Incident description: gas leak 2016

In connection with testing and load mapping of the main power turbine, electricity consumption on the facility needed to be increased. One of the systems run to generate load was system 26, gas injection. This system had been delivered after commissioning, but had not been in regular operation because drilling of the injection well was unfinished. System 26 is not normally used, since the gas is usually exported.

The gas injection compressor was started up and the system run in recirculation mode with the anti-surge valve fully open. This was considered advantageous because it gave the compressor a consistently high load while gas injection was not needed. Gas injection was isolated both upstream and downstream so that it circulated in a closed system.

The plant operator had passed the leak point a few minutes before the incident occurred, without registering unusual noise or vibration. The operator on the deck below heard a bang, followed by a high-pitched noise. He could not see or smell the gas leak, but left his work location immediately together with two other people who were nearby.

Two gas detectors on the same deck level as the leak were triggered after seven and nine seconds respectively. They would normally have initiated automatic emergency shutdown (ESD), but had been disconnected in connection with another job in the area. The control room operator registered alarms on the disconnected detectors, and contacted the operator in the field to clarify if the detection was related to the job under way. However, the noise from the leak in the area was too high for them to communicate. When a third gas detector was activated, the control room operator removed the disconnection from the first-mentioned detectors. That led to automatic ESD and blowdown.

After the incident, the packing box for the anti-surge valve on the injection compressor was found to have failed because both gland bolts had fractured. After isolation, three additional stud bolts in the flange faces between valve and pipe system on the inlet and outlet sides were also found to be fractured. The initial leak rate has subsequently been calculated at 4kg/s, with the total quantity leaked put at 560 kg.

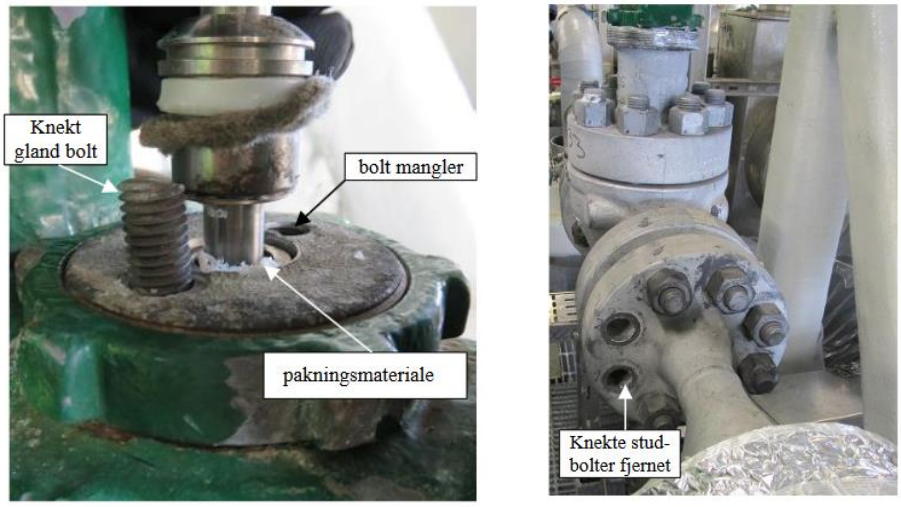

Figure 1 Left: damaged gland bolt on the packing box for the anti-surge valve. Right: outlet flange on the anti-surge valve.

Causes

Direct cause

- Failure of the packing box in the anti-surge valve because of fatigue in bolts.

Underlying causes

- Acoustically induced high-frequency vibrations.
- Liquid precipitation from the anti-surge valve.
- Faulty design (dimensioning of the anti-surge valve), possibly because of a failure in communication between operator, contractor, compressor supplier and valve supplier.

Lessons and recommendations

- Reduce the flow coefficient (C_V) on existing two-inch anti-surge valve.
- Upgrade to three-inch anti-surge valve, but with the original C_V.
- Change operational conditions to avoid liquid precipitation.
- Vibration monitoring which covers the whole operational window.