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Risk and Process Safety Management Services

Hesham Hanafy

Senior process safety engineer

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What is a Safety Case?

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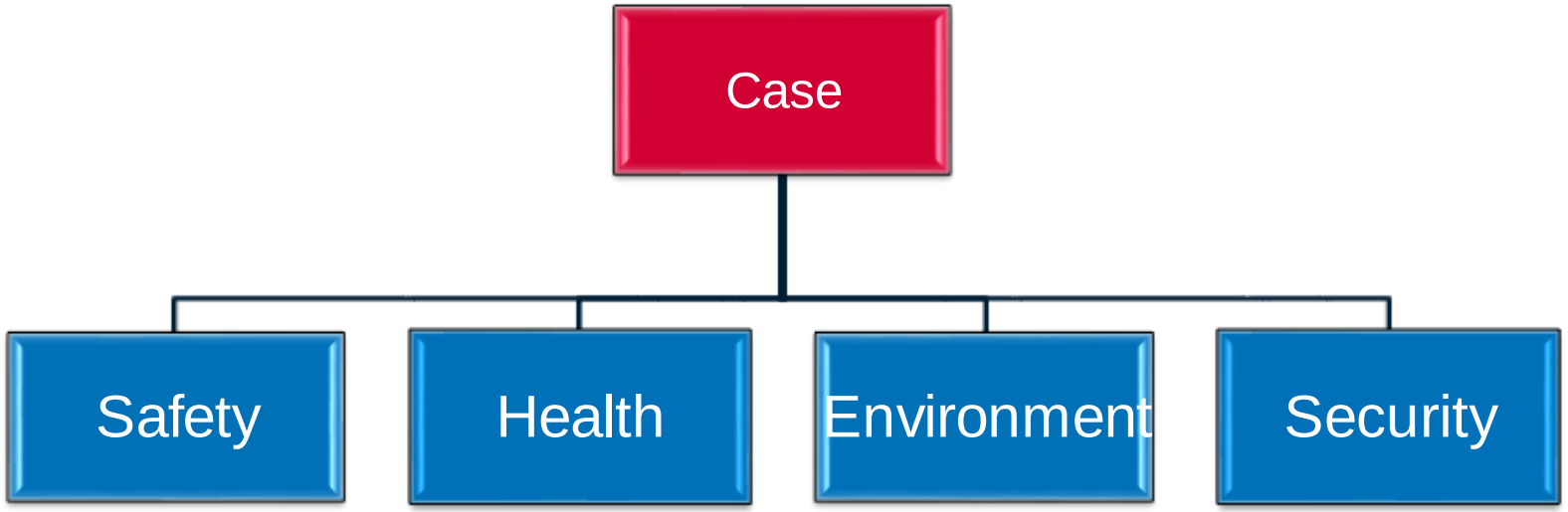
Types of case for safety, etc.



Safety Case

HSE (or EHS or SHE) Case: Health, Safety and Environment

HSES Case: Health, Safety, Environment and Security

All elements may or may not be included in a Case

I will referred to all of them today as a Safety Case

What is a Safety Case?

Safety Cases are detailed documents demonstrating that the facilities are:

Designed

Constructed

Commissioned

Operated

Decommissioned

in such a way as to minimise risks to personnel, the public and, for HSE cases, the environment

Video

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What is a Safety Case used for?

to demonstrate to management and employees, investors, contractors and, where relevant, the regulator and/or the public that adequate controls are in place to ensure that the major HSE risks arising from a particular operation are both tolerable and reduced to as low as reasonably practicable (ALARP)

to provide a reference point for everyone involved with facility operations to define the requirements for effective control of safety issues

When is a Safety Case necessary?

- Corporate requirement (e.g. for all operations above a certain risk threshold)
- Legal requirement (e.g. Seveso III led to UK COMAH (Control of Major Accident Hazards) Regulations)
- To demonstrate HSE management, either internally or externally

Normally required where there is a perceived Major Hazard/Accident

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Major hazards/ accidents

"An uncontrolled occurrence in the operation of a site which leads to severe or catastrophic consequences to people, assets, the environment and/or company reputation. The consequences may be immediate or delayed and may occur outside as well as inside the site. There will generally be a high potential for escalation"

Abu Dhabi National Oil Company. *Code of Practice on Control of Major Accident Hazard,* ADNOC-COPV5-01, Version 1, April 2004

"An occurrence (including in particular, a major emission, fire or explosion) resulting from uncontrolled developments in the course of the operation of any establishment and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances"

The Control of Major Accident Hazards Regulations 1999 , UK HSE

"Major Accidents represent the ultimate, most dangerous way in which a offshore engineering project can go wrong. Accidents cause death, suffering, pollution of the environment and disruption of business."

CMPT, A Guide to QRA for Offshore Installations

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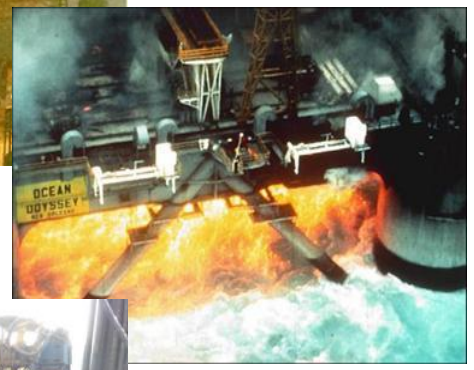
Major accident hazards

Release of H_2S or hydrocarbon gases onboard rig
Personnel working at height
Helicopter and helideck operations
Uncontrolled descent of overhead object/release of tension
Falling objects from structural failure of derrick or equipment
Hydrocarbons in formation: blowout
Uncontrolled pressure release from vessels, piping or hoses
Loss of station keeping ability
Loss of stability
Fire in accommodation spaces



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Why have a Safety Case?

The motivation for a Safety Case is to:
provide a focus and rationale for safety activities: leading to efficient analysis and evaluation
provide a focus for assurance
provide a reviewable demonstration of safety so that all stakeholders can be involved
demonstrate discharge of duty to public and stakeholders
allow interworking between standards and innovation (not fixed to regulatory framework)

In many countries, and for many companies, a nuclear facility, oil company, rail company, etc. cannot operate a facility without an approved Safety Case or similar document: Permissioning Regime

Who is the Safety Case for?

The target audience for the Case needs to be clearly defined.

This will have a major effect on the style and content of the Case

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Background in incidents

Seveso 1976 Milan – EU
Sevseso III Directive

Piper Alpha 1988 – UK Safety
Case Regime

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Accidents are expensive

Chernobyl $200-300,000,000,000
Exxon Valdez $5,000,000,000
Fukushima $250,000,000,000
Piper Alpha $1,270,000,000*
Petrobras P36 $515,000,000*
Petrobras' Enchova PCE-1 $461,000,000*
Sleipner A $365,000,000*

*Based on US Dollars in 2002 from http://www.oilrigdisasters.co.uk

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Safety Cases: worldwide

Requirement varies between countries: Safety Cases more likely to be required in countries with goal setting legislative regimes

UK & Europe have been proactive and tend to require Safety Cases for industries with major accident potential

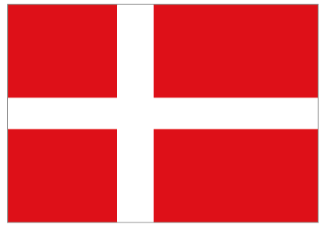
Often no requirement in countries with rule-based (prescriptive) systems, but here there can be a need for Safety Reports to demonstrate compliance in high accident potential industries

Major operators in some industries (e.g. oil and gas) apply systems worldwide: applied as a business requirement both to minimise risk to people and damage to asset and/or reputation

Countries with well developed Safety Case requirements: oil and gas

REGULATIONS RELATING TO MATERIAL AND INFORMATION IN THE PETROLEUM ACTIVITIES (THE INFORMATION DUTY REGULATIONS)

Petroleum Safety Authority Norway (PSA)
Norwegian Pollution Control Authority (SFT)
Norwegian Social and Health Directorate (NSHD)



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What Does a Safety Case Look Like?

