



# PROCESS SAFETY MANAGEMENT PROGRAM STANDARD EGPC-PSM-ST-003 PSM STANDARDS

The Egyptian Process Safety Management Steering Committee (PSM Egypt)

PSM TECHNICAL SUBCOMMITTEE

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## 1. INTRODUCTION

Process Safety Management (PSM) is an application of engineering and management principles and systems to the identification, understanding, and control of process hazards to protect employees, facility assets, and the environment.

It is important to keep in mind that process safety incidents are often “high consequence, low-frequency events.” Therefore, it is possible for a plant or facility, and even the entire industry to have declining numbers of incidents for many years, and then have a very serious incident (multiple fatalities or catastrophic asset damage) with little or no change in operation.

The objective of this standard is to provide a simple fit for purpose structured methodology for implementing a PSM program as per the 20 elements of AIChE CCPS's Risk-Based Process Safety (RBPS) PSM framework to ensure the integrity and safety of the operations taking into consideration design, operational, maintenance, and human factors to control process safety incidents.

The PSM RBPS standard also helps companies to design and implement more effective process safety management systems covering (1) design a process safety management system; and, (2) improve process safety management practices.

## 2. Purpose

The purpose of this standard is to help the Companies belong to The EGPC and the Holding Companies for a better overall understanding of that PSM. This standard describes the main components of the PSM, as well as establishes consistent requirements for planning, conducting, and implementing the PSM elements for the Companies belong to The EGPC and the Holding Companies. PSM for the Companies belong to The EGPC and the Holding Companies shall be in accordance with the requirements of this Standard.

### 3. SCOPE

This document stipulates the mandatory requirements applicable to the Egyptian General Petroleum Corporation (EGPC) and Oil and Gas Holding Companies, including the Egyptian Natural Gas Holding Company (EGAS), the Egyptian Petrochemical Holding Company (ECHEM), and the South Valley Petroleum Holding Company (GANOPE) covering all of their operational subsidiaries, state-owned companies, affiliates, and joint ventures.

ENTITIES and their COMPANIES and contractors shall ensure that all requirements listed herein are fully understood, implemented, complied with, and monitored at all times including current operations, existing and future projects during the whole projects' lifecycle from feasibility through decommissioning.

### 4. Definitions & Abbreviations

**ENTITIES:** hereinafter are used to indicate EGPC and Holding Companies i.e., EGAS, ECHEM, and GANOPE that are required to enforce implementation of this standard across their COMPANIES.

**COMPANIES:** hereinafter are used to indicate operating company, subsidiary, affiliated, Joint Venture companies that are required to comply with ENTITIES' standards.

For other definitions and abbreviations, refer to PSM Glossary document EGPC-PSM-GL-011.

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## 5. Application of the framework of RBPS management

This PSM program standard focuses on the requirements that should be fulfilled by companies (Large or small) to ensure the integrity and safety of operations and helps to define what steps should be in place to measure whether those requirements are being done.

### 5.1 RBPS Design and Improvement Criteria

The RBPS approach recognizes that all hazards and risks in an operation or facility are not equal; consequently, apportioning resources in a manner that focuses effort on greater hazards and higher risks is appropriate. Using the same high-intensity practices to manage every hazard is an inefficient use of limited resources. A risk-based approach reduces the potential for assigning an undue amount of resources to manage lower-risk activities, thereby freeing up resources for tasks that address higher-risk activities.

The RBPS strategic approach is founded on the principle that appropriate levels of detail and rigor in process safety practices are predicated on three (3) factors:

- A sufficient understanding of the risk associated with the processes on which the process safety practices are focused.
- The level of demand for process safety work activity (e.g., the number of change requests that must be reviewed each month) compared to the available resources.
- The process safety culture within which the process safety practices will be implemented.

## 5.2 Risk-based PSM pillars

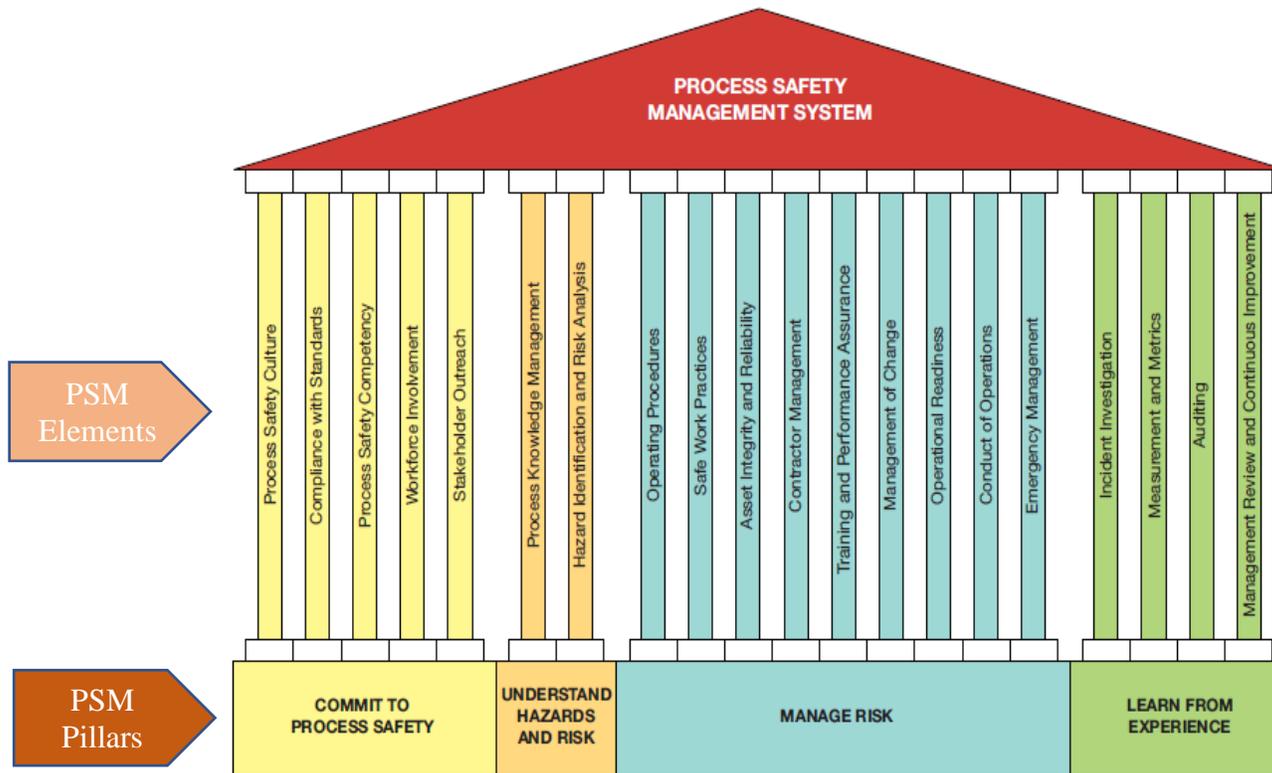


Figure (1) Pillars (Foundational Blocks) and associated Elements that constitute a sturdy RBPS Management System [1]

### 5.2.1 1st Pillar - Commitment to Process Safety

It is the cornerstone of process safety excellence. Management commitment has no substitute. Companies generally do not improve without strong leadership and solid commitment. The entire company must make the same commitment. A workforce that is convinced that the company fully supports safety as a core value will tend to do the right things, in the right ways, at the right times, even when no one is looking. This behavior should be consistently nurtured, and celebrated, throughout the company. Once it is embedded in the company culture, this commitment to process safety can help sustain the focus on excellence in the more technical aspects of process safety.

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### 5.2.2 2nd Pillar - Understand Hazards and Risk

The company understands hazard and risk and principal of risk significance are better able to allocate available resources in the most effective manner to achieve the best and effective utilization of the workforce.

### 5.2.3 3<sup>rd</sup> Pillar – Managing Risk

Focuses on three (3) issues:

- (1) Prudently operating and maintaining processes that pose the risk.
- (2) Managing changes to those processes to ensure that the risk remains tolerable.
- (3) Preparing for, responding to, and managing incidents that do occur.

Managing risk helps a facility deploy management systems that help sustain long-term, incident-free, and profitable operations.

### 5.2.4 4th Pillar - Learning from Experience

Involves monitoring, and acting on, internal and external sources of information. Despite a company's best efforts, operations do not always proceed as planned, so companies must be ready to turn their mistakes – and those of others – into opportunities to improve process safety efforts. The most cost-effective ways to learn from experience and seek continual improvement are to:

- (1) Correct deficiencies exposed by internal incidents and near misses.
- (2) Utilize management reviews as ongoing "due diligence" reviews to maintain continuous Improvement.
- (3) Apply lessons learned from other companies.

In addition to recognizing these opportunities to better manage risk, companies must also develop a culture and infrastructure that helps them remember the lessons and apply them in the future.

### 5.3 PSM program Implementation approach

The PSM program implementation approach is based on systematic steps to ensure monitoring of the overall process to achieve effective implementations as follows:

- **Maintain a Dependable Practice**

Ensure that the element requirements are clear, specific, documented, and issued in the company's guidelines/procedures to help guide the implementation and execution of the program and ensure that workforce follows through and complies with the process in a consistent, safe manner. Guideline/procedures should be consistent throughout the company.

