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SAPIA Process Safety Professional Competency Guideline

DOCUMENT CONTROL

Date of Revision	Revision	Person	Version Number
January 2023	New		A

LIST OF ABBREVIATIONS

ALARP	As Low as Reasonable Practical
API	American Petroleum Institute
ECSA	Engineering Council of South Africa
HAZOP	Hazard and Operability Study
KUE	Key Undesirable Event
LOC	Loss of Containment
LOPA	Layers of Protection Analysis
LOTO	Lockout Tagout
MHI	Major Hazardous Installation
MOC	Management of Change
OSHA	Occupational Safety and Health Administration
PDA	Potential deviation Analysis
PHA	Process Hazard Analysis
PS	Process Safety
PSSR	Pre Start-up Safety Review
PSV	Pressure Safety Valve
RCA	Root Cause Analysis
SHE	Safety Health and Environment
SIL	Safety Integrity Level

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SAPIA Guideline

INTENT OF GUIDELINE

This guideline is intended to guide SAPIA members on the competency requirements for different levels of a process safety professional. This guideline does not take away the responsibility of the Members to ensure that persons appointed as process safety professionals are competent and comply with all legislative requirements.

SCOPE OF USE

This guideline is intended for SAPIA members in South Africa (SA). Non-SAPIA members will require the permission of SAPIA on the use of this guideline and will do so solely at their own discretion without any liability to SAPIA or its members. This guideline is not a list of procedures.

EXCLUSIONS OF GUIDELINE

This guideline is not a legally binding document. It serves to share best practice to ensure that process safety incidents and accidents can be prevented. This guideline is also not exhaustive. Risk assessments at facilities may determine unique risks peculiar to specific sites which need to be considered.

1. Introduction

As occupational safety tends to be more skill based, process safety relies more on knowledge. Competence in the context of this guidance is defined as a set of capacities (skills, experience, knowledge and the willingness to follow rules and procedures) which will provide the necessary abilities to enable individuals to potentially perform certain tasks. Process safety competencies according to this definition includes skills and knowledge on human factors issues, as for instance:

- Avoiding conflicting goals
- Handling of unforeseen events
- Situation awareness
- Avoiding fatigue
- Good man-machine interface

2. Scope

This guideline deals with the competencies of process safety professionals at different levels.

It does not include transient performance shaping factors such as stress, workload, fatigue, distraction etc. Developing competence according to this guidance therefore will not in itself guarantee safety, but it will improve the predictability of good performance.

3. Definitions

Bow-tie analysis
A risk evaluation method that can be used to analyse and demonstrate causal relationships for top risk scenarios. In the context of SHE, the bow-tie methodology is used to unpack the SHE top risks / KUEs.

Critical control
A control that is crucial to preventing the KUE or mitigating the consequences (corrective controls). This is a management choice of the most significant controls, based on an 80/20 principle – controls with most effect on reduction of risk event impact and probability (consequence and likelihood).

Fault Tree Analysis
A quantitative method for representing the logical combinations of various system states which lead to a top event in order to determine whether there is enough protection.

Failure Mode and Effects Analysis
A systematic, qualitative hazard identification technique focused on equipment failure modes and effects of their failures.

Hazard and Operability Analysis (HAZOP)
A systematic, qualitative hazard identification technique applied to a firm design, using a series of guide words to study deviations from the design intent of relevant process parameters in order to identify potential hazards and operability problems.

Hazard identification
A systematic approach to identify and characterize material and process conditions that may result in hazardous events, like explosions, fires, and releases of toxic materials.

Inherently safer design
The pursuit of designing hazards out of chemical processes and equipment, rather than the use of engineering or procedural controls to reduce the frequency or mitigate the consequences of potential hazardous events. (Examples are: replacing a solvent with a less hazardous one, or using less severe process conditions, e.g. lower pressure)

Layer of Protection Analysis (LOPA)
This is a semi-quantitative process for evaluating the effectiveness of independent layers of protection in reducing the likelihood or severity of an undesirable event in order to determine whether there is enough protection.

Management of change
A systematic procedure for the review of proposed changes to the documented process technology and / or facilities or personnel, considering potential hazards brought onto the process, materials, equipment or operation, and their elimination or control as a result of the change.

