



Repeating a High Potential Incident

James Peyton
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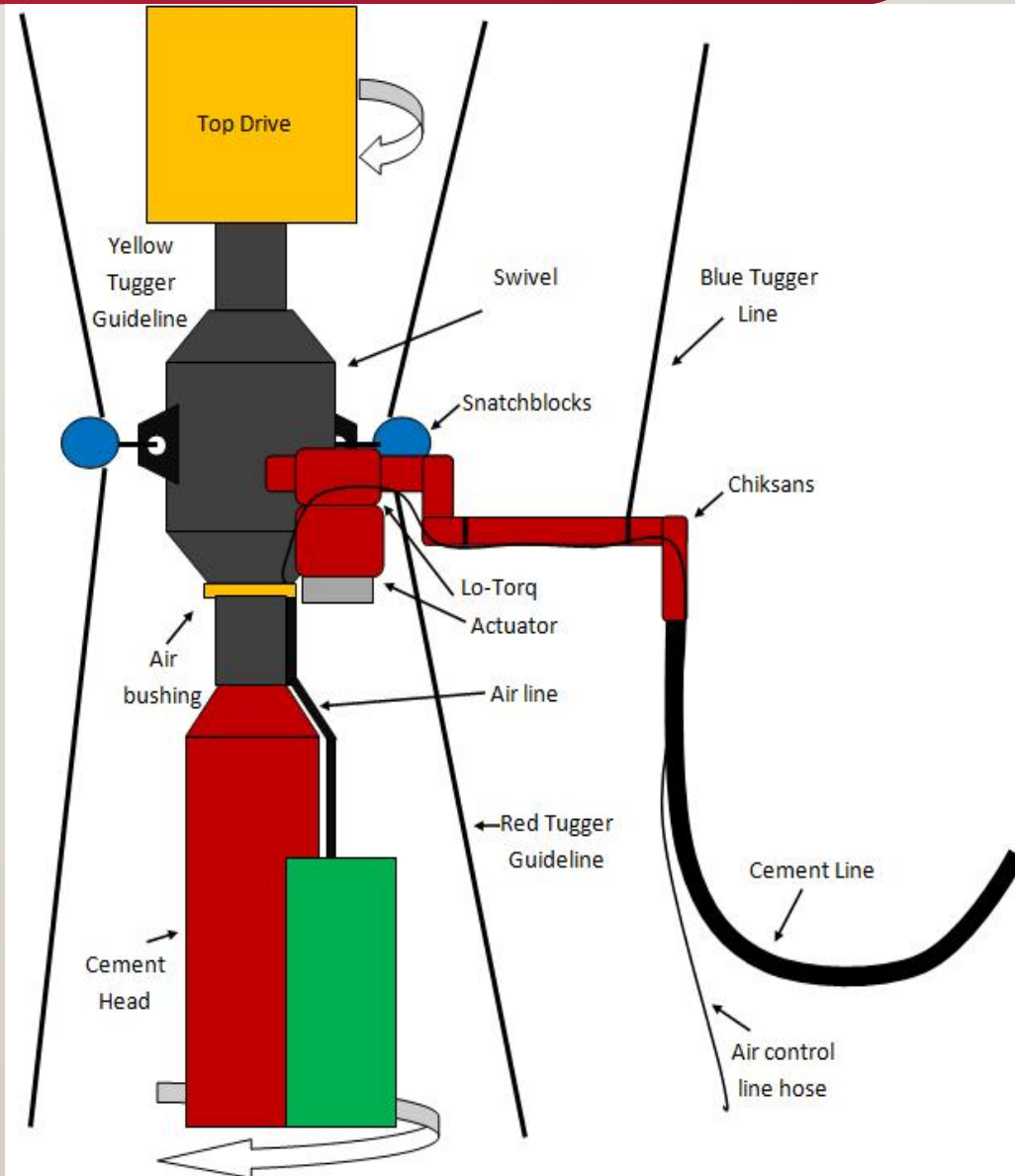


Agenda

- Top Drive Cement Head overview
- Overview of two recent High Potential Incidents during cement jobs
- Summary of investigations and findings
- Challenges encountered

Top Drive Cement Head

- § Made up below Top Drive to landing string
- § Enables cement darts to be launched
- § Remotely actuated valves to reduce man-riding
- § Enables rotation of workstring and casing during cement job
- § Rotating during a cement job improves annular cement quality



