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Process Hazard Analysis With RiskPoynt

Operationalize Bow Ties From HAZOP Studies

19 April 2023

Agenda

- Short Introduction to RiskPoynt
- High Level Overview of HAZOP & LOPA
- Industry Need
- How It Works

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What Is RiskPoynt?

What Is RiskPoynt?

- Acquired by Prometheus Group in 2022
- CRV / Barrier management software
  - Cloud-deployed visualization tool, 100% SaaS
  - EHS solution that pairs well with ePAS, Scheduling, Operator Rounds
- Operating since 2011, Over 190 Oil and Gas Facilities with >100 more new sites being added with ongoing projects
  - Covering the hydrocarbon value chain from Upstream offshore platforms and FPSO facilities, through Midstream collection and processing facilities and transmission pipelines, to Downstream processing and LNG plants

Why Have RiskPoynt?

Major Accident Hazard Prevention!

- Barrier management is about major accident hazard prevention
- Systems are designed to visualize integrity, allowing operators to Gain Control and Operate Safely
- Barrier management **reduces** the **likelihood** of major accidents occurring and improves communication on major accident hazards and cumulative risk

What Is a Major Accident Hazard (MAH)?

A source of danger that has the potential to cause a major incident, whether that involves multiple fatalities and/ or significant damage to plant, equipment, or the environment

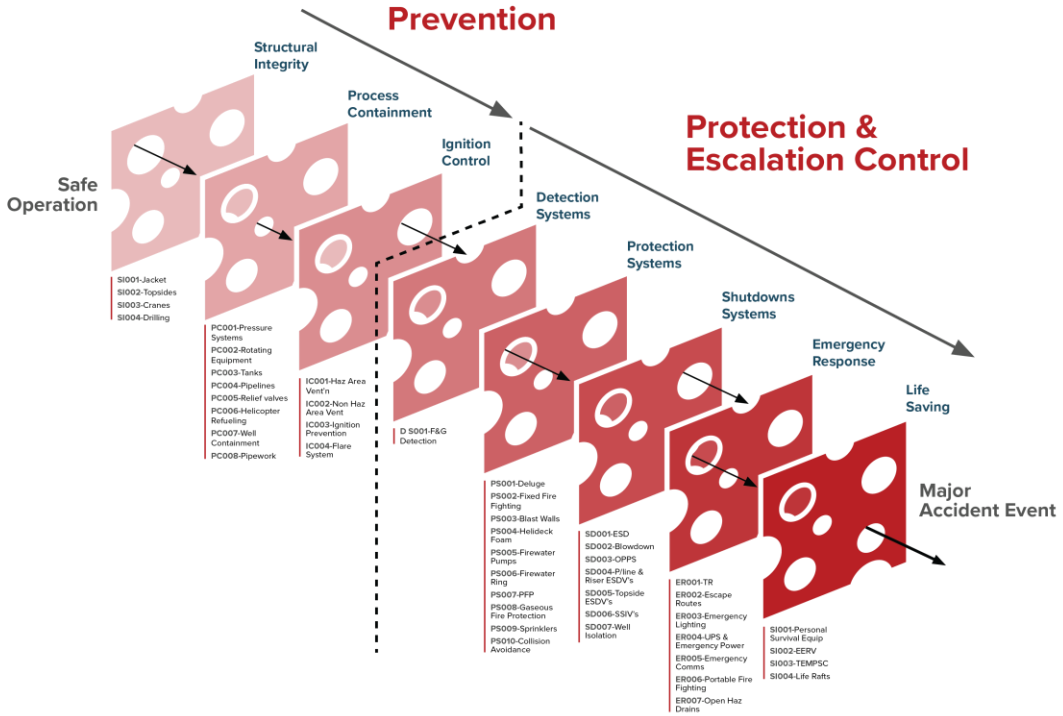
What Is a Barrier?

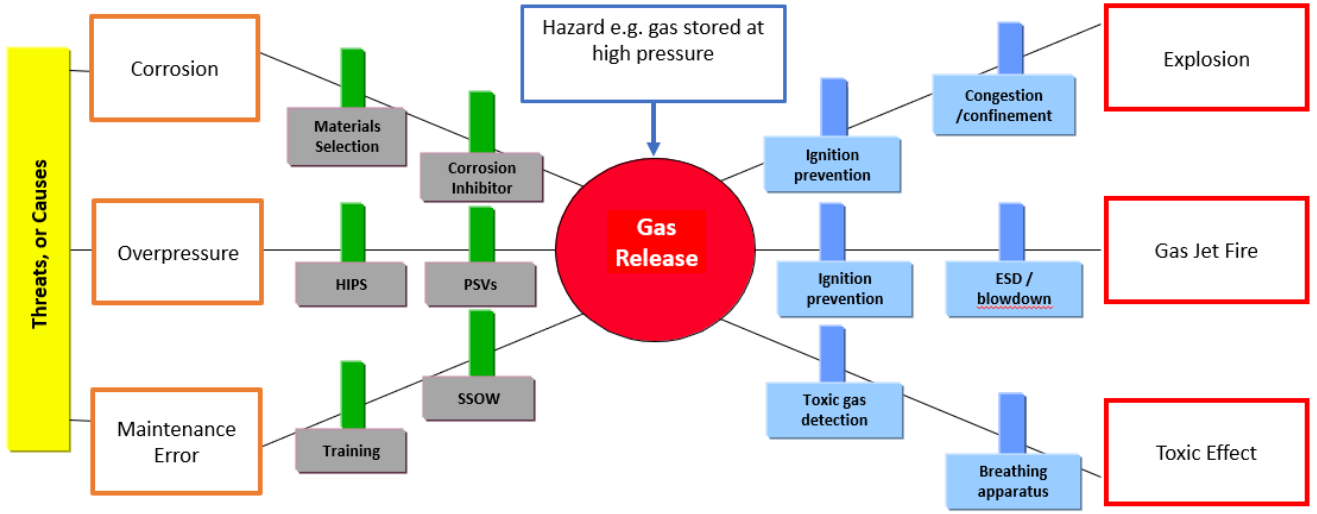
Barriers are functional groupings of safeguards which the system visualizes the ‘Fit for Service’ using Red / Amber / Green coded ‘Swiss Cheese’ barriers identifying the conditions and accumulative risk status within the operational hierarchy.

Barrier Management means the effective monitoring, evaluation and management of operational risk across the portfolio of complex integrated facilitates ensuring people, plant and process are ‘fit for service.’