- **Conduct Element Activities**

By implementing element guidelines/procedures consistently over time, guidelines/Procedures that are not followed are of little value. Tolerance or endorsement of working solely from memory or using alternatives to approved guidelines/procedures can lead to highly unpredictable, and sometimes unwanted unsafe operation. To promote their use and full implementation, guidelines/procedures should be available to the user at the time and location that they are needed.

- **Monitor the System performance**

An annual internal audit on the implementation compliance for each element will help determine whether the implementation of the element requirements is performing as intended and producing the desired results, also it is recommended to have an external audit review with 3 to 5 years intervals.

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## 5.4 PSM Elements performance requirement

### 5.4.1 PROCESS SAFETY CULTURE

**Process safety culture** has been defined as, “the combination of group values and behaviors that determine how process safety is managed”. [1]

To achieve the element objectives, the company shall establish and maintain practices that; set safety as a core value, provide strong leadership, enforce a high standard of performance. Furthermore, the company shall develop and implement a sound culture by maintaining a sense of vulnerability, empowering individuals to fulfill PS responsibilities, and ensuring open and effective communication. Eventually, the company shall provide continuous monitoring of performance.

**The following activities are the minimum requirements to achieve the element performance expectations:**

- A documented process safety policy is in place and signed by the Chief Executive Officer (CEO) or the appropriate unit Managing Director (MD).
- Establish clear process safety objectives, performance targets, and action plans and evaluate performance regularly.
- Ensure that process safety procedures are developed, rolled out, documented for the facility.
- Educate managers in process safety culture, vision, expectations, roles, responsibilities, and standards.
- Ensure that process safety awareness sessions are delivered for various levels within the company.
- Establish responsibilities and reinforce accountabilities for process safety roles.
- Ensure that employees know what is expected of them by effectively communicating the process safety policies, goals, and plans for achieving the desired process safety performance.
- Directors and managers promote an open and trusting environment and understand how their behaviors impact others.
- Adequate resources are available and assigned to comply with process safety requirements.
- Ensure that process safety performance rewards and corrective actions are consistently applied.

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- Implement a policy of zero tolerance for deliberate violations of process safety policies, procedures, and rules, develop a disciplinary system that has clear criteria for acceptable and unacceptable behaviors.
- Establish a lesson learned system to monitor process safety incidents within the industry and share key learnings with the facility workforce.
- Frequently Assess relevant avenues of communication for potential improvement.
- Involve all levels of the company in planning and evaluating the performance of process safety initiatives.
- Distribute newsletters containing culture supportive articles to the general population of the company, and use stand-downs to draw attention to acute or chronic issues.
- Implement and track a diverse set of metrics that encompasses a balanced mix of leading and lagging indicators.
- Conduct periodic audits and reviews of the company's process safety culture.
- Implement an effective management review system (refer to Article 3.4.20).

### 5.4.2 COMPLIANCE WITH STANDARDS

The **Compliance with Standards** Element describes a process for maintaining adherence to the attributes of a standards system which are applicable standards, codes, regulations, and laws, **and** the steps a company might take to implement the standards element. [1]

To achieve the element objectives, the company shall establish and maintain practices to ensure consistent implementation of the standards system that includes developing a written program that identifies all process safety obligations and monitoring sources of potential changes to those obligations. Eventually, the company shall evaluate the compliance and act on compliance review results.

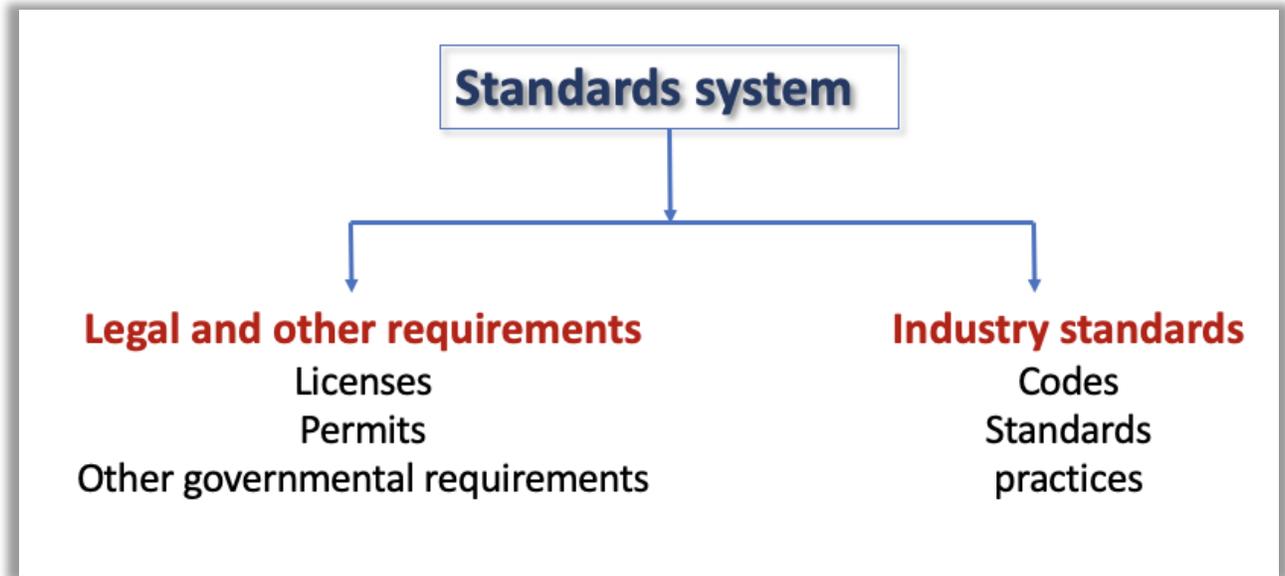


Figure (2) Standards system

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**The following activities are the minimum requirements to achieve the element performance expectations:**

- Establish written program documentation.
- Assign a standards element owner and define the roles and responsibilities for personnel.
- Ensure that the requirements of current and forthcoming, applicable legislation, regulations, licenses, permits, codes, standards, practices, and other governmental requirements are identified, documented, and kept current.
- Create and maintain an activity record for all standards compliance assurance activities.
- Develop specific standards review procedures for each standard requirement.
- Provide access to standards materials for all personnel who need them.
- Maintain compliance with each process safety-related standard requirements.
- Maintain access to a newsletter service to keep up to date on changes.
- Provide initial and refresher training to appropriate personnel on relevant standards and modify awareness-level communication and training items to convey changes in process safety obligations, and provide specific training for employees who evaluate the compliance with the relevant process safety laws, legislation, and other requirements.
- A periodic review of regulatory coverage will help ensure that facilities remain aware of new or revised interpretations and help minimize the likelihood of receiving regulatory citations.

### 5.4.3 PROCESS SAFETY COMPETENCY

Competency can be defined as the knowledge and experience to conduct a task safely, adequately, and efficiently. Developing and maintaining process safety competency encompasses three interrelated actions; continuously improving knowledge and competency, ensuring that appropriate information is available to people who need it, and consistently applying what has been learned.

The competency element focuses on organizational learning, as well as the components that comprise an individual’s competence (knowledge, skill, and ability). [2]

Organizational learning is the process by which an organization improves itself over time through gaining experience and using that experience to create knowledge. The knowledge created is then transferred within the organization, three key processes occur in organizational learning, 1- Knowledge creation, 2- Knowledge retention, 3- Knowledge transfer.

To achieve the element objectives, the company shall maintain dependable practices that include establishing a PSM competence assurance program, highlighting element benefits, and promoting a learning organization, then the company shall execute activities that help maintain and enhance process safety competency. Eventually, the company shall periodically check the value derived from the activities.

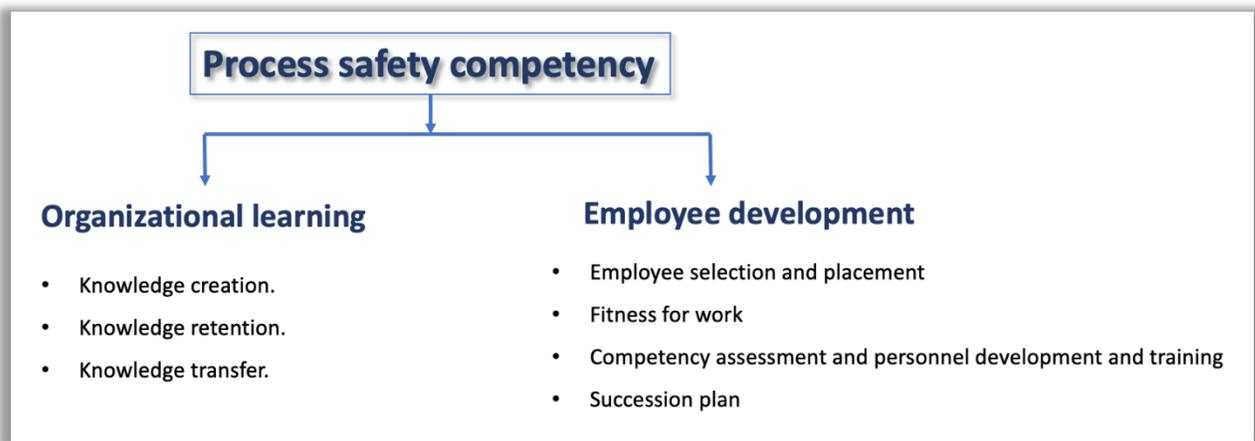


Figure (3) Process safety competency focuses.

