2018-G: Gas leak when replacing manifold valve

A gas leak occurred in connection with replacing a manifold valve. Confirmed gas initiated a general alarm, ignition source disconnection, emergency shutdown and deluge.

The leak originated from the flare system via the flare header, through a two-inch orbit valve to the test manifold and on to a manifold valve which was being remounted following a maintenance job. See Figure 1. The maintenance job was done with the orbit valve as a single barrier against the flare system. Following the incident, it was discovered that this valve was not in the closed position as indicated in the valve and blind list.

In parallel with the maintenance job, it became necessary to blow down a well to the flare system. This was down by opening two manual ¾-inch valves in series. The gas leak occurred as these valves were opened. The operator quickly grasped that the well blowdown and the leak could be connected, and the one valve was closed about 70 seconds before the operator evacuated the area. The leak was registered by gas detectors for about three minutes.

A few minutes after the initial leak, it was decided to blow down the high- and low-pressure manifolds, which caused a new and longer period of leakage to the open air (at a rate virtually the same as the initial leak). Gas detectors registered the leak for about five minutes. Deluge was under way when this leak began. The maximum leak rate is estimated at 0.43 kilograms per second (kg/s).

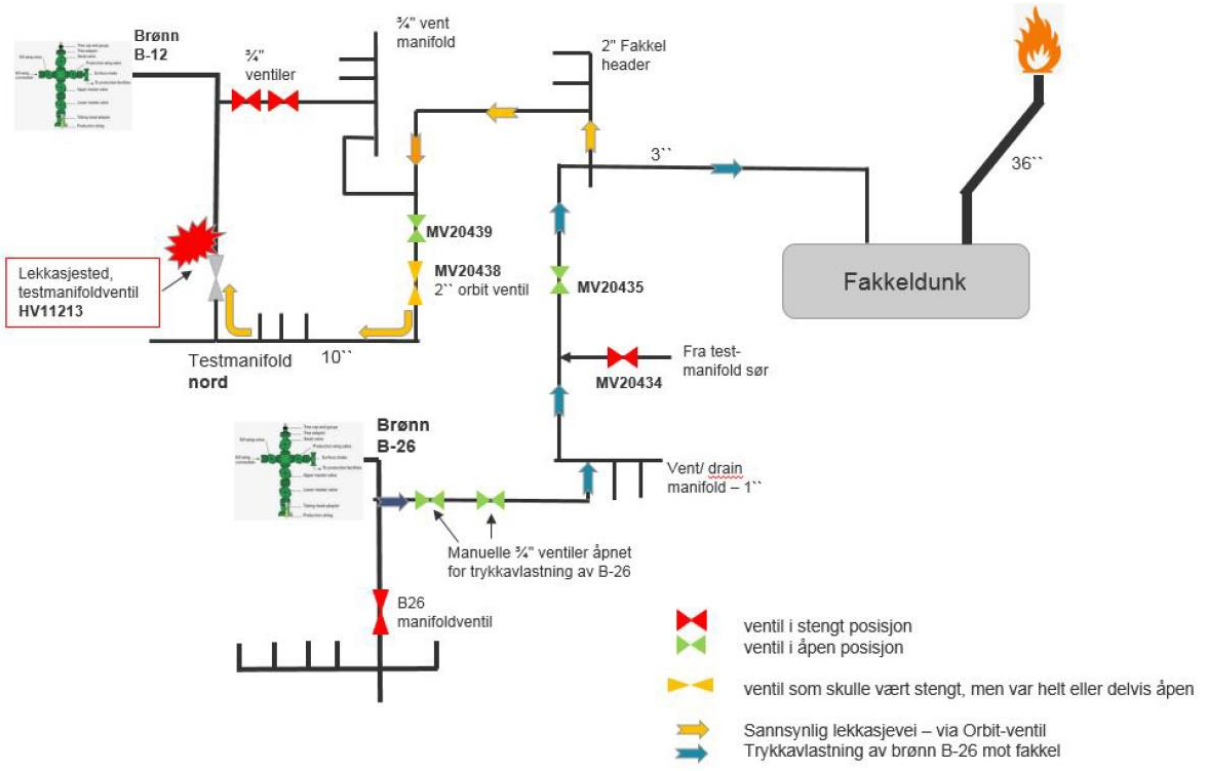

Figure 1 Diagram of the incident.

Causes

Direct causes

The immediate cause of the gas leak was that the orbit valve, which functioned as a single barrier against the flare system, was not properly closed during remounting of the manifold valve. The leak

arose when the flare was simultaneously pressurised because a well was blown down. There are two possible reasons why the orbit valve was not properly closed.

1. An attempt was made to close the valve, but it had remained open by three-five millimetres.
2. Closing the valve had been overlooked when establishing the isolation plan or when opening after the plan had been established.

No clear causes have been identified because of uncertainty over the course of events leading up to the leak.

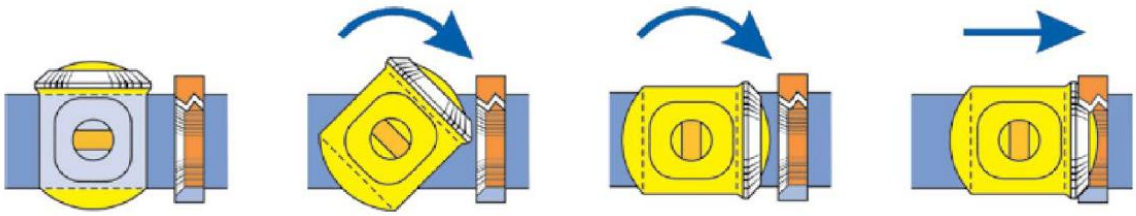

Figure 2 Illustration of an orbit valve in a pipeline – status from fully open (left) to fully closed (right)

Underlying causes

- The orbit valve could have been standing open after an **attempt to close it** because of inadequate expertise and experience with a valve type which is seldom operated and which is operated rather differently from other ball valves.
- The orbit valve could have been **forgotten in the open position** because the work process for setting, verifying and approving isolation has an inherent vulnerability to human factors such as memory lapses, faulty operation, unintentional opening and so forth.

Lessons learnt and recommendations

1. Hold a working meeting to discuss and raise awareness of the vulnerability to human factors when implementing isolation plans. The discussion should address:
    - where requirements involve varying practice and unclear points
    - identifying possible requirements for clarification, both locally and in the work process.
2. Clarify work processes/requirements for strengthening the organisational barrier elements which could prevent hydrocarbon leaks. This covers:
    - clarifying the method for verifying the isolation plan
    - clarifying when marking should be done in the field
    - clarifying requirements for change of status in an established isolation plan.
3. Assess measures for enhancing process operator expertise through courses in process safety.
4. Verify whether infra-red point gas detectors function during deluge.