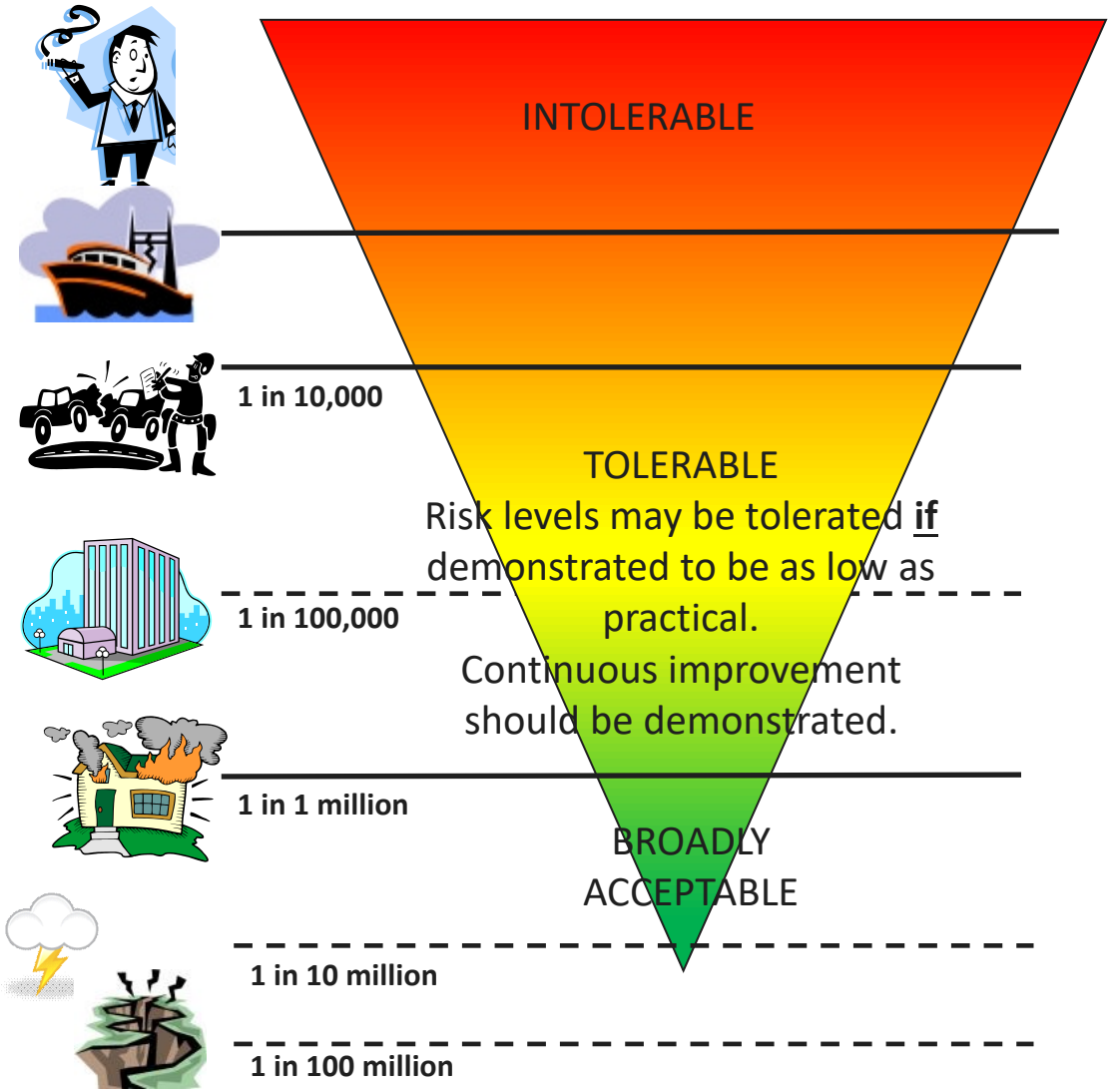
What Is a Barrier?

Barriers are organized by their function. Prevention barriers are to the left and escalation and protection are to the right. Barriers function independent of each other but a lineup of degraded barriers means an increase in MAH potential.





Likelihood x Severity = Risk

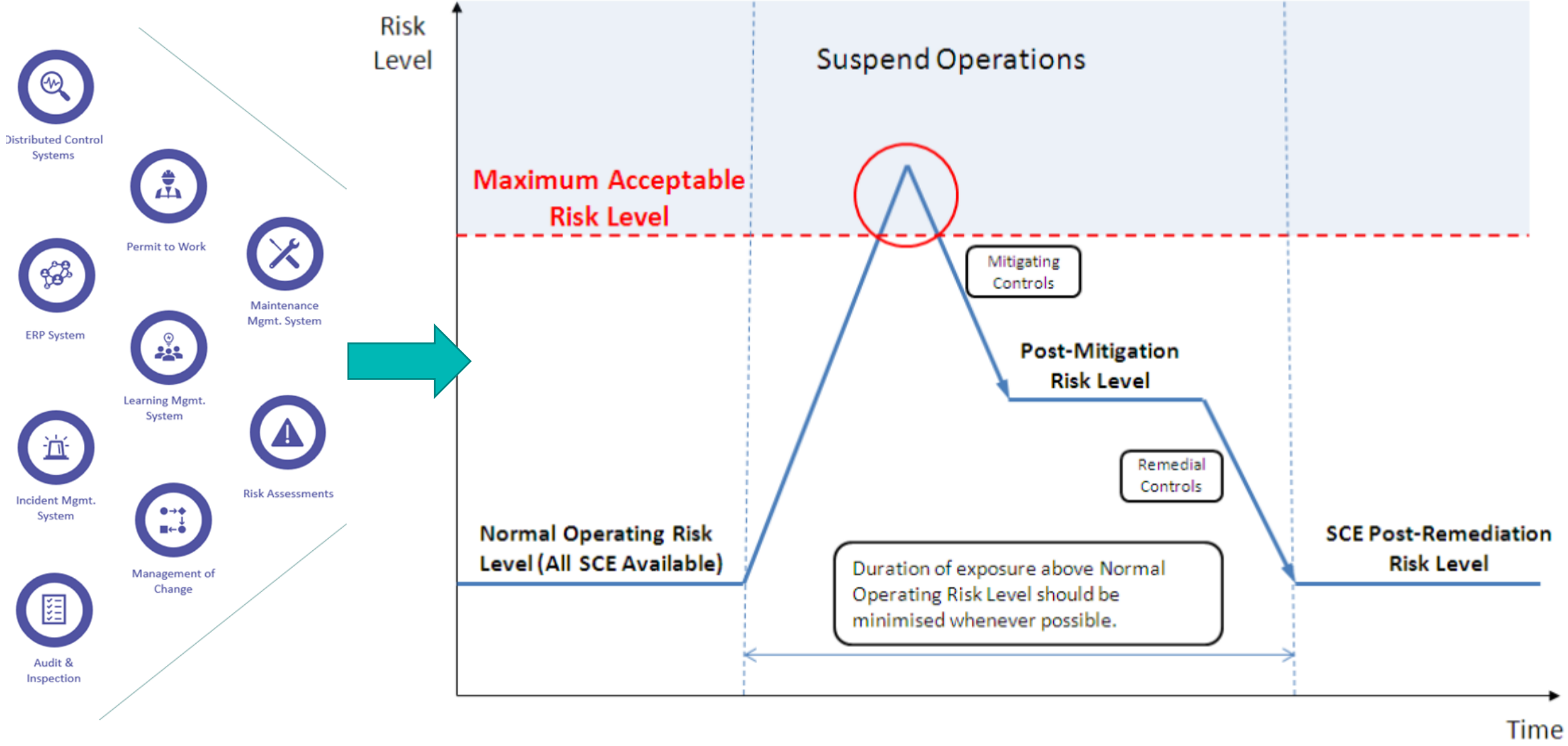


Max. tolerable risk for workers
10^{-3} / y (1 in 1,000/yr)