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Logistics HSE Case

Demonstrating how the hazards and risks related to operations are suitably and sufficiently managed.

In particular the Major Accident Hazards

Part 1 - Introduction	Brief description of Case inc. objectives and scope. Identifies document owner, requirements for review/ update and responsible person.
Part 2 - Facilities Description	Provides an overview of facilities and operations focusing on how hazards are controlled.
Part 3 - HSE MS	Provides a description of the HSE system in place for managing the HSE risks associated with the operations.
Part 4 – Risk Management	Provides a demonstration that all potential significant hazards have been identified, the risk from the hazards evaluated and understood, and the controls to manage the causes and consequences are in place.
Part 5 – Emergency Response	This part summarises the Emergency Response Plans including emergency scenarios and emergency response organisation.
Part 6 – Conclusions & Action Plan	Conclusions on reaching the objectives. Actions required to ensure risk are reduced to ALARP level.

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Safety Case Tools and Techniques

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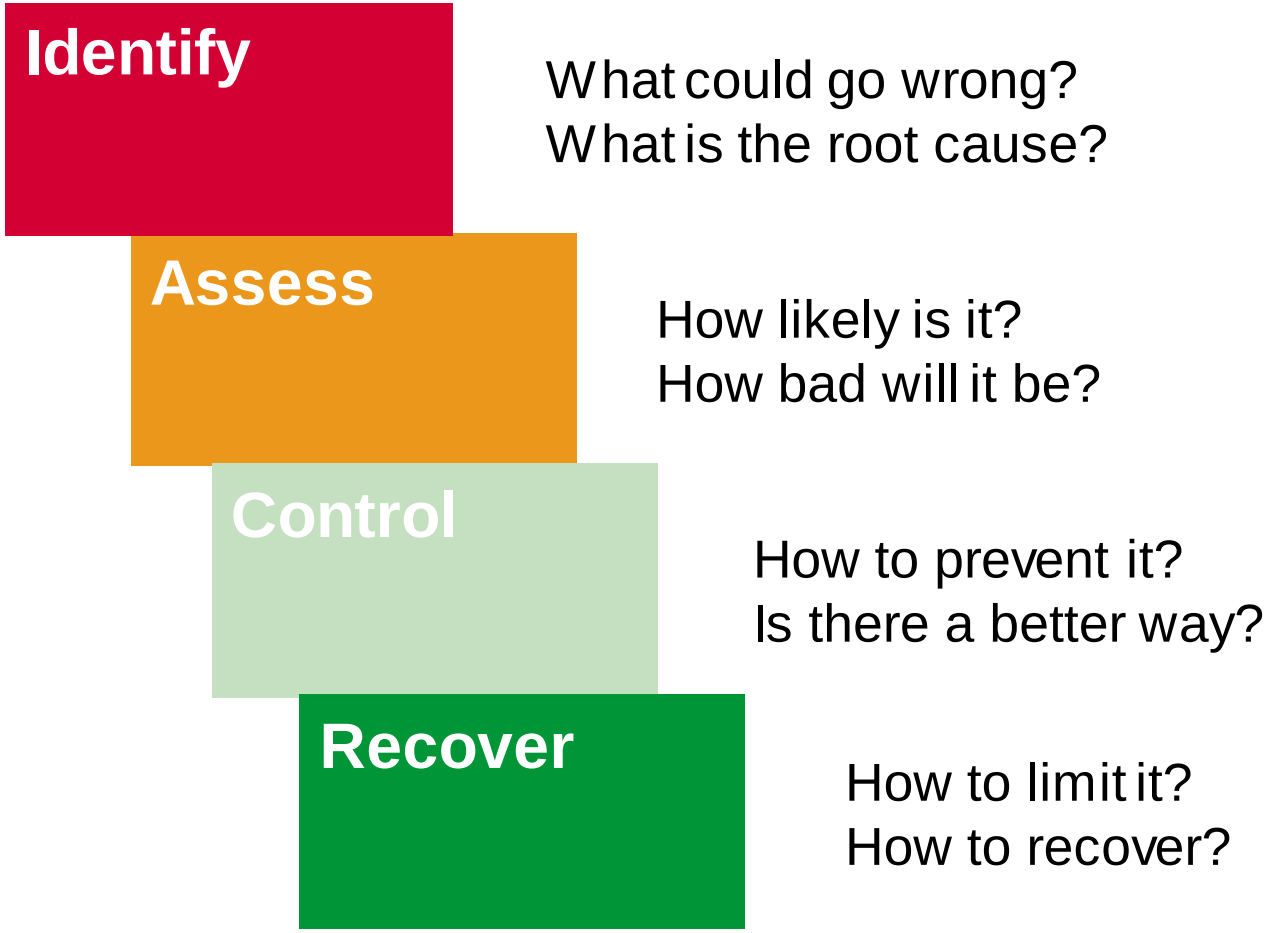
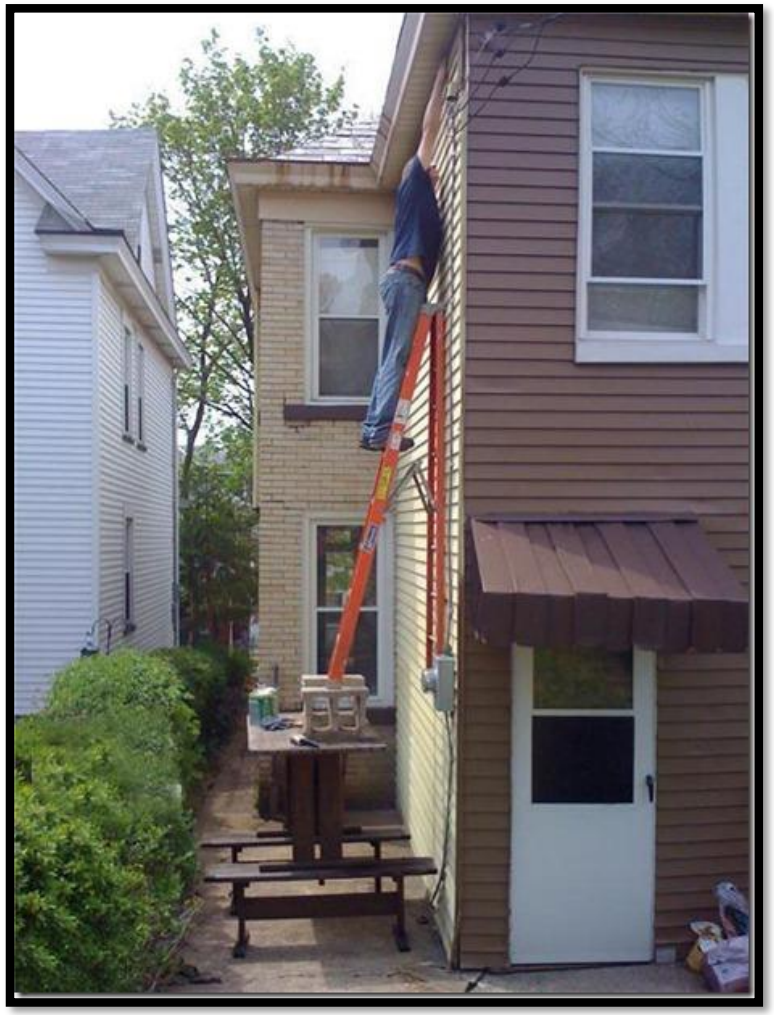
Risk evaluation and management