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**The following activities are the minimum requirements to achieve the element performance expectations:-**

**Activities for organizational learning:-**

- Ensure that enhancement of competency is aligned with the business's strategic plan.
- Develop a set of measurable objectives for maintaining and enhancing process safety competency, identify and fund activities that are likely to support progress toward organizational objectives that promote competency.
- Assign responsibility for championing efforts to maintain and enhance process safety competency.
- Create a technology manual that documents the history of the process as well as the knowledge that is critical to maintaining process safety competency.
- Document what information is available in a manner that facilitates searches.
- Provide a means to quickly locate technical information, facilitate maintenance of existing information, and logically file new information.
- Proactively push safety-critical information to potentially affected facilities and key personnel; do not depend on others to discover a need to know about an issue.
- Designate one or more individuals in the company to monitor other companies in the same industry, new technical developments, other information such as incidents occurring.
- Participate in industry associations and other networks that provide insight into how process safety is managed at other companies.
- Hold periodic technical seminars on subjects related to process safety.
- Incorporate lessons from previous incidents in training and similar activities.
- Periodically compare the objectives that were established in the overall competency improvement plan to the benefits that have been derived from work activities that support the competency element.
- Based on a periodic review with senior management and key personnel from operating facilities, adjust plans or the resources provided to various plans/activities.

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**Activities for competency assessment and employee development:-**

- Establish a competency management system that identifies the required knowledge, skills, and abilities (KSAs) for each job compared to the job candidates skills and ensures periodic evaluation and update (assessment) of the workers KSAs and fitness for work against the requirements of their assigned role and responsibilities.
- Ensure that the required process safety competencies, fitness for work, and health monitoring requirements are defined for all roles in the company.
- Ensure that a process is in place for screening, selection, and placement of employees which confirms their compliance with the specified requirements for the role.
- Ensure that Individual and collective experience and knowledge are maintained and are carefully considered when personnel changes are made.
- Ensure that roles and responsibilities are realistically designed to take account of human capabilities and limitations and other key human and organizational factors.
- Ensure that a staffing development and succession plan is in place for all positions with PSM responsibility.
- Ensure that the organizational structure, and continuity of PSM critical positions, are reviewed periodically.
- Ensure that arrangements for employee selection, placement and competency, and health assurance are understood and followed.
- Compliance and performance trends are reviewed by specified levels of management.

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#### 5.4.4 WORKFORCE INVOLVEMENT

The **Workforce Involvement** Element addresses the diversity of roles that workers can fulfill in support of process safety management system development, implementation, and enhancement. [1]

To achieve the element objective, the company shall establish and maintain practices to ensure consistent implementation that includes developing a written program and ensuring all facility personnel basic awareness of the program. Conducting the work activities shall be through providing appropriate inputs to the program. After planning and implementation practices company shall monitor the system for effectiveness.

Workforce participation might be required in activities such as HIRA, process hazard reporting, and incident investigation.

**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Develop written program documentation for managing the overall workforce involvement element and for administering workforce involvement activities within the various RBPS elements.
- Establish an owner for the workforce involvement element to monitor and ensure its effectiveness on a routine basis.
- Provide awareness training on the workforce involvement element to all workers.
- Include personnel from all levels of the company in a regularly scheduled program of field safety and housekeeping inspections.
- Directors and managers engage employees and contractors in two-way communication regarding process safety policies, objectives, performance targets, action plans, and sharing of lessons learned from inside and outside the company.
- Provide systems for workers to provide their input and make sure suggestions under the workforce involvement program receive appropriate feedback.
- Ensure timely implementation of recommendations accepted under the workforce involvement program.

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- Conduct periodic onsite meetings, during which workers from all levels collaboratively indicate potential opportunities for system improvements.
- Encourage formal and informal activities that enhance workforce involvement, for example, safety suggestion programs, safety lotteries, other incentives for participation, job observation programs, safety councils and focus teams, and management by walking around.
- Implement controls to ensure the integration of contract workers into the workforce involvement program (contractor companies, especially transient or short-term contractors, may be especially difficult to engage and actively involved in the process).
- Institute a program that provides recognition or awards for safe behaviors to be given by peers.
- Develop key metrics for monitoring the performance and effectiveness of the workforce involvement element.
- Involve the workforce in identifying suitable RBPS metrics and in monitoring and communicating this information to management.
- Maintain auditable records documenting workforce involvement activities.

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#### 5.4.5 STAKEHOLDER OUTREACH

**Stakeholder outreach** is the seeking out individuals or groups that can be or believe they can be affected by company operations and engaging them in a dialogue about process safety and establishing a relationship with community organizations, other companies and professional groups, and local, state, and federal authorities, as well as providing accurate information about the company and facility's products, processes, plans, hazards, and risks. [1]

The **Stakeholder Outreach** Element describes a process for identifying, engaging, and maintaining good relationships with appropriate external stakeholder groups (outreach), the attributes of an outreach system.

To achieve the element objectives, the company shall identify communication and outreach needs through defining the stakeholders and the relevant scope, conduct communication outreach activities by sharing appropriate information through appropriate communication pathways and tools, and maintaining external relationships. Finally, follow actions and commitments to stakeholders and share the feedback with management.

**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Create a program to guide external communication, information sharing, and outreach activities and develop a plan for engaging each stakeholder group.
- Define the scope of the outreach system so that types of information to be shared and sources of changes are monitored.
- Survey stakeholder groups to determine important issues/concerns and focus plans on the major issues.
- Ensure and demonstrate that the consultation process with statutory and non-statutory stakeholders is appropriate and proportionate and follows a defined process.
- Assign an owner of the outreach system to routinely monitor its effectiveness.
- Define the roles and responsibilities of personnel involved with information sharing and outreach.
- Involve senior/executive level management in strategic outreach activities.

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- Provide awareness training and refresher training on the outreach system to all employees and to all affected management employees who are assigned specific roles within the outreach system.
- Develop appropriate communication tools, such as small meetings, community gatherings, conferences, etc.
- Maintain a communications action item follow-up log to ensure that requests for information are met in a timely fashion.
- Solicit feedback from stakeholders following individual encounters to determine if their concerns and issues were addressed.
- Ensure that appropriate process safety information is published in the public domain to demonstrate the company's commitment to continually improving its performance.
- Develop and implement crisis communications plans when unplanned communication "episodic event" occurs, for example, facility incidents, company/Industry incidents.
- Provide advanced training for the leadership team on crisis management communication.
- Establish and collect data on outreach performance metrics and efficiency indicators.
- Keep records on the activities involved in conducting the information sharing, ensure that Individual records are kept, the outreach activities of key personnel are documented and comprehensive stakeholder interaction information is documented from all outreach activities.

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#### 5.4.6 PROCESS KNOWLEDGE MANAGEMENT

The **knowledge** element primarily focuses on information that can easily be recorded in documents, such as written technical documents and specifications, engineering drawings and calculations, specifications for design, fabrication, and installation of process equipment, and other written documents such as safety data sheets (SDSs). [1]

To achieve the element objectives, the company shall establish and maintain relevant practices to ensure consistent implementation that includes a written policy, define the element scope, assign responsibilities to competent personnel, also company shall Catalog process knowledge in a manner that facilitates retrieval, Protect, update and ensure the use of process knowledge.

**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Create a written policy governing the knowledge element, Specify the scope of the knowledge element, including the various types of information and documentation that should be created compiled for each unit at the facility.
- Define a retention policy for all documentation and records.
- Compile chemical hazard information (such as toxicity information, permissible exposure limits, reactivity, etc.), process technology information (such as a simplified process flow diagram, Material, and energy balances, etc.), and process equipment information (such as material of construction, ventilation system design basis and calculations, interlocks, etc.).
- Maintain and store calculations design data, and similar information in central files and document information in a user-friendly manner.
- Ensure that competent personnel is responsible for maintaining current and accurate process knowledge, reviewing changes to the process knowledge, and understand the scope of management of the change system to ensure the change authorization before updating process knowledge.
- Make information available, updated and those kept electronically are safeguarded.
- Ensure that documentations are structured (ex: file documents by equipment or type of information rather than by capital project number).
- Eliminate parallel copies of process knowledge, particularly if they are not sanctioned as part of the knowledge element.
- Implement a means to prevent the use of out-of-date process knowledge.

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- Periodically review and assess the adequacy of process knowledge and gather new information when needed.
- Maintain a protected archive of the process knowledge.
- Provide a means to ensure the fidelity of process knowledge and prevent unauthorized changes that would corrupt the information.
- Implement a means to check out (retrieve) copies of process knowledge from system for revision.
- Provide training to employees who need to use process knowledge on how to use it and how to interpret data it contains.
- Assess whether the information is adequate to meet the needs of the risk element and other RBPS elements at each point in the unit's life cycle.
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

### 5.4.7 HAZARD IDENTIFICATION AND RISK ANALYSIS

Hazard Identification and Risk Analysis (HIRA) is a collective term that encompasses all activities involved in identifying hazards and evaluating risk at facilities, throughout their life cycle, to make certain that risks to employees, the public, or the environment are consistently controlled within the company’s risk tolerance. [1]

To achieve the element objectives, the company shall establish a documented risk management system in a controlled procedure or a written program to ensure consistent implementation, integrate HIRA activities into the life cycle of projects or processes, clearly define the scope of HIRAs and assure adequate coverage, involve competent personnel, make consistent risk judgments and verify HIRA practices remain effective.