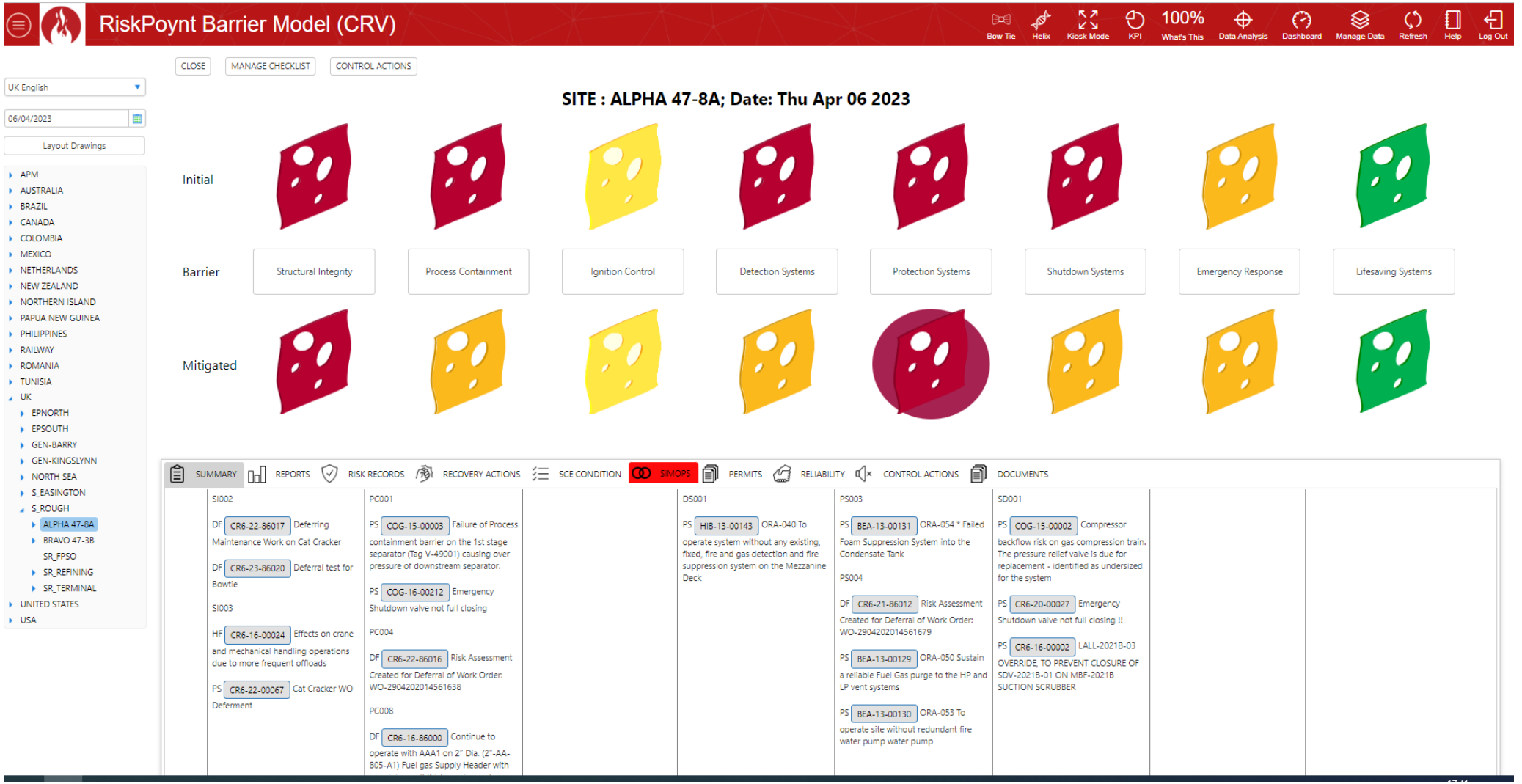
Max. tolerable risk for public
10^{-4} / y (1 in 10,000/yr)

Broadly acceptable risk below
10^{-6} / y (1 in 1,000,000/yr)

What Is Cumulative Risk?



What Is Cumulative Risk?



The Result

Companies that use Barrier Management:

- Lower likelihood of MAH events occurring
- Align to international standards (IOGP)
- Use facts to decide prioritization changes, targeting work on equipment that keeps the operator safe
- Broaden communication on operational risks so all personnel are aware of the condition of the facility
- Promote and foster a culture of safe operations and inclusion – everyone has a part to play in safety
- Measurable success in barrier condition over time
- **Safer operations improve production**

HAZOP and LOPA Functions

Defining The Process

Periodic Safety Reviews
Safety Reviews,
Process Hazard (HAZOP) Reviews

Annually or
as dictated by events?