Hazard identification



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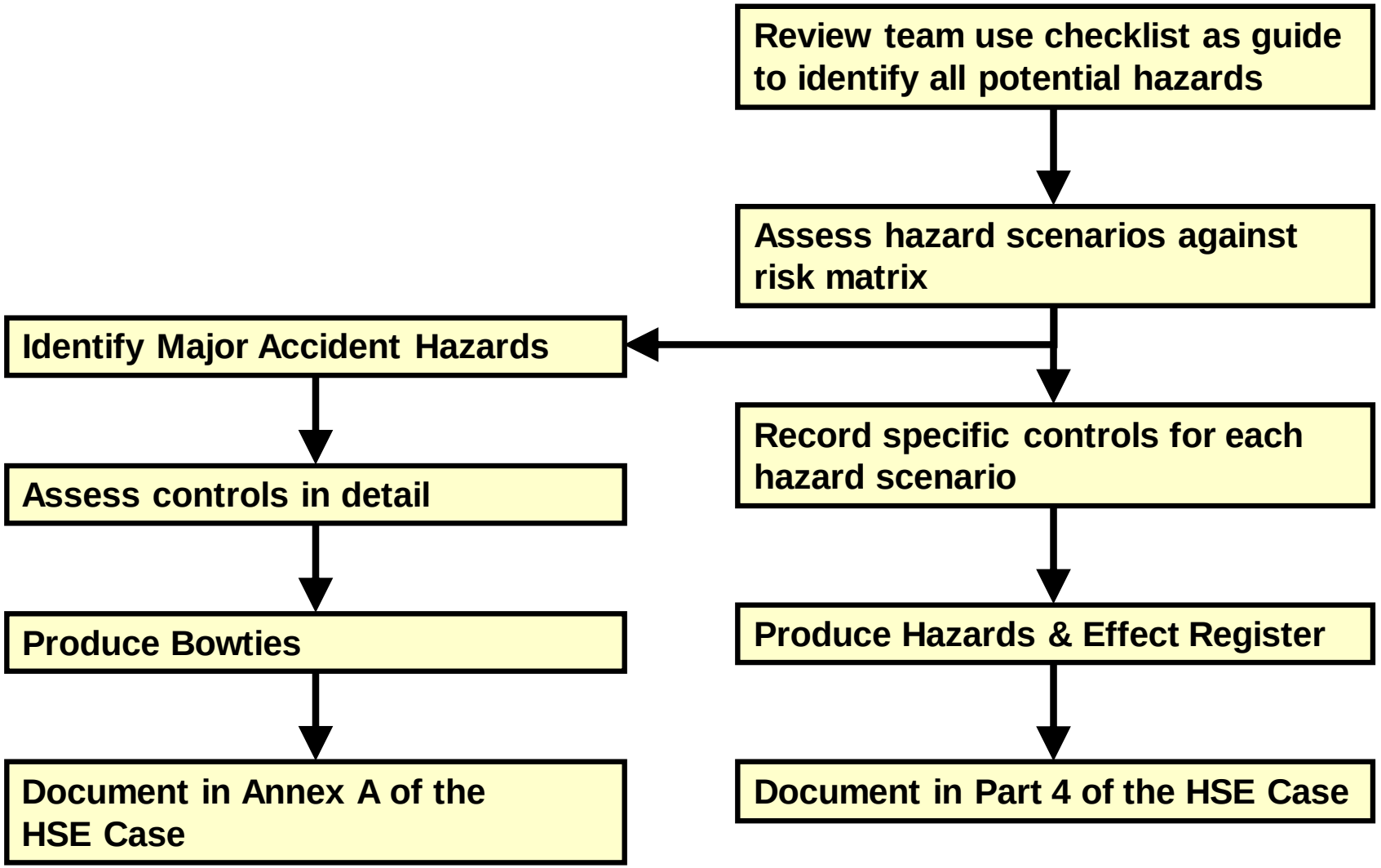
Hazard Identification & Assessment Process



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Hazard Checklist

Review all the potential Hazards

No.	HAZARD DESCRIPTION
H-01	**Hydrocarbons**
H-01.01	Crude oil under pressure
H-01.02	Hydrocarbons in formation
H-01.03	LPGs
H-01.04	LNGs
H-01.05	Condensate, NGL
H-01.06	Hydrocarbon gas
H-01.07	Crude oil at low pressure
H-01.08	Wax
H-01.09	Coal
H-02	**Refined Hydrocarbons**
H-02.01	Lube and seal oil
H-02.02	Hydraulic oil
H-02.03	Diesel fuel
H-02.04	Aviation fuel, petrol
H-03	**Other Flammable Materials**
H-03.01	Cellulosic materials
H-03.02	Pyrophoric materials
H-03.04	Carbon fibre reinforced material
H-03.04	Dry vegetation
H-04	**Explosives**
H-04.01	Detonators
H-04.02	Conventional explosives
H-04.03	Perforating gun charges
H-04.04	Explosive gases
H-05	**Pressure Hazards**
H-05.01	Bottled gases under pressure
H-05.02	Water under pressure
H-05.03	Non hydrocarbon gas under pressure in pipeworks

No.	HAZARD DESCRIPTION
H-14	**Open Flame**
H-14.01	Heaters with fire tube
H-14.02	Direct fired furnaces
H-14.03	Flares
H-15	**Electricity**
H-15.01	Voltage > 50 - 440V in cables
H-15.02	Voltage > 50-440V in equipment
H-15.03	Voltage > 440V
H-15.04	Lightning discharge
H-15.05	Electrostatic energy
H-16	**Electromagnetic Radiation**
H-16.01	Ultraviolet radiation
H-16.02	Infra red radiation
H-16.03	Microwaves
H-16.04	Lasers
H-16.05	E/M radiation: high voltage ac cables

H-25	**Ergonomic Hazards**
H-25.01	Manual materials handling
H-25.02	Damaging noise
H-25.02	Loud, steady noises >85dBA
H-25.03	Heat stress
H-25.04	Cold stress
H-25.05	High humidity
H-25.06	Vibration
H-25.07	Work stations
H-25.08	Lighting
H-25.09	Incompatible hand controls
H-25.10	Awkward location of workplaces and machinery
H-25.11	Mismatch of work to physical abilities
H-25.12	Mismatch of work to cognitive abilities
H-25.13	Long and irregular working hours/shifts
H-25.14	Poor organisation and job design
H-25.15	Work planning issues
H-25.16	Indoor climate
H-26	**Psychological Hazards**
H-26.01	Living on the job/away from family
H-26.02	Working and living on a live plant
H-26.03	Post traumatic stress
H-27	**Security Related Hazards**
H-27.01	Piracy
H-27.02	Assault
H-27.03	Sabotage
H-27.04	Crisis
H-27.05	Theft, pilferage
H-28	**Use of Natural Resources**
H-28.01	Land take
H-28.02	Water
H-28.03	Air
H-28.04	Trees, vegetation
H-28.05	Gravel
H-29	**Medical**
H-29.01	Medical unfitness
H-29.02	Motion sickness
H-30	**Hazardous Goods**
H-30.01	Dangerous goods in transport activities

Use to build list of all hazards present

CGE Risk Management Solutions
Making risk understandable

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Qualitative Risk Assessment Matrix

Increasing Frequency of Occurrence – HOW OFTEN

Increasing Severity Of Consequences – HOW BAD

SEVERITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Community	Environment	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No effect					
1	Slight injury or health effect	Slight damage	Slight effect	Slight effect					
2	Minor injury or health effect	Minor damage	Minor effect	Minor effect					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate effect					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major effect					
5	More than 3 fatalities	Massive damage	Massive effect	Massive effect					

