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TNChE Asia 2025

Best Practice: Digitalisation of Operational Safety for O&M Practical Strategy

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Contents

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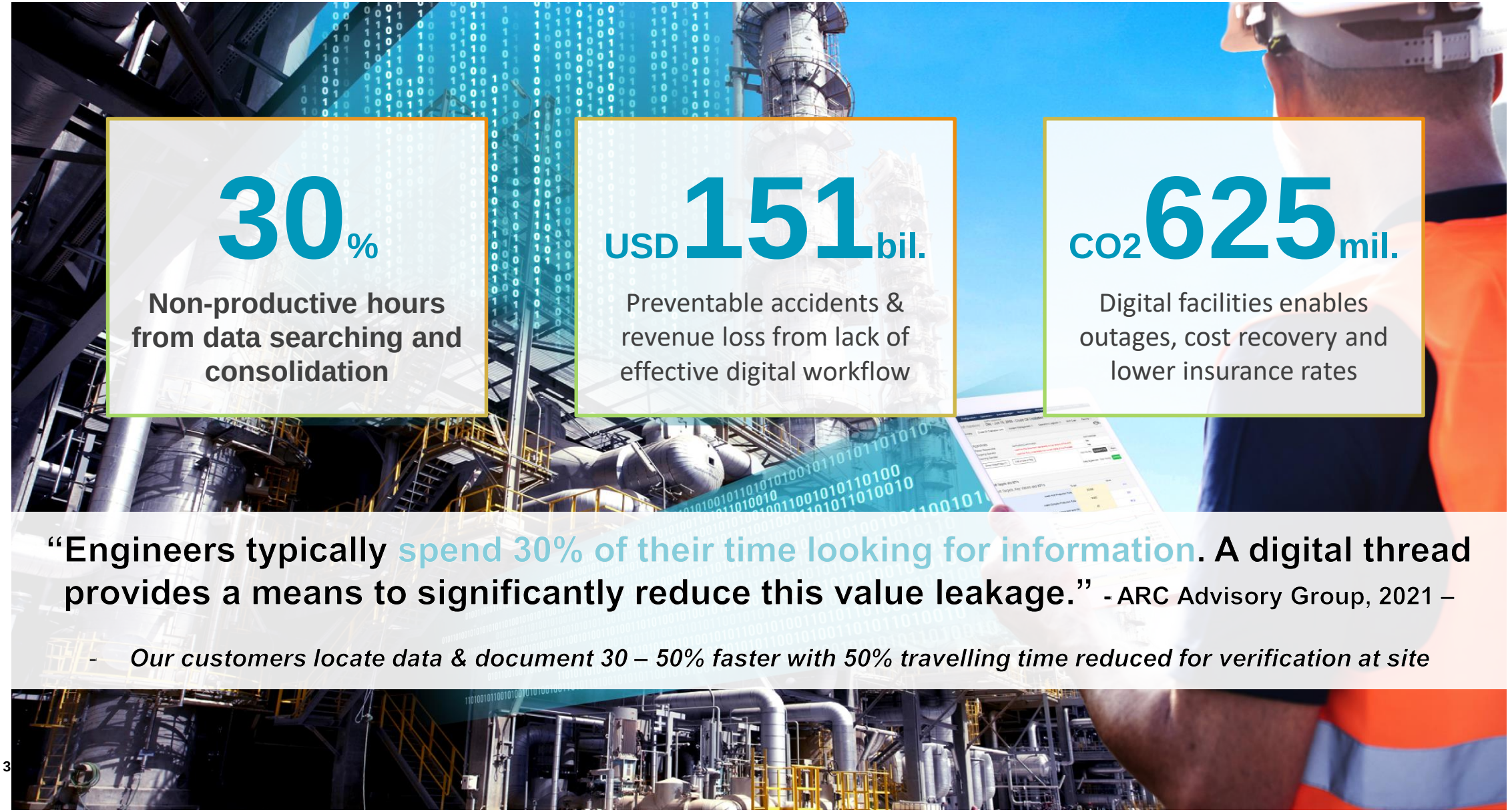
Case for Change | Operations Value Leakage from Data Searching



30%

Non-productive hours from data searching and consolidation

USD 151 bil.

Preventable accidents & revenue loss from lack of effective digital workflow

CO2 625 mil.

Digital facilities enables outages, cost recovery and lower insurance rates

"Engineers typically spend 30% of their time looking for information. A digital thread provides a means to significantly reduce this value leakage." - ARC Advisory Group, 2021 –

- *Our customers locate data & document 30 – 50% faster with 50% travelling time reduced for verification at site*

Case for Change | Challenges of Performance Monitoring

Manual Intervention

80% time spent on data extraction & reporting – leading to human error

Localised Data

Data resides in local machine and is unavailable online for interaction with other digital solutions

Reactive

No early warning indications on equipment performance & deterioration

Automated Updates

Automated data retrieval and report generation with virtual analyser functionality

Data Centralisation

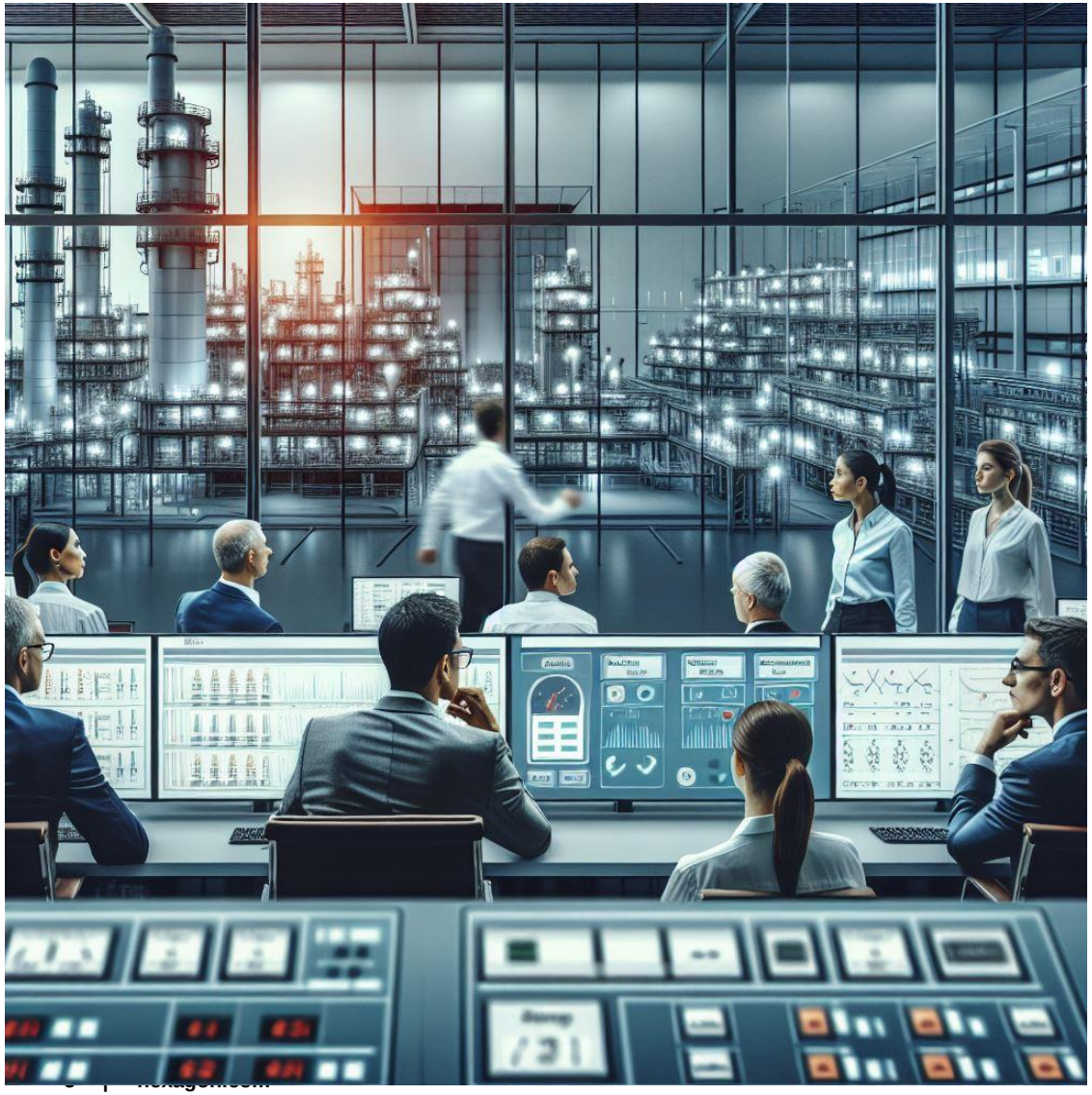
Online server with hourly data generation, ready for integration with any digital application

Predictive

Visualizing integrity & performance of instrumentation and control system to make more informative decisions

