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SPIEZ LABORATORY

Description of an Accident due to Increasing Pressure in an Air-Tight Room

Lessons Learned and Implementation of Technical Safety Measures

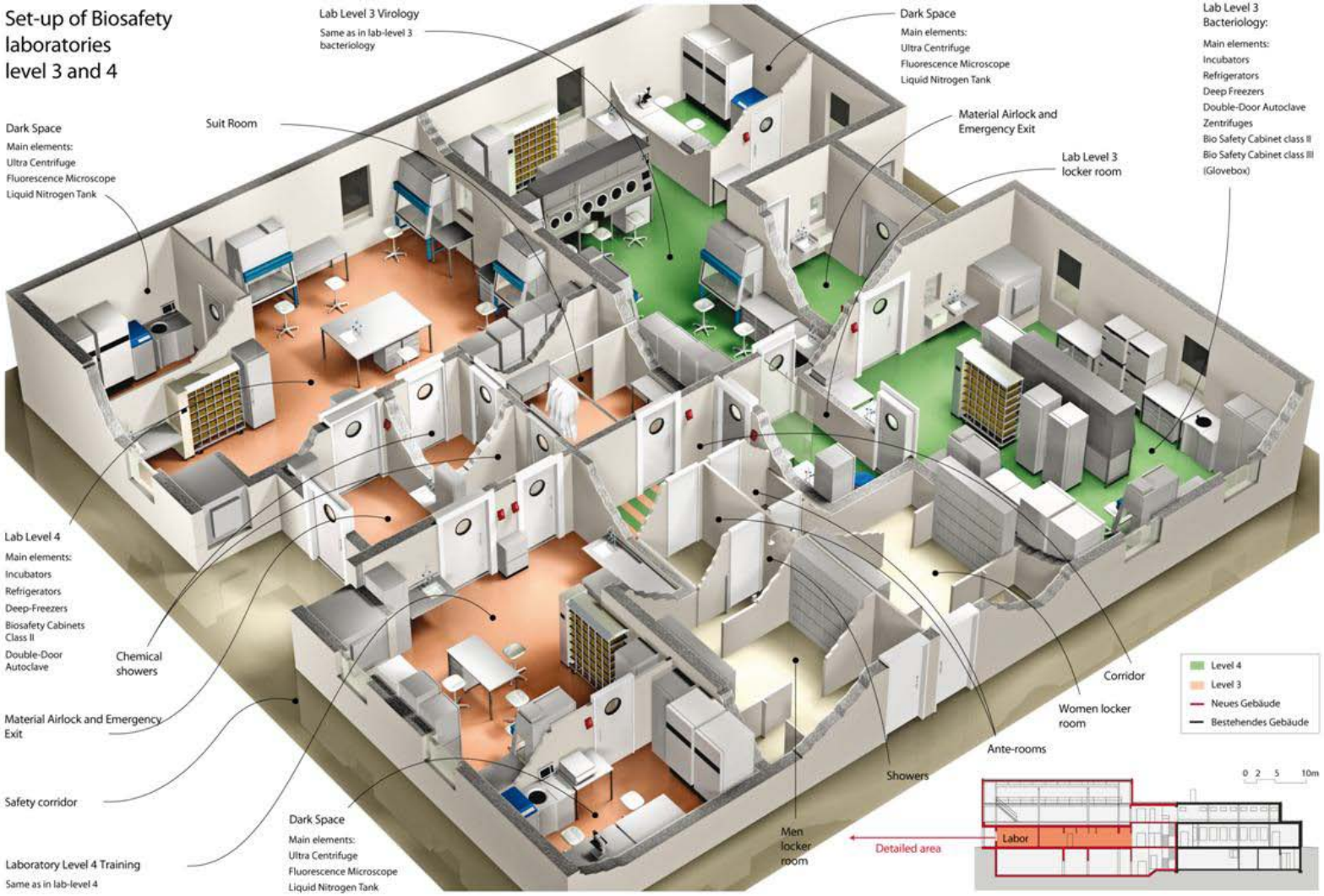
55th Annual Annual Biological Safety Conference
Orlando, USA
19. – 24. October 2012

Overview

- What happened?
- What caused the event?
- Analysis
- Solution
  - Pressure release system
- Summary

What happened?

