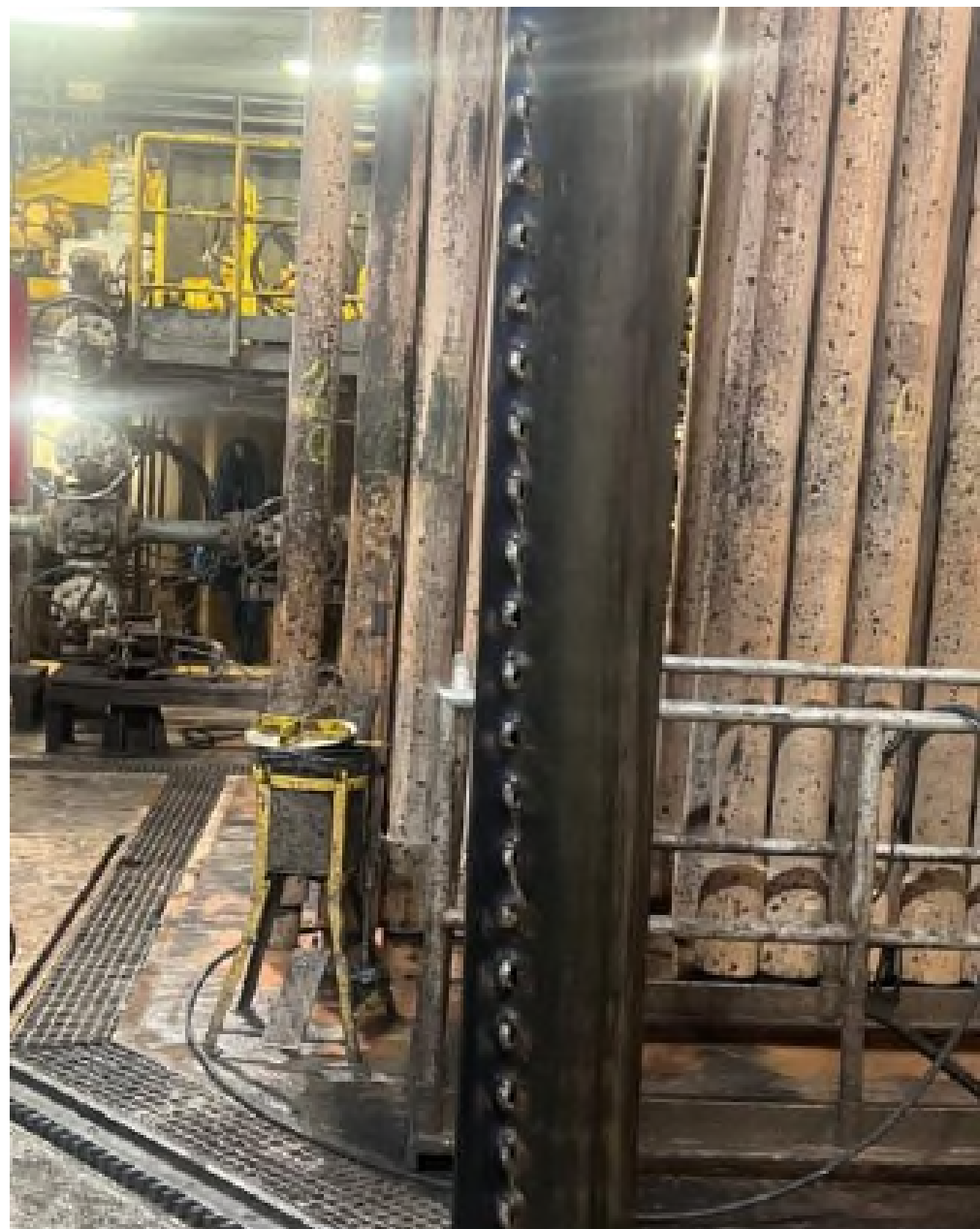




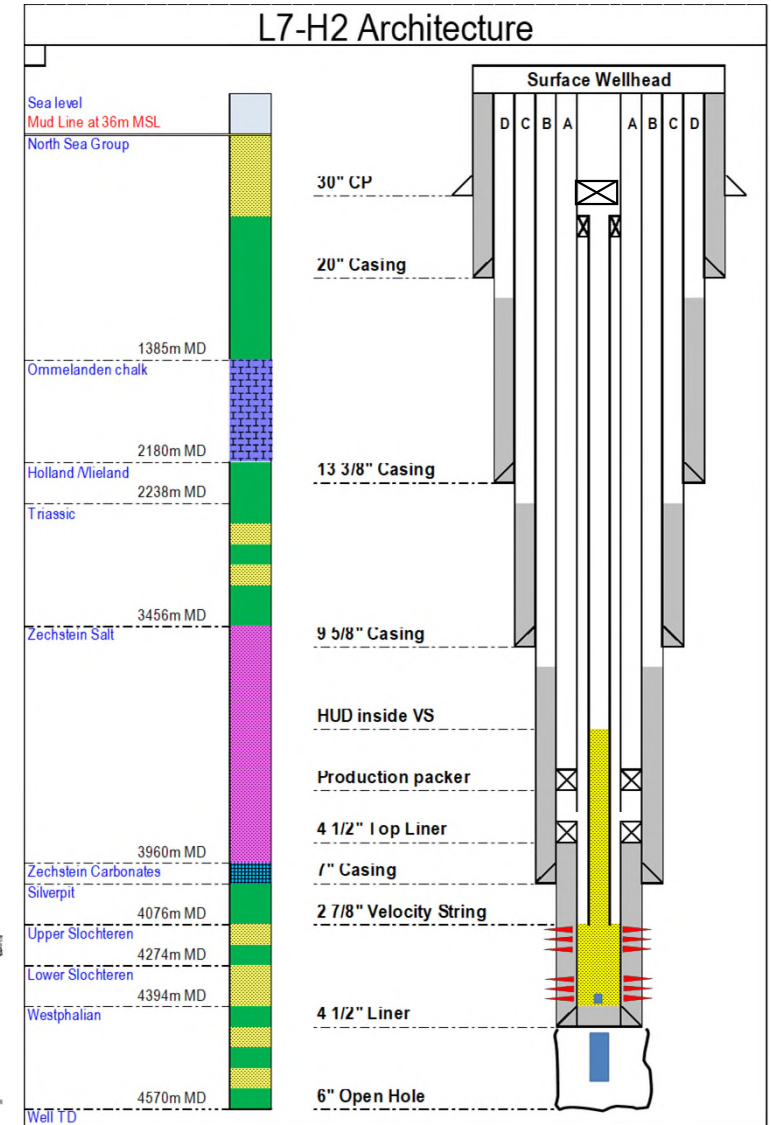
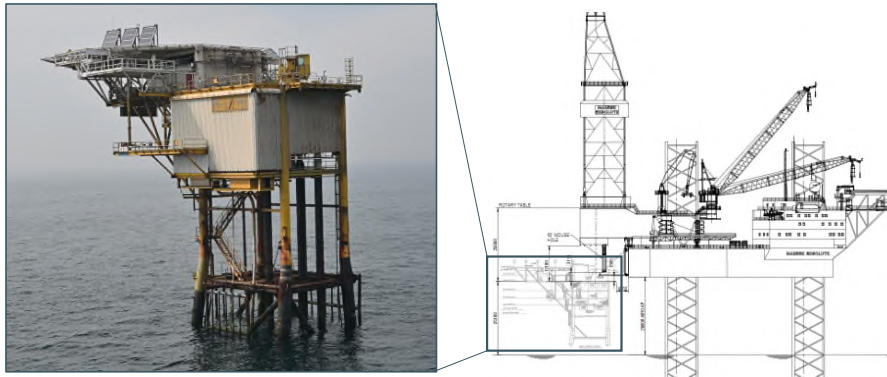
TotalEnergies

