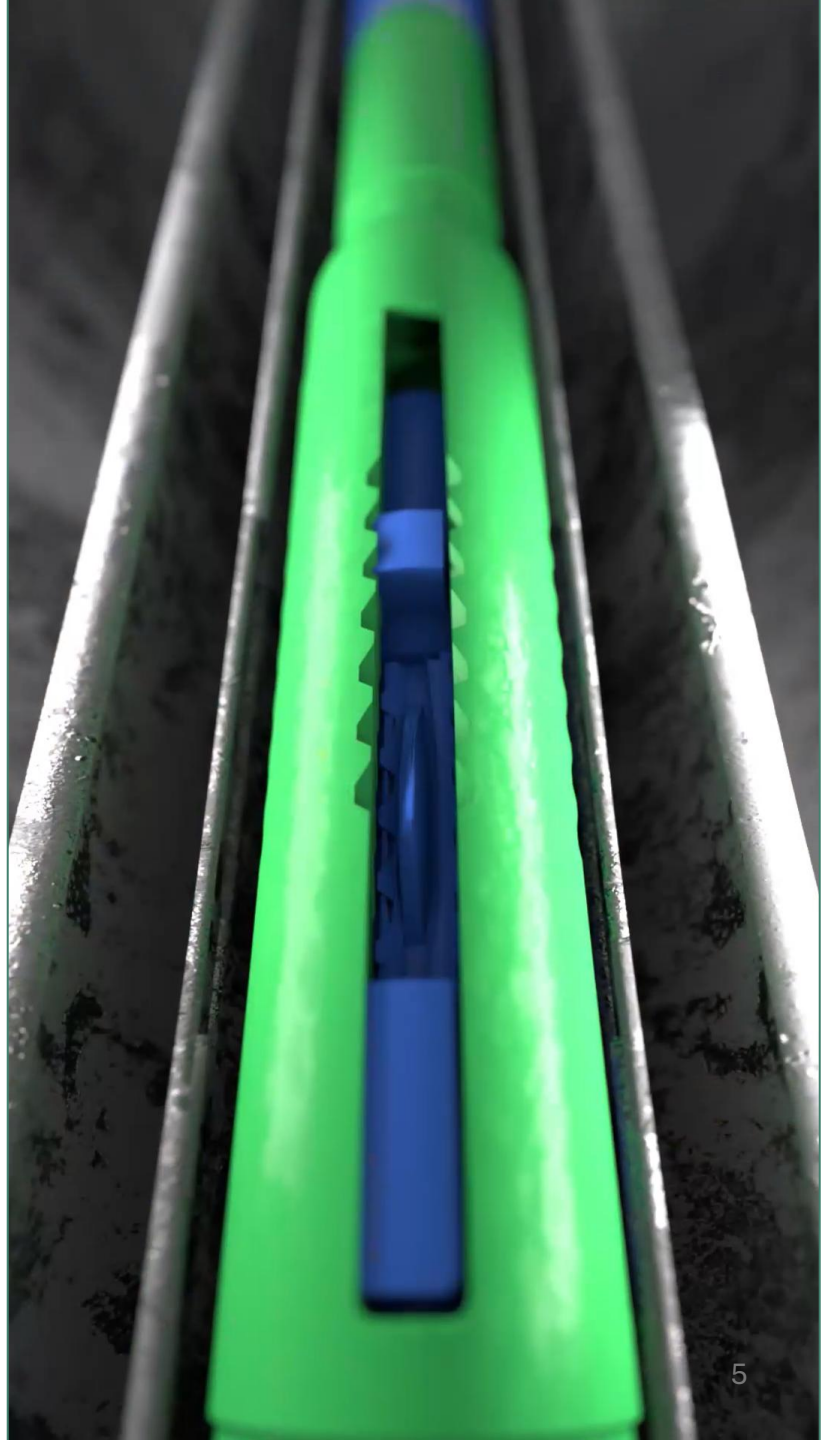
Information

- Ability to Perforate 3 ½” – 20” casing.
- Explosive free.
- Remove the cost and complexity of operating explosive perforating guns.
- Reduced HSE exposure for personnel, reduce personnel in red zone.
- Easier handling and transport due to smaller operational footprint.
- Make fewer lifts due to smaller footprint.
- Flexibility for combined operations in one-trip with fewer personnel.
- Can be run on coiled tubing with over 400 runs on coil to date. Thus eliminating the need for a rig, creating substantial savings.
- Run in live-well environment.
- No internal casing burrs or deformation – allowing full bore tool access.

- 4 large TFA slots created per activation.
- Scallop shape aids in creating annulus standoff.
- Perforations all face the same direction creating a turbulent effect when cleaning the annulus.

- Perforation blade does not leave the casing body so no risk of damaging the casing on the back side.
- Depth of penetration can be controlled should there be a restriction in the annulus.