Conservative Approach → **Future**

Case for Change | Aspiration of the Future – Operations Vision

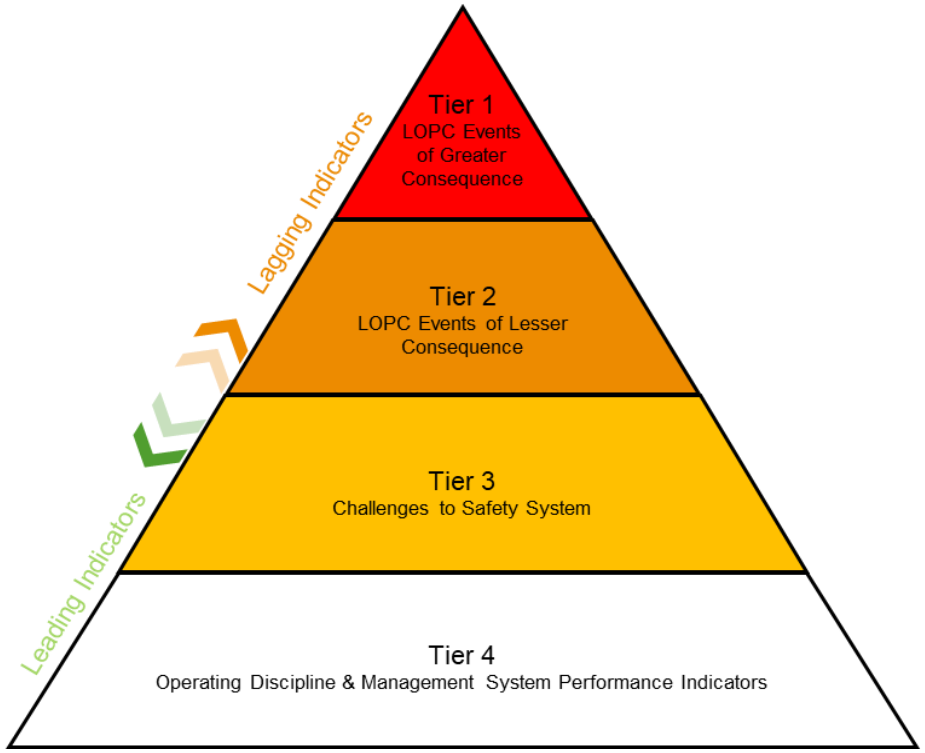


- Effective Alarm System
- Optimized Control Loops
- Safe Operating Limits Managed & Monitored
- Effective Operator Situation Awareness
- Full Visibility and Control of Safety System Status
- Fully Digitalized Logbooks, Permits, Duties, etc.
- Actionable KPI’s

Layers of Process Safety – Only For Governance?

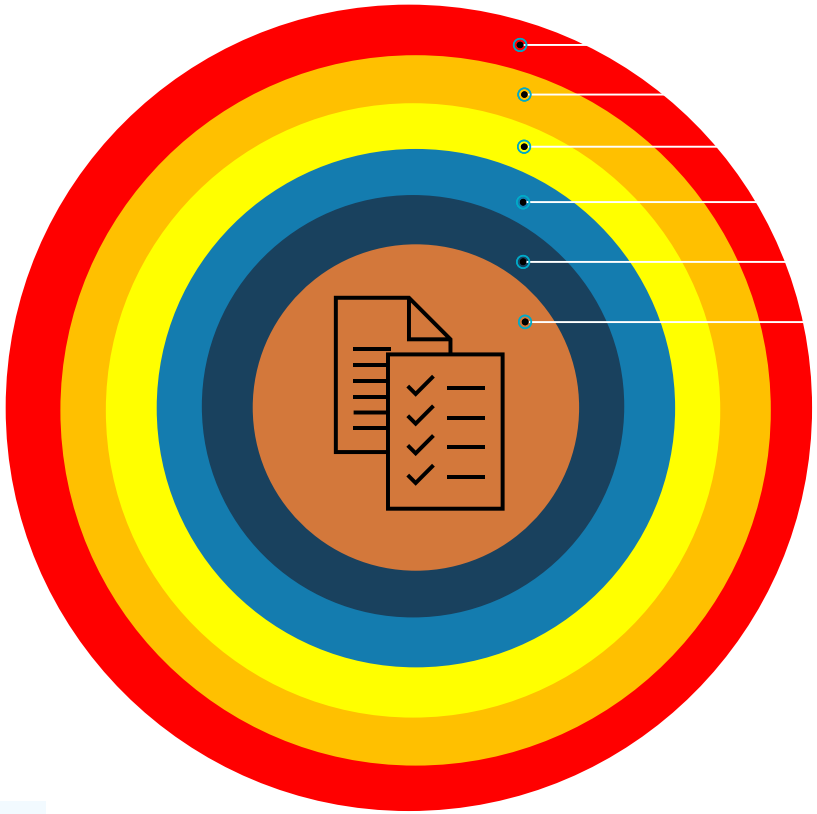
- Evacuation
- Process Relief & Containment
- Safety Shutdown Systems
- Alarms & Operator Interventions
- Regulatory Controls
- Procedures & Management Systems

Process Safety Layers | Measure to Improve



Reference | API 574

- Conceptually based on the "incident pyramid"
- Identifies leading and lagging process safety indicators to drive performance
- Tier 1 is the most lagging, Tier 4 is the most leading
- Tiers 1 and 2 are measure of actual releases and may be used for national reporting
- Tiers 3 and 4 are intended for internal or site use



Evacuation

Process Relief & Containment

Trip/SIS Activation/Unit Shutdown

Alarms and Operator Interventions

Regulatory Control Loops

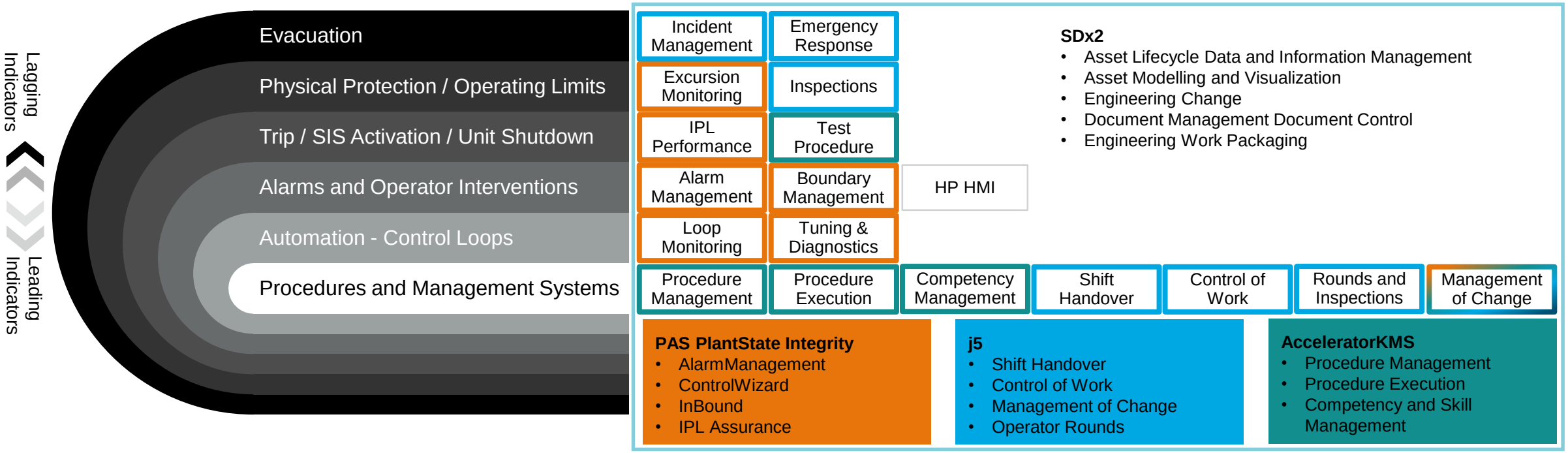
Procedures and Management Systems

Measuring, understanding, and improving leading indicators (Tier 3 and 4) can prevent Tier 1 and Tier 2 events from occurring

Metrics Drive Actions!

Operational Risk Management

Hexagon Solutions alignment to Layers of Protection Analysis Framework



Hexagon is uniquely positioned to provide the most complete and comprehensive Barrier Management solution to the market.

Link to infographic

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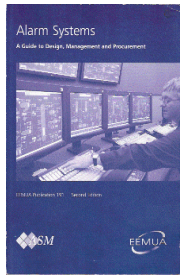
Alarm Management Document | Journey of Excellence

1994 — Texaco Milford Haven

1998 — EEMUA 191
1st Edition
2nd: 2007
3rd:2013



2001 — YA-711
Principles for Alarm System Design

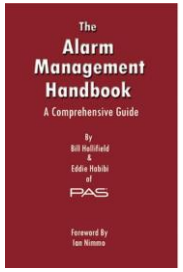
NORWEGIAN PETROLEUM DIRECTORATE

2003 — NA102
Germany
Rev. 2008

NAMUR

Work Begins on ISA-18.2

2006 — 1st ED.

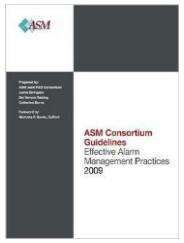


2008 — 2008
Electric Power Guidelines Issued
Co-authored by PAS

EPRI
ELECTRIC POWER RESEARCH INSTITUTE

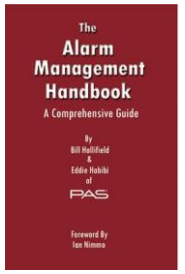
2009 — ISA-18.2 Issued!

ISA



2009 ASM Alarm Book Issued

2010 — 2nd ED.



energy API

API RP-1167 Pipeline Alarm Mgt.

