# Process Safety Forum

Knowledge Exchange Note #008 – Issued on 13th April 2026

## Artificial Intelligence in Major Hazard Industries

*This knowledge exchange note is shared in order to promote learning and improve safety. You should seek appropriate guidance regarding the relevance, accuracy, and completeness of this alert to your circumstances prior to implementation.*

### Theme

Leadership, Management Systems, Risk Management, Learning Organisation

Awareness-raising of the potential impact of Artificial Intelligence developments on Process Safety and major accident risk management.

Sector: Cross-sector (Energy, Chemicals, Manufacturing, Infrastructure)

NOTE: The aim of this Knowledge Exchange is to inform and raise awareness – however, the development of AI technology, applications and governance is a rapidly changing landscape. Accordingly, caution should be exercised in using the content of this document, and PSF may issue future information reflecting changes in all these aspects as they develop.

### Summary of Issue

How should Artificial Intelligence systems be governed when they influence decisions affecting Major Accident Hazard (MAH) risk?

PSF member organisations are increasingly encountering AI-based tools proposed for predictive maintenance, inspection prioritisation, alarm analytics, anomaly detection, operational monitoring and a rapidly broadening range of applications. These technologies offer potential operational benefits but also raise questions regarding governance, accountability, and assurance when they influence major-hazard risk management.

This knowledge exchange note summarises emerging industry thinking and highlights practical governance principles that may assist organisations considering the use of AI in safety relevant applications.

### Current Status

Artificial Intelligence technologies are rapidly becoming embedded within industrial operations. The rate of change in the state of the art is currently measured in months, meaning that application-specific guidance will quickly become outdated. For this reason, the focus of this note is on governance principles likely to remain relevant as technology evolves. Applications integrating these technologies across high-hazard industries include, and are not limited to, the following:

- predictive maintenance systems analysing equipment health
- anomaly detection within process data
- inspection and maintenance prioritisation tools
- alarm management analytics

- computer vision monitoring of operational activity
- engineering and process safety support tools, e.g. HAZOP assistants

These technologies may improve efficiency and provide additional insight into asset condition and operational behaviour. However, when AI tools influence decisions that affect MAH risk management, they introduce new considerations regarding reliability, transparency, governance, and human oversight.

Major hazard industries rely on well-established frameworks based on hazard identification, barrier management, operational discipline and independent assurance. An example is the Energy Institute PSM Framework, whose 20 Elements cover all aspects of risk management – grouped under 4 areas (Process Safety Leadership; Risk Identification and Assessment; Risk Management; and Review & Improvement).

AI systems should therefore be understood within this context rather than treated purely as digital innovations.

Furthermore, existing regulatory regimes already apply, and will continue to do so. Duty holders remain responsible for controlling risks so far as reasonably practicable, regardless of whether decisions are made by humans or by machines.

## AI Interaction with Major Accident Hazard Barriers

AI systems can influence different aspects of MAH risk management, including the following:

*Monitoring and diagnostics*
Examples include predictive maintenance, anomaly detection and condition monitoring systems that identify emerging equipment degradation or abnormal plant behaviour.

*Decision support*
AI may influence inspection prioritisation, maintenance scheduling or alarm analysis. In these cases, the system informs human decisions rather than executing them directly.

*Operational optimisation and control*
More advanced systems may interact with process control strategies or operational optimisation tools. As AI moves closer to operational control, the potential implications for MAH risk management increase.
Regardless of application, organisations should consider whether the use of AI could influence the integrity or performance of major accident hazard barriers.

## Core Governance Principles

Where AI interacts with MAH risk, organisations should apply the same discipline used for other safety-critical systems.

Implementing the following governance principles may assist organisations considering AI adoption:

*Treat it like a safety-critical system*
If AI has the potential to influence MAH management, it should be subject to appropriate engineering discipline. This includes testing, validation, defined operating limits and performance monitoring.

*Document it like part of the safety case*
The role, assumptions and limitations of AI systems should be clearly described within safety management systems and, where appropriate, within Safety Cases or COMAH safety reports.

*Monitor it like a barrier that may become degraded*

AI performance should be monitored to identify drift, deterioration or unexpected behaviour. Monitoring approaches may mirror existing barrier health monitoring practices already used within MAH management systems.

*Never allow AI to operate without human accountability*

Duty holders retain full responsibility for managing major accident hazards. AI should support human decision-making rather than replace it. Personnel responsible for operational control must remain competent to interpret outputs, challenge recommendations and override automated decisions when necessary.