- No internal burrs created.
- All deformation is at the point of contact with the casing.
- ID remains the same above and below the perforation

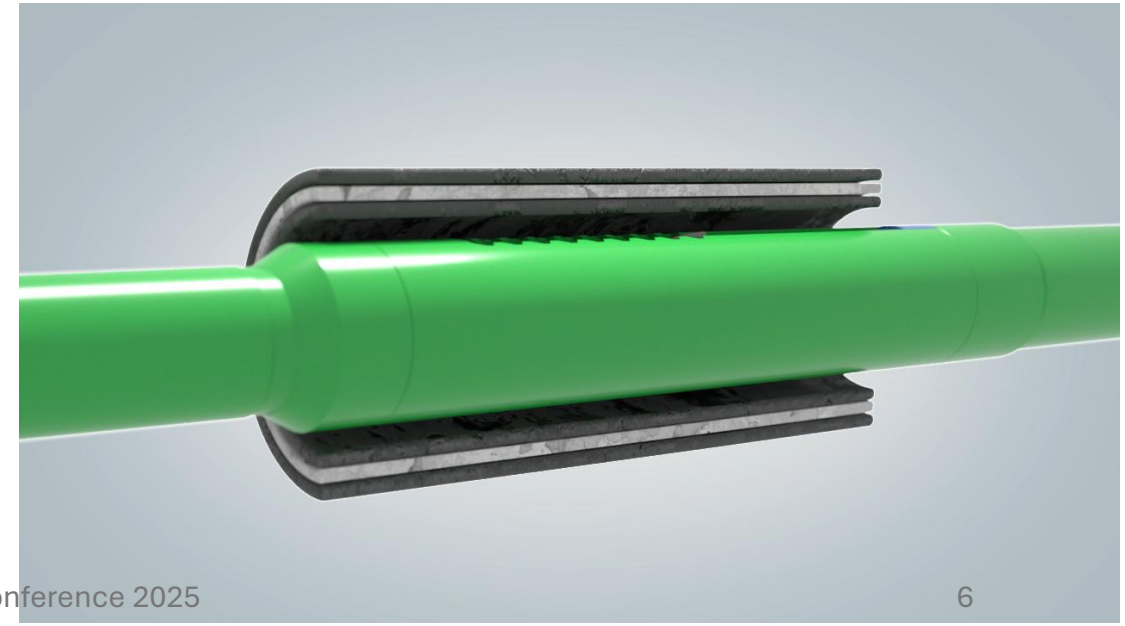


GATOR DPT

Deep Perforating tool – Dual Casing Mechanical Perforator

Information

- Ability to Perforate 3 ½” – 20” casing.
- Can perforate two casing strings out to formation at once.
- Remove the cost and complexity of operating explosive perforating guns.
- Reduced HSE exposure for personnel, reduce personnel in red zone.
- Easier handling and transport due to smaller operational footprint.
- Can also be run on coil tubing.

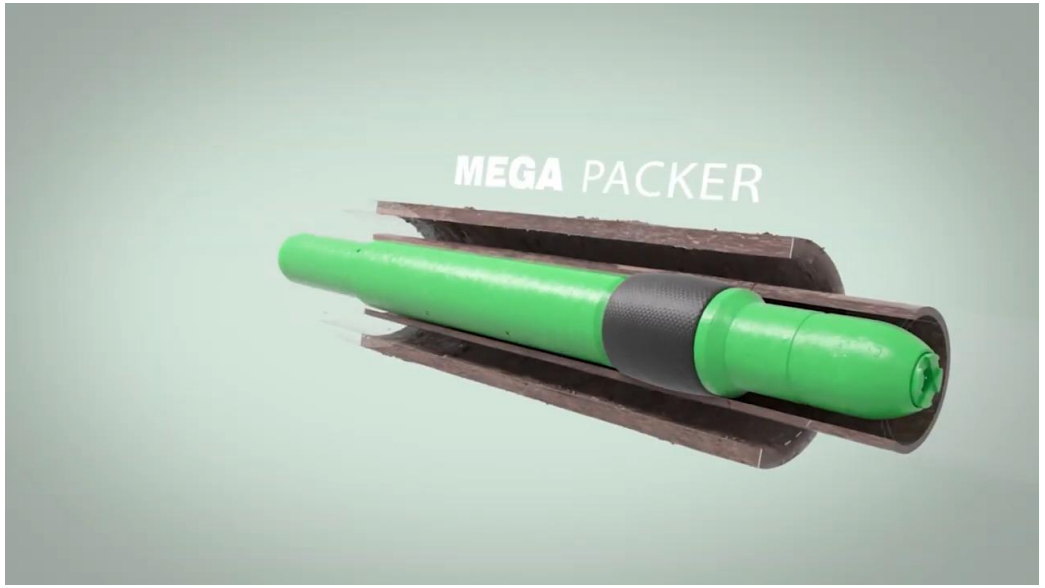


MPX – MEGA PACKER

Mega Packer Casing Expander

Information

- Latest Lee Energy Technology.
- 8 successful Runs globally.
- We can currently expand 7”, 7 5/8” and 9 5/8”.
- Once Expanded the tool creates a base for cement in the A&B annulus.



