

IICA Gas Detector Functional Safety Course

4. Hazard & Risk Assessment



4. Hazard & Risk Assessment

GAS DETECTOR FUNCTIONAL SAFETY
OVERVIEW COURSE



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Purpose

Explains the key principles of Hazard and Risk Assessment applicable to the first stage of the lifecycle.

TOPICS

Hazards, Hazardous Events, Risk

Overall process for Hazard and Risk Assessment

Hazard Analysis

Risk Analysis

Risk Assessment

Case Study

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Key Definitions

hazard

- a potential source of harm

hazardous event

- an event resulting from realisation of a hazard
- has “consequences”

severity

- the severity of the consequence of a hazardous event
- units depend on type of consequence
- e.g. no. of fatalities, dollars, ...

likelihood

- the probability of a consequence of a given event in a given time period
- may be expressed as a “frequency”

risk

- the expected value of loss
- i.e. the combination of “likelihood” and “severity” of event consequence (harm)

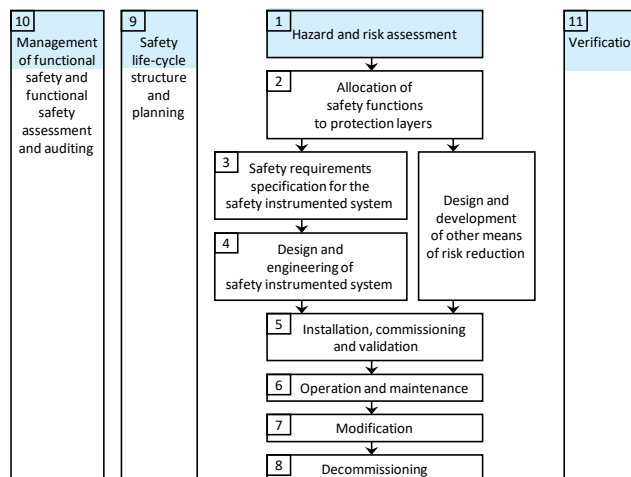
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Lifecycle Phase 1 – Hazard & Risk Assessment

Output is a list of hazardous events with their process risk and acceptable risk



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Hazard & Risk Assessment - Objectives

Identify hazardous events and for each

- the factors that contribute to it
- its likelihood
- its consequences
- the associated process risks

Determine the risk reduction required

- To reduce the process risk to less than the acceptable risk

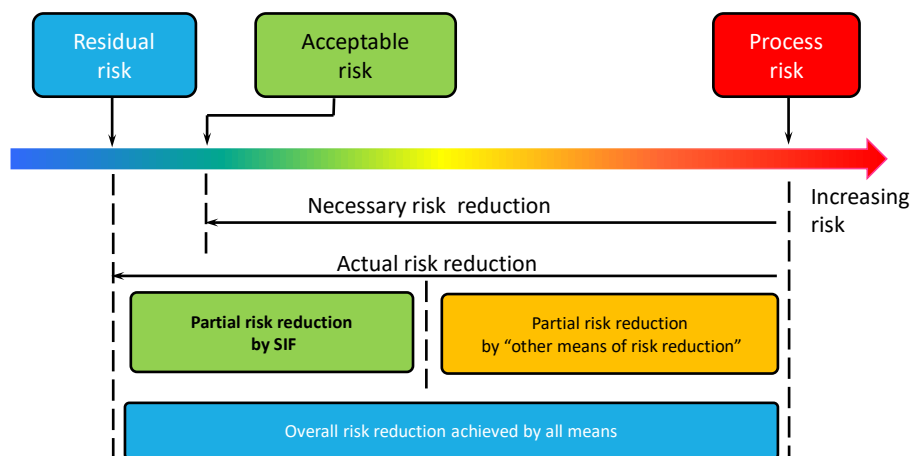
Document the above as outputs from this phase

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Overall Risk Reduction process

