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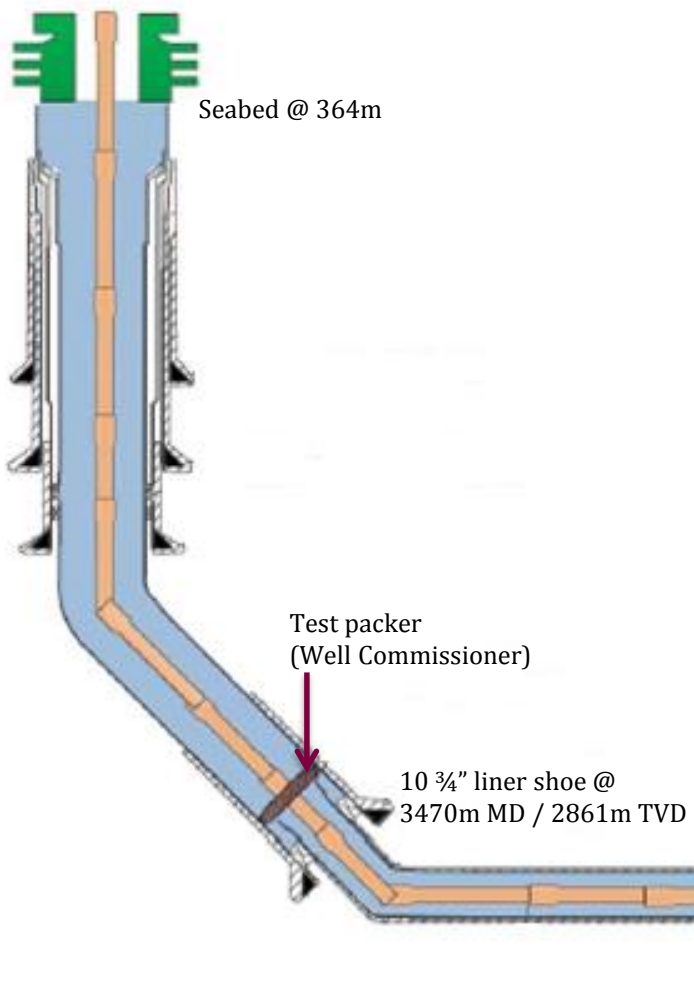
"Sharing To Be Better“

