

Barrier Management over the Lifecycle

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He has over 16 years of risk management and technical safety engineering experience in multiple high-hazard industries including oil and gas, clean energy and civil nuclear.

David's key experience includes leading Hazard Identification (HAZID) and bowtie analysis studies, safety/HSE case production, and the development and delivery of training, including at MSc level.

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Longford, Australia gas explosion of 1998

Trouble brewing

“prior to any disaster there will always be information somewhere within an organisation that trouble is brewing”

“critical information must not be allowed to lie around unrecognised, ignored or buried like some landmine waiting to be triggered.”¹

Professor Andrew Hopkins



Fairfaxmedia/THE AGE/ RAY KENNEDY. - <https://www.icheme.org/knowledge-networks/safety-centre/news/the-long-view-on-longford/>

¹ Lessons from Longford: The Esso Gas Plant Explosion, Hopkins, 2000

Agenda

- So what do we need to know?
 - Risk identification and assessment
 - Bowties

- How are we managing risk?
 - Confidence in the barriers now
 - Confidence into the future

- Understanding and communicating barrier health and responsible parties



So what do we need to know?

1. What could cause us harm?

- What are our major hazards that could lead to a potential incident?

2. What will protect us?

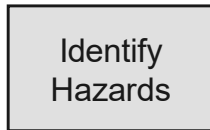
- What are the critical barriers (safeguards) we rely upon to control these risks?

3. How do we know?

- Are we confident the barriers will function as designed when required?
- What is the minimum level of performance required?
- Are these critical barriers available and effective throughout the life of our asset?

Risk identification and assessment process

Identify



Hazard Checklist

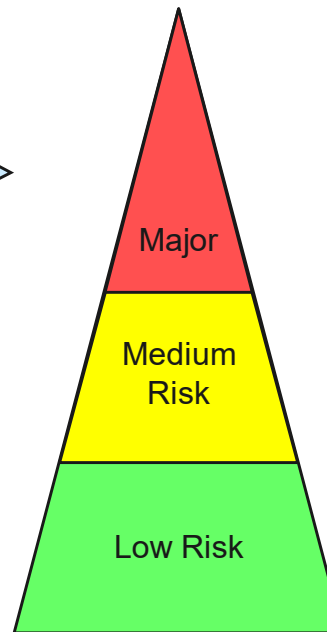
Ref. No.	Hazard Name	Possible Source
H-01 Hydrocarbons (liquid)		
H-01-001	Liquid fuel: diesel (LSD)	Compress plants, tanks
H-01-002	Condensate	Storage tanks, gas wells, gas pipelines, gas separator vessels
H-01-003	Hydrocarbon gas	Reservoirs, wells, oil/gas separator, gas processing plants, compressor, gas pipeline
H-01-004	Coal	Mineral extraction, coal fuel source
H-01-005	Crude (oil)	Reservoirs, wells, pipelines, pressure vessels, storage tanks
H-01-006	Hydrocarbons from shale	Mineral activities, extraction of shale deposits
H-01-007	Oil Spills	Tar sands, bituminous sands (dry, sand, water, bitumen)
H-01-008	Other hydrocarbon source	Subsea gas hydrates
H-02 Hydrocarbons (infectious)		
H-02-001	Liquefied Petroleum Gas (LPG)	Process fractionating equipment, storage tanks, transportation (ships in G, propane) and oil cars
H-02-002	Operational hydrogen	Hydrogen handling systems, vehicle maintenance
H-02-003	Kerosene/Jet Fuel	Aircraft, portable devices, portable tenders, heating systems, storage tanks
H-02-004	Gas Oil (Diesel Fuel Heating Oil)	Vehicle handling systems, vehicle maintenance
H-02-005	Heavy Fuel Oil	Shipping fuel, bunkers, heating systems, storage tanks
H-02-006	Lubricating Oil (Base Oil)	Engines and rotating equipment, hydraulic plants, hydraulic systems and parts
H-02-007	Asphaltic Extracts	Heavy fuels, petroleum pitches and resins, rubber and plastic, asphalt
H-02-008	Waxes and Resin Products	Filter separators, well heaters, and pipelines
H-02-009	Bitumen and Bitumen Derivatives	Road construction
H-02-010	Polystyrene	Fluorocarbon boilers
H-03 Explosives		
H-03-001	Detonators	Seismic operations, pipeline construction
H-03-002	Commercial Explosive Material	Seismic operations, blasting, construction, firework display, mining
H-03-003	Shaped Charges	Well completion activities, demolition

Assess

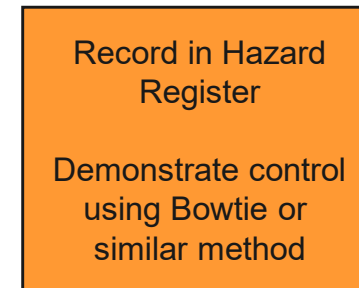


Risk Assessment Matrix

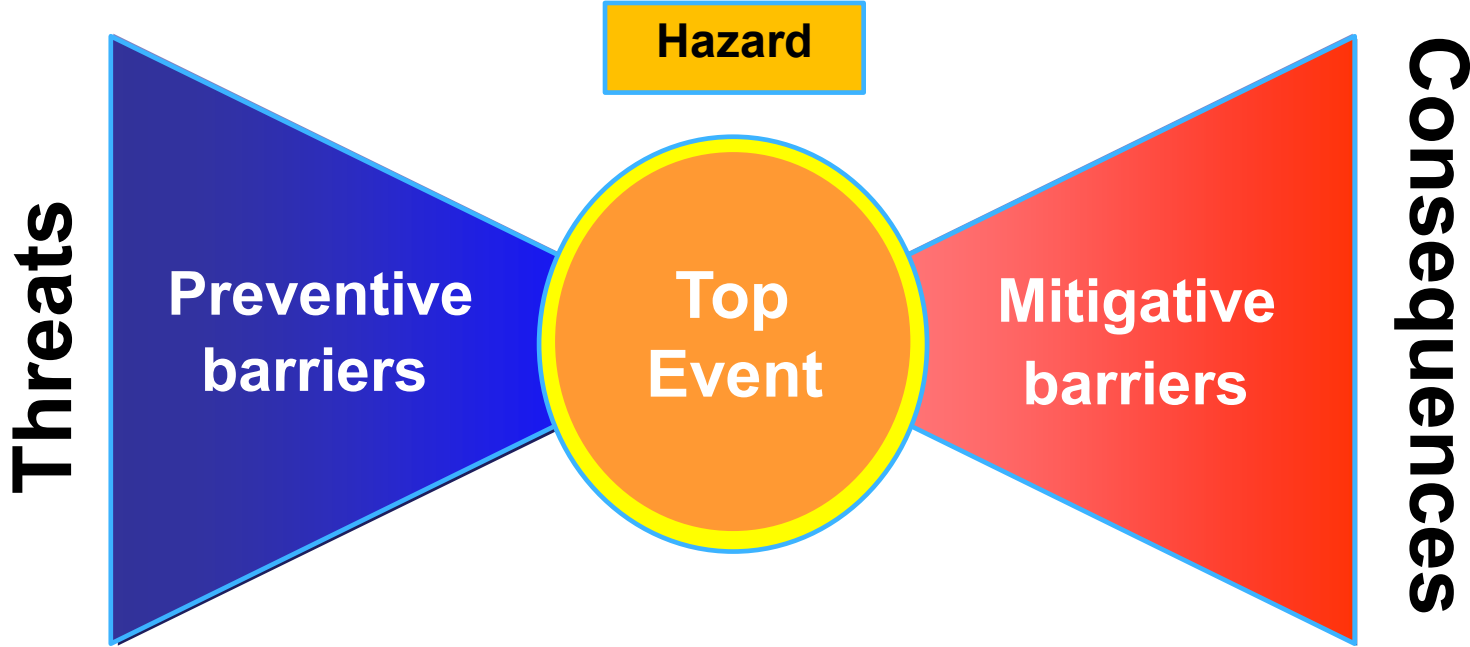
		Likelihood				A	B	C	D
		Low	Medium	High	Frequent				
Severity	High	Zero impact	Low Risk	Outstanding Occurrence of an Event	Some Attention	High	Very High	Very High	Very High
	Major	Medical Treatment	100K to 500K	1000 to 100K	Local Public Concern	2	3	4	5
	Significant	171	100K to 100K	1000 to 100K	Regional Public Concern	3	4	5	6
	Severe	Fatality	100K to 100K	1000 to 100K	National Public Concern	4	5	6	7
	Extremely Severe	Multiple Fatalities	100K to 100K	1000 to 100K	International Public Concern	5	6	7	8