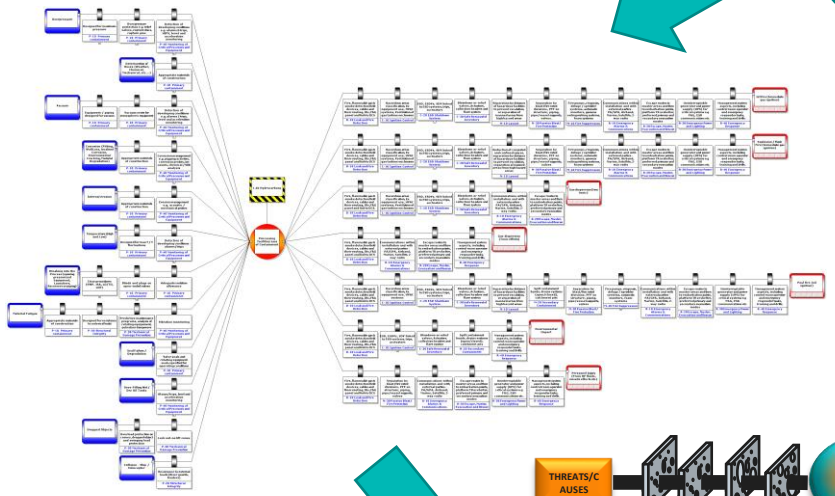
Barrier Assurance Activities

- WMS
- Tech. Authority
- ICP/IVB input

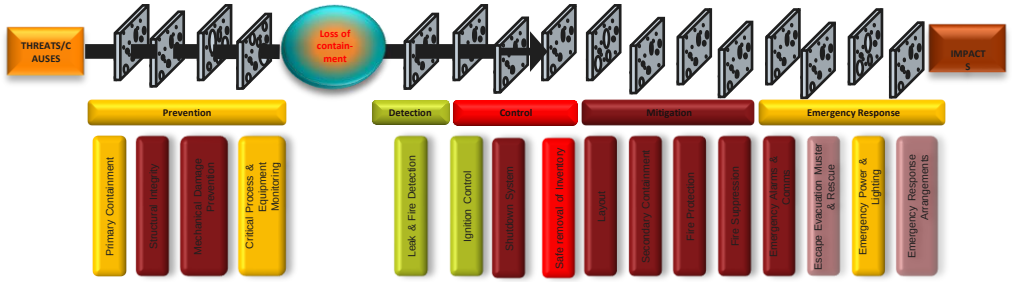
Daily / weekly / monthly

Operational Risk Assessment

- Mitigation measures
- Asset risk assessment teams
- - Tech. Authority review



Detailed Bow Tie Diagrams underpin the model

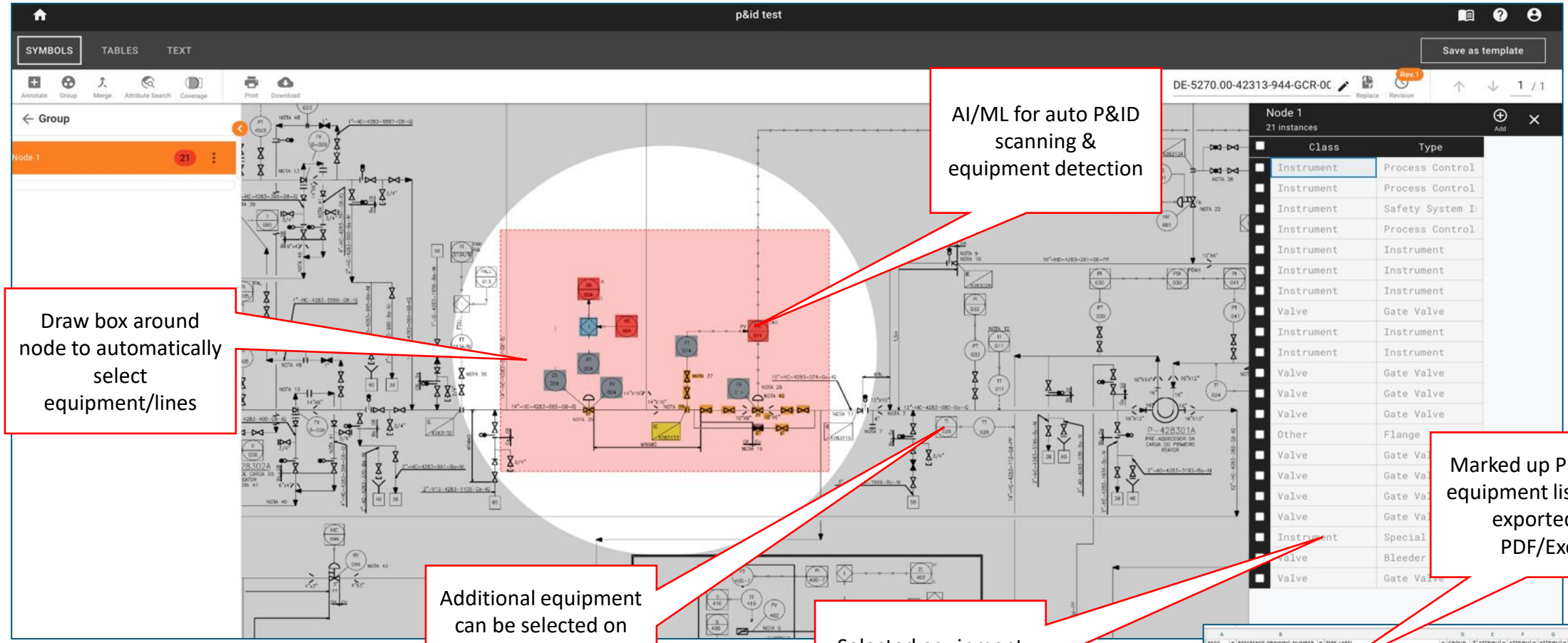


Cumulative risk profile presented on barrier model
- Justification of basis for continued safe operation
- Management review and approval

RiskPoynt HAZOP/ LOPA to Bowtie Integration

- Reduce time to implement RiskPoynt
  - Rapidly convert legacy HAZOP/LOPA studies into operational Bowties for CRV consumption
- Smart scanning of HAZOP studies
  - Uses fuzzy logic, identifies equipment, keywords, etc.
  - Automatically drafting Bowties
- Electronic scanning of P&ID's
  - Allowing markup of nodes and digitization of equipment data

P&ID Markup & Node Definition



Many Different HAZOP Formats

Deviation		Causes		Consequences		Consequence Categories			Safeguards		ALARP?
						CAT	S	Hazardous Material			
1.2.	Flow More	1.2.1.	Fail open control valve on blanketing line 500PICA200A or failure of 500PICA200, leading to opening of 500PICA200A while closing 500PICA200B. Consequence: 1.3.2.1	1.2.1.1.	Potential overpressure of V5002. LOPC, fire and explosion. LOPA Scenario: 1.3	P	5B	1 H2	1 SWS002/S, sized for this scenario. LOPA Scenario - IPL Item: 1.3.1		Y, as cost of other options is considered grossly disproportionate
									2 Emergency Response (valid for fire scenario, but not taken credit for as explosion is highest risk for fatality). LOPA Scenario - IPL Item: 1.3.2		
									3 Ignition control. LOPA Scenario - IPL Item: 1.3.3		
									4 Explosion probability. LOPA Scenario - IPL Item: 1.3.4		
				1.2.1.2.	Less H2 flow to K5001A/B, refer to 1.1.2 Cause: 1.1.2						
1.4.	Flow Reverse	1.4.1.	500PICA027 loop fails such that valve opens, so that fresh gas spill back line is open.	1.4.1.1.	Pressure at the suction starts to build up against the shut check valve HS0035. Potential overpressure of V5001. LOPC, fire and explosion. LOPA Scenario: 1.4	P	5B	1 H2	1 SWS001/S protects V5001 against overpressure and is sized for this scenario. LOPA Scenario - IPL Item: 1.4.1		Y, as cost of other options is considered grossly disproportionate
									2 Emergency Response (valid for fire scenario, but not taken credit for as explosion is highest risk for fatality). LOPA Scenario - IPL Item: 1.4.2		
									3 Ignition control. LOPA Scenario - IPL Item: 1.4.3		
									4 Explosion probability. LOPA Scenario - IPL Item: 1.4.4		

Mapping HAZOP to Bowtie

Deviation	Causes	Consequences	Consequence Categories			Safeguards	ALARP?	Safety Critical Elements	HAZOP Recommendations	
			CAT	S	Hazardous Material			PEFS Tag nr.	HAZOP Recommendations	Responsibility
	1.1.3. Failure of loop such that drain valve 500UZ871 opens (control valve of 500LISA001). Consequence: 1.3.1.1	1.1.3.1. Gas to flare. Loss of H2. Community impact.				1. Size of the on/off valve 500LISA001 is 20 mm to minimize the H2 flow. 2. 500GBO008 off-norm alarm to alert operator to check drain valve.	Y, as cost of other options is considered grossly disproportionate			
	1.1.4. Control valve 500PICA200A to V5002 blanketing fails closed. Cause: 14.6.1	1.1.4.1. Reduced suction pressure P5001A/B (still liquid height in feed vessel V5002). Feed pump P5001A/B will run slightly off his pump curve. Economic impact. No hazardous consequence.								
1.2. Flow More	1.2.1. Fail open control valve on blanketing line 500PICA200A or failure of 500PICA200, leading to opening of 500PICA200A while closing 500PICA200B. ~~Consequence: 1.3.2.1~~	1.2.1.1 Potential overpressure of V5002. LOPC, fire and explosion. LOPA Scenario: 1.3		5B	1. H2	1. SVV5002/S, sized for this scenario. LOPA Scenario - IPL item: 1.3.1 2. Emergency Response (valid for fire scenario, but not taken credit for as explosion is highest risk for fatality). LOPA Scenario - IPL item: 1.3.2 3. Ignition control. LOPA Scenario - IPL item: 1.3.3 4. Explosion probability. LOPA Scenario - IPL item: 1.3.4	~~Y, as cost of other options is considered grossly disproportionate~~	Threat Barrier	LOSS OF CONTROL	
		1.2.1.2. Less H2 flow to K5001A/B, refer to 1.1.2 Cause: 1.1.2								
1.3. Flow Misdirected	1.3.1. Manual bypass around 500UZ871 inadvertently opened	1.3.1.1. Refer to 1.1.3 Cause: 1.1.3								