Influx through failed cement in shoetrack during completion operations

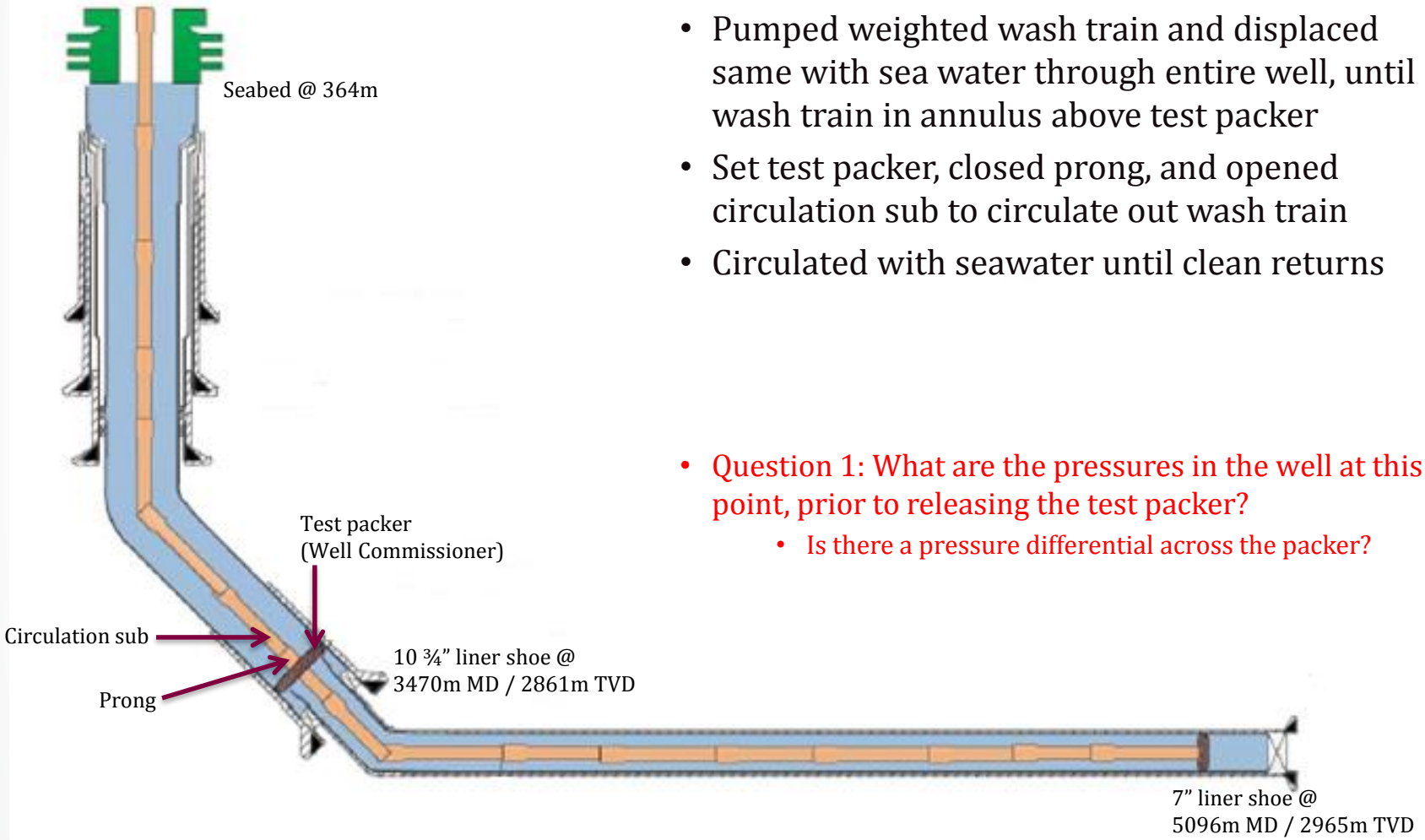
Well status – completion operations



- 7" liner cemented across reservoir
- Well filled with 1.54 SG OBM
- 7" liner inflow tested with base oil inside string
  - 147 bar u-tube pressure on string after pumping base oil. Set test packer.
  - Bled off to 10 bar on string side to give pressure decrease below test packer.
- Pumped up pressure back to 147 bar and released test packer with 20 ton overpull

- Not known at this point: The base oil volume pumped was too low so the inflow test pressure was insufficient; seawater gradient would result in 30 bar lower pressure at 7" shoe