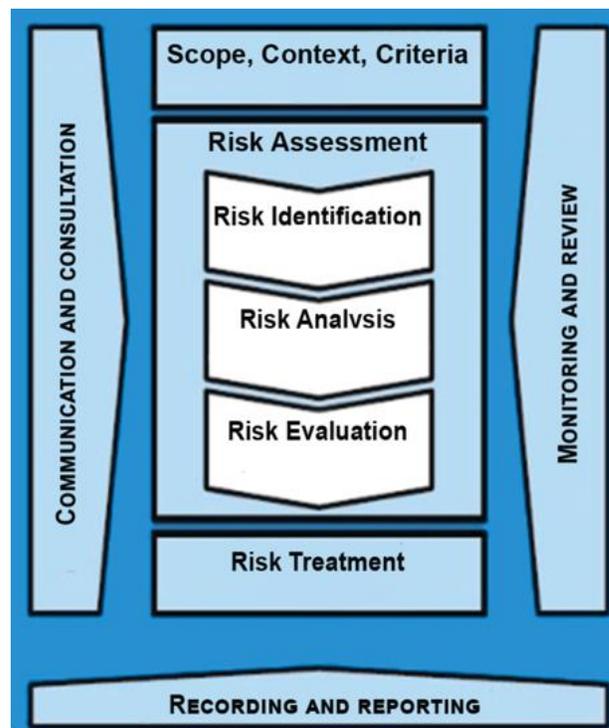


Figure (4) Risk management process.

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**The following activities are the minimum requirements to achieve the element performance expectations:**

- Establish and implement formal procedures to manage risk when HIRAs should be performed.
- Determine the minimum objectives of each required analysis.
- Determine the process systems and chemicals to be addressed in the program and develop a list of units and activities to which the risk system applies.
- Define the basis for judging risks and risk tolerance criteria.
- Address the criteria for selecting risk control measures in the HIRA procedure and maintain current risk tolerance criteria.
- Ensure learnings from incidents from both inside and outside the company.
- Define the roles and responsibilities for risk activities.
- Assign a job function as the owner of the risk system to monitor its effectiveness on a routine basis.
- Provide awareness training on the risk system to all affected employees and contractors.
- Provide detailed training to all employees and contractors who are assigned specific roles within the HIRA element.
- Specify the qualifications for participating in HIRAs and Use qualified leaders.
- Train team leaders and participants in the use of risk assessment techniques and risk tolerance criteria.
- Ensure that completed HIRA are reviewed, approved, and accepted by specific levels of management appropriate to the magnitude of the risk, and any decisions are documented.
- Document the hazards, risks, recommendations, and control measures from the analysis in a formal report.
- Document the residual risk for each operation, unit, and facility.
- Address HIRA recommendations and document their resolution, including specific actions that address the recommendations. Prioritize actions based on risk and benefit.
- Communicate risks to potentially affected personnel, including contractors.
- Communicate with stakeholders, including emergency management agencies, the hazards and risks identified, the recommendations for risk reduction, and the residual risks.
- Archive the HIRA results, along with key materials and information used by reviewers.
- Update HIRA as changes occur and review/update at a defined appropriate frequency.
- Verify that risk practices remain effective by keeping a running status of all HIRA reviews.
- Establish risk performance and efficiency metrics.
- Provide input to internal audits of risk practices based upon the HIRA performance metrics.

### 5.4.8 OPERATING PROCEDURES

Operating procedures are written instructions (including procedures that are stored electronically and printed on demand) that list the steps for a given task and describe the way the steps are to be performed. Good procedures also describe the process, hazards, tools, protective equipment, and controls in sufficient detail that operators understand the hazards, can verify that controls are in place and can confirm that the process responds in an expected manner. [1]

To achieve the element objectives, the company shall establish and maintain relevant practices including management controls to ensure the maintenance and continual improvement of the operating procedures quality, control procedure format, and content. The company shall conduct a task analysis to identify what operating procedures are needed and ensure that procedures are followed and maintained.

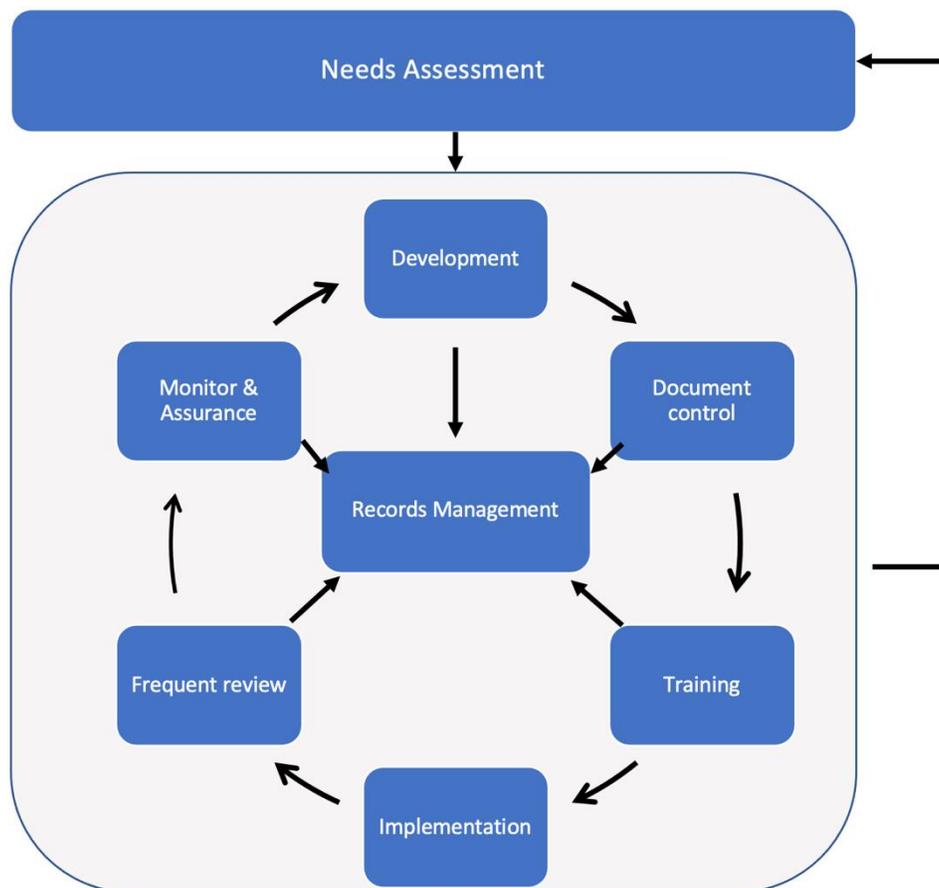


Figure (5) Operating procedure model [2]

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**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Develop a written policy describing the management system for the procedures element that describes the process for updating, and maintaining operating procedures.
- Identify tasks that are performed by each operator or logical group of operators.
- Validate the task list and review to determine which tasks require a written procedure.
- Review the operator training program to determine the necessary level of detail for operating procedures.
- Include all operating modes in the task list, for example, temporary shutdown, shut down for annual maintenance, emergency shutdown, startup after each type of shutdown, initial startup, temporary operation, and normal operation.
- Format procedures in a consistent manner and select the best type of procedure for each task.
- Ensure that procedures are developed and approved and clearly state what to do, and for critical steps or tasks, how to determine if the step or task was completed correctly.
- Develop a procedure numbering or index system that is logical to the end-user.
- When procedures are interrelated, provide clear, distinct, but not excessive references.
- Verify and validate those new procedures describing existing operations conform to existing and intended practice.
- Use procedures as a training aid.
- Make procedures available to operators at all times.
- Instill a practice of identifying errors in procedures and correcting errors promptly.
- Establish the interval for procedure review based on risk or other objective criteria, including input from operators and other affected personnel.
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

#### 5.4.9 SAFE WORK PRACTICES

This element helps control hazards and manage risk associated with non-routine work, aims to set out good practices for work control, permit to work, task risk management, and the management of HSE and process safety risks introduced into the business by the execution of maintenance or construction work. [1]

Procedures are generally divided into three categories. Operating procedures, as described in section 3.4.8, govern activities that generally involve producing a product. Maintenance procedures (as described in Section 3.4.10) generally involve testing, inspecting, calibrating, maintaining, or repairing equipment. Safe work procedures, which are often supplemented with permits (i.e., a checklist that includes an authorization step), fill the gap between the other two sets of procedures. Safe work practices help control hazards and manage risk associated with nonroutine work.

In this context, a nonroutine activity is any activity that is not fully described in an operating procedure. Nonroutine does not refer to the frequency at which the activity occurs; rather, it refers to whether the activity is part of the normal sequence of converting raw materials to finished products.

To achieve the element objectives, the company shall establish and maintain practices that ensure consistent and effective implementation that includes identifying types of nonroutine work to control, where and when in the facility's life cycle the safe work procedures should apply and then develop and enforce the use of set work procedures. Eventually, the company shall review the system implementation and correct the addressed errors/violations.

