European Commission

Joint Research Centre

Common Inspection Criteria for Incident Investigation Programmes

A Seveso Inspection Series Publication

Wood, M.

2026

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Joint Research Centre
https://joint-research-centre.ec.europa.eu

JRC144774
EUR 40590

PDF ISBN 978-92-68-35193-2 ISSN 1831-9424 doi:10.2760/3547730 KJ-01-25-661-EN-N

Luxembourg: Publications Office of the European Union, 2026

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How to cite this report: Wood, M., *Common Inspection Criteria for Incident Investigation Programmes - A Seveso Inspection Series Publication,* Publications Office of the European Union, Luxembourg, 2026, https://data.europa.eu/doi/10.2760/3547730, JRC144774.

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Abstract

This publication on Common Inspection Criteria is intended to share knowledge about technical measures and enforcement practices related to major hazard control and implementation of the Seveso Directive (2012/18/EU). The criteria were developed by Seveso inspectors to aid in dissemination of good enforcement and risk management practices for the control of major industrial hazards in Europe and elsewhere. This particular issue provides criteria for assessing the adequacy of incident investigation programmes established by operators of Seveso III sites.

the Seveso Directive requires site operators covered by the Directive to demonstrate that they have an effective incident investigation programme. However, there are a wide variety of approaches to shaping an incident investigation programme. Moreover, incident investigation and accident analysis are niche fields within process safety, which means that there is an opportunity to spread knowledge in this area through publication of these performance criteria.

Note that this document is not intended as a technical standard nor as a summary or replacement of any existing standards on the matter. This publication is part of the ongoing series of publications on Common Inspection Criteria (CIC) to support inspection by authorities who have responsibility for monitoring and oversight of hazardous sites. The criteria were developed by the EU Technical Working Group for Seveso inspectors, representing the collective knowledge and experience of inspectorates throughout Europe with responsibility for implementing inspection requirements of the EU Seveso Directive (2012/18/EU) for the control of major chemical hazards. The publication is intended to aid the dissemination of good enforcement and risk management practices for the control of major industrial hazards both in Europe and elsewhere.

1. Introduction

Since the establishment of the Seveso Directive in 1982, the Major Accident Hazards Bureau (MAHB) of the European Commission's Joint Research Centre (JRC) has provided scientific support to this European legislation aimed at prevention and mitigation of major accidents involving hazardous substances. The Seveso Directive is based on a performance-based framework, driven by the nature of substances involved, and employs a proportional risk-based approach. In particular, MAHB analyses accidents for lessons learned and emerging trends, facilitates exchange of challenges and practices across Member States, and makes the information that it creates and collects available through various tools and publications.

One of JRC's most important roles has been fostering Member State exchange on challenges and good practice for inspecting major hazard, so-called "Seveso", sites. Notably, the sources of chemical accident risk are highly diversified, far more than any other technological risk, such as aviation or nuclear energy risk, The EU database of Seveso establishments (eSPIRS) specifically identifies 38 different industries. Moreover, many of these industries are collections of several subindustries, e.g., the chemical and petrochemical industries can be divided into 50 or more subindustries. For this reason, there are hundreds of processes and substances, all of them with their own unique hazardous elements, that can be the source of a chemical accident. Through regular exchanges of the EU Technical Working Group on Seveso Inspections ("TWG 2"), the JRC enables the authorities to discuss complex issues surrounding the dynamic and diverse risk management concerns they face in performing their Seveso monitoring and oversight duties.

The TWG 2, guided by the JRC but led by representatives of EU/EEA Seveso inspectorates, prioritises topics for exchange. These topics can be focused on components of good safety management, necessary for all sites (so-called "horizontal topics") such as emergency response or risk assessment approaches. Alternatively, they can be targeted to managing risks associated with specific types of dangerous substances or in specific industries (so-called "vertical topics"). The TWG 2 has created a number of product lines within the Seveso Inspection Series of publications for disseminating good practice based on these exchanges.