2012 — In German!
2012

2014 — IEC 62682
Begins 2010
Published Oct 2014

IEC

2015 — ISA-18.2 Expected Update 4Q 2015

ISA

2022 — Japanese Language

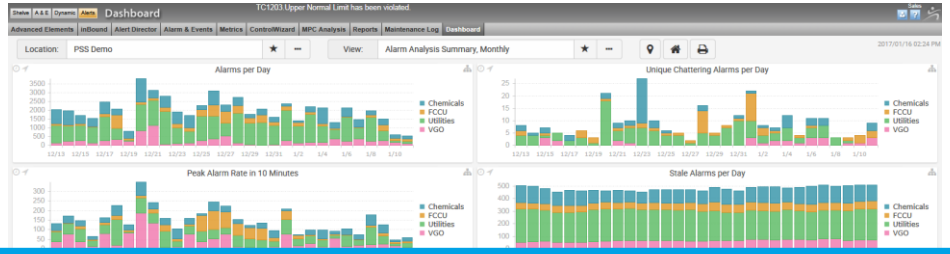
ISA

Not Policing But To Make Use for Operation/Maintenance Efficiency

Use Case: 1. Alarm Management Analysis Tools

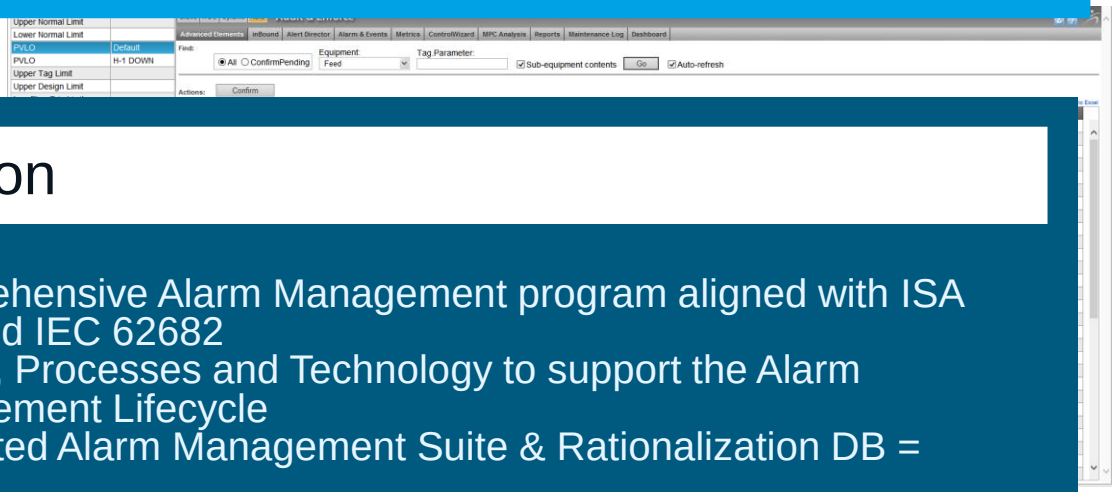
PlantState Integrity Alarm Management

- Alarm and Event Analysis/Metrics
- Documentation and Rationalization
- Audit and Enforce
- Dynamic Alarming
- Alarm Shelving
- Alert Director



Challenge

- No Guideline, wrong configuration, too many alarms & Operator lost confidence
- Silo Rationalization DB and Alarm Management Event Analysis



Solution

- Comprehensive Alarm Management program aligned with ISA 18.2 and IEC 62682
- People, Processes and Technology to support the Alarm Management Lifecycle
- Integrated Alarm Management Suite & Rationalization DB = MADB

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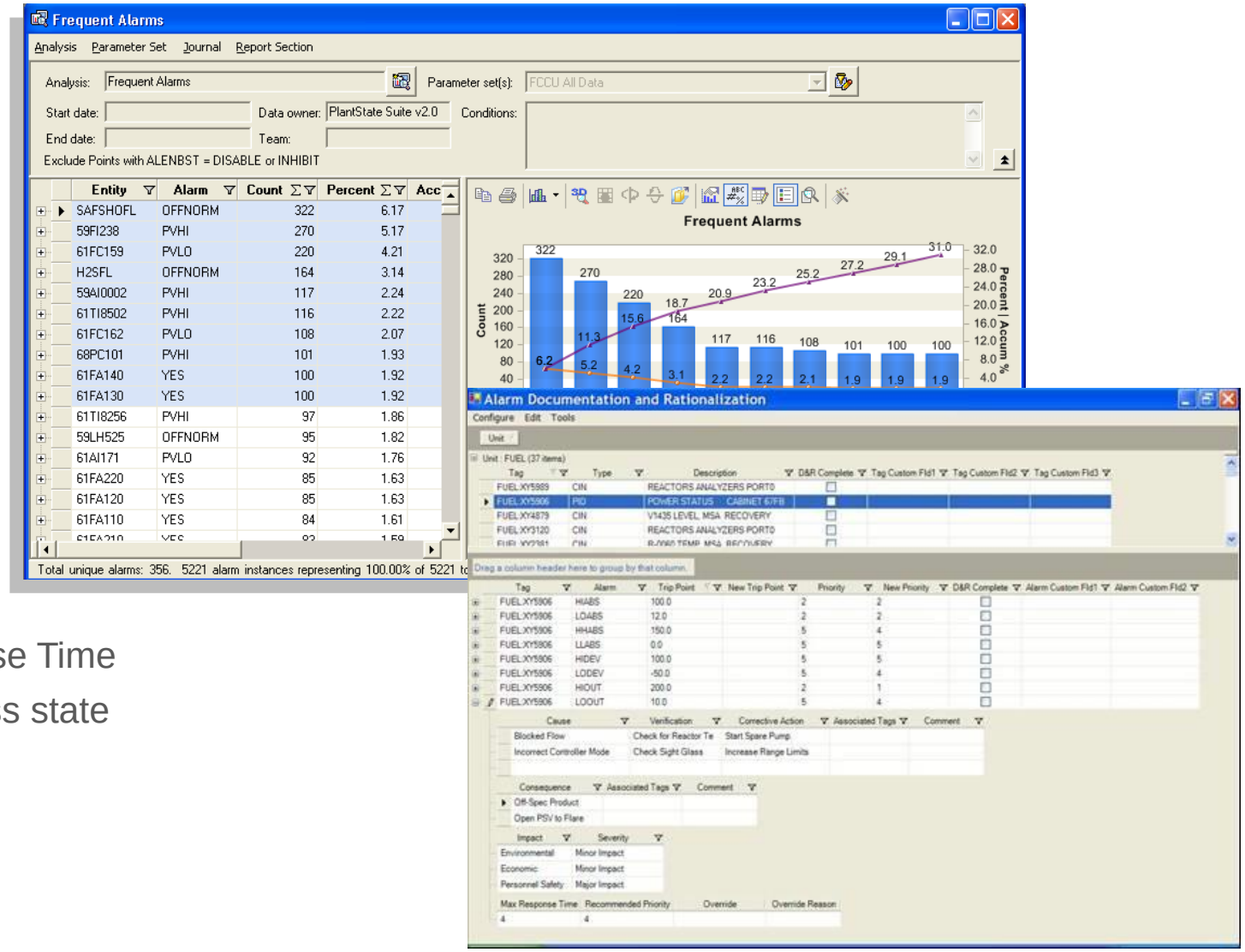
Integrated AEA & D&R = MASTER ALARM DATABASE (MADB)

- **Document Alarms**
  - Causes
  - Consequences
  - Corrective Actions
  - Classification
- **Classify Alarms**
  - Process Performance
  - Equipment safety
  - Your Classification System
- **Rationalize Priorities**
  - Impact / Severity / Maximum Response Time
  - Priority and Trip Point for each process state
- **Template based work process**
  - Create templates from any alarm
  - Apply templates to any alarm



Automated Realtime MADB Audit

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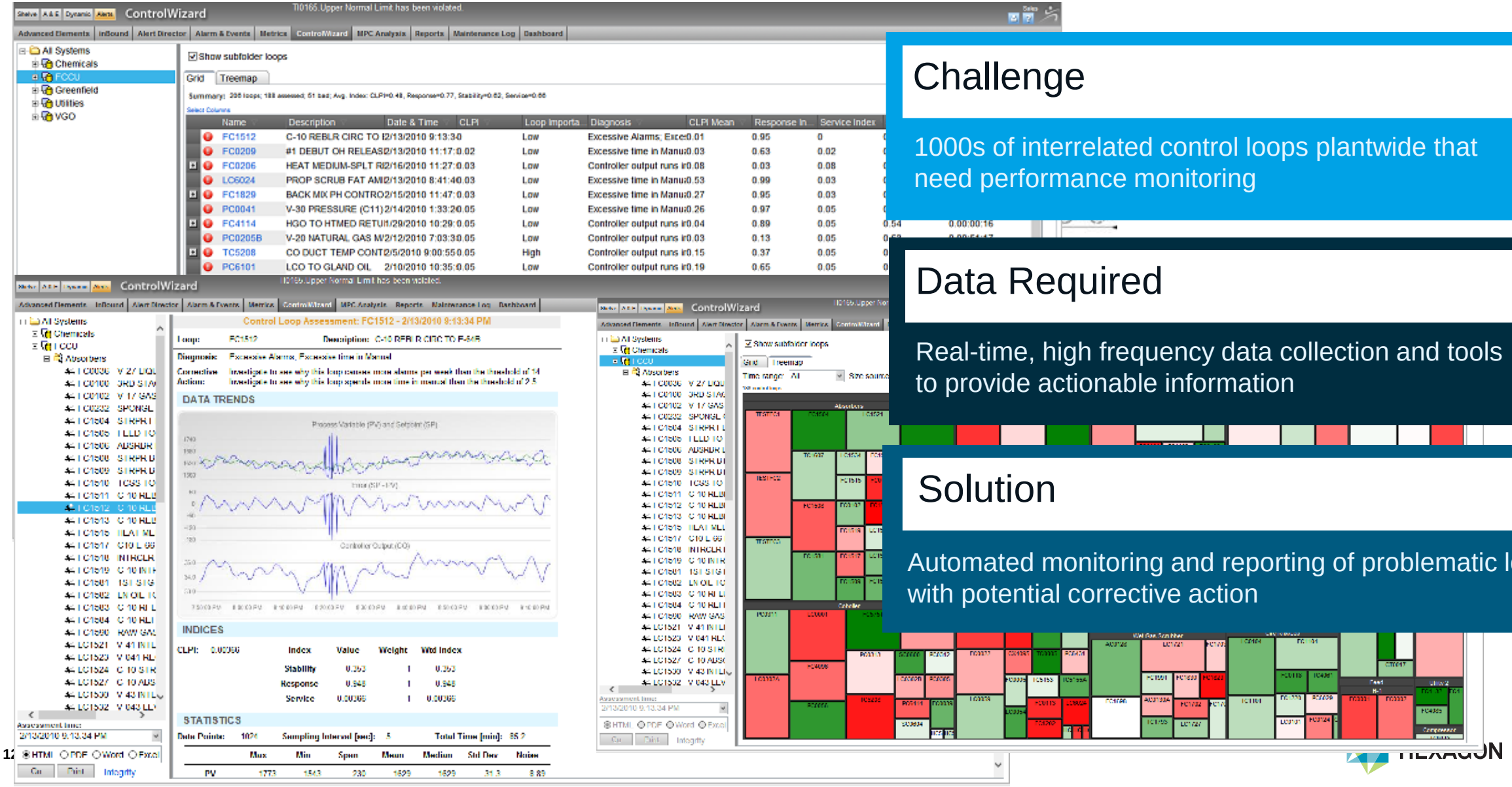
Use Case: 2. Control Loop Performance Management



