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CERN's cryogenics safety record

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What is safety ?

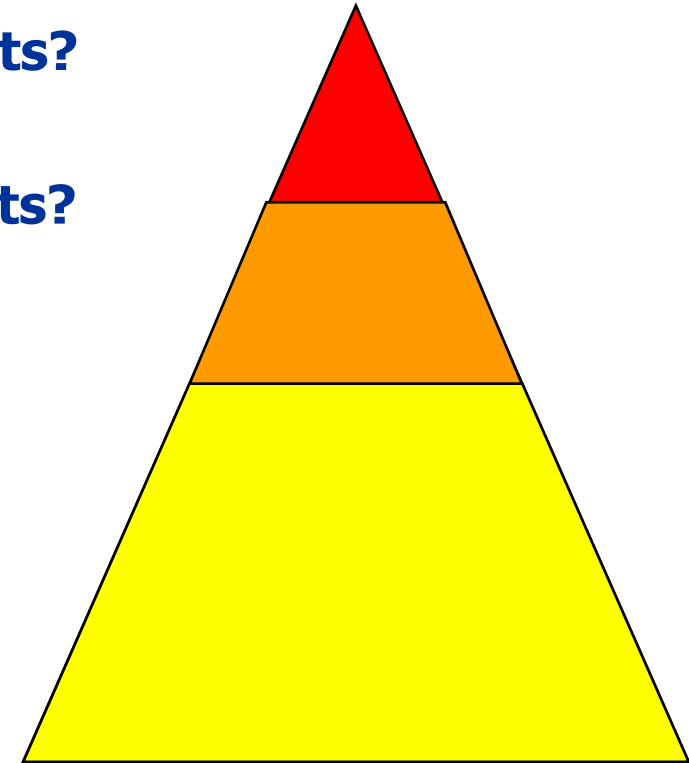
- **Everyone perceives safety differently!**
- **This is only one definition:**
Safety is the state of being "safe" (from French *sauf*), the condition of being protected against physical, social, spiritual, financial, political, emotional, occupational, psychological, educational or other types or consequences of failure, damage, error, accidents, harm or any other event which could be considered non-desirable.
- **BUT, what are WE talking about?**



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What is safety?

- **Is safety about avoiding major incidents?**
- **Is safety about avoiding minor incidents?**
- **Is safety about avoiding everyday incidents?**
- **OR still something else?**