Tapered String Perforate, Circulate, Cement (PCC) and Casing Expansion

Case History #1

250t

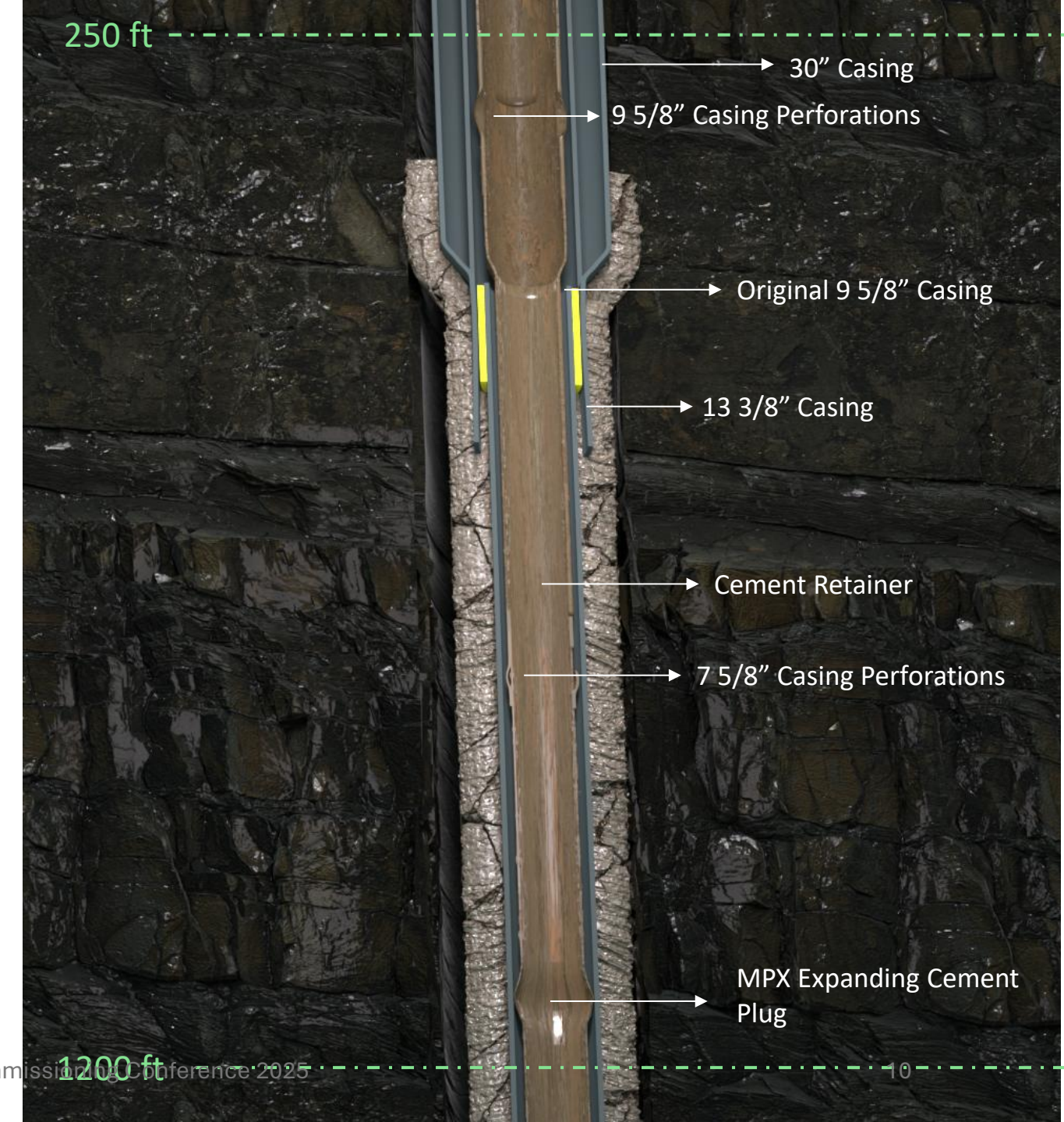
Well Overview

- Well intervention work had previously been carried out on this well where the original 9 5/8” casing had been cut.
- There was potential OBM trapped behind this string highlighted in yellow.
- A combination 9 5/8” x 7 5/8” was then run. This string was not cemented and contained sea water