Challenge

1000s of interrelated control loops plantwide that need performance monitoring

Data Required

Real-time, high frequency data collection and tools to provide actionable information

Solution

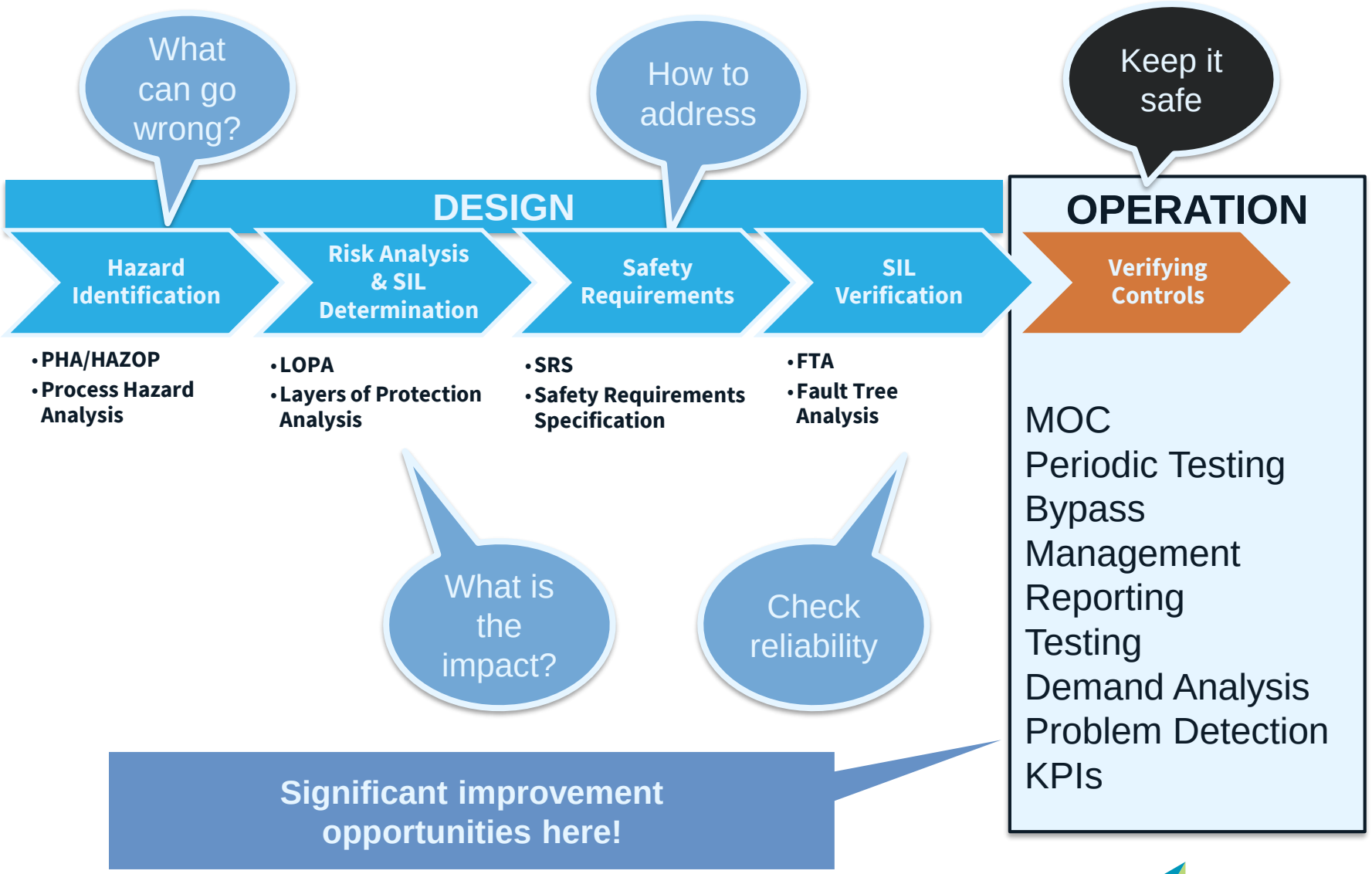
Automated monitoring and reporting of problematic loops with potential corrective action

Use Case 3. IPL - Safety Lifecycle Management in Operations

Most of the work by experts is **before Operations**

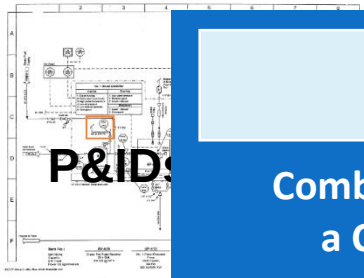
The experts **move on** to other projects

Complex tasks are **supposed to** happen during Operation, but expertise and time availability are often lacking…



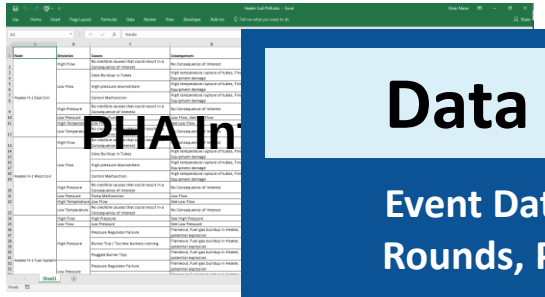
IPL Assurance – Instrument Protective Function

- Improves plant safety and operational awareness of Independent Protection Layer (IPL) performance.
- Optimizes plant resources by automating IPL integrity reporting.
- Provides an audit trail for IEC and OSHA compliance.
- Consolidates important IPL information.



Challenge

Combine Disparate Sources of Information To Get a Complete Picture of Risk and Performance Monitoring of IPL Applications



Data Required

Event Data, Maintenance Records, Operator Rounds, PHA, SIL/SIS and Other Information

Solution

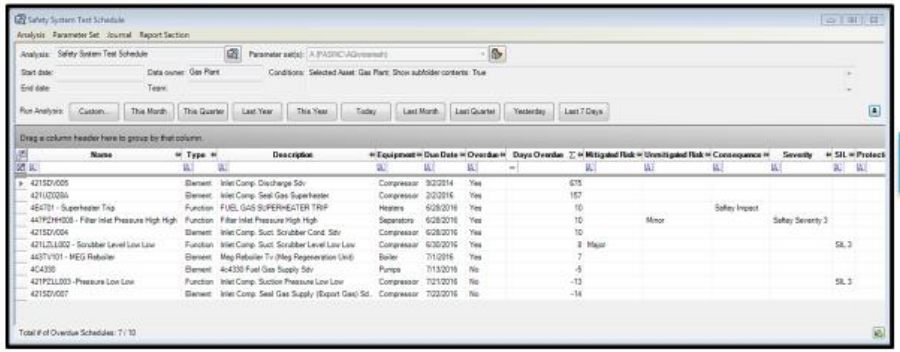
Comprehensive Solution To Aggregate Information From Disparate Sources To Help Monitor Performance and Visualize Risk

Digitised Safety System Management

IPL Analytics

Configuration and Design Data for Each SIF

Design Time, Process Safety Time, Testing Interval, Risk, Consequence, Severity, SIL Level, etc.