USE OF SLOT-JET-ISOLATE FOR CASING RECOVERY APPLICATION



L7-H2 OVERVIEW

- Well was located on L7-H satellite platform, Dutch sector SNS
- Drilled in 1989
- Gas producer
- Well configuration:
 - J-shape well with max 30° inclination
 - Heavy-Architecture, with 2" and 7" casing
 - Completed with 4 1/2" tubing and perforated 4 1/2" liner
 - 2-7/8" coiled tubing velocity string (CTVS) installed in 2011
- Abandoned in Dec'22 – Feb'23



L7-H2 P&A DESIGN

• CP #1 – Reservoir isolation

Objective:

- **IZI #1 isolation** (group of below-salt flow zones)
- IZI #1: **gas bearing**, depleted (118 bar / 0.3sg EMW), potential re-pressurization to 1.10-1.12 sg EMW in geological timeframe

Strategy:

- 60m Combined barrier (annulus cement logged)
- Leave production packer in place (*non-retrievable*)
- Set across Zechstein Salt or Buntsandstein shale

• CP #2 – Isolation of intermediate flow zones

Objective:

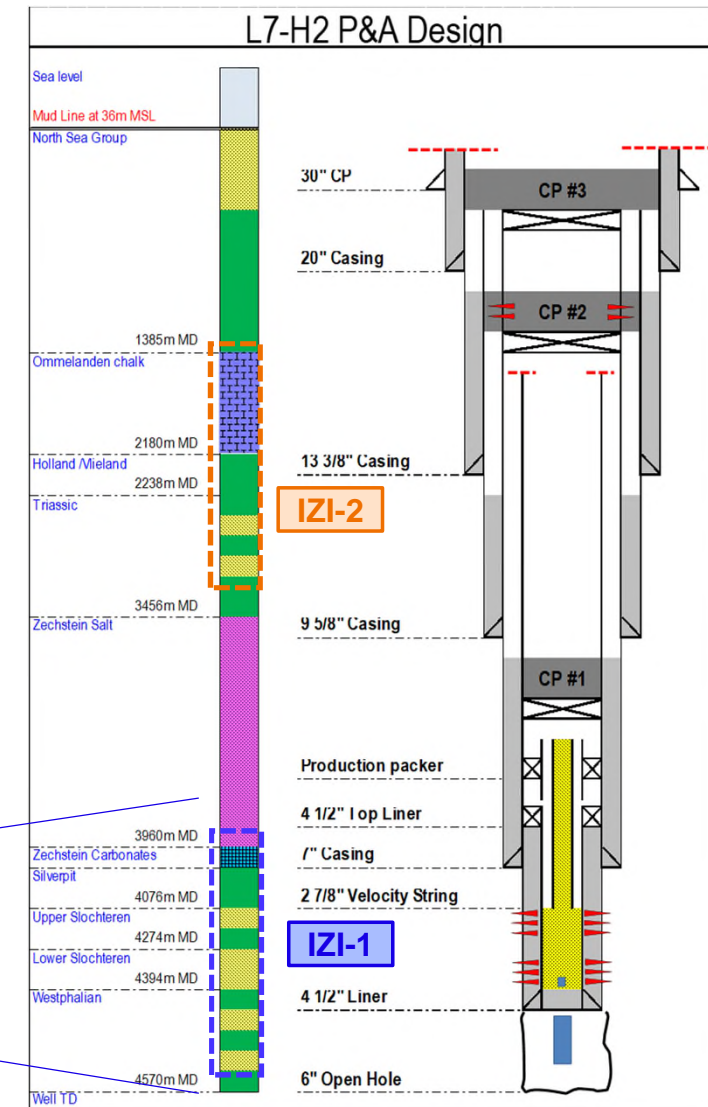
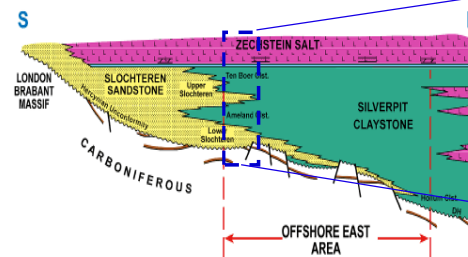
- **IZI #2 isolation** (group of above-salt flow zones)
- IZI #2: **water bearing**, very poor reservoir properties, 1.15-1.17 sg EMW