2. Common Inspection Criteria: Background and Purpose

The Common Inspection Criteria publications is one of these product lines. First conceived in 2013, it is intended to aid the dissemination of performance criteria that can be used to promote effective enforcement approaches across EU inspectorates, and by extension, risk management practices on chemical hazard sites. As with all products of the TWG 2, the entire complement of Common Inspection Criteria publications can be found on the JRC's Seveso Inspection Series web portal.

Notably, the Common Inspection Criteria do not provide scientific explanations of the hazard phenomena they are addressing or risk management requirements of the Seveso Directive. This choice is deliberate since the criteria are intended for EU process safety experts, not the general public. All such experts in the private and public sector would already have substantial knowledge of the Seveso Directive and chemical process safety principles and the main risks associated with usage and handling of dangerous substances in industrial contexts.

The CIC publications are intended to share findings from the collective knowledge of the EU Seveso inspector community. This document is not intended as a technical standard nor as a summary or replacement of any existing standards on the matter but as a reference that may be useful for EU competent authorities seeking to improve and enhance their Seveso inspection protocols.

In addition, the criteria are result-oriented without detailed guidance on how to set up an incident investigation programme. This approach is consistent with the performance-based philosophy of the Seveso Directive, in which operator compliance is based on achievement of objective requirements with freedom to choose the manner in which they are achieved.

The content of this publication are generally applicable to any chemical hazard site to ensure that when incidents occur, lessons are learned to prevent future accidents. Hazardous chemicals are present in a vast range of industrial, commercial and public sector activities. They are not only regularly used or handled in chemical and energy industries, but also are routinely present in such diverse activities as electronics production, paper manufacturing, water treatment, hospitals, farming, waste management, warehouses and logistics. While these criteria are targeted for use by inspectors of chemical hazard sites, they can be easily adapted also for use by operators of any establishment in any industrial or commercial sector that uses hazardous substances.

3. Common Inspection Criteria for Incident Investigation Programmes

The publication aims to provide a criterion for Seveso inspectors for assessing the incident investigation programme of a Seveso site operator. The recording and investigation of incidents are key inputs to risk management strategy of site operators as well as the wider network of plants and industries dealing with similar dangerous substances and process vulnerabilities. The results of incident investigation programmes lead to corrective actions that make sites safer, and even more importantly, to lessons learned that can make the plant, company and the industry safer over the long term.

For this reason, the Seveso Directive requires site operators covered by the Directive to demonstrate that they have an effective incident investigation programme. However, there are a wide variety of approaches to shaping an incident investigation programme. Moreover, incident investigation and accident analysis are niche fields within process safety, which means that there is an opportunity to spread knowledge in this area through publication of these performance criteria.

The Common Inspection Criteria on incident investigation is number 17 in the Seveso Inspection Series of publications. It is intended to provide baseline criteria to support effective and meaningful inspection of chemical incident investigation programmes on chemical hazard sites. The criteria are specifically associated with fulfilment of Seveso Directive requirements under Article 8 (5) establishing Safety Management System requirements that are further defined in Annex III.

The topic was selected by the EU Technical Working Group on Seveso Inspections as part of a series of Common Inspection Criteria on mitigating the effects of chemical accidents.

In large part, the knowledge shared in this publication on incident investigation represents the unique competence of the Major Accident Hazards Bureau in lessons learning and accident analysis, supported by the experience and expertise within the TWG 2. The EC's Major Accident Hazards Bureau is globally recognized for its expertise on this topic and within the EU on how this knowledge can be applied to achieve EU Seveso Directive requirements. On occasion, the author used other sources to complement and improve the document and these references are duly cited when relevant.

In this document, the scope and objectives of an inspection are described in Section 2. The criteria are presented in two parts in Section 3 and Section 4. Section 3 outlines the elements of a programme that demonstrate that the operator has an incident investigation process ready to launch when an incident occurs. Section 4 provides criteria for assessing that the operator has an appropriate follow-up programme to ensure that incidents are recorded and investigation findings are properly managed to improve safety.

