

# Process Hazard Analysis With RiskPoynt

Operationalize Bow Ties From HAZOP Studies

**31 May 2023**

# Agenda

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

# 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 APM (Asset Performance Monitoring), Permit to Work (ePas), Planning & Scheduling, Mobility/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?

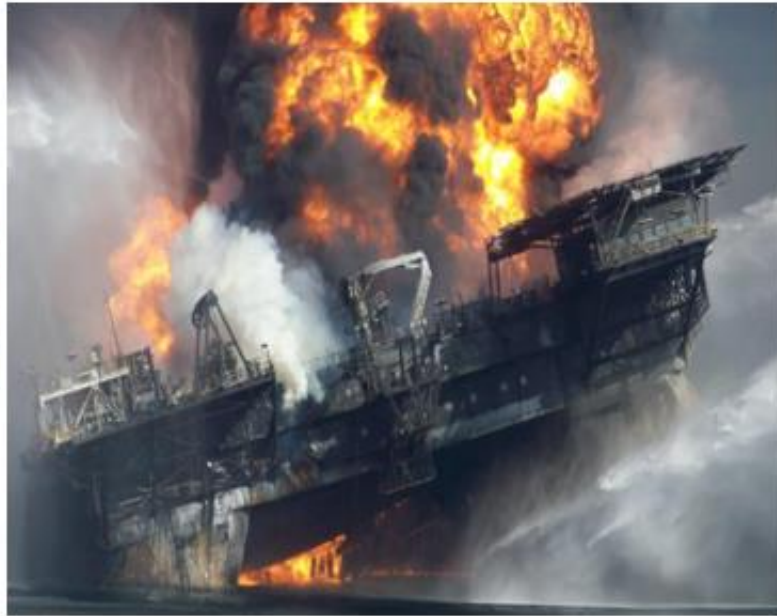
# Major Accident Hazard Prevention!

- 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

Macondo



Piper Alpha



Ocean Ranger

# What Is a Barrier?

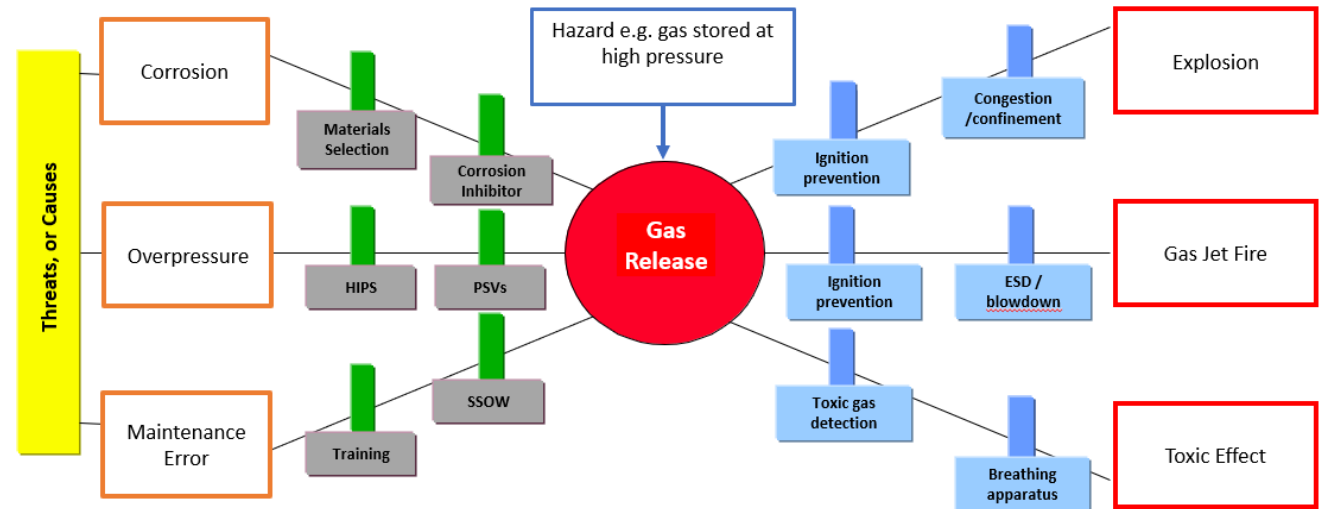
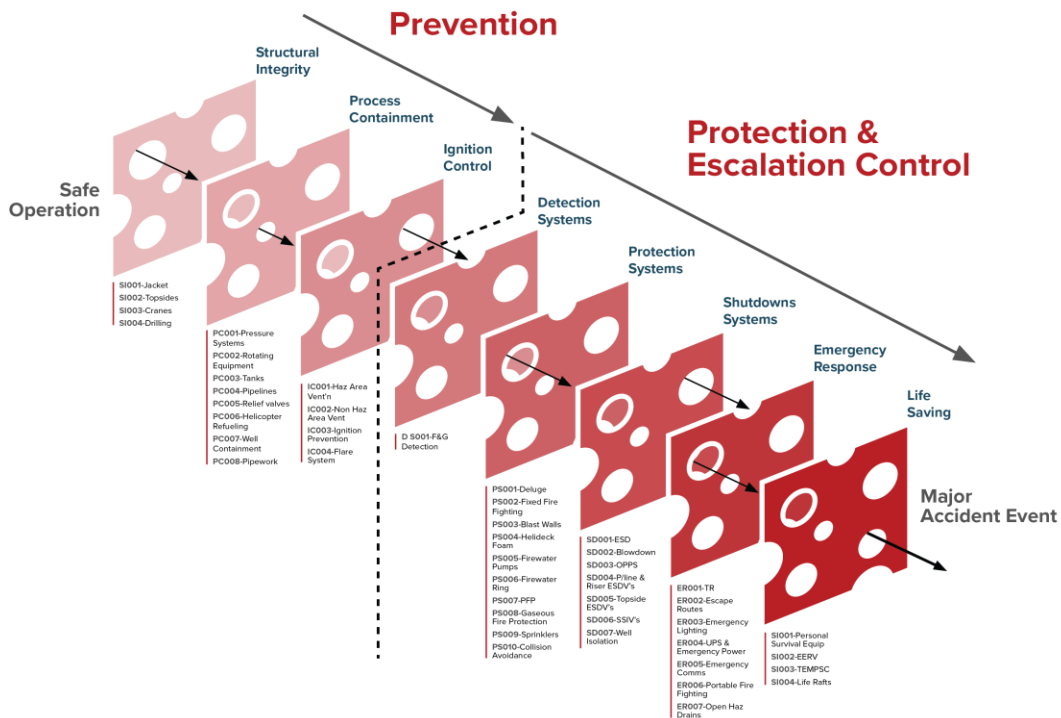
**Barriers** are functional groupings of safeguards which the system visualizes the 'Fit for Service' using **Red** / **Amber** / **Green** coded 'Swiss Cheese' barriers identifying the conditions and accumulative risk status within the operational hierarchy.

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?

