

Incident description: gas leak 2016

A factory acceptance test (FAT) was conducted in connection with manufacturing a manual isolation valve (double expansion gate valve). After the FAT, a pressure relief valve (PRV) was installed on the gate valve. The spring in the PRV was incorrectly adjusted. This meant that the set point for the valve was unstable – in other words, the pressure required to open the PRV could vary.

The gate valve with PRV was installed with the above-mentioned fault built in. The mechanical completion report was issued, but did not include a check of the cavity or the PRV. During construction, all necessary checks of the piping system were conducted through a line-up of the system, and this was documented in a commissioning test procedure (CPT). However, the gate valve cavity and the PRV were not included in the CPT. The gate valve was nitrogen-helium tested when it stood in the open position. That meant pressure in the cavity increased only gradually, and it is unknown whether it reached line pressure before the test ended. If the cavity is also to be pressurised in such testing, this type of valve must be placed in the intermediate position.

At start-up, gas injection began with an operational pressure of 150 barg. The PRV opened because its spring was incorrectly adjusted. Since the PRV was not connected to a vent or flare, the gas was released to the process area.

Gas was detected and ESD 2 initiated on confirmed gas. All ESD actions functioned as intended. The emission rate was put at 0.58kg/s. Blowdown took seven-eight minutes to complete.

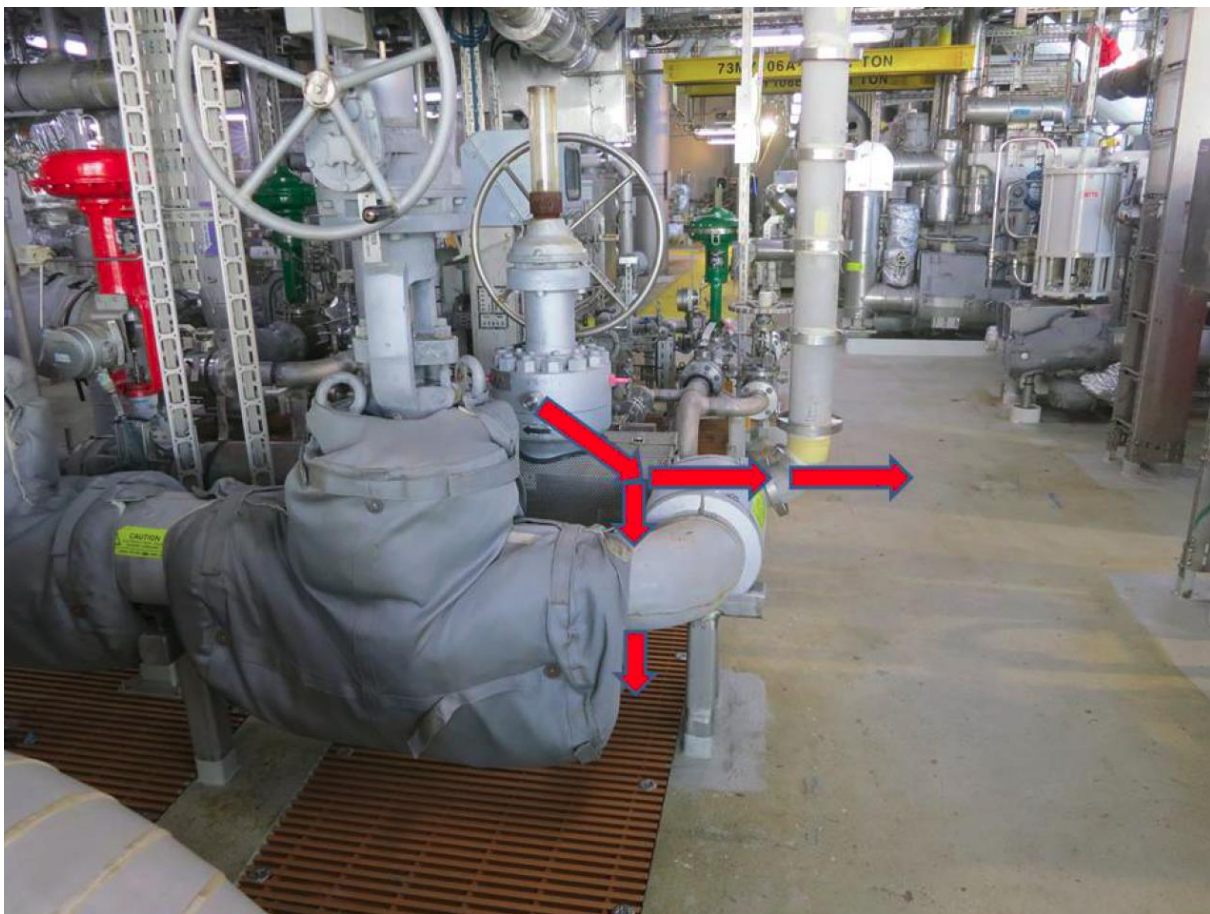


Figure 1: The pressure relief valve with the direction of flow indicated by red arrows.

Causes

Direct cause

- The PRV on a double expansion gate valve opened because the spring was incorrectly adjusted (outside its area of operation and thereby in an unstable condition).

Underlying causes

- The PRV installed on the gate valve cavity does not have its own tag number. That means such valves are not registered in the maintenance system and are thereby excluded from the preventive maintenance programme.
- The PRV was not identified as a potential leak source in the design or the risk assessment, and was not fitted with a vent line. Possible gas leaks would thereby be emitted directly to the process area.
- The PRV is installed on a gate valve in a gas process system. This type of valve only requires a PRV if fluid might enter the cavity.
- During the construction phase, it was decided not to use a commissioning checklist for the piping system. As a result, no checklist has been prepared which covers testing of the valve cavity, and the PRV was not adjusted.

Lessons and recommendations

- Identify other valves in the gas system which are not subject to condensate accumulation in the cavity. Replacing any PRV installed in the cavity with a blind plug is recommended for these valves.
- All PRVs installed on valves in fluid systems or in other systems where fluid can accumulate in the cavity must be identified, given a tag number, registered in the maintenance system and allocated a maintenance programme in accordance with the procedure for this.
- The same type of PRV and arrangement is installed in the valve cavity for both fluid and gas lines – in other words, the PRV releases fluid directly to the process area when it opens. An assessment is needed of whether existing solutions accord with the regulations, normative standards and supplier recommendations, and whether these PRVs can remain as they are or should be connected to the flare system or back to the process upstream from the main valve.
- Introduce obligatory refresher courses for operators which highlight the importance of good tightening in both open and closed positions for double expansion gate valves.
- In future projects, it is recommended that the procedure for pressure testing cavities in all types of valves covered by AME B16.34 is checked and implemented correctly. All valves affected must be in the correct position and the cavity with pressure relief must be pressurised when leak-testing the system. See the test procedure, which states: “Unless otherwise specified, all valves within the test limit must be placed in the intermediate position. This will ensure that the valve cavity is pressurised”. In addition, a PRV installed on the valve cavity must be tested and a test report prepared.