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**The following activities are the minimum requirements to achieve the element performance expectations:**

- Develop a procedure that describes how nonroutine work is authorized and controlled, and a supporting system of procedures and permits to authorize and control non-routine work including identification and assessment of the risks arising from work tasks and the corresponding control measures.
- State which nonroutine activities are covered by procedures or permits (or which are not covered).
- Ensure that the preparation and implementation activities of non-routine work shall include:-
  - Pre-job safety meeting attended by all concerned parties to address the risk arising from the task.
  - Toolbox talks to ensure communicating the task-related aspects, risks, and control measures to the execution team.
- Provide awareness training to all employees.
- Ensure that persons authorized to approve or perform permits have the training and experience to understand a wide range of hazards and knowledge of well-established methods to manage risk associated with the hazards.
- Require direct communication between the group that operates the equipment or is responsible for the area in which the work will be performed and the group that will execute the nonroutine work.
- Ensure that ongoing work is well communicated to unit operators and other potentially affected employees.
- Establish a system to routinely inspect work areas to determine if (1) safe work procedures are being followed, (2) permit conditions appear to be appropriate, and (3) permit conditions are being followed.
- Review completed permits before filing or discarding them and based on the results of the review, take steps to improve accuracy and completeness of permits.
- Ensure that completed task risk assessments are reviewed and approved by specified named competent individuals appropriate to the magnitude of the risk and any decisions are documented.
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

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#### 5.4.10 ASSET INTEGRITY AND RELIABILITY

The **asset integrity** element is the systematic implementation of activities, such as inspections and tests necessary to ensure that important equipment will be suitable for its intended application throughout its life. Specifically, work activities related to this element focus on (1) preventing a catastrophic release of a hazardous material or a sudden release of energy and (2) Maintaining the ongoing integrity and ensuring high availability (or dependability) of critical safety or utility systems that prevent or mitigate the effects of these types of events. [3]

To achieve the element objectives, the company shall establish and maintain relevant practices that include developing a written program, defining the element scope and Integrating the asset integrity element with other goals.

Moreover, the company shall identify equipment and systems that are within the scope of the asset integrity program and assign ITPM (inspection, test, and preventive maintenance) tasks.

For successful execution of the element work activities company shall develop and maintain knowledge, skills, procedures, and tools properly and sufficiently to achieve the element's ultimate goal of ensuring that equipment remains fit for its intended purpose.

Finally, company shall review system effectiveness, analyze data, and carry out actions.

**The following activities are the minimum requirements to achieve the element performance expectations:**

- Develop a written program for implementing the asset integrity management (AIM) supported with written policies or procedures to guide the implementation and execution of the program.
- Define the scope of the AIM program in terms of how equipment is identified as being covered and those units or areas in which the policy does and does not apply.
- Develop a company- or facility-wide standard that summarizes the applicable design, test, and inspection requirements for each type of equipment.
- Establish a clear organizational roles, responsibilities and accountabilities for AIM activities, including independence of the testing and inspection organizations, to ensure that site management is receiving current and accurate information on the status of the site AIM program.
- Create reporting mechanisms for condition of assets, AIM program status, asset failures and integrity-related incidents.

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- Ensure that work activities associated with the AIM are integrated with initiatives to reduce downtime, increase output and yield, and improve quality via improved equipment reliability.
- Ensure that assets are uniquely identified on an asset register that provides up-to-date asset lists and equipment records, including location and equipment specification data.
- Develop a feasible ITPM plan that is based on recognized standards, manufacturers' recommendations, equipment history, internal requirements, and the expected consequence(s) of failure of the specific equipment item.
- Ensure that safety-critical elements are identified, listed, and included in the ITPM plan.
- Establish preventive maintenance work orders in the CMMS (computerized maintenance management system) based on the ITPM plan.
- Include steps in preventive maintenance, repair, and overhaul procedures to ensure that equipment is fit for service when it is turned over to the production team.
- Identify critical repair activities and determine if the manufacturer's maintenance manual, along with safe work procedures, adequately controls and governs repair work. If not, develop written procedures to fill gaps that are identified.
- Develop specifications for critical repair parts and maintenance materials and ensure that vendors supply parts and materials that conform to specifications.
- Become familiar with requirements related to special certifications for inspectors and ensure that inspectors hold the certifications listed in applicable standards.
- Provide tools and training required to conduct tests and inspections and to store test data and equipment history in a manner that can be easily analyzed.
- Ensure usage of proper analytical techniques to assist decision making in the AIM program where applicable, such as Reliability-Centered Maintenance (RCM), Layer of Protection Analysis (LOPA) and similar analysis approaches, Fault Tree Analysis (FTA) and Markov analyses, Equipment failure analysis, Root Cause Analysis (RCA).
- Develop, implement a Risk-Based Inspection (RBI) program for the asset.
- The AIM program shall be supported by QA/QC that ensures asset quality from time the asset is designed until the time it is taken out of service for retirement or re-use.
- Ensure that deviations from approved inspection and maintenance programs are approved by specified named competent individuals commensurate with the risk.
- Develop a procedures to ensure that findings and recommendations from the asset inspection and maintenance programmes are appropriately prioritised, analyzed and followed up.
- Based on the results of tests and inspection activities, make appropriate adjustments to the inspection or test interval, and use the results to plan overhaul, replacement, or other corrective actions.

- Seek new knowledge related to the asset integrity program and update ITPM tasks accordingly.
- Establish a means to efficiently collect and analyze data and highlight anomalies.
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

### 5.4.11 Contractor Management

**Contractor management** has been defined as a system of controls to ensure that contract workers can perform their jobs safely, and that contracted services do not add to or increase facility operational risks. Contractor management also addresses the responsibilities of the contracting company and the contract employer in implementing a contractor management program.

Apart from **contracts** management and **overall contractor management**, **contractor safety management's** main concern is the contractor HSE compliance, starting from the work planning, pre-qualification, and selection of the contractors then developing the agreement and following up the execution till the demobilization phase and evaluating the contractor. [4]

To achieve the element objectives, the company shall establish a documented contractor management system in a controlled procedure or a written program to ensure consistent implementation and identify when contractor management is needed.

The execution phase **includes an** appropriate selection of contractors, establish expectations, roles, and responsibilities for contractor safety program implementation and performance. Finally, Monitor the contractor management system for effectiveness.



Figure (6) Contractor management process

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**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Develop a procedure for implementing the contractor management element, including corporate standard procedures, requirements, and so forth, for contractor screening and selection to be used at all company facilities, across all regions. These standards will help ensure consistency across the company (particularly if screening and selection are a facility's responsibility).
- Establish an element owner at the facility level for the contractor management.
- Define roles and responsibilities for facility staff who oversee the contractor management.
- Appropriately Select Contractors, develop and maintain a list of pre-screened candidates, and select contractors based upon their functional capabilities, experience and safety performance, and soundness of their safety programs.
- Provide a carefully controlled waiver policy to address situations in which the only available contractor for a particular service does not meet minimum requirements for safety program and performance.
- Documentation of the contractor screening and selection process should be periodically audited by an authority independent of this process.
- Conduct a pre-job meeting with the selected contractor to address safety issues, clearly establish a mutual understanding of company expectations for contractor safety performance, establish a roles and responsibilities matrix to formalize agreements on safety matters between the company and the contractor.
- Provide and confirm awareness training for contractor personnel and retain records of training given, including the means used to confirm understanding, as appropriate.
- Identify required certifications for specialized skill or craft work, such as for welders, heavy equipment operators, non-destructive testing technicians, instrument calibration and so forth, and ensure that required documentation of such certifications is maintained.
- Conduct unannounced field inspections and audits of contractor work activities and record
- Include the contract workforce in any relevant emergency response drills.
- Promptly respond to and resolve safety issues identified by contractors.
- Maintain records of contractor injuries and illnesses.
- Maintain control over contractor temporary facilities.
- Maintain records substantiating contract award decisions for successful and unsuccessful bidders.
- Maintain records of contractor safety performance during the contract, including inspection and audit results, illness and injury statistics, and incident investigation findings.
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

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#### 5.4.12 Training and Performance Assurance

Training is practical instruction in job and task requirements and methods. It may be provided in a classroom, workplace, or on the job, and its objective is to enable workers to meet some minimum initial performance standards, to maintain their proficiency, or to qualify them for promotion to a more demanding position. [1]

Performance assurance is how workers demonstrate that they have understood the training and can apply it in practical situations. Performance assurance is an ongoing process to ensure that workers meet performance standards and to identify where additional training is required.

To achieve the element objectives, the company shall establish and maintain practices that ensure consistent and effective implementation, includes the establishment of a training program, defining roles and responsibilities, training needs, and control training materials and records. Furthermore, Company shall ensure the efficiency of the training, monitor worker performance, and validate the training program effectiveness.

**The following activities are the minimum requirements to achieve the element performance expectations:**

- Develop a written procedure for managing the training element that describes the process for creating, updating, and maintaining training materials.
- Include specific roles and responsibilities in the management system procedure governing the training element.
- Ensure that employee training and development needs are identified through a systematic process, for example, identify who must be trained in the hazards of the process and the depth of that training, identify who must be trained in process safety.
- Ensure that the addressed training needs shall fill the gap between target PS competency and actual PS competency as described in the relevant section (Section 5.4.3 process safety competency).
- Maintain a library of current, approved training materials and provide a means to ensure that training materials are updated to reflect changes in the process.
- Provide a means to track worker training records, such as completed courses, performance records, projected needs, and so forth.
- Solicit worker input on the training required to successfully perform each job and task.
- Categorize training requirements for knowledge-based, rule-based, and skill-based tasks, consistent with the written operating and maintenance procedures.