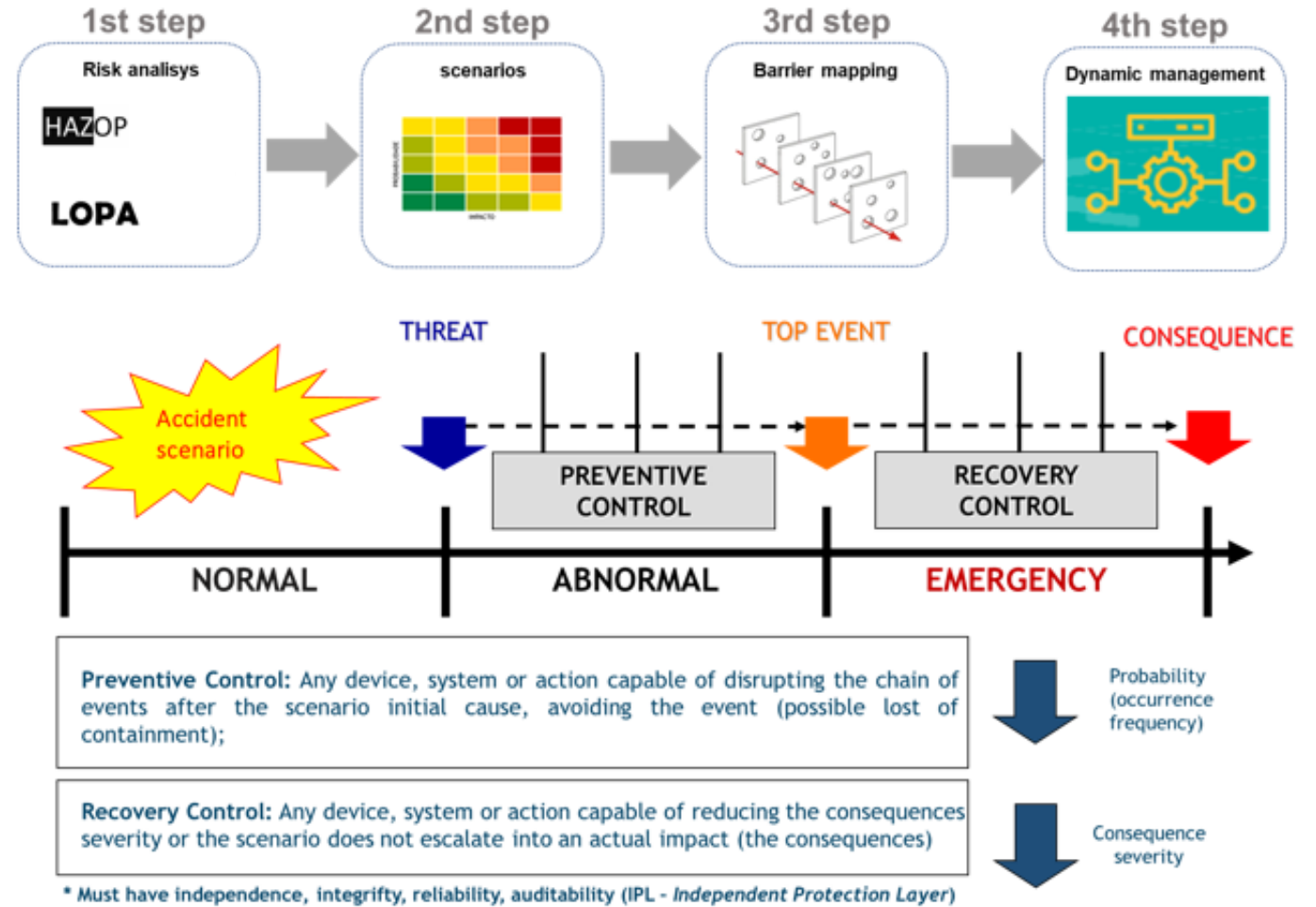
Barriers are organized by their function. Prevention barriers are to the left and escalation and protection are to the right. Barriers function independent of each other but a lineup of degraded barriers means an increase in MAH potential.



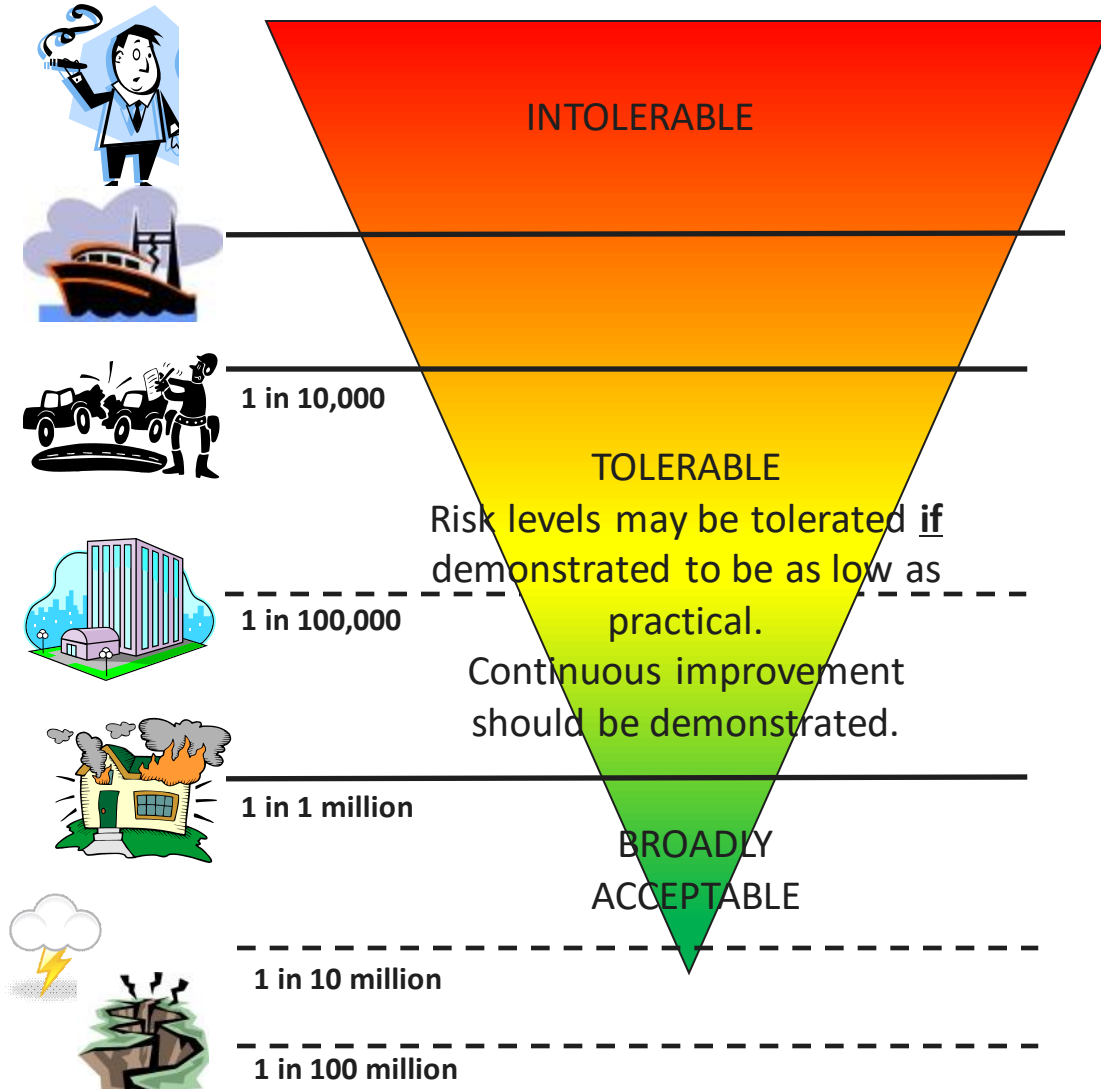
# What Is a Barrier?

RiskPoynt enhances understanding of specific scenarios and provides **clear indication that the safeguards** (risk-control measures) are in place and performing properly.

Summarizes and **communicates the health** (effectiveness) and **importance** (criticality) of these **safeguards** to support the **decision-making**.