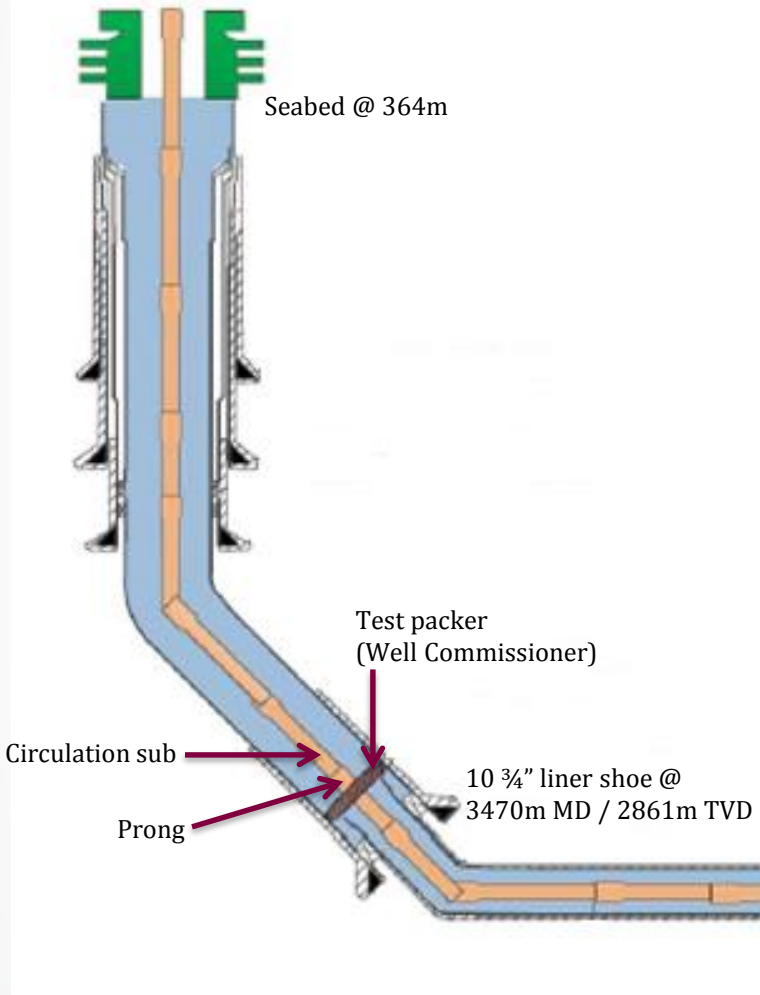
Washing and displacement to sea water



- Pumped weighted wash train and displaced same with sea water through entire well, until wash train in annulus above test packer
- Set test packer, closed prong, and opened circulation sub to circulate out wash train
- Circulated with seawater until clean returns

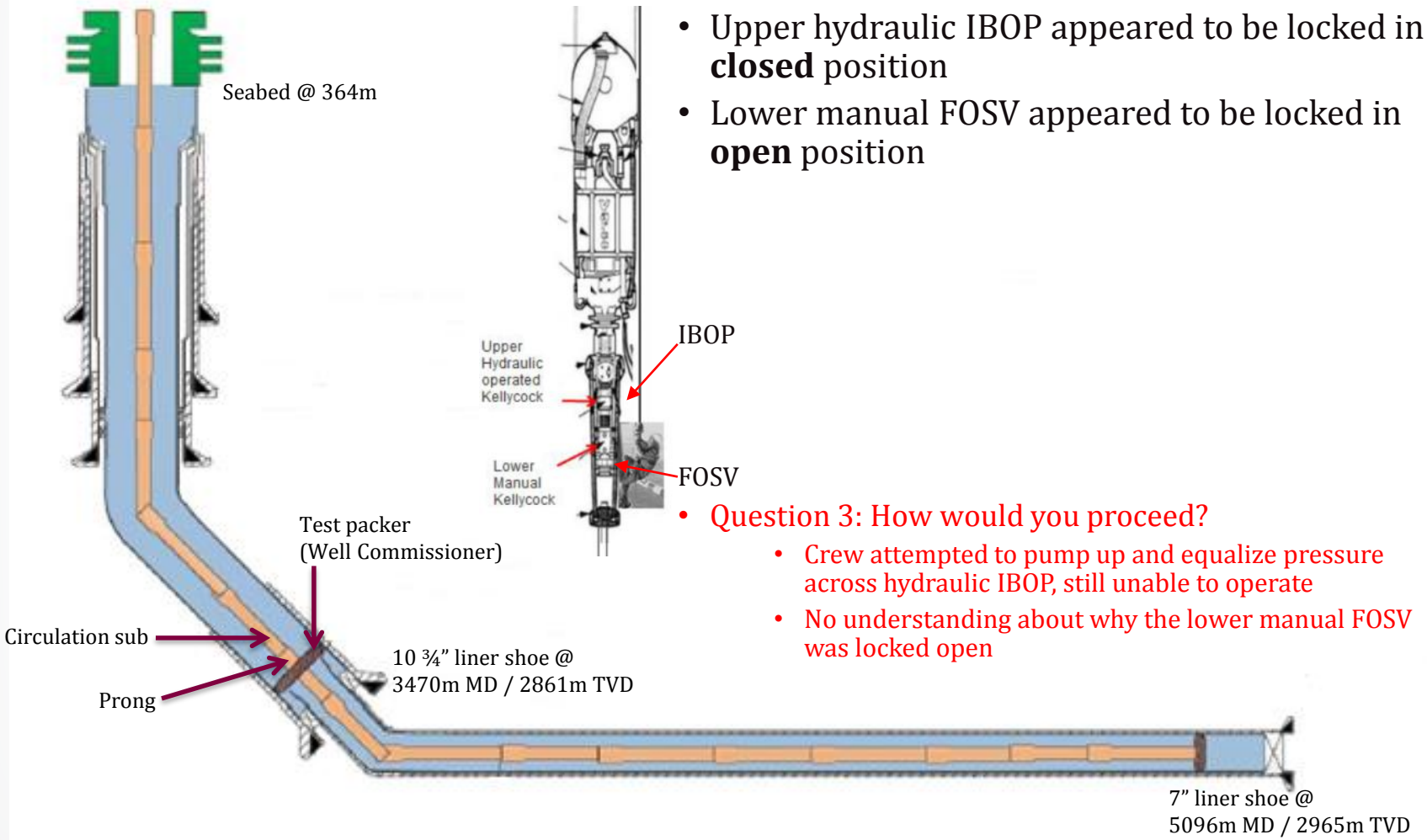
- Question 1: What are the pressures in the well at this point, prior to releasing the test packer?
  - Is there a pressure differential across the packer?