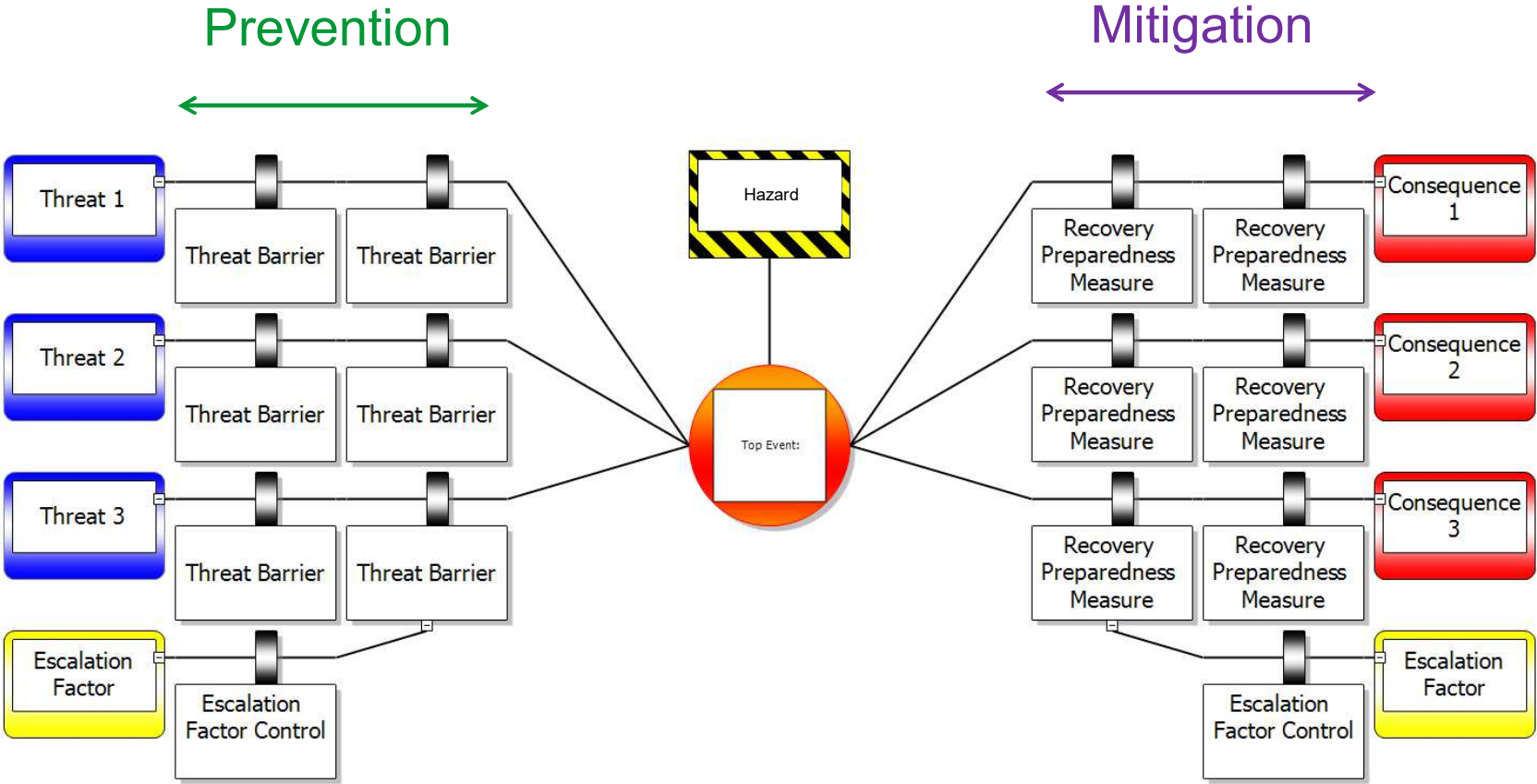
Manage



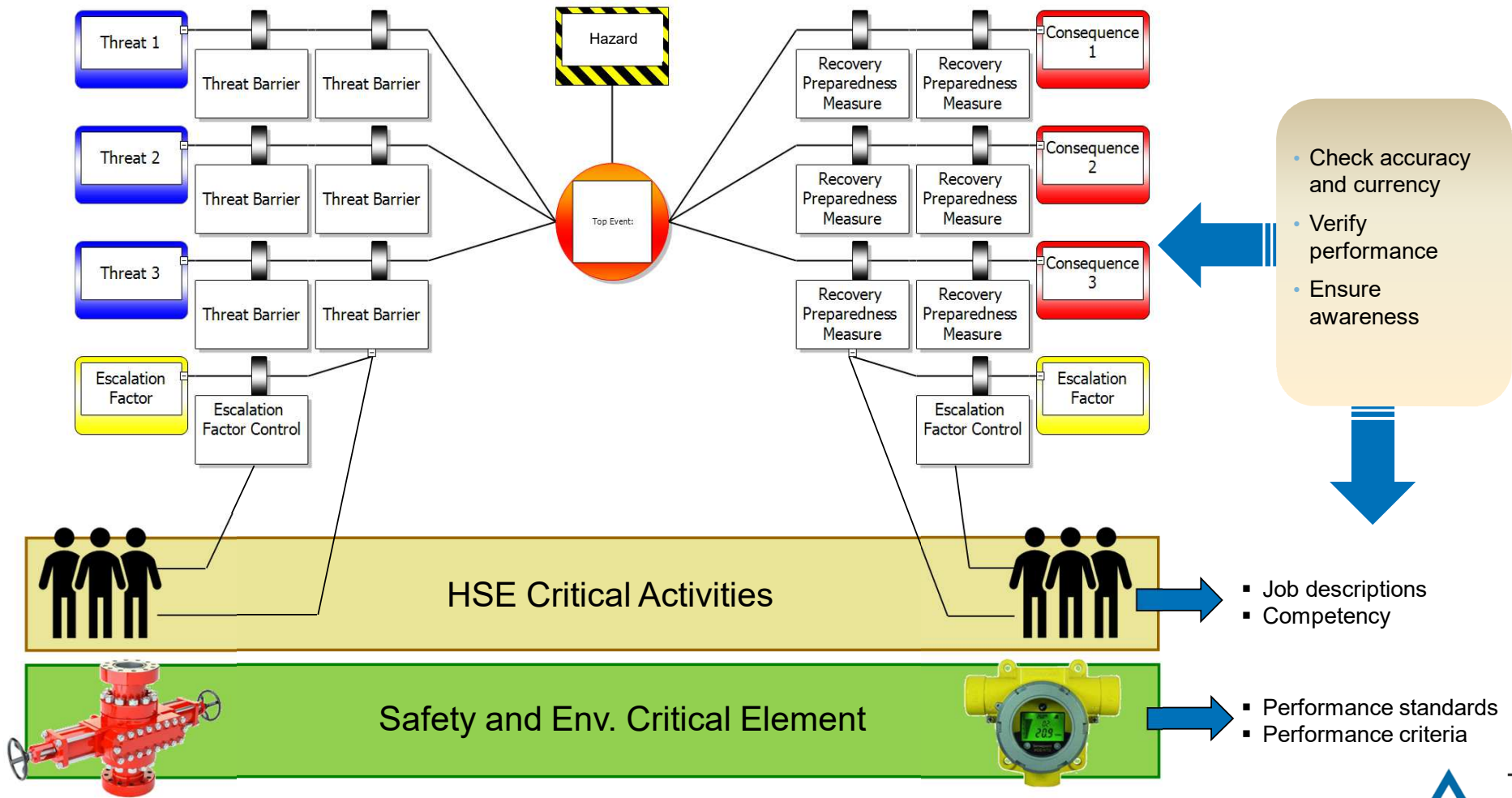
Bowtie structure



Bowtie example



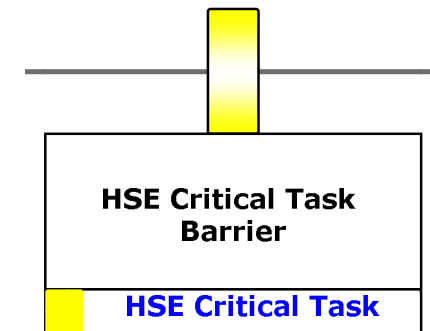
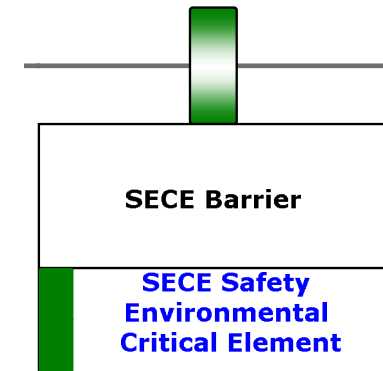
How controls are made effective in bowties