1200 ft

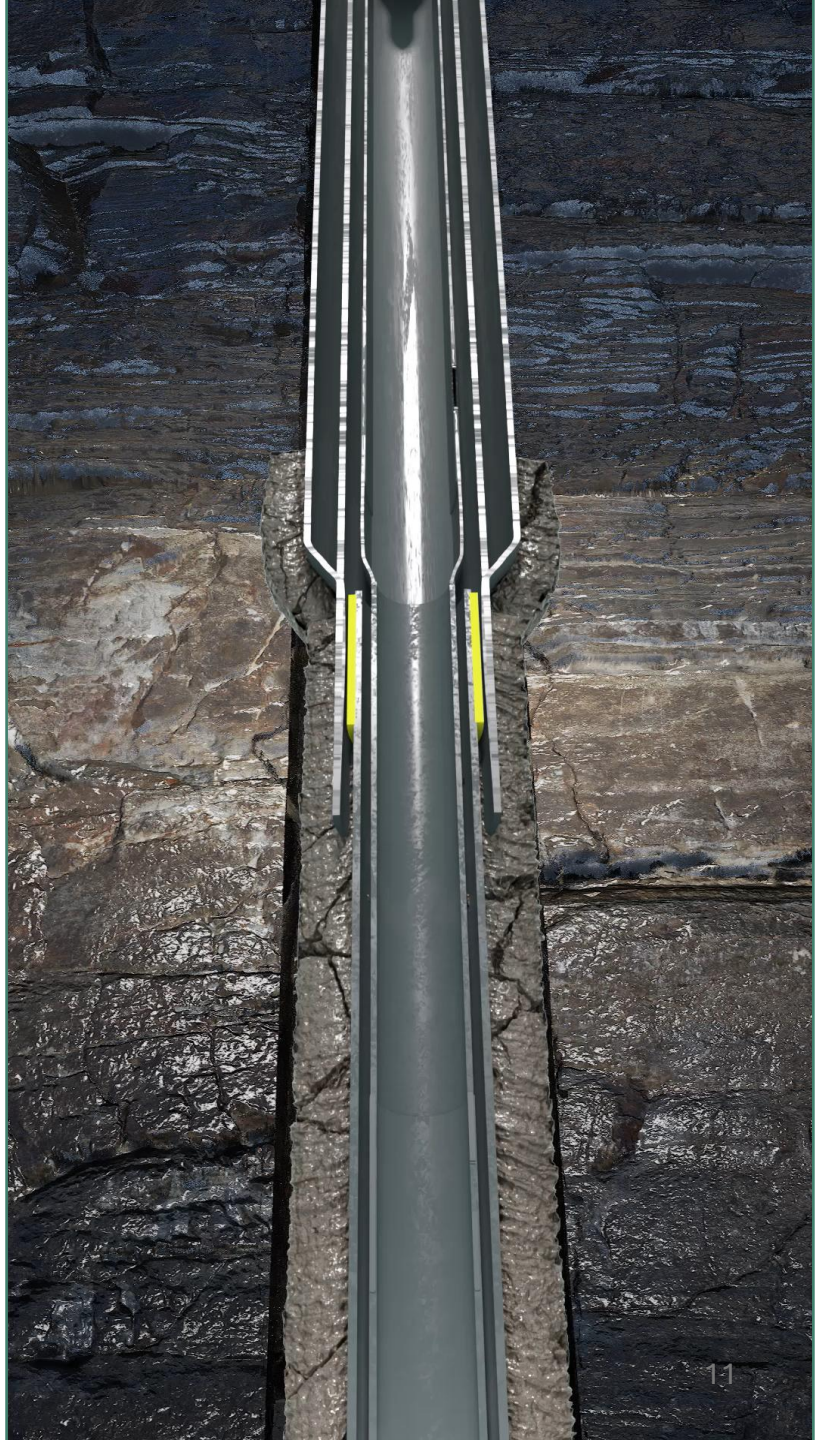
High Level Operational Steps

- Run 825 Gator and punch 9.5/8” casing shallow (below seabed)
- Run and set Mega-Packer, expanding 7.5/8” tieback into original 9.5/8” casing.
- Run Gator and perforate the 7.5/8” casing tieback just above set Mega-Packer.
- Set CX - RTP packer in 7.5/8” tieback, circulate out inhibited seawater from B annulus.
- Run and set CX-SVE Cement Retainer in 7.5/8” casing.
- Circulate B annulus to cement to seabed – Thereby encapsulating the section of OBM (yellow)
- Pressure test B annulus cement



