

An aerial night view of an industrial plant, possibly a refinery or chemical processing facility. The scene is illuminated by various lights, including bright yellow lights from process units and blue lights from buildings. A complex network of pipes and structures is visible. Overlaid on the image is a risk visualization consisting of red and green lines and shapes that trace paths through the facility, likely representing high-risk areas or process flows. The visualization is semi-transparent, allowing the underlying industrial structures to remain visible.

The power of combining PHA, Bowtie and Risk visualisation

Risk Recontextualized

Paul Tours

 Wolters Kluwer

Just the Facts.....



Paul Tours, 47 Years old
Principle Solutions Engineer EHS, Europe
@Wolters Kluwer – Enablon (5 Years)

British born

Past 30 years worked, studied and lived in
Germany

Previous Roles include:

Senior Consultant and Product Manager

Database Marketing Manager

Software Developer

Unplanned Maintenance – Includes PSM events

38
\$M in lost
production

27
lost days (Avg)

7
% improvement
from better
analysis

Per Site

Annually In Oil and Gas

High performance organizations use Process Safety Management as a framework for Operational Excellence

- PSM is 30+ years old & **always** challenging
- Written by leaders from industry (DuPont, Shell, ICI...) who wanted optimal and reliable operations
- Accomplished by creating a learning, continuously improving organization
- Optimal operations means less process safety incidents and environmental events as a byproduct
- PSM has no end. It's not like projects with an end date
- The definition of compliance and excellence is always changing, and so must you and your execution

Data Collection – 1993



14 Elements Dependent & Overlapping to Help Ensure Reliable & Safe Operations



14 Elements

~~Dependent & Overlapping~~ to Help
Ensure Reliable & Safe
Operations





Key PSM challenge areas

Information management



Performance



Awareness



Deliver actionable information
at the right time to the right people
to make the right decision.

What dynamic PSM means for you

PSM Performance

- Single source of truth fosters improved compliance
- Enterprise-wide best practices sharing reduces repeat incidents
- Exponential value through connecting MOC with PHA, bowties, barrier management and Control of Work

Visual Risk Management

- Cumulative risk visualizes real-time risk across your facility, using various live and static data points
- Insight into various levels of data, from asset integrity to process safety bowties
- Actionable insights for stakeholders at all levels

Awareness

- View aggregated risk state of your site, up to a month into the future
- Improved risk-based operational decision making with heat-map visualisation
- Line of sight from corporate level to in-field barrier risk status

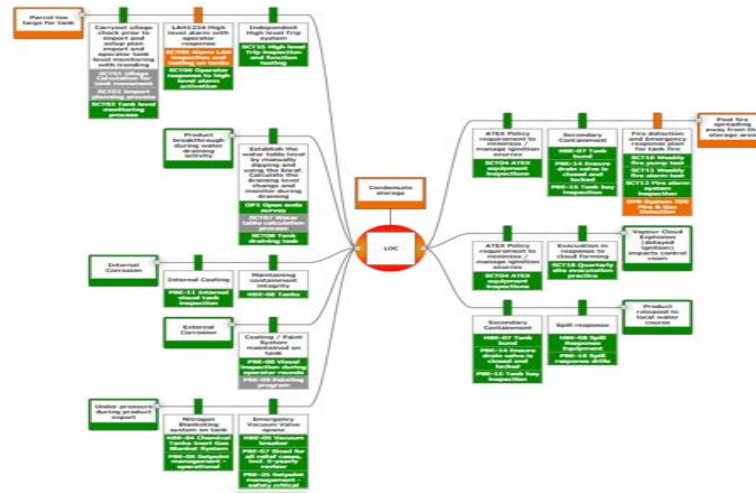
From design review



Process Hazard Analysis

- Design & engineering review studies (e.g., HAZOP, LOPA, SIL, What-if)
- Provide all relevant data (e.g., MOCs, PSM events, inspections)
- Initiate fundamental improvement

to visualization



Bowtie Risk Analysis

- Practical and visual risk models
- Connect to EHS for holistic risk view
- Support ERM, EHS and PSM managers
- Mid- to long-term decision making

into operations



Cumulative Risk View (CRV)

- Operationalized real-time barriers
- Actionable cumulative risk views
- Leverage existing data sources
- Control of Work integration
- Drive operational decision making

Integrated PSM solution across functions, to prevent events, to save time and to rationalize software in your application landscape

What if?

- Real time overview of the safeguards and controls
- Instant insights on relevant Audits and inspections
- See all changes (MOC's) that have taken place
- You are aware of all incidents and near misses
- Immediately know what Actions are still outstanding

Gets you...

- Reduce lead time needed for preparing PHA's
- Greater accuracy in PHA
- Shared learnings across the whole organisation

So, if PHAs are
only the
beginning....

Risk Management via Bowties

ARE YOU IN CONTROL?

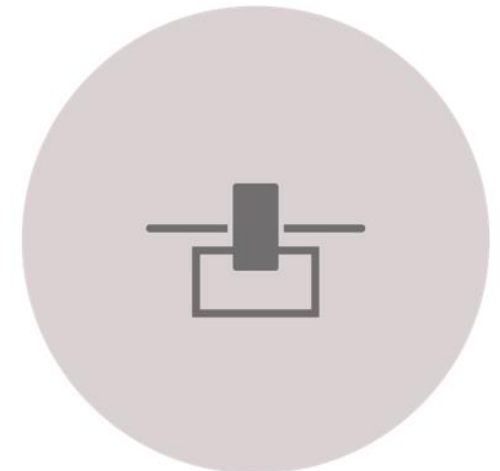
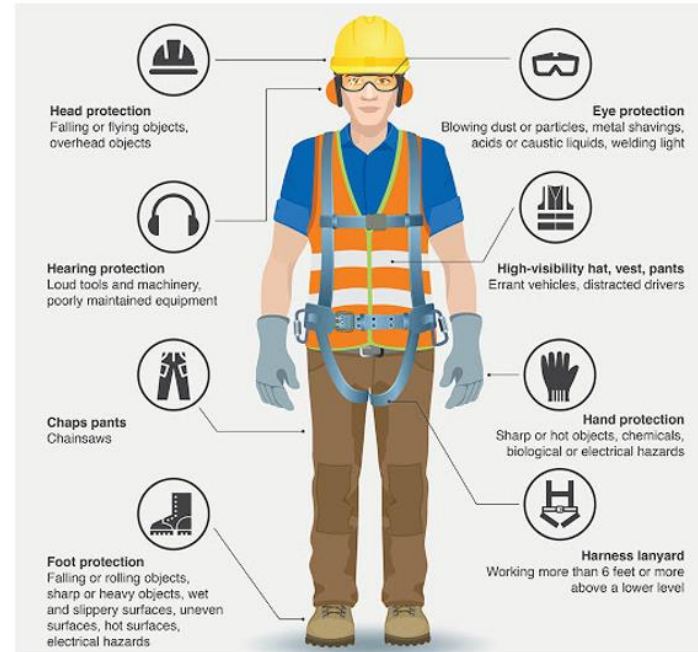
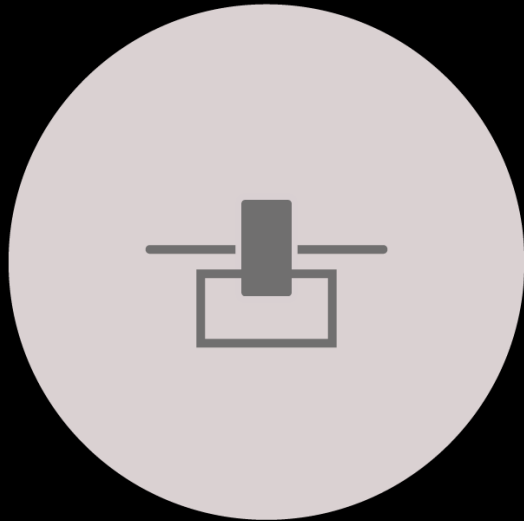
Answer the three basic questions

1. Do you understand what can go wrong?
2. Do you know what systems prevent this from happening?
3. Do you have information to assure they are working effectively?