High Potential Incident #1

- § Pumping cement for open-hole abandonment plug
- § Rotating at 50 RPM
- § After 7mins, swivel seized suddenly
- § Cement hose wraps around cement head
- § Sheave on tigger line torn apart and found on pipe deck 33 metres from drill floor
- § No one hurt



Investigation #1

- § Investigation team sent to rig
- § Cement head was rotated above limit (20 RPM)
- § A single guideline was used to hold swivel stationary (2 recommended)
- § Swivel stripped down - no damage identified
- § Swivel rotated freely in workshop
- § No definitive root cause of the failure identified



Incident #2

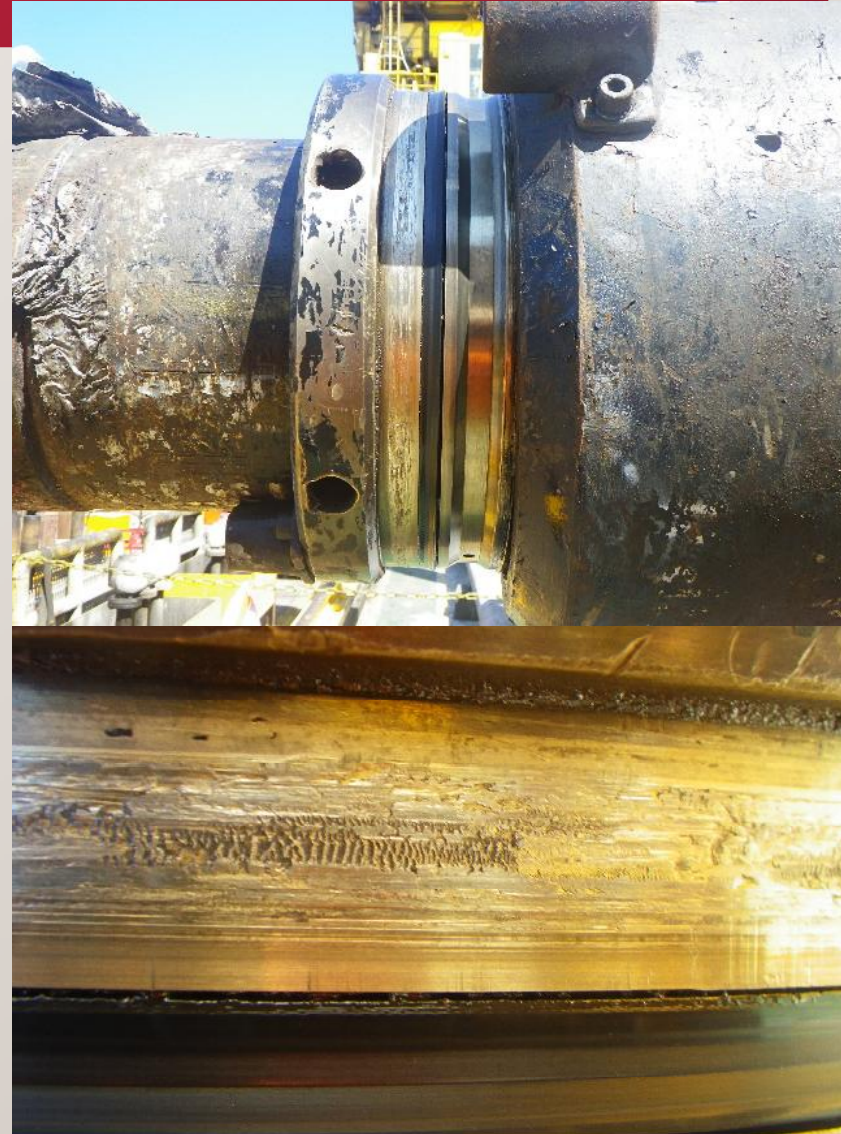
- § Cement head rigged up with 2 guidelines
- § Rotating the liner at 12 RPM whilst circulating prior to cement job
- § Swivel section of the cement head assembly locked up
- § Cement hose, control lines and tigger lines turned and came into contact with guidelines
- § The lo-torq actuator, weighing approx 8kg, was ripped off and dropped from a height of 9.5m above the drill floor to rest in a girder 5.5m above the drill floor
- § No one hurt