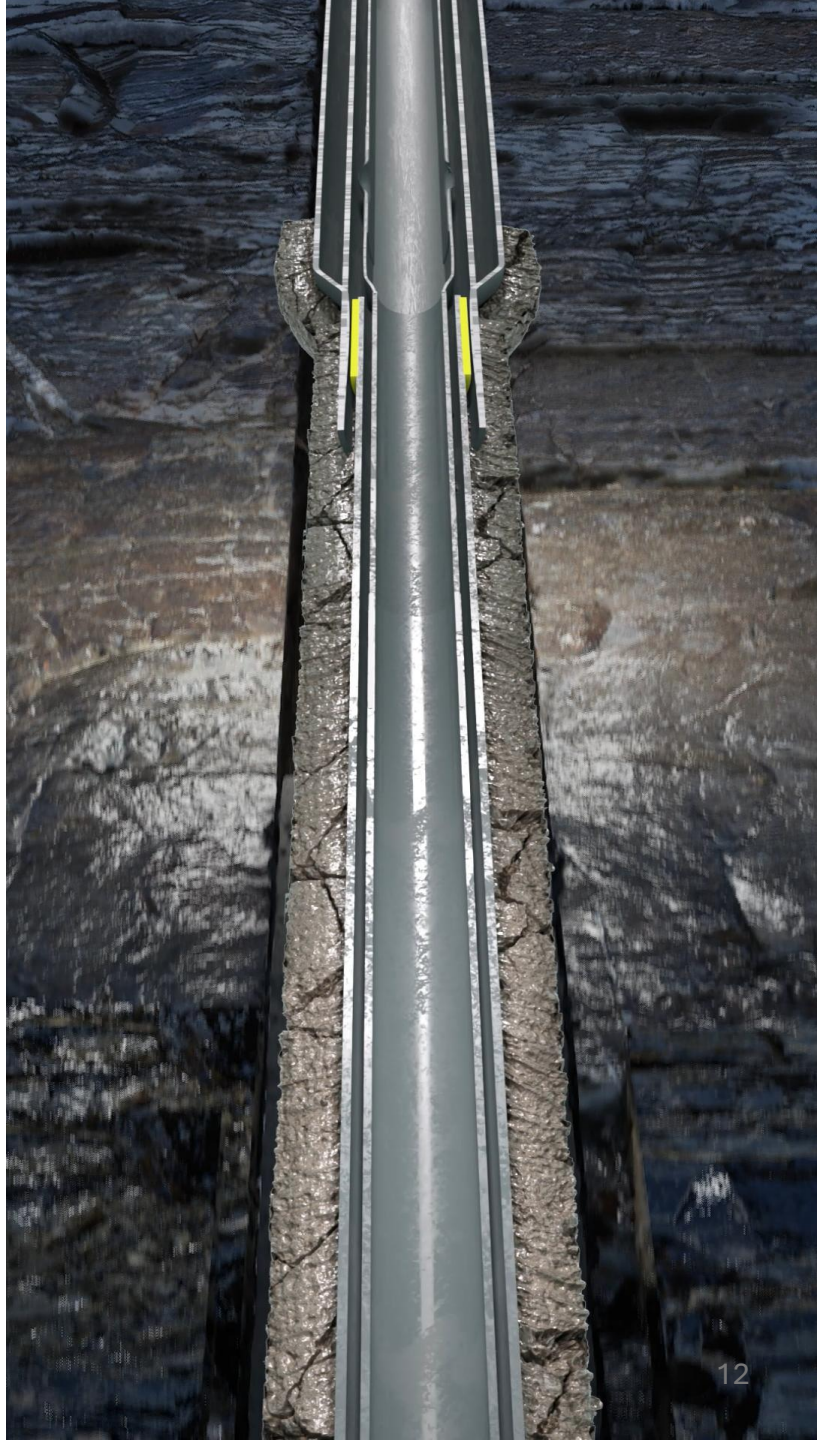
GATOR PERFORATOR

- **Run 825 Gator and punch 9.5/8” casing shallow (below seabed)**



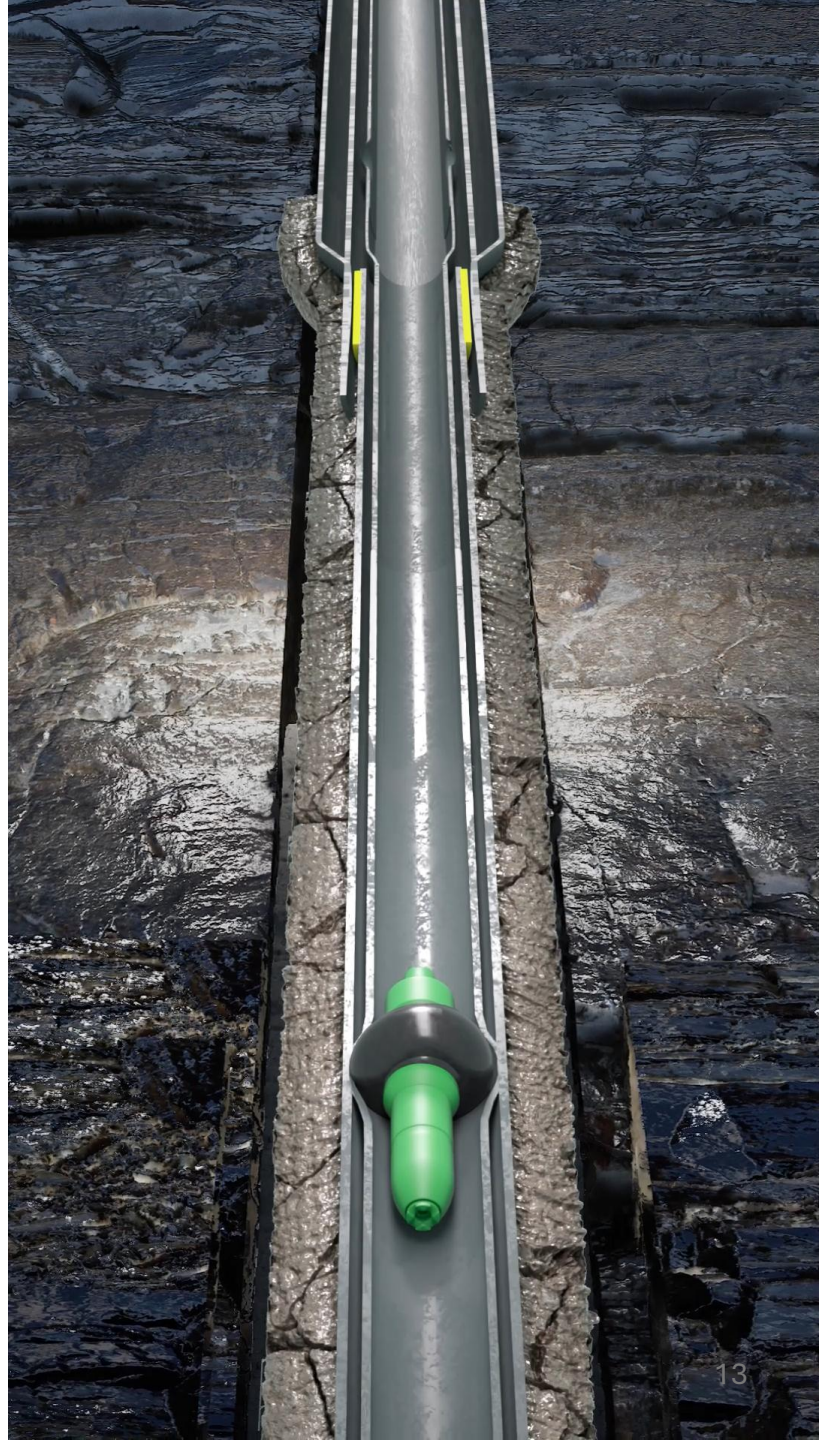
MEGA PACKER

- **Run and set Mega-Packer, expanding 7.5/8” tieback into original 9.5/8” casing**