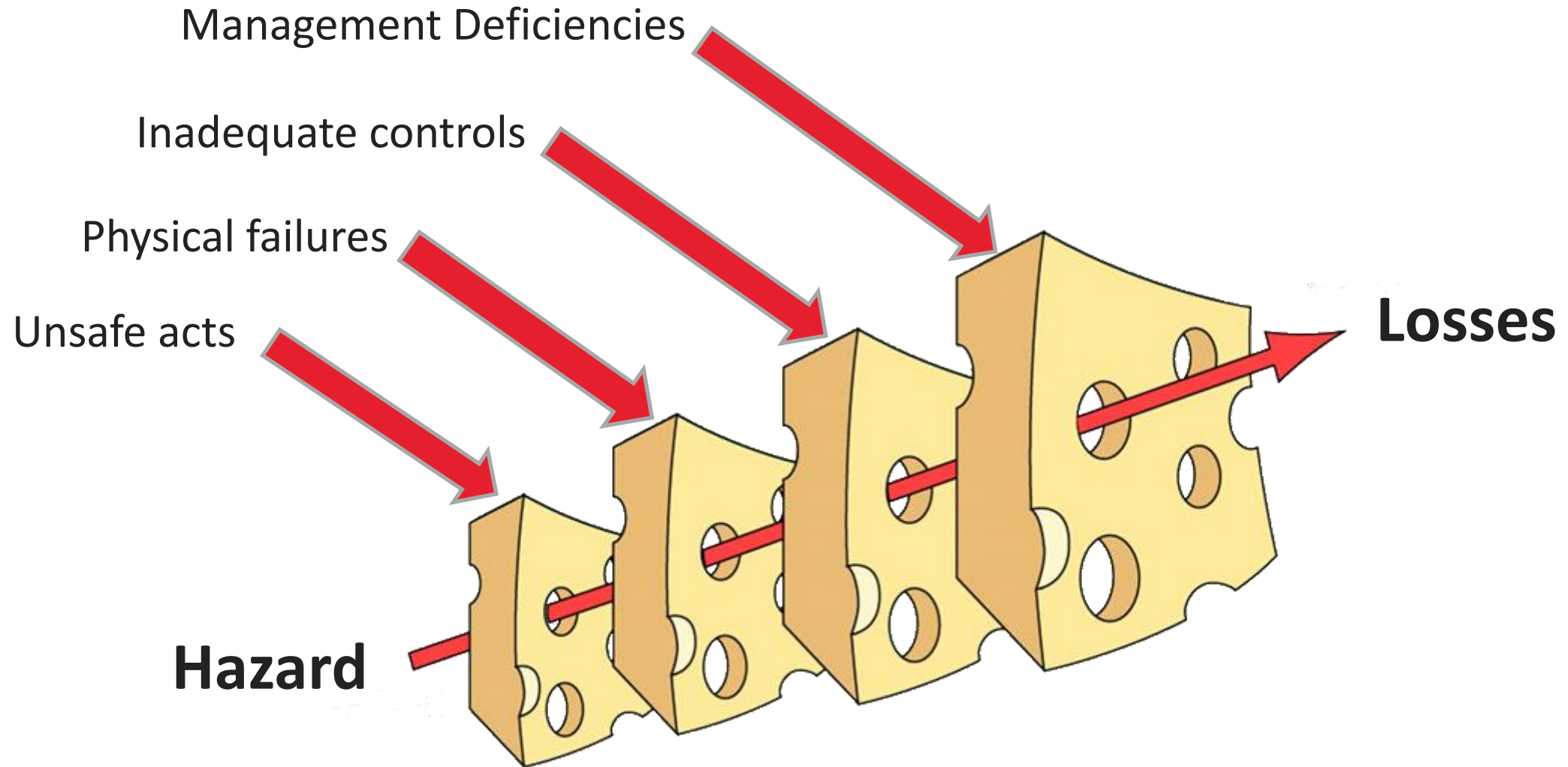
BARRIER

Control | Safeguard | SCE | Layer of Protection

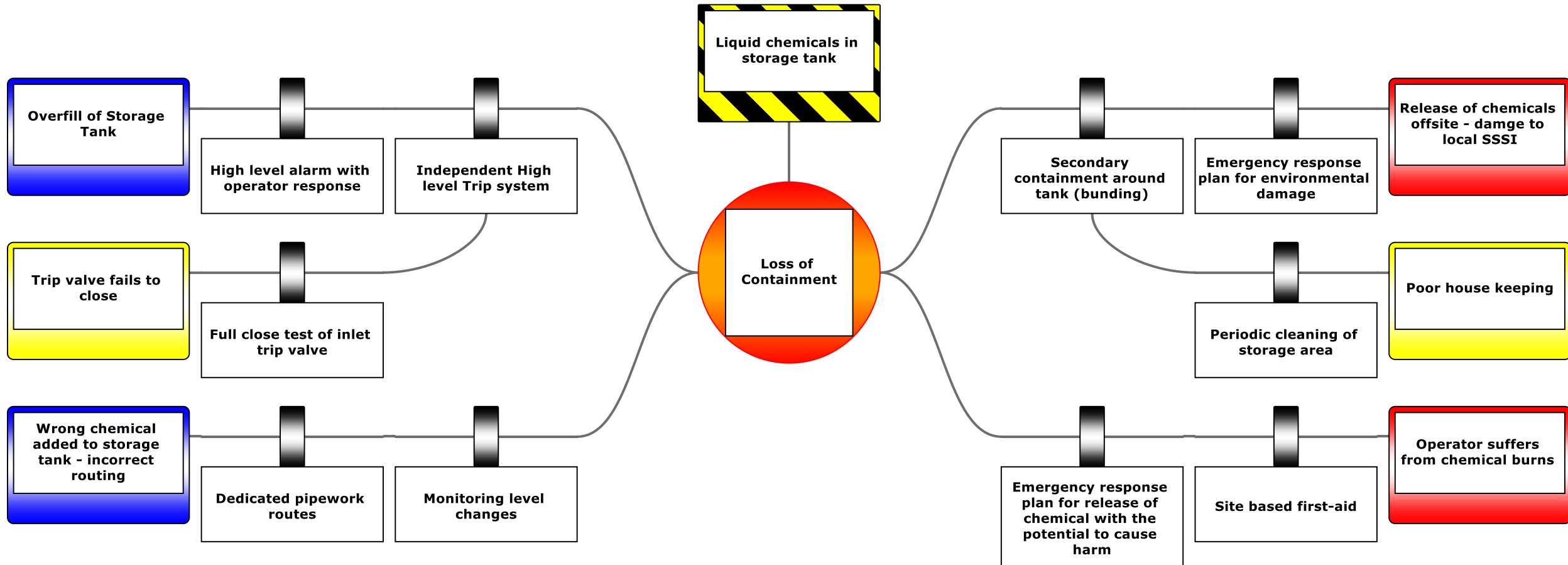
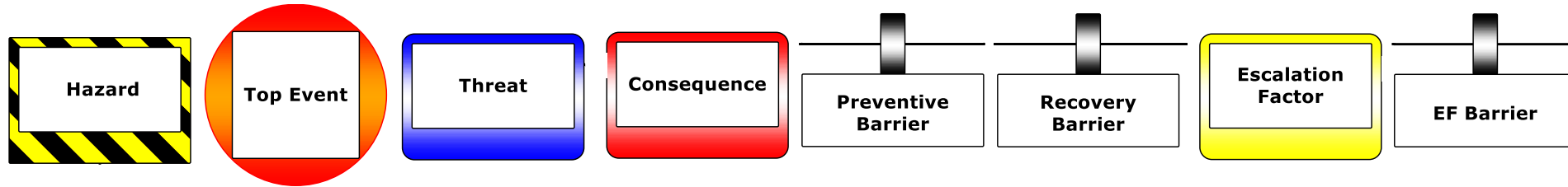
“Safety barriers are the physical or non-physical means planned to prevent, control, or mitigate undesired events”