# 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?



Distributed Control Systems



Permit to Work



ERP System



Maintenance Mgmt. System



Learning Mgmt. System



Incident Mgmt. System



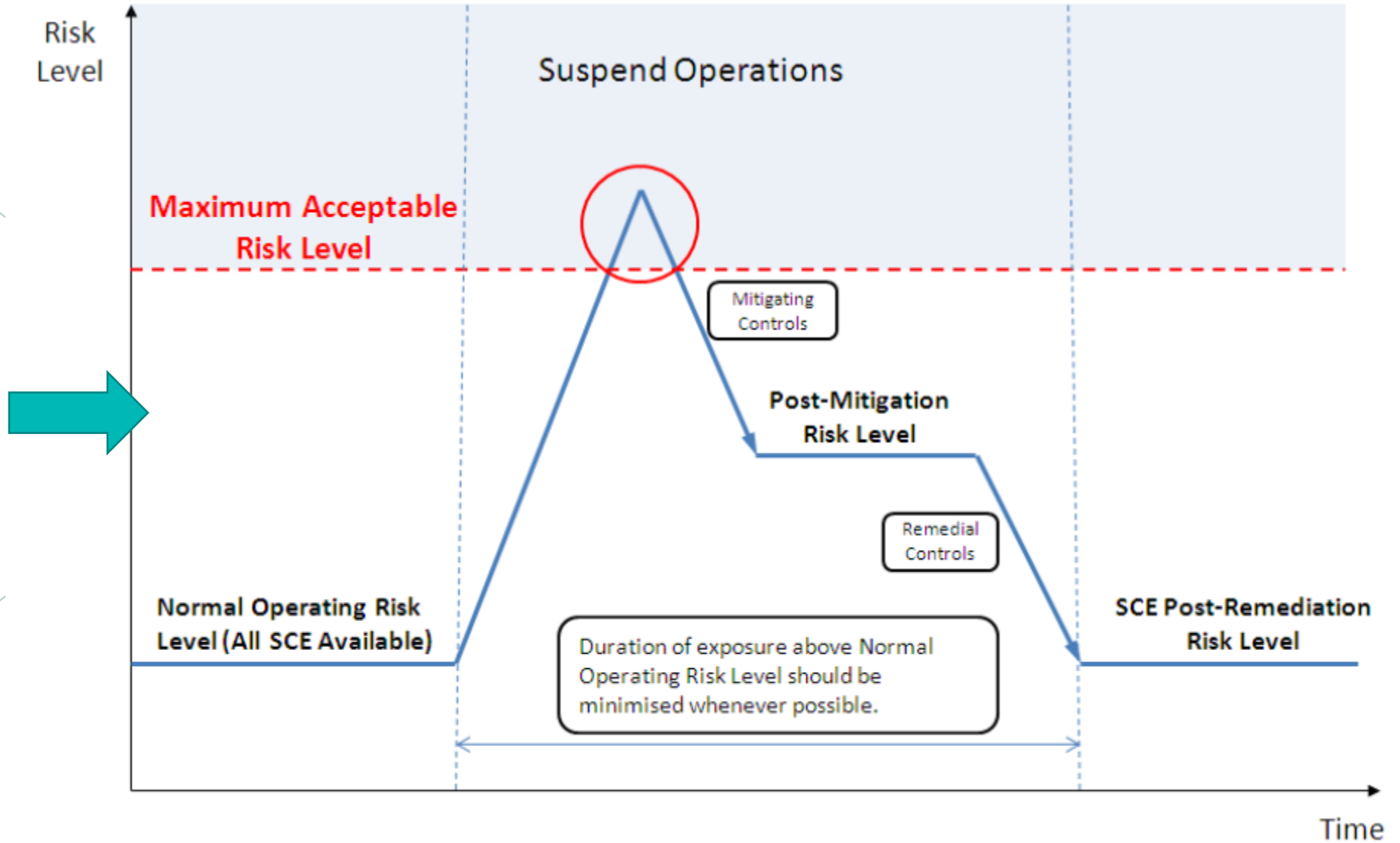
Risk Assessments



Management of Change



Audit & Inspection



# What Is Cumulative Risk?

☰
🔥 RiskPoyn Barrier Model (CRV)

🔗 Bow Tie
🌀 Helix
🔄 Kiosk Mode
📊 KPI
📈 100%
📊 Data Analysis
📄 Dashboard
📁 Manage Data
🔄 Refresh
📖 Help
🚪 Log Out

UK English

06/04/2023

Layout Drawings

- ▶ APM
- ▶ AUSTRALIA
- ▶ BRAZIL
- ▶ CANADA
- ▶ COLOMBIA
- ▶ MEXICO
- ▶ NETHERLANDS
- ▶ NEW ZEALAND
- ▶ NORTHERN ISLAND
- ▶ PAPUA NEW GUINEA
- ▶ PHILIPPINES
- ▶ RAILWAY
- ▶ ROMANIA
- ▶ TUNISIA
- ▶ UK
  - ▶ EPNORTH
  - ▶ EPSOUTH
  - ▶ GEN-BARRY
  - ▶ GEN-KINGSLYNN
  - ▶ NORTH SEA
  - ▶ S\_EASINGTON
  - ▶ S\_ROUGH
  - ▶ ALPHA 47-8A
  - ▶ BRAVO 47-3B
  - ▶ SR\_FPSO
  - ▶ SR\_REFINING
  - ▶ SR\_TERMINAL
- ▶ UNITED STATES
- ▶ USA

**SITE : ALPHA 47-8A; Date: Thu Apr 06 2023**

	Structural Integrity	Process Containment	Ignition Control	Detection Systems	Protection Systems	Shutdown Systems	Emergency Response	Lifesaving Systems
Initial								
Barrier								
Mitigated								

CLOSE

MANAGE CHECKLIST

CONTROL ACTIONS

📄 SUMMARY
📊 REPORTS
🛡️ RISK RECORDS
🔄 RECOVERY ACTIONS
☰ SCE CONDITION
🔴 SIMOPS
📄 PERMITS
👤 RELIABILITY
🔊 CONTROL ACTIONS
📄 DOCUMENTS

<p>SI002</p> <p>DF <span style="border: 1px solid #ccc; padding: 2px;">CR6-22-86017</span> Deferring Maintenance Work on Cat Cracker</p> <p>DF <span style="border: 1px solid #ccc; padding: 2px;">CR6-23-86020</span> Deferral test for Bowtie</p> <p>SI003</p> <p>HF <span style="border: 1px solid #ccc; padding: 2px;">CR6-16-00024</span> Effects on crane and mechanical handling operations due to more frequent offloads</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">CR6-22-00067</span> Cat Cracker WO Deferment</p>	<p>PC001</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">COG-15-00003</span> Failure of Process containment barrier on the 1st stage separator (Tag V-49001) causing over pressure of downstream separator.</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">COG-16-00212</span> Emergency Shutdown valve not full closing</p> <p>PC004</p> <p>DF <span style="border: 1px solid #ccc; padding: 2px;">CR6-22-86016</span> Risk Assessment Created for Deferral of Work Order: WO-2904202014561638</p> <p>PC008</p> <p>DF <span style="border: 1px solid #ccc; padding: 2px;">CR6-16-86000</span> Continue to operate with AAA1 on 2" Dia. (2"-AA-805-A1) Fuel gas Supply Header with</p>	<p>DS001</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">HIB-13-00143</span> ORA-040 To operate system without any existing, fixed, fire and gas detection and fire suppression system on the Mezzanine Deck</p>	<p>PS003</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">BEA-13-00131</span> ORA-054 * Failed Foam Suppression System into the Condensate Tank</p> <p>PS004</p> <p>DF <span style="border: 1px solid #ccc; padding: 2px;">CR6-21-86012</span> Risk Assessment Created for Deferral of Work Order: WO-2904202014561679</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">BEA-13-00129</span> ORA-050 Sustain a reliable Fuel Gas purge to the HP and LP vent systems</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">BEA-13-00130</span> ORA-053 To operate site without redundant fire water pump water pump</p>	<p>SD001</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">COG-15-00002</span> Compressor backflow risk on gas compression train. The pressure relief valve is due for replacement - identified as undersized for the system</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">CR6-20-00027</span> Emergency Shutdown valve not full closing !!</p> <p>PS <span style="border: 1px solid #ccc; padding: 2px;">CR6-16-00002</span> LALL-2021B-03 OVERRIDE, TO PREVENT CLOSURE OF SDV-2021B-01 ON MBF-2021B SUCTION SCRUBBER</p>
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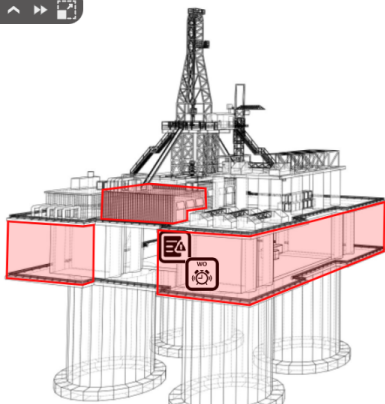
# What Is Cumulative Risk?

**RiskPoyn Barrier Model (CRV)**

Areas for ALPHA 47-8A : ALL :

Mitigated

Barrier: Structural Integrity, Process Containment, Ignition Control, Detection Systems, Protection Systems, Shutdown Systems




**RiskPoyn Barrier Model (CRV)**

Areas for SR\_TERMINAL : ALL :

Mitigated

Barrier: Structural Integrity, Process Containment, Ignition Control, Detection Systems, Protection Systems, Shutdown Systems, Emergency Response, Lifesaving Systems