4. Scope and objectives of the criteria

The criteria in this publication are associated with operator's obligation to implement a Safety Management System (SMS), as required by Article 8 and described in Annex III of the Seveso Directive. An incident investigation programme is an obligatory component of the SMS under item vi covering performance monitoring as follows (highlighted in bold):

> vi) monitoring performance — adoption and implementation of procedures for the ongoing assessment of compliance with the objectives set by the operator's MAPP and safety management system, and **the mechanisms for investigation and taking corrective action in case of non-compliance. The procedures shall cover the operator's system for reporting major accidents or 'near misses', particularly those involving failure of protective measures, and their investigation and follow-up on the basis of lessons learnt.** The procedures could also include performance indicators such as safety performance indicators (SPIs) and/or other relevant indicators …

The scope and objectives of an inspection of operator compliance with this requirement are summarised in Sections 2.1 and 2.2.

5. Scope of an incident investigation programme

In general, the inspector should expect that an incident investigation programme on a chemical hazard site will consist of:

— an incident investigation strategy that guides when and how incidents are conducted

— arrangements for the involvement of appropriate competences and other technical support

— protocols for identifying and making corrective actions and recommendations to the safety management system

— practices for recording incident information and assuring the completion of follow-up actions

Figure 1. Ten-point prompt list – Accident investigation

Source: Rospa website

Figure 1 presents the elements of the incident investigation process as recommended by the Royal Society of the Prevention of Accidents (RoSPA). It is an example of the many models and guidance available in open sources that hazardous site operators can consult to shape an incident investigation programme that meets the criteria in this publication.

5.1 Objectives of an inspection of the incident investigation programme

The inspection should verify that the operator's incident investigation programme fulfills the requirements of Annex III of the Directive. According to the Annex III element (vi), "monitoring performance, the operator must have:

— a system for reporting major incidents or near misses, particularly those involving failure of protective measures

— investigation of the incident for the purpose of identifying lessons learned

— follow-up to lessons learned in the investigation

By design, a well-managed incident investigation system would also ensure compliance with the requirements of Article 16 in the event of a major accident. In such a case, the operator must inform the relevant competent authority (or authorities) of essential findings of the investigation in terms of circumstances of the event, processes, substances, and other important factors, as well as the steps to be taken to mitigate effects and prevent a future incident of similar nature from recurring.

To demonstrate compliance with these requirements, the operator's programme should have elements in place that convincingly illustrate the operator's readiness to investigate and commitment to managing the outcomes to obtain and implement recommendations from the investigation findings.

1) **Readiness to investigate.** Elements to support this role includes all those components that facilitate the identification of relevant incidents for lessons learning, define the scope, objectives and procedures to follow, and assure the assignment of adequate resources to obtain sufficient understanding of how and why the incident happened and extract important lessons learned.

2) **Management of investigation outcomes.** This part of the investigation programme consists mainly of practices in place to record, disseminate and implement corrective actions and lessons learned from the investigation.

Sections 3 and 4 provide specific criteria for inspecting these two aspects.

6. Inspection of readiness to investigate

There are a number of elements in the investigation programme that are required to ensure Readiness to Investigate. At minimum, the programme should include the following:

— Criteria for identifying incidents for investigation

— Scaling and terms of reference

— Identification of roles and responsibilities

— Investigation action plan

— Selection of the investigation team

— Investigation procedures

7. Criteria for identifying incidents for investigation

The operator should have a defined criterion for incidents to be investigated. The criteria should start with the definition of a process safety event, including both