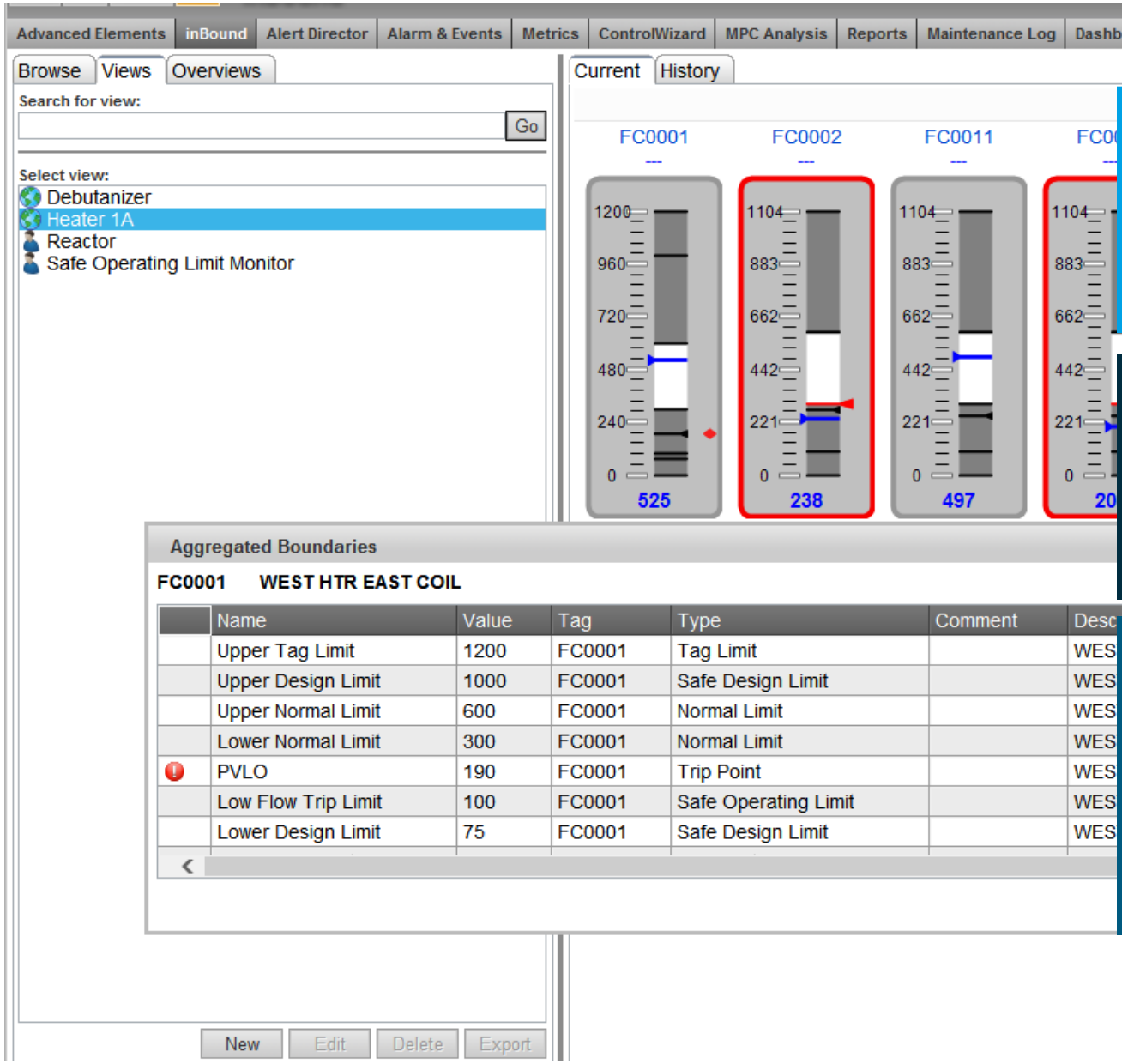


Safety System Performance Analysis and Reports

Process and Event Data from the control system

SIF Activation, Success or Failure Verification, Bypass, Un-Bypass, Test, etc.

Use Case: 4. Boundary Management



Challenge

Unable to understand the performance of the process against Design/Operating/Optimal Limits

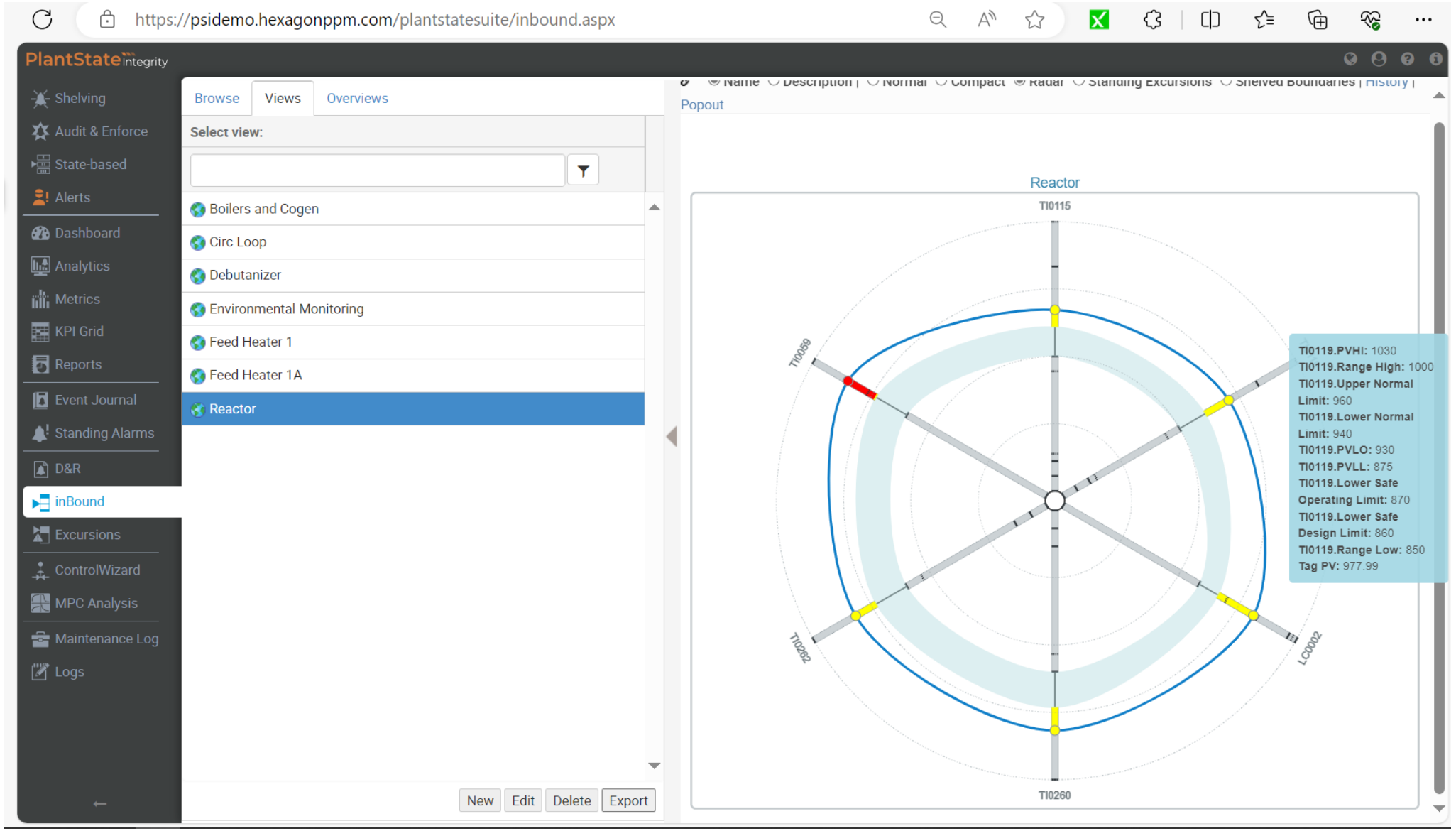
Data Required

Boundary information from disparate sources and real-time process data

Solution

Technology to consolidate boundary information, cross reference with alarm information and monitor the process in real time

Inbound – Integrating SDL/SOL/NEL/MDL



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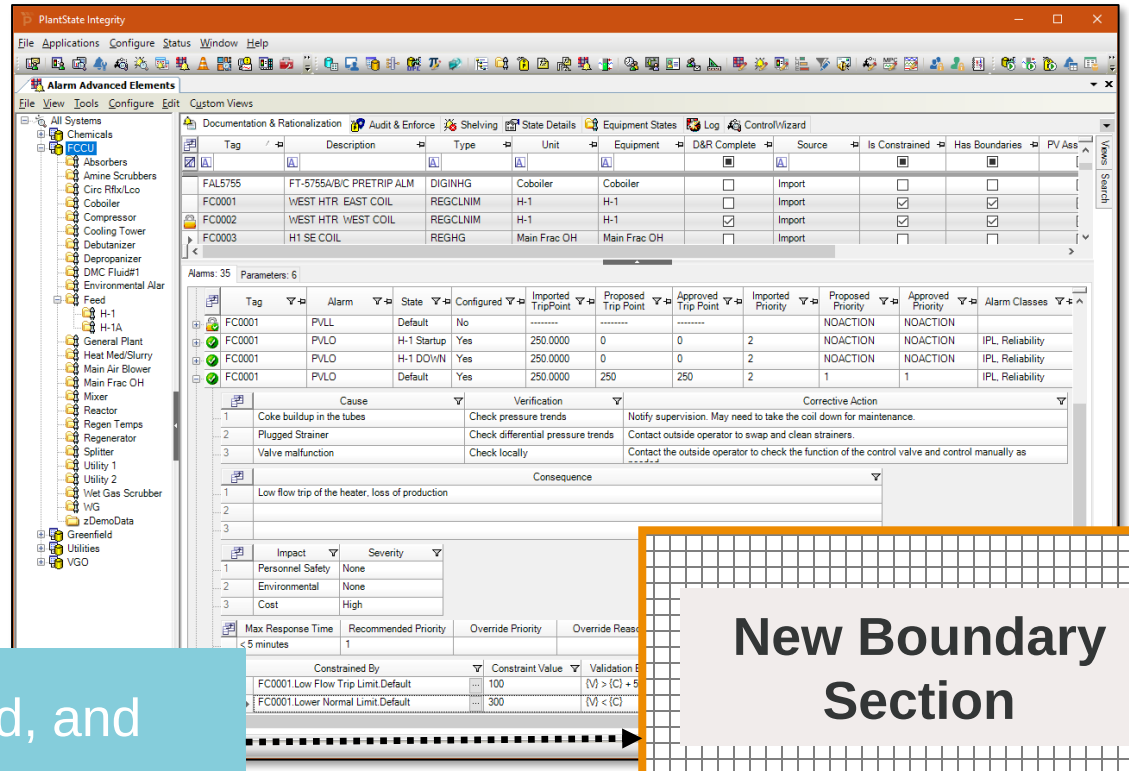
Where to Consolidate it? The Master Alarm Database

MADB Capabilities

- Secure, with controlled access
- Create a new section for mapping SIS/SIF/IPLs
- Link to the **correct DCS and SIS sensor points** for **monitoring and analysis**
- Correct “single truth” is now in an MOC-controlled environment



Boundary Excursions are detected, analyzed, and automatically reported.

SIF Activations are detected, analyzed, and automatically reported.