Type	Area	Barrier	PS Code	Record No	Details	Initial Score	Mitigat... Score	PEAR	Status	Approved	Valid To	Extens...	Duration
Process Safety	AD - DIESEL GENERATOR SET 1	DS	DS001	H18-13-00143	ORA-040 To operate system without any existing, fixed, fire and gas detection and fire suppression system on the Mezzanine Deck	12	12	RA-C	Overdue	22/03/2017	18/05/2019	1	2583
Process Safety	AD - DIESEL GENERATOR SET 1	SI	SI003	CR6-22-00267	Cat Cracker WO Deferment	14	9	AS-C	Review		30/12/2022	0	184
Process Safety	AD - DIESEL GENERATOR SET 1	SD	SD001	CR6-20-00027	Emergency Shutdown valve not full closing !!	9	9	AS-C	Review		30/12/2022	0	259
Process Safety	AD - HELIDECK	PS	PS004	BEA-13-00129	ORA-050 Sustain a reliable Fuel Gas purge to the HP and LP vent systems	12	12	RA-B	Review		29/01/2021	4	2583
Process Safety	AD - HELIDECK	PS	PS004	BEA-13-00130	ORA-053 To operate site without redundant fire water pump water pump	14	14	EA-D	Review		30/09/2022	2	2583
Process Safety	AD - LEVEL 2	PS	PS003	BEA-13-00131	ORA-054 * Failed Foam Suppression System into the Condensate Tank	12	12	RA-D	Review		31/12/2020	8	2583
Process Safety	AP - CELLAR DECK	SD	SD001	COG-15-00002	Compressor backflow risk on gas compression train. The pressure relief valve is due for replacement - identified as undersized for the system	11	11	RA-A	Review		31/12/2020	8	2583
Process Safety	AP - HP separator	PC	PC001	COG-15-00003	Failure of Process containment barrier on the 1st stage separator (Tag V-49001) causing over pressure of downstream separator.	8	8	PA-B	Review		29/01/2020	13	2583
Process Safety	AP - HP separator	PC	PC001	COG-16-00212	Emergency Shutdown valve not full closing	9	9	AS-C	Overdue	22/03/2017	23/02/2019	4	2583
Process Safety	AP - LEVEL 3	SD	SD001	CR6-16-00002	LALL-20218-03 OVERRIDE, TO PREVENT CLOSURE OF SDV-20218-01 ON MBF-20218 SUCTION SCRUBBER	12	12	RA-B	Overdue	22/03/2017	12/06/2019	2	2517

# What Is Cumulative Risk?

**RiskPoynt Barrier Model (CRV)**

**SITE : ALPHA 47-8A; Date: Fri May 12 2023**  
**LOSS OF CONTAINMENT, RISER AND FLOWLINE**

UK English | 12/05/2023 | Layout Drawings

- ▶ APM
- ▶ AUSTRALIA
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- ▶ COLOMBIA
- ▶ INDIA
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  - ▶ USA

PERFORMANCE STANDARD	TA Owner	Emergency	CM	PM	Deviation	MOC Overdue	Equip Status	Conflicting Permits (A)	Passing Valves (Weighted Count)	SCE
SI001 - SUBSEA STRUCTURE	Structural	1	0	0	0	0	0	0	0	SCE
SI002 - TOPSIDE STRUCTURE	Structural	0	4	0	0	0	0	0	0	CM
SI003 - CRANES AND LIFTING EQUIPMENT	Cranes and Lifting Equipment	0	4	0	0	0	0	0	0	PM
PC001 - PRESSURE VESSEL, HEAT EXCHANGERS	Pressure Systems	0	15	0	0	0	0	0	0	SCE
PC004 - PIPELINES	Pipelines	1	0	0	0	0	0	0	0	SCE

# 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

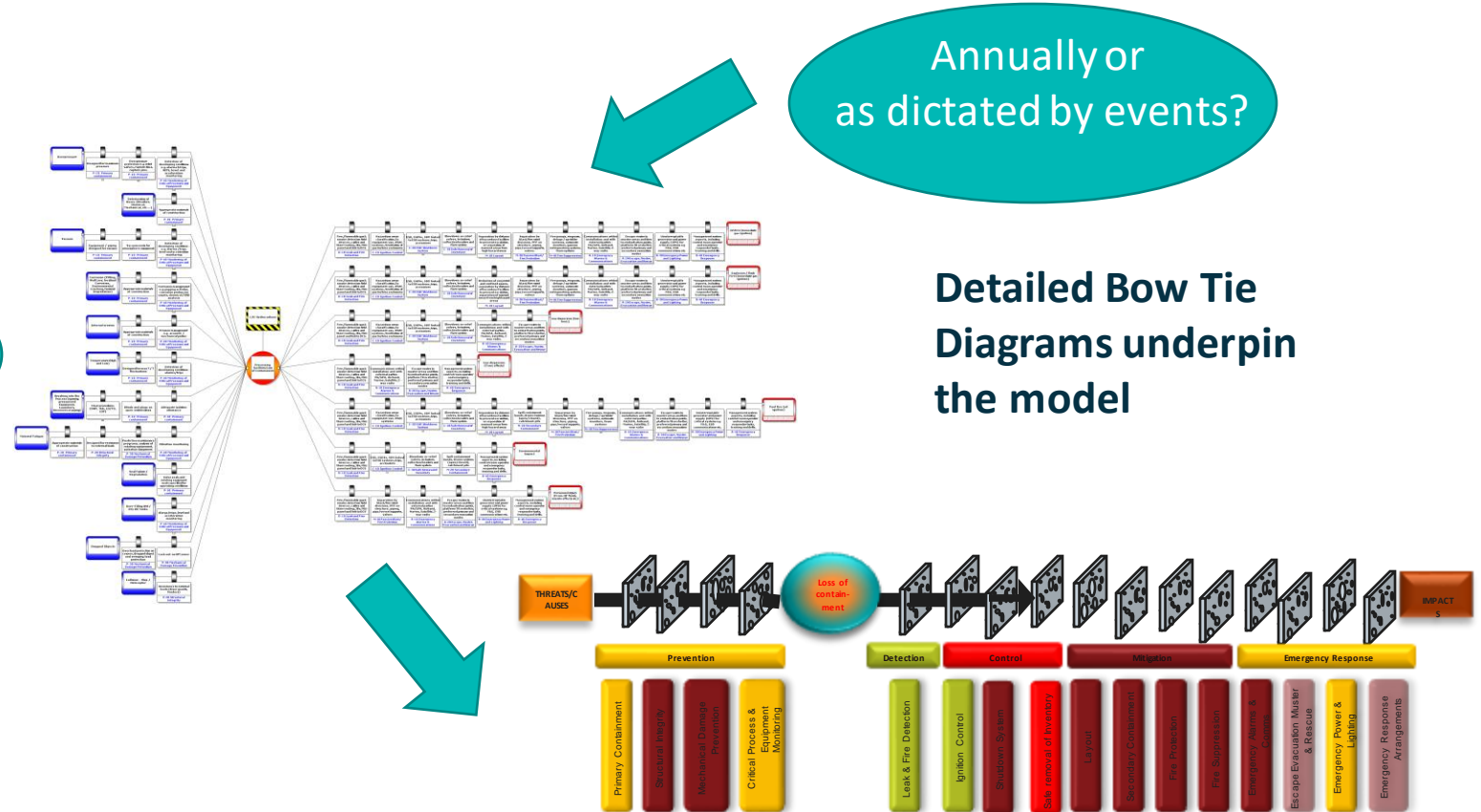
## Barrier Assurance Activities

- WMS
- Tech. Authority
- ICP/IVB input

Daily / weekly / monthly

## Operational Risk Assessment

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



Annually or as dictated by events?

**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

AI/ML for auto P&ID scanning & equipment detection

Draw box around node to automatically select equipment/lines

Additional equipment can be selected on the dwg and added to the node

Selected equipment within node can be edited manually

Marked up P&ID and equipment list can be exported to PDF/Excel

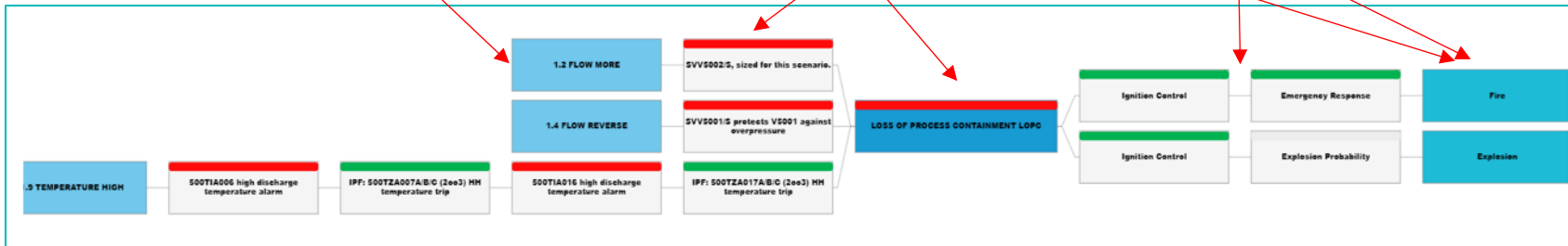
PAGE	REFERENCE DRAWING NUMBER	TYPE LABEL	GROUP	ATTRIBU	ATTRIBU	ATTRIBU	NOTES
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	RV			812
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	LT			813
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	ZT			812
1	DE-5270.00-42313-944-GCR-305	Process Control System in Primary Location (Panel)	Node1	PS			827
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	LG			843
1	DE-5270.00-42313-944-GCR-305	Process Control System in Primary Location (Panel)	Node1	LI			812
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	PT			827
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	LT			812
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	PT			826
1	DE-5270.00-42313-944-GCR-305	Process Control System in Primary Location (Panel)	Node1	LALL			812
1	DE-5270.00-42313-944-GCR-305	Instrument	Node1	TI			824
1	DE-5270.00-42313-944-GCR-305	Process Control System in Primary Location (Panel)	Node1	TS			824
1	DE-5270.00-42313-944-GCR-305	Process Control System in Primary Location (Panel)	Node1	PALL			827
1	DE-5270.00-42313-944-GCR-305	Process Control System in Primary Location (Panel)	Node1	LI			813