Prepare for displacement to heavy brine



- Released test packer (5 ton overpull), closed circulation sub and opened prong
- Observed increase in trip tank
  - Spaced out and closed UPR, total gain 1.4 m3
  - SICP stabilized at 80 bar after 5 min. IBOP was previously closed due to parallel pumping operation, so no SIDPP available
  - SICP corresponded to reservoir pressure, indicating leaking 7" shoetrack cement
  - Prepared for displacing back to 1.54 SG OBM
  - Meanwhile, attempted to open IBOP on DDM, no go…
- Question 2: Any comments to this situation?

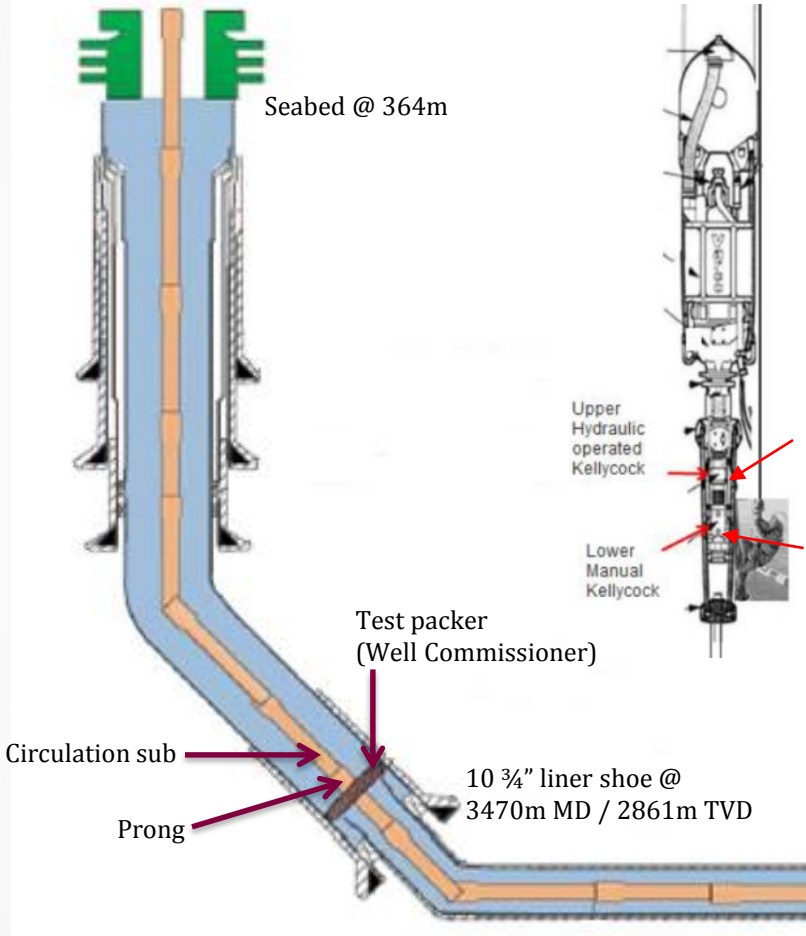
Well shut in with 80 bar SICP



- Upper hydraulic IBOP appeared to be locked in **closed** position
- Lower manual FOSV appeared to be locked in **open** position

- Question 3: How would you proceed?
  - Crew attempted to pump up and equalize pressure across hydraulic IBOP, still unable to operate
  - No understanding about why the lower manual FOSV was locked open