Threat

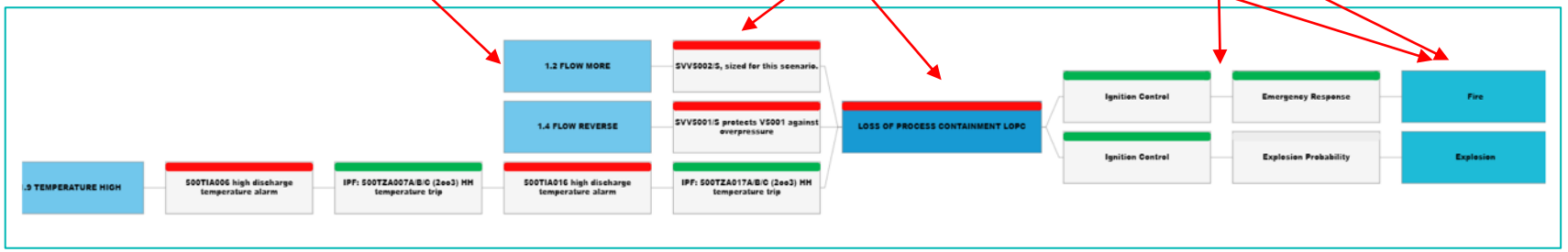
Initiating Event

Consequence

Top Event

Consequence

Consequence Barriers



HAZOP / LOPA

Bowtie

Outcome – Operational Bow Tie

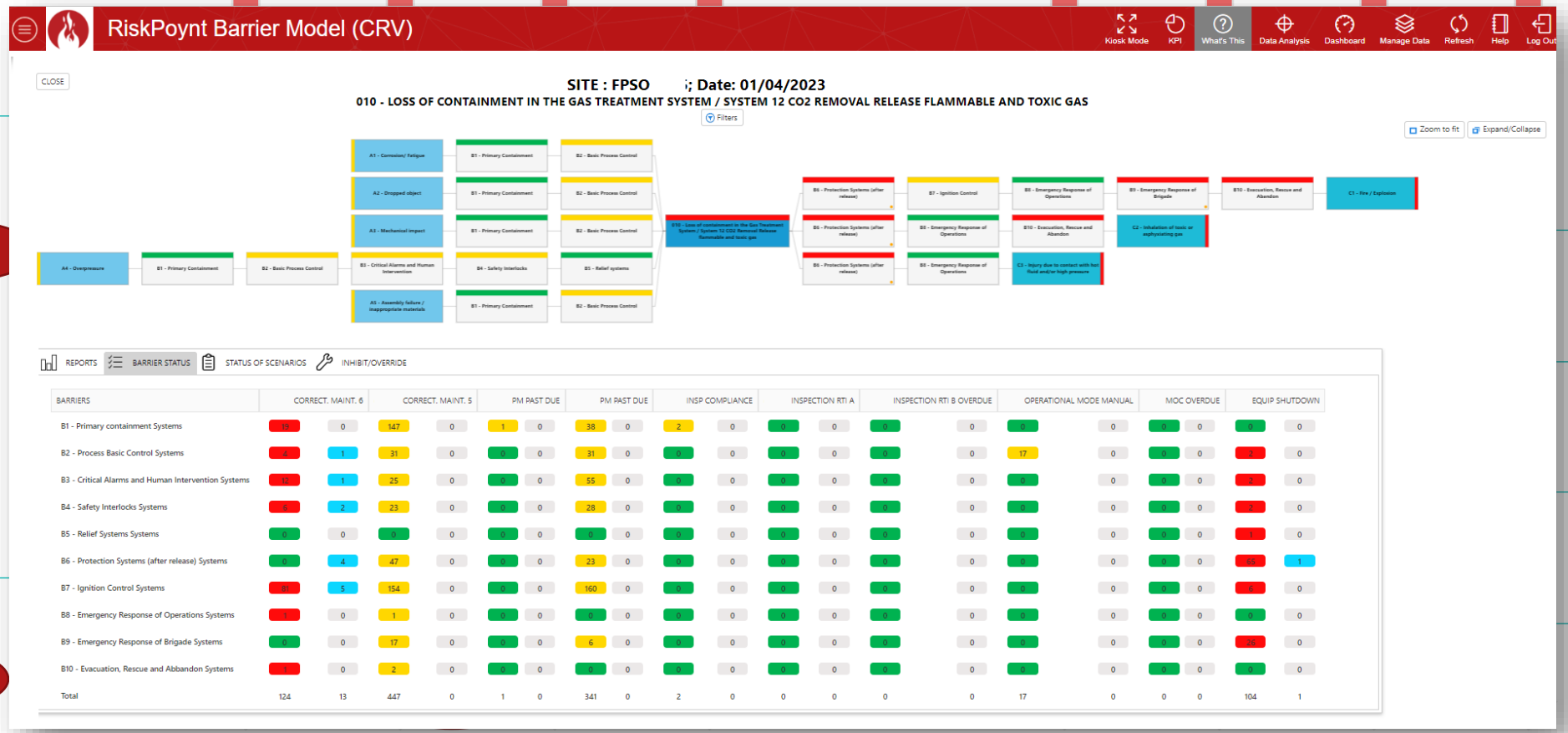
SI | PC | IC | DS | PS | SD | ER | LS

1.2.1 Fail open control valve on blanketing line 500PICA200A or failure of 500PICA200, leading to opening of 500PICA200A while closing 500PICA200B.

IEF 1.00E-1

1.4.1 500PICA027 loop fails such that valve opens, so that fresh gas spill back line is open.

IEF 1.00E-1



BARRIERS	CORRECT. MAINT. 6		CORRECT. MAINT. 5		PM PAST DUE		PM PAST DUE		INSP COMPLIANCE		INSPECTION RTI A		INSPECTION RTI B OVERDUE		OPERATIONAL MODE MANUAL		MOC OVERDUE		EQUIP SHUTDOWN	
B1 - Primary containment Systems	19	0	147	0	1	0	38	0	2	0	0	0	0	0	0	0	0	0	0	0
B2 - Process Basic Control Systems	4	1	31	0	0	0	31	0	0	0	0	0	0	0	17	0	0	0	2	0
B3 - Critical Alarms and Human Intervention Systems	12	1	25	0	0	0	55	0	0	0	0	0	0	0	0	0	0	0	2	0
B4 - Safety Interlocks Systems	5	2	23	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	2	0
B5 - Relief Systems Systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
B6 - Protection Systems (after release) Systems	0	4	47	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	65	1
B7 - Ignition Control Systems	91	5	154	0	0	0	160	0	0	0	0	0	0	0	0	0	0	0	6	0
B8 - Emergency Response of Operations Systems	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B9 - Emergency Response of Brigade Systems	0	0	17	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	26	0
B10 - Evacuation, Rescue and Abbandon Systems	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	124	13	447	0	1	0	341	0	2	0	0	0	0	0	17	0	0	0	104	1

1.2.1.1 Fire

1.2.1.1 Explosion

1.4.1.1 Fire

1.4.1.1 Explosion

HAZOP/LOPA With RiskPoynt

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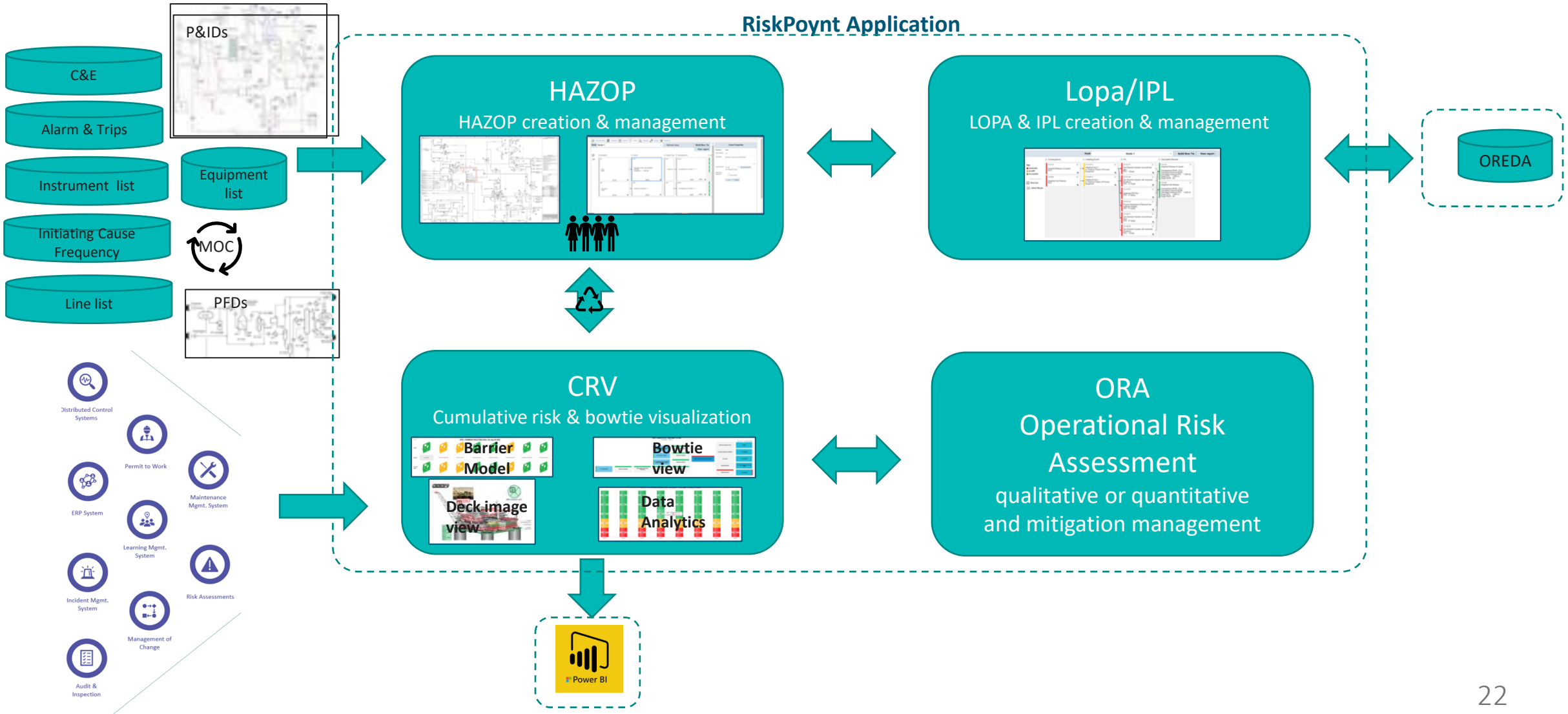
High Level Overview