What caused the event?



What caused the event?

Building Situation at Time of Event

- Air tight rooms
  - BL-42.1
    - average volume flow (leakage rate) according to AUS/NZ Standard of -0.07 l/s (at -200 Pa)
    - Pressure decay over 20 min according to Canadian guidelines of 48.95 Pa (-500 Pa starting pressure)
- Air tight dampers shut once room pressure is outside of +/- 20 Pa for more than 2 min
- No pressure release system in place
- Rooms equipped with LN2-cryotanks amongst other equipment

What caused the event?

Timeline of Events

- 2 people enter lab and open door to adjacent room
- Door stays open for ~ 2 min while “hellos” are exchanged and the LN2-cryotanks are filled for the first time (=> tank @ RT)
  - leading to initial pressure equilibrium between rooms and
  - probably causing the air tight dampers to shut
- Door is shut
- LN2 flows into cryotanks in an airtight room with dampers shut leading to an increase in pressure (later experiments show that room pressure may increase very quickly and exceed 1000 Pa positive pressure within a very short time frame)
- Door is unlocked and hits victim in face

Analysis

Risk Assessment – Possible Causes of Positive Pressure

- LN2-Cryotanks
- Breathing air supply
- Compressed air (e.g. valves in waste water treatment plant)
- CO_2 (e.g. incubators)
- Steam generators (e.g. waste water treatment plant)
- Heat from equipment (fridges, incubators, etc.): 1°C corresponds to ~ 347 Pa.

Analysis

Risk Assessment - Conclusions

- No need for airtight dampers to shut because pressure is outside of its intended range => BMS adjustments.
- HVAC system needs to cope with excess pressure in rooms due to LN2 or breathing air (BSL4) => HVAC adjustments.
- Four situations may still occur where airtight dampers shut while labs are still “operational”:
  - technical failure, e.g. loss of compressed air controlling dampers (loose hose)
  - earth quake causing shut down of all rooms
  - software failure
  - operating / human error

Solution

Installation of a Pressure Release System

Requirements:

- Needs to be self-controlled (no complicated control mechanisms)
- Pressure inside rooms may not exceed design specifications (no release of organisms at 500 Pa positive pressure)
- Pressure inside rooms may not rise above a level that does no longer allow doors to be opened (emergency exit)
- Can be fumigated
- Still functional in case of fire (no fire extinguishing system in place)

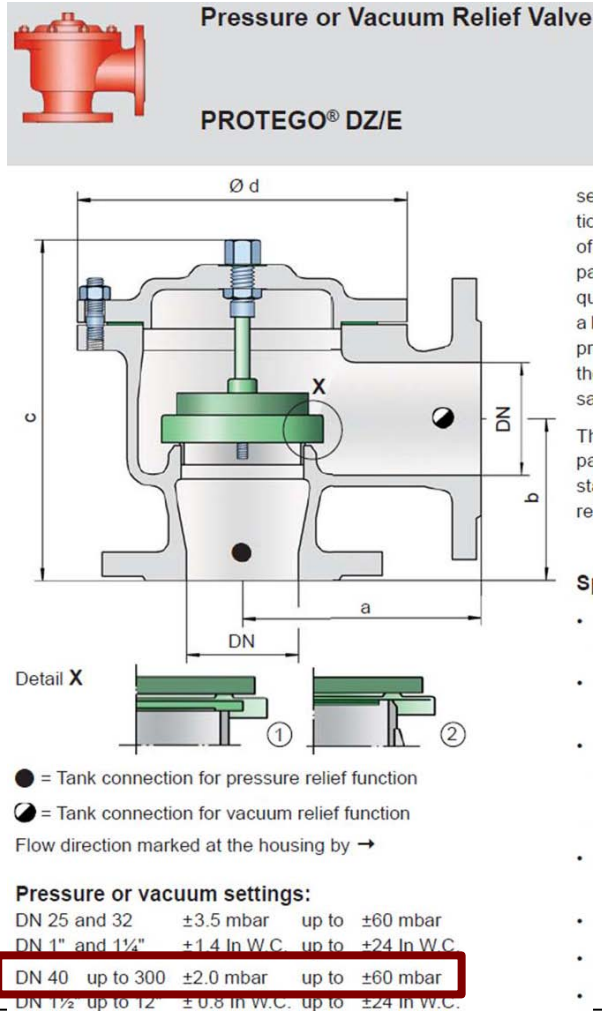
Solution

Pressure Release System

Solution

Pressure Release Valve

- Mechanical valve
- No additional control mechanisms
- Valve opens at approximately 200 Pa