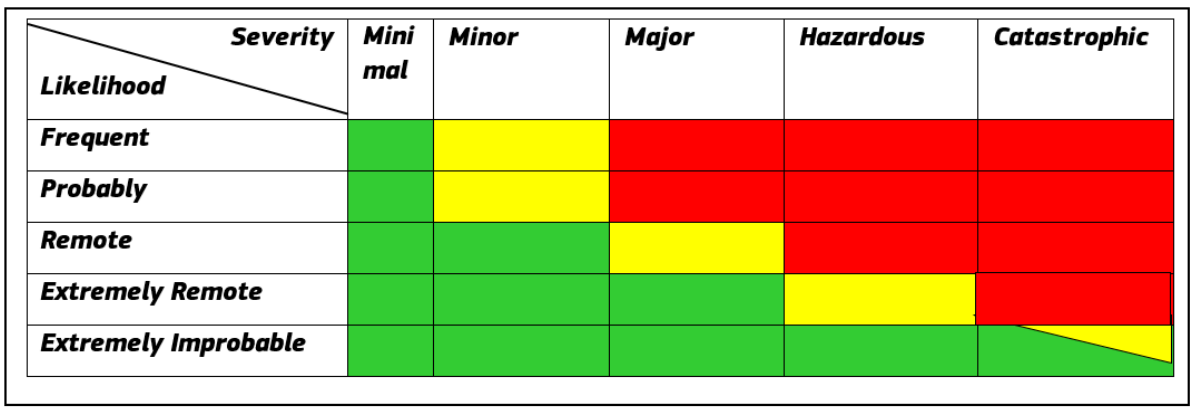
- incidents involving a release of a dangerous substance with minor or major impacts
- incidents, such as “near misses” that may or may not involve a release of a dangerous substance but had the potential to cause serious harm

At minimum, the criteria should further define what is considered a dangerous substance and also the criteria for determining classifying incidents as serious, near misses, and possibly other categories. Cowley suggests a classification system that defines an event either as an *actual accident,* a *near miss* or a *potential accident* (Cowley, 2020). Whatever classification approach is selected by the operator, the criteria should be clear and unambiguous, It should also be inclusive of intentional acts that can cause release of a dangerous substance. The criteria may also include types of failures or human actions that automatically qualify an incident as a candidate for internal reporting and investigation.

The classification system should follow a clear logic and be connected to the level of effort in the investigation follow up assigned for each type. For example, near misses that could have had serious impacts are considered to have a higher investigation importance than near misses that would not have had serious impacts. Other factors that may be considered in classifying incidents to assign different levels of safety importance include level of severity, complexity of failure (e.g., involvement of other operations), involvement of the safety management system, relevance (e.g., repeatability, implications for other processes and sites, etc). Some companies use a risk matrix to classify different levels of investigation (see **Figure 2)**.

Various industry organisations have also provided practical guidance on how to assess and classify incidents for different levels of investigation. For example, the Centre for Chemical Process Safety (CCPS) and the API Recommended Practice (RP) 754 introduce a four-tier approach to incident classification in its Process Safety Metric Guide for Leading and Lagging Indicators (Center for Chemical Process Safety, 2018).

Figure 2. Example of a risk matrix that can be used to classify incident types



Source: JRC, 2025

8. Scaling and terms of reference

The operator should have proportionate approaches to investigating actual and potential incidents of differing safety importance. There should be suitable processes for deciding on the scale and depth of investigation and to draw up initial terms of reference. A scaled approach includes:

— A minimum level of actions taken and actors involved once a process safety incident has been identified

— Actions and actors involved at subsequent levels of importance

— Linkage of different categories of investigations to relevant investigation procedures

— Differentiated reporting and dissemination requirements

For each level of investigation, the programme should have clearly defined expectations in regard to who should be involved in the investigation, the range of resources and competences that might be required, and protocols for recording and communicating results.

9. Identification of roles and responsibilities

At minimum, the site should have established an internal staff function to lead coordination of the investigation. The investigation coordinator is responsible for establishing the scope and objectives of the investigation and overseeing the proper implementation of the investigation protocols. They also will usually handle selection of any internal investigation team members, and/or external investigation consultants, as relevant, and allocation of resources to fulfil needs of the investigation. The lead investigation coordinator should have sufficient seniority in the organization to obtain the necessary resources and solicit cooperation from other staff.