RiskPoynt Offering

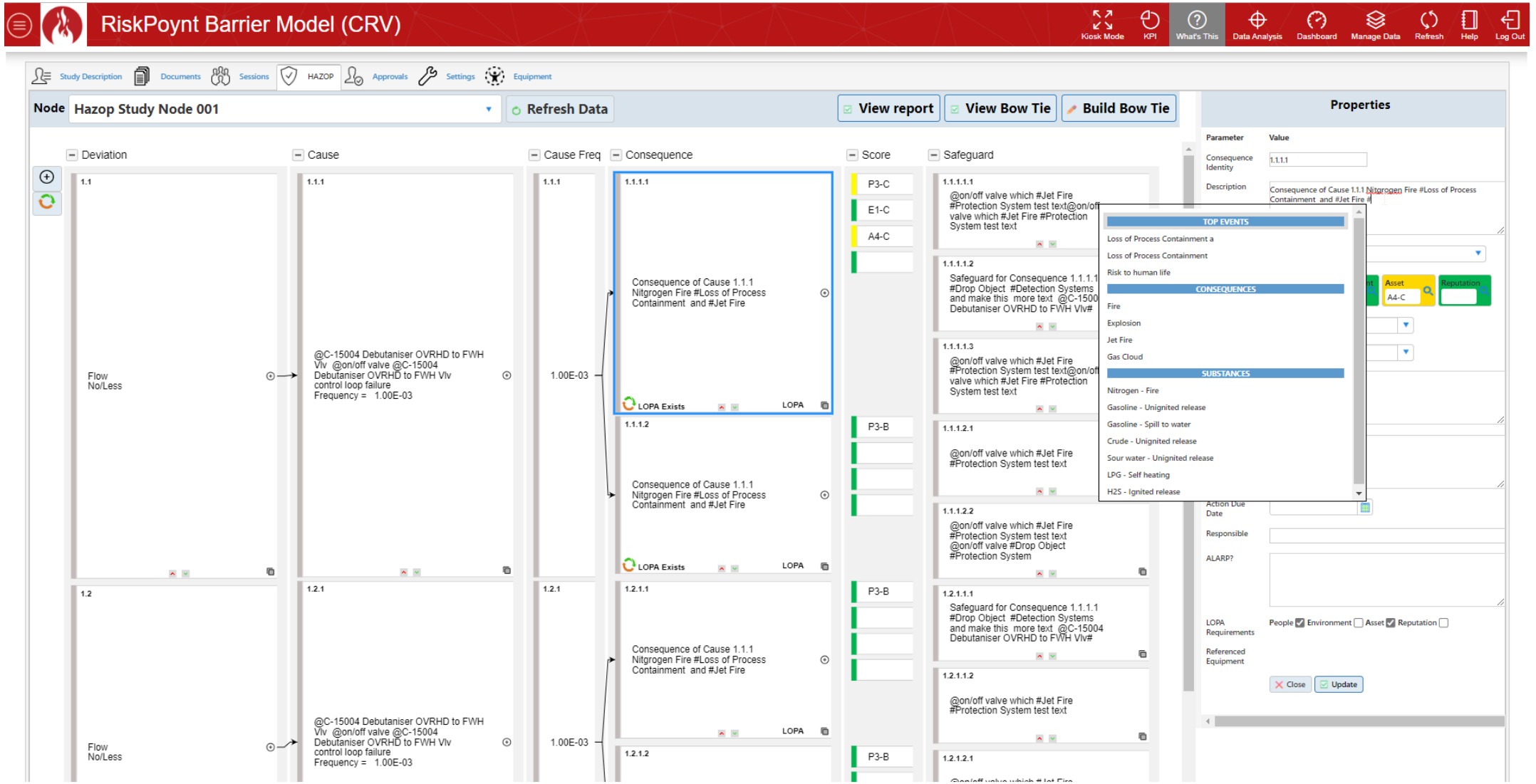
- HAZOP, LOPA, and Bowtie integrated within one application
- ‘Drag & Drop’ user interface for HAZOP & LOPA creation
- Instant generation of Bowtie from HAZOP
- Real-time operational status of Bowtie, based on existing RiskPoynt Cumulative Risk principles
- Configurable bowtie degradation ruleset, based on simple ‘pass-through’ RAG or complex Initiating event frequency / Probability of Failure on Dement (PFD) calculations
- Traceability of impact of MOC / ERP etc. from Bowtie back to HAZOP

