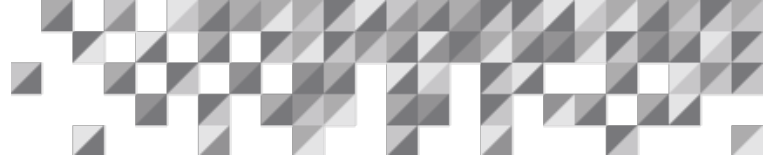# Effectively Manage Mechanical Integrity using Process Safety Enterprise®

An ioMosaic White Paper

Date: June 27, 2024

Overview

Process Safety Enterprise® (PSE), a cloud-based platform, helps manage mechanical integrity, ensuring compliance with OSHA's PSM standard. This white paper details the key features of PSE, including:

- Document Control System: Easily stores and retrieves documents
- Intelligent Form Builder: Creates customizable forms
- Action Tracking System: Manages all tasks related to mechanical integrity
- Reporting and Dashboard/KPI: Provides real-time insights into activities
- Mechanical Integrity Workflow: Guides users through referencing the relevant equipment form, assigning the Inspection, Testing, or Preventive Maintenance (ITPM) task, approving the request, scheduling the work, entering and reviewing the data, ensuring the next ITPM data is appropriate, scheduling issue resolutions, updating documentation as needed, and closing the workflow.

A case study highlights how PSE and a Mechanical Integrity / Asset Integrity workflow could have helped to prevent this disaster by managing mechanical integrity effectively.

Introduction

Asset Integrity Management (AIM) or Mechanical Integrity (MI) is crucial to the Occupational Health and Safety Administration (OSHA) Process Safety Management (PSM) 29 CFR 1910.119 standard. This element maintains the equipment in the covered process per Recognized and Generally Accepted Good Engineering Practices (RAGAGEP) and/or manufacturers' recommendations to ensure it is always suitable for the intended use. Businesses often encounter challenges managing an AIM program, as it involves the intricacies of developing and implementing the policies, procedures, and workflows to create and execute Inspection, Testing, and Preventive Maintenance (ITPM) of PSM equipment and track ITPM deficiencies. Tracking recurring ITPM and resolving deficiencies requires considerable time and resources. Overlooking these tasks risks the safety of employees, the plant assets, the community, and the environment. Moreover, an accident could lead to production interruptions.

An effective AIM program should include capturing the design parameters and specifications of PSM equipment and the Recognized and Generally Accepted Good Engineering Practices (RAGAGEP) used to design the equipment and choose the materials of construction. The manufacturers' operating manual can also identify the required ITPM for equipment bought off-the-shelf (pre-engineered equipment.) A document management system is needed to gather, use, and maintain this important information.
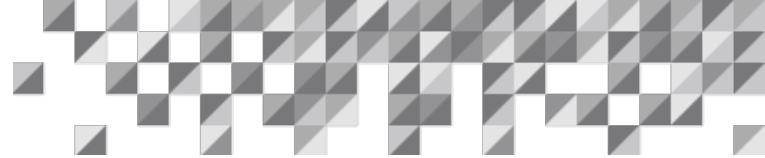
The AIM system should also document the required ITPM and frequencies for the equipment within and in support of the PSM process using the established RAGAGEP and/or manufacturers' recommendations. A workflow works best to document and anticipate the upcoming ITPM, especially for extended shutdowns that require extensive pre-planning. The workflow should specify whether the ITPM can be done with the plant fully functioning, the plant shutdown and energized or de-energized, or the specific equipment de-energized or energized but idle. These distinctions are very important for planning purposes.

The ITPM workflow should also assign the ITPM to qualified internal employees or contractors with the expected start and end dates. Depending upon the site procedures, the managers should seek relevant management approvals from Maintenance, Environmental, Health, and Safety (EHS), Operations, or others.
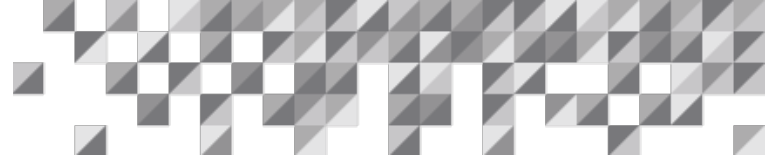
The workflow should also specify if permits such as confined space entry, hot work, or line breaking are required and if scaffolding or lifting equipment is needed to access the equipment. If critical equipment has been identified, this information should be part of the AIM workflow to allow prioritization when needed. The process should also state whether positive material identification is required when replacing piping, parts, and equipment.

After completing the ITPM, the report should be saved in a file linked to the equipment. A qualified person should review and approve the report and determine if any deficiencies must be addressed.

The AIM workflow should manage ITPM deficiencies and provide a process for the qualified person to determine how to address and track them. Typical options include taking the equipment with the deficiency out of service, mitigating the equipment or procedures to operate the equipment safely before the repair can be made, conducting a fitness-for-use evaluation, initiating a temporary repair before the permanent repair can be made, or approving a permanent repair. The decisions and approvals for each option should be included in the workflow with the option of generating a Management of Change if planned modifications are not replacement in kind.