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- Ensure that training and development programs are a combination of formal courses, coaching, and practical work.
- Develop or procure training materials and define the qualifications for a trainer, review quality of course plans, presentations, and exercise materials.
- Identify how and where each training module can best be presented.
- Identify what training and on-the-job training must be completed before a worker or visitor can enter the facility.
- Identify when refresher training must be performed (both to retain skills and to meet any regulatory requirements).
- Develop methods for testing trainee progress toward, and achievement of, minimum acceptable performance standards.
- Identify metrics by which training program effectiveness will be judged.
- Ensure that training and development programs are formally reviewed to assess their effectiveness and identify issues that need to be addressed and improvement opportunities
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

### 5.4.13 Management of Change

**Management of Change** describes the management practices involving the recognition of change situations, the assessment of hazards, authorization requirements and the decision on whether to allow a change to be made and necessary risk control and follow-up measures. The MOC element helps ensure that changes to a process do not inadvertently introduce new hazards or unknowingly increase risk of existing hazards. [1]

The need for change may arise in several different forms from various sources, including strategic decisions, risk assessments, employee suggestions, management reviews, assurance findings, technology advances, and incident investigations.

To achieve the element objectives, the company shall maintain dependable practices includes establishing a documented MOC system in a controlled procedure or a written program to ensure consistent implementation, identify potential change situations, evaluate possible impacts and complete follow-up activities, involve competent personnel. Ensure keeping MOC practices effective by periodic monitoring, maintenance, and corrective action.

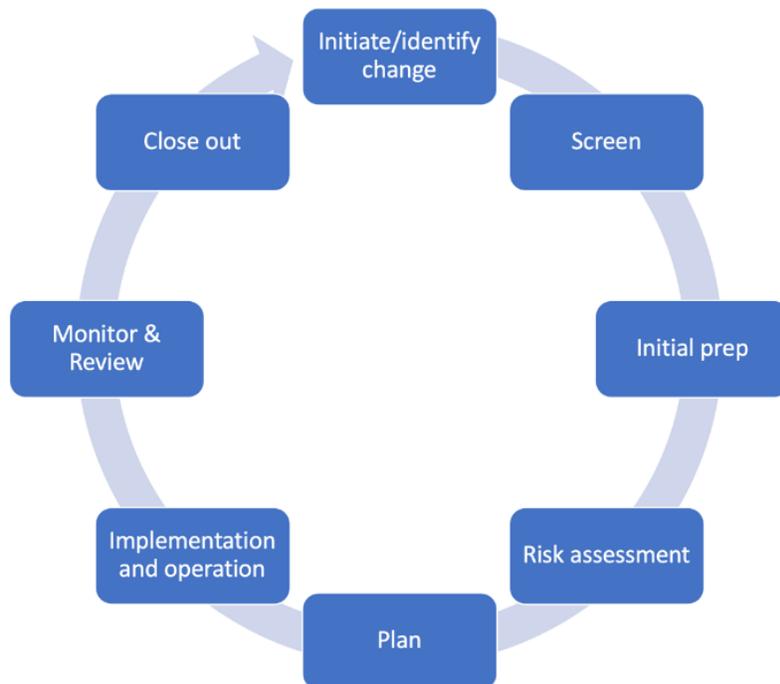


Figure (7) MOC lifecycle model [2]

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**The following activities are the minimum requirements to achieve the element performance expectations:**

- Develop a written procedure for managing the MOC element.
- Assign a job function as the owner of the MOC system.
- Define the technical scope of the MOC system so that the types of changes to be managed are unambiguous and the sources of changes are monitored, the scope shall include (RBPS management system, plant layout or equipment, location arrangement, facility and equipment, new chemicals, software Policies, procedures, process technology, organizational change, etc.).
- The processes for managing change shall include:
  - Initiation
  - Screening
  - Initial preparation
  - Risk assessment
  - Planning
  - Implementation and operation
  - Monitor and review
  - Closeout
- If temporary changes are permitted, the MOC review procedure should address the allowable length of time that the change can exist. and the procedure should include a process to confirm the removal of temporary changes or restoration of the change to the original condition within the period specified in the approved change request.
- If emergency changes are permitted, the MOC review procedure should define (1) what constitutes an emergency change and (2) the process for evaluating and authorizing the emergency change.
- Document the rationale for not addressing specific types of changes in the MOC system if applicable.
- Develop a list of areas, departments, and activities to which the MOC system applies.
- Define the MOC roles and responsibilities for various groups of personnel.
- Develop specific examples of changes and replacement in kind (RIK) in the MOC procedure.
- Provide awareness training and refresher training on the MOC system.
- Provide detailed training to all affected employees and contractors who are assigned specific roles within the MOC system.
- Identify the types of information necessary to properly evaluate changes within the scope of the MOC system.
- Apply appropriate technical rigor for the MOC review process.

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- MOC reviews should be performed by qualified personnel as the performance will only be as good as the people that are involved in conducting the reviews.
- The approach to risk identification and assessment should address risks to health and safety (including process safety), environment, reputation, security, third party assets, and business continuity.
- Use appropriate analytical techniques to review the potential safety and health impacts of the change.
- Assess possible Impacts to determine whether the change introduces a new hazard or increases the risk associated with an existing hazard.
- Decide Whether to Allow the Change, each change should be authorized by a person(s) with designated approval responsibilities.
- Update all process knowledge before the startup of the change.
- Create a system to resolve MOC review action items and to document their completion.
- Once a change is authorized, it is released for implementation. Typically, the execution of a change is performed via work practices under other RBPS elements by facility staff or contractors involved in the design, engineering, or construction.
- Closeout activities should be conducted to ensure proper implementation, a close-out checklist should be applied to ensure that all relevant documentation has been updated, all relevant training carried out, and all relevant MOC documentation collated and archived.
- Establish and collect data on MOC performance and efficiency indicators.
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

#### 5.4.14 OPERATIONAL READINESS

**The Operational Readiness** element ensures that shut down processes are verified to be in a safe condition for re-start, it describes the management practices for performing pre-startup reviews of (1) new processes, (2) processes that have been shut down for modification, and (3) processes that have been administratively shut down for other reasons. [1]

To achieve the element objectives the company shall maintain dependable practices includes establishing a formal procedure for performing readiness reviews, determining triggers of the readiness practice, Identifying areas and situations for which the review applies. Then conduct appropriate readiness reviews as needed and make startup decisions based upon readiness results and ensure that readiness practices remain effective.

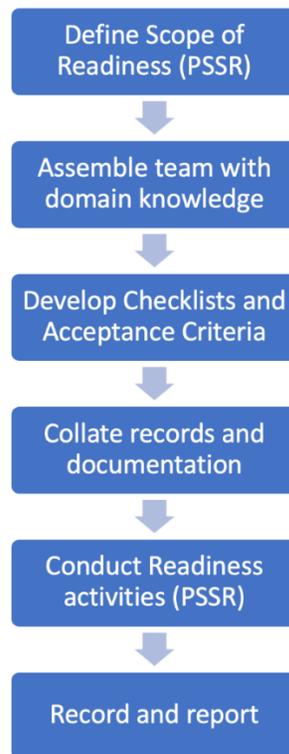


Figure (8) Operational readiness process

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**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Develop a procedure for implementing the readiness reviews, the procedure shall determine the content/issues to be addressed for each type of startup.
- Assign a job function as the owner of the readiness system.
- Define the readiness roles and responsibilities of various groups of personnel.
- Determine the types of readiness reviews that are needed and when to conduct them.
- Determine the areas of the facility in which the readiness procedure applies. Also, identify areas/situations where it does not apply.
- Provide training on the readiness system to employees and contractors.
- Create a list of the necessary information that should be provided to participants of readiness reviews.
- Use checklists, to conduct and document the basis for the readiness review.
- Authorize startups based upon readiness review results as specified in the written program.
- Communicate decisions and actions from the readiness review.
- Create a system to address readiness review action items and to document their completion.
- Retain readiness review records.
- Establish and collect metrics data on the readiness element.
- Provide input to internal audits of readiness practices based upon learnings from the metrics data.

#### 5.4.15 CONDUCT OF OPERATIONS

**Conduct of operations** has been defined as the execution of operational and management tasks in a deliberate and structured manner, it provides a guideline to all disciplines to enhance performance in process safety, personal health and safety, environmental responsibility, quality, productivity, and profitability. [1]

The conduct of operations system is to reliably accomplish the mission of the company within the framework of its core values, move the company toward its goals. Conduct of operations encompasses the ongoing management systems that are developed to encourage the performance of all tasks in a consistent, appropriate manner.

To achieve the element objectives, the company shall maintain a dependable practice that includes establishing a documented operations program to maintain reliable worker performance, define roles and responsibilities and establish a standard for performance. Furthermore, the company shall control operations activities by enforcing the following operating procedures and safe work practices (refer to Sections 8 and 9), ensure workers qualification and proper training (refer to Section 12) and assign adequate resources.

Also, the company shall monitor organizational performance, Poor performance must be analyzed so that appropriate corrective actions can be implemented. Operations program effectiveness shall be validated.