GATOR & PACKER

- Run Gator and perforate the 7.5/8” casing tie back just above set Mega-Packer
- Set CX-RTP packer in 7.5/8” tieback, circulate out inhibited seawater from B annulus

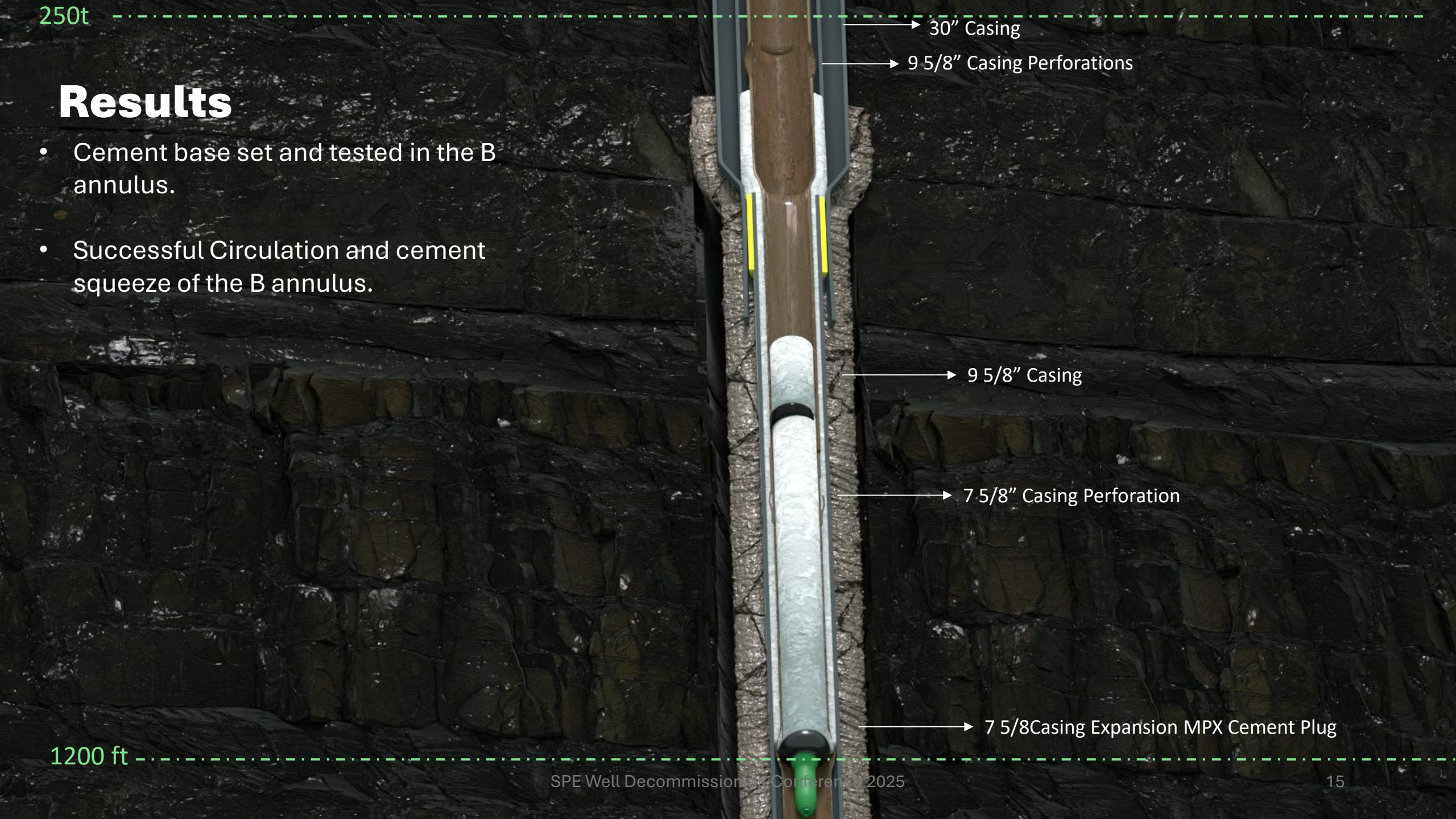


CEMENT RETAINER

- Run and set CX-SVE Cement Retainer in 7.5/8” casing
- Circulate B annulus to cement to seabed (green) – Thereby encapsulating the section of OBM (yellow)
- Pressure test B annulus cement

Results

- Cement base set and tested in the B annulus.
- Successful Circulation and cement squeeze of the B annulus.