Effective AIM systems help companies document, plan, and execute required ITPM based on RAGAGEP and/or manufacturer's recommendations and address equipment deficiencies. Both workflows help companies comply with the PSM requirements of the 29 CFR 1910.119 standard.

For businesses serious about implementing a comprehensive and evergreen PSM compliance system, ioMosaic offers the Process Safety Enterprise® (PSE) (Figure 1). PSE is a cloud-based platform enabling easy ongoing management of process safety data, helping businesses achieve compliance, manage risk, and remain competitive. Unlike any other system available in the market today, PSE is a centralized web-based application that integrates all PSM elements and workflows,

making it THE ultimate solution for managing AIM systems effectively. This white paper will delve into the key features of the AIM workflows and how they benefit companies seeking to improve and elevate their AIM system to eliminate or mitigate catastrophic incidents caused by deficient equipment.

To help you better understand the requirements of the PSM standard, we recommend training, like the PSM Essentials eLearning course offered by Process Safety Learning®. We also recommend the Basic and Intermediate AIM eLearning courses.

Figure 1. Process Safety Enterprise® (PSE)
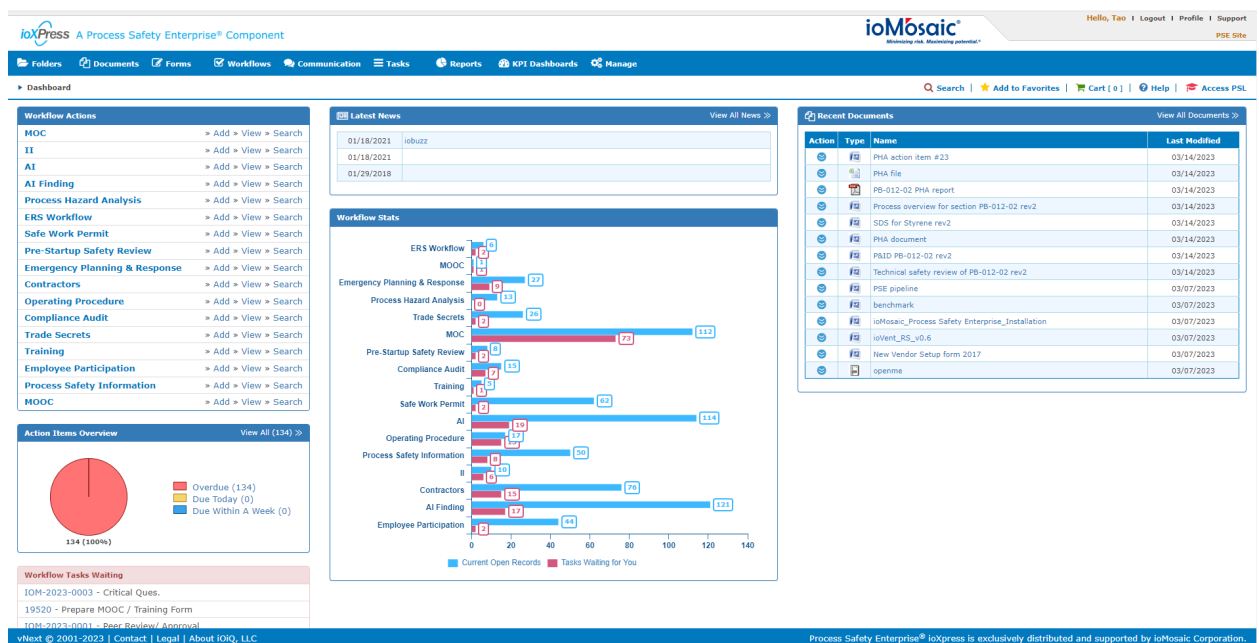
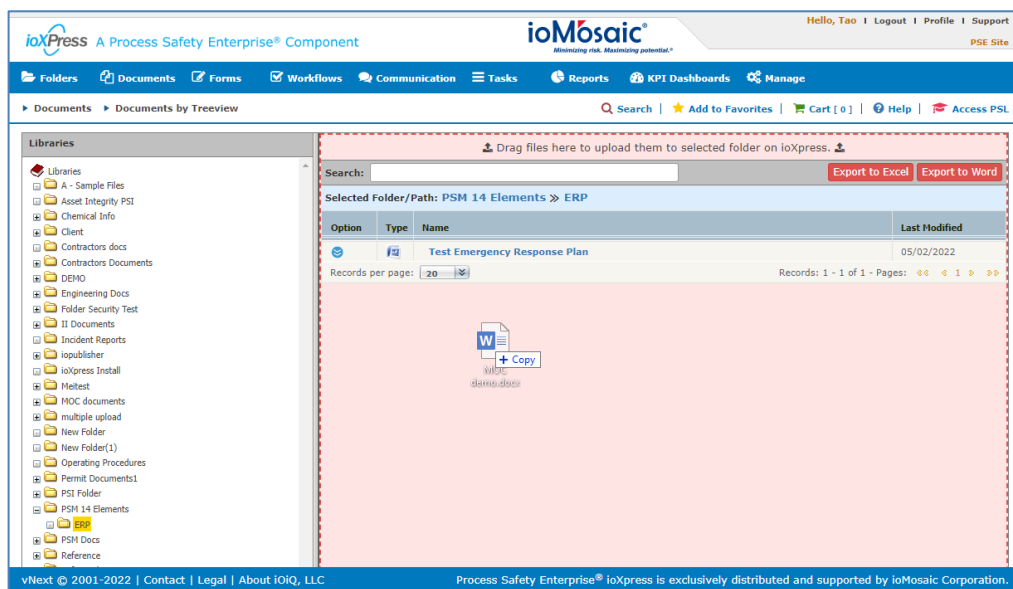Source: ioMosaic Corporation – PSE