# 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.  <a href="#">Cause: 1.1.2.1</a>	1.2.1.1. Potential overpressure of V5002. LOPC, fire and explosion.  <a href="#">LOPA Scenario: 1.1</a>	P	SB	1 H2	1 SW5002/S, sized for this scenario.  <a href="#">LOPA Scenario - IPL Item: 1.1.1</a>	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). <a href="#">LOPA Scenario - IPL Item: 1.1.2</a>	
		3 Ignition control. <a href="#">LOPA Scenario - IPL Item: 1.1.3</a>					
		4 Explosion probability. <a href="#">LOPA Scenario - IPL Item: 1.1.4</a>					
		1.2.1.2. Less H2 flow to K5001A/B, refer to 1.1.2 <a href="#">Cause: 1.1.2</a>					
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 H50035. Potential overpressure of V5001. LOPC, fire and explosion.  <a href="#">LOPA Scenario: 1.4</a>	P	SB	1 H2	1 SW5001/S protects V5001 against overpressure and is sized for this scenario.  <a href="#">LOPA Scenario - IPL Item: 1.4.1</a>	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). <a href="#">LOPA Scenario - IPL Item: 1.4.2</a>	
						3 Ignition control. <a href="#">LOPA Scenario - IPL Item: 1.4.3</a>	
						4 Explosion probability. <a href="#">LOPA Scenario - IPL Item: 1.4.4</a>	

# Mapping HAZOP to Bowtie

Deviation	Causes	Consequences	Consequence Categories		Safeguards	ALARP?	Safety Critical Elements		HAZOP Recommendations	
			CA	S			PEFS Tag nr.	HAZOP Recommendations	Responsibility	
	1.1.3. Failure of loop such that drain valve 500UZ871 opens (control valve of 500LISA001). <a href="#">Consequence: 1.3.1.1</a>	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. 500GB0008 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. <a href="#">Cause: 14.6.1</a>	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. <a href="#">Consequence: 1.3.2.1</a>	1.2.1.1. Potential overpressure of V5002. LOPC fire and explosion. <a href="#">LOPA Scenario: 1.3</a>		SB	1. H2	1. SVV5002/S, sized for this scenario. <a href="#">LOPA Scenario - IPL item: 1.3.1</a> 2. Emergency Response (valid for fire scenario, but not taken credit for as explosion is highest risk for fatality). <a href="#">LOPA Scenario - IPL item: 1.3.2</a> 3. Ignition control. <a href="#">LOPA Scenario - IPL item: 1.3.3</a> 4. Explosion probability. <a href="#">LOPA Scenario - IPL item: 1.3.4</a>	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 <a href="#">Cause: 1.1.2</a>								
1.3. Flow Misdirected	1.3.1. Manual bypass around 500UZ871 inadvertently opened	1.3.1.1. Refer to 1.1.3 <a href="#">Cause: 1.1.3</a>								



HAZOP / LOPA

Bowtie

# Outcome - Operational Bow Tie



**RiskPoynt Barrier Model (CRV)**

SITE : FPSO ; Date: 01/04/2023

010 - LOSS OF CONTAINMENT IN THE GAS TREATMENT SYSTEM / SYSTEM 12 CO2 REMOVAL RELEASE FLAMMABLE AND TOXIC GAS

The bow tie diagram shows a central event: '010 - Loss of containment in the Gas Treatment System / System 12 CO2 Removal Release Flammable and Toxic Gas'. To the left, there are five barriers: A1 - Corrosion/Fatigue, A2 - Dropped object, A3 - Mechanical Impact, A4 - Overpressure, and A5 - Assembly failure / Inappropriate maintenance. To the right, there are three barriers: B1 - Primary Containment, B2 - Basic Process Control, and B3 - Critical Alarms and Human Intervention. Further right, there are more barriers: B4 - Safety Interlocks, B5 - Relief Systems, B6 - Protection Systems (after release), B7 - Ignition Control, B8 - Emergency Response of Operations, B9 - Emergency Response of Brigade, and B10 - Evacuation, Rescue and Abandon. The final outcome is 'C1 - Fire / Explosion'.

REPORTS BARRIER STATUS STATUS OF SCENARIOS INHIBIT/OVERRIDE

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	10	0	147	0	1	0	38	0	2	0
B2 - Process Basic Control Systems	4	1	31	0	0	0	31	0	0	0
B3 - Critical Alarms and Human Intervention Systems	10	1	25	0	0	0	55	0	0	0
B4 - Safety Interlocks Systems	6	2	23	0	0	0	28	0	0	0
B5 - Relief Systems Systems	0	0	0	0	0	0	0	0	0	0
B6 - Protection Systems (after release) Systems	0	4	47	0	0	0	23	0	0	44
B7 - Ignition Control Systems	81	5	154	0	0	0	160	0	0	6
B8 - Emergency Response of Operations Systems	1	0	1	0	0	0	0	0	0	0
B9 - Emergency Response of Brigade Systems	0	0	17	0	0	0	6	0	0	24
B10 - Evacuation, Rescue and Abandon Systems	1	0	2	0	0	0	0	0	0	0
Total	124	13	447	0	1	0	341	0	2	104