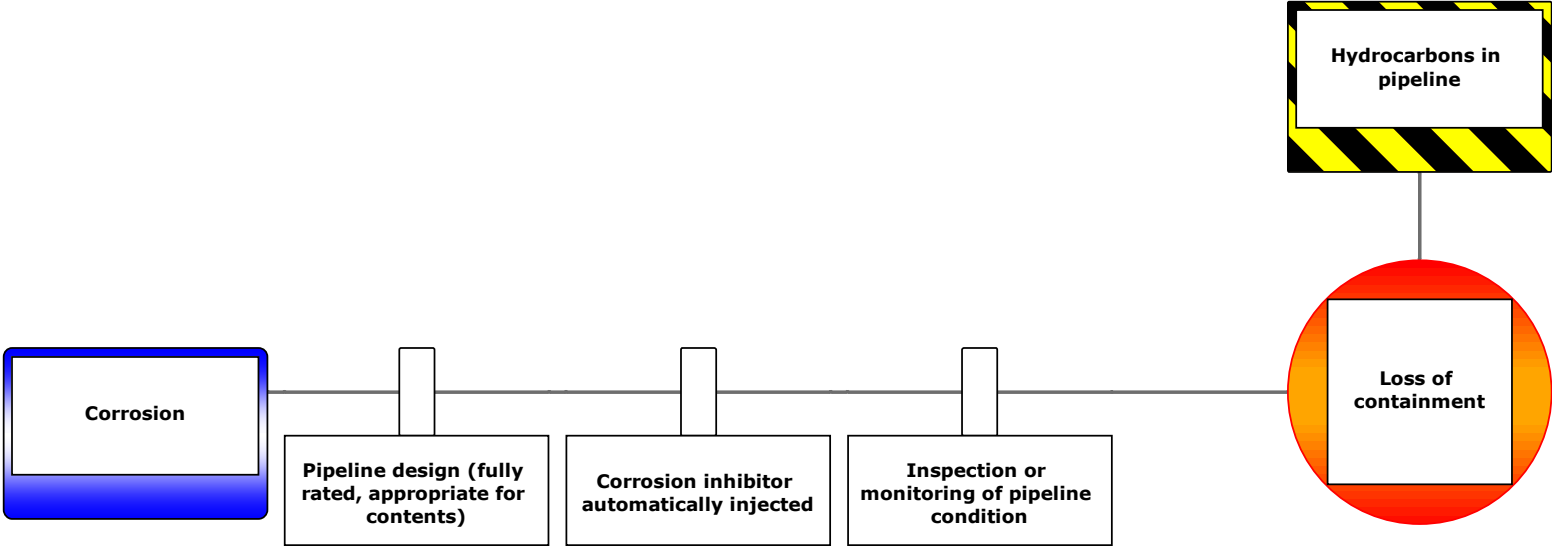
How this looks on a bowtie

- Safety and Environmental Critical Elements (SECE)
 - Hardware barriers
 - Managed by Performance Standards (which define inspection, testing, maintenance requirements)

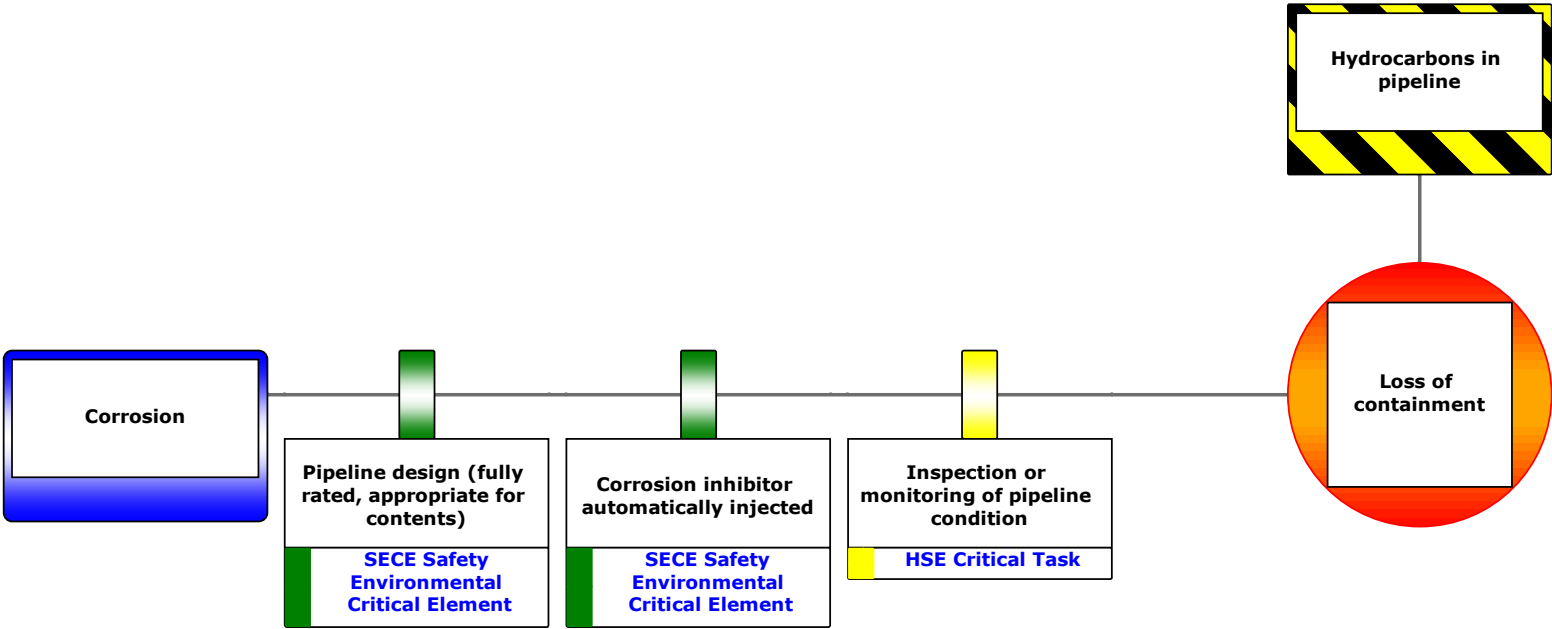
- HSE Critical Tasks / Activities
 - Human barriers
 - Group or set of tasks/actions necessary for the development, implementation, operation or maintenance of a barrier