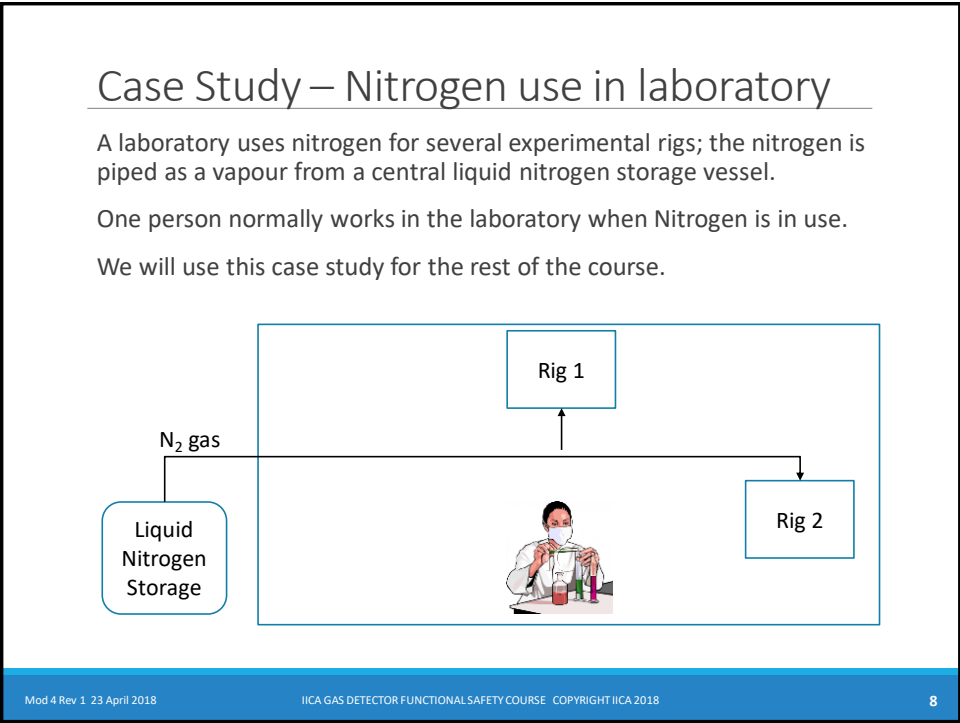
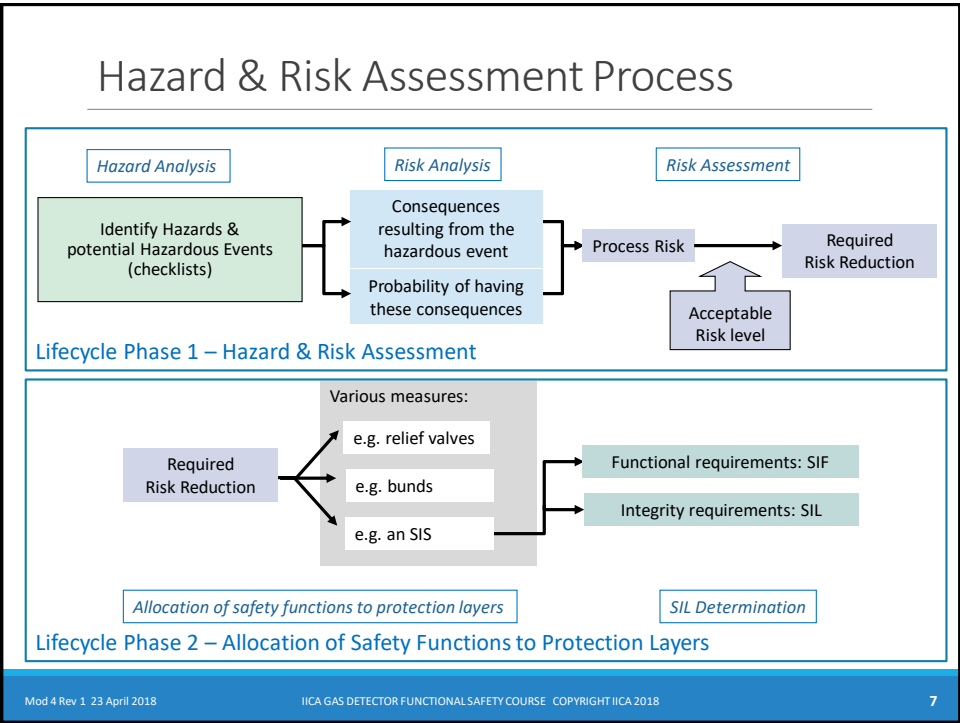