Handling the situation

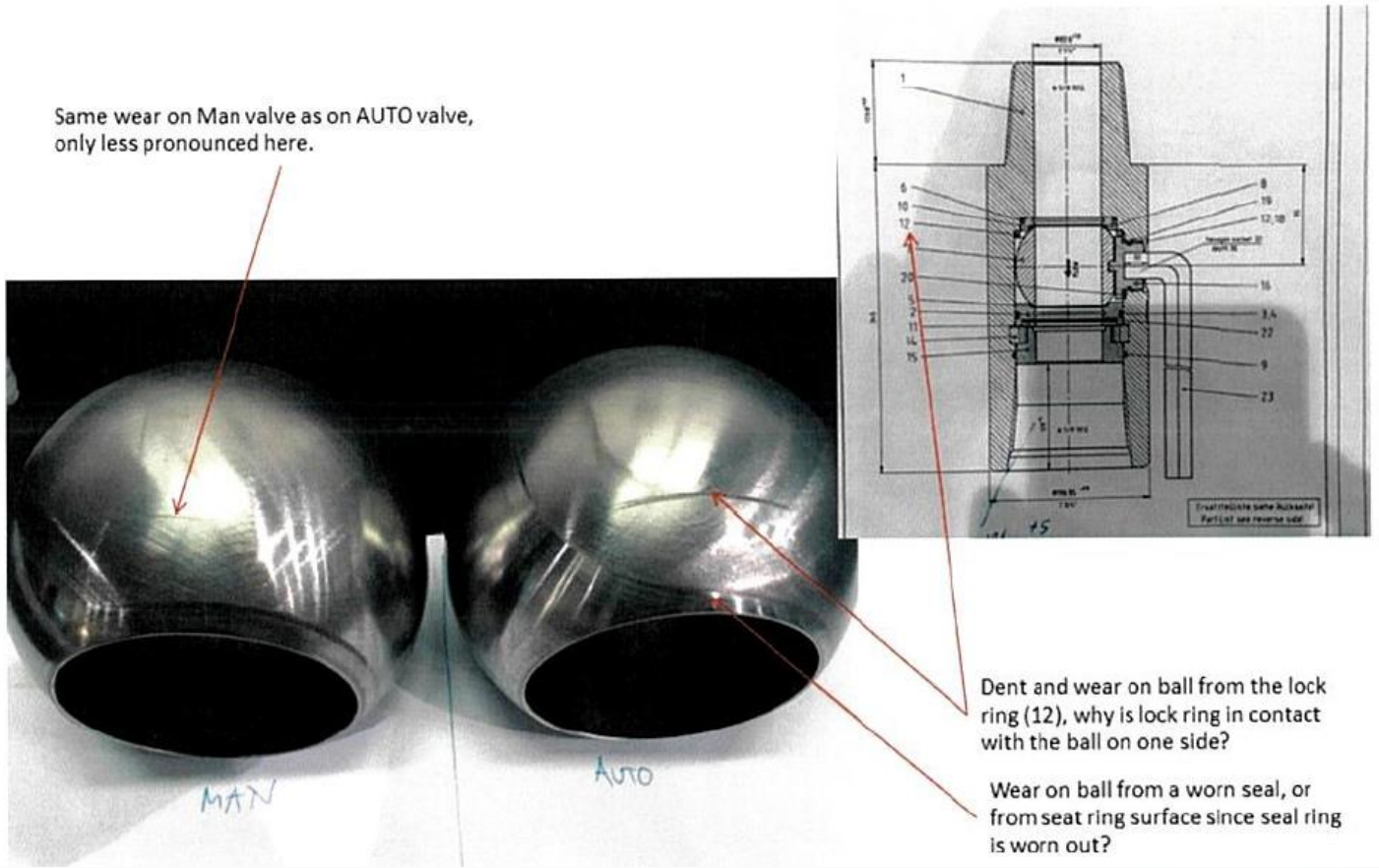


- Decided to increase IBOP actuator pressure from 57 bar to 80 bar, still within operational limits
  - ➢ Successful in opening IBOP
- Well killed by pumping 1.54 SG OBM
- Question 4: Why did the IBOP operational torque increase to unexpectedly high values?
- Question 5: How do you test IBOP / FOSV valves on your installation?