10. Investigation action plan and investigation management

There should be a plan of action for what happens once an incident has occurred. This action plan should assign actions to functions within the organization, starting with management and staff and their roles in making decision regarding how the investigation proceeds. The action plan should begin with when the incident has been concluded and start with classification of the incident to determine of the scale of the investigation needed. It shall also include identification of any urgent corrective actions that need to be taken to avoid an imminent reoccurrence of a similar event.

Once the incident has been classified and a scale of investigation assigned, the management should take appropriate actions to initiate the investigation, starting with selection of the investigation team and launching the investigation according to the established procedures as per the scale of investigation that has been assigned.

11. Selection of the incident investigation team

Investigations can be conducted by in-house teams or outsourced, or a combination thereof, particularly when the incident has complex elements that require specialist competences. The decision to use internal or external resources should be based on a realistic view of investigation requirements. In general, the organisation that is in charge of conducting the investigation, whether internal or external, should have:

— Demonstrated experience in investigating process incidents to establish the factual circumstances

— Logical and objective (and documented) methods and principles for conducting incident investigation, including gathering and integrating evidence, generating and testing hypotheses, and deriving conclusions. These analytic methods should be suitable for the type of incident as identified based on the selection criteria.

— A multi-disciplinary approach with the availability of specialised competences when necessary

— An open, team-based attitude with strong communication and management skills, so as to direct investigation team operations and handle witnesses and experts effectively

— Independence in reporting on the facts and determining conclusions and recommendations

12. Investigation procedures for all incidents

The inspector should verify that existing procedures and guidance are sufficient for gathering the necessary data following accidents and incidents. The operator should have detailed documentation of investigation procedures. They should include the different stages of the process, individuals and their roles in the process, and an approximate schedule for completing different levels of investigation. These procedures should establish a clear chain of command.

Moreover, in accordance with standard good practice for process safety incident investigations, the procedures should establish minimum guidance on:

— **Scope and objectives.** How to define the scope and objectives of the investigation, including direct and underlying causes, and lessons learned

— **Identification of resource and competence requirements.** According to the scope and objectives, there should be a reflection on specific competences that may be needed, including the level of staff involvement, as well as the associated resources to support acquisition of services and expertise.

— **Selection of the investigation team.** Selecting investigation team members and competences, as appropriate for the level of investigation. The team should include representation from the operational staff of the unit and the unit management.

— **Roles and responsibilities.** Roles of each member of the team should be defined. The chain of command should be established with a lead investigation coordinator and lead investigator designated (sometimes the same person for small scale incident investigations)

— **Methodology selection.** Expectations or criteria regarding methods to use for different parts and/or types of investigations. The Accident Analysis Benchmarking Exercise describes advantages and disadvantages of various common methods used for investigation and analysis.

— **Collecting and analysing evidence.** Including how to inspect the scene, process operations, equipment involved, substances released, release phenomena, sequence of events and causality, observations of witnesses and other actors with knowledge relevant to the sequence of events. The degree to which the following elements are mandatory will depend on the classification (minor to major importance) of incident to be investigated.

  - Detailed procedures on securing the scene
  - Management of information collection from witnesses, including immediately after the incident and scheduling and interviewing witnesses after the fact
  - Involvement of operative level employees, safety representatives, and supervisors in the investigation
  - Obtaining and determining the physical data that are relevant to the investigation and associated visual information (for example maps, diagrams, photographs, field check)
  - Obtaining samples of spills, vapors, residues.
  - Establishment of chain-of-custody to control items and samples collected
  - Development of test plans for physical data, including chemical samples

- Techniques to strengthen and confirm data reliability, e.g., triangulation and corroboration
- Appropriate use of methods at different phases of the investigation to establish sequence of events, causal links, and draw conclusions

— **Reference documentation and expertise. P**otentially useful documentation and expertise that could be consulted in the event of an incident

— **Presentation of findings**. Protocols for presentation of evidence and factual information from the investigation