Solution

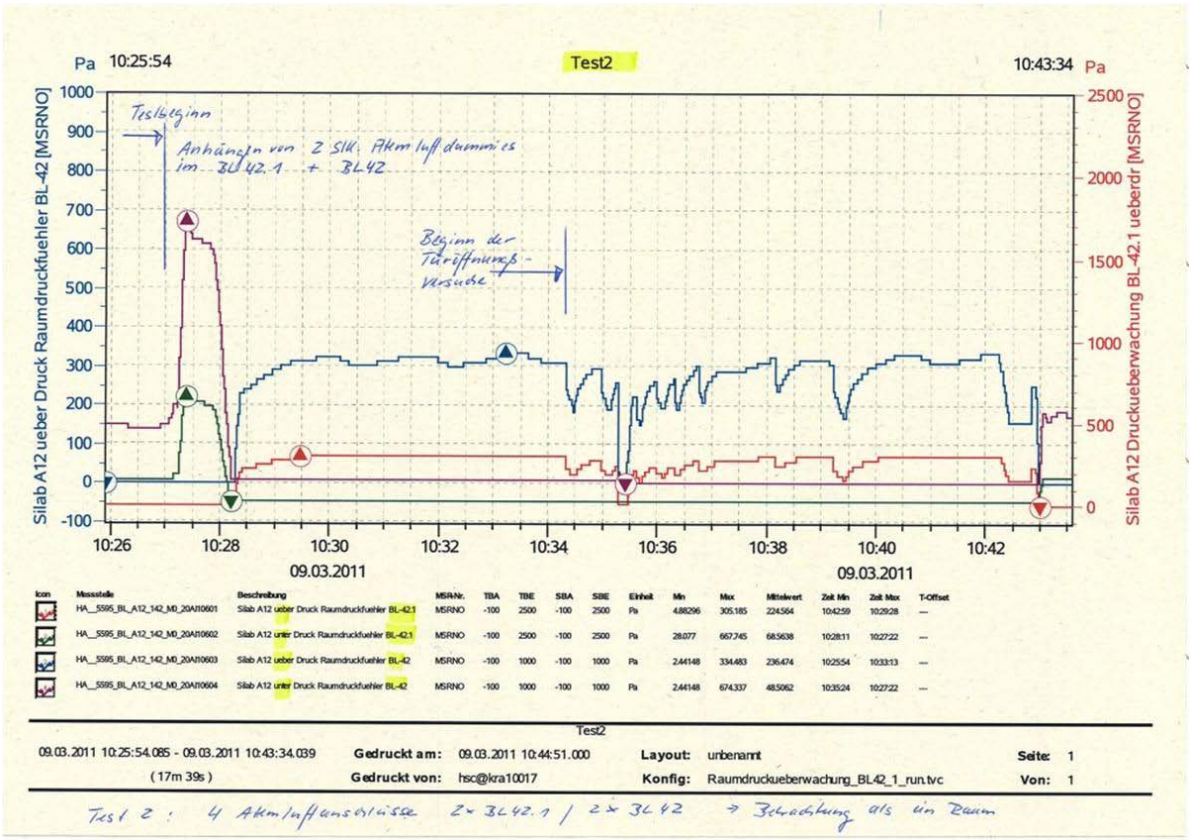
Filter Box

- BSL3: 1x H13
- BSL4: 2x H13
- Filters heat-resistant up to 300°C

Solution

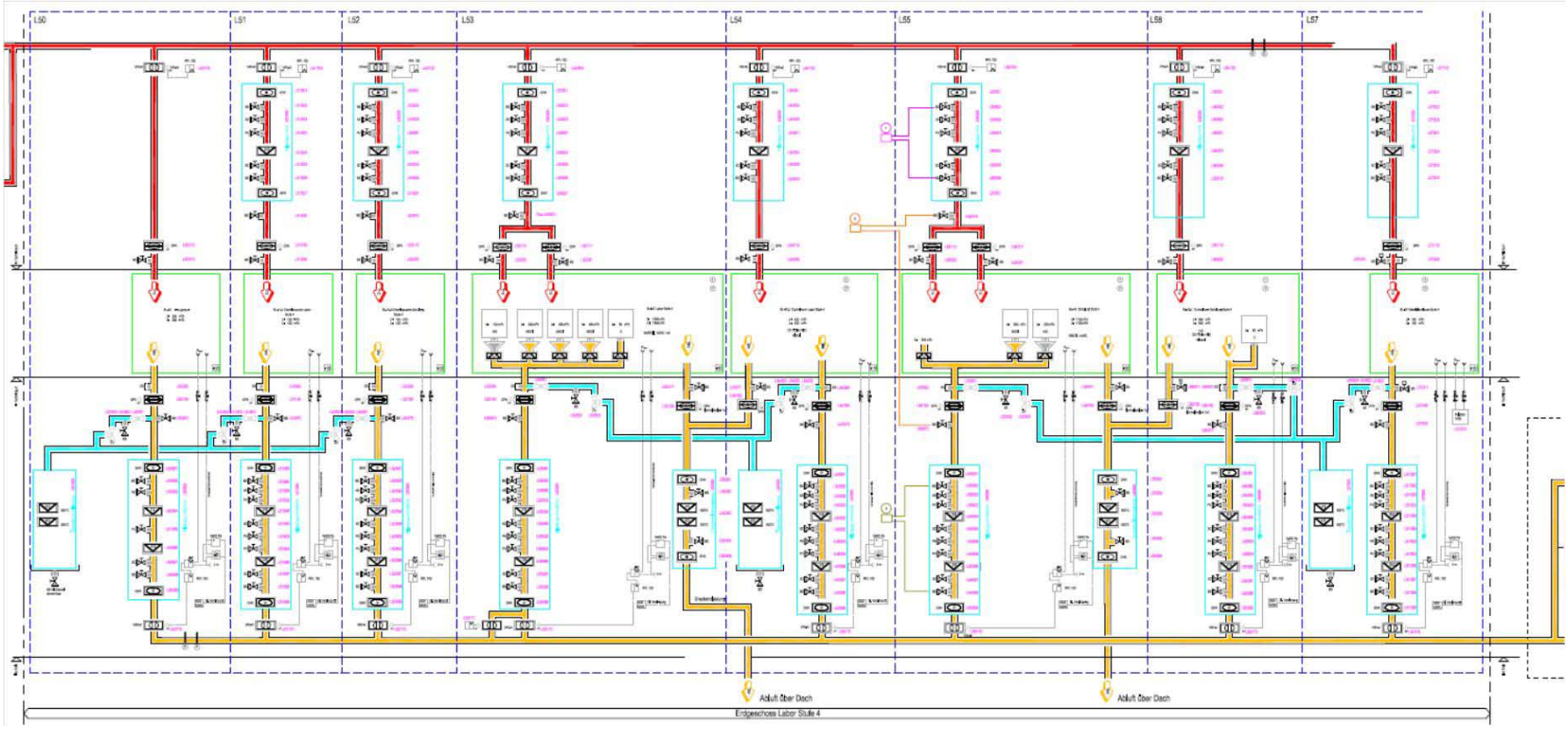
Tests to See whether Doors May still Be Opened

- Max. pressure ~ 350 Pa
- Overall flow resistance of valve, ducts & filter
- 100 Pa correspond to 10 kg/m2 => max. weight pushing against doors = 100 kg