Note – swivel was a different S/N to previous incident

Investigation #2

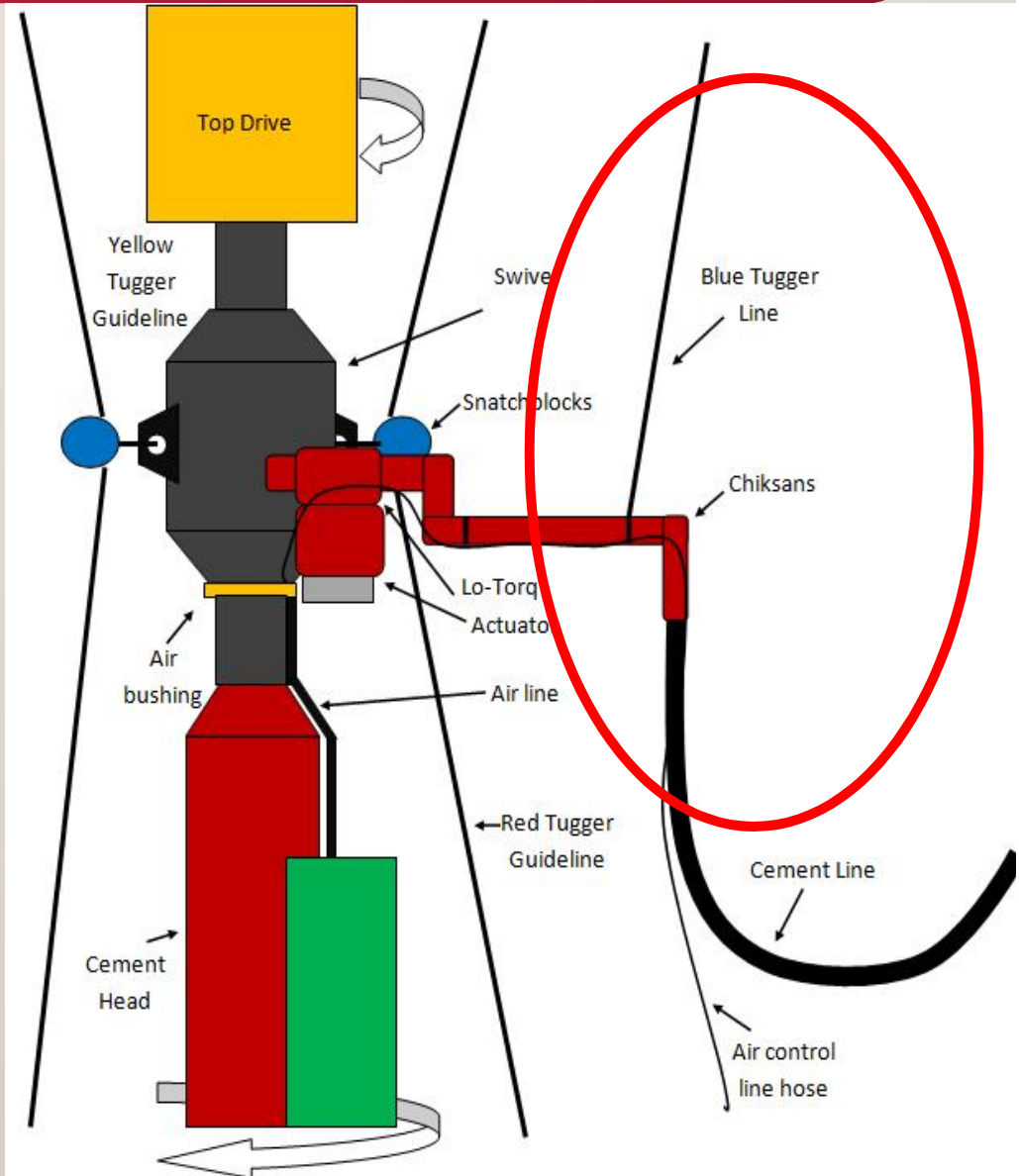
- § Repeat incident
- § Investigation team mobilised to rig
- § All measures implemented from previous investigation were in place
- § Initial investigation focussed on visible galling on swivel air bushing
- § Air bushing is a third-party modification and not documented in maintenance procedures
- § Recommended improvements to procedures to capture changes to tools