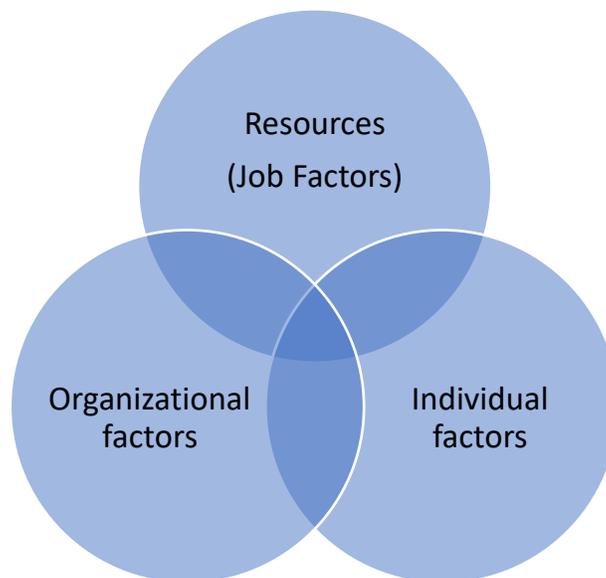


Figure (9) Conduct of operations key factors

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**The following activities are the minimum requirements to achieve the element performance expectations:-**

**Organizational factors: -**

- Realistic, measurable, and challenging goals and objectives for operation should be established covering operation reliability and safety, production capacity & quality, and energy consumption optimization where high standards of performance are expected.
- Develop procedures, permits, checklists, and other written standards governing the operations element.
- Management should ensure that procedures are put in place to cover the interfaces and communications between shifts, operation division, and other groups in on-site companies at the plant.
- Develop comprehensive procedures to ensure that safe operating limits (SOL) are defined and recorded for all assets and systemically monitored and strictly manage excursions outside safe operating envelope (SOE).
- Ensure consequences of deviation and steps to correct and/or avoid the deviation from SOL are consistently defined, documented, maintained and readily communicated.
- Ensure written procedures for shift handover or exchange.
- Ensure procedures are in place to manage abnormality and decision making when any parameter which is out of acceptable range occurs and ensure appropriate reporting and corrective actions.
- Ensure that those authorizing deviations from standard procedures are aware of the risks and have a sense of vulnerability.
- Identify metrics by which operations effectiveness will be judged.
- Coordinate on-the-job training activities with current operating conditions.
- Establish and promote an environment that welcomes questions regarding the safety of all aspects of the operation, including nonroutine activities, even if the activities are planned and executed by experts.
- Periodically audit work practices in the field to verify that they are consistent with training.
- Establish a system to routinely inspect work areas to determine if (1) best practices are being followed, (2) abnormal activities are controlled by appropriate permits, and (3) good housekeeping is being maintained.
- Review completed logs and reports and based on the results of the review, take steps to improve their accuracy and completeness.

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#### Human factors:

- Maintain accountability by applying the "Operation Discipline" principle where system governing conduct trusting people to do their jobs, holding them accountable for their failings, and rewarding them for their behaviors are key aspects of a Conduct Of Operations/Operation Discipline system.
- Management shall ensure that adequate, qualified & competent workers are selected and receive the appropriate training to perform their duties most professionally.
- Periodically review of control room staffing to ensure it is adequate for routine and non-routine conditions.
- Train all employees and contractors in the conduct of operations element and provide refreshment training as necessary.
- Encourage workers to act deliberately and stop if conditions do not match their expectations within approved company procedures.

#### Job factors (Resources):

- The human-machine interface should be designed, labeled, and maintained in a manner that facilitates the collection of information at any given time to maintain safe conditions.
- Develop and use protocols for communications between workgroups.
- Establish a system to control access to process areas and control room.
- Apply consistent labeling and color-coding to all equipment.
- Apply special labeling and color-coding to all safety-critical equipment.
- Operating areas should be well lit, and lighting failures should be promptly corrected.

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#### 5.4.16 Emergency management

**An emergency** is a sudden, urgent, usually unexpected occurrence or event requiring immediate action, **Emergency management** is the overall approach for preventing emergencies and managing those that occur.

Emergency management includes (1) planning for possible emergencies, (2) providing resources to execute the plan, (3) practicing and continuously improving the plan, (4) training or informing employees, contractors, neighbors, and local authorities on what to do, how they will be notified, and how to report an emergency, and (5) effectively communicating with stakeholders in the event an incident does occur. [1]

To achieve the element objectives, the company shall develop a written program with a defined scope, designate an owner and define roles and responsibilities, involve competent personnel, prepare for emergencies, and periodically test the adequacy of plans and level of preparedness.

**The following activities are the minimum requirements to achieve the element performance expectations:**

- Develop a written emergency management plan that specifies all of the activities that support this element including actions to protect and account for employees, contractors, and visitors.
- Define the scope of the emergency response plan including the physical scope, types of emergencies considered, and define roles and responsibilities.
- Designate a single person who has overall responsibility for the facility's emergency management.
- List accident scenarios that represent the range of consequences identified in previous hazard identification and risk assessment work activities.
- Establish unit or building preplans that address the range of accident scenarios that have been identified.
- Establish a mutual aid scheme involving relevant third parties and external emergency services.
- Based on the plans that are developed, provide the facilities and equipment necessary to execute the plans including equipment for emergency communications.
- Ensure Adequate numbers of competent personnel are available to fulfill the defined roles in the emergency plans.

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- Identify emergency response and evacuation equipment, including required inspections, tests, and other preventive maintenance or replacement activities, and establish a system to ensure that equipment is properly maintained and tested.
- Train incident commanders and all Emergency Response Team (ERT) members on all of the skills needed to mount an emergency response or rescue effort effectively and safely.
- Ensure that all personnel (1) are aware of the emergency response program, (2) understand the facility's policy governing actions to take in an emergency, and (3) know how to recognize and report an emergency.
- Train managers and technical personnel who take an active role in emergency management, but who do not direct or actively participate in the tactical response.
- Ensure that neighbors know what to do in the event they are notified of an emergency.
- Maintain emergency response plans current and accurate, and periodically review the plans.
- Periodically conduct drills to assess the (1) effectiveness of the plan and (2) state of readiness of the ERT and conduct tabletop exercises or other actions to train managers and other personnel who would help manage the crisis.
- Conduct a formal critique using independent, experienced observers.
- In addition to exercises and drills, periodically evaluate the emergency management plan to ensure that all of the elements required to maintain a dependable practice are in place and remain effective.
- Record any deficiencies or recommendations for improvement resulting from exercises, drills, assessments, and audits; resolve them into action plans, and implement the action plans.
- Ensure that element compliance and performance trends are reviewed by specified levels of management.

### 5.4.17 Incident Investigation

An essential aspect of health, safety, and environment and process safety performance improvement is learning from incidents (both accidents and near hits/misses) and taking appropriate action to prevent their recurrence. Management should ensure that incidents are consistently reported and investigated and that identified actions and learnings are implemented on a timely basis.

To achieve the element objectives, the company shall maintain a dependable incident reporting and investigation practice and implement a relevant program consistently across the company. Moreover, the company shall identify potential incidents for investigation, use appropriate techniques to investigate incidents, document incident investigation results, follow through on results of investigations and trend data to identify repeat incidents that warrant investigation and finally monitor incident investigation practices for effectiveness.

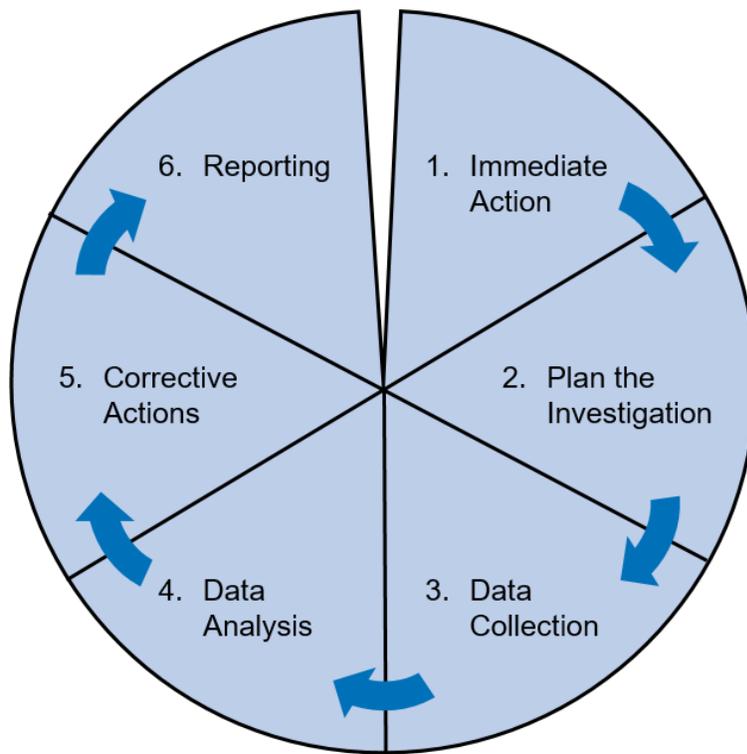


Figure (10) Six steps for incident investigation

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**The following activities are the minimum requirements to achieve the element performance expectations:**

- Establish a procedure for incident investigation and to include at least, to report on, collect data related to, investigate, and learn from incidents and ensure to define the technical scope of the incidents element by specifying the risk and consequence thresholds that trigger different levels of investigations.
- The accident investigation shall include the following steps:
  - Immediate action
  - Plan the investigation
  - Data collection and analysis
  - Corrective actions and Reporting
- Provide awareness training and refresher training on incidents element processes to all employees and contractors, focusing on the appropriate reporting of incidents, including near misses, and the basic approach of the incident investigation program.
- Provide Root cause analysis (RCA) and forensics training to incident investigation leaders, focusing on the skills needed to lead an investigation team and the use of RCA techniques, and provide RCA review training to managers responsible for championing, guiding, and reviewing incident investigations, focusing on the essential elements and products of an RCA (less skill training is required for this group).
- Ensure that the reporting of incidents and a near miss by all personnel including contractors and suppliers is obligatory, identify and eliminate barriers for reporting incidents.
- Develop a list of information, data, interviews, and records that incident investigators typically consider collecting during investigations.
- Ensure that the investigations identify root causes, including human and organizational factors, and recommendations to address them are identified.
- Establish a system to promptly address and resolve the incident report recommendations.
- Ensure that completed investigations are reviewed and approved by specific levels of management appropriate to the classification of the incident.
- Share findings and lessons learned with industry peer groups, respecting business confidentiality.
- Establish and collect incident investigation performance metrics.
- Perform self-assessments of the management systems and practices for the incidents element.
- Perform management reviews of the incident investigation process.
- Perform active assessments of data, such as logs, data trends, and emergency response actuations, that could identify near misses and incident precursors.
- Follow results of investigations and prioritize recommendations and track to completion.
- Perform a periodic analysis of the incident database to identify adverse trends and report them to management.