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

1.2.1.1 Fire

1.2.1.1 Explosion

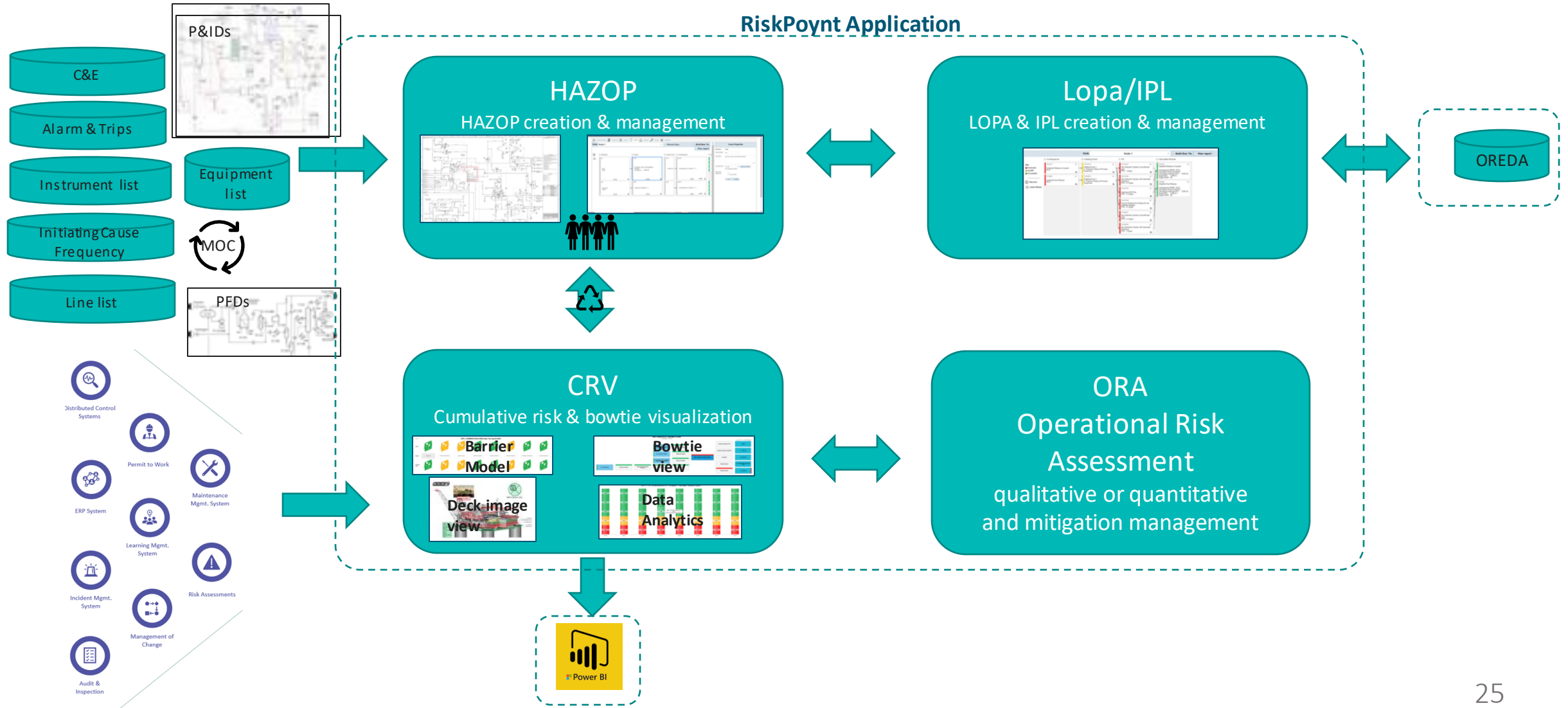
1.4.1.1 Fire

1.4.1.1 Explosion

# HAZOP/LOPA With RiskPoynt



# 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 Demand (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

The screenshot displays the RiskPoynT Barrier Model (CRV) software interface. The main window shows a table of hazard analysis results for 'Node Hazop Study Node 001'. The table is organized into columns: Deviation, Cause, Cause Freq, Consequence, Score, and Safeguard. A dialog box titled 'Properties' is open over the table, showing details for a selected consequence (1.1.1.1.1). The dialog includes sections for 'TOP EVENTS', 'CONSEQUENCES', and 'SUBSTANCES', along with fields for 'Action Due Date', 'Responsible', 'ALARP?', and 'LOPA Requirements'.

Deviation	Cause	Cause Freq	Consequence	Score	Safeguard
1.1 Flow No/Less	1.1.1 @C-15004 Debutaniser OVRHD to FWH Vlv @on/off valve @C-15004 Debutaniser OVRHD to FWH Vlv control loop failure Frequency = 1.00E-03	1.1.1 1.00E-03	1.1.1.1 Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire LOPA Exists LOPA	P3-C E1-C A4-C	1.1.1.1.1 @on/off valve which #Jet Fire #Protection System test text@on/off valve which #Jet Fire #Protection System test text 1.1.1.1.2 Safeguard for Consequence 1.1.1.1 #Drop Object #Detection Systems and make this more text @C-1500 Debutaniser OVRHD to FWH Vlv# 1.1.1.1.3 @on/off valve which #Jet Fire #Protection System test text@on/off valve which #Jet Fire #Protection System test text 1.1.1.2.1 @on/off valve which #Jet Fire #Protection System test text 1.1.1.2.2 @on/off valve which #Jet Fire #Protection System test text @on/off valve #Drop Object #Protection System
1.2 Flow No/Less	1.2.1 @C-15004 Debutaniser OVRHD to FWH Vlv @on/off valve @C-15004 Debutaniser OVRHD to FWH Vlv control loop failure Frequency = 1.00E-03	1.2.1 1.00E-03	1.2.1.1 Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire LOPA Exists LOPA	P3-B	1.2.1.1.1 Safeguard for Consequence 1.1.1.1 #Drop Object #Detection Systems and make this more text @C-15004 Debutaniser OVRHD to FWH Vlv# 1.2.1.1.2 @on/off valve which #Jet Fire #Protection System test text 1.2.1.2.1 @on/off valve which #Jet Fire #Protection System test text

**Properties Dialog Box:**

- Parameter Value:** Consequence Identity: 1.1.1.1, Description: Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire #
- TOP EVENTS:** Loss of Process Containment a, Loss of Process Containment
- CONSEQUENCES:** Risk to human life, Fire, Explosion, Jet Fire, Gas Cloud
- SUBSTANCES:** Nitrogen - Fire, Gasoline - Unignited release, Gasoline - Spill to water, Crude - Unignited release, Sour water - Unignited release, LPG - Self heating, H2S - Ignited release
- Action Due Date:** [Field]
- Responsible:** [Field]
- ALARP?:** [Field]
- LOPA Requirements:** People  Environment  Asset  Reputation
- Referenced Equipment:** [Field]
- Buttons:** Close, Update

# Creation LOPA From HAZOP Consequence



RiskPoynt Barrier Model (CRV)

Kiosk Mode KPI What's This Data Analysis Dashboard Manage Data Refresh Help Log Out

Node Hazop Study Node 001 Refresh Data View report View Bow Tie Build Bow Tie

Consequence	Initiating Event	IE PFD	IPL	EF PFD	C/M PFD	RHS PFD	Calculated Results
1.1.1.1.1 Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire # P3-C	1.1.1.1.1 Initiating Event 1 Cause for Deviation 1.1	1.1.1.1.1 1.00E-02	1.1.1.1.1.1 Safeguard for Consequence 1.1.1.1 #Drop Object #Detection Systems and make this more text @C-15004 Debutaniser OVRHD to FWH PFD: 1.0000E-02	1.00E-02	1.00E-02	1.00E-02	1.1.1.1.1 Consequence PEAR : P3-C, Calculated Achieved PEAR : P3-A, Calculated Achieved PFD : 1.0000E-11, Target PFD : 1.0000E-01
1.1.1.1.2 Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire # A4-C	1.1.1.1.2.1 Initiating Event 1 Cause for Deviation 1.1	1.1.1.1.2.1 1.00E-02	1.1.1.1.2.1 Safeguard for Consequence 1.1.1.1 #Drop Object #Detection Systems and make this more text @C-15004 Debutaniser OVRHD to FWH PFD: 1.0000E-02	1.00E-02	1.00E-02	1.00E-02	1.1.1.1.2 Consequence PEAR : A4-C, Calculated Achieved PEAR : A4-A, Calculated Achieved PFD : 1.0000E-08, Target PFD : 1.0000E-01
1.1.1.2.1 Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire # P3-B	1.1.1.2.1.1 Initiating Event 1 @C-15004 Debutaniser OVRHD to FWH Vlv @on/off valve @C-15004 Debutaniser OVRHD to FWH Vlv control loop failure	1.1.1.2.1.1 1.00E-03	1.1.1.2.1.1 @on/off valve which #Jet Fire #Protection System test text PFD: 1.0000E-04	1.00E-04	1.00E-04	1.00E-04	1.1.1.2.1 Consequence PEAR : P3-B, Calculated Achieved PEAR : P3-A, Calculated Achieved PFD : 1.0000E-09, Target PFD : 1.0000E-01
1.1.1.2.2 Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire # P3-B	1.1.1.2.2.1 Initiating Event 1 @C-15004 Debutaniser OVRHD to FWH Vlv @on/off valve @C-15004 Debutaniser OVRHD to FWH Vlv control loop failure	1.1.1.2.2.1 1.00E-03	1.1.1.2.2.1 Safeguard for Consequence 1.1.1.1 #Drop Object #Detection Systems and make this more text @C-15004 Debutaniser OVRHD to FWH PFD: 1.0000E-02	1.00E-02	1.00E-02	1.00E-02	1.1.1.2.2 Consequence PEAR : P3-B, Calculated Achieved PEAR : P3-A, Calculated Achieved PFD : 1.0000E-09, Target PFD : 1.0000E-01

### Properties

Parameter	Value
Identity	1.1.1.1.1
Description	Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire #
Consequence Ranking	P3-C
Target Ranking	4D
Target PFD	1.0000E-01
Achieved Ranking	P3-A
Achieved PFD	1.0000E-11
Target ALARP?	<input type="checkbox"/>
Required Risk Reduction PFD	
Required Risk Reduction Factor	0
Overall Risk Reduction Factor	0

$$F = \sum(IEFs \times P_e \times PFD_1 \times PFD_2 \times PFD_n) \times P_r \times PFD_{RHS}$$
 IEF = Initiating Event Frequency  
 PFD<sub>n</sub> = Probability of Failure on Demand for Valid Barriers (n being the total number of valid barriers for each IE)  
 PFD<sub>n</sub> = Probability of Failure on Demand for Valid Barriers on the right hand side of the bowtie  
 P<sub>e</sub> = Enabling Factor  
 P<sub>r</sub> = Conditional Modifier(s)  
 Σ = The Sum of (IEF x PFD<sub>n</sub>) as required

