SAFETY ALERT

Near Miss – Casing stud failure on water injection pump

Description of Incident:

Three operators were conducting a routine start of a water injection pump. One Operator was opening/monitoring the discharge. While carrying out the task a stud (fastener) from the pump casing failed and was projected in the air. The system was operating at 120bar at the time. The stud landed on the deck approximately 1.4 meters away from the Operator. The pump was stopped immediately, and the manual suction and discharge valves were closed. Water injection was shut down approximately 5 minutes later. The stud weighed 4.4kg.

Findings:

This was a high potential, near miss incident, related to an API 610 BB3 style of pump, specifically a 6x8x12.5” MSD 7 stg. The fastener was a 1.75” UN stud (BS 4882 GR B7). It was not designed to see or withstand sea water corrosion. However, the pump casing

was. The pumpset was reliable and was being operated within all recommended operating parameters. It was pumping de-aerated sea water. The pump materials were standard for a sea water injection pumpset. There was no condition monitoring data in alarm. The pump had been in service for an excessive period with only minor routine maintenance having been conducted. The fastener failed due to erosion and corrosion.

Good Practice Guidance:

The incident in this safety alert is unusual, however it was a serious incident. The fastener that failed was one of the main pressure containing fasteners on an API 610 BB3 pump. Therefore, it is sensible to conduct a review of all other similar BB3 pump applications to see if there is a risk of a similar occurrence:

1. Review pump length of time in service, has it been in service for 10 years plus without overhaul? This style of pump has a centre bearing that is lubricated with the pumped fluid.
2. Conduct visual inspection of the pressure containment fasteners, what is the general condition, are they visibly badly corroded? It is not possible to assess the stud condition using NDT without removal of the nut.
3. What is the pumped fluid? Is it corrosive if it is in contact with the pumps pressure containment fasteners?
4. Is there a history of pump casing erosion, could this lead to corrosion/erosion of the pressure containment fasteners?
5. Are there any planned maintenance routines in place to inspect or schedule pump overhaul?
6. As part of pump overhaul, consider coating the two long casing fasteners to minimise corrosion/erosion effects if the pumped fluid does get to them, HVOF tungsten carbide suggested. This relates to fasteners 14 and 34 in this alert, the ones closest to the shaft and the last stage impeller. Only the area of the stud closest to the casing join requires additional protection.

If the answers to the above questions relating to your pumps cause concern, please take action to lower the risk. Possible risk reduction measures include the following;

a) Barrier off high risk areas or contain a fastener at risk of failing (short term).
a) Schedule/plan overhauls where required.
b) Put in place planned maintenance to inspect high risk pumps.

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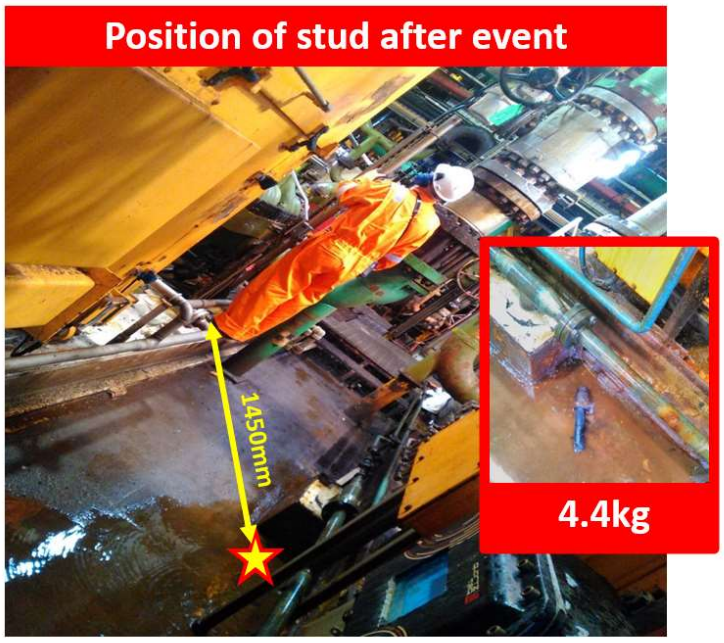
Images:



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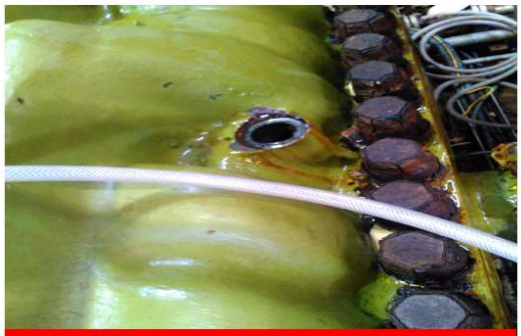
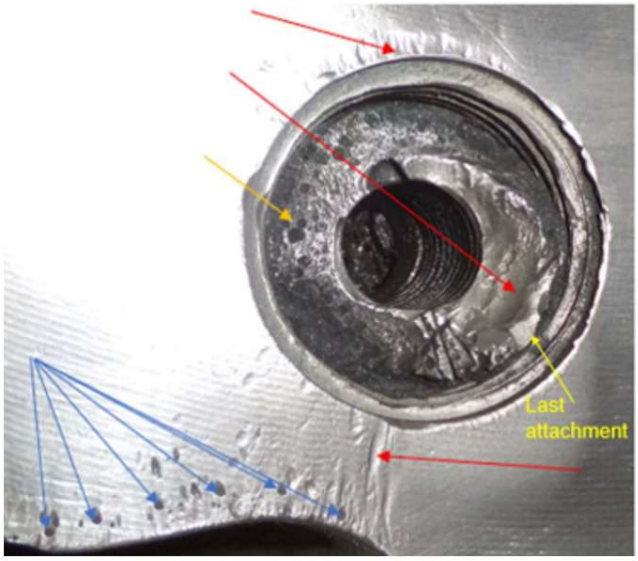
The threaded section is 45mm in diameter



Where the stud came from

Stud on opposite side of water injection pump casing



The bottom of the failed fastener is cleaned however still in the casing hole. (Note hole in centre is due to attempts to remove the rest of the remaining stud)

Blue arrows show pump OEM original design hydraulic profiling holes

Red arrows indicate erosion, smooth surfaces, even extending out the other side of the fastener hole

Orange arrow indicates corrosion

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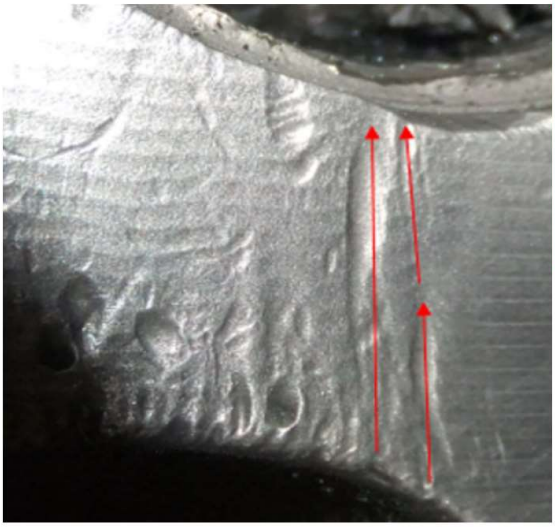

Cleaned area of erosion leak path to the fastener from last stage impeller (approx. 120barg), these channels are small approx. 0.75mm wide by 0.25mm deep, however this is enough to allow the sea water to get to the fastener. Hydraulic vortex erosion under this 120 barg is the estimated failure mode, this has also damaged/destroyed the gasket at his point

This is the failed fastener, cleaned, showing evidence of corrosion and erosion damage.

Red arrows show erosion

Yellow arrow shows the final attachment point

Orange arrow shows corrosion

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