BOWTIES USE SWISS CHEESE CONCEPT

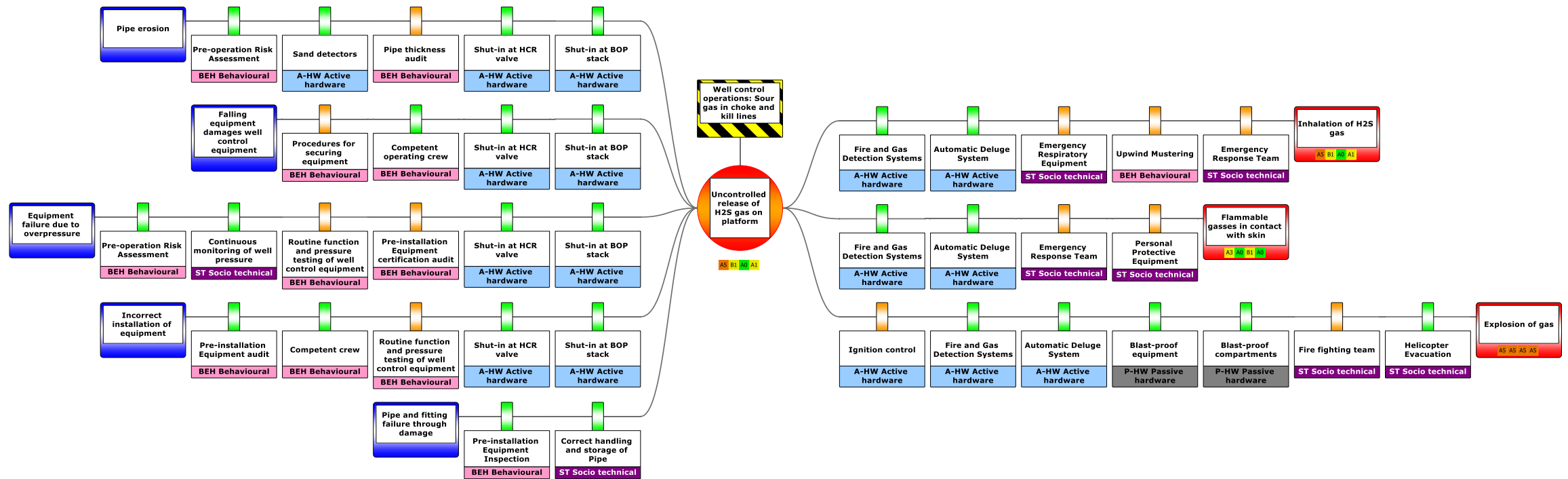


Bowtie in 8 steps



BOWTIE APPLICATION

Process safety Well control operations



Cumulative Risk Visualisation – Barrier Management

Barrier Management

A visual representation of your: Processes Safeguards and Controls

Uses a heatmap to show current status of controls

Using api feeds and simple data imports and from external system – Maximo, SAP, PI, Audits, inspections...

Shares a common FLOC table from SAP

Quick and Intuitiv understanding of where the current issues are across your site, aswell as and impending issues.

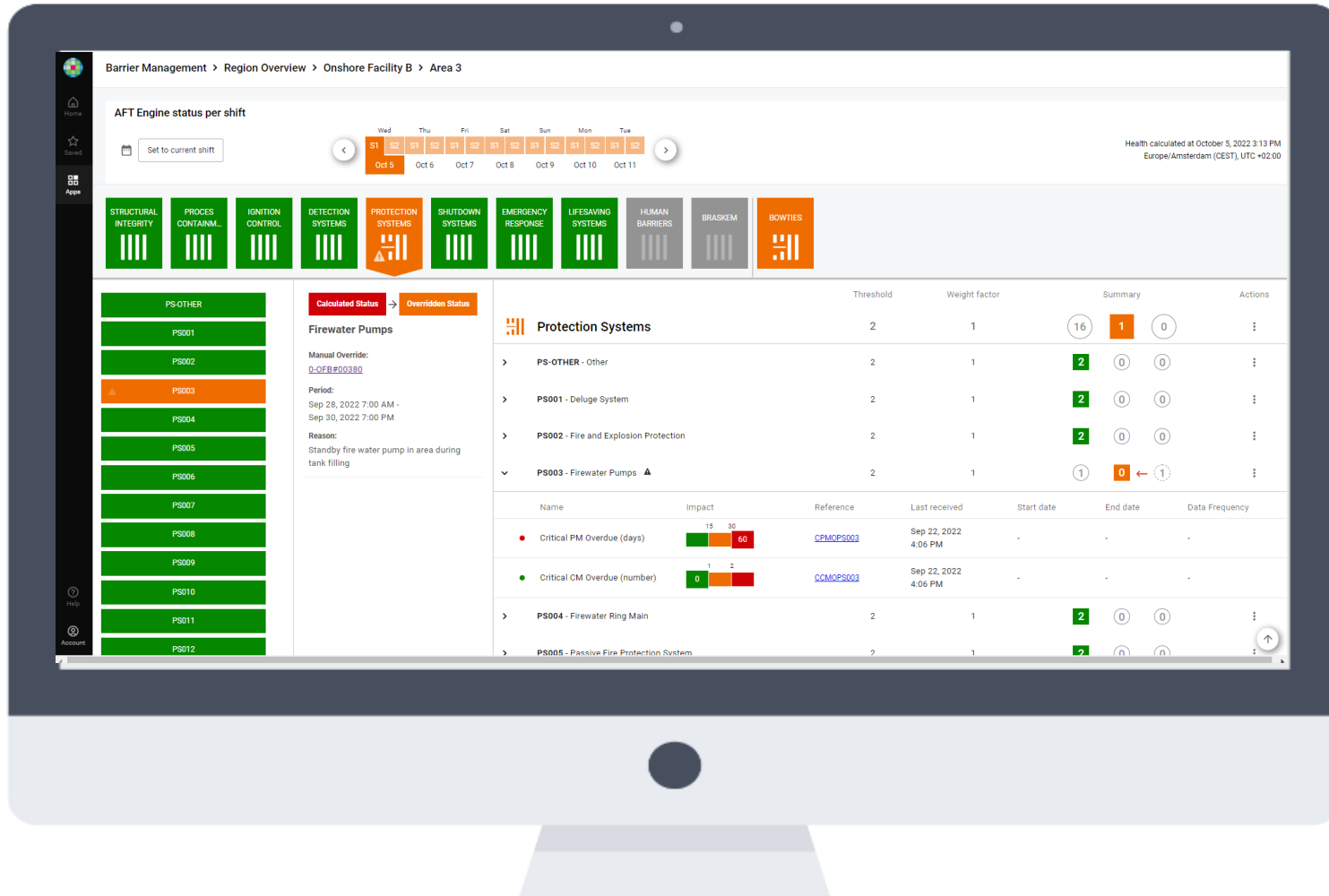
Criticality levels easily set at all levels