Permit to Work
All work conducted on a site requires authorisation. Work permits are required for all types of maintenance work, modifications as well as production related work that is not routine and is not covered by a written work procedure.

PHA – Process Hazard Analysis
The application of an organized, methodical approach using an approved methodology to identify, evaluate, and control the hazards and risks associated with process facilities. It includes some or all the following activities:

- Inherently safer process evaluation;
- Hazard exploration and identification;
- Consequence assessment;
- Risk assessment;
- Human factors evaluation;
- Building siting evaluation; and
- Development of recommendations.

Process Safety Management
Application of management systems and controls (programs, procedures, audits, evaluations) to a manufacturing or chemical process in a way that process hazards are identified, understood, and controlled so that process-related injuries and incidents are prevented.

Pre Start-up Safety Review
A system to confirm, before the introduction of hazardous chemicals, that new or modified facilities are in accordance with design specifications; free of leaks, adequate procedures are in place; appropriate hazard analyses or management of change reviews have been conducted; and training of affected personnel has been completed.

Professional certificated engineer
A person registered in that category in terms of section 18(1)(a)(iii) of the Engineering Profession Act.

Professional engineer
A person registered in that category in terms of section 18(1)(a)(i) of the Engineering Profession Act.

Professional engineering technician
A person registered in that category in terms of section 18(1)(a)(iv) of the Engineering Profession Act.

Professional engineering technologist
A person registered in that category in terms of section 18(1)(a)(ii) of the Engineering Profession Act;

Recognised and Generally Accepted Good Engineering Practice
The use of procedures and recommended practices published by credible organisations, including recommendations of original equipment manufacturers.

Safety Integrity Level (SIL)
This is a performance criterion for a safety instrumented system (for example a high-level trip) defining the range of probabilities of the function failing to perform its required action on demand (probability of failure on demand).

4. Importance of Process Safety Competence?

Many process safety incidents happen because the necessary knowledge or competence is not available at the right time in the right place. Process safety competency often also has a role in ensuring that the correct actions are taken when a process safety incident occurs and may be critical to reducing the impact of the event and preventing escalation of the incident.

Some of the more important process industry incidents quickly found links to process safety competency in every case:

- Flixborough (UK, 1974):
  Explosion due to a release from a temporary bypass assembly of inadequate design operated by insufficiently competent people (Health and Safety Executive 1975).

- Piper Alpha (UK, 1988):
  The public enquiry into the Piper Alpha explosion in 1998 concluded that the operating company failed to ensure that a key supervisor was sufficiently competent in the operation of the permit to work system.

- Longford (Australia, 1998):
  Failure to identify hazards and properly train operators. Insufficient understanding led to a critical incorrect valve operation (Hopkins 2000).

- BP Texas City (USA, 2005):
  Key Technical Findings: A lack of supervisory oversight and technically trained personnel during the start-up, which is a hazardous period. The operator training program was inadequate.

- Buncefield (UK, 2005):

There should be a clear understanding of major accident risks and the safety critical equipment and systems designed to control them. At the core of managing a major hazard business should be clear and positive process safety leadership with board-level involvement and competence to ensure that major hazard risks are being properly managed.

Process safety competence plays a vital role in preventing or mitigating process incidents for the following reasons:

- Competent people are less likely to initiate situations that could lead to an incident
- Competent people can detect the early signs that an incident is possible and prevent it from occurring
- Competent people can mitigate the impact of an event to reduce the potential for harm

The focus of process safety is to prevent fires, explosions and chemical accidents in chemical process facilities or other facilities dealing with hazardous materials such as refineries, and oil and gas (onshore and offshore) production installations.

Approach to Develop Process Safety Competency

A trend is noticed that oil and chemical companies, create and structure their own process safety programmes. The proportion of internal and external activities varies greatly depending on their size, their resources and alignment with their strategic objectives in this area.

The increasingly complex and technical demands of process safety management have placed a large demand on existing resources across the process industries. Success requires the utilization, involvement, and full support of all staff at a site. Success also demands that a substantial portion of staff be competent and capable of contributing.