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Making risk understandable

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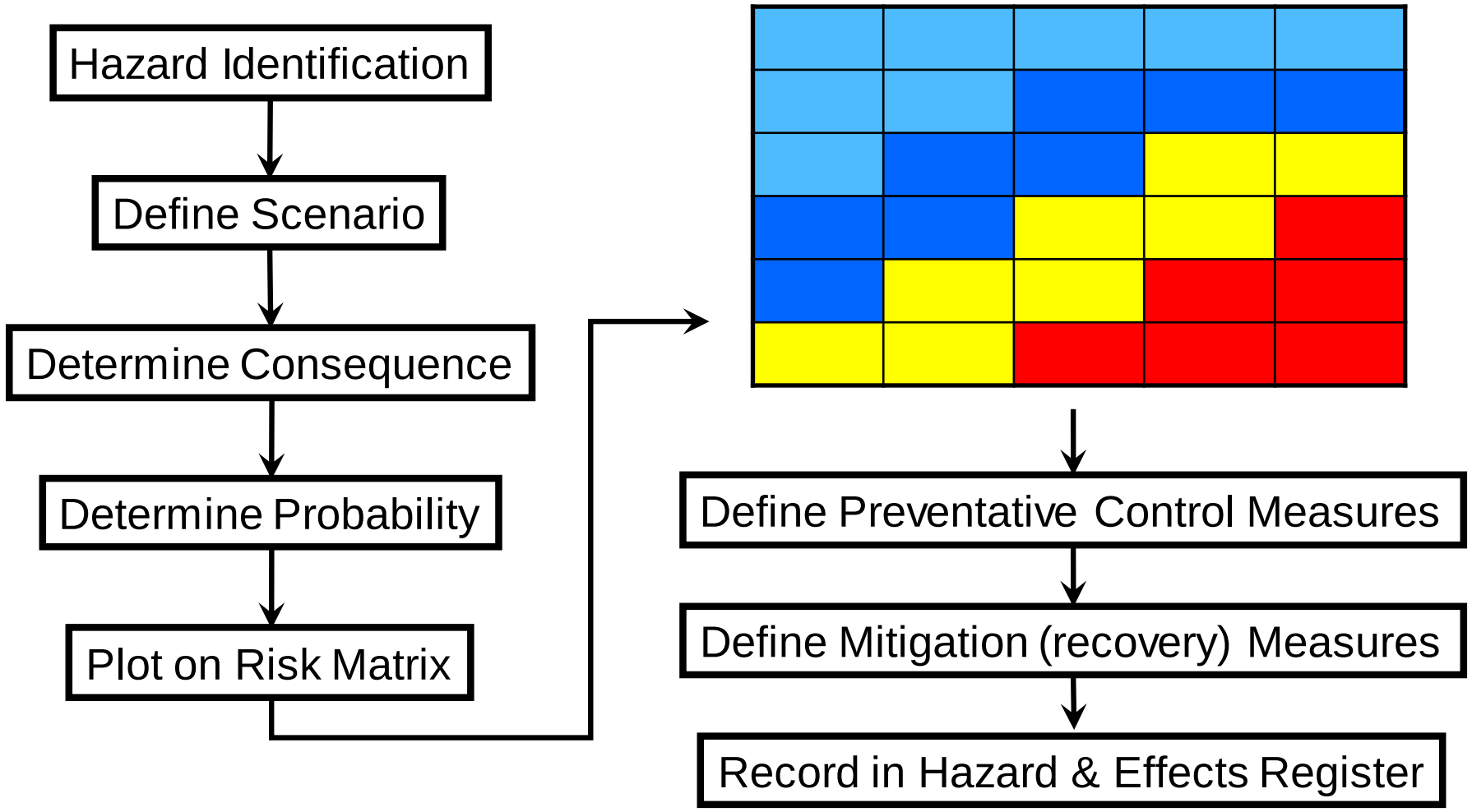
Summary of HAZID, Qualitative Risk Assessment Process



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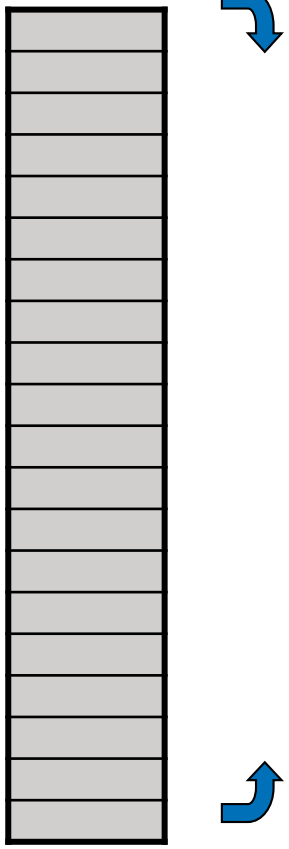
Risk Matrix used to Filter Major HSE Risks



RISK MATRIX

Screening Process

SEVERITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Community	Environment	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No effect					
1	Slight injury or health effect	Slight damage	Slight effect	Slight effect		LOW			
2	Minor injury or health effect	Minor damage	Minor effect	Minor effect					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate effect			MEDIUM		
4	PTD or up to 3 fatalities	Major damage	Major effect	Major effect					
5	More than 3 fatalities	Massive damage	Massive effect	Massive effect				HIGH	

Demonstrate Control Management via HSE MS & Hazards and Effects Register

Detailed Risk Assessment for all Level 5 Consequence & High Risk

Demonstrate Control Management via Bowties & HSE Critical Tasks & Elements

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Barrier analysis

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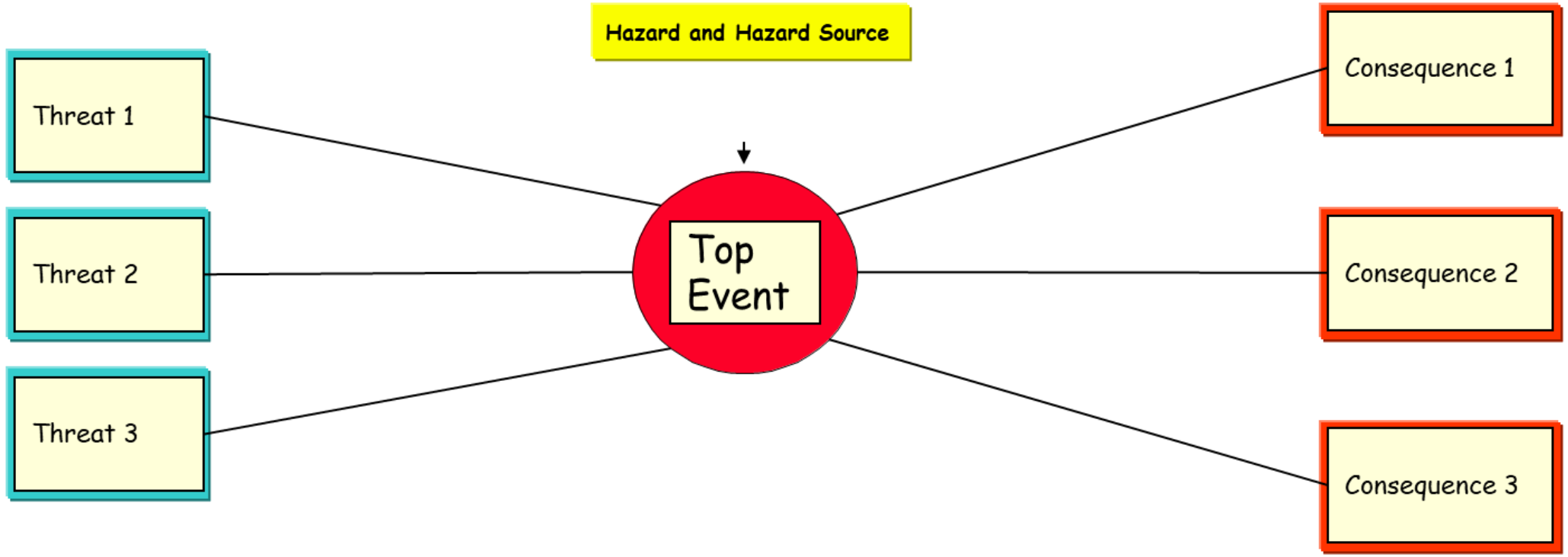
Building a Bowtie