Integrating of Data Points



- **Integrity Data:** Audits and assurance, Competence Management, Inspections, Engineering data
- **Operational Intervention:** Process Control Systems, Historian, Shift logs, Operator rounds, Permits, temporary defeats
- **Barrier Challenges and failures:** Incident Management, Management of Change, Process upsets, PSM Events.

Barrier Management in a nutshell



Boost asset integrity

View near real-time barrier status across your enterprise based on various live and static data points, see current and future state, and ensure up-to-date calculations, mitigations and overrides

Cumulative Risk: Safeguards & Controls Overview

Location

- Site Float
- Productic
- Storage a
- Offloadin
- 2 escalated
- AFT Engi
- 0 escalated
- AFT Machi
- 0 escalated
- Below Liv
- Quarters
- 0 escalated

System Category	System Name	Calculated Status	Overridden Status	Manual Override	Period	Reason
STRUCTURAL INTEGRITY	SI-OTH	Green	Green			
	SI001	Green	Green			
	SI002	Green	Green			
	SI003	Green	Green			
	SI004	Green	Green			
	SI005	Green	Green			
	SI006	Green	Green			
	SI007	Green	Green			
	SI008	Green	Green			
	SI009	Green	Green			
	SI010	Green	Green			
	SI011	Green	Green			
SI012	Green	Green				

Firewater Pumps

Manual Override: [0-QFB#00380](#)

Period: Sep 28, 2022 7:00 AM - Sep 30, 2022 7:00 PM

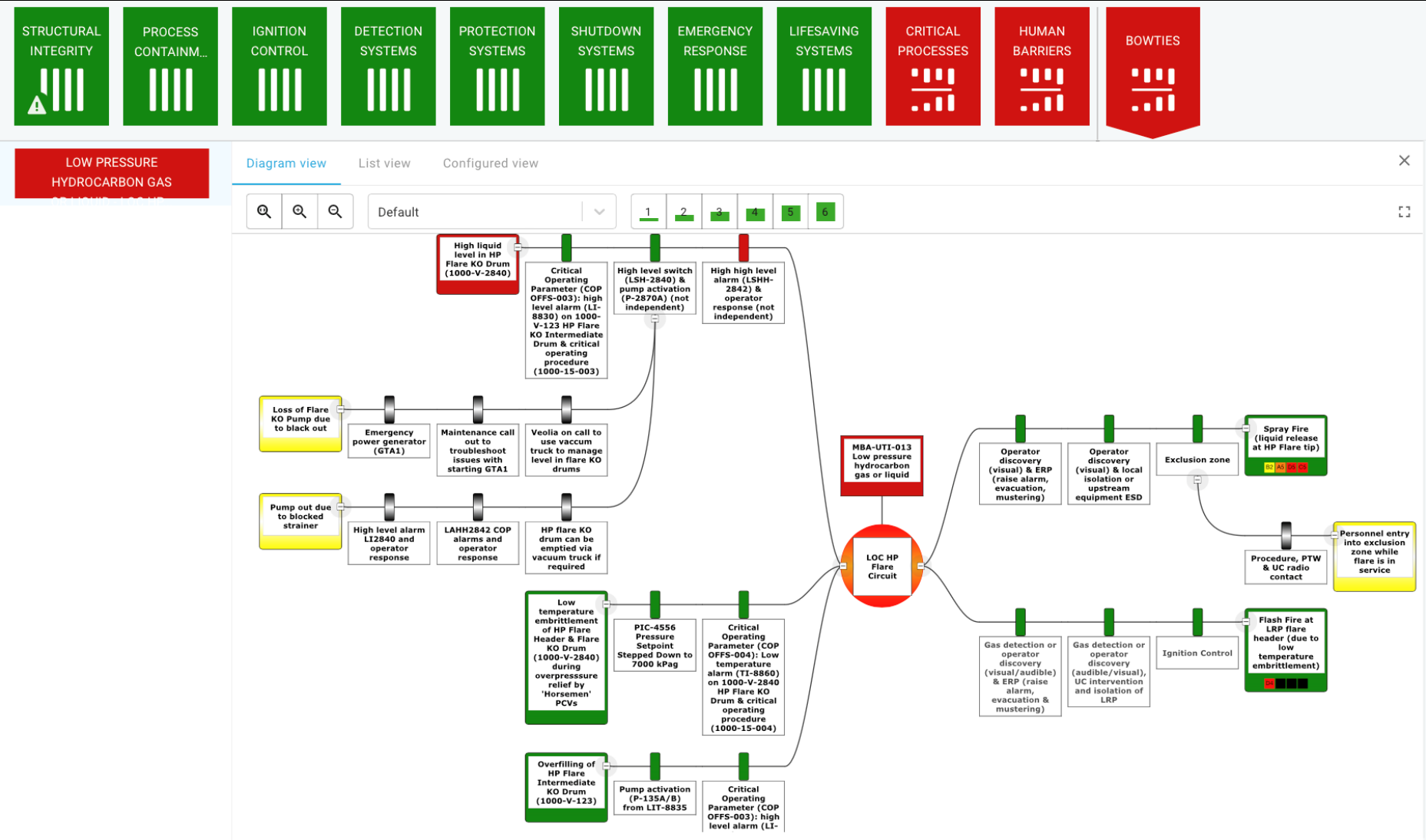
Reason: Standby fire water pump in area during tank filling

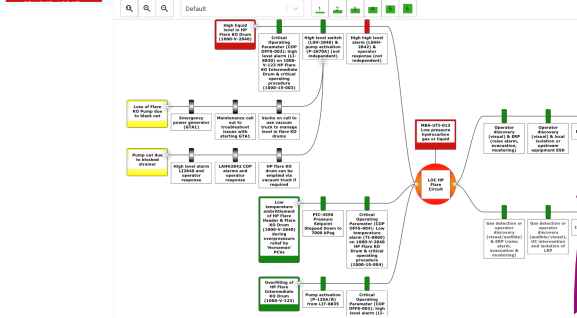
System Name	Threshold	Weight factor	Summary
Protection Systems	2	1	16 1 0
> PS-OTHER - Other	2	1	2 0 0
> PS001 - Deluge System	2	1	2 0 0
> PS002 - Fire and Explosion Protection	2	1	2 0 0
> PS003 - Firewater Pumps ⚠	2	1	1 0 1

Name	Impact	Reference	Last received	Start date	End date
● Critical PM Overdue (days)	15 30 60	CPMOPS003	Sep 22, 2022 4:06 PM	-	-
● Critical CM Overdue (number)	1 2	CCMOPS003	Sep 22, 2022 4:06 PM	-	-

System Name	Threshold	Weight factor	Summary
> PS004 - Firewater Ring Main	2	1	2 0 0
> PS005 - Passive Fire Protection System	2	1	2 0 0

Dynamic Bowtie





Refrigerant: Chiller Vessel - A...