Unfortunately, the process safety competencies required for people to become fully involved are not easy to achieve quickly. New engineering graduates may have academic exposure to safety engineering principles and critical thinking skills, but they generally lack specific training on process safety fundamentals, though that is changing in engineering curriculum. More importantly, new graduated always lack the practical experience required to make sound risk management judgments and they lack the skill required for many tasks in process safety management, such as leading process hazard analyses.

Similarly, operations personnel may have the practical, hands-on experience required, but they often lack the technical skills necessary to perform some of the skill-based tasks that fall to them, and they may also lack the analytical background to evaluate and manage risk effectively.

Developing, measuring, and maintaining individual competency

Competency is the skill or ability to do something well enough to meet a standard. An individual gains competency through the combination of natural abilities, general education, experience, and specific skill and task training.

Some of these components, such as education or experience (knowledge), can be measured directly and minimum standards established. However, evaluation of the competency level requires demonstration of the ability and judgment by others who are already competent.

Developing and maintaining organizational competency

An organization gains competency through the identification and development of the requisite skills, but skills alone are not enough. Organizational competency also requires that information is developed and shared, that a learning culture is maintained to ensure that the skills are developed and applied in an effective manner, and that performance measures are monitored to continuously evaluate performance and re-evaluate organizational needs.

Step 1: Skills – What are the organization's needs?

Understanding the organization's process safety skill requirements is the first building block of developing competency across the organization. A gap analysis is essential to develop these skill requirements.
Establish process safety goals and objectives, it is possible to identify what skills, individual competency levels, and resources are needed to successfully meet those objectives.

Step 2: Identify Candidates
After the organization has identified the inventory of process safety skills and resources needed, it must now determine how those needs will be met. There are many factors outside the scope that must weigh into this decision for each organization.

When using internal resources, it is important to continually look for and identify good candidates early in the process for further development as advanced and expert resources. Awareness and knowledge training provide ideal opportunities to begin this process.

Step 3: Culture - Develop Career Paths and Opportunities
Incorporate the process safety skills inventory and competency requirements into the normal career progression for all roles. When considering individuals for advancement or promotion, consider the development and demonstration of process safety competencies appropriate to the role. In each discipline, establish the minimum competencies required to progress to the next level. Reward those who exceed the minimum requirements with additional learning opportunities, special projects, coaching assignments, individual recognition, and promotions.

Step 4 – Build individual competency
Individuals build competency through their natural abilities, education, training, and experience. Formal training classes provide the basic awareness and knowledge necessary, but advanced skills require application and hands-on experience in real-world applications. Mentors who have already demonstrated advanced skills can be assigned to each new learner to provide guidance, feedback, encouragement and support.

Step 5 – Maintain Proficiency and Extend Skills
Organizations maintain and extend process safety competency by providing a supportive culture, making information available, and evaluating performance. A supportive process safety culture begins with management's understanding, commitment, and unwavering support of process safety management as a critical risk management tool. Resources are made available, priorities are clearly established, and key performance indicators are monitored and discussed to ensure that process safety related activities are completed.

Step 6 - Measure and evaluate results, re-evaluate needs

A strong set of leading and lagging metrics is essential to measuring and monitoring performance. Most of the metrics associated with process safety competency are activity based, such as the following examples:

- Ratio of near misses report to number of accidents that occur
- Training sessions completed
- Achievement of specific competency goals
- Timely completion of investigations or all causal factors and root causes
- Timely completion of high quality MOCs
- Timely completion of high quality PHAs
- Timely completion of compliance and best practice audits
- Timely closure of recommendations and action items
- Timely completion of and good results from human factors audits
- Procedure quality and accuracy audits

Periodically, it is also important to review and re-evaluate the organization's process safety goals and objectives to determine how things are going. Determine if the goals are relevant and are, they are being

achieved. Identified if competency needs being met and have new needs become apparent. Ensure that the process safety plans and strategies are completely aligned with the organization's overall goals.