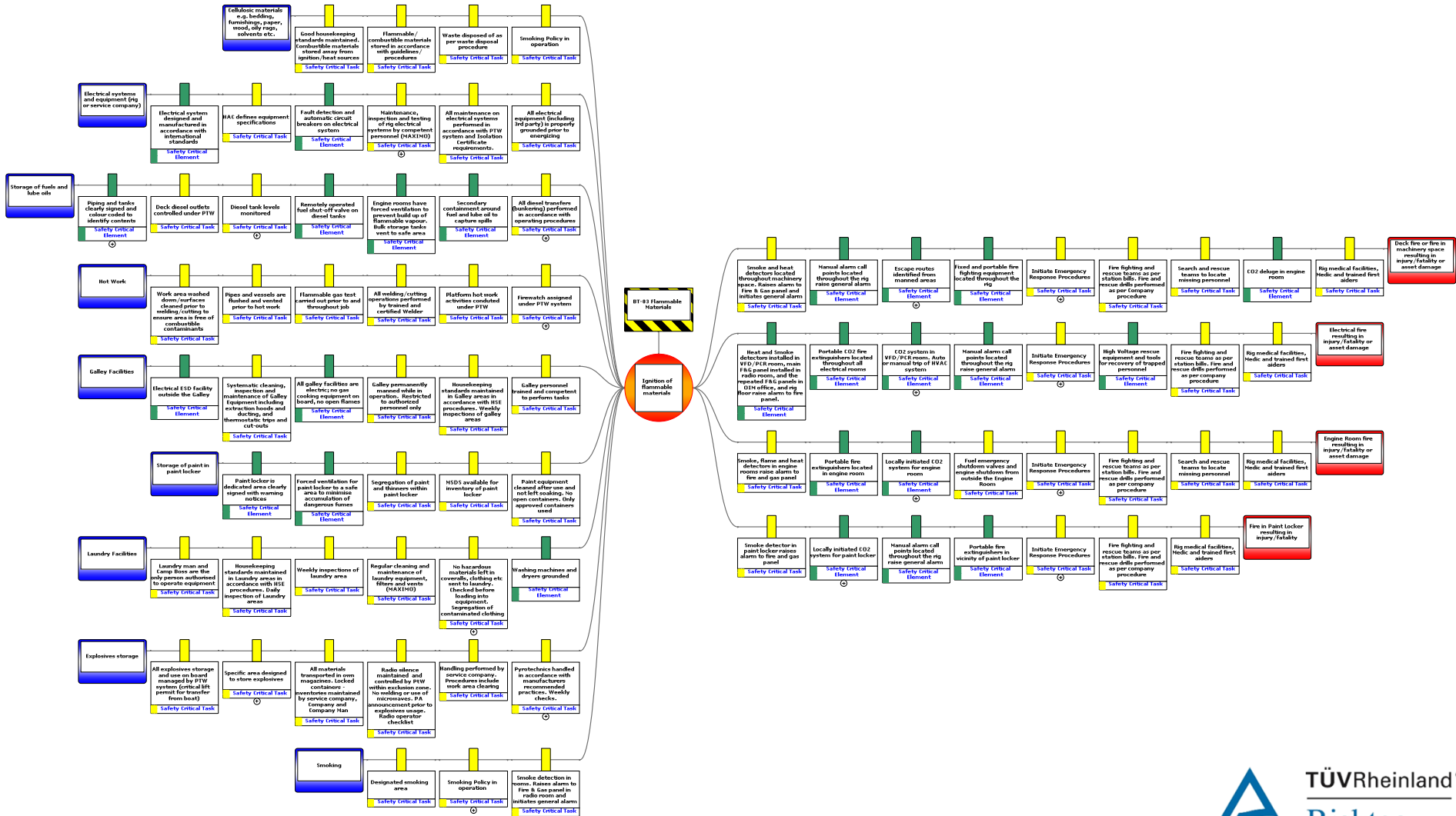


Bowtie Barriers Example

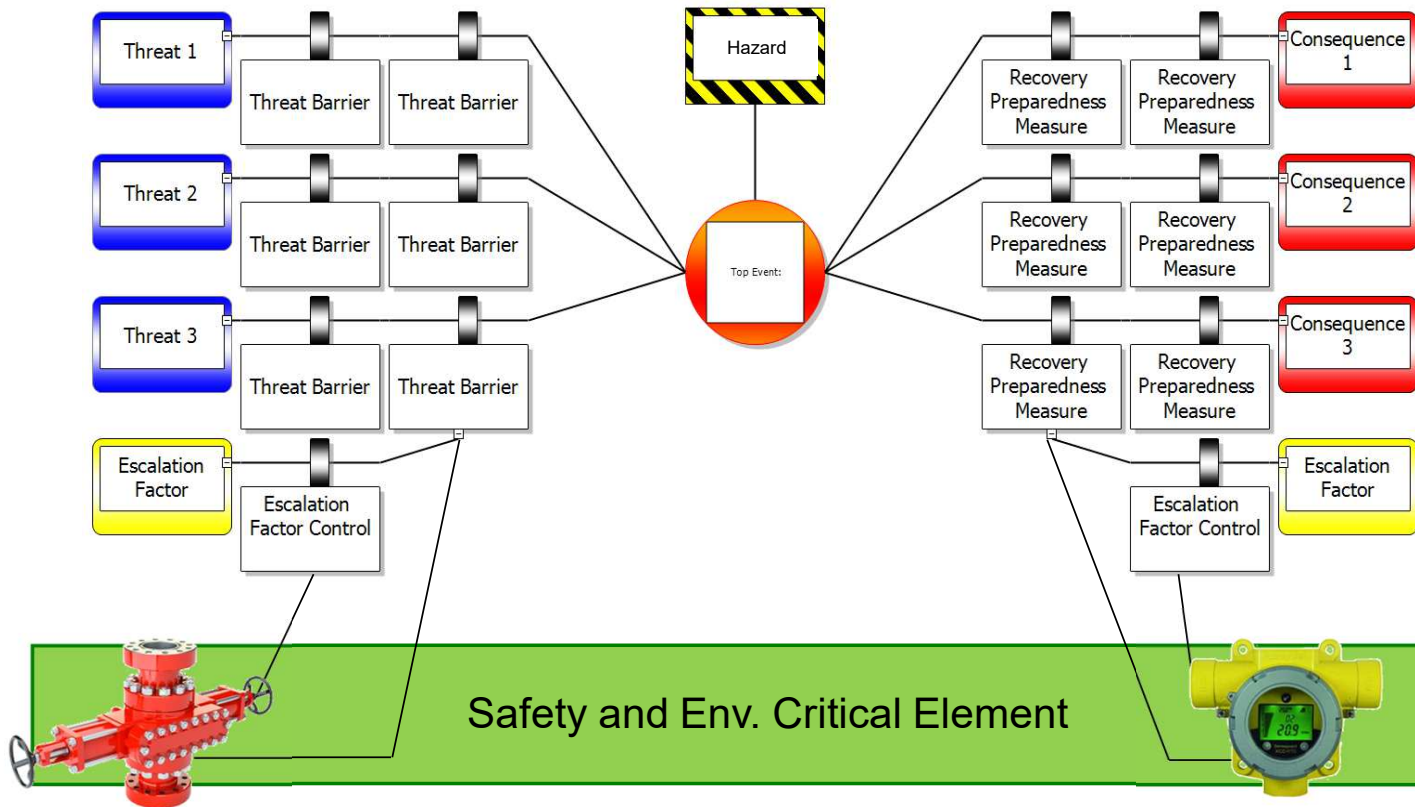


Bowtie Barriers Example





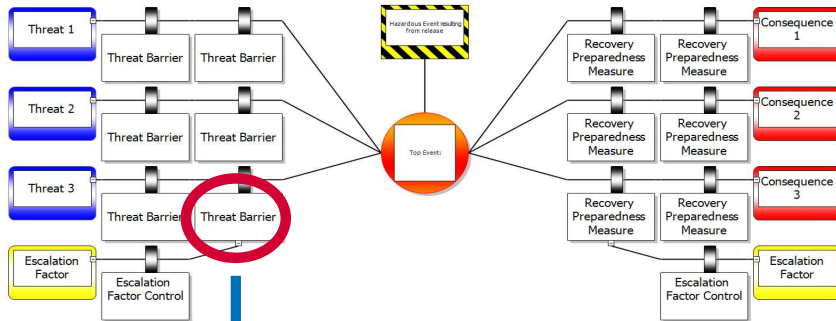
SECEs & bowties



Engineered systems as barriers on major accident hazard bowtie diagrams are SECEs

- Performance standards
- Performance criteria

SECEs

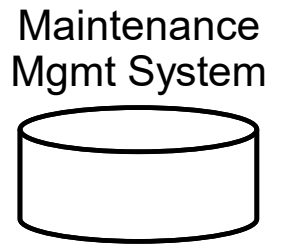


...to ensure each risk control works...

SECE

Performance Standard

Maintenance and Inspection Requirements



Technical Integrity Verification Plan

SECE performance may be independently verified through independent Technical Integrity Management Scheme...