ANNUAL INSPECTION CHECKLIST

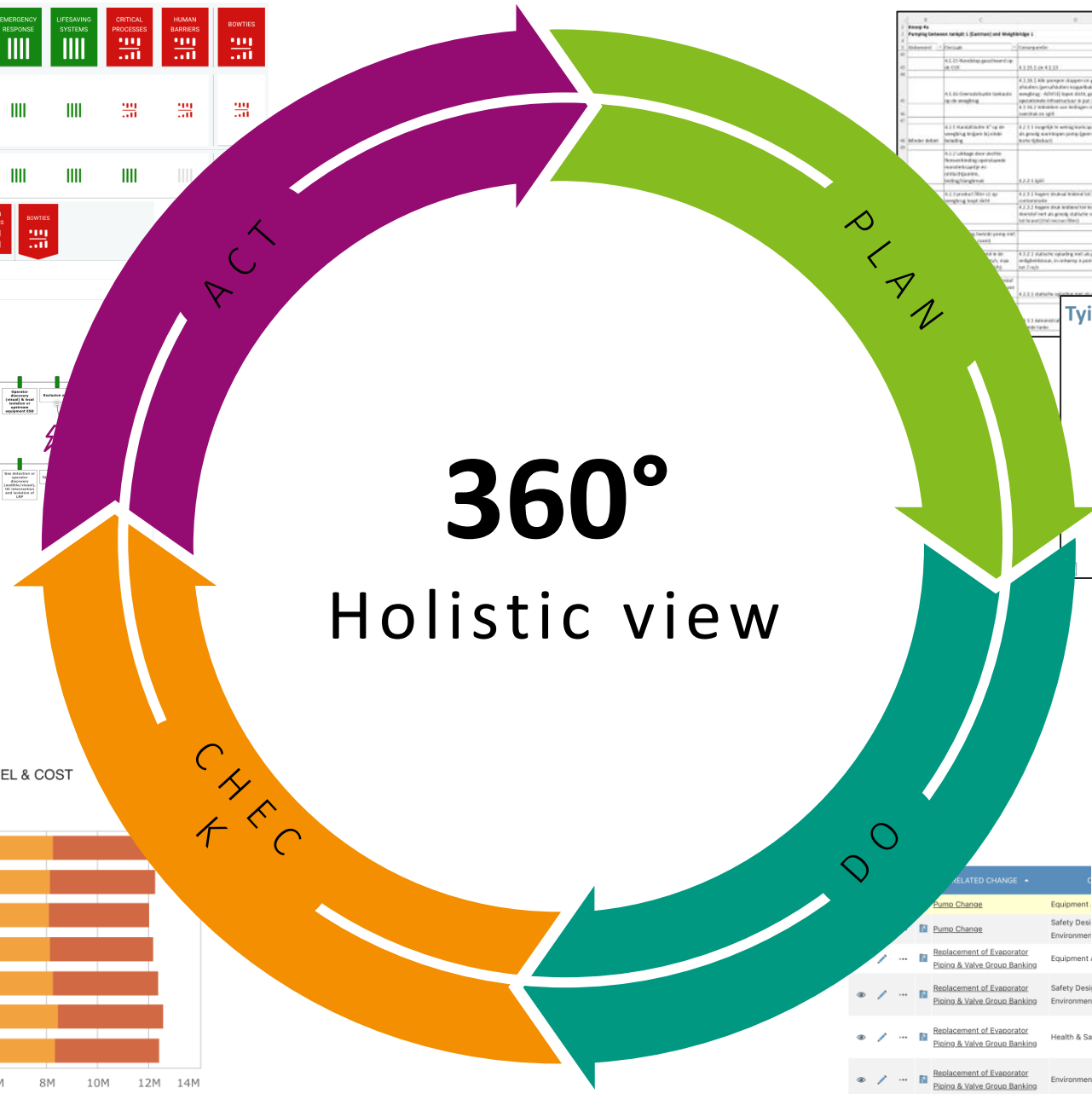
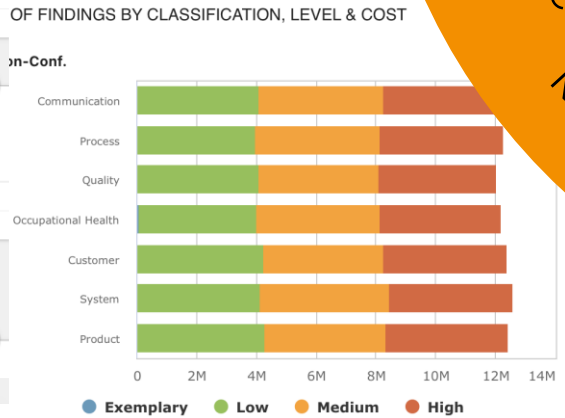
Check Oil (Drain if needed)

Yes
No

OF FINDINGS BY CLASSIFICATION, LEVEL & COST

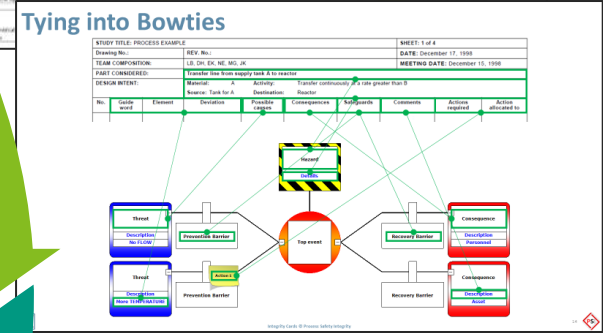
Communication
Process
Quality
Occupational Health
Customer
System
Product

During Visual Inspection. Was Any Damage



Planung

Item No.	Item Description	Start Date	End Date	Status
1.1
1.2
1.3



Action Plans

Definition	Achievement	EMAIL	APPROVAL	NAME	SOURCES	NODE	ENTITY	PRIORITY	STATUS
...	the SWPPP program for Denver	Independent	Chicago	Medium	Not Started	
...	the SWPPP program for Denver	Independent	Chicago	Medium	Not Started	
...	Complete the renewal of the Trade Name filing.	Independent	Denver	Medium	Not Started	
...	the SWPPP program for Denver	Independent	Chicago	Medium	Not Started	
...	Rework NC Products	1 source	Chicago	Immediate	Not Started	
...	Recalibrate Machine	1 source	Chicago	Minor	Not Started	
...	Complete the renewal of the Trade Name filing.	Independent	Denver	Medium	Not Started	

