Incident

Pressure testing fatality

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Summary

A fatal explosion occurred on an offshore installation when a casing failed due to overpressure during a pressure test. Although the exact cause of the incident was not established, use of high-pressure sources for testing integrity of equipment, even with an inert fluid, is hazardous. To reduce vulnerability to a single point of failure, this paper highlights some possible multiple layers of protection with proven reliability that could have been considered in this situation.

Keywords: High pressure, integrity testing, overpressure

Introduction

On 15 May 2021 a worker died at a normally unattended offshore installation in the Gulf of Mexico. He was working with a colleague to carry out a pressure test of the 16-inch casing of a gas well. The accident report[1] stated that the casing failed due to overpressure. The explosion that occurred as a result of the pressure being released resulted in fatal injuries to the worker. Although the test fluid being used was flammable the release did not ignite.

Figure 1 – Photo of the facility involved[1]

Facility description

The accident occurred at the Eugene Island Block 158 #14 Platform in the Gulf of Mexico, approximately 40 miles (64 km) from the coast of Louisiana. The water depth at the location was approximately 82 feet (25 metres).

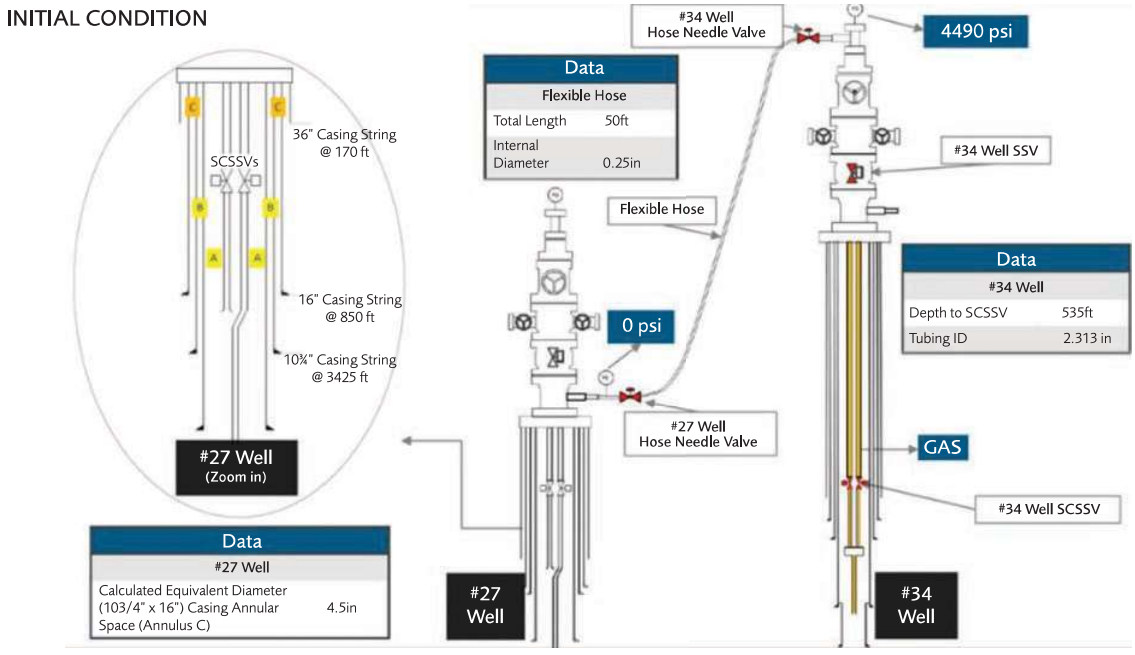

Figure 2 – Arrangements for testing casing of Well #27 using gas from Well #341

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Pressure testing method

Casing is embedded into the hole drilled when creating an oil/gas well. Its purpose is to support the well and to protect the tubing that runs inside and carries oil or gas to the surface.

Casing of Well #27 was being tested using gas from Well #34. A high-pressure hose was rigged up between needle valves on the wells. A fixed pressure gauge was permanently installed on #34. A temporary digital pressure gauge was fitted to #27 to allow the test pressure to be monitored. The plan was to use the needle valves to control the flow of gas.

Casing failure

The design rating for Well #27 casing being tested was 1,640 psig (113 barg). The pressure in Well #34 was 4,490 psig (309 barg), so significantly higher than the casing design pressure. The plan was to only allow enough gas to flow through the high-pressure hose to pressurise the casing to 250 psig (17.2 barg), well below its design pressure.

The accident report states that the casing of Well #27 failed because of an "overpressure event." The pressure released as a result of this failure travelled to the surface where personnel were standing. This was sufficient to cause fatal injuries, disfigure a section of grating above the casing deck and blow off a section of handrail that was never recovered. Paint on surrounding structure beams was blasted down to bare metal.

Accident causes

The following were identified as possible causes of this accident:

- Personnel carrying out the test were not aware of the casing design pressure;
- Test procedures were inadequate;
- The temporary test equipment did not include either a pressure regulating device or pressure safety valve;
- Management of change was not carried out for use of the temporary test equipment;
- The units shown on the digital pressure gauge being used could be switched between psig and barg.

Although there was no definitive evidence, if personnel had not correctly identified the units displayed on the pressure gauge it is highly likely that they would have taken the casing to a pressure much greater than planned (i.e. 1 barg is 14.5 psig). Without a pressure safety valve there would be no safety barrier to protect against this error.

Management failures

The accident report[1] found that the operating company (Fieldwood Energy LLC) had a written Safety and Environment Management System (SEMS) manual that was supposed to be supported by a facility level hazard analysis, Job Safety Analyses (JSA), Management of Change (MoC) and Safe Working Practices (SWP). On the day of the accident inadequate planning had resulted in the work party being instructed to carry out the pressure test without any procedures. They were left in the situation where they "had to figure out how to conduct the test as they performed the job"[1]. The underlying reasons for the management failures were not identified.

Conclusion

Use of high-pressure sources for testing integrity of equipment is hazardous. Whilst use of an inert fluid (e.g. nitrogen/water) reduces the hazard, this accident highlights that pressure alone can lead to fatalities (in this case although the test fluid was flammable there was no ignition).

A digital gauge that can display different units of measurement increases the likelihood of human error. But there are multiple failures that could have similar consequences (e.g. gauge technical failure, design data misinterpreted or communicated, inattention or distraction).

To reduce vulnerability to a single point of failure there should always be multiple layers of protection with proven reliability in place whenever dealing with significant hazards. In this case a properly rated regulator and/or a pressure safety valve would have prevented the casing from being overpressured.

Any temporary arrangement should undergo a suitable evaluation before use. For this example, the questions that should have been asked included:

- Can a less hazardous test medium be used? In this case, a lower pressure source and an inert gas would have been safer. Hydro testing is even safer.
- Is the test equipment design suitable? In this case there were no engineered controls in place that protected against potential human or technical failures (e.g. gauges).
- Is the test procedure suitable and sufficient for the people carrying out the test? In this case the people carrying out the test lacked some critical information (e.g. casing design pressure).

This evaluation would normally be covered by using management of change procedures that should cover temporary as well as permanent changes to plant and equipment.

References

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