Strategy:

- 50m barrier (*by Perf & Wash in a base case*)
- Set across Lower North Sea Group

• Environmental Cement plug

- NABM in B- and C-annulus
- Cut Casings **6m below** mudline



7" CASING CUT & PULL

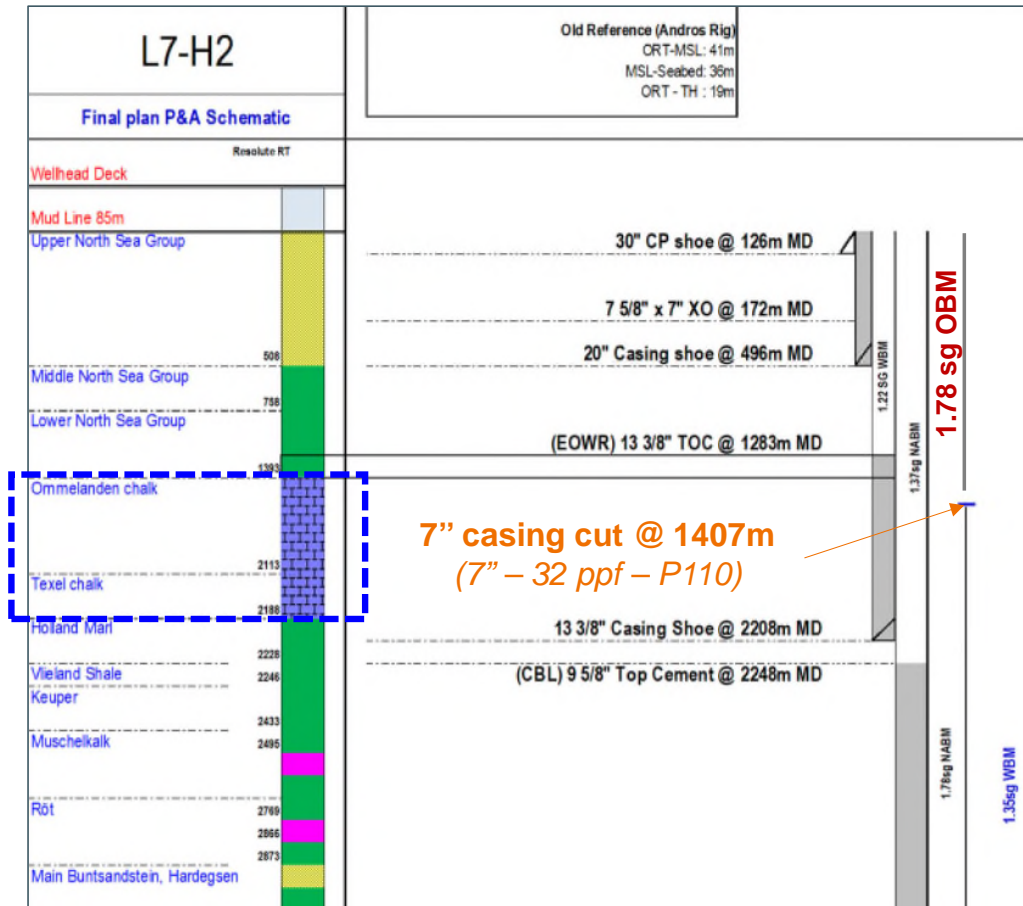
- Reservoir was successfully abandoned after CTVS recovery
- Next step: intermediate water bearing flow zone abandonment (Ommelanden chalk):
 - Cut 7" casing at the top of Ommelanden. Pull to surface
 - Set abandonment cement plug by PWC

Operations overview:

- Cut 7" casing at 1407m. Positive indications of cut.
- Attempt to displace 7" x 9-5/8" annulus w/ 130 bar – negative
- Attempt to pull 7" casing – negative with 180T HL (100T overpull)

Options:

