THE FLYING GAS BOTTLE

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Abstract

During a test of a superconducting solenoid magnet a 50 liter gas bottle was attracted by the magnet and ended up sticking inside the magnet aperture. Fortunately the bottle was not damaged and only one person was slightly injured. After this incident the safety rules for any work in the vicinity of this magnet were reviewed.

THE SETUP

A test stand had been build up to test a new superconducting solenoid magnet for one of the HERA experiments. The magnet had a maximum field strength of 1 Tesla and only a very small iron yoke, resulting in a strong stray field.. The cryogenic supply consisted of a dewar vessel and a 50 liter gas bottle filled with helium at 200 bar, which was used to press the liquid helium out of the dewar into the magnet. Measurements of the magnetic field quality were done with a magnetic probe inside the aperture of the solenoid magnet.

INITIAL PROBLEMS

During a test of the magnet the pressure reading of the helium bottle indicated a pressure below the limit that had been set for ramping down the magnet and exchanging the bottle. As the cryogenic system was located behind the magnet, it was mandatory to ramp down the magnet before a gas bottle was transported alongside the magnet. In this case the pressure was so low that there was no time to ramp down the magnet (approximately 10 minutes). In order to avoid a quench due to insufficient helium flow in the magnet it was decided to exchange the helium bottle with the magnet at full power. This was against the safety rules, which did not allow transporting any magnetic material inside the test area with the magnet on. The safety officer of the test area did some quick calculations and decided that it was safe to transport the bottle on a trolley low on the ground, maintaining a minimum distance between the bottle and the magnet. Under his guidance a new gas bottle was carefully brought to the cryogenic system.

Unfortunately now it was realized that this new gas bottle, although marked as a helium bottle by an engraving in the bottle, carried a label which showed a different gas species. The safety officer himself carried this wrong bottle out of the test area and brought in a new bottle, now without an additional person as a guide.

THE ACCIDENT [1]

The safety officer, who was also the technical coordinator of this experiment, was in a hurry now to avoid the imminent quench of the magnet.

He stumbled, the gas bottle got nearer to the magnet than foreseen and was attracted by the magnet.

The flying gas bottle pressed the safety officer against a hard object. He received a laceration on the forehead and a black eye.

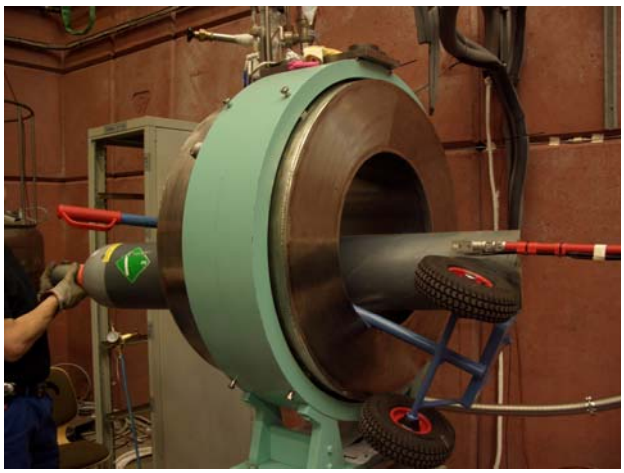

Figure 1: The bottle inside the magnet.

Figure 1 shows the magnet just after the accident. The bottle and the trolley are sticking inside the magnet aperture. Fortunately the bottle was not damaged. At this time the magnet is being ramped down. Someone holds the bottle to prevent it from falling out of the magnet. The red rod on the right side of the picture carries the magnetic measurement device, which was destroyed by the bottle.

Figure 2 shows the whole test area, with the gas bottle still sticking inside the magnet. The entrance to the test area is in the foreground, the cryogenic system is located at the wall behind the magnet.

REASONS FOR THE ACCIDENT

The main cause of the accident was the stumbling of the safety officer, caused by pressure of time to avoid a quench of the magnet.

Additional reasons for the accident were:

- The pressure reading of the helium supply was out of order. This created the hectic rush to avoid the quench.
- The cryogenic system was located behind the magnet, so that the gas bottles had to pass by the magnet.
- One gas bottle carried two different labels.

LESSONS LEARNED FROM THE ACCIDENT

The main lesson learned from this accident was that safety rules have to be applied at all times and must not be modified ‘on the fly’.

Gas systems (including the pressure reading) should always be kept in good working order and gas bottles

should only be filled with the gas species engraved on the bottle.

The test area was modified in a way that the helium bottle was placed at the entrance of the area.

Inside the test area the region where magnetic fields above 300 Gauss are possible was marked with an additional chain. All employees working in this area were instructed about the relevance of this chain.

Later the solenoid magnet was installed in one of the experimental areas of HERA. Temporary access to this area was managed by the HERA machine operators. Special safety rules in connection with the magnet were:

- Temporary access to this area was allowed only after the technical coordinator of the experiment had verified that the magnet was switched off for at least ten minutes.
- Warning signs (“High magnetic fields”) around the magnet were switched by a reed relay which was positioned directly in the magnet.
- After work had been done in the vicinity of the magnet, a thorough search for any magnetic material left in the area had to be carried out.
- All fire extinguishers and breathing apparatus in this experimental hall were equipped with non-magnetic bottles.

Figure 2: The test area right after the accident.

REFERENCES

[1] Annette Nienhaus, “Unfalluntersuchung, 22.9.04”, DESY –D5-, not published.