Document Control System

The document control system of PSE's platform is a key component facilitating easy access to all critical process safety data. It allows users to add documents using a simple drag-and-drop (Figure 2) feature. This action quickly organizes documents into folders for easy retrieval. Its advanced search function indexes all documents with full text, allowing users to find necessary information quickly. An embedded document viewer feature not only enhances accessibility but also bolsters security measures. By granting users view-only permissions, they can view documents as images, preventing unauthorized downloads and eliminating the need to log into their computers for access. This document control component is an effective tool for managing various data types, including but not limited to engineering data, process safety information (PSI), equipment forms, procedures,
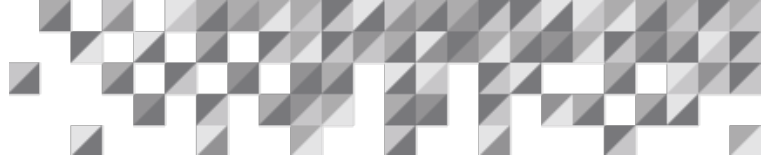
records, pictures, videos, animation, and reports. This component further ensures that all stakeholders have easy access to vital information related to the AIM system stored in a centralized location.

Figure 2. Drag and drop feature to add document(s)

Source: ioMosaic Corporation – PSE

Intelligent Form Builder

PSE also includes an intelligent form builder for efficient data capture and linking to documents in a central digital library. This dynamic form builder enables users to create practical, customizable forms to capture equipment design parameters and materials of construction. Equipment specifications, criticality, damage mechanisms, and the type and frequency of ITPM can also be easily captured on dynamic forms.

The ability to customize forms for unique equipment forms ensures that all necessary data is captured accurately and consistently. Moreover, this feature allows for easy export of data to an Excel format, making data analysis and sharing even more seamless. Implementing a customizable form builder like the one in PSE streamlines an AIM process by capturing data accurately and efficiently.

Figure 3 shows an example of an equipment form. The tab for "Inspection Records" documents the required ITPM and frequencies. The AI workflow can be accessed directly from this tab to launch the AI workflow and execute the required ITPM.
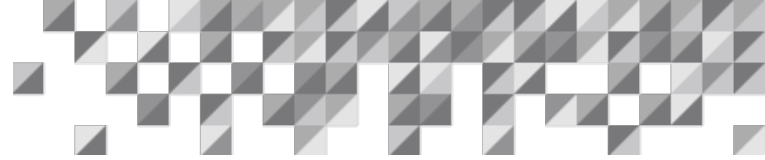
Figure 3. Example of Equipment Form

Source: ioMosaic Corporation – PSE

Asset Integrity Workflow

PSE is the only process safety platform that integrates all of OSHA's Process Safety Management (PSM) elements using visual workflows in a single enterprise system. This workflow includes PSM's 14 elements using workflows, action tracking modules, and document control. The Asset Integrity (AI) and Asset Integrity Finding workflows allow companies to access and manage their equipment data, ITPM plans, and deficiency information more efficiently and easily.

The Asset Integrity workflow establishes steps for initiation, work order generation, approvals, scheduling, reporting, capturing costs, reviewing and approving the work, verifying or changing established tests and intervals, updating documentation, addressing deficiencies, and closing the workflow. This workflow (and all PSE workflows) is easily customized to meet the specific needs of any company.

PSE's Asset Integrity workflow module includes pre-built equipment forms for typical equipment, such as pressure vessels, pumps, and interlocks. The forms capture pertinent PSI, such as the equipment specifications, criticality, damage mechanisms, and ITPM tasks and frequencies. These pre-built forms ensure a company's AIM process is consistent and captures all necessary

information. Unique equipment forms can also be added easily. The workflow also includes approvals from key managers that can be company-specific.