Condition Modifier	1.00E+00
IE, IPL, EF	1.0000E-11
Right Hand Side	1.0000E+00

Close

# Creation Bow Ties From HAZOP

**RiskPoyn Barrier Model (CRV)**

Study Description Documents Sessions HAZOP Approvals Settings Equipment

Node Hazop Study Node 001 Refresh Data View report View Bow Tie Build Bow Tie

**HAZOP to RiskPoyn Bowtie**

Deviation	Cause	Cause Freq	Consequence	Score	Safeguard
1.1	1.1.1 SDV 30000 malfunctions closed while running multiple plants (2001) Frequency = 1.00E-01	1.00E-01	1.1.1.1 Potential to fail lines and equipment downstream of compressor. Potential explosion. Potential personnel injury (I). LOPA team increased pressure. Blocked compressor outlet addressed in other nodes.	PEA	1.1.1.1 Each compressor has PSHH 1.1.1.2 Discharge PSV sized for blocked outlet 1.1.1.3 RHS Barrier
1.1	1.1.2 SDV 30000 malfunctions closed while running single plant (2001) Frequency = 1.00E-01	1.00E-01	1.1.2.1 Potential to fail lines and equipment downstream of compressor. Potential explosion. Potential personnel injury (I). LOPA team increased pressure. Blocked compressor outlet addressed in other nodes.	PEA	1.1.2.1 Each compressor has PSHH 1.1.2.2 Discharge PSV sized for blocked outlet 1.1.2.3 RHS Barrier
1.1	1.1.3 Block valve on inlet or outlet of AC-302 Plant #1 Amine Air Cooler left closed (1401) Frequency = 1.00E-02	1.00E-02	1.1.3.1 Potential to fail lines and equipment downstream of compressor. Potential explosion. Potential personnel injury (I). LOPA team increased pressure. Blocked compressor outlet addressed in other nodes.	LOPA	1.1.3.1 Each compressor has PSHH 1.1.3.2 Discharge PSV sized for blocked outlet 1.1.3.3 RHS Barrier
1.2	1.2.1 External fire near F-300, AC-302, and T-301		1.2.1.1 Potential to fail lines and equipment downstream of compressor. Potential explosion. Potential personnel injury (I). LOPA team increased pressure. Blocked compressor outlet addressed in other nodes.	LOPA	1.2.1.1 PSV 30201, set at 1440 psig on AC-302 1.2.1.2 RHS Barrier

**Bowtie Diagram:**

- Block valve on inlet or outlet of AC-302 Plant #1 Amine Air Cooler left closed
- Each compressor has PSHH
- Discharge PSV sized for blocked outlet
- External fire near F-300, AC-302, and T-301
- PSV 30201, set at 1440 psig on AC-302
- SDV 30000 malfunctions closed while running multiple plants
- Discharge PSV sized for blocked outlet
- SDV 30000 malfunctions closed while running single plant
- Each compressor has PSHH
- Discharge PSV sized for blocked outlet

**Node 1 Loss of Process Containment**

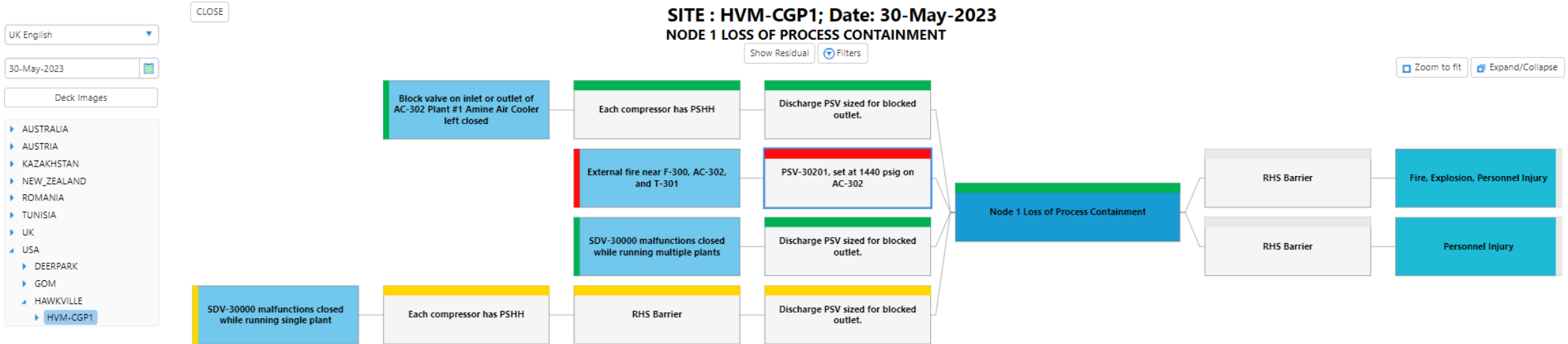
- RHS Barrier
- Fire, Explosion, Personnel Injury
- RHS Barrier
- Personnel Injury

**Properties**

Parameter	Value
Identity	1.1.1.1.1
Description	Consequence of Cause 1.1.1 Nitrogen Fire #Loss of Process Containment and #Jet Fire #
Consequence Ranking	P3-C
Target Ranking	4D
Target PFD	1.0000E-01
Achieved Ranking	P3-A
Achieved PFD	1.0000E-11
Target ALARP?	<input type="checkbox"/>
Required Risk Reduction PFD	
Required Risk Reduction Factor	0
Overall Risk Reduction Factor	0
Workings	$F = \sum(IEFs \times P_e \times PFD_1 \times PFD_2 \times PFD_3) \times P_e \times PFD_{HS}$ <p>IEF = Initiating Event Frequency                      PFD<sub>n</sub> = Probability of Failure on Demand for Valid Barriers (n being the total number of valid barriers for each IE)                      PFD<sub>HS</sub> = Probability of Failure on Demand for Valid Barriers on the right hand side of the bowtie                      P<sub>e</sub> = Enabling Factor                      P<sub>e</sub> = Conditional Modifier(s)                      Σ = The Sum of (IEF x PFD<sub>n</sub>) as required</p>
Condition Modifier	1.00E+00
IE, IPL, EF	1.0000E-11
Right Hand Side	1.0000E+00

1.1.1.2.2 1.1.1.2.2.1 1.1.1.2.2.1 1.1.1.2.2.1 1.1.1.2.2

# Screen Images – Demonstration



SUMMARY | REPORTS | RISK RECORDS | RECOVERY ACTIONS | CONSOLIDATED SCE VIEW | SCE CONDITION | BARRIER MATRIX | PASSING VALVES | RELIABILITY | CONTROL ACTIONS | DOCUMENTS | STATUS OF SCENARIOS

INHIBIT/OVERRIDE

Barrier PSCODE	Reference	Details	Mitigation Control	Recovery Plan	Actionee	Raised Date	Target Date
SI S1001	HCP-23-00001 (PS)	BP Demo test RA	test mitigation	test recovery		02-Mar-2023	

10 items per page | 1 - 1 of 1 items



# Screen Images – Demonstration

**SITE : HVM-CGP1: Date: 30-May-2023**

**PSV-30201, set at 1440 psig on AC-302**

PSV-30201, set at 1440 psig on AC-302

**Initiating Event**

Normal Risk
Abnormal Risk
Mitigated Risk

Export to Excel

Equipment No	Chan...	Equipment Name	PS Code	Explanation	Emerge...	AM Prev	AM Corr	P...	C...	Defe...	PI or DCS	M...	MOC Overdue	RA Count	P2W Pending	PV Count
PSV-30201		PSV-30201 Gas Air Cooler AC-302	PC007	Risk Assessments (RA) Count = 1	0	0	0	0	0	0	0	0	0	1	0	0