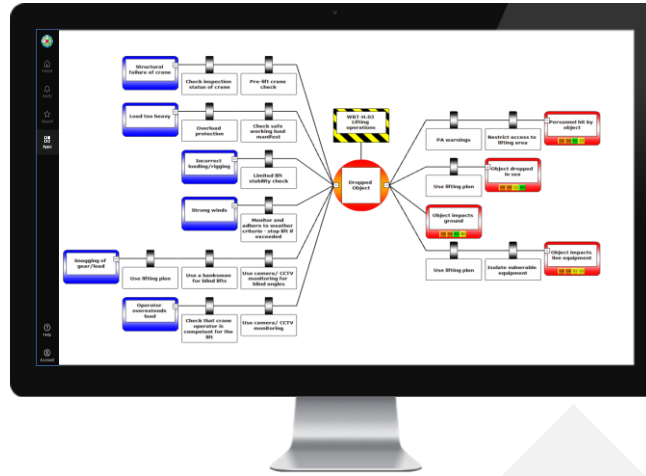
From **design review**



Expert team conducts **process hazard analysis** to identify hazards and plan controls using methods like **HAZOP** and **LOPA**



to **visualization**



EHS or process safety specialist **builds bowtie** using learnings from risk register and incident investigations database



into **operations**



Dynamic bowties are linked to data sources to show real-time **cumulative risk** to drive risk-based operational decision making in the field



- Thank you



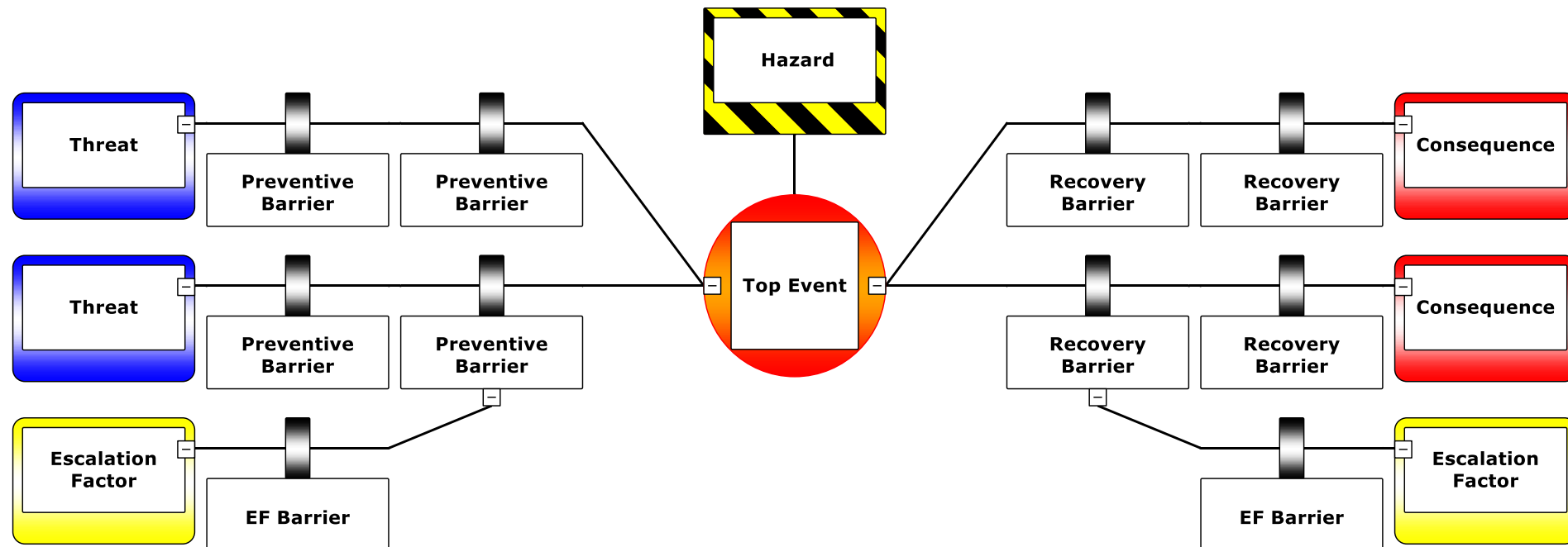
Paul Tours

Enabling Sales Teams with Process, Technology
and Training



BOWTIE METHOD

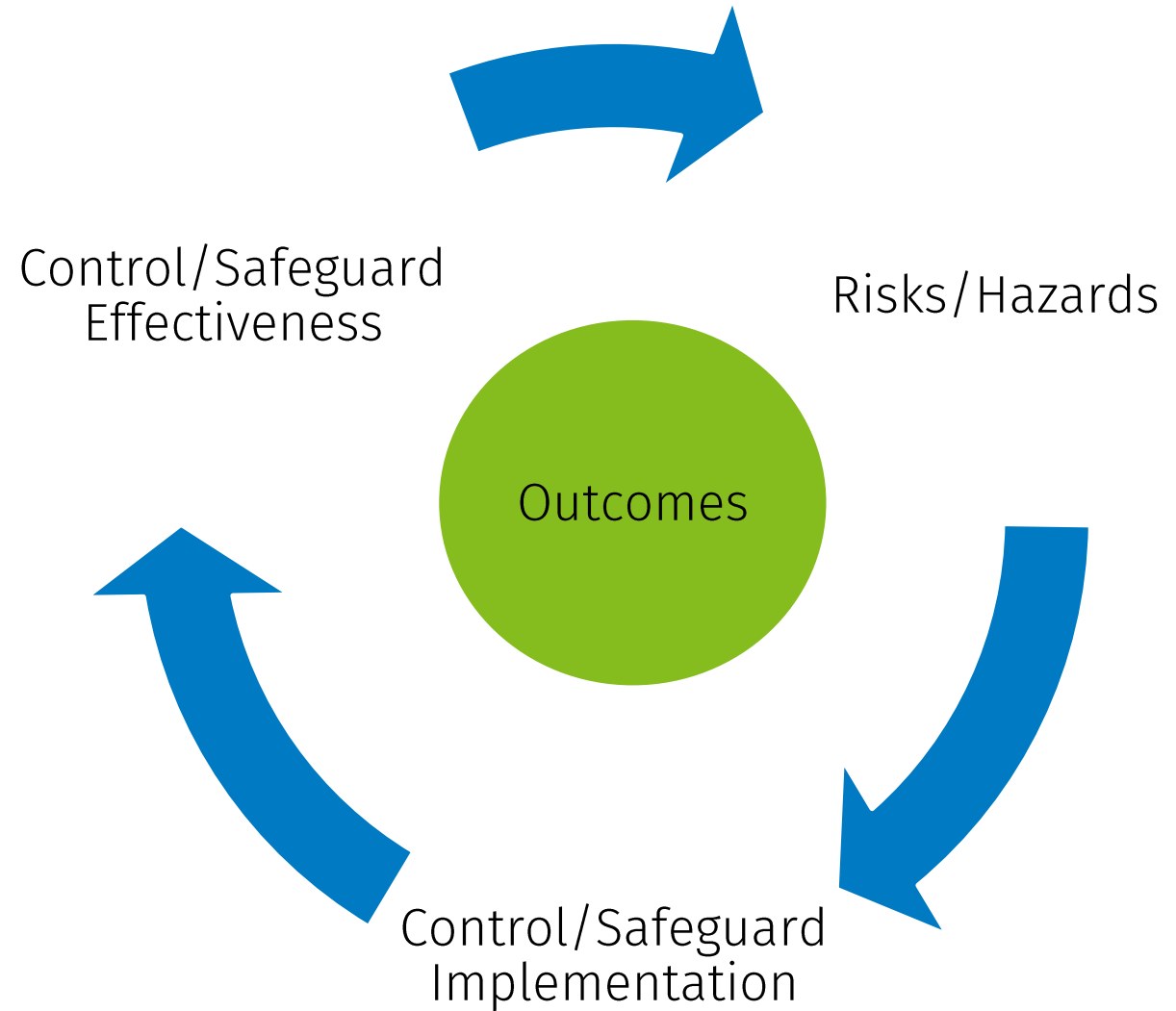
- Scenario-based (qualitative) visual risk analysis
- Focus on identifying and managing barriers (controls)
- Risk-based decision making and efficient resource application
- Risk communication, awareness and organizational learning