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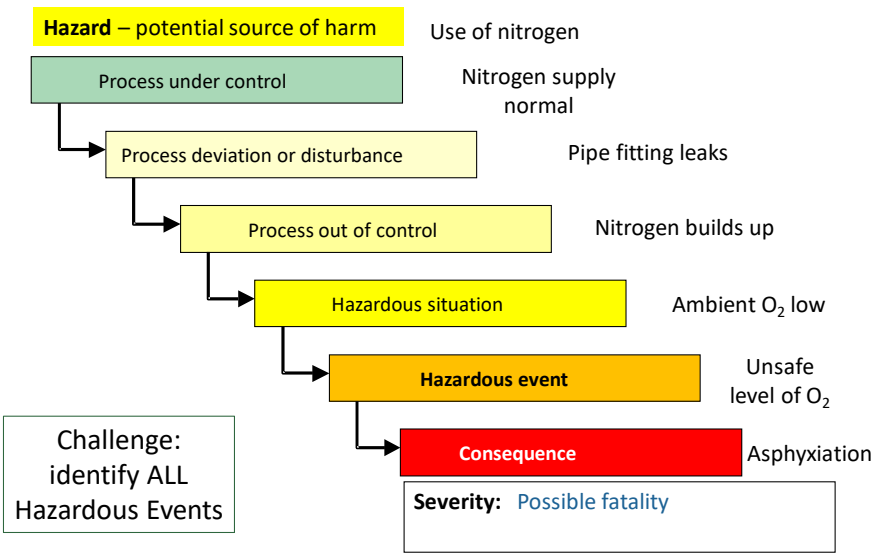
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Hazard Analysis

Hazardous Event Chain



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Hazard Analysis

Identify hazards from laboratory gases

Should use a structured process to identify all hazards

- Laboratory hazards are typically well known
- HazOp is widely used in process industries

Checklist approach is recommended for laboratories:

- See:
<https://www.acs.org/content/acs/en/about/governance/committees/chemicalsafety/hazard-assessment.html>

Responsibility of laboratory management

Example hazard:

“Nitrogen used in an enclosed laboratory”

HAZOP – Hazard & Operability Study

Goals of a HAZOP

- identify potential causes of process upsets which could lead to significant safety or operability consequences
- decide whether the current design ensures that the risk from each scenario is suitably low
- recommend modifications that reduce the risk to an acceptable level

Who's involved in HAZOP

Team of 6-8 people

Different areas of expertise

- project engineer,
- operations representative,
- process design engineer,
- discipline engineers (mechanical, instrument/control etc.)

A trained HAZOP leader (independent preferred)

- often a specialist risk engineer

A minute taker (one of the above but not the leader)

- good training role for junior process engineer

HAZOP Study - Sequence

Select a Piping and Instrument Diagram (P&ID)

Select a "Node"

- usually a vessel or piece of equipment with associated piping

Apply a Guide Word to a Process Parameter

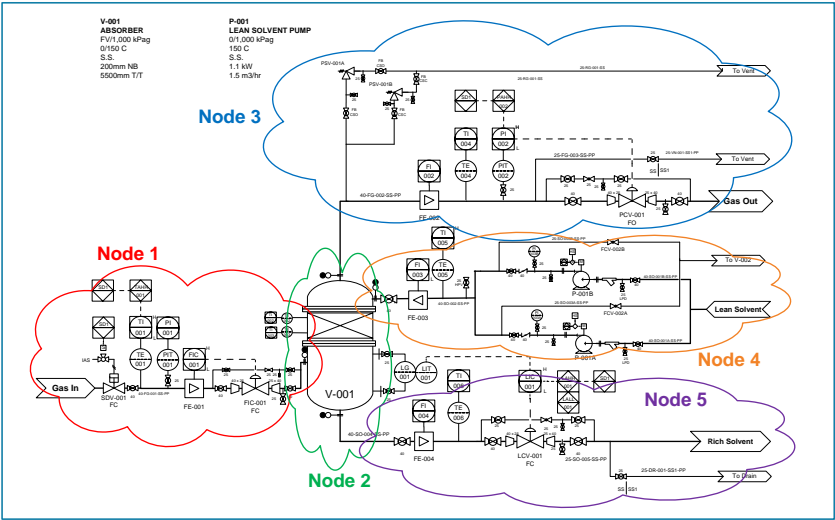
- high, low, zero, reverse - flow, temperature, pressure, level, composition etc.
- examine possible causes
- examine consequences
- list existing safeguards
- decide upon action
- record discussion and decision
- repeat for next guideword

Continue until all nodes are complete

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What's a HAZOP Node?