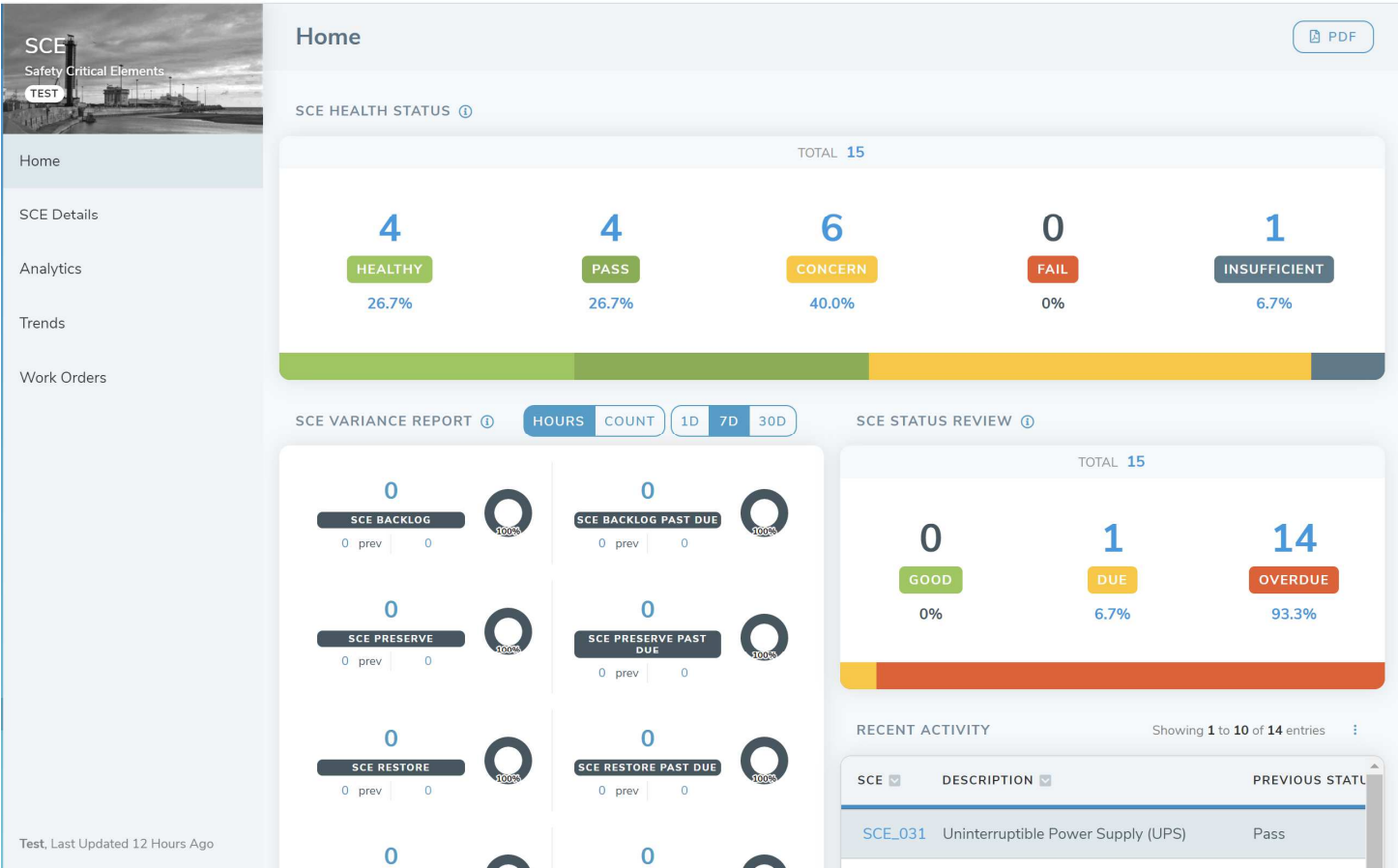
Bowties will identify SECEs - each barrier that is dependent on a Critical system or equipment

How can we communicate this?

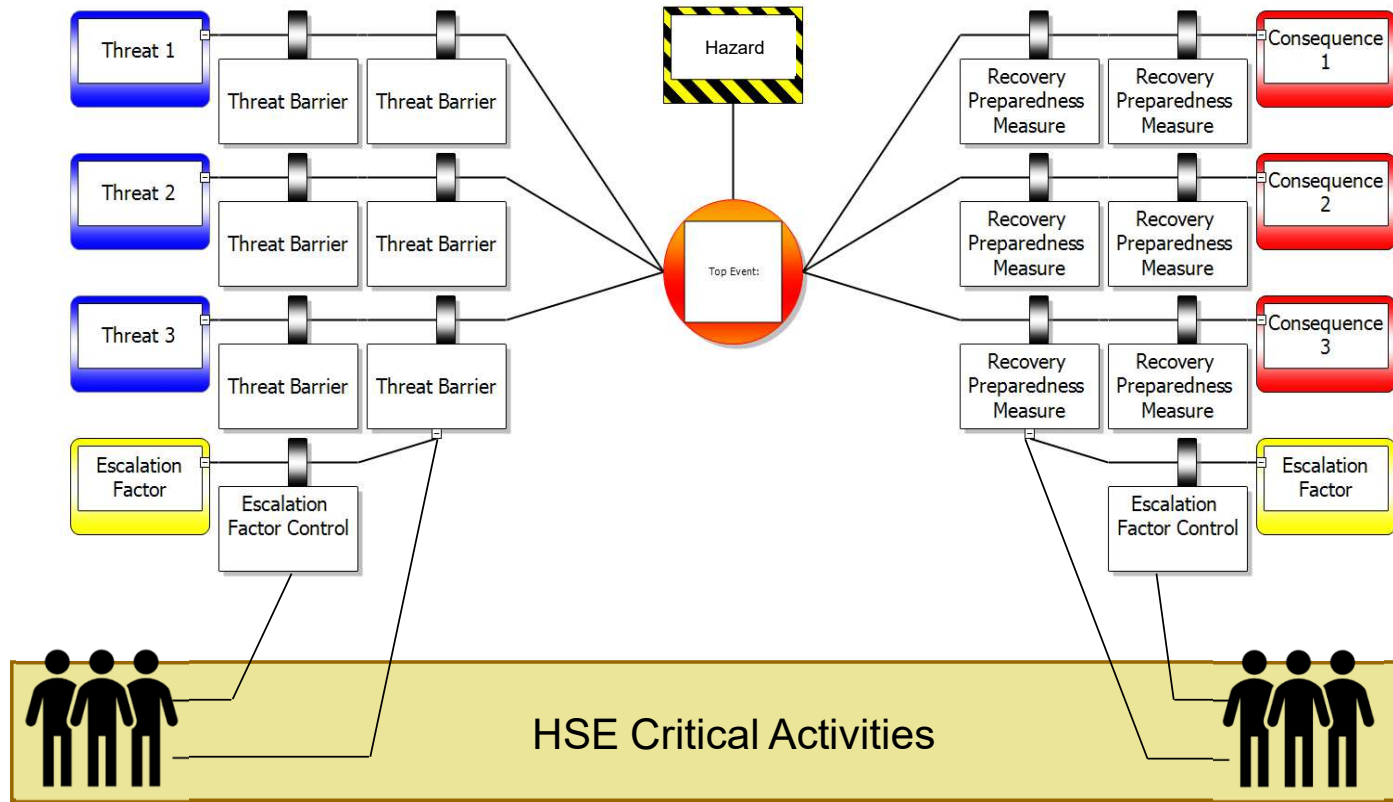
- A Key Performance Indicator (KPI) is a measure / evaluate trends or success at reaching specific defined targets
- Can be described as 'Leading Indicators' or 'Lagging Indicators'