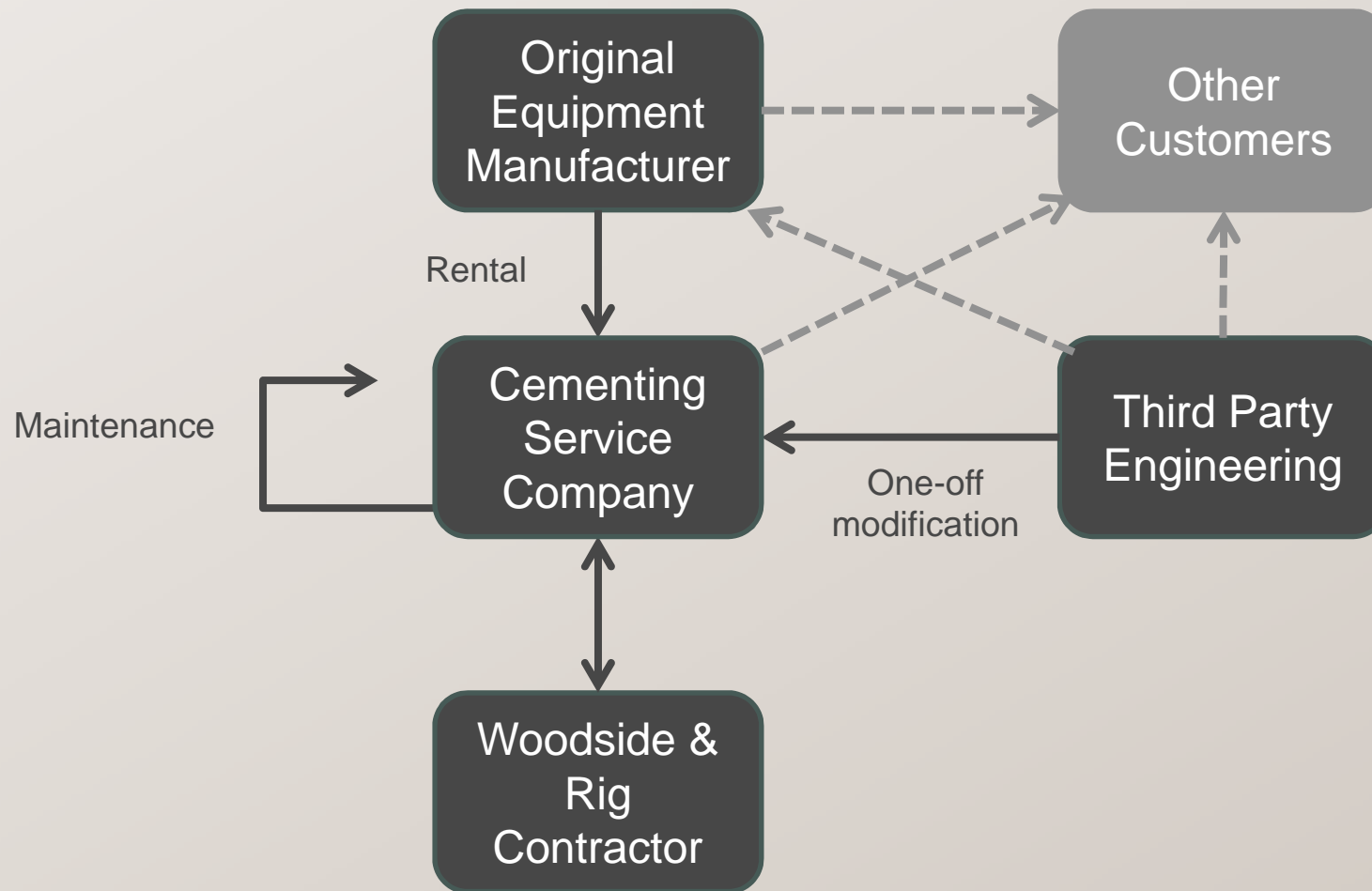
Galling on Air Bushing

Rig Up

- § Cement line must be supported to remove load on connection
- § Recommended rig-up for cement head does not cover how cement line is supported
- § Multiple methods
- § Recommended procedure be reviewed for entire system

