



LEARNING FROM INCIDENTS

AWARENESS ALERT

2014AW05

Shell Global Solutions

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Fatalities during a Leak Repair Clamp Re-injection

Target audience for this alert

- Pressure Equipment Teams
- Production Operations
- Maintenance
- Process Safety

What happened

In November 2013, two leak repair technicians were in the initial stages of performing a re-injection of sealant into a leak sealing clamp on a 16" bonnet- valve body flange joint. The stud bolts securing the bonnet catastrophically failed. Boiler feed water at 70 bar (1015 psi) and 290°C (554°F) was released. The two technicians were killed instantly.

Why it happened

After the incident, analysis identified that 14 of the 20 1 ½" ASTM A193 B7 stud bolts on the flange joint were degraded due to Stress Corrosion Cracking (SCC). The other six bolts had no signs of SCC and fractured due to the overload from failure of the other bolts.

The damage to the bolts likely occurred some time after the clamp was installed in 2011. It is believed that alkaline boiler feed water came in contact with the bolts while the valve was out of service, but still under pressure for a period of time.

A design or construction flaw in the valve caused excessive stress in the stud bolts. The ring type joint did not fit together properly because the diameter of the groove in the bonnet was too small. It is believed that several stud bolts had to be tightened close to their minimum yield strengths. This was not known when the clamp was installed or re-injected.

See Attachment 1 – Team Industrial Safety Notice for additional details of the incident, investigation, and learnings

Lessons learned

- Flange joint leaks can affect bolt integrity. Temporary leak sealing can expose bolts to process fluids and may create conditions that allow bolt degradation to take place without being detected. External visual examination may not identify a loss of bolt integrity.
- The potential for bolt degradation due to corrosion, erosion or stress corrosion cracking should be considered when repairing or clamping leaks. Some factors to consider include the potential for a corrosive environment



Figure 1 – Similar Valve with bonnet clamp

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contained around the bolting due to the temporary repair, signs of alkaline or acidic material or exposure to H₂S, systems temporarily out of service, activities that can increase bolt stresses.

- The history of the flange joint and any flange leaks should be considered when a clamp is designed. The history can indicate that the flange bolts may not be in good condition or that the load may be un-evenly distributed across the bolts. These conditions may require a clamp design that includes bolt replacement and/or a strong-back. Note that in this incident a strong-back would only have been effective if designed as 'full strength' to allow for multiple bolt failure.
- A defective flange joint may cause excessive stresses on bolts. The need for leak sealing and re-injection can be due to latent defects such as misalignment, over-tightening and flange damage. Injection (and re-injection) can further increase the stress on the bolted assembly.
- Re-injection of leak sealing clamps on a flange joint can trigger a failure if the underlying flange joint assembly is compromised. Each re-injection should be considered as an engineering intervention, controlled through MOC to assure the integrity and suitability of the repair.
- Temporary repairs should be replaced with a permanent solution according to the schedule agreed with the Pressure Equipment Integrity group.

Further information

- Attachment 1 – TEAM Industrial Services Safety Notice



Total Antwerp
Lessons Learned - Sa

- Learning Materials



Safety Meeting
Learning Session DSM



Learning
Opportunities DSM-AI



LFI Summary
DSM-AW-201405.doc



Safety Meeting
1-pager DSM-AW-201

- Related LFIs:

- [DSM-AW-200802 – Temporary Pipe Clamp Failure](#)
- [DSM-AW-201211 - Temporary Leak Repairs](#)

- [Pressure Equipment Integrity Management DSM Standard DSM-1510002-ST](#) (Section 6.5)

- [DEPs](#) –

- [RMP 31.40.60.50-Gen. Pipeline Repairs](#)

- Stress Corrosion Cracking and other Degradation Modes are described in the Refining MCI Infobase through the CWW as described in the [MCI Infobase Shell Wiki article](#)

- [External Standards](#)

- ASME PCC-1 Guidelines for Pressure Boundary Bolted Flange Joint Assembly
- ASME PCC-2 Repair of Pressure Equipment and Piping

- P&T MMI [GET CONNECTED Wiki Site](#)

- Manufacturing LFI Coordinator



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