Dual Casing Perforate, Circulate, Cement (PCC) and Casing Expansion

Case History #2

Well Overview

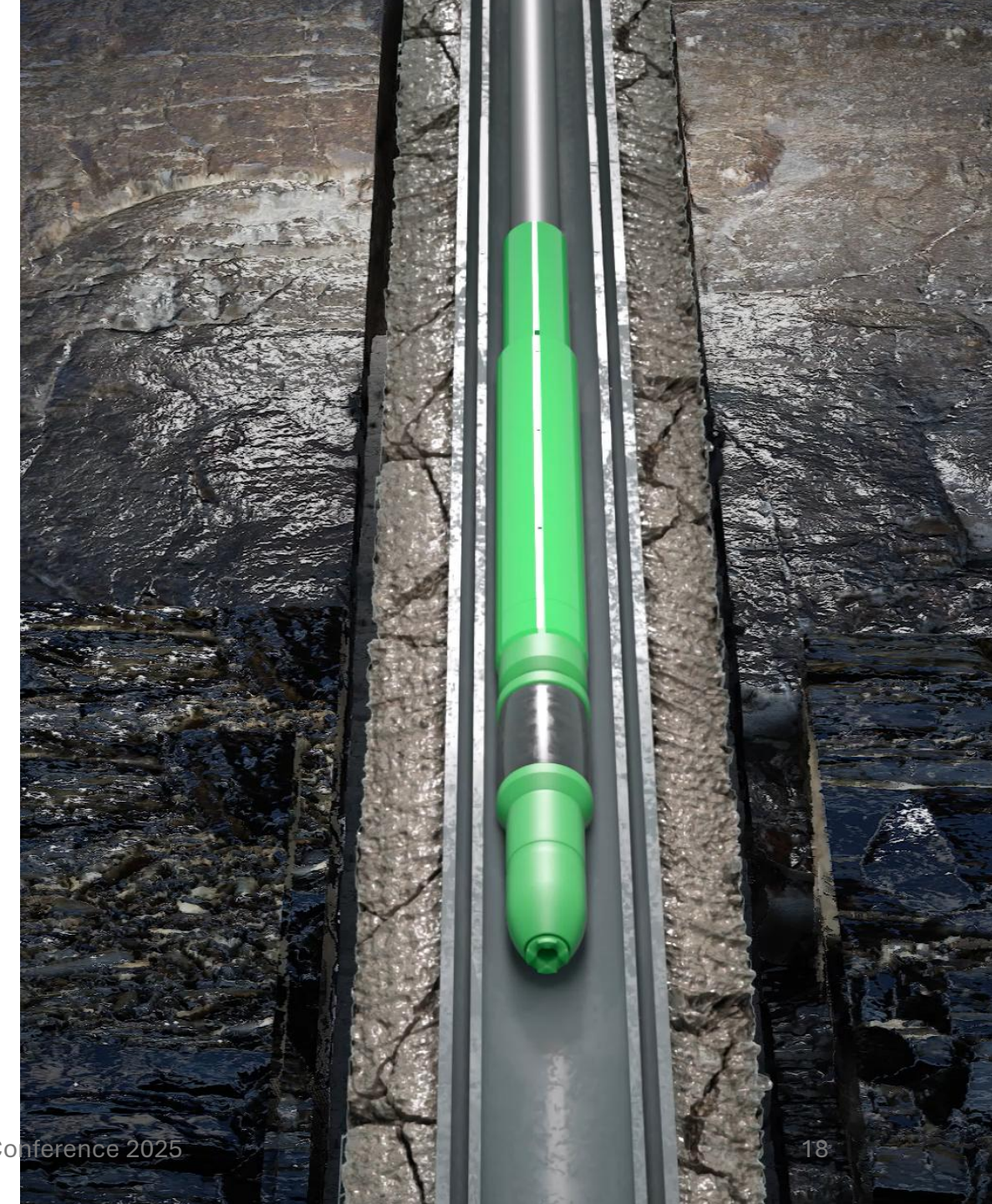
High Level Steps

1. Run in MPX to 1728ft and set as cement foundation for the A&B annulus.
2. Use the Gator Perforator to gain access to the B Annulus and circulate clean, then place cement.
3. Use the Dual casing mechanical perforator to Perforate 9-5/8” x 13-3/8” casing, clean the C Annulus then place cement.

Run # 1

MPX – Casing Expander

- Run in MPX to 1728ft and set as cement foundation.



Run # 2

Perforating B annulus to gain circulation for cementing B annulus with the Gator Mechanical Perforator.

- BHA was picked up and RIH to a depth of 260ft and the tool was activated; a further activation was made at 262ft.
- The BHA was then tripped into 1698ft the tool was activated; a further activation was made at 1696ft.
- The Coretrax CX-RTP packer was placed at 1670ft. Circulation was then attempted between the upper and lower perforations without success, pressuring up to 900psi.

Multiple Perforations and Circulations

- As you can see from the table on the right multiple perforation and circulation attempts were made, finally achieving circulation in the B annulus at 305ft.
- This was Circulation between perforation depth 262ft and 305ft with the packer set at 278ft.
- Once circulation was confirmed and returns were seen at surface the circulation sub was opened and rates achieved via the upper and lower perforations was 7bpm @ 90psi.
- The BHA was then POOH.
- One of the key benefits of the Gator and CX-RTP packer combinations is the repeatability of both tools.

Seq	Depth (ft)	Packer Setting
1	262	
2	260	
3	1698	
4	1696	
1	1670	Circulation attempted after setting RTP @ 900 psi – no success
5	1573	
6	1571	
2	1564	Circulation attempted after setting RTP @ 900 psi – no success
7	1479	
8	1475	
3	1452	Circulation attempted after setting RTP @ 900 psi – no success
9	1384.5	
10	1382	
4	1370	Circulation attempted after setting RTP @ 900 psi – no success
11	1006	
12	1004	
5	982	Circulation attempted after setting RTP @ 900 psi – no success
13	819	
6	791	Circulation attempted after setting RTP @ 900 psi – no success
14	535	
7	509	Circulation attempted after setting RTP @ 900 psi – no success
15	305	
8	278	Circulation attempted after setting RTP @ 300 psi – successful

Run # 3

Perforating B and C annulus to gain circulation for cementing C annulus.