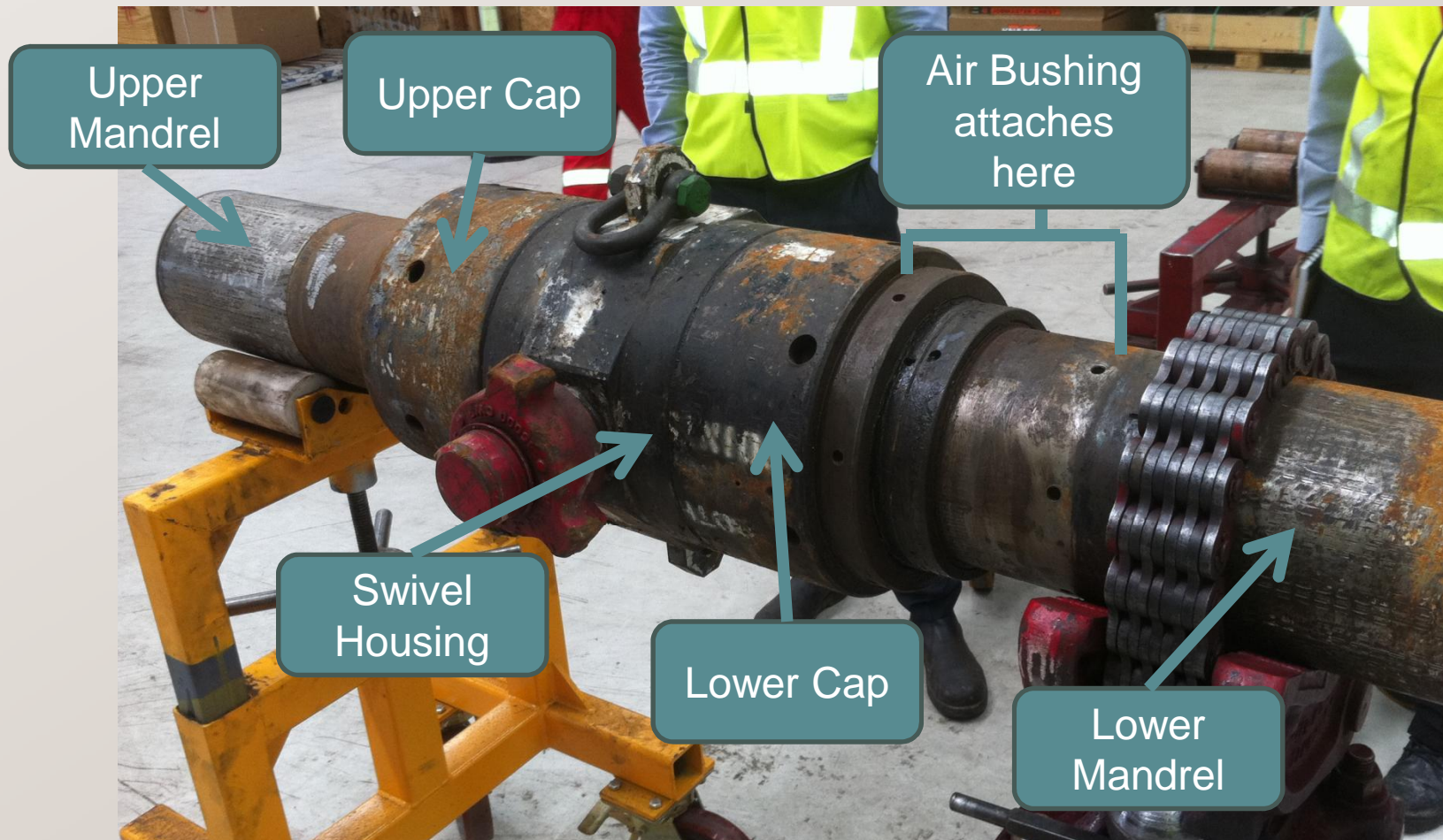


Organisational Interface



Testing the Swivel

- § The damaged air bushing was made up to the swivel
- § The swivel could still be freely rotated





Missing the Root Cause

- § At this point no root cause could be identified
- § Potential contributing factors:
 - Galling on air bushing
 - Rig up of cement head
- § Assumptions at this point:
 - All parts of the tool were believed to be completely investigated and understood
 - All other possible causes of failure had been ruled out
- § Investigation was almost finalised at this point:
 - Concluding the wrong root cause
 - Real root cause remained unsolved
 - Potential to repeat another dropped object or fatality
- § However, another problem was soon discovered...