5. Six key elements (pillars) of process safety

The elements (pillars) of process safety are as follow:

ELEMENT	TOPIC
Culture	• Safety leadership, responsibility and workplace culture
Knowledge and competence	• Process safety concepts • Hazard identification and risk assessment • Hazard awareness to the operation
Engineering and design	• Safety in design • Asset integrity • Codes and standards • Management of change
Human factors	• Human factors
Systems and procedures	• System manuals and drawings • Process and operational status monitoring and handover • Service provider and supplier selection and management • Safe systems of work • Project delivery • Management of major emergencies and preparedness • Incident reporting and investigation
Assurance	• Legislation and regulations • Audit, assurance, management review and intervention

6. Process safety professionals

The following process safety professional categories were identified:

- PS Graduate Engineer / Practitioner:
  - Operations, Maintenance or outside Process Safety professional with more than 5 years' experience or a university graduate.

- PS Engineer / Specialist:
  - Engineer with more than 5 years' experience and a university degree or Specialist with more than 7 years' experience.

- PS Senior Engineer / Senior Specialist:
  - Engineer with more than 10 years' experience and a university degree, Senior specialist more than 10 years' experience.

- PS Lead / Manager:
  - Engineer or Specialist with 13 years or more related experience

Note:
For a person to be a professional certified engineer, professional engineer, professional engineering technician or professional engineering technologist the person have to comply to ECSA requirements as set out in the Government Gazette dated 26 March 2021.

7. Process safety Competencies

The required competencies are divided into the following categories:

- Company specific procedures, training and courses
- External training
- Process safety related procedures and specifications
- Process safety element training
- API specifications

Awareness (A)
Has knowledge of the theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things.

Basic application (BA)
Performs fundamental and routine tasks. Requires occasional supervision. Increased functional expertise and ability. Works with others.

Skilled application or proficiency (S)
Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches' others. Assesses and compares alternative options.

Mastery or expert (M)
Advanced experience in the skill. Applies creative solutions to complex problems. Defines and drives critical business opportunities and needs. Represents the organisation internally and externally on critical issues. Sets standards within the organisation. Recognised as a subject matter expert.

Required (R) to complete training

Company specific procedures/training/courses	PS Graduate Engineer Practitioner	PS Engineer Specialist	PS Senior Engineer Specialist	PS Lead Manager
Understanding Process Safety Management	R	R	R	R
Factory/Process overview – Company specific	R	R	R	R
Life Savings Behaviours / Rules - Company	R	R	R	R
Process safety fundamentals - company	R	R	R	R
Understanding Risk Assessment Tools (PDA, LOC etc.)	R	R	R	R
Incident management Procedure and Tool Utilization - company specific (classification, RCA, learnings, etc)	R	R	R	R
Types of Fire -external	R	R	R	R
Types of Explosion - External	R	R	R	R
Safety Plant Specific Training - Company specific	R	R	R	R
OHSA Awareness	R	R	R	R
Hazard Identification	R	R	R	R
Incident Investigation Process Training	R	R	R	R
Permit to Work - company specific	R	R	R	R
Process Safety Barriers	R	R	R	R
Process safety barrier model training	R	R	R	R
Conducting Process Safety Audits - External	R	R	R	R
Process safety training for operational personnel	R	R	R	R
Process safety awareness training	R	R	R	R
Management of Change training and use of tool / paper system	R	R	R	R

SHE hazards and effects register - Generic (high risk management) (KUE)	R	R	R	R
Process safety culture and leadership	A	B/A	S	R
Section 8 & 14 awareness	R	R	R	R
PSV adequacy	R	R	R	R

External training	PS Graduate Engineer Practitioner	PS Engineer Specialist	PS Senior Engineer Specialist	PS Lead Manager
HAZOP basic	R	R	R	R
PHA team leader (Upfront knowledge for fire assessments etc.)	A	R	R	R
LOPA	A	R	R	R
HAZOP facilitator. Include procedural HAZOPs.	A	R	R	R
Hazop leadership	A	R	R	R
SIL determination	A	R	R	R
WHAT IF ANALYSIS	A	R	R	R
Incident investigation & human factors	R	R	R	R
Human factors	A	R	R	R
Fundamentals of process safety	R	R	R	R
Bowtie Analysis	R	R	R	R
Bowtie Tools (software/license comes with the training)	R	R	R	R
Dispersion modelling (software/license comes with the training)	A	R	R	R
MHI	A	R	R	R
Process safety Auditing	A	R	R	R
Nebosh process safety training	A	R	R	R