The Hazard

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The Top Event

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The Threats

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The Consequences

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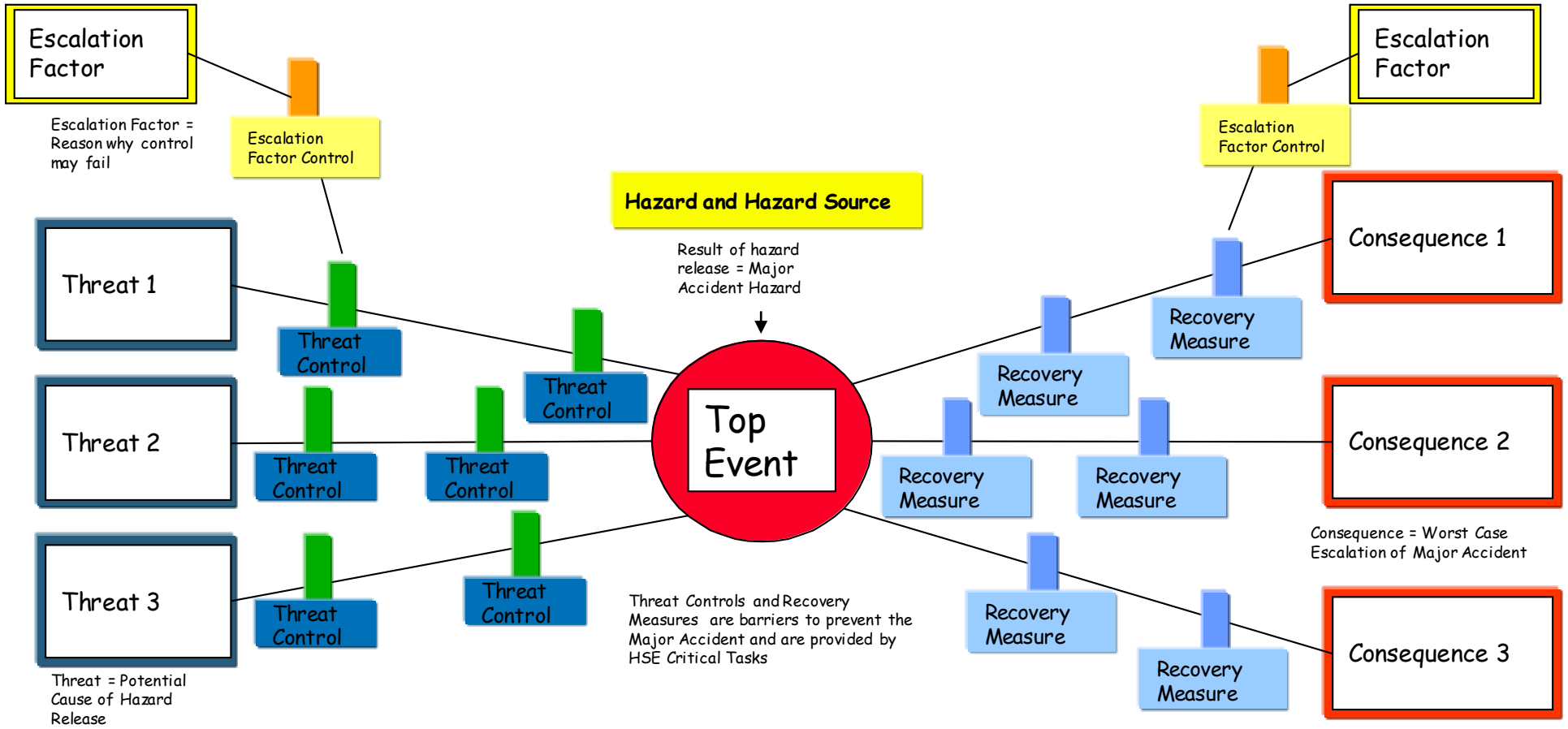
Document Control (preventative) and Recovery (mitigative) Barriers



What could cause it to go wrong

What could go wrong

What could happen if it does go wrong

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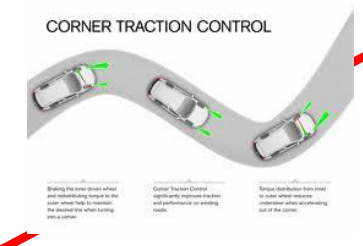
Building a Bowtie



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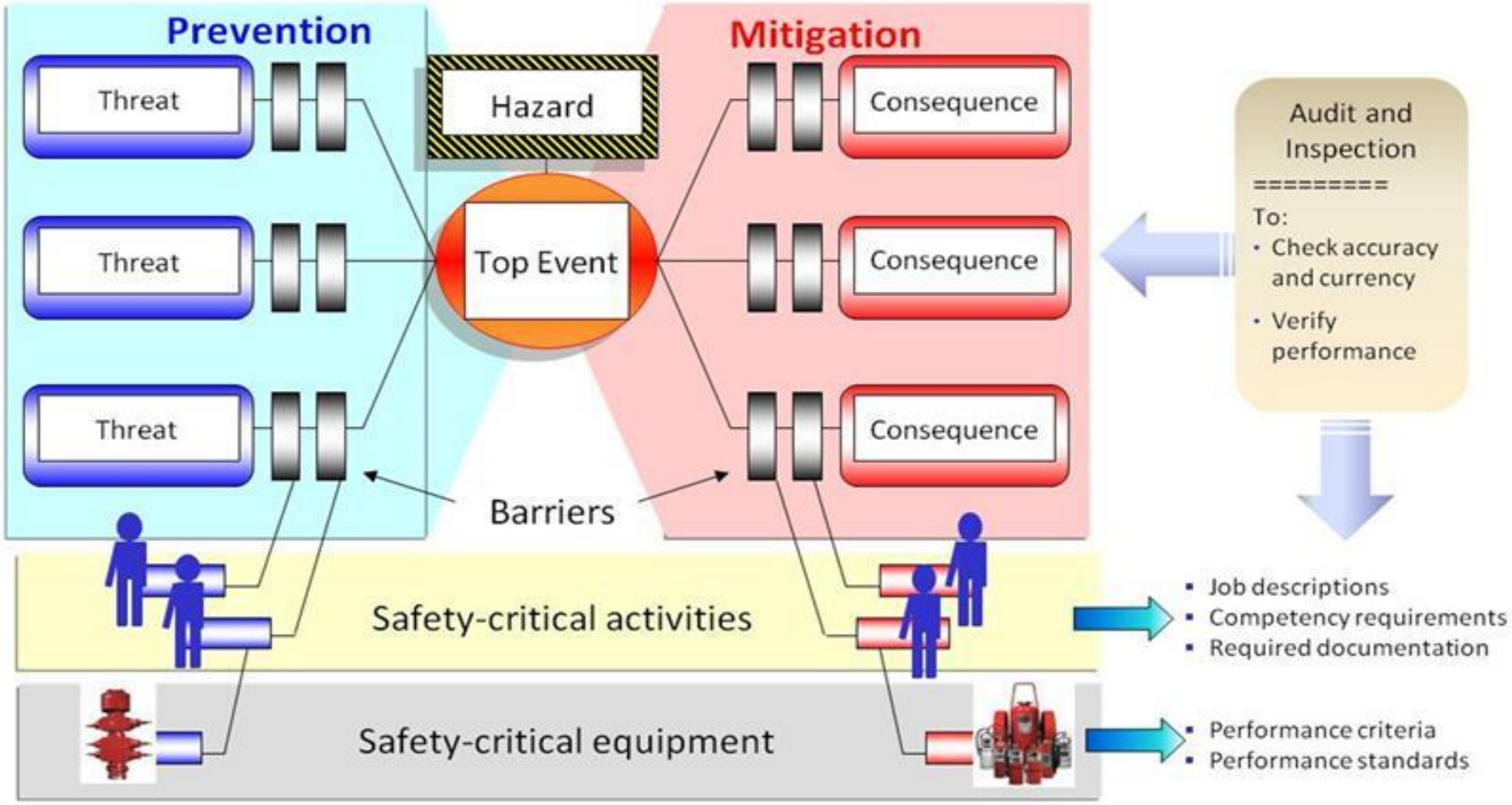
Assuring Hazard Management Over Time



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What is an HSE-critical element?

An HSE-critical element can be defined as *a system, equipment or structural item which could cause or contribute substantially to; or the purpose of which is to prevent/detect; or mitigate the effect of; a major health, safety or environmental accident hazard.*

Examples:

- Hydrocarbon containment
- Fire and gas detection system
- Emergency shutdown system
- Cranes and lifting equipment
- Evacuation equipment

What is an HSE-critical task?