Figure 4 illustrates the steps in the AI workflow steps. Completed steps are in blue, Inactive steps in light gray, Not applicable steps in dark gray, and Ready steps are in green. The workflow can only be closed once all required steps are completed.

The two green Ready steps illustrate that the current ITPM can be finalized while the AI Finding workflow is started. The Start AI Finding workflow step will be gray and Not Applicable if no deficiencies are found.

The AI workflow within PSE ensures the PSM equipment and equipment that supports the PSM process, such as fire equipment, are routinely maintained per the OSHA standards and guidelines.
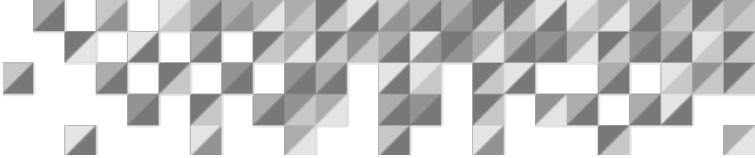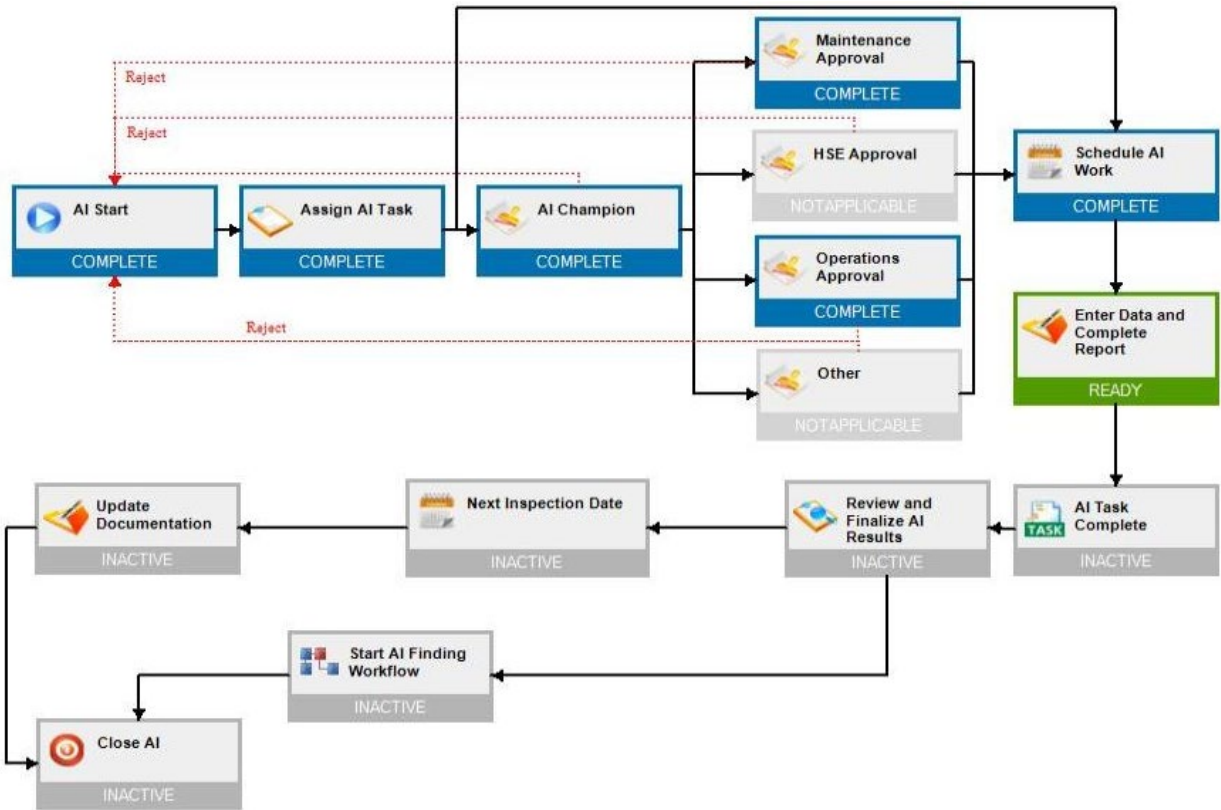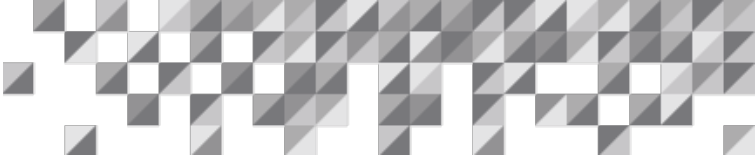
Figure 4: Example of Asset Integrity Workflow

Source: ioMosaic Corporation – PSE

Asset Integrity Finding Workflow

PSE's Asset Integrity Finding workflow module can be initiated from the AI workflow or directly within the AI Finding workflow. If this workflow is generated from the AI workflow, the essential information will be pre-populated to save time and ensure that the two workflows have identical data.