But also

- Need for more efficiency
 - Installations and environments become more complex
 - Aging installations
 - Less people / expertise is leaving industry
- Broader perspective required
 - Climate change and natural events
 - Cyber security
- Push for a dynamic PHA
 - Use of actual frequencies and failure data
 - Critical controls management

A control-centric data model creates the links which add value

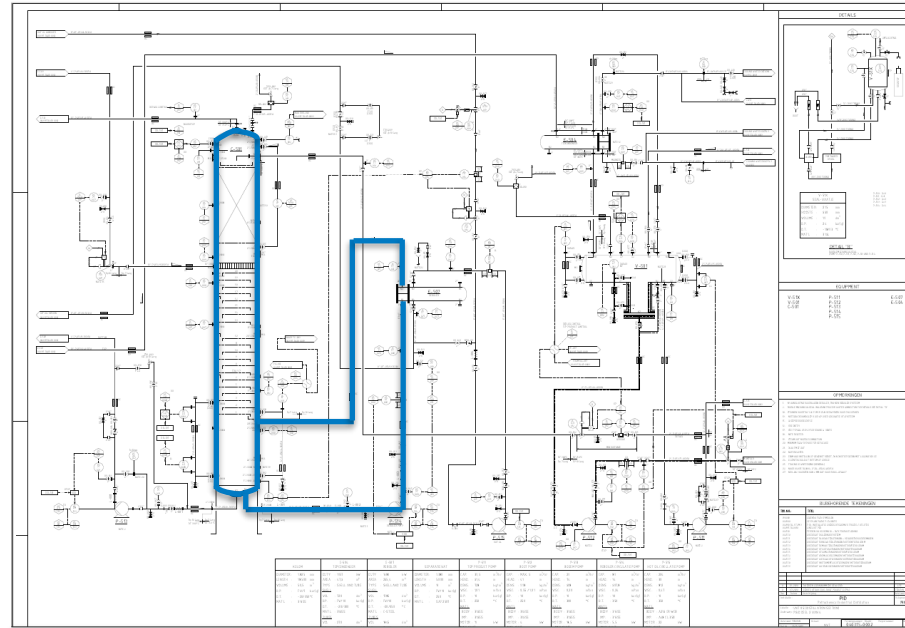


Design

P&ID



C-501 distillation column + Reboiler E-506



Design Parameters

- P-top = 0,32 bar
- T-top = 213°C
- P-bottom = 0,4 bar
- T- bottom = 263°C
- DP = 7 bar
- DT = 300°C
-



Process upsets 2017-2022

- Critical alarms
- SIS activations
- PSV openings
-

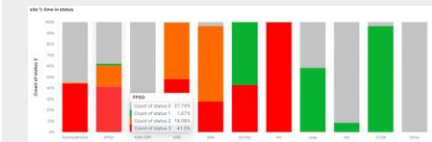


Potential Safeguards

Tag	Description	Criticality SAP
LZ-002	Level shutdown bottom	A
TT-023	Temp. alarm pump A	-
TT-018	Temp. alarm pump B	A
PZ-012	Pressure shutdown	A
PT-012	Pressure transmitter	C
SD-501	Shutdown valve	A
PT-06	Pressure transmitter	A
PSV-002	Pressure relief @7 bar	A



Barrier performance



Incidents 2017-2022

- #5642 - Tier 2 process event

Industry

- Distillation column explosion
- Column flooding due to failure of level indicator



MOC's

MOC #	Phase	Subject	Risk	Emergency
Permanent				
MOC-2015-0023	7 - Closed	PID Readiness	Normal	Normaal
MOC-2016-0036	8 - Upgrade to project	2nd DETO unit 5 vapour system	x	Low Risk
MOC-2016-0083	8 - Upgrade to project	Independent temperature trip temperature trip unit 5	x	Normal
MOC-2016-0084	8 - Upgrade to project	Re-routen vacuum water unit 5 to MS-202	x	Low Risk
MOC-2016-0121	1 - Select	Control of exit pressure and temp PID units	x x x x	Normal
MOC-2019-131	7 - Closed	Migration control system PID & TOB	x x x x	Normal
MOC-2020-049	3 - Define (detailed)	MS202 in service of unit 5 condensate	x	normal
MOC-2020-055	5 - Operate	Replacement of emergency diesel generator cooling water PID 5	x x x x	Normal
MOC-2021-018	0 - Identify	Increase of ttemperature cooling water top condensot	x	Normal
MOC-2021-019	0 - Identify	Increase of colling water pressure > process pressure	x x x x	Normal
Temporary				
MOC-2015-0108	7 - Closed	Relief valves unit 5 to VRB-5	x	Normal
				Spood



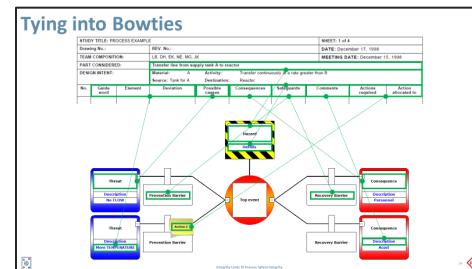
Visualization

- Practical and visual risk models
- Connect to EHS for holistic risk view
- Support ERM, EHS and PSM managers
- Mid- to long-term decision making

HAZOP Work Sheet



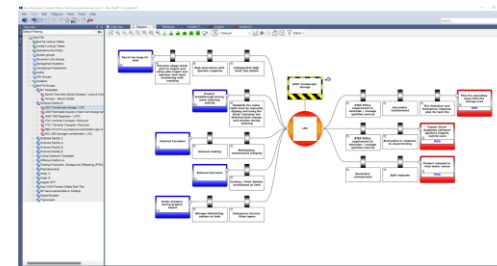
Translation



- Rule set
- Validation



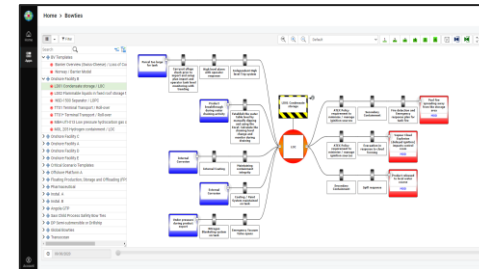
Enhance



- Operational scenarios
- Mitigation barriers
- Barrier elements
- Meta data



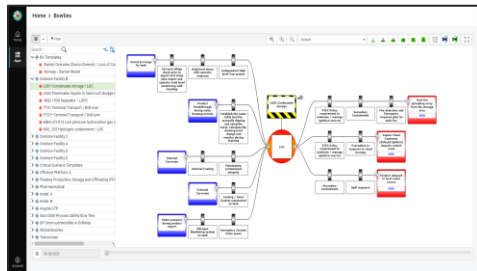
Communicate



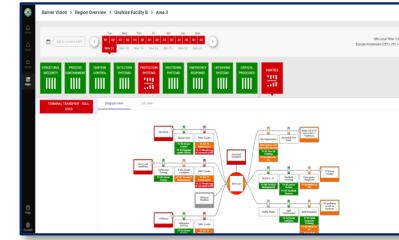
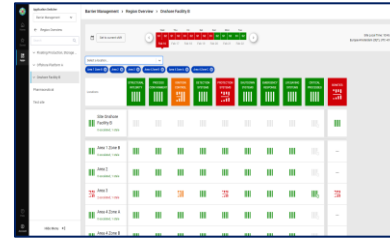
- Accessible for organization
- Understandable format