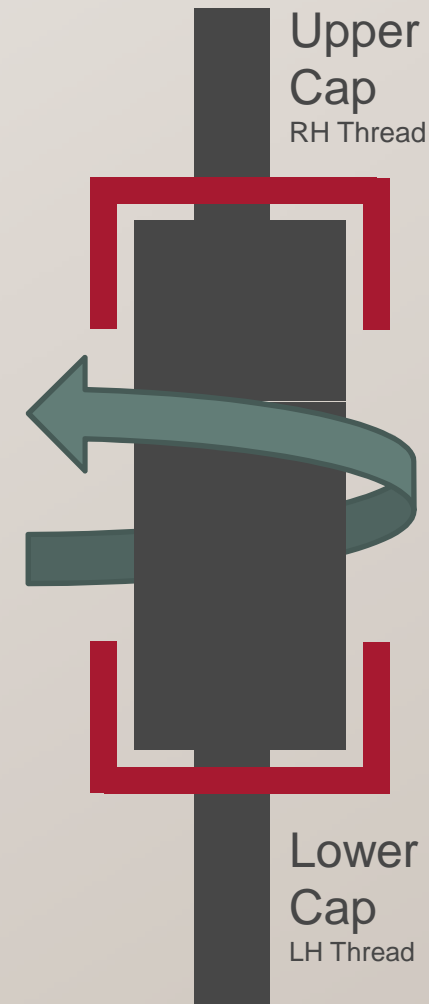
Discovering the Root Cause

- § Due to chance encounter with technician
- § The upper cap was backed off a few millimetres and the swivel completely locked up



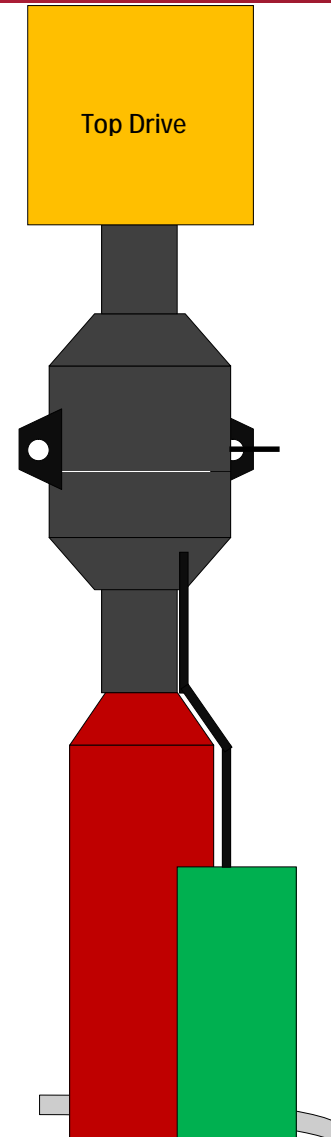
Swivel Caps

- § It was discovered a similar problem had been seen before and corrected
- § The LOWER cap had been observed to back off when rotating causing the swivel to seize up
- § This was due to RH rotation backing of the upside down RH thread on the lower cap
- § The direction of the thread on the LOWER cap was reversed to prevent this issue occurring (RH thread changed to LH thread)
- § The swivel involved in the incident had this modification
- § Conclusion: the caps can be caused to back off due to backlash during RH rotation



Eliminating the Risk

- § Use of the swivel increases the chance of dropped objects
- § Cementing via the top drive will eliminate this risk
 - No guidewires required
 - No cement line connected to cement head
- § Trade-off with other risks
 - Cementing up Top Drive
- § Normal operation in Norway
- § Not an instant solution





Conclusion

- § Incident investigations may not always discover the root cause of an incident
 - Offshore conditions cannot usually be replicated exactly in workshop
 - Tools cannot be tested with all operational loading conditions (pressure, tension, heat, vibration etc)
 - Tools are complex and we may miss the root cause
- § Inability to find root cause increases likelihood of repeat incidents
- § Equipment should not be used again unless a high level of certainty exists that the root cause(s) have been identified and addressed
- § Further mitigation measures should be used to minimise risk and exposure when equipment is used again and doubt exists e.g.
 - Risk assessments
 - Keep people clear