Benefits to Operators

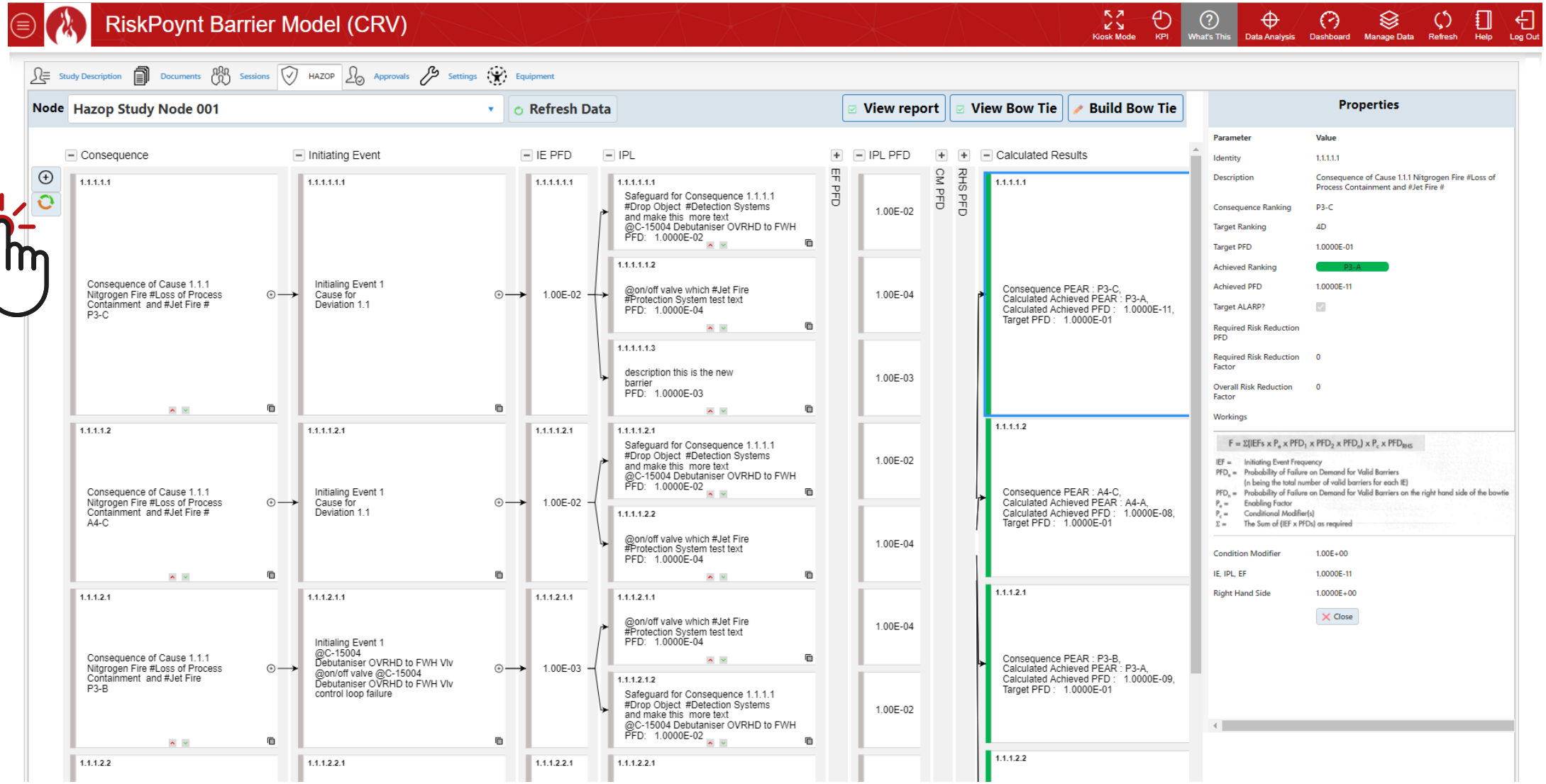
- During the HAZOP workshop, causes, consequences, etc. are codified to allow automatic creation of Bowtie
- Creating LOPA from HAZOP when safeguards are out of tolerance
- Creating Bowties from HAZOPs is no longer a time-consuming manual review process
- Integrated solution means any changes to equipment are managed through the entire process
- Cumulative risk to the operator can be visualized at specific ‘top event’ / Major Accident Hazard level e.g. *Loss of Containment (Gas Compression)*
- Executive dashboard of ‘Major Accident Hazard’ status traceable back to Safety Case
- Relationship between MAH and Equipment status- which degraded equipment is impacting the MAH and why?