1 - 1 of 1 items

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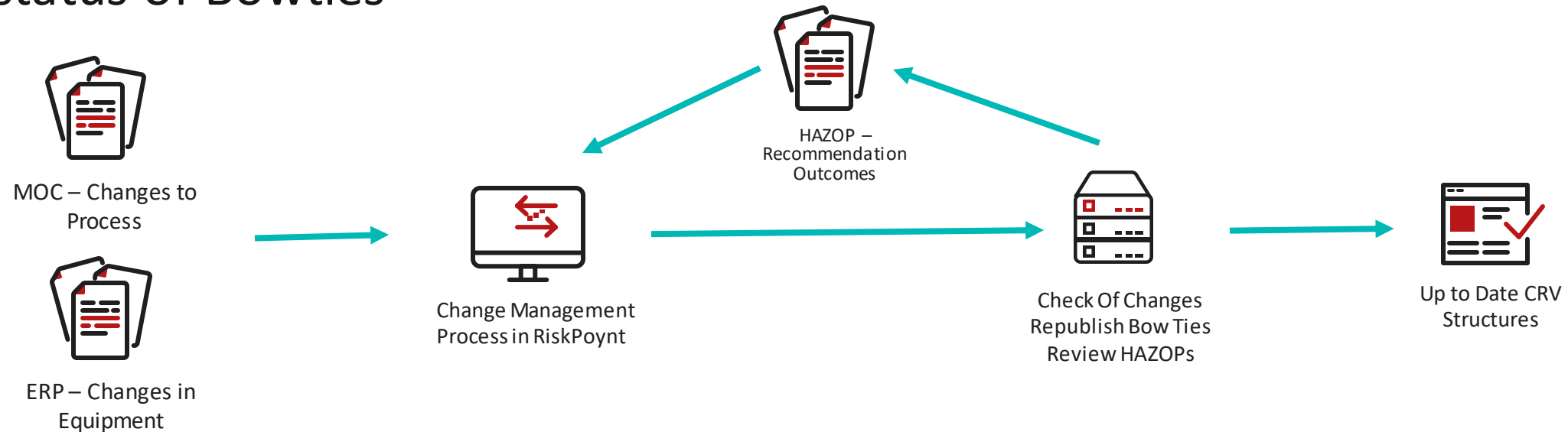
SCENARIOS

SI CODE	Reference	Details	Mitigation Control	Recovery Plan	Alertance	Raised Date	Target Date
SI SI001	HCP-23-00001 (PS)	BP Demo test RA	test mitigation	test recovery		02-Mar-2023	

1 - 1 of 1 items

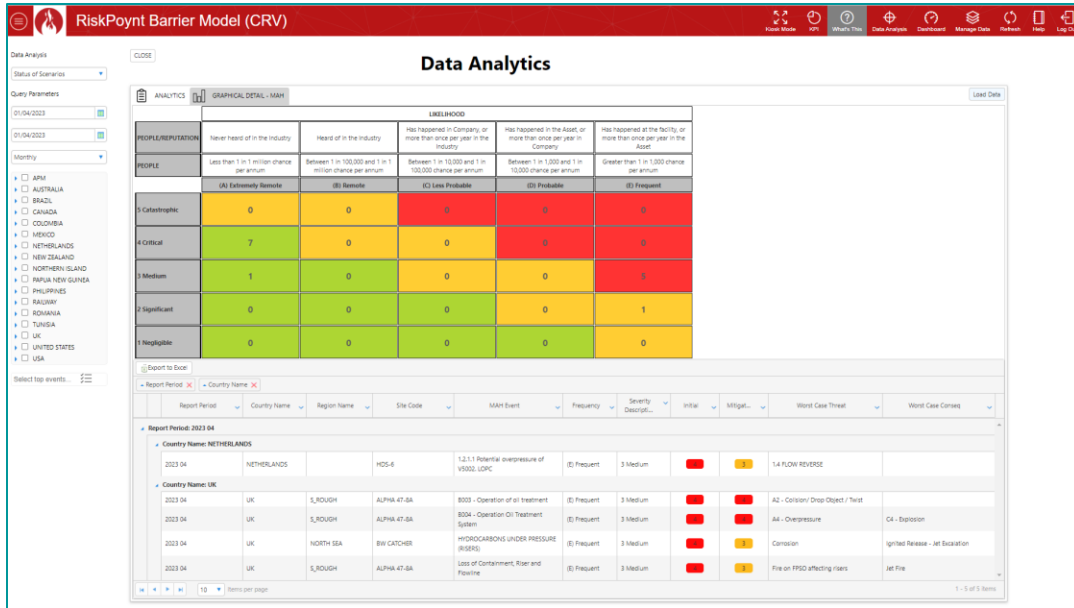
# Manage Change in the Process End to End

- 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

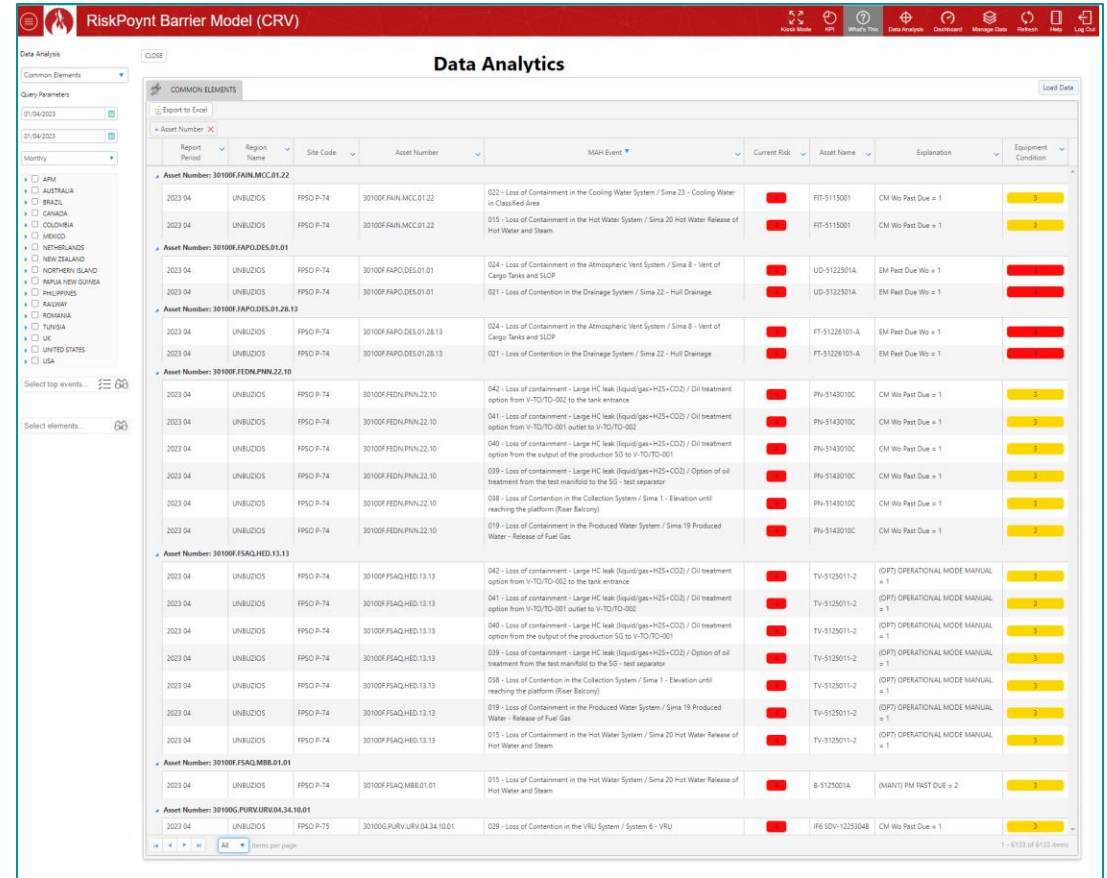


# Benefits to Operators

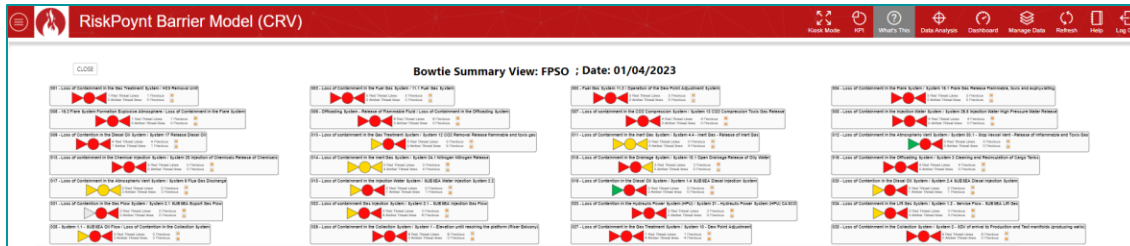
- Executive Dashboard



- Relationship between MAH and Equipment status



- Cumulative Risk Visualize by Specific Top Event



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# Questions?

# Thank You

PROMETHEUS GROUP  
EUROPEAN | USER  
CONFERENCE

Michael Mostert