- Conventional cut & pull in short sections
- Thor system from Archer
- Downhole jack
- Section milling / swarfless section milling
- **Slot-Jet-Isolate**. Selected based on:
 - Flexibility of the proposed solution
 - Availability (mobilized on short notice)



7" CASING SLOT-JET-ISOLATE

Casing recovery plan:

- Identify intervals of settled solids with ultrasonic log (CAST-CBL)
- Run Slot-Jet-Isolate BHA with 7" wash cup positioned below SJ tool
- Displace well to 1.35 sg WBM above 7" casing cut
 - In order to provide rheology and solids carrying capacity
- Slot 1m of 7" casing above the top of identified solids accumulation
- Displace 7" x 9-5/8" annulus above the slots from OBM to 1.35 sg WBM
- Slot & jet 7" casing downwards across identified intervals of solids accumulation
- Pull to the top of slotted interval (once slotting is completed or slotting action is lost)
- Convert SJ tool into washing mode (flow directed below 7" wash cup)
- Wash 7" x 9-5/8" annulus across the slotted interval
- Pull 7" casing with spear BHA

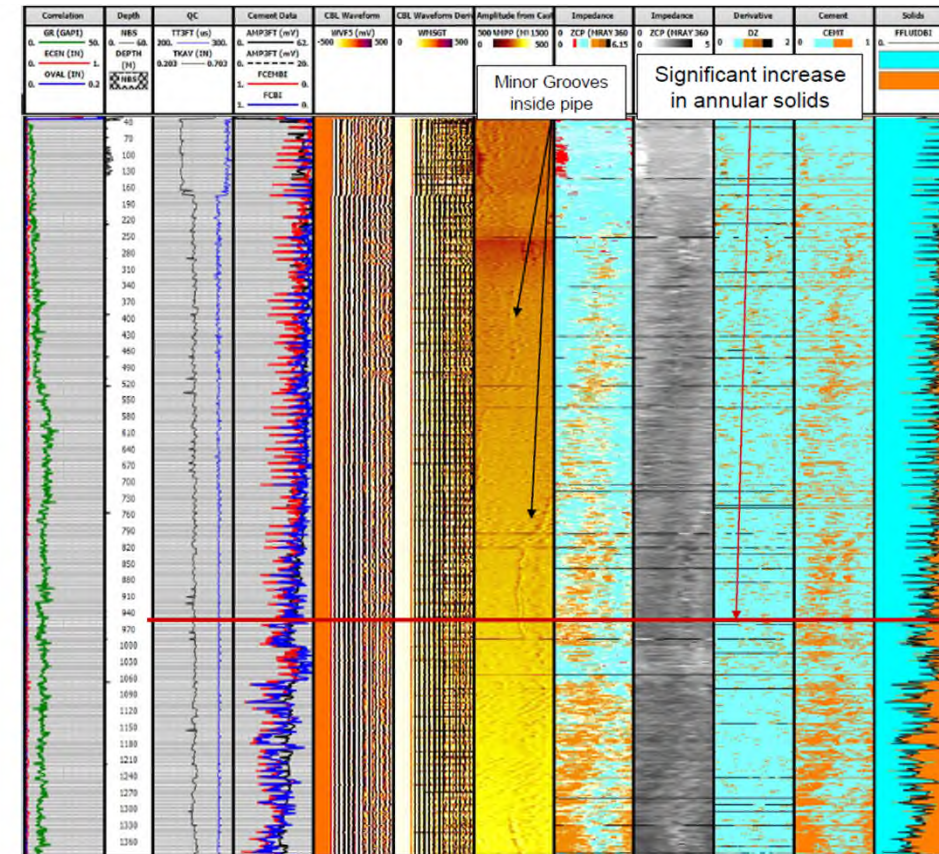


7" CASING SLOT-JET-ISOLATE

- Mobilize 2 x 5-7/8" SJ-I tools to the rig
- Mobilize 4-3/4" DC
- Perform CAST-CBL log to identify the intervals of settled solids
 - Interval of interest was in concentric casings configuration
 - Conclusive outcome of the log

Overall Interval (30 – 1387.5mMD)

- Increase in annular solids with depth is generally observed.
- Minor mud solids observed above 223m
- Fair amount of solids observed between 223m - 960m, particularly on the low side.
- Increased azimuthal presence of solids is seen below 960m and more uniformly prominent below 1063.
- Good agreement seen between ACE bond index and 3ft pipe amplitude trend, showing general increase in mud solids with depth.