IBOP and FOSV investigation findings

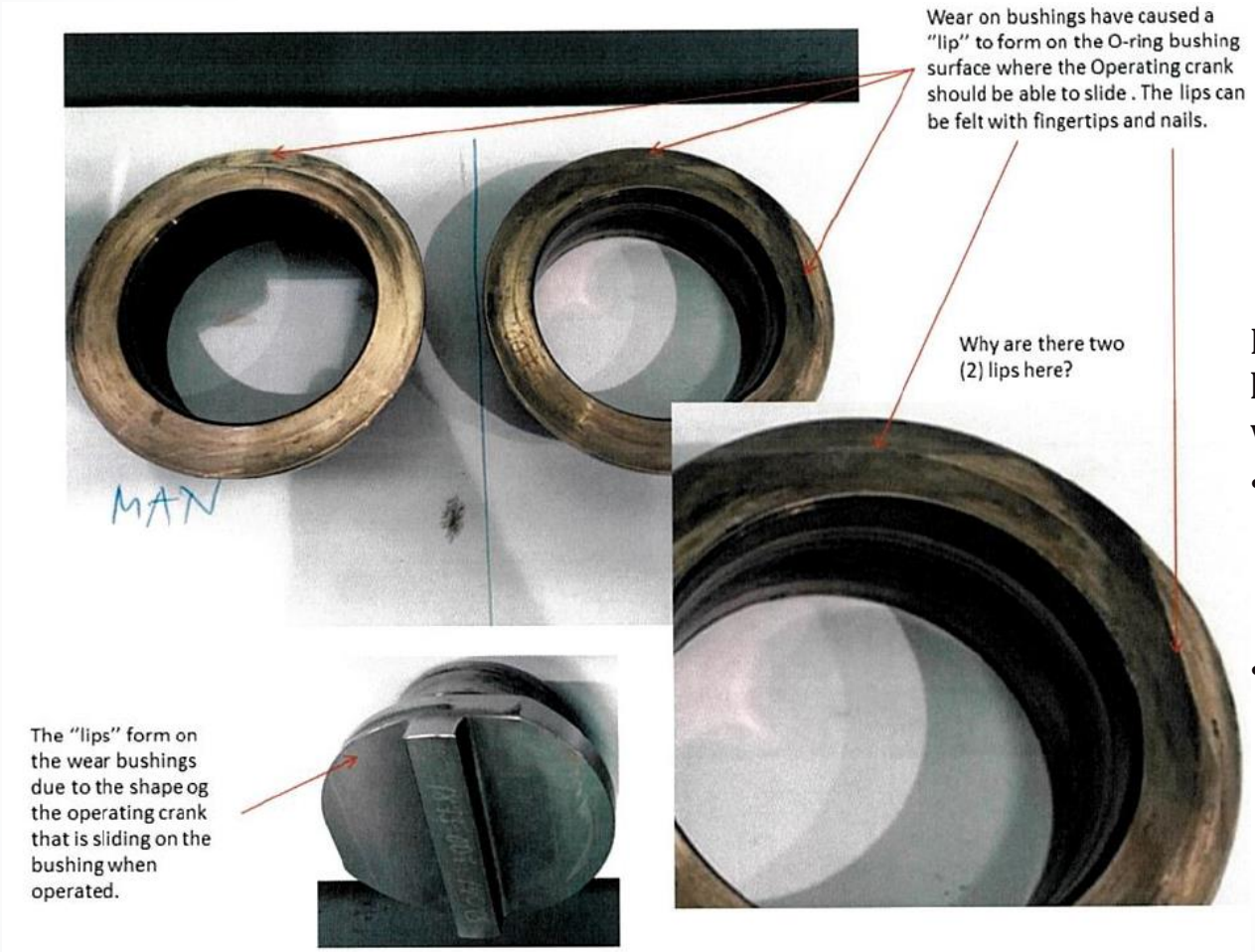
Managed to reproduce the high operational torque in workshop

- Wear marks on ball indicating contact between ball and lock ring above



- Question 6: Do you have a tracking system for IBOP and manual FOSV?

IBOP and FOSV investigation findings



Managed to reproduce the high operational torque in workshop

- 2 wear lips on bushing surface indicating possible rotation of bushing vs. crank
- No maintenance history found. Function testing under pressure not implemented.

- Question 7: How do you inspect the Top Drive installed automatic and manual valves if done offshore?

Learnings and recommendations

- Inflow test pressure was insufficient, due to insufficient detail in operational procedure
  - Include both volume and expected pressure in operational procedure
  - After inflow test, the well shall still be monitored
- No tracking system for valve maintenance
  - Notify contractors of expectation
- Valves had significant wear while still passing pressure tests
  - Suggest review of existing FOSV's and stab-in kelly-cocks
  - Recommend to use improved valve designs, available on the market
  - Establish routines for change-out based on operational history
- Weakness in valve design was not uncovered during routine testing without pressure on valve when operating it
  - Acquire vendor operational torque values to operate valve. To be available on drill floor.
  - Discuss with vendor about routinely test-operating the valve under pressure.