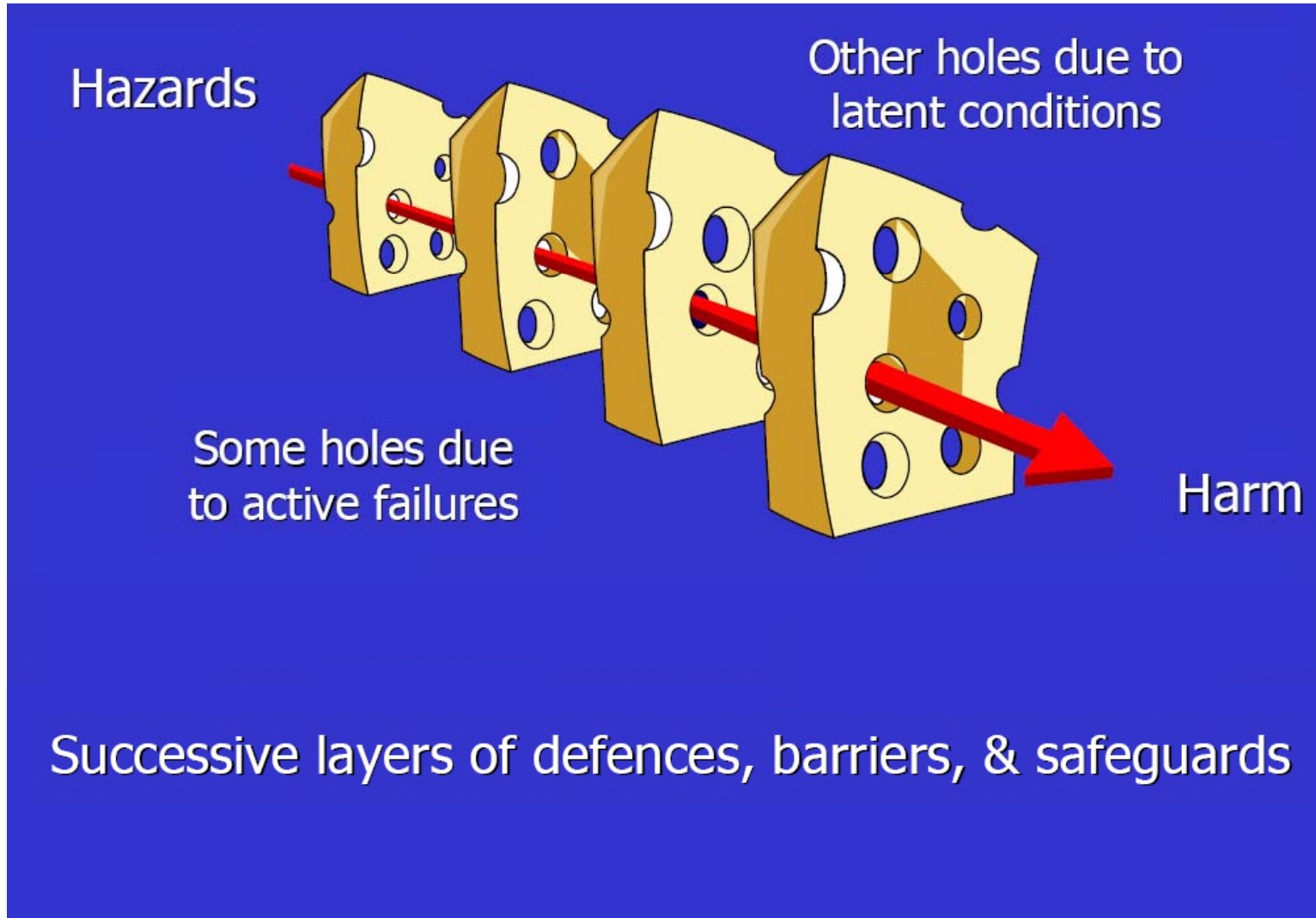




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What is safety? - James Reason and the Swiss Cheese Model



Is safety about building defences, barriers and safeguards?



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Safety might be about creating a „high reliability organisation“ culture

- **Preoccupation with failure**
 - Learn from incidents!
 - Overconfidence can be dangerous!
 - Be attentive to details!
- **Reluctance to simplify interpretations**
 - Encourage different views and respect them!
- **Sensitivity to operations**
 - Communicate experiences!
- **Commitment to resilience**
 - Be flexible!
- **Deference to expertise**
 - Move authority to expertise!

So far the definition...



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What CERN does: « safety policies at CERN »

- **CERN rules and regulations**
 - » e.g. cryogenic safety instructions, pressure code
- **CERN's safety organisation**
 - » safety hierarchy independent of line hierarchy
- **Reviews**
 - » e.g. specification reviews, engineering design reviews
- **Training**
 - » sensibilisation for cryogenic dangers
- **Documentation and procedures**
 - » plant documentation (PIDs, electric diagrams, manuals)
 - » work permits (AOC)
 - » LOTO (lockout-tagout)
- **Individual and collective protection**
 - » protective clothing, oxycells, ODH detection systems
- **Inspections**
 - » regular inspections of cryogenic installations



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Incidents and accidents

- **cold burn risk**

- **CASES**

- » 05.09.2000 burned hand with liquid nitrogen while re-installaing a safety valve
- » 24.10.2002 burned hand with liquid nitrogen
- » 16.10.2004 burned right hand while closing nitrogen bottle after a demonstration