## Board Oversight and Governance

Where AI systems influence MAH risk management, their adoption should be visible within existing governance arrangements.

Boards and executive leaders in high-hazard industries retain responsibility for overseeing major accident risk and ensuring appropriate control frameworks exist.
Boards should therefore ensure that:

- AI applications affecting safety-critical decisions have clear executive ownership
- the role and limitations of AI systems are understood at leadership level
- assurance processes exist to validate system performance where AI is involved
- organisations retain sufficient competence to challenge AI automated outputs
- AI-related risks are incorporated into existing risk management and assurance processes

AI governance should not sit solely within digital or IT functions. Where these systems influence inspection, maintenance, barrier monitoring or operational decisions they should be visible within established MAH governance arrangements.

The pace of development in Artificial Intelligence technologies is rapid. Boards should therefore ensure they receive periodic updates on the organisation's use of AI and the associated risk controls. Governance arrangements, policies and procedures relating to AI should be reviewed and reassessed at an appropriate frequency to ensure they remain effective as technology and its applications evolve.

## Potential Challenges

Organisations implementing AI in high hazard environments may encounter several challenges in these broad areas:

*Data quality*

AI systems depend heavily on historical data which may not adequately represent abnormal operating conditions or failure scenarios.

*Model drift*

Performance may deteriorate over time as operating conditions change or new data patterns emerge.

*Workforce capability*

Personnel must understand how AI tools operate, their limitations and how outputs should be interpreted.

*Integration with legacy systems*

Industrial environments and processes often involve complex interactions between digital tools, control systems and safety instrumented functions which may span various technologies over several decades.

*Cyber security*
Data integration and connectivity may introduce new cybersecurity considerations.

There may be tension between protecting operational data and sharing data with technology providers. Organisations will need pragmatic governance arrangements to manage this balance.

## Actions for Industry

PSF members may wish to consider the following actions as a starting point:

*Strengthen governance*
Ensure AI applications affecting MAH risk are incorporated within risk management, management of change and assurance processes.

*Maintain engineering discipline*
AI tools should not bypass established safety engineering practices or MAH barrier management frameworks.

*Integrate AI failure modes into hazard analysis*
Potential AI-related failure modes may need to be considered during hazard identification, risk assessment and alarm rationalisation studies where relevant.

*Maintain human competence*
Automation should not erode the vital role of competent people, exercising sound engineering judgement or diagnostic capability within operational teams managing plant and processes.

*Share learning across sectors*
The PSF knowledge exchange mechanism provides an opportunity for organisations to share experiences and emerging practices relating to AI deployment in high hazard environments.

## Conclusion

Artificial Intelligence technologies are likely to become increasingly common and intertwined within industrial operations. These tools offer opportunities to improve monitoring, analysis and operational efficiency. However, where they influence major accident hazard management they introduce new governance considerations.

Major hazard industries already possess robust risk management frameworks built around engineering discipline, barrier integrity and human accountability. The safe adoption of AI will depend on ensuring that these principles continue to apply.

Wherever AI touches MAH risk, organisations should treat it with the same rigour applied to any other safety-critical system. The pace of change with AI developments also requires that organisations continually update and review AI's role in their organisation, operational processes and governance.

## Further reading – previously circulated PSF documents and existing guidance:


1. Institute of Directors and Process Safety Forum (2025) *Standard – Business Risk Management Competency for Board Members of High Hazard Industries.* London: Institute of Directors and Process Safety Forum.

2. Institute of Risk Management (2025) *Digital Ethics Guidelines: AI Ethics Addendum for Large Language Models and Generative AI.* London: Institute of Risk Management.

3. Process Safety Forum (2019) *Operational Guidance.* Process Safety Forum. Available at: https://www.p-s-f2.org.uk (Accessed: March 2026).

4. Process Safety Leadership Group (2008) *Safety and Environmental Standards for Fuel Storage Sites – Final Report.* Buncefield Major Incident Investigation Board.

5. Process Safety Leadership Group (2025) *Principles of Process Safety Leadership.*

6. Salus Technical Presentation to the OEUK HSE Conference, 2026

7. Health and Safety Executive (2015) *Control of Major Accident Hazards Regulations 2015.*

8. Health and Safety Executive (2015) *Offshore Installations (Safety Case) Regulations 2015.*