New Boundary Section

New IPL Section

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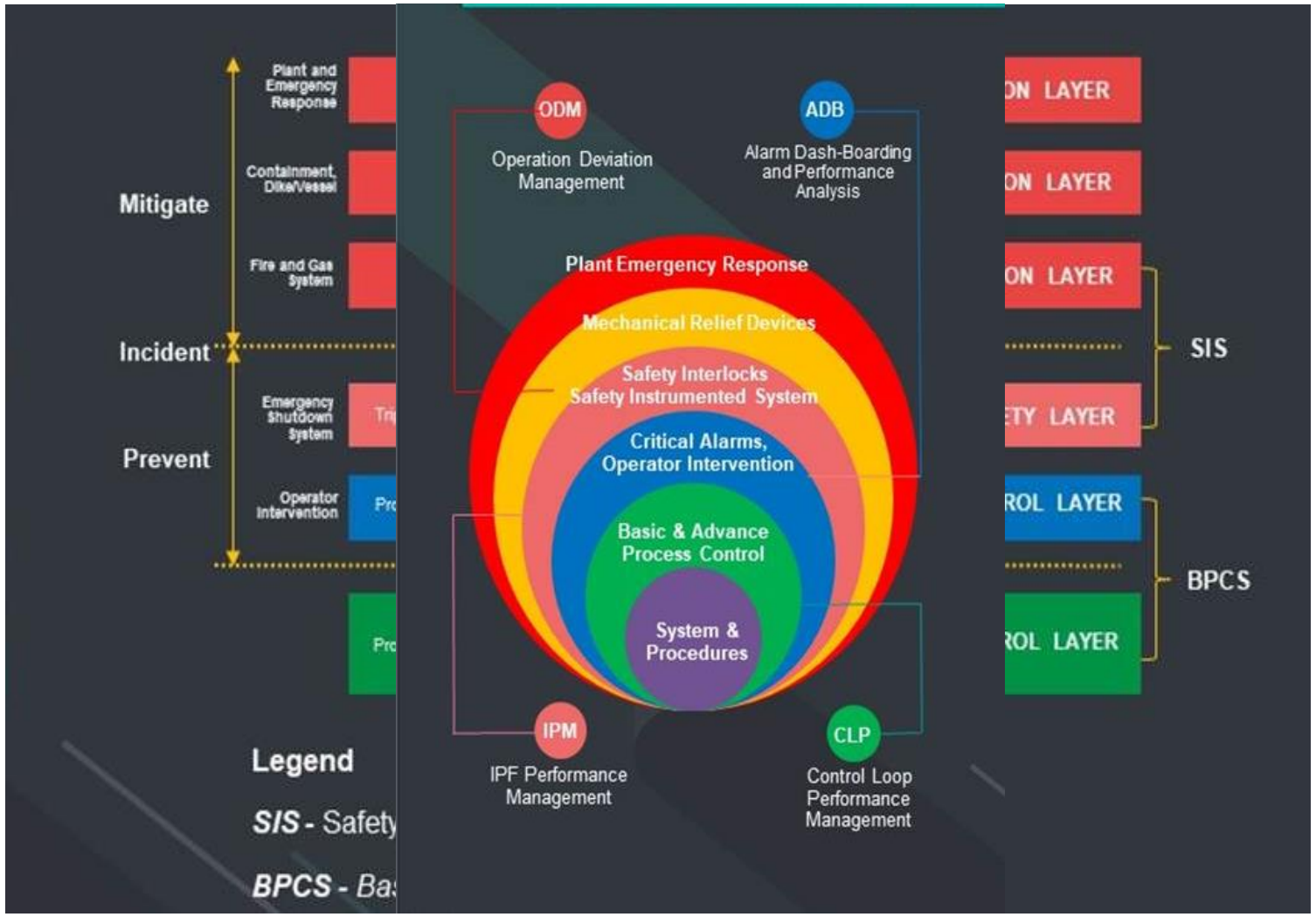
Case Study – Oil & Gas, Refineries, PetroChem Industries Company



1. **Improve safety** by reducing Process alarm per hour per operator and having real time critical data, Managing Bypass and Critical Boundary

2. **Improve production** by monitoring and react on the nonperforming controller

3. **Reduce Unplanned Shutdown** by reacting to analysis on every Protection Layer as and indication of Performance
   - Process Alarm – Loop Performance – Boundary – Safety System Analysis

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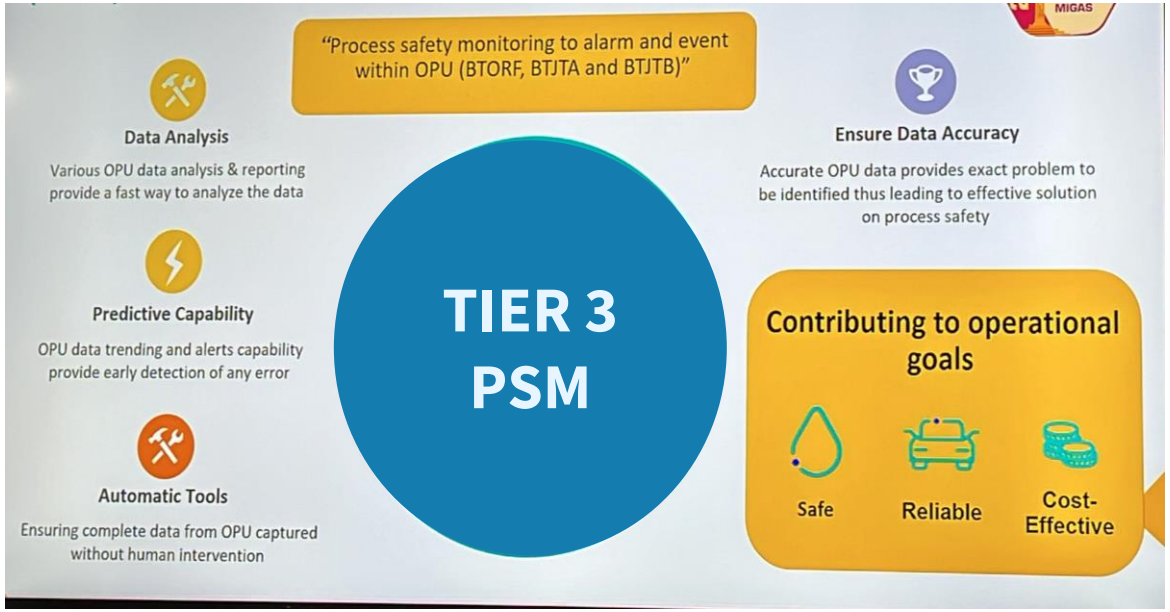
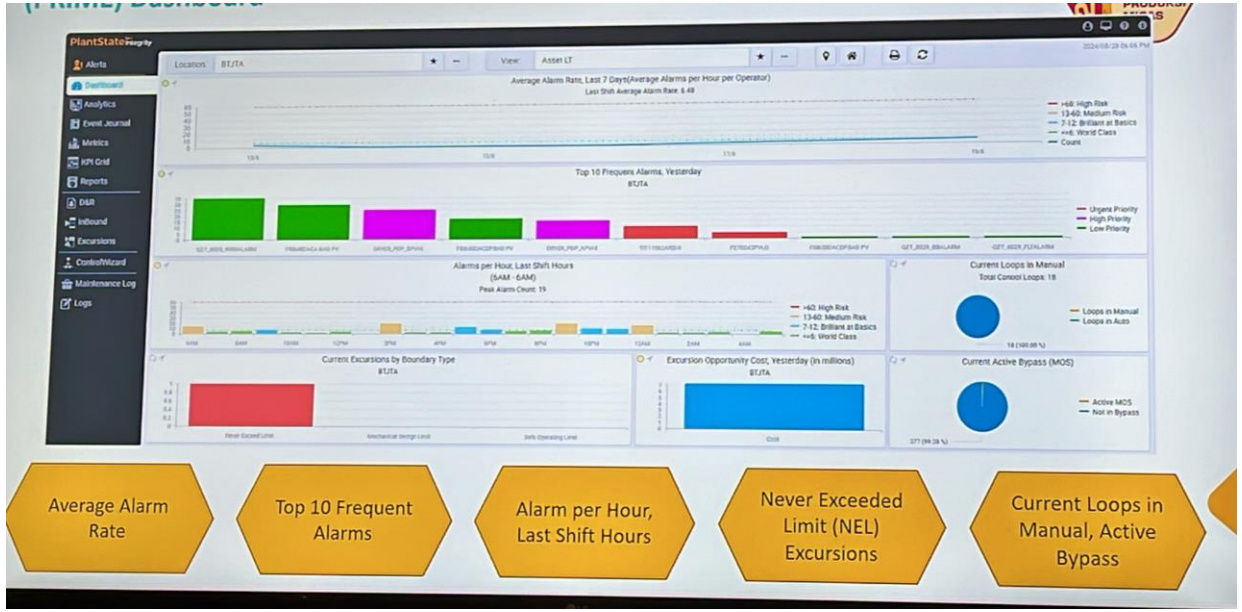
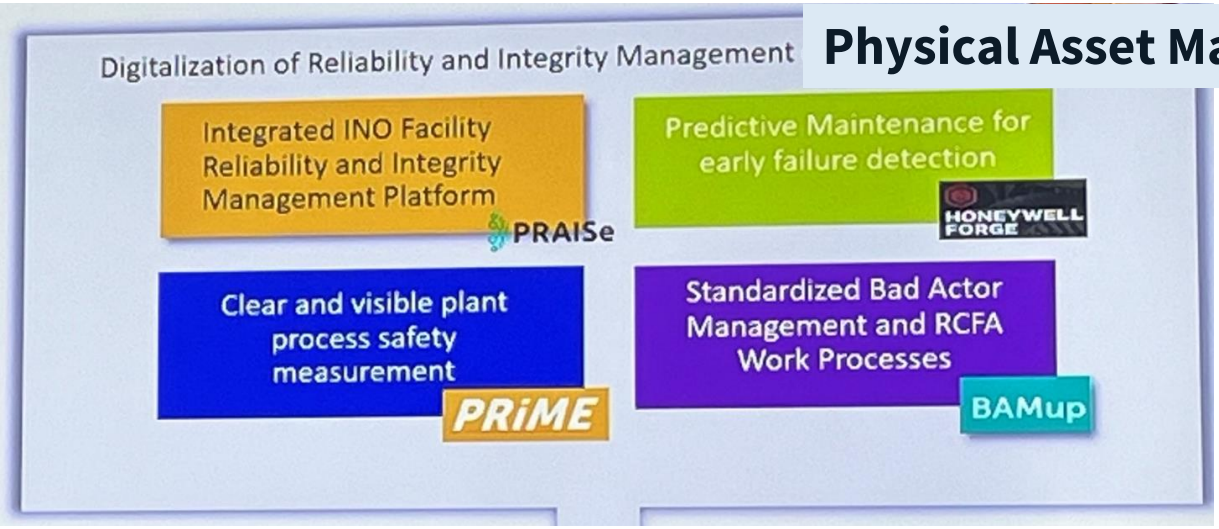
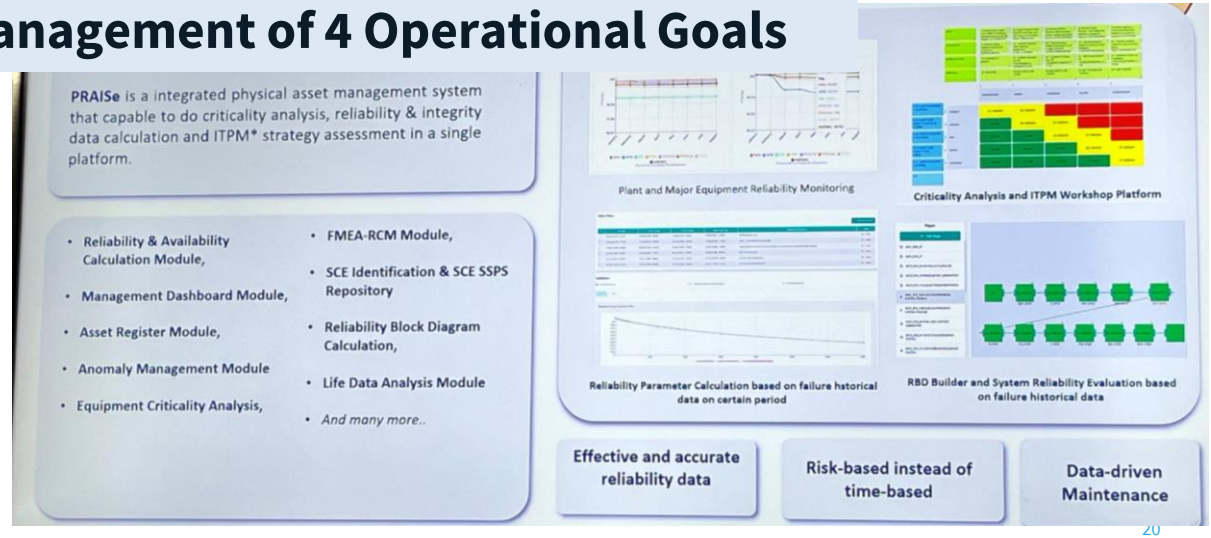