PS related procedures	**PS Graduate Engineer Practitioner**	**PS Engineer Specialist**	**PS Senior Engineer Specialist**	**PS Lead Manager**
Process isolation procedure – LOTO (lock out and touch and tag separate procedures)	A/BA	M	M	M/S
Classification of hazardous locations in a plant	A/BA	M	M	M/S
Safety device bypass	A/BA	M	M	M/S
Isolation and lock out	A/BA	M	M	M/S
Temporary online leak sealing – Clamps/Wraps/Boxes	A/BA	M	M	M/S

Production prestart up safety review	A/BA	M	M	M/S
Clearance for operation (PSSR)	A/BA	M	M	M/S
Flexible hose procedure	A/BA	M	M	M/S
Confined Space Entry	A/BA	M	M	M/S
Management of Change	A/BA	M	M	M/S
Facility Siting	A/BA	M	M	M/S
Process safety certification exams	A/BA	M	M	M/S
Flange management	A/BA	M	M	M/S
Understanding inherent safer design	A/BA	M	M	M/S
ALARP principles	A/BA	M	M	M/S
Safety instrumented systems	A/BA	M	M	M/S
Process safety element training	A/BA	M	M	M/S
Identification of critical controls	A/BA	M	M	M/S
Assurance of critical controls	A/BA	M	M	M/S
Six pillars of process safety	A/BA	M	M	M/S

API specifications	**PS Graduate Engineer Practitioner**	**PS Engineer Specialist**	**PS Senior Engineer Specialist**	**PS Lead Manager**
API 752 - Management of Hazards Associated with Location of Process Plant Buildings	A	R	R	R
API 753 - Management of Hazards Associated with Location of Process Plant Portable Buildings	A	R	R	R
API 754 - Process safety performance indicators	A	R	R	R
API 755 - Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries	A	R	R	R

Appendix A - OSHA PSM Elements

- **Employee Participation**

The first and foremost thing that is required for the implementation of PSM elements is employee participation. Employees of production as well and maintenance departments should be involved in the PSM elements. A representative from both departments should be included in the meetings and discussions conducted on PSM-related issues.

- **Process Safety Information**

Every process has some degree of risk along with it. It is necessary to share the risk involved with the workers working on the process. It's the employer's responsibility to create a document on process safety information and make it accessible to the workers working on the process.

- **Process Hazard Analysis**

Process hazard analysis is the technical mandate of PSM where it is required to perform a detailed analysis on process and identified the hazard includes in the process. All the consequences in case of system failure should be analysed in detail by the dedicated team. According to the OSHA, teams should be comprised of person who is expert in that field to have a proper analysis.

- **Operating Procedures**

Every operation that is being performed in the industry must be done as per the standard operating procedure. Experts should prepare the standard operating procedures for every activity and task to avoid mishaps. Standard operating procedures are prepared to avoid errors that can happened while performing tasks.

- **Training**

Training is the most important part and should be done mandatory according to the OSHA. To perform operations with safety, it is important that the person should be trained, hence it is necessary that the person working on highly hazardous chemicals should be trained and through the competent sheet. OSHA requires training procedures should be well documented. Training management system software makes it easy to handle training as well as competent test.

- **Contractors**

Prior to giving operation or project on contracts, it is employers responsibility to ensure that all the workers including contract workers and company employees are aware of the risk and potential hazards of all the process.

- **Pre-Start-up Safety Review**

Prior to starting the plant after a shutdown or commissioning of the new plant, PSSR is important. PSSR ensures that the process is safe and ready in operating condition. All the checklist and safety points should be reviewed for new and modified facilities. OSHA requires to perform a Pre-Start-up Safety Review even if a single component or process is being modified or added.

- **Mechanical Integrity**

All the equipment had their life. As they are used in the process, wear and tear and operating conditions decrease the life of the equipment. Poor condition equipment can cause an accident and has the potential to harm human life and property. Hence it is important to perform tests and check the mechanical integrity and document those details.

- **Hot Work Permit**

Various types of work and jobs in being conducted in industry and as an administrative tool, a permit to work is issued. There are primarily 5 types of work permits that are being issued viz. General work permit, height work permit, hot work permit, confined space work permit, and excavation work permit. Among these work permit, hot work is relatively dangerous as high temperature