KPI dashboard

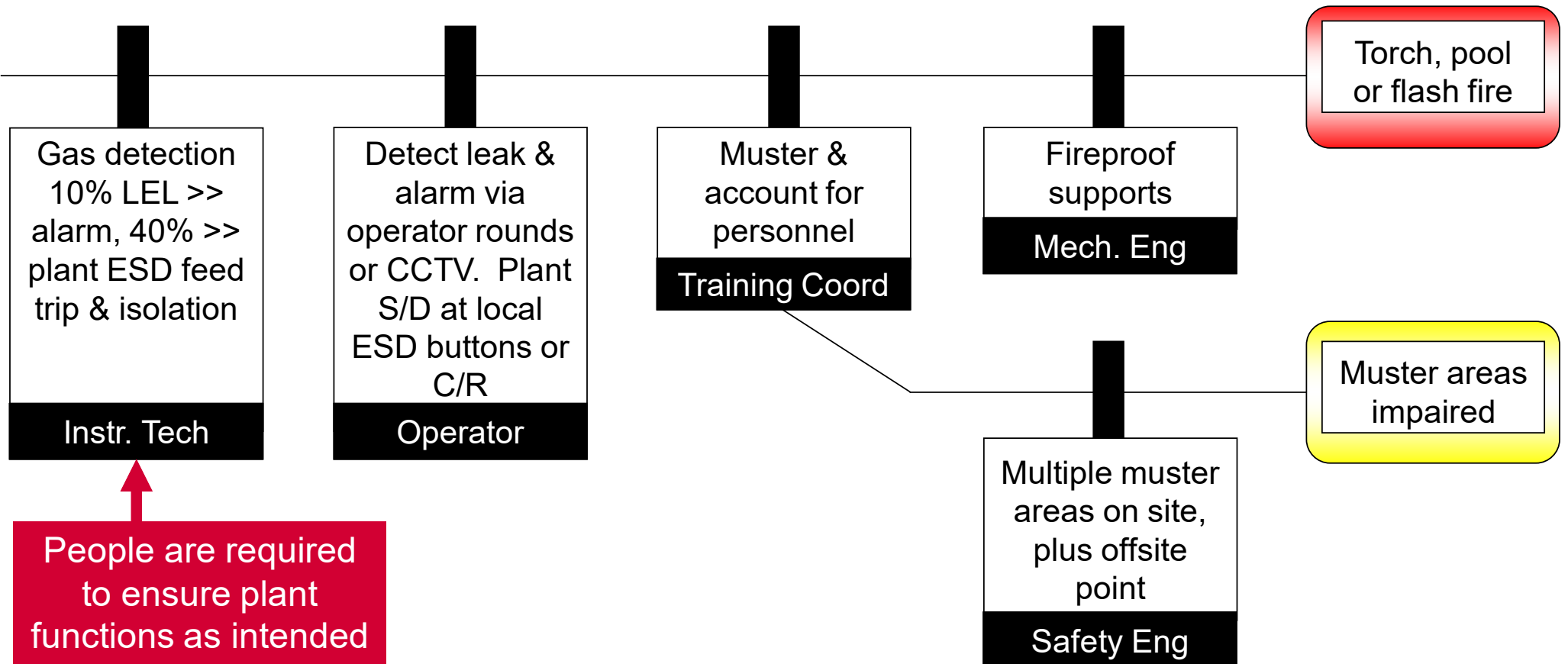


HSE Critical Activities and bowties

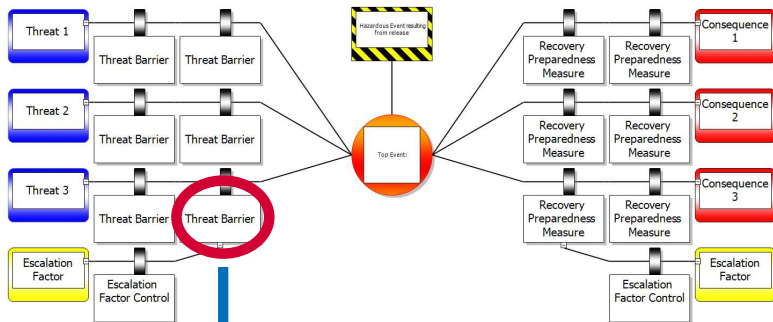


Personnel who undertake SCE performance assurance activities are in safety-critical roles, as well as those who carry out “human intervention actions”

Who's responsible & what must they do?

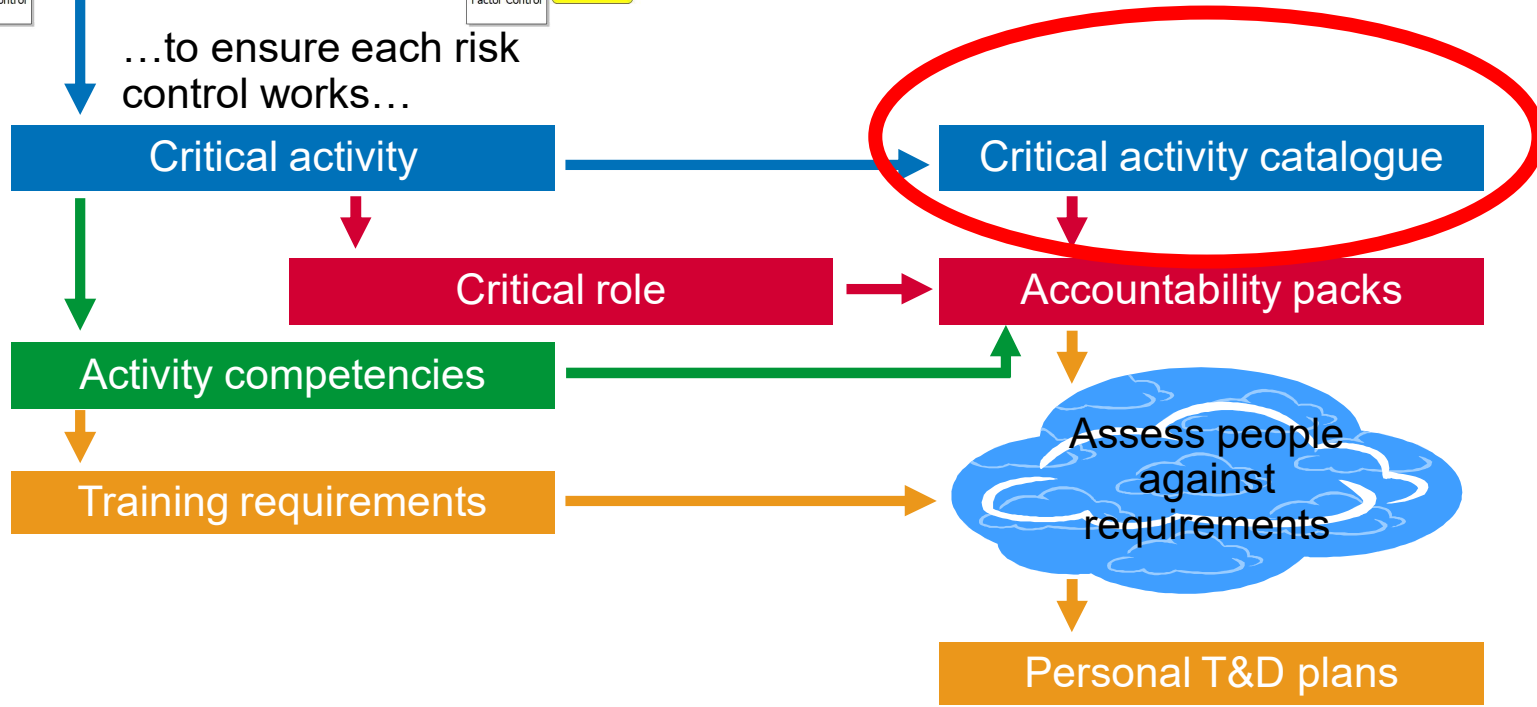


Link between bowties and training & competence



Competent people provide resilience against major risks

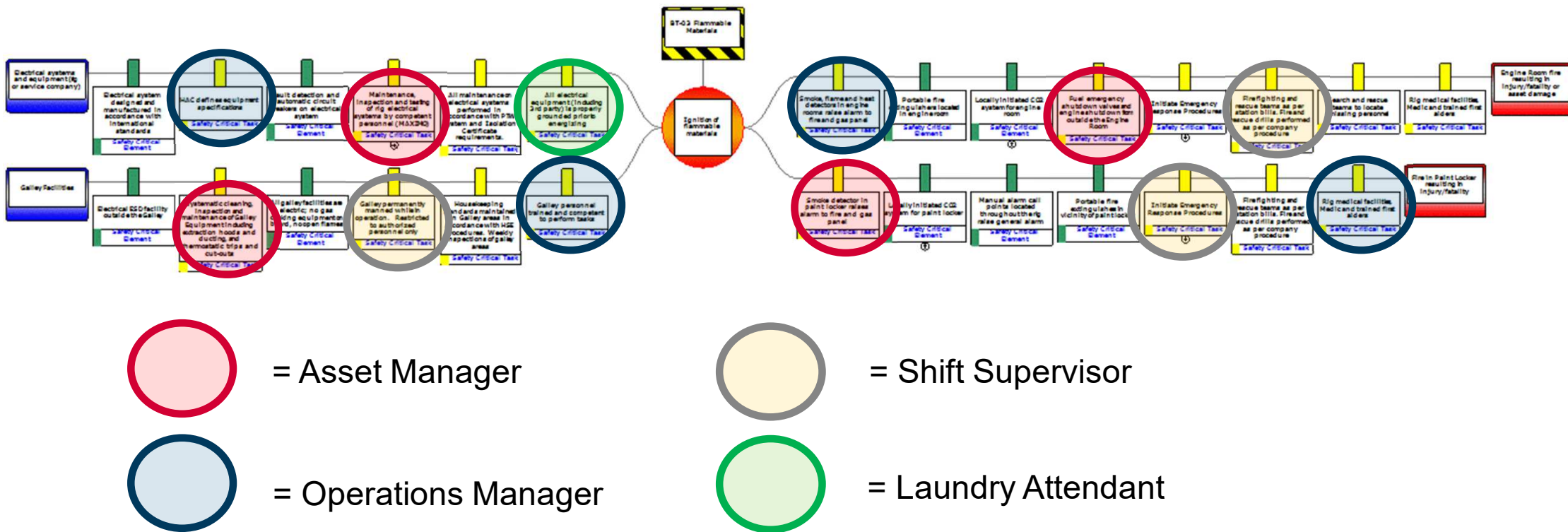
...to ensure each risk control works...