Physical Asset Management of 4 Operational Goals





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Win the Day: ADB – LP Separator Level Transmitter

Approx. Value Creation: **RM 700k**

Upstream Indicative Process Safety Performance Indicators

Alarms — Total Alarms: 2,090 — Average Alarm Rate: 1

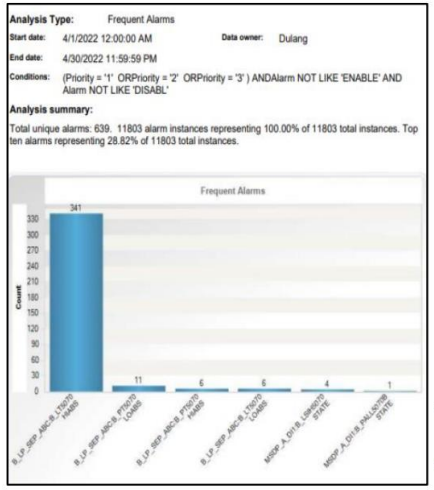
Tag	Alarm	Alarm Type	Point Description	Priority	Count	Chattering	Repetitive	First Timestamp
TCP2_AI1:B_TI5521	HIABS	Process	TRN 2 1ST STG DISCH TEMP	3	402			4/25/2022 6:12:30 AM
B_HOT_OIL:B_LT6400	LOABS	Process	V- 507 INTERFACE LEVEL	2	167			4/23/2022 9:36:43 PM
B_LP_SEP_ABC:B_LT5070	HIABS	Process	V-507 INTERFACE LEVEL	2	138			4/23/2022 2:44:24 PM
B_OILY_WTR:B_LT5850	HIABS	Process	V-585 INTERFACE LEVEL	3	79			4/25/2022 4:53:39 PM
CSDP_CGCE:PZT6031_EN	HIABS	Process	PZT-6031 ENGINEERING VALUE	2	43			4/23/2022 9:17:50 AM
489MF_CIN:XS_54320_B	STATE	Others	TURBINE1 ENCLSURE COM.AIR 60%LEL	2	42			4/23/2022 7:06:56 AM
489MF_CIN:XS_54321_B	STATE	Others	VENT EXH 60% LEL	2	42			4/23/2022 7:07:00 AM
PRE_TREAT:PT6070	HIABS	Process	A6070 CO2 REMV FUEL GAS INLET	2	42			4/23/2022 9:17:49 AM
DLB_WHCP_DI1:BPZT04S_MC	STATE	Others	MOS CNFIRM-WELL B04S HI-LO PILOT	2	39			4/23/2022 8:21:41 PM
FUEL_GAS:PT6030	LOABS	Process	V6030 FG SCRUBBER TO FLTR COALS	2	37			4/23/2022 9:36:03 AM
FUEL_GAS:PT6030	HIABS	Process	V6030 FG SCRUBBER TO FLTR COALS	2	35			4/23/2022 9:17:51 AM
CGCE_TCP_AI:PT2450	LOABS	Process	HPC 1 SUCTION GAS PRESS	2	29			4/23/2022 7:06:32 AM
TCP2_AI1:B_TI5575	HIABS	Process	TRN 2 2ND STG SUCT TEMP	2	25			4/23/2022 2:12:42 PM
CGCE_CSDP:B_PZAHH6075D	STATE	Process	PZT-6075 HIGH-HIGH ALARM	1	19			4/23/2022 11:17:56 AM
CSDP_CGCE:PZT6075_EN	HHABS	Process	PZT-6075 ENGINEERING VALUE	1	19			4/23/2022 11:17:58 AM
TCP2_DI1:B_XL55311	STATE	Others	GCM TRAIN 2 STOP	2	19			4/23/2022 9:40:11 AM
B_SURGE_ABC:B_LT5080	LOABS	Process	V-508 CRUDE LEVEL	2	17			4/23/2022 9:23:19 AM
CSDP_CGCE:PZT6075_EN	LLABS	Process	PZT-6075 ENGINEERING VALUE	1	17			4/23/2022 9:37:04 AM
B_HP_SEP_ABC:B_LT5041	LOABS	Process	V-504 CRUDE LEVEL	2	14			4/23/2022 10:27:43 AM
GAS_COND:B_FT5532	LOABS	Process	SEAL GAS FLOW (SKID 2)	1	14			4/23/2022 9:39:13 AM
B_OILY_WTR:B_LT5851	HIABS	Process	V-585 CRUDE LEVEL	2	13			4/23/2022 10:58:19 AM
CGCE_TCP_AI:PT2435	HIABS	Process	LPC 2 SUCTION GAS PRESS					
CGCE_TCP_AI:PT2436	LOABS	Process	LPC 2 DISCHARGE GAS PRES					
PRE_TREAT:B_PT6071	LOABS	Process	A6070 CO2 REMV FUEL GAS I					
TCP2_AI1:B_PI5521	LOABS	Process	TRN 2 1ST STG DISCH PRESS					
TCP2_AI1:B_PI5575	LOABS	Process	TRN 2 2ND STG SUCT PRESS					

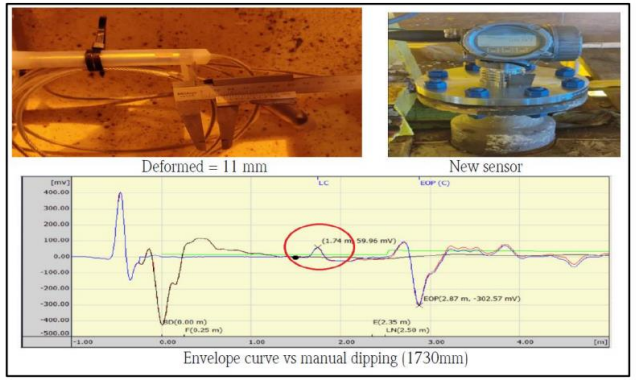
Legends: COP — Region: PMA — Field: Dulang — Year: 2022 — Month: April — Last Update: 7/8/2022 11:54:38 AM

- Frequent alarms appear for consecutive weeks. Steps by steps troubleshooting initiated.
- PRIME ADB has helped PMA in **EARLY DETECTION** of deformed transmitter

Win the Day: ADB – LP Separator Level Transmitter

Approx. Value Creation: **RM 700k**



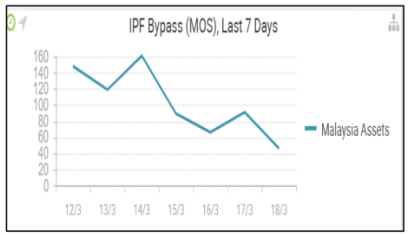


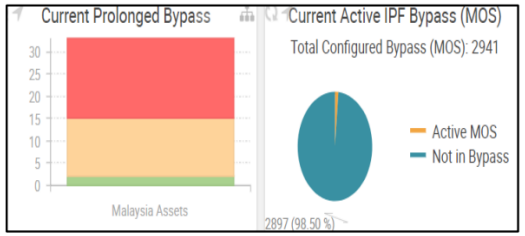
- Frequent alarms appear for consecutive weeks. Steps by steps troubleshooting initiated.
- PRIME ADB has helped PMA in **EARLY DETECTION** of deformed transmitter

Win the Day: IPM – High SCE Bypass

Approx. Value Creation: **USD 10mil**

- 29 prolonged bypasses has been identified during bi-weekly sitting of Offshore platforms.
- Collaboration between Instrument, Frontliners, Asset team, Process Technologist to chart way forward for each tags.
- 17 bypassed has been normalized related to current operating and parameter and setpoints.
- 12 SSBOC with details discussion between SMES, PTS-PSM and Operations.