Solution

Installation of System in all Rooms Requiring Pressure Release



Solution

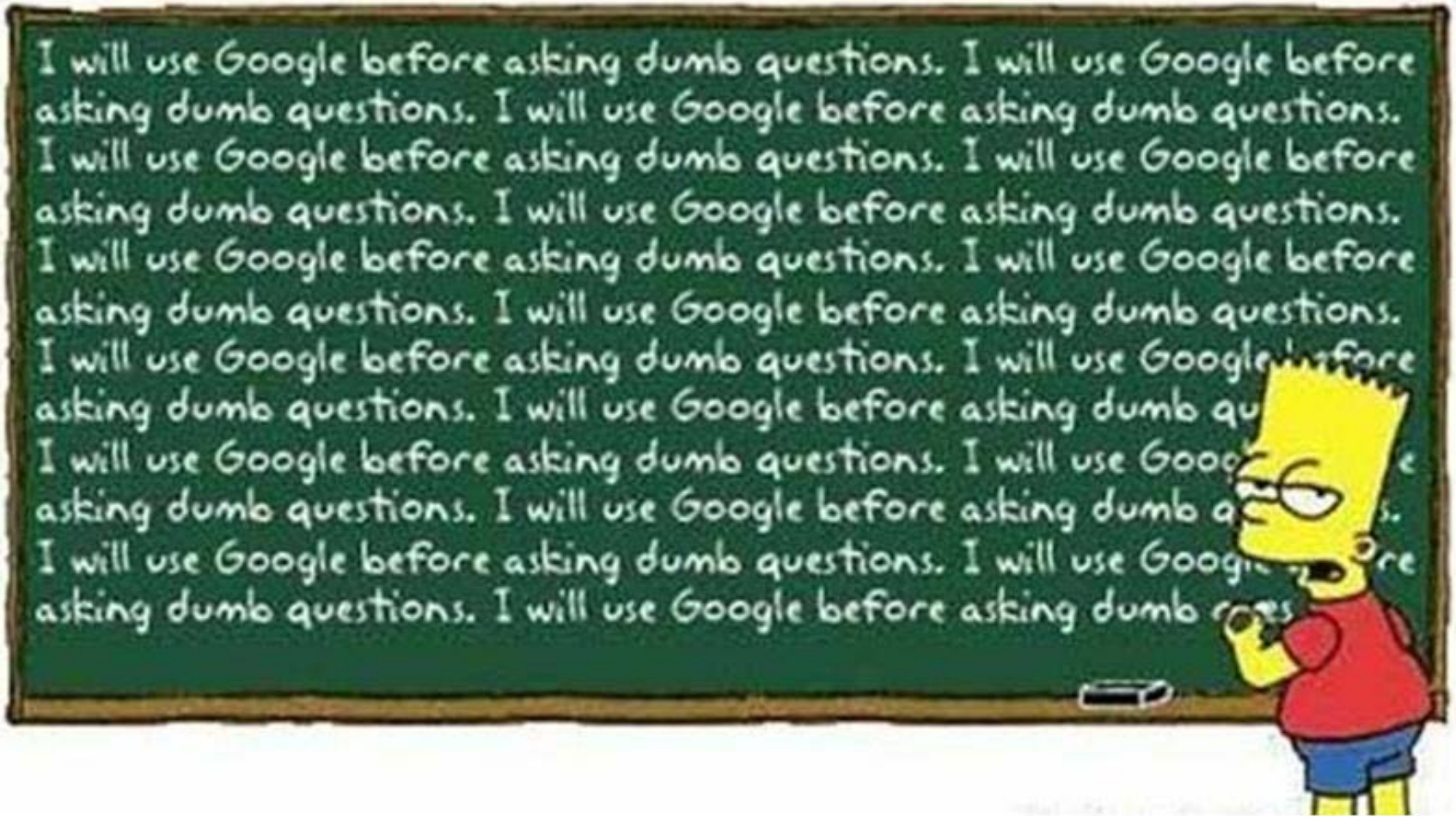
Fumigation

- VHP fumigation
- BI (10^6): no growth (cycle development, i.e. not validated)

Summary

- Accident could have been prevented
- A lot of lessons learned
- Many causes of temperature rises and thus pressure increases
- Installation of pressure release system
- May also be a solution at other facilities

Questions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