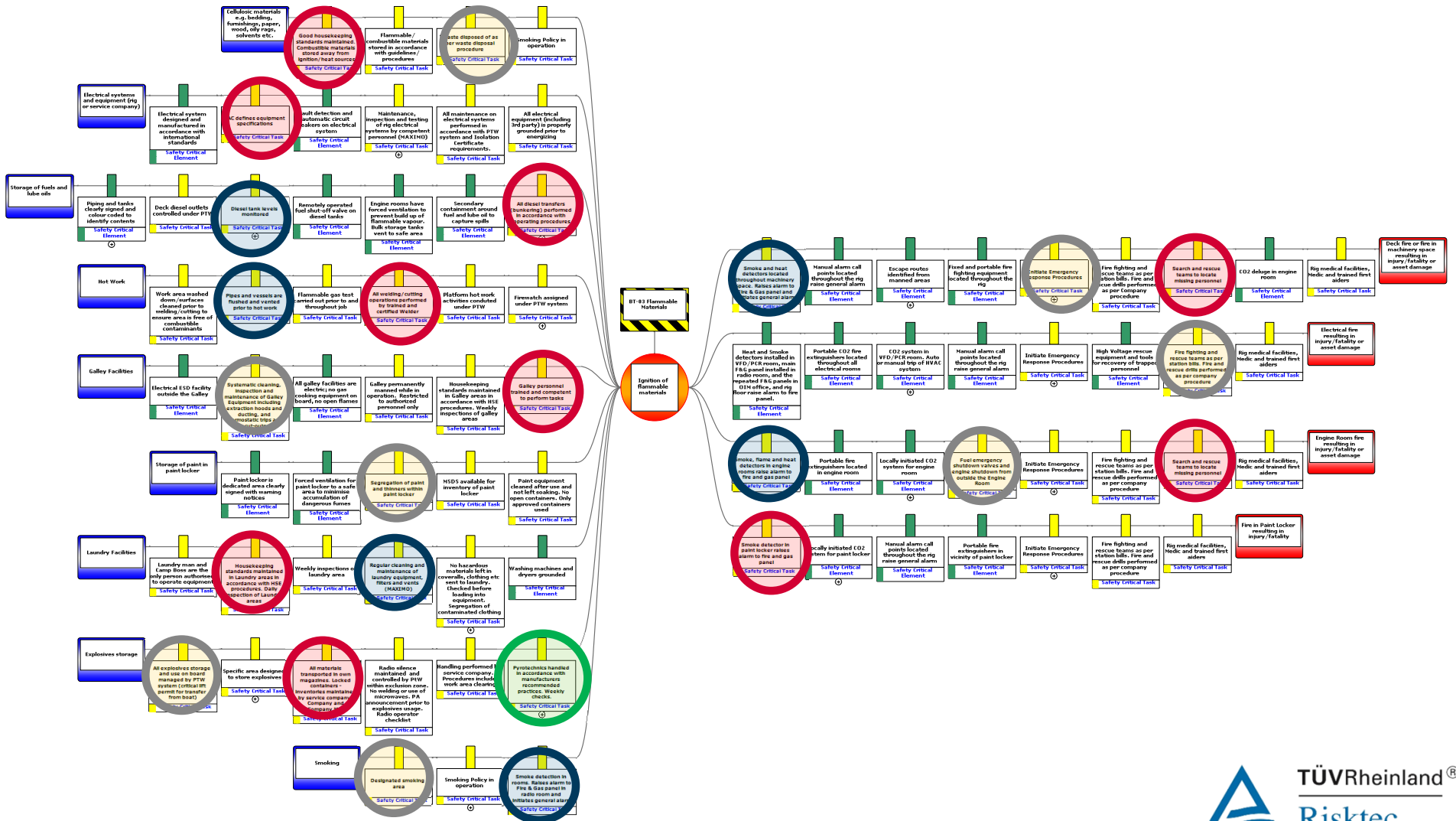


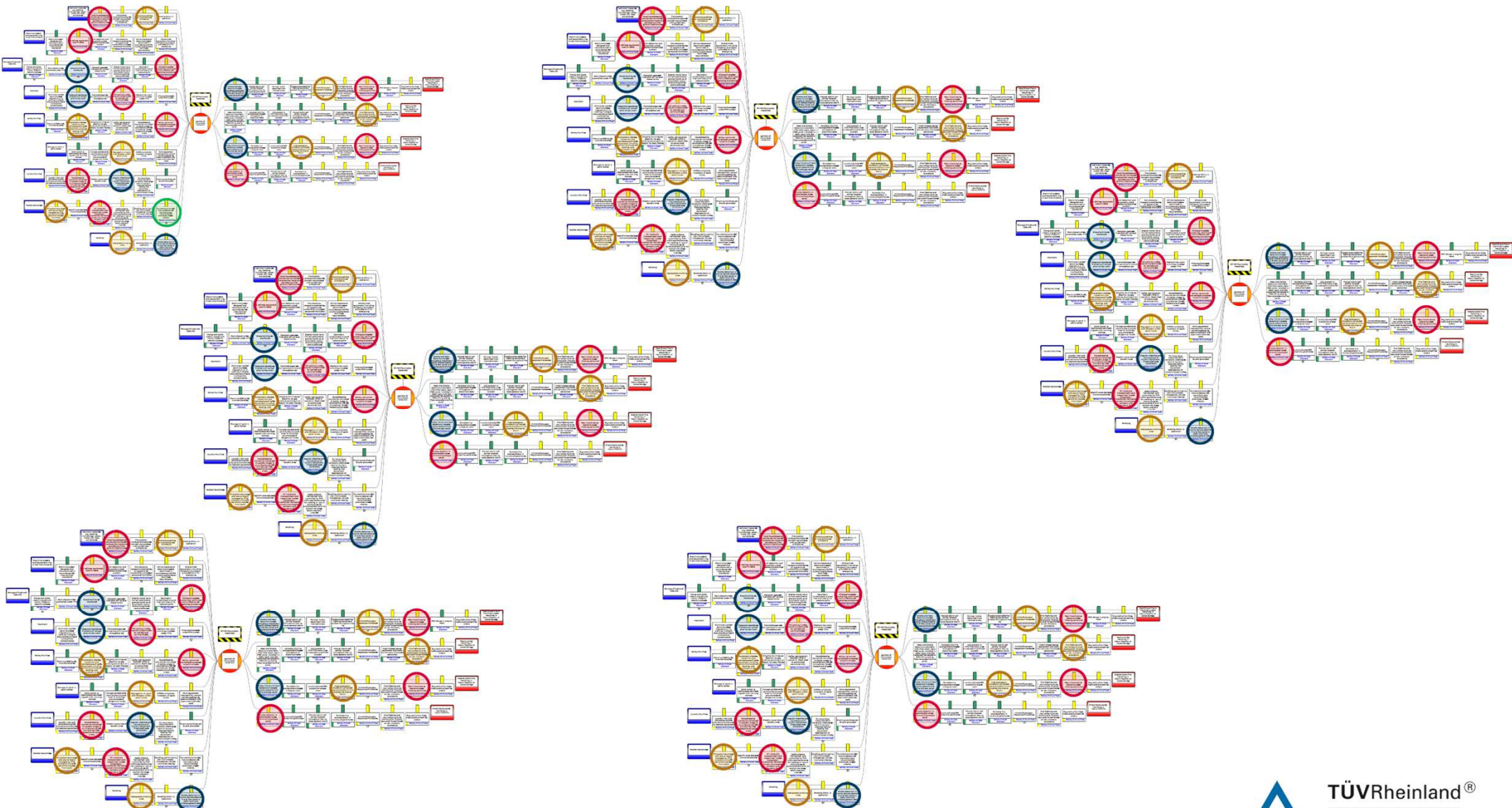
...use
Competency
Mgmt System

HSE Critical Tasks

- By taking each HSE Critical Task in turn, we can group them by Job Role







HSE Critical Tasks by Job Role

Asset Manager

- 1. Ensure competency of personnel hired for HSE Critical Positions
- 2. Manage HSE MS Interface/Bridging Documentation
- 4. Ensure appropriate Emergency Response Plan in place
- 5. Approve override of safety features on any equipment.
- 6.....

Operations Manager

- 1. Ensure ongoing competency of personnel in HSE Critical Positions
- 2. Schedule housekeeping audits
- 4. Implement and manage PTW system
- 5. Implement and maintain ERP and implement training and emergency response drills
- 6.....

Shift Supervisor

- 1. Conduct appropriate supervision of personnel
- 2. Monitor process conditions
- 3. Respond to alarms in accordance with alarm management guidelines
- 4. Maintain headcount inventory for personnel on site
- 5. Update permit register
- 6.....