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Process Safety KPI

[Open]

PSPI KPI Reporting Flow

Manual PSPI Management Reporting

Process Owner : Process Safety Engineer, Prod Supt., Instrument Technician, Instrument Engineer, HSE Process Safety Engineer

No	Required Data Input	PSPI Reporting Process											
		Data Collection				Data Processing & Analysis				Output Collection			
		Method	PIC	Lead Time	Accuracy	Method	PIC	Lead Time	Accuracy	Method	PIC	Lead Time	Accuracy
1	Average Alarm/hour/operator	Manual Extraction from DCS	Prod Supt / Instr Tech	3 Days	Accurate	Manual analysis using Excel	Instr Eng	3 days	Less Accurate	Manual Collection from PIC	Process Safety Engineer	1 Day	Less Accurate
2	Peak Alarm rate/10 minutes	Manual Extraction from DCS	Prod Supt / Instr Tech		Accurate	Manual analysis using Excel	Instr Eng		Less Accurate	Manual Collection from PIC	Process Safety Engineer		Less Accurate
3	IPF Fail on demand	Manual Extraction from DCS	Prod Supt / Instr Tech	2 Days	Less Accurate	Manual analysis using Excel	Instr Eng	1 Day	Less Accurate	Manual Collection from PIC	Process Safety Engineer		Less Accurate
4	IPF activation on demand	Manual Extraction from DCS	Prod Supt / Instr Tech		Accurate	Manual analysis using Excel	Instr Eng		Accurate	Manual Collection from PIC	Process Safety Engineer		Accurate
5	NEL Excursion	Manual Extraction from DCS	Prod Supt / Instr Tech		Less Accurate	Manual analysis using Excel	Instr Eng		Less Accurate	Manual Collection from PIC	Process Safety Engineer		Less Accurate
TOTAL LEAD TIME & ACCURACY LEVEL				6 Days	Less Accurate			4 Days	Less Accurate			1 Day	Less Accurate

Process Safety KPI Reporting from 9 days to 1 day with accuracy and validated data – via Hexagon PSI

Process Owner : Process Safety Engineer, Prod Supt., Instrument Technician, Instrument Engineer, HSE Process Safety Engineer

No	Required Data Input	PSPI Reporting Process											
		Data Collection				Data Processing & Analysis				Output Collection			
		Method	System	Lead Time	Accuracy	Method	PIC	Lead Time	Accuracy	Method	PIC	Lead Time	Accuracy
1	Average Alarm/hour/operator	Automatic data capturing from DCS	PRIME	Real Time	Accurate	Automatic Analysis using Software	PRIME	Real Time	Accurate	Manual Analysis Using PRIME report/Dash board	Process Safety Engineer/HSE Process Safety Engineer	1 Day	Accurate
2	Peak Alarm rate/10 minutes												
3	IPF Fail on demand												
4	IPF activation on demand												
5	NEL Excursion												
TOTAL LEAD TIME & ACCURACY LEVEL				Real Time	Accurate			Real Time	Accurate			1 Day	Accurate

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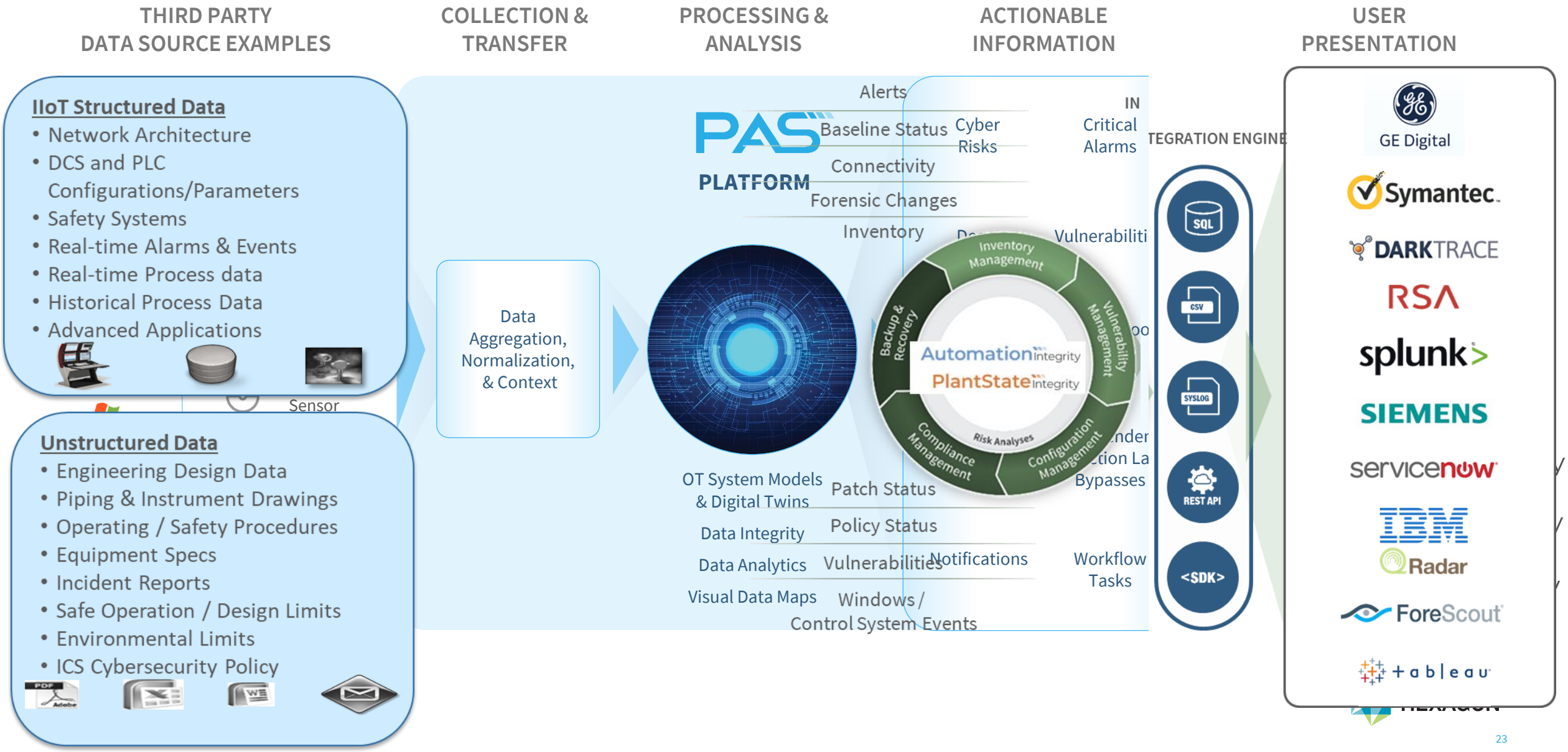
Plant Digital Data Model Structure Overview



Components of Operational and Maintenance Management - VISION

Control Loop

Bypass

Process Controls

Interlock

Alarm Limits

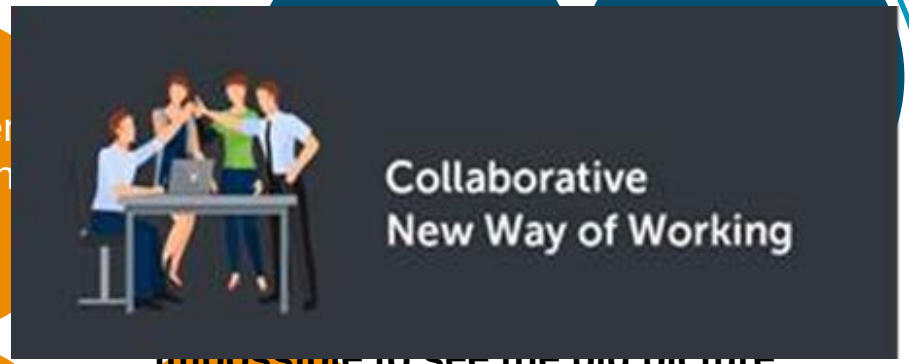
Operations

Preventative Maintenance

Testing

Maintenance

Independent Protection Layers



Design /Optimal Limits

Safety Integrity Level

Process Hazard Analysis

Safety Instrumented System

Process Safety

Piping & Instrument Diagram

Alarm Rationalization

Engineering

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3 Take-aways

- **Practical Digitalization** - Hexagon can help customers expand and interconnect their digitalization, unlocking new potential for their business and increasing potential benefits through a holistic and integrated approach.
- **Interoperability** - Centralize and visualize all types of asset information from data historians, the CMMS, the DCS, EAM, PLC and SCADA systems.
- **Smart Digital Reality** - Bringing It All Together - Using our Smart Digital Reality, you can deploy a comprehensive digital twin with Current Technology that enables an information management data ecosystem that's built and maintained throughout the asset lifecycle, allowing for a continuous journey of operational excellence.

Q & A

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Thank you.

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empowering an autonomous future

Come and visit us at Booth D6!

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