- **asphyxiation risk**

- **SITUATION**

- » during commissioning (2007)
 - 1 ODH alarm every 2 months
 - 1 undetermined alarm every month
- » from 350 ODH sensors on site

- **CASES**

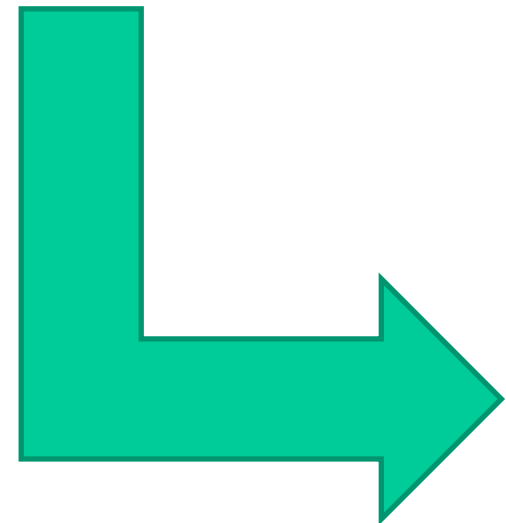
- » x.x.xxxx Cold nitrogen gas enters a gallery and triggers alarm
- » x.x.xxxx Helium leaks from line that is pressure tested



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Incidents and accidents

- **Hardware failures**
- **CASES**
 - » Break of a pipe on a liquid nitrogen tank – loss of liquid nitrogen
- **Software failure and operation failures**
- **SITUATION**
 - » They happen every day, but they are not necessarily recorded!





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Round-table discussion

- **equipment safety issues**
 - » re-qualification of cryogenic storage vessels
 - » re-calibration of safety valves
- **philosophies**
 - » how to improve on safety
- **national norms and standards**
 - » difficulties with incoherences
 - » missing standards
- **risk analysis methods**
 - »



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Cryogenic installations at CERN ... from the safety point of view

- **850000 m³ of asphyxiating gas stored**
- **27 km of tunnels 100 m underground**
- **at least 100 manholes that access confined spaces**
-



- **Indeed incidents are a sensitive topic. I suggest we continue the conversation Tuesday morning 9:00 In our office. I'll send an invite separately. Here are some thoughts on how I would approach the topic.**
- **I would not start with saying our safety record is good.**
- **I would start by asking who has recently picked up a new hobby, be it bird watching, keeping a dog / cat, or sailing Or reading SF books. Then what did you notice? The moment you have it, you notice more and more of them and you learn more and more about it!**
- **With incidents the same phenomenom happens. The moment you start paying attention, the more and more you see them and more and more you learn from them. The alternative strategy is not paying attention. Sooner or later big mishaps are bound to happen. That is what analyses from all major accidents tell us.**
- **What happens if you keep and increase paying attention? You learn more and more about them, but also you start to wonder: what makes a bird a bird, what makes a bat different from a bird. Why do would I exclude them from my hobby?? This is an interesting disussion, but I would not spend too much time on it.**
- **I'd rather jump to the conclusion:**
- **(1) Incidents are unexpected events that (could have) cause losses.**
- **(2) This very broad definition includes operational mishaps and long term health effects (e.g. from exposure to chemicals)**
- **(3) It is not realistic to investigate all of them (too time consuming) so we must find some heuristics (rules of thumb) to make this decision.**
- **(4) Here are some suggestions for such rules**
 - **- appetite: if people suspect there is something to learn then start an investigation**
 - **- potential: if the incident is not an (serious) accident by sheer luck, then we should investigate**
 - **- actual losses: injured people, damage to installation, delays in planning**
- **(5) The objective of the investigation should be to identify the causes, "what made this happen", so curiosity driven. It should not be constrained to the people on the shop floor.**
- **(6) The final step is: identify what could be improved to prevent recurrence**