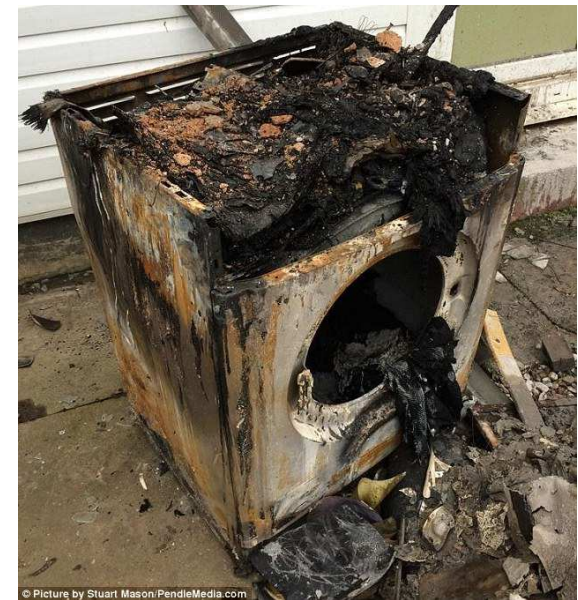
Laundry Attendant

- 1. Remove fluff from the tumble dryers

The Laundry Attendant example

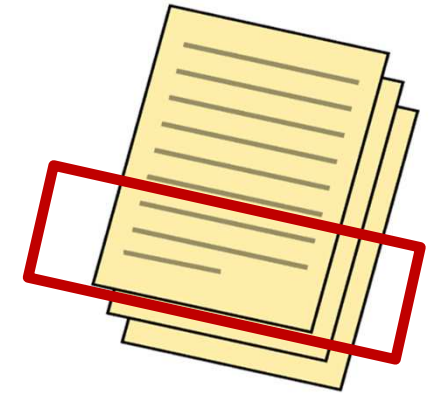
Laundry Attendant Responsibilities:

- Sort, wash, dry, press, and fold clothing and other textile items
- Remove stains from items using the appropriate procedures
- Perform minor sewing duties
- Track which items belong to whom
- Keep an updated inventory of laundry detergents and sewing kits
- Remove fluff from the tumble dryers
- Ensuring that the facility remains clean at all times
- Respond to user queries, concerns, and complaints



How can we communicate the HSE Critical Tasks

- Job descriptions which clearly identify HSE Critical Tasks
- Presentations
- Posters
- Information available on intranet



Facility (Example) Intranet Page
Please select the information that you wish to view

- Executive Summary
- Introduction**
- HSE Management System
- Facility Description
- Risk Management
- Emergency Response
- Performance Monitoring

Supporting Information

- HAZID Studies
- HAZOP Studies
- Bowtie Diagrams
- HSE Critical Tasks by Job Role
- Location Drawings
- Performance Standards
- Action Register
- References

SAFETY CASE

What is a Bowtie?

Bowtie Basics

The Bow-tie is a model that represents how a Hazard can be released, escalate, and how it is controlled. This is the basic structure of the bow-tie diagram – hence the name:

The Bow-tie diagram contains the elements required to effectively manage the Hazard such that the risks are tolerable and ALARP.

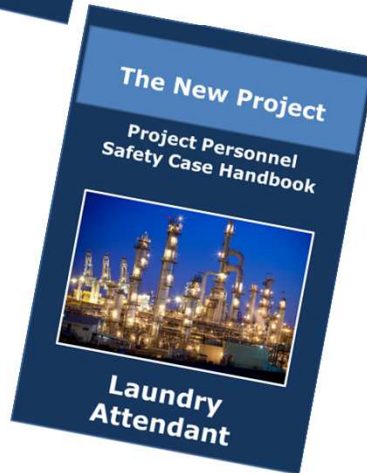
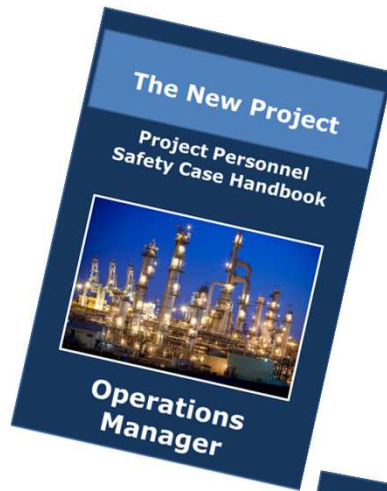
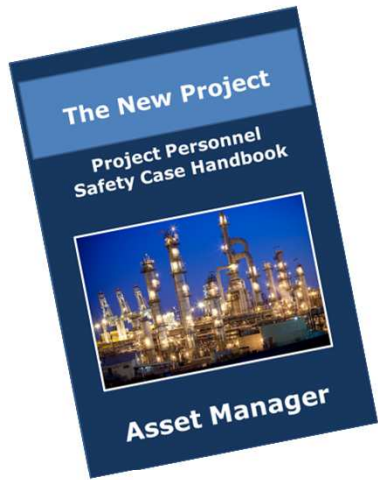
Bow-tie Development Process

Bow-tie Components

Hazard - An object, physical effect, or condition with potential to harm people, property or the environment
Top Event - the 'release' of the Hazard, the first undesired consequence, loss of control
Threat - A possible cause that will potentially release a hazard and produce a Top Event
Threat Barrier - A protective measure put in place to prevent threats from releasing a hazard
Consequence - An event, or chain of events, that results from the release of a hazard
Consequence Barrier - Measures that reduce/mitigate consequences arising from the release of a hazard
Escalation Factors - A reasonably foreseeable threat that can impact the ability of a barrier to effectively manage the Threat or Consequence
Escalation Factor Controls - Measures put into place to prevent or mitigate the effects of Escalation Factors

Page 2

Handbooks for all personnel



Individual Safety and Environmental Critical Tasks
All Personnel

Activity	4.1.41
Name	Declaration of Prescription Drugs
Description	
Any substance for which a prescription has been written by a licensed medical practitioner for consumption by the individual for whom it is written or ordered must be declared in accordance with the Drugs and Alcohol Policy. Prescriptions shall be in the holder's name with the prescription date no more than 1 year from issue.	
Relevant Documents	
<ul style="list-style-type: none"> PEO_2571.0 Drug and Alcohol Substances 	
Verification	
Medical Records	

Individual Safety and Environmental Critical Tasks
Drill Crew

Activity	2.1.12
Name	Monitoring Drilling Systems
Description	
Monitor operation of all drilling systems, perform regular derrick inspections and alert Driller/AD of any potential problems e.g. drill line damage/excess wear, non-operational safety systems, loose objects in derrick, potential equipment collisions Make daily checks on dead man anchors at end of drill line (position, torquing) and number of wraps of drill line on draw works.	
Relevant Documents	
<ul style="list-style-type: none"> Daily Check sheet Derrick Picture Book Training and Competency 	
Verification	
Driller handover notes Training records	

Software showing barrier status

The screenshot shows the VIVA software interface. On the left is a navigation menu with categories: ASSETS, HAZARDS, BOWTIES, SAFETY CRITICAL ELEMENTS, SAFETY CRITICAL ACTIVITIES, ROLES, PROCEDURES, and ASSURANCE DASHBOARD. The main area displays a list of barrier items:

Item ID	Description	Status	Completion Date	Action
4.12	Electrical Equipment Maintenance	Red (Not Functional)		RECORD
5 - Security				
5.01	Continuous Security Surveillance	Green (In Place)	Completed by DavidMcDade (david.mcdade@risktec.tuv.com) on 2023-12-07	RECORD
5.02	Weather Monitoring	Red (Not Functional)		RECORD
5.03	Entrance Gate Security	Green (In Place)	Completed by DavidMcDade (david.mcdade@risktec.tuv.com) on 2023-12-07	RECORD
5.04	Park Security	Red (Not Functional)		RECORD
5.05	Drone Footage Monitor	Green (In Place)	Completed by DavidMcDade (david.mcdade@risktec.tuv.com) on 2023-12-07	RECORD
5.06	IT Security Measures	Red (Not Functional)		RECORD
6 - Vehicle Operation				
6.01	Driving the Boats to and from the Island	Red (Not Functional)		RECORD
6.02	Helicopter Pilot	Green (In Place)	Completed by DavidMcDade (david.mcdade@risktec.tuv.com) on 2023-12-07	RECORD
6.03	Drone Operation	Red (Not Functional)		RECORD
6.04	Driving	Red (Not Functional)		RECORD

Record Inspection
Completion Data
2023-12-07

Concerns?

Barrier Status
 In Place
 Partially Impaired functionality
 Not Functional

Comment

Record Inspection
Completion Data
2023-12-07

Concerns?

Barrier Status
 In Place
 Partially Impaired functionality
 Not Functional

Comment

CANCEL SAVE

Conclusion

- The barrier management approach using bowties defines:
 - SECEs
 - HSE Critical Activities
- These are managed through MMS and Competency Management System
- Further communication and management is beneficial:
 - KPI dashboards
 - Critical roles booklets
 - Software showing barrier status
- This wholistic approach enables risks to be better understood and hence proactively managed, not only today but through-life



Thank you

Have a safe and secure day!

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Q&A