#### 5.4.18 Measurement and Metrics

Process safety metrics are critical indicators for evaluating a process safety management system's performance, a combination of leading and lagging metrics is often the best way to provide a complete picture of process safety effectiveness.

- **Lagging metrics.** A retrospective set of metrics based on incidents that meet an established threshold of severity. In other words, lagging indicators measure control barrier defects, events, and consequences. Lagging metrics describe events that already occur. (5)
- **Leading metrics.** A forward-looking set of metrics that indicate the performance of the key work processes, operating discipline, or layers of protection that prevent incidents. In other words, leading indicators measure the maintain of the control barrier strength (see barrier definition) i.e., activities to maintain risk control system. (5)

The primary objective of the metrics element is to provide a means for near-real-time monitoring of the performance and efficiency of a process safety management system that provides information to decision-makers by measuring the company's performance in controlling the process hazards and risks.

To achieve the element objectives, the company shall establish a written description of the metrics practices with appropriately defined scope, determine triggers for metrics collection and reporting, then the company shall conduct metrics acquisition and use metrics to make element corrective action decisions and keep metrics practices effective.

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**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Establish and implement procedures to develop and maintain process safety management performance and efficiency metrics.
- Assign an owner of the metrics system to monitor the program's effectiveness on a routine basis and define the metrics roles and responsibilities for various groups of personnel.
- Develop appropriate metrics for each RBPS element.
- Determine when metrics data are gathered.
- Determine the facility areas in which the metrics element should be applied.
- Provide training on the metrics system and detailed training to those who are assigned specific roles within the metrics system.
- Maintain records of metrics system data.
- Ensure that an appropriate means exists for collecting data on selected RBPS elements.
- Summarize and communicate metrics data to relevant stakeholders in a useful format.
- Establish action limits for the metrics and use metrics to make element corrective action decisions.
- Create a communication process for the RBPS health status and potential corrective actions/adjustments to the RBPS elements.

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#### 5.4.19 Auditing

There are three types of audits, Internal audits (or first-party) are typically performed inside a company to measure the strengths and weaknesses relative to its internal business objectives, while an external audit (or second party) is usually performed at the request of a customer (or a company contracted to act on the customer's behalf) on a supplier of products or services, and certification audit (third party), a certification body auditor assesses whether an enterprise complies with the relevant standard. [6]

The audits element is intended to evaluate whether management systems are performing as intended. It complements other RBPS control and monitoring activities in elements such as management review, metrics, and inspection work activities that are part of the asset integrity and conduct of operations elements.

The audits element comprises a system for scheduling, staffing, effectively performing, and documenting periodic evaluations of all RBPS elements, as well as providing systems for managing the resolution of findings and corrective actions generated by the audits.

To achieve the element objectives, the company shall establish a written program governing the audits element, involve competent personnel and identify when audits are needed, conduct element work activities (as mentioned below), and use audits to enhance RBPS effectiveness.

**The following activities are the minimum requirements to achieve the element performance expectations:-**

- Develop an audits program that addresses issues such as the scope of application, scheduling, team staffing, recommendation resolution, and documentation of audits.
- Establish an audits element owner.
- Define roles and responsibilities for the audits element.
- Develop and review audit protocols.
- Define the skills needed for the audit team members.
- Provide the required training to the audit team members.
- Ensure audits independence and apply controls to ensure that auditors do not review activities with which they have a direct association.
- Establish baseline schedules for audits.
- Identify triggers for additional audits.

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- Select team members, assign RBPS management system elements to the respective team members and confirm their availability.
- Assign audit responsibilities to audit team members based on expertise, experience, and interest.
- Assemble and distribute to the team members information that will assist in their preparation for the audit.
- Plan audit activities and prepare the onsite agenda.
- Gather audit data through records sampling and reviews, observations, and interviews.
- Assess RBPS implementation strengths, weaknesses, and gaps relative to established requirements.
- Report preliminary audit observations and findings in periodic meetings during the audit.
- Conduct an audit close-out meeting.
- Prepare a draft report and forward it to the appropriate facility personnel for a review then Issue the final report and forward it to the appropriate facility personnel.
- Develop an action plan to address report findings.
- Assign responsibilities and establish deadlines.
- Follow up-to resolve, and document resolution of, audit recommendations.
- Maintain required documentation of the audit, including resolution of recommendations.
- Monitor RBPS performance and maturation over time.
- Identify continuing RBPS management system or performance weaknesses.
- Implement RBPS management system enhancements by applying corrective actions to the addressed underlying problems with management systems.
- Identify RBPS management system strengths and communicate.
- Disseminate information on RBPS management system best practices to other facilities.

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#### 5.4.20 Management Review and Continuous Improvement

Management review is the routine evaluation of whether management systems are performing as intended and producing the desired results as efficiently as possible. It is the ongoing “due diligence” review by management that fills the gap between day-to-day work activities and periodic formal audits.

Management review shall ensure continuing suitability, adequacy, and effectiveness of the PSM system, and its outputs shall include decisions related to the continuing suitability, adequacy, and effectiveness of the PSM system in achieving its intended outcomes, and continual improvement opportunities.

To achieve the element objectives, the company shall establish a management review program, define roles and responsibilities, establish standards for performance and validate program effectiveness, conduct review activities (as mentioned below) and monitor organizational performance.

**The following activities are the minimum requirements to achieve the element performance expectations:**

- Develop management review procedure.
- Include specific roles and responsibilities in the management system governing the management review element.
- Establish baseline schedules for reviews.
- Identify measures by which the effectiveness of management reviews will be judged.
- Establish the scope of the review and confirm the review schedule.
- Gather information necessary for the review, prepare a presentation.
- The inputs of the management review may include but are not limited to the following:
  - a- the status of actions from previous management reviews;
  - b- changes in external and internal process safety knowledge, including the results of the evaluation of compliance with standards; and HIRA studies;
  - c- the extent to which the process safety objectives have been met and any needed support from the leadership;
  - d- information on the process safety metrics, including trends in incidents, process safety near misses, process safety audit results, and results of involvement of workers;
  - e- relevant outreach(es) with stakeholders;
  - f- opportunities for continual improvement.

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- Conduct the review meeting and ensure active participation and encourage transparency in the management review meeting.
- Assess RBPS implementation strengths, weaknesses, and gaps relative to established requirements.
- Document the review and forward it to the appropriate facility personnel.
- Develop an action plan to address review findings.
- Assign responsibilities and establish deadlines.
- Follow up to resolve review recommendations and document resolution.
- Identify relevant metric(s) for each RBPS element.
- Trend RBPS performance over time.
- Periodically spot-check work practices in the field to verify that they are consistent with RBPS element requirements.

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## 6. PSM Elements allocations and accountability

The overall purpose of adopting an RBPS management system is to define the systems that are implemented to ensure effective process safety management to achieve the best performance according to the AIChE Center for Chemical Process Safety (CCPS, 2007) Guidelines for Risk-Based Process Safety commitments. Each company covered in the scope of this standard is responsible for the embrace of process safety management in their processes and ensuring Process safety culture enhancement among their personnel. They are also responsible for assigning PSM element owners between departments to maintain accountability and achieve target performance. PSM Element Owners are responsible for defining and reviewing the PSM measurements and metrics (KPIs) related to their assigned element, as well as for ensuring that reporting of KPIs is done within the defined timelines. The PSM Element Owners are also responsible for keeping and providing, upon request, records of information to support the reported KPIs.

## 7. Monitor Organizational Performance

A safety management system can be seriously deficient yet appear satisfactory by superficial measures. The paperwork appears to be in place and no serious incidents have been recorded. Complacency replaces a sense of vulnerability, and the execution of program tasks becomes an obligatory routine. The collective input from site visits, team discussions, internal audits, and management reviews shall provide dynamic and consistent support for the implementation of the PSM program as well as fill the gap between day-to-day work activities and periodic formal external audits. The purpose of monitoring the organizational performance is to gauge the effectiveness of the PSM program implementation and to prevent an organizational embrace of such inefficient and potentially dangerous inertia. This would ensure that these potential deficiencies are proactively identified and resolved before they are revealed by an audit or incident.

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