7" CASING SLOT-JET-ISOLATE

Run #1

- RIH to casing cut depth and displace well to 1.35 sg WBM
- Pull to 950m (10m above the build up of solids based on log)
- Proceed to slot 1m interval: **only 3 slots made** (not enough weight to achieve continuous slotting action)
- Attempt to displace 7" x 9-5/8" annulus: **negative**

Run #2

- P/U backup tool. Convert the tool for upward slotting (with overpull)
- Run to 900m (50m above initial slots). Slot upwards 9m interval of 7" casing (**struggle to initiate slotting action, 5 negative attempts, no overpull taken by the string**)
- Displace 7" x 9-5/8" annulus above slotted interval
- Run to 1390m (10m above casing cut). Slot upwards from 1390m to 1255m (avoiding couplings based on casing tally). **1,755 slots made (135m)** in a single row. **Lost overpull & slotting action.**
- **Attempt to convert tool into washing mode – negative.** Wash slotted interval of 7" casing (circulation through jetting nozzle above pack-off cup). **Barite seen at shakers.**
- At surface: observe slotting blade broken in 2 pieces (retained in the tool and recovered to surface), bottom sub not sheared into washing mode and significant washout around jetting nozzles.



7" CASING SLOT-JET-ISOLATE

Run #3

- P/U primary tool. Convert the tool for upward slotting
- Run to 900m. Slot 7" casing from 902m to 1170m (30-45 T overpull). **3,055 slots made (270m)** in a single row. **Lost overpull & slotting action.** Non-slotted interval: 1170 – 1255m (85m).
- Convert tool into washing mode (**3 attempts required**). Wash slotted intervals of 7" casing (circulation through the nozzles both above and below pack-off cup). **Sticky barite returns at shakers.**
- Position 7" pack-off cap in the unslotted section and wash the annulus behind the casing. Interpretation is complicated by part of the flow going above the cup, however, good indications of washing the annulus (barite returns, steady decrease in SPP).
- Repeat washing passes, circulate out Hi-Vis, POOH.
- At surface: slotting blade broken in 2 pieces (retained in the tool and recovered to surface), upper nozzle washed out, cup damaged, lower nozzles below the cup are OK.



7" CASING SLOT-JET-ISOLATE

Casing recovery

- Engage spear into 7-5/8" casing stump. **Pull casing free with 83 T overpull.**
- Pull and L/D casing.
- On 7 joints found slots in the elevator area and in the coupling, use torch and hammer to close the slots and smoothen the area
- Observed spiraling of the slotted line



7" CASING SLOT-JET-ISOLATE

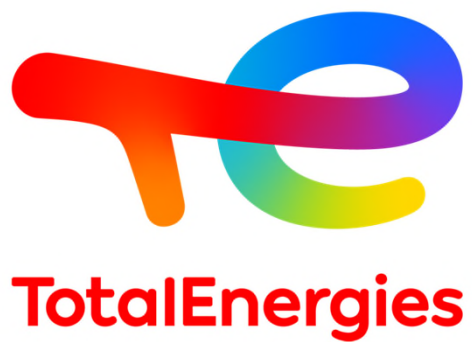
CONCLUSION

- Solution worked well to recover the casing stuck in settled barite
- Helped to avoid section milling, cut & pull in short sections, etc.
- Equipment is systematically mobilized to be available on stand-by during P&A in similar well configurations (planned cut & pull with heavy mud in the annulus)

LESSONS LEARNT (mainly on Titan Torque / Baker Hughes side)

- Nozzles layout, hard facing around the nozzles
- Multiactivation circ sub; design modification for the flow to be fully diverted below the cup in upwards slotting tool configuration
- Blade strengthening (broken pieces sent for metallurgical testing and evaluation)





Thank you