The Asset Integrity Finding workflow establishes steps for initiation, various workflows depending upon how the finding will be managed, completing and approving the chosen action, updating documentation, conducting training, and closing the workflow. Management of Change (MOC) is either required or an option within the workflow, depending upon the action taken. For example, taking equipment out of service would require an MOC. If an MOC is required, the MOC workflow can be initiated from the AI Finding workflow and will pre-populate the key information. The AI Finding workflow can be customized to meet the specific needs of any company.

Figure 5 illustrates the AI Finding workflow steps, including Take Equipment Out of Service, Initiate and Complete Fitness-for-Service (FFS) Evaluation, Continued Service with Mitigation, Continued

Use and Repair in a Timely Manner with the option of a Temporary Repair Required Before Continued Use, and Repair Required Before Continued Use. This workflow has the same colors and designation as the AI workflow. The workflow can only be closed once all required steps are completed.

The AI Finding workflow within PSE ensures thorough documentation and tracking and the timely resolution of equipment deficiencies to completion as required by the OSHA standards and guidelines.

Figure 5: Example of Asset Integrity Finding Workflow
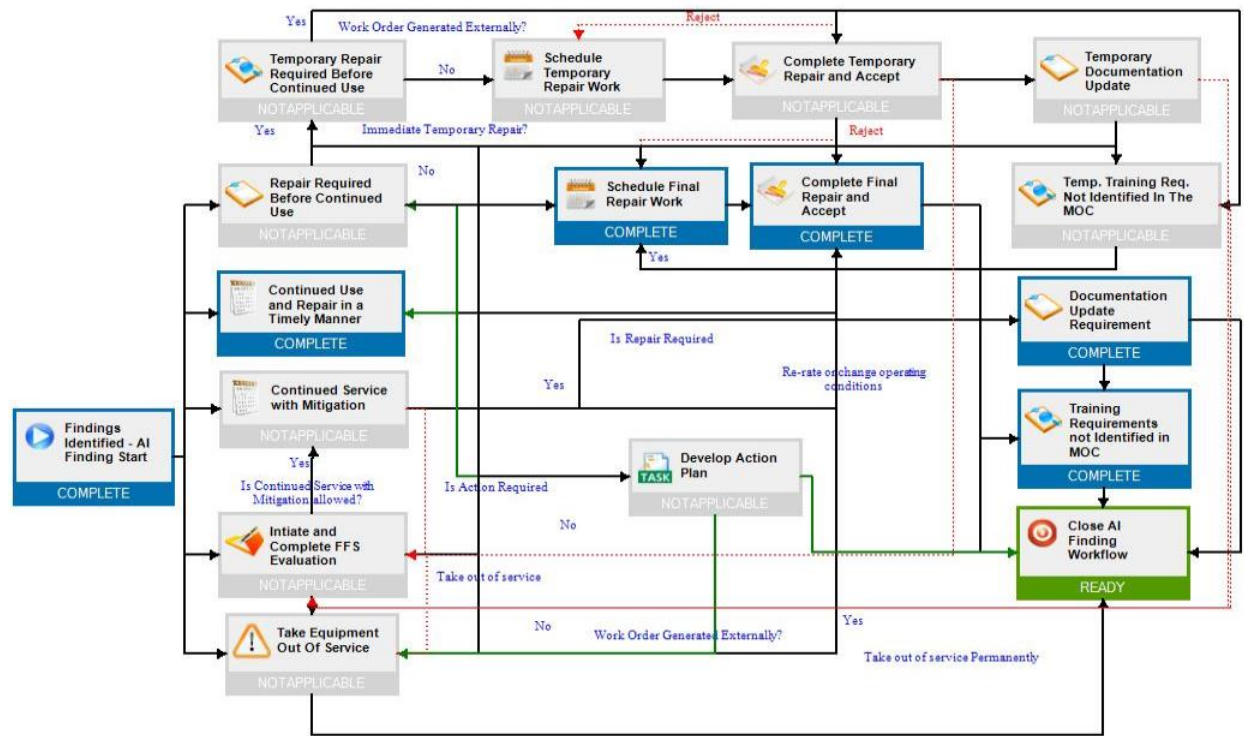
Source: ioMosaic Corporation – PSE

Action Tracking System

PSE features a comprehensive action item management system (Figure 6). It tracks all tasks related to each process safety management workflow, such as AI and AI Findings. This feature ensures that all action items are managed within the platform, reducing or eliminating the risk of overlooked or forgotten tasks. An additional feature, the 'Automatic Reminders,' enforces all tasks to be completed on time.
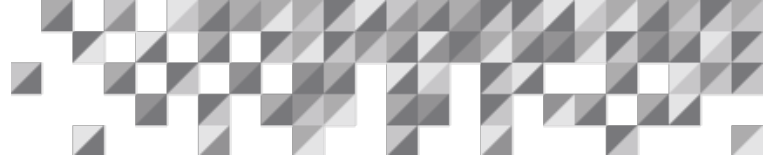
Figure 6. AI Action item

Source: ioMosaic Corporation – PSE

Reporting and Dashboard/KPI

Effective dashboards (Figure 7) and reports (Figure 8) are invaluable 'must have' assets for any data-driven enterprise looking to increase performance and productivity. With well-designed dashboards featuring various widgets such as bar charts, pie charts, line charts, and tables, PSE provides a comprehensive overview of the PSM program from a single source. These dashboards allow business owners to make quick, informed decisions at a glance based on real-time data.