Operational HSE-critical tasks: operational tasks where actions (or inactions) taken while performing such tasks could lead directly to a Significant Incident.

Examples:

- Calibrate relief valve
- Isolate process plant
- Inspection of platform structure
- Maintain well control

Management HSE-critical tasks: tasks where action (or inaction) while performing such tasks could lead indirectly to a Significant Incident

Examples:

- Develop maintenance plan for HSE-critical system
- Assess competence of persons with Level 1 HSE-critical tasks
- Develop emergency response plan

Quantitative Risk Assessment

A QRA attempts to answer the following questions:

- What can go wrong?
- How often does it happen?
- How bad are the consequences?
- Is the risk acceptable?

Quantitative Risk Assessment

Quantified Risk Assessment (QRA) may be carried out to assess:

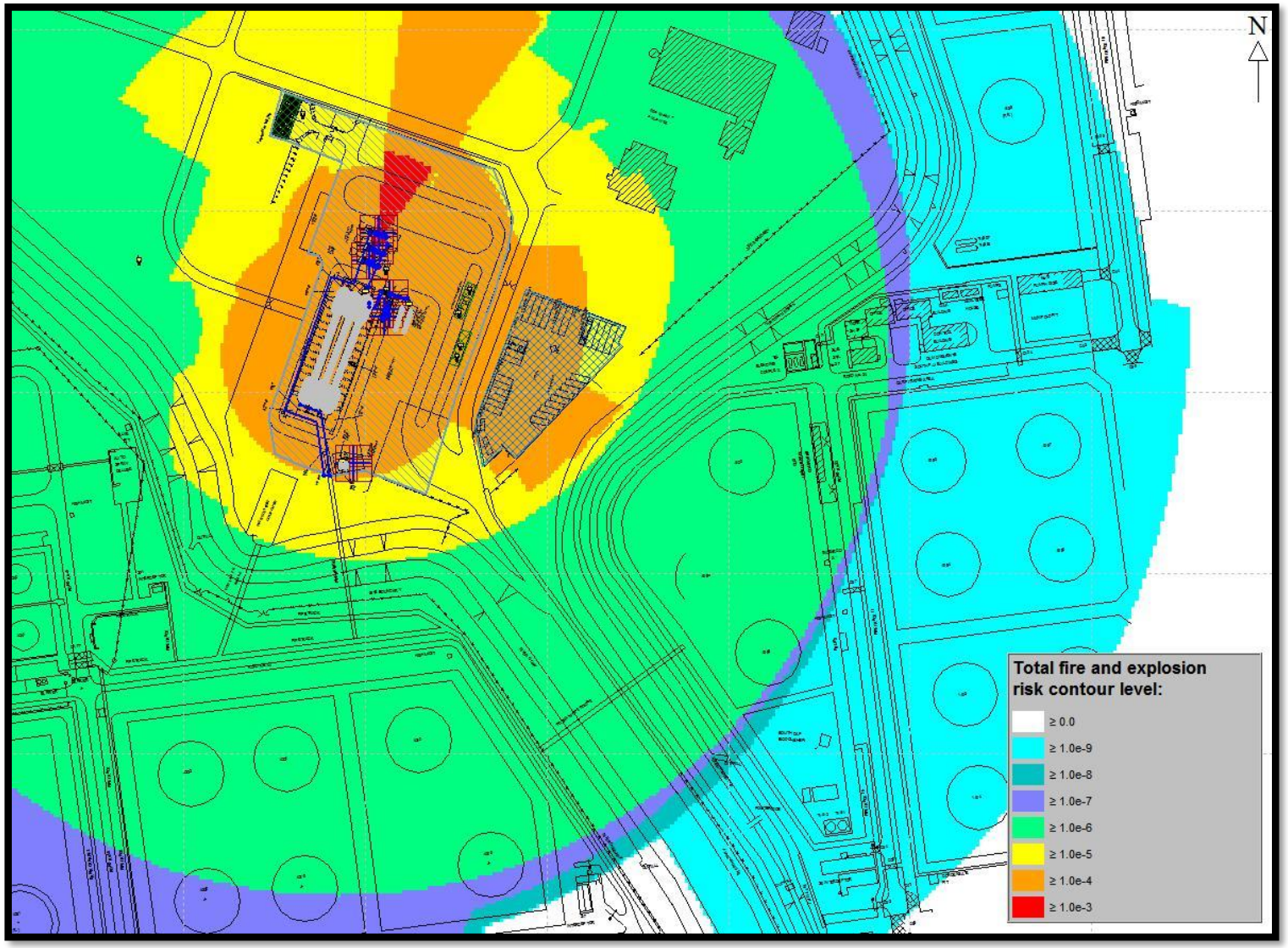
Individual risk for each worker group (i.e. probability of an individual being killed in any one year)

Risk to public in areas around the facility

Contribution of each major hazard to potential losses of life

Risk to environment

Risk to people



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Best uses of QRA in a Safety Case

Helping to reduce risk by supporting:

- Risk-based decision-making
- Comparison of options during the design phase or for modifications during operations
- Demonstration that risk levels are reduced as low as reasonably practicable (ALARP)
- Definition requirements for emergency response planning

Safety Case tools: summary

Hazard identification tools

Risk assessment tools

Event analysis tools

Barrier analysis and demonstration tools

Quantified analysis

Demonstrating ALARP

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ALARP demonstration

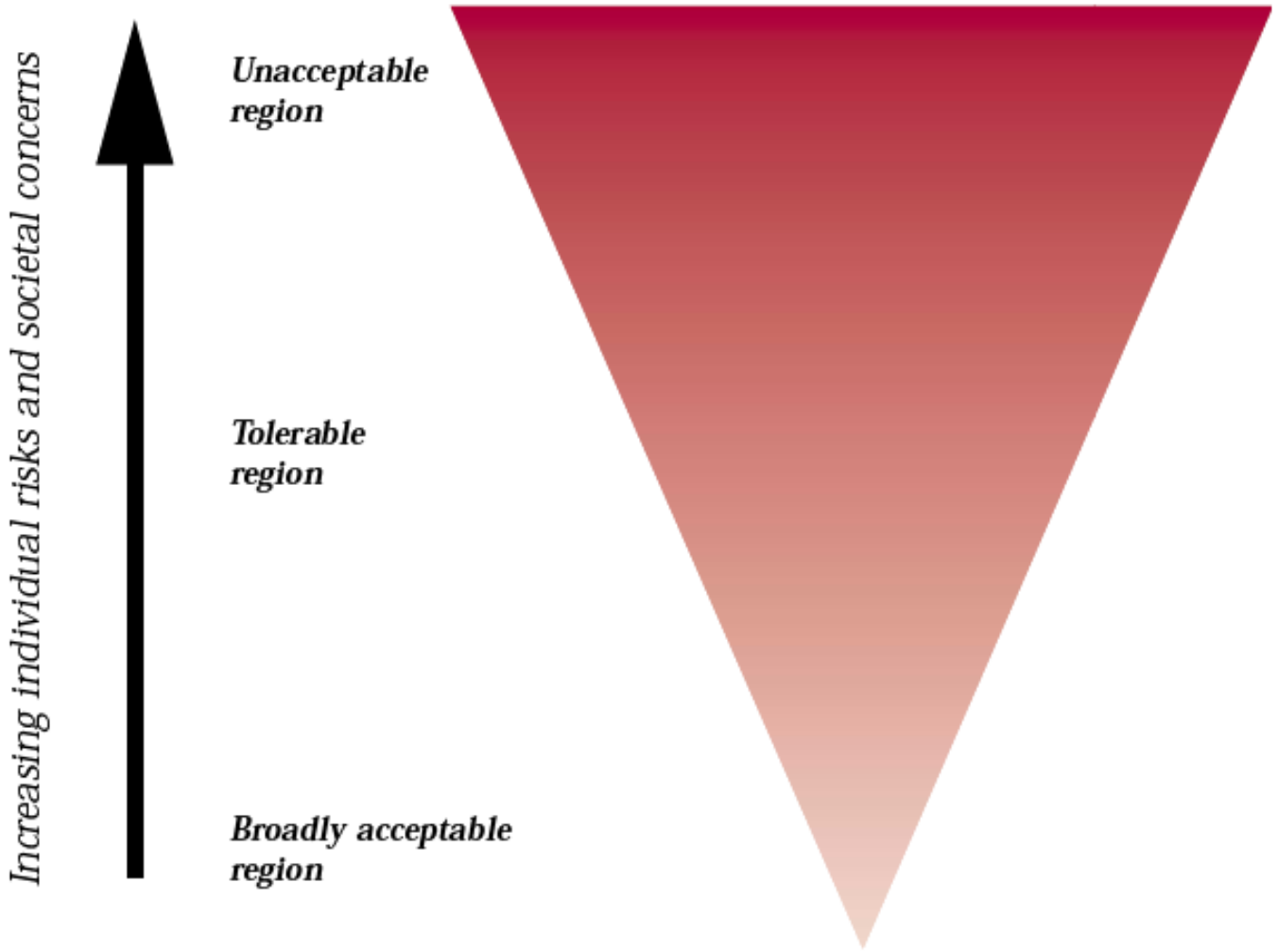
The Safety Case must demonstrate that risks are ALARP:

As Low As Is Reasonably Practicable

ALARP is achieved at:

“the point, objectively assessed, at which the time, trouble, difficulty and cost of further reduction measures become unreasonably disproportionate to the additional risk reduction obtained”

Elements of a Safety Case ALARP assessment



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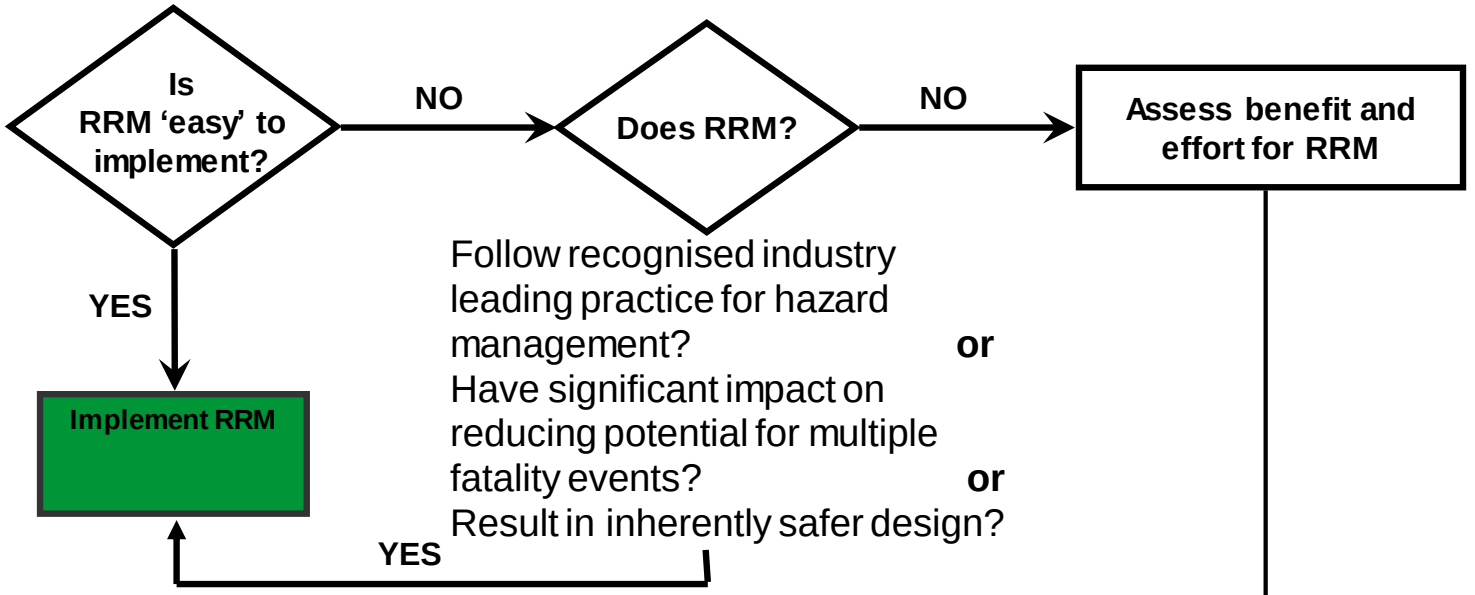
ALARP: can we do anything more?



- ❖**Met Standards?**
- ❖**Looked for Improvements?**
- ❖**Assessed Improvements?**

		Effort (time and/or cost)		
		Low	Medium	High
Benefit (risk reduction)	Low	Consider	Do not implement	Do not implement
	Medium	Implement	Consider	Consider, if risk high
	High	Implement	Implement	Consider

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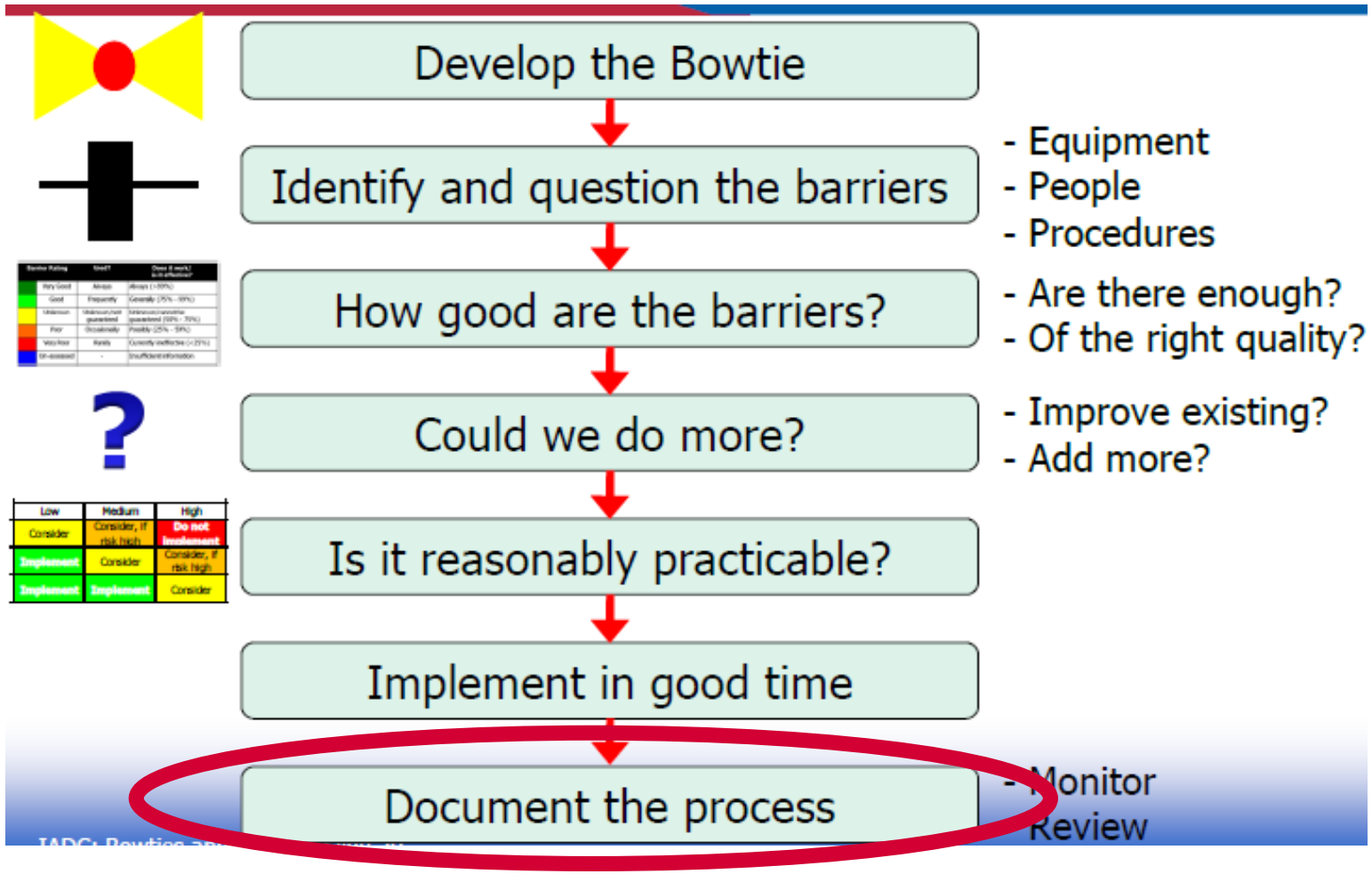
ALARP process summary



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Getting it Right (and keeping it up to date...)