HAZOP Recording

HAZOP Report Sheet

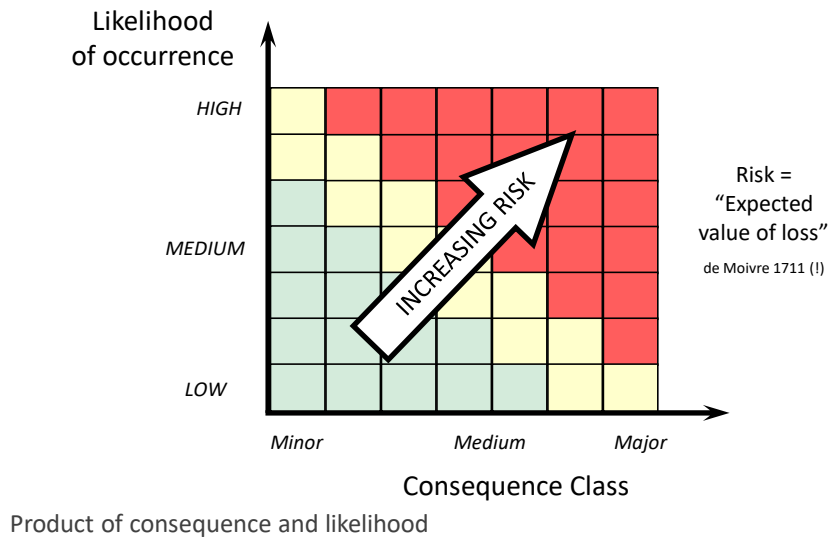
Project:		Date:		Leader :	
Design Intent:		PRESENT:			
Drawing No:		Page: 1 of			
Line No:		Hazop No:			
Hazop Actions Complete	Sign	Indicator	Date		
Hazop Leader:					
Process Area/Department Manager					

#	Item	Deviation	Possible Causes	Consequences	Safeguards	Action Required	Actionee	By	Closeout Comments
	Overview								
	Flow	High							
	Flow	Low/Zero							
	Flow	Reverse							
	Pressure	High							
	Pressure	Low							
	Temperature	High							
	Temperature	Low							
	Impurities								
	Composition								
	Instruments								
	Testing								
	Startup checks								
	Operability								
	Electrical								
	Materials								
	Reliability/Simplicity								
	Commissioning/Startup								
	Breakdown, shutdown								
	Services								
	Effluent								

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What is Risk?



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Consequence & Severity

Consequence Categories

- Safety – harm to people
- Environmental – harm to the environment
- Financial – loss of profit
- Others?

Severity grouped in bands

- safety based on likely injuries & fatalities

Laboratory example:

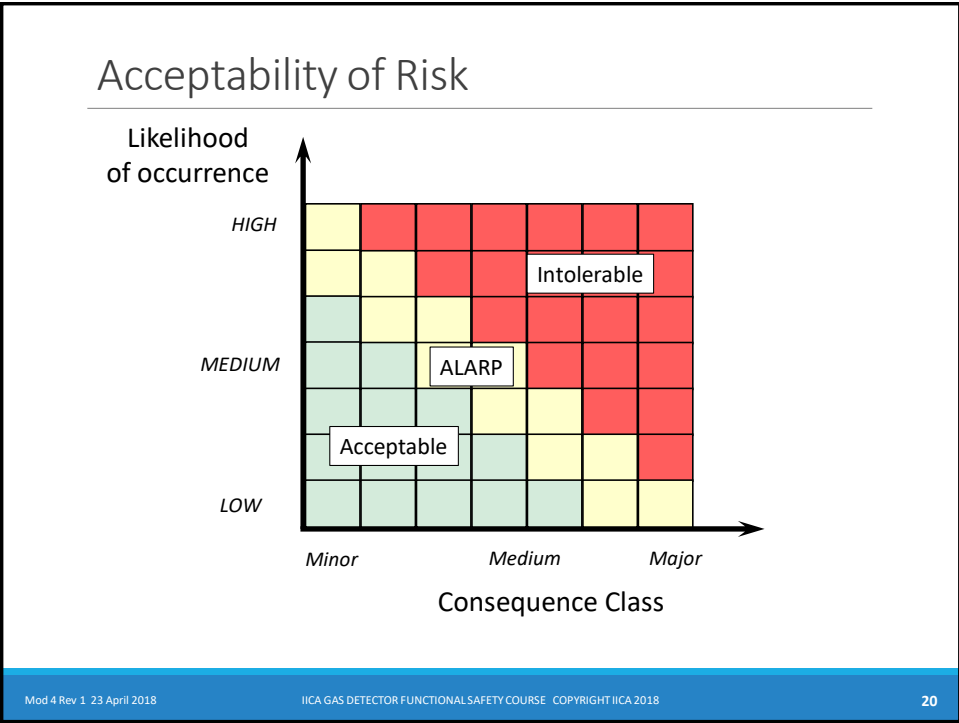
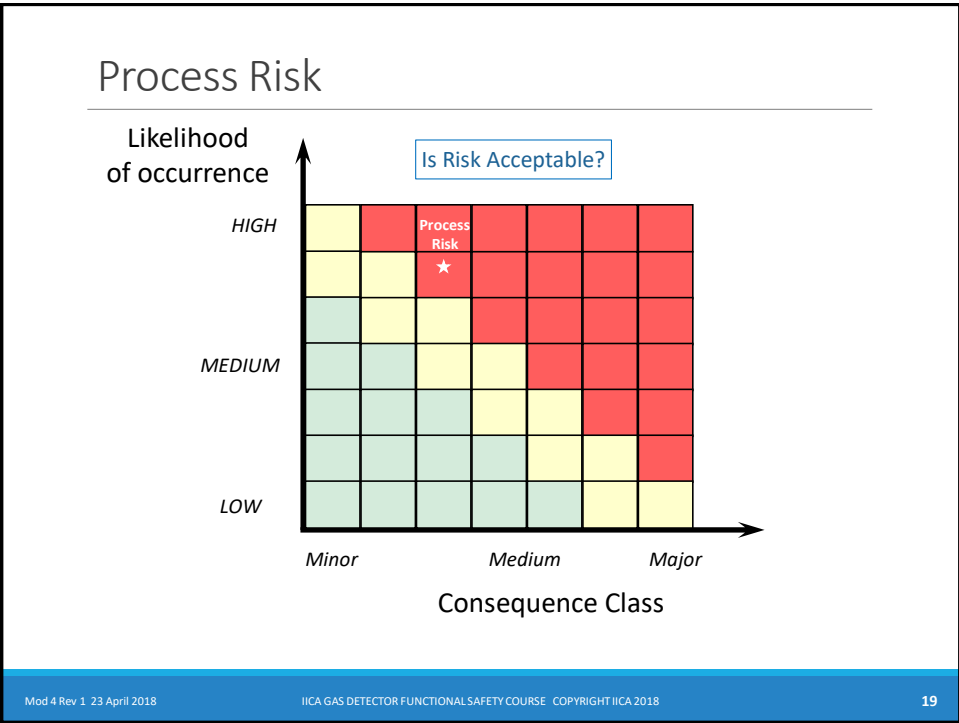
"Asphyxiation of one person. Possible fatality."