- Planned perforation depths 280ft ,270ft, 1210ft and 1200ft
- BHA was picked up and RIH to a depth of 280ft and the tool was activated; a further activation was made at 270ft.
- The BHA was then tripped into 1210ft the tool was activated; a further activation was made at 1200ft.
- The Coretrax RTP packer was placed at 1180ft. Circulation was then attempted between the upper and lower perforations without success, pressuring up to 900psi.

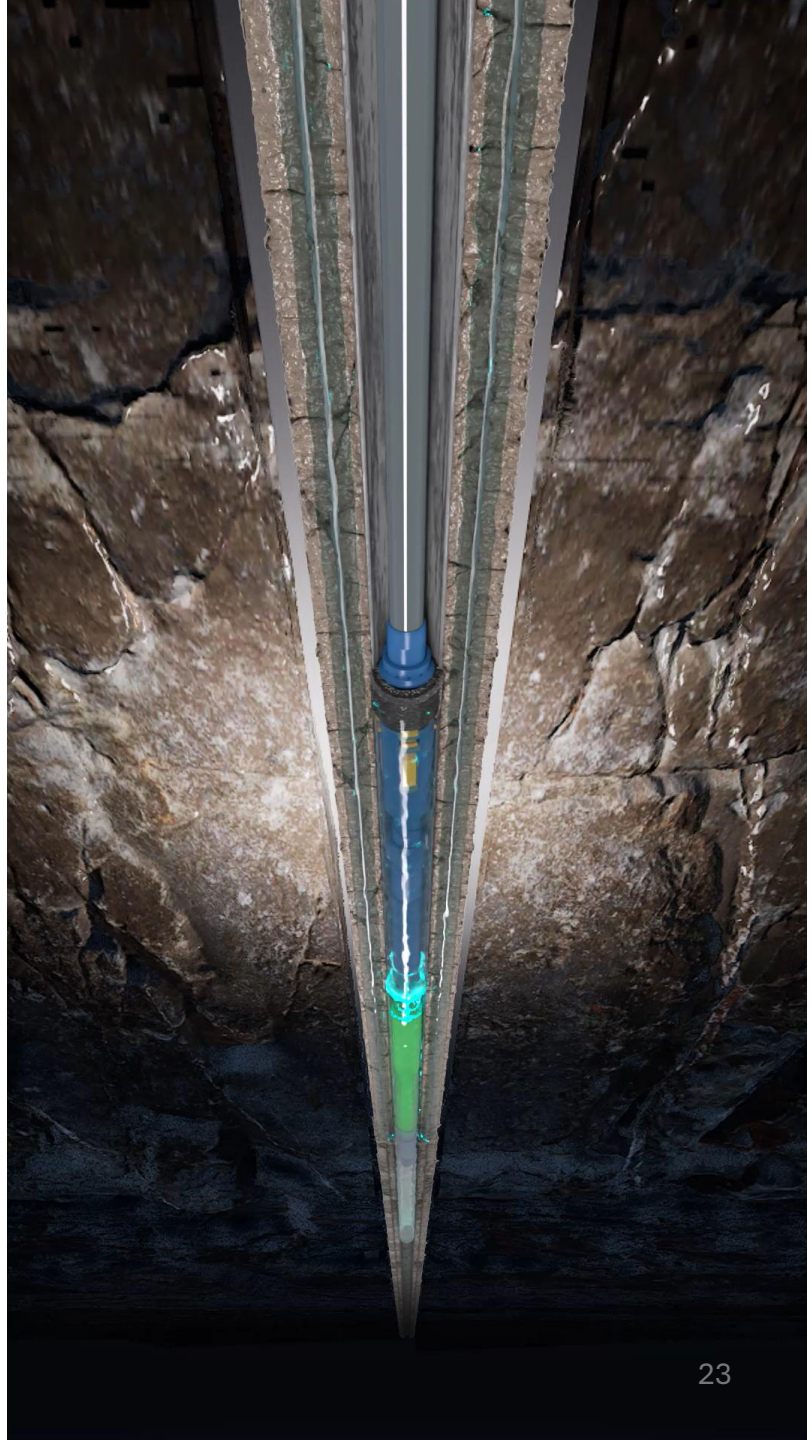
Multiple Perforations and Circulation attempts

- As you can see from the table on the right multiple perforation and circulation attempts were made, finally achieving circulation in the C annulus at 800ft This was Circulation between perforation depth 280ft and 800ft with the packer set at 765ft.
- Once circulation was confirmed and returns were seen at surface the circulation sub was opened and rates achieved via the upper and lower perforations was 5.5bpm @ 170psi.
- The BHA was then POOH.
- Cement retainer was then run to place cement in the C annulus.

Seq	Depth (ft)	Packer Setting
1	280	
2	270	
3	1210	
4	1200	
1	1180	Circulation attempted after setting RTP @ 900 psi – no success
5	1000	
6	990	
2	965	Circulation attempted after setting RTP @ 900 psi – no success
7	800	
8	790	
3	765	Circulation attempted after setting RTP @ 850 psi – success

Run # 4 & 5
CEMENT RETAINER

- CX-2 Bridge plug was run prior to Cement retainer run to reduce the sump from the set MPX at 1728ft.
- CX-SVe Cement retainer was then run and set to place cement into the C Annulus.



Thank you | Questions

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A special thanks to the whole team at Coretrax for their dedication and support to continued successful operations.