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Attributes of a good Safety Case

Complete

Clear

Rational

Accurate

Objective

Appropriate

Integrated

Current

Forward looking

A good Safety Case will be…

Succinct and value for money

Structured, clear and logical

Developed by the operator for the operator

A living document ensuring the process of continuous improvement

Remedial/Forward Action Plans

The RAP/FAP is a plan to resolve:

- Outstanding actions
- Improvements
- Shortfalls

Identified during development of Safety Case, and necessary to ensure that risk is reduced to ALARP and that intent of Safety Case is met

Also known as Forward Action Plans (FAP)

Maintaining the Safety Case

Update to reflect significant changes

Continually updated and kept as a “live” document

Thorough review every five years and reapplication for Railway Certificates & Authorisations

Periodic Safety Review (PSR) nuclear safety (typically every ten years); UK NII LC15

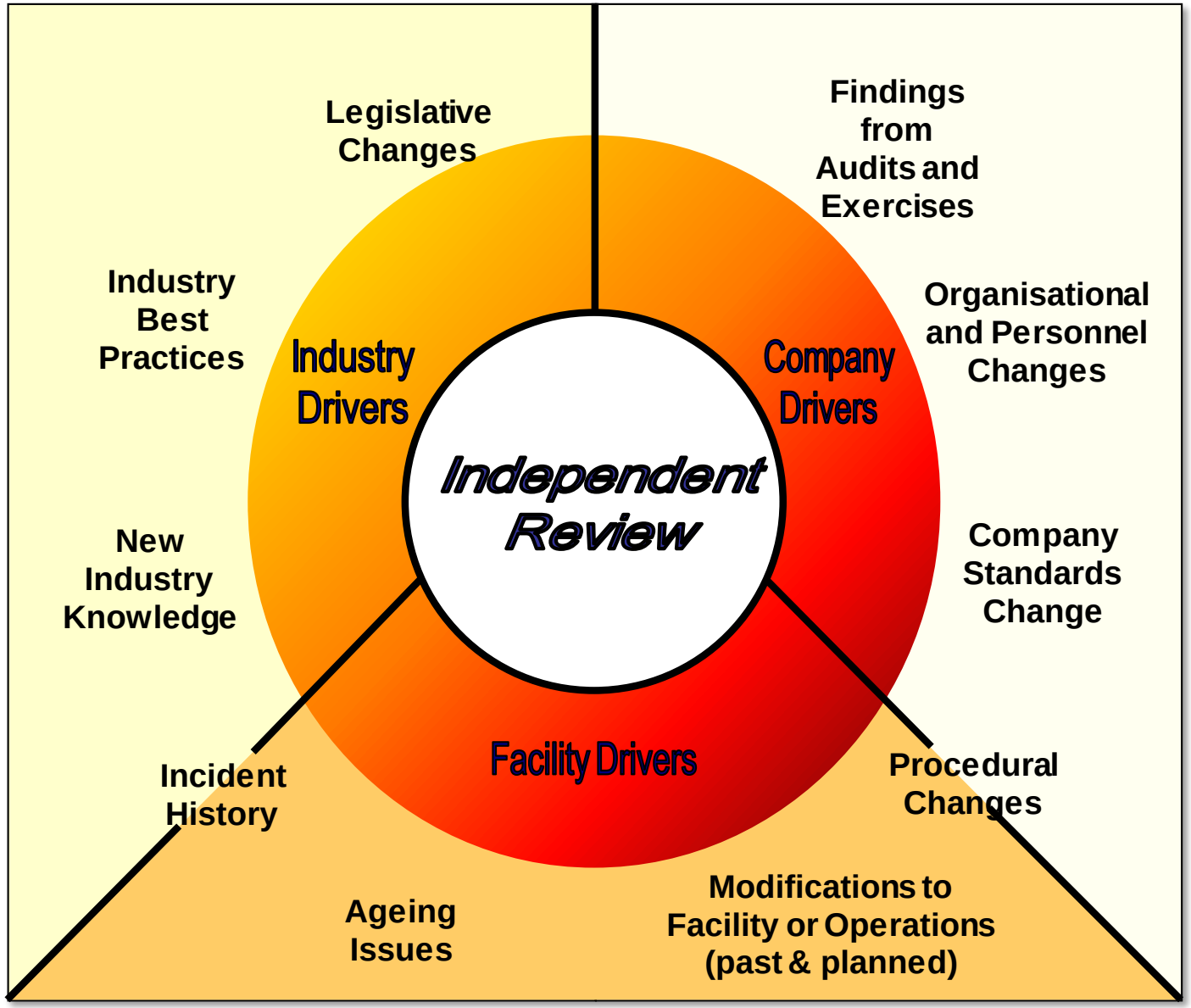
Drilling Safety Case typically 3 – 5 years

External review/audit no longer required for Railways

Assign responsibility to a Safety Case Manager

Ensure employees are involved in process, made aware of contents and receive updates

Periodic review topics



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Benefits of the Safety Case

Improved understanding of hazards and risks

- Systematic approach
- Identify issues
- Operator understands plant better than regulator
- Improvement/formalisation of SMS

Improvement plan

- Areas of improvement identified and assessed
- Continuous improvement

Improved interaction with Regulator

- More efficient and effective
- Regulator focus on key issues

Safety Case development good practice

Make use of existing assessments where possible

Involve the workforce

Record hazards and risks

Use qualitative approaches initially

Ensure major accident events are appropriately assessed

Use QRA appropriately

There is no shortcut to ALARP

Manage the risk, don’t just analyse it

Implement the Case, don’t just look at it on the shelf

Risk management requires **ACTIONS** not **WORDS**

HSE/Safety cases

A Good Safety Case should tell a story:

Site Discreption	•What we are •What we do •What we have
HSE Management system	•How we organize people to prevent, control, or respond to incidents.
Hazard Identification & Risk assessment	•What can go wrong •How often might it be •How bad it might be
Risk control measures	•What our systems are to prevent or mitigate the consequences
Emergency response	•How we respond if a major accident occurs

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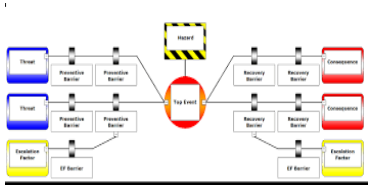
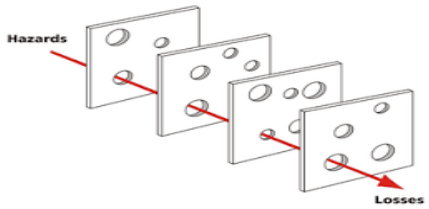
Major accident hazard (MAH)

Bowties





Safety case documentation

Identify hazards

Generate hazard and effect register

Screen for major accident hazard MAH

Identify Threats and consequences for each MAH

Identify prevention and mitigation barriers for each threat /consequence

Safety critical elements SCE

- Identify safety critical elements from bowtie barriers
- Identify critical maintenance and inspection activities for each element.

Safety critical activities SCA

- Identify safety critical activities from bowtie barriers
- Define role and responsibilities and competency requirement for each SCA

People

- Assign roles to bowtie barriers.

- H&ER
- Design safety case
- Work instruction
- ERP
- Operating manuals
- Maintenance and inspection plan

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“The sum of the quality of our individual contributions to safety determines whether our colleagues live or die”
Brian Appleton, Technical Advisor to the Piper Alpha Enquiry

Questions

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