How It Works

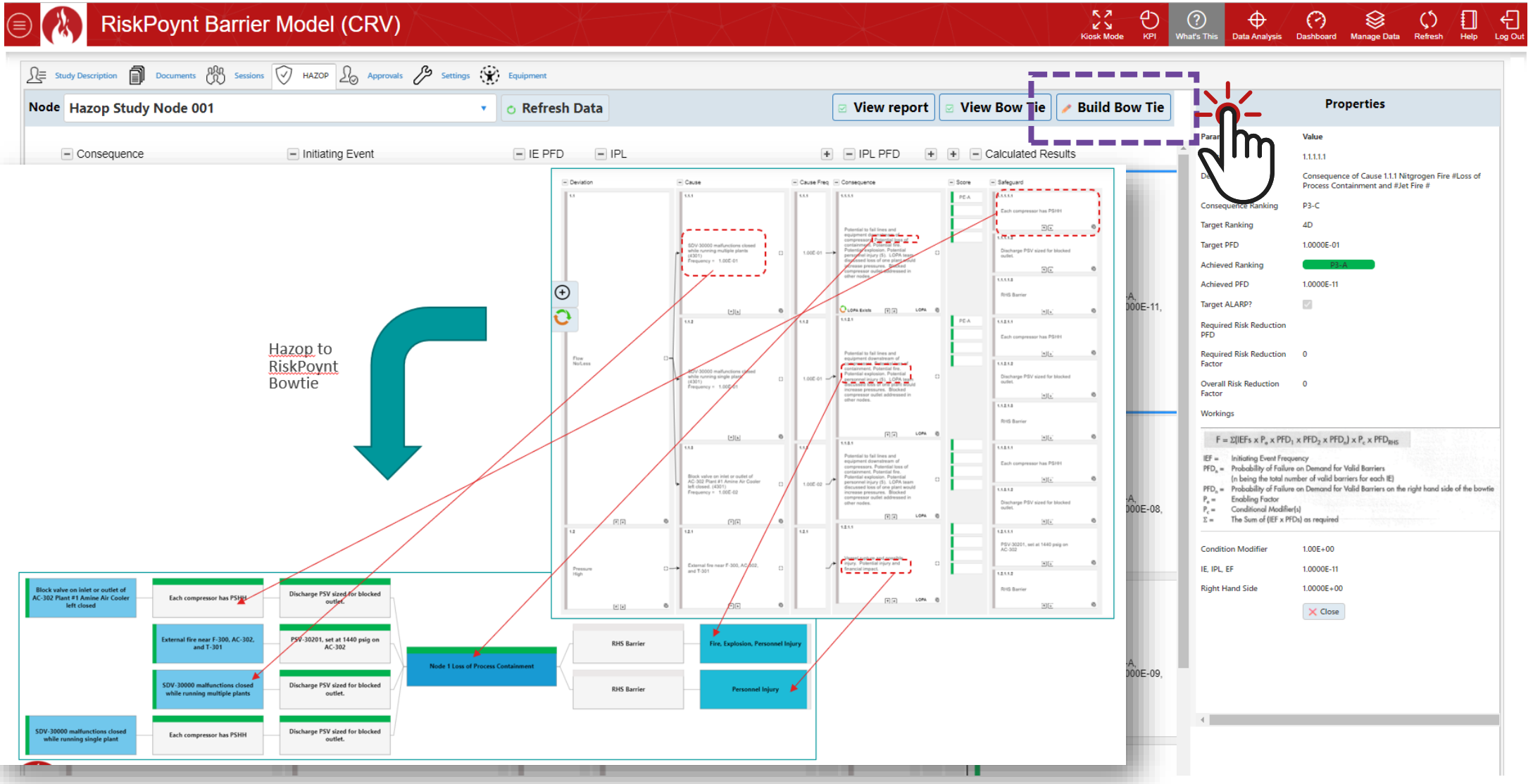
Codification During Scribing



Creation LOPA From HAZOP Consequence



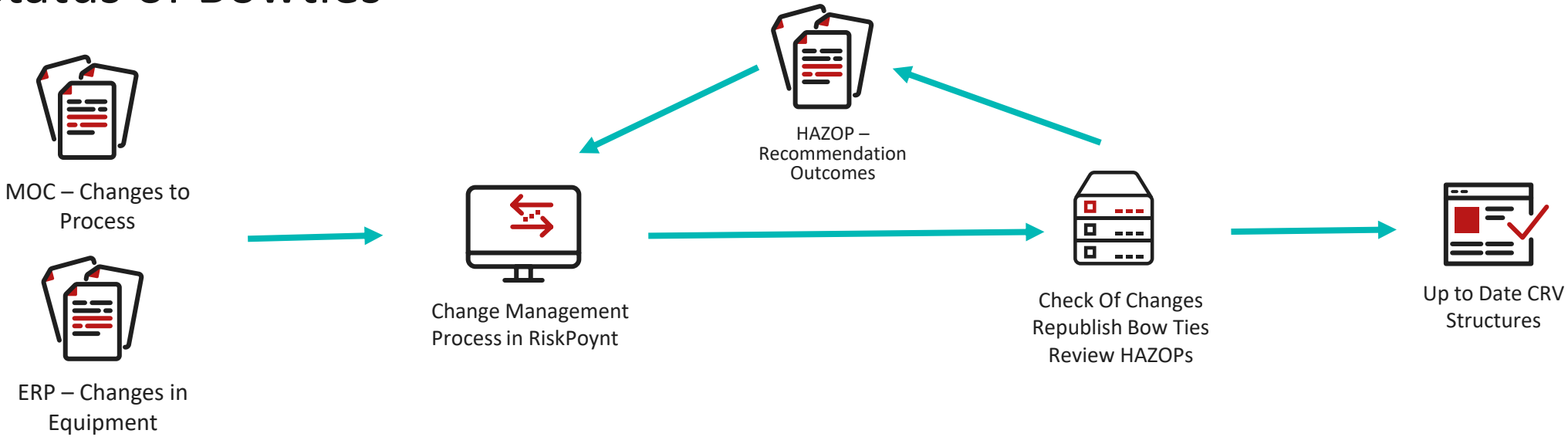
Creation Bow Ties From HAZOP



Demonstration

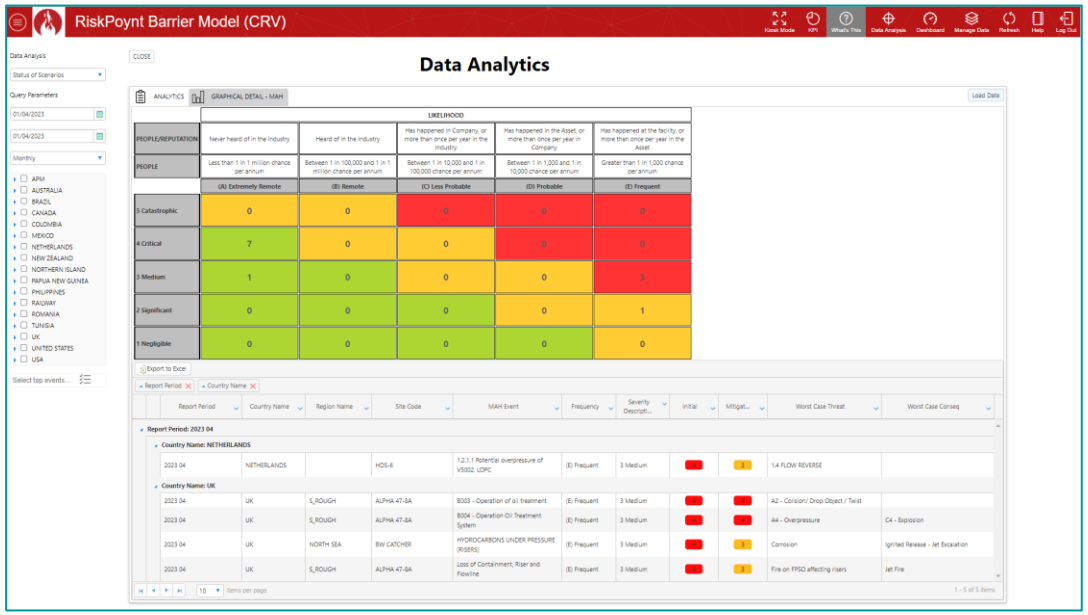
Manage Change in the Process End to End

- Impacts from MOCs, etc. can instantly be seen on Bowtie and Hazop
- Obsolete Hazops can be identified where MOC/ERP modification to plant or operating envelope has occurred
- RiskPoynt already has full register of operational impacts; work orders, MOCs, Risk Assessment, etc., so these can be used to show operational status of Bowties

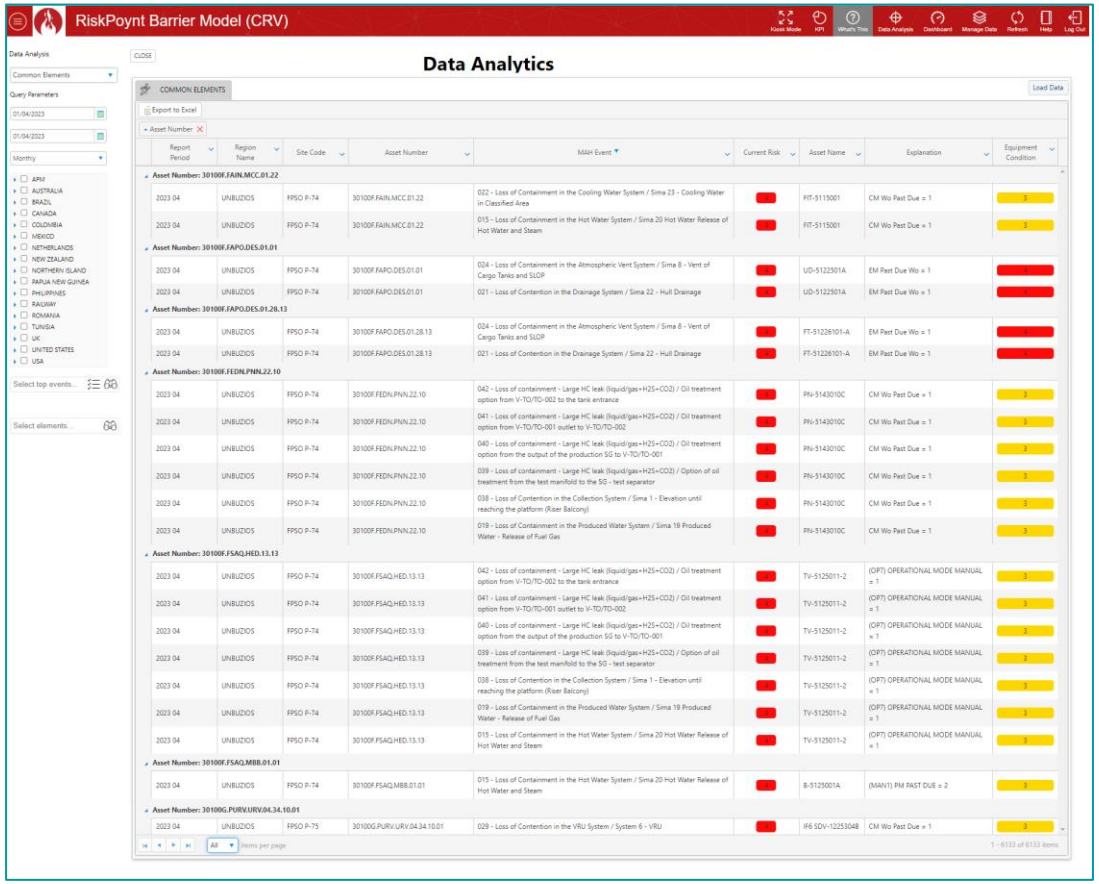


Benefits to Operators

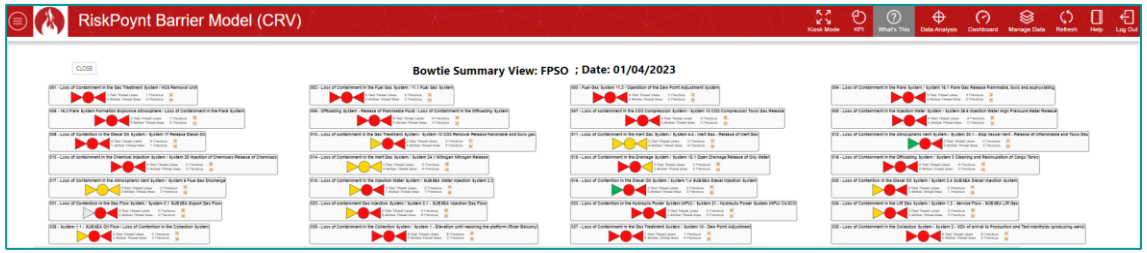
- Executive Dashboard



- Relationship between MAH and Equipment status



- Cumulative Risk Visualize by Specific Top Event



Questions?

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Michael Mostert