

# Memorandum

## T-1

3 September 2020 KW

Case no: 2020/182

### Equinor – Heimdal – investigation of a work accident – conclusions from technical studies of equipment involved

The Petroleum Safety Authority Norway has investigated an incident on the Heimdal field in the Norwegian North Sea on 28 November 2019, where two people were seriously injured. Its investigation report includes a discussion of uncertainties related to possible defects in the equipment involved.

The PSA's investigation report was completed in May 2020, before the technical examination of the equipment concerned had been completed. It therefore contains no conclusions on possible defects in or impairments to the pump, manometers or nitrogen gas cylinder before the event.

DNV GL AS was commissioned to study the booster pump/compressor and nitrogen gas cylinder involved in the incident on Heimdal. This assignment involved a technical description of function, function testing, and a material investigation of equipment involved in the incident. The objective of the investigation was to clarify the equipment's function and actual capacity and to check if there was any degradation of the equipment before the event.

The DNV GL study was completed in July 2020. Based on its findings, the following conclusions have been drawn:

- Function testing of manometer showed:
  - Both gas-in (250 bar) and gas-out (1000 bar) manometers showed movement/reading when pressure was applied
  - Both manometers gave wrong reading according to applied load/ pressure. Gas-in showed approximately 70 bar too low reading, while gas-out showed approximately 70 bar too high reading. Resetting the indicator needle (manually) on the gas-out manometer gave a similar reading to actual pressure applied.
  - Manometer readings showed increasing reading when increasing pressure was applied.

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- The fracture in the gas bottle showed microvoid coalescence dimpled rupture indicative of a ductile overload fracture. The gas bottle did not show any degradation in the form of corrosion or mechanical damages that may have weakened the bottle prior to the incident.
- Material examination showed a microstructure and hardness similar to other gas bottles examined by DNV GL from other manufactures. Material certificate has not been received by DNV GL and it is therefore not concluded if the values corresponds to certificate values.
- Most of the damages observed to compressor and tubing/hoses appear to be secondary damages as a consequence of the incident, i.e. pressure wave and mechanical impact loads from failure of the bottle.

Equinor has also commissioned a bursting test with a nitrogen gas cylinder similar to the one involved in the incident. This was conducted by pressurisation with nitrogen and using the same type of booster pump.

The test yielded the following results:

- measured time to pressurise from 130 to 200 bar was 20 seconds
- it took less than four minutes to pressure from 130 bar to the bursting point at 635 bar
- the cylinder broke into four pieces when it burst.

*Results from the tests and technical investigations do not alter the conditions described in the PSA's investigation report.*