— **Presentation of causal theories and conclusions.** Explanation of possible causes explored and conclusions reached as justified by the evidence and deductive reasoning[1]

— **Determining follow-up actions and recommendations.** Definitions on the range and type of recommendations to be derived from the investigation, including corrective actions and lessons learned, and details on how they should be written

— **Communication protocols.** Communication of investigation progress and final results, minimum reporting requirements, including who should be in communications, what should be communicated and when

[1] The JRC publication, Accident Analysis Benchmarking Exercise: Project Report provides an overview of structured methods, the pros and cons of different methods, and an assessment of each one's value in different phases of the organisation. (The link to the report can also be found on the Lessons Learned webpage of the MAHB Minerva website.)

13. Managing investigation outcomes

The purpose of incident investigation is to determine causality and identify changes that can be made to improve the operation of the unit, the site, the company and in some cases, industry, standards and regulations. The process of deriving a benefit from the investigation starts with the presentation of findings, conclusions and recommendations in the investigation report. Then follows a process of communicating and implementing the findings to achieve the recommendations.

For this purpose, the operator should include detailed guidance on what should be included in investigation reports and on the presentation of findings, conclusion and recommendations in the investigation procedures. In addition, the site operational procedures should include instructions on communication of recommendations and following up and monitoring the implementation until their completion.

The main components of this part of the programme should address:

— Incident and investigation reporting

— Presentation of findings and conclusions

— Accountability and monitoring of recommended actions

14. Incident and investigation reporting

The incident investigation programme2 should require all incidents that are investigated to be reported in an accident register maintained by the organisation. Each report would at minimum include the following information:

- Scope and objectives
- Date, time and duration of the event
- Names of report authors, the investigation team, and experts and organisations that may have contributed analyses.
- The type of incident, according to the incident classification system, and the criteria that determined the classification
- Where the incident will be registered, internal and external (if any) and criteria for justifying external reporting
- Process installation and equipment directly involved in the incident. The type of operation underway (e.g., loading and unloading) may also be included, and what passive and active mitigation measures were activated
- Substances involved, including their volumes and hazardous properties. If any substances were released, the type of substance and volume released.
- Accident description and sequence of events, starting with the initiating event up until control measures were no longer required and immediate consequences ceased, including images that might help illustrate what happened
- Description of the emergency response and any consequences.
- Cause of the incident, including direct and underlying causes and lessons learned
- Immediate corrective actions and precise recommendations to improve safety management, the actions necessary to fulfil the requirements, the timeline for completion, and who is responsible

The accident reporting procedures should also foresee different levels of detail in reporting that will be appropriate to actual or potential consequences of incidents. As investigations increase in depth and breadth, more details would be expected. Investigation report requirements should include elaboration on various elements In particular, data collection and analyses methods, the kinds of structured methods used to understand relationships and causality, and an elaborated narrative to explain how the evidence pointed towards conclusions including decisions of the investigation team

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[2] This document predominantly uses the term “chemical incident” and “chemical accident” interchangeably, although by default, “chemical incident” is the preferred term, as is also the practice in the field of chemical process safety. However, it is not always clear which term is better, chemical incident or chemical accident, in some contexts. The aim of process safety management is to prevent serious chemical *accidents* but the preferred strategy for preventing serious chemical accidents is to prevent all chemical *incidents* (or potential chemical incidents

to follow particular lines of inquiry and how this contributed to deducing causality and lessons learned.

Consequence descriptions in accident reports should contain complete descriptions of all the impacts on and off site, including as much as possible quantitative information. Relevant consequences normally include human health impacts, including onsite and offsite deaths and injuries, impacts on the environment and wildlife, property damage, population affected by evacuation and shelter in place orders, and impacts in the community including interruptions of utilities and traffic. They should also specify any human health impacts on responders and lessons learned that can be derived from the implementation of the emergency plan during the incident.