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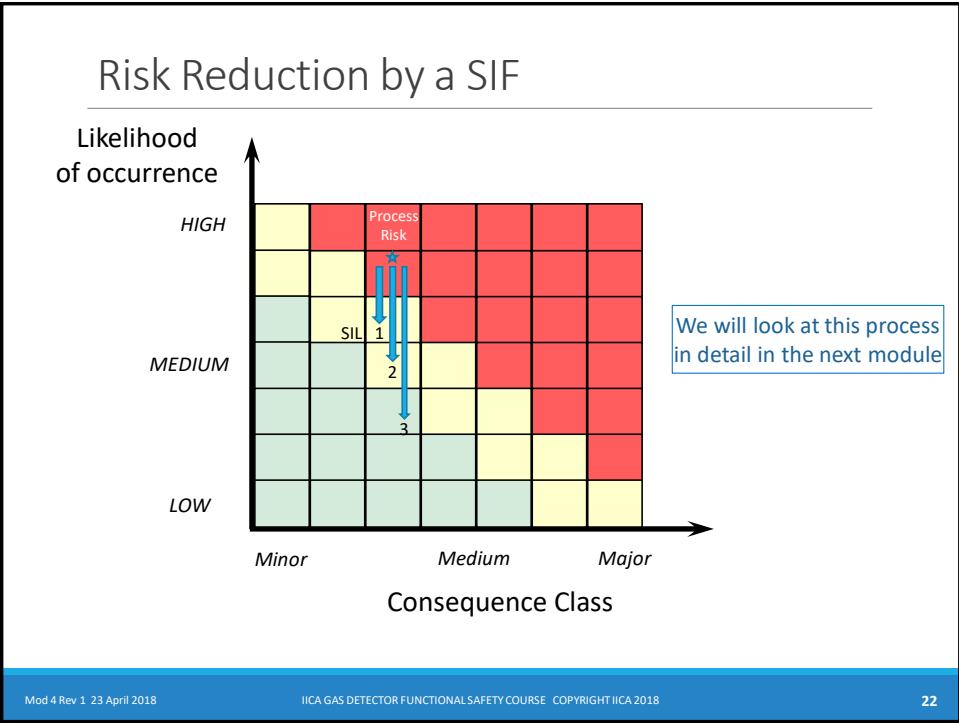
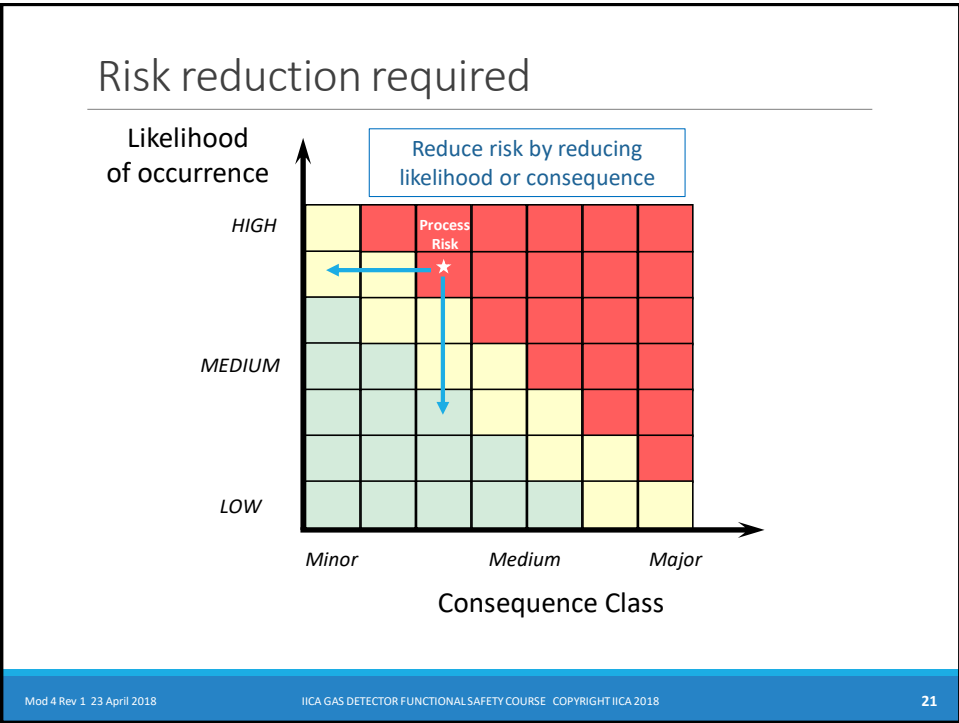
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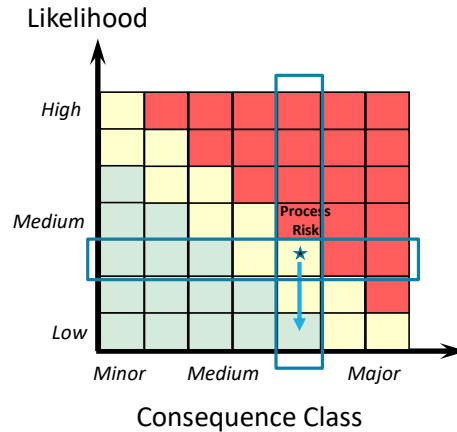
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Case Study – Nitrogen use in laboratory

Hazard & Risk Analysis

- Hazard
 - Nitrogen vapour
- Hazardous Event
 - Asphyxiation by Nitrogen in room
- Consequence
 - Possible fatality
- Likelihood of release in room
 - Unlikely (less than once per year)
- Risk reduction required



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Summary

Introduced basic concepts of Hazard & Risk Analysis

A Hazard can result in a Hazardous Event that can cause harm

The Risk of the Hazardous event is a function of

- the severity of the consequence of the event
- the likelihood of the consequence

First identify all Hazards and Hazardous events

Analyse the risk of each hazardous event

Is it acceptable?

If not, the risk must be reduced to an acceptable level

A SIF is one means of reducing risk

- the higher the SIL, the more it reduces risk

Questions?