Operationalization

- Operationalized real-time barriers
- Actionable cumulative risk views
- Leverage existing data sources
- Control of Work integration
- Drive operational decision making

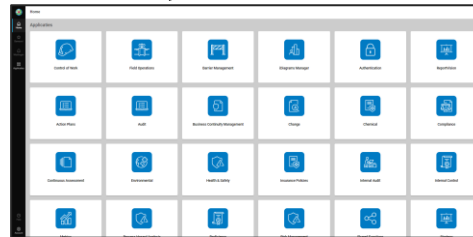


Cumulative Risk View



- Calculate and visualize cumulative risk
- Barrier (Swiss cheese) view
- BowTie view
- Workflows to manage the risk (risk record, mitigation, barrier override)

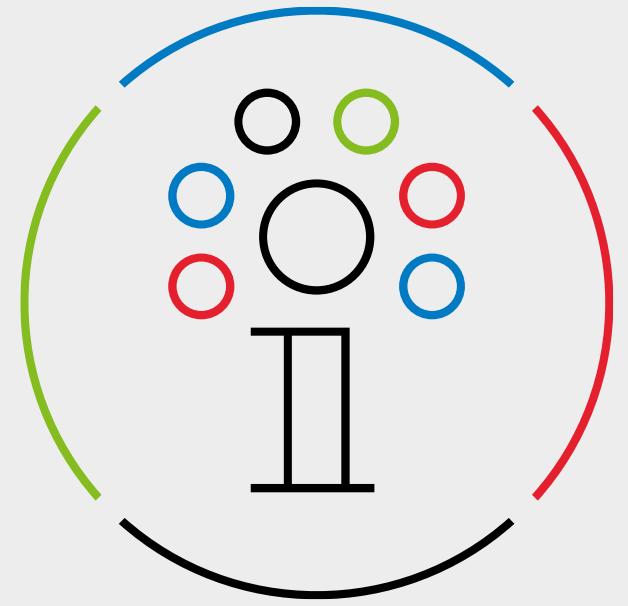
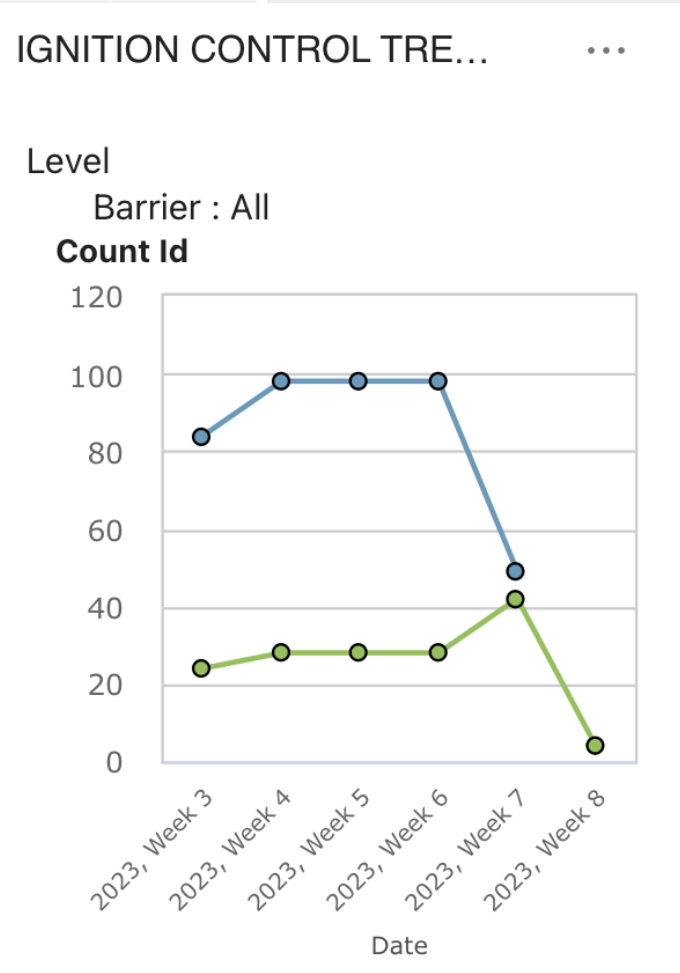
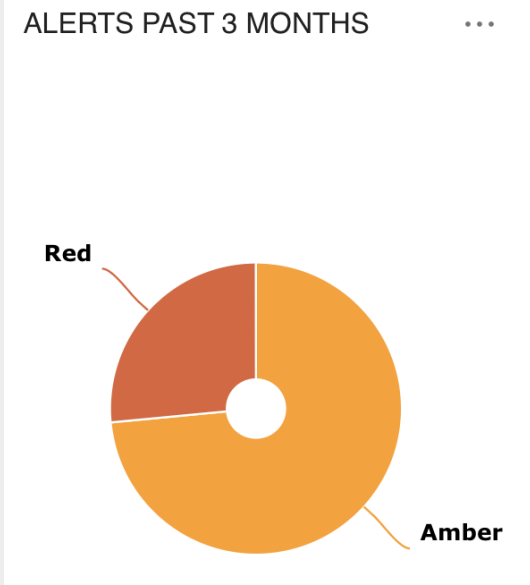
Other processes



- Management of Change
- Incident Investigations
- Risk Register
- Business Continuity
-

Hazard Analysis PHA Addendum - Evaporators in Ammonia Refrigeration System In Review

Equipment	159	CODE	ENTITIES	TYPE	NAME	STATUS	NEXT INSPECTION	MIGRATION COMPLETE
Sites	1	ME.1	Corporate	Medical Equipment	120act Audiometric Suite	Operative	Over 1 year late	✓
Meetings	2	24W07	Denver	Environmental Assets	24W07	Operative		✓
Nodes	2	24-W20	Denver	Environmental Assets	24-W20	Operative		✓
Actions	2	Refrig.Room.A123	Corporate	Cooling & Heating	A123 Refrigeration	Operative		✓
MoC's	1	A12	Sydney	Machine	A-1242 Elevated Work Platform	Out of Order		
Inspections	1083	IMS_Equi_14	Detroit	Machine	Abrasive Flow Machine	Operativ		
Non Conformances	1	AUDIO1	Atlanta	Medical Equipment	Acoustic Systems Audiometric Exam Booths	Operativ		
Incidents	1065	ME.2	Atlanta	Medical Equipment	Acoustic Systems Audiometric Exam Booths	Operativ		
Bowtie	2	HAL.1	Houston	Water Supply/Pond/River/Lake	Anaerobic Lagoon 1	Operativ		
		IMS_Equi_34	Atlanta	Tank	AST - 5,000 - Gasoline	Operativ		



Holistic view & Trending reports