15. Presentation of findings and conclusions

The operator should have clear guidelines on the presentation of findings and conclusions from the investigation derived from the scope and objectives. The investigation report should be required to establish a clear link between the findings and recommendations of investigations linked to the scope and objectives of the investigation. The investigation programme should require corrective actions and lessons learned recommendations and have criteria to guide these decisions.

The inspector can look at examples of incident reports and look for evidence that good practice in presenting findings and recommendations were followed. Evidence of good practice in an investigation report includes:

Identification of direct causes. The technical causes should be precisely identified and explained with proper technical terminology.

Identification of underlying causes. The investigation should examine and report on causal links to specific aspects of the safety management systems and organisational issues. As much as possible, the reasons for the safety management system failures should be analysed. For example, to establish if and why (risk assessments, inspections, operating procedures, etc.) for the activities concerned were inadequate, had not been properly implemented or had been allowed to degrade.

Recommendations for corrective actions. These actions refer to often immediate and sometimes urgent actions required to reduce critical vulnerabilities that could, if not corrected, soon lead to another incident at the same location or within the same organisation. For example, in the case of a mechanical integrity issue, there may be a recommendation to review if the failure that caused the accident is also present in similar equipment throughout the organisation. If the incident revealed an error in operational procedures, the procedures should be immediately corrected and all involved employees should be retrained accordingly.

Lessons learned recommendations. Lessons learned should be identified separately from corrective actions. Lessons learned are generally actions that take a broader look at what management decision or failures contributed to the incident. Different actors and operations than those directly involved in the incident may be linked to lessons learning, especially as incidents progress from minor to serious. These recommendations can include actions or a universal nature, such as risk awareness, competency requirements, and numerous other safety management system elements that have application across a wide number of operations.

All corrective actions and lessons learned should be associated with a schedule and a responsible unit and manager.

Failure to learn from lower-level incidents has led to many major accidents that could have otherwise been prevented. While step change in organizational performance can be found necessary as a result of investigating a major accident, sustained iterative change in the form of actions fueled by lower-level incident investigations is crucial to success in process safety and should be recognized and encouraged by the inspector wherever possible.

Technical guidance for analysing and extracting lessons learned from incidents can be found in the JRC Handbook for Learning Lessons from Chemical Accidents - A Technical Guide to Analyzing and Investigating Accidents for Learning. In addition, the JRC has published several lessons learned analyses from chemical incidents whose links are available from the MAHB Minerva Lessons Learned webpage and MAHB Minerva publications page.

16. Accountability and monitoring of recommended actions

The investigation programme should also have a system of following up on recommended actions to completion. This final step in the programme requires a commitment from the company to a tracking system that is actively used to record and periodically check the progress of the implementation of each action.

Some key elements that are usually present for effective accident follow-up include:

Evaluation system. Each action should be assessed in terms of time and resource needs, priority, and expected time to completion. Each recommendation should be included in strategic planning for the future with links to other related actions where appropriate.

Routine review of uncompleted actions. At each level of the organization, there should be a frequency established for reviewing recommended actions from incident investigations. Often this review may be incorporated into review of other feedback such as recommendations from audits, performance monitoring systems, and other inputs. These reviews should require comments on progress, explanation for why any actions are delayed paying particular attention to prioritisation, and decisions and resources needed for continuing to completion.

Ensuring accountability. Recommendations, whether corrective actions or lessons learned, should be specifically assigned to a unit and functional role of the organization, who is responsible for ensuring the implementation in a timely fashion. Accountability for implementation can be included in performance reviews of the unit and auditing feedback.

Allocation of resources and time. Another indicator of a commitment to completing incident follow-up is that the annual staff and budget allocations for implementing actions are compatible with the time and resources estimated in strategic planning and assigned at the appropriate level of the organization (e.g., the operation, department, or business unit who takes the lead in implementation).