Customizable reports are available for Inspections and Findings. The inspection Report tracks ITPM due within the timeframe chosen at the top, and Overdue Inspections show all ITPM past its due date. This report can be used to plan shutdowns. The Findings Report shows the same information for Findings currently being worked on (open) and those past their expected resolution date.

Moreover, the reporting and dashboard capabilities provide real-time visibility into AIM-related activities, allowing organizations to quickly identify trends and areas of concern. This capability enables timely corrective action, reducing the risk of incidents and non-compliance. PSE's robust reporting and dashboard/KPIs are essential tools for optimizing operations and mitigating potential risks.
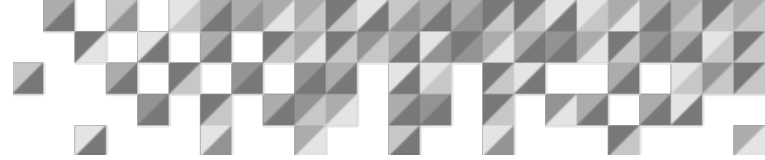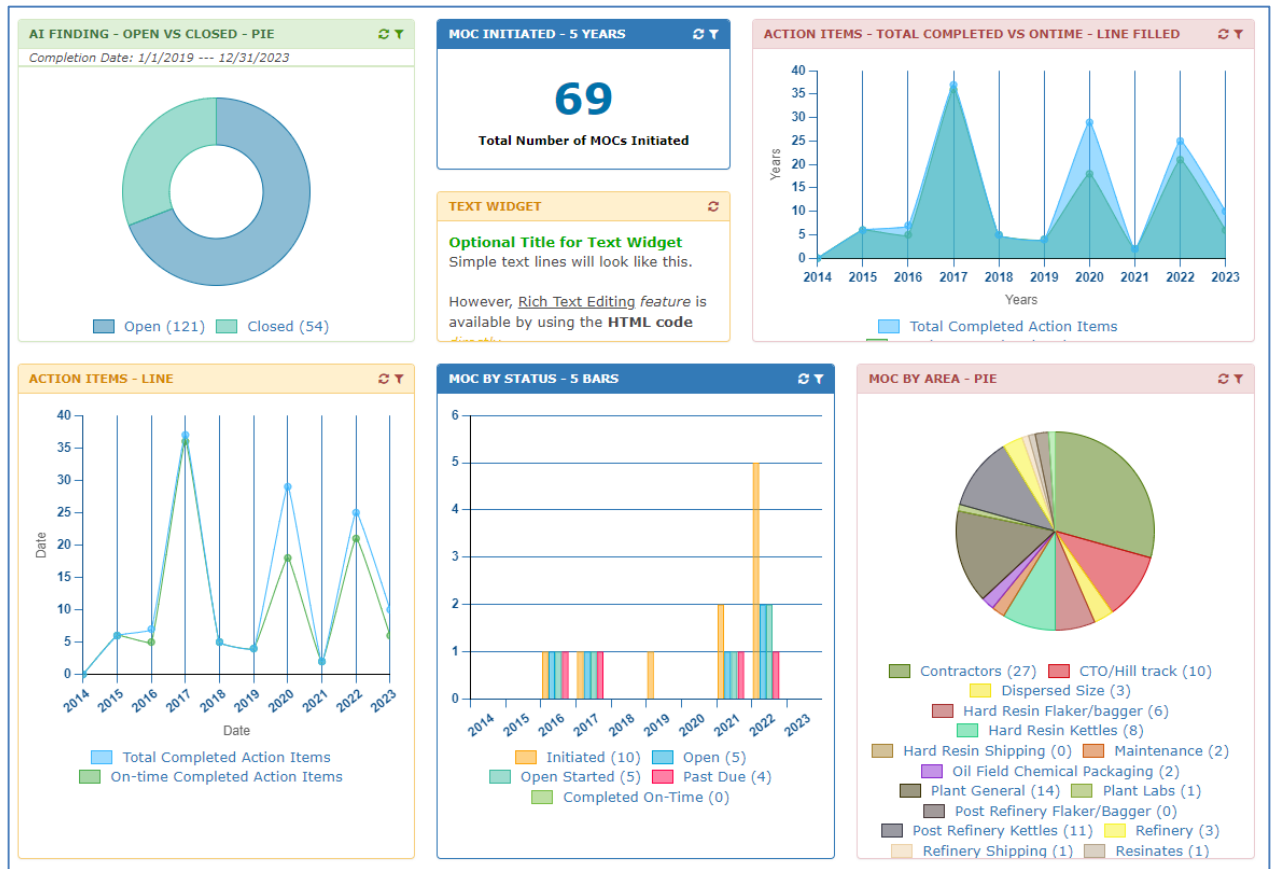
Figure 7. Dashboard/KPI
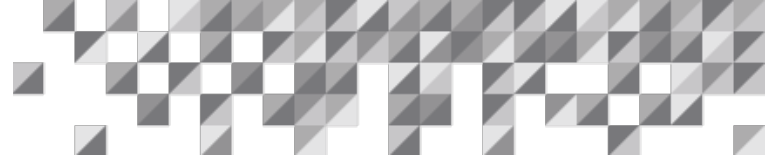

Source: ioMosaic Corporation – PSE

Figure 8. Inspection Report (Due and Overdue)

| AI Dashboard | Inspection Reports | Findings Reports |

Start Date: 11/10/2023   End Date: 5/10/2024

| Equipment Type | Inspection Type | Plant Site | Units Name | Equipment Criticality |
| Select item(s) | Select item(s) | Select item(s) | Select item(s) | Select item(s) |

Run Report

Inspection Due Report   Export to Excel   Display 10 records Per Page

Equipment Number	Form Name	Equipment Type	Inspection Type	Next Inspection Date ▼	Plant Site	Unit Name	Equipment Criticality	PMI?	Operation Status	Inspection workflow started?	AI Due Date
P-444	15061 - dddd / AI - Centrifugal Pump	Pump - Centrifugal	Lube Equipment	12/6/2023	Dispersed Size	B and G	B- High	Yes	Full production	No	N/A
P-444	15061 - dddd / AI - Centrifugal Pump	Pump - Centrifugal	Vibration	12/13/2023	Dispersed Size	B and G	B- High	Yes	Full production	No	N/A
222	15487 - / AI - Agitator	Agitator	Functionality Check	1/9/2024	CTO/Hill track	Asphalt Plant	B- High	No	Equipment energized & idle (not producing material)	No	N/A

Page 1 of 1 | 1   Total Records: 3

Inspection OverDue Report   Export to Excel   Display 10 records Per Page

| Equipment Number	Form Name	Equipment Type	Inspection Type	Next Inspection Date ▼	Plant Site	Unit Name	Equip Criticality	PMI?	Operation Status	Inspection workflow started?	AI Due Date
A-123	15120 - R-123 Agitator / AI - Agitator	Agitator	Vibration	1/18/2020	Hard Resin Kettles	B and G	B- High	No	Full production	AI Workflow 15122	08/27/2020
P-234	14839 - P-234 / AI - Piping Circuit	Piping Circuit	Thickness	7/1/2020	Post Refinery Kettles	Asphalt Plant	C- Medium	No	Full production	No	N/A
444	14687 - 444 / AI - Pressure Vessel	Column - Packed	Electrical PM	7/1/2020	Hard Resin Flaker/bagger	B and G	C- Medium	No	Plt SD & de-energized	No	N/A
PSV-222	14932 - xsss / AI - Relief Valve	Other	Pull for inspection	8/5/2020	Post Refinery Kettles	B and G	A - Very High	No	Equipment energized & idle (not producing material)	No	N/A

Source: ioMosaic Corporation – PSE

Case Study – The Consequences of a Deficient AIM Program

The Challenge

The US Chemical Safety and Hazard Investigation Board (USB) investigated the January 9, 2014, Freedom Industries chemical spill in Charleston, West Virginia. According to the USB, Freedom Industries spilled approximately 11,000 gallons of a mixture that primarily contained Methylcyclohexane methanol (MCHM) and a lesser amount of polyglycol ethers into the Elk River. Tank 396 was found to have internal pitted corrosion that created the two holes that leaked the mixture.

The mixture made it downstream to the West Virginia American Water (WVAW) water treatment plant, which could not treat and remove all the chemical mixture from the drinking water. WVAW issued a do-not-use order for the drinking water, which impacted about 300,000 residents. Even with the order, 369 emergency room visits were believed to be linked to people exposed to the water. Symptoms included nausea, vomiting, and abdominal pain. Many businesses, schools, and public offices were also closed.

The CSB found no documentation of prior inspections or maintenance for tank 396. They also found the dike that should have contained a tank spill to have cracks and holes the leak traveled through. Freedom was aware of the dike's issues but did not repair them before the incident. Finally, the leak traveled down a deteriorated underground culvert and reached the river.
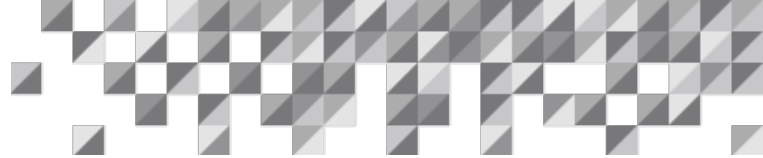
A robust AIM program should have been in place to avoid this disaster. However, an existing program solely relying on individuals to track and execute the required Inspection, Testing, and Preventive Maintenance (ITPM) and maintain the documentation can be prone to human error. Creating a documented program that relies on an electronic program for managing the AIM program can improve process safety oversight and employee and contractor safety. An electronic program can also reduce the risk of worker fatalities and injuries using appropriate hazard management and reduce the risk of catastrophic events due to equipment malfunction or failure.

This article, The Price of a Deficient Asset Integrity Program, can help your company understand the consequences of a deficient AIM program and access training information and checklists to begin creating or improving your AIM program.

Our Approach

The Process Safety Enterprise® Asset Integrity and the Asset Integrity Finding Workflows are part of a cloud-based platform that provides a centralized database accessible and visible to all employees and contains a step-by-step guided workflow. This workflow could have minimized or eliminated the Charleston incident referenced in the case study.

Additionally, PSE can integrate multiple sites and various data into one uniform system (which would have further minimized the incident) by:

- Setting up sign-on access for users at all facility sites
- Identifying and developing consistent data definitions and metrics
- Standardizing search queries to ensure data quality
- Devising site-specific and corporate reporting capabilities

Customizable workflows are available within PSE and can assist with creating unique AIM forms and workflows.

PSE's built-in features, such as the automatic assignment of approvals, action item tracking, document linking, and email notifications, all contribute to ensuring the documentation and execution of the AIM program are properly captured, accessible, and visible to employees.

The Benefits

For companies serious about their process safety compliance and AIM program, PSE is a user-friendly platform with workflows for document control that is scalable and affordable.
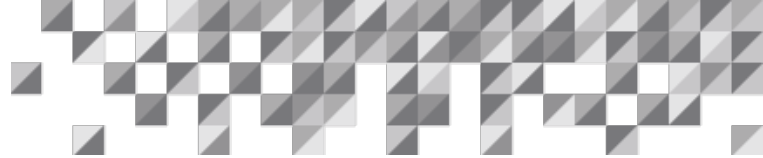
PSE is a user-friendly Computerized Maintenance Management System (CMMS) that is scalable and affordable for those companies who do not want to implement a large and complicated system. The organized workflows and equipment forms streamline creating, executing, tracking, and documenting the required ITPM for the covered process.

The equipment forms streamline the process of documenting and maintaining the Process Safety Information for pressure vessels, tanks, piping, and other equipment within the covered process or that supports it. The equipment forms provide a tab for creating and documenting the required ITPM and frequencies for each piece of equipment or controls. The AI workflow can be initiated from that tab to execute the ITPM, or the user can go straight to the AI workflow. Any deficiencies found within the AI workflow can prompt initiating the AI Finding workflow from the workflow. Key information is automatically populated to the Finding workflow to save time and ensure data consistency.

Finally, the PSE workflows have metrics that can track overdue workflows and the percentage of open or overdue workflows. The metrics are graphed with interactive data, allowing you to drill down to the specific data. This feature saves time as the user investigates potential issues with the AIM program. Reports can also be generated to view the status of all workflows.
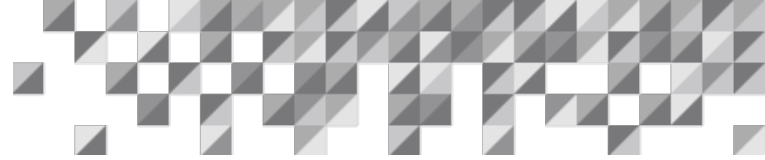
Conclusion

Managing an AIM program effectively and consistently can be challenging; fortunately, Process Safety Enterprise® (PSE) provides an integrated solution that makes the AIM process more efficient and effective. With its dynamic form builder, action tracking feature, and integrated workflows to standardize the process, companies reduce the risk of incidents and non-compliance.

PSE offers additional benefits, including enhanced collaboration, improved data management, and increased compliance with process safety regulations. With the reporting and dashboard capabilities, organizations can easily identify trends and potential areas of concern, gaining real-time visibility into all process safety-related activities. The automatic notification system sends reminders and alerts, ensuring items are addressed in a timely manner.

PSE's customizable AIM workflow modules include AI integrity and AI Findings workflows that execute required ITPM and track deficiencies to completion. These workflows ensure all required work is completed and information is captured in one centrally located platform.

PSE is the only product of its kind in the market today that provides an all-inclusive process safety compliance platform that makes compliance easy.

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Useful Links

PSE link to software demo requests

PSE link to PSE overview

AIM basic training information Link

AIM intermediate training information Link

AIM checklist Link

AIM Article Link

Additional PSE White Papers:

PSM Compliance Made Easy with Process Safety Enterprise®

Effectively Manage Changes to Processes, Chemicals, Equipment, and Personnel Using PSE

Process Safety Enterprise® Asset Integrity Management Service (AIMS) and KPI Dashboard