Involvement of the leadership. Effective incident investigation requires buy-in from top management down, starting with senior leadership. The presence of management can be verified in a number of ways, for example, the existence of routine review of actions from incidents and audits at higher levels of the organisation, periodic communications from operations to management on the status of actions and lessons learned, sign-off on routine reviews at the operational level, allocation of budget for implementing recommended actions, and initiatives led by management to implement certain lessons learned organization wide. It is crucial that senior leaders are aware of all significant investigation findings, maintain accountability for recommendations assigned to their level in the organization, and seek assurances on the performance of corrective action management.

Ensuring accountability. Recommendations, whether corrective actions or lessons learned, should be specifically assigned to a unit and functional role of the organization, who is responsible for ensuring the implementation in a timely fashion. Accountability for implementation can be included in performance reviews of the unit and auditing feedback.

Implementation of actions to ensure lasting change. Incidents often indicate systemic vulnerabilities, both at the small (operational) scale as well as large scale (site or organizational level). The identification of lessons learned should include a recognition of the wider significance and be implemented accordingly. Hence, where there is a failure in a procedure that is a routine company procedure, for example, loading and unloading, the lessons learned should be

implemented in a way that avoids the failure in future for all actions involving that same operation. This type of improvement can be manifested as a procedural change plus training, awareness measures, competency requirements, and other cross-operational activities that are part of the safety management system.

Another typical and unfortunate example would be failures in safety assessment processes leading to a lack of understanding of the major accident risk of a certain hazard, which can have many downstream effects and ultimately lead to an incident. While corrective actions to address the specific incident that occurred may be immediately apparent through the course of the investigation, preventative actions sufficiently upstream in the safety management system consisting of safety assessment procedure and management competency requirement updates could prevent many similar and otherwise unforeseen incidents from occurring across the wider organisation. Sometimes a company-wide policy change may be required.

Keeping the institutional memory alive. It is already an accomplishment if organisations can implement lessons learned effectively and repeatedly. However, over time, the corporate memory fades and collectively the company can forget why certain procedures and protocols are in place. There are a number of incidents where slight changes to protocols, originally implemented for safety purposes, have caused serious and even catastrophic events. Inspectors cannot make sites have corporate memory, but they can encourage them to pass on the reasons why the rules are in place. Managers can demonstrate that they understand the risk significance of following protocols and they can communicate this understanding repeatedly in training and staff exchanges. They can also use events to commemorate incidents or good safety performance to reinforce these messages.

Furthermore, the Seveso Inspections Series' Good Practice Report on Learning Lessons from Accidents provides a number of insights on how to recognize, or become, a learning organization.

17. Conclusions

Incident investigation is a critical element of safety management on chemical hazard sites. Lessons learning from incidents is essential to preventing future chemical incidents and reducing their consequences. In addition, incident records provide a valuable input to analysis of failure trends and process vulnerabilities. Hence, the Seveso Directive recognises incident investigation and performance monitoring general as a cornerstone of effective risk management of chemical hazard sites.

There is considerable guidance available for operators to use to shape such programmes, but it is voluminous. In particular, many fields, such as aviation, defence, and nuclear safety, to name a few, also prioritise incident investigation and multiple organisations in these fields also produce guidance on incident investigation programmes. With so many good and detailed sources of information, there are many models and strategies that an operator can choose to follow. However, the information can be overwhelming, even confusing and sometimes even contradictory. It can be a challenge for hazardous site operators to sort through the various approaches and identify one that suits them best.

However, it is even more challenging for hazardous site operators, responsible for overseeing compliance on several chemical hazard sites, each of which may belong to a different industrial or commercial sector, to assess that an operator's incident investigation programme is sufficiently robust to fulfil the obligation of the Seveso Directive.

These Common Inspection Criteria aim to address this complexity by providing a framework of performance-based criteria that focuses on the results achieved by the programme. Likewise, the criteria are equally available to operators to establish the basic structure in which various models and good practices can then be applied to achieve its objectives. If the vast majority of hazardous site operators achieve these criteria, operators will make a strong contribution to fulfilling their general obligation to protect citizens and the environment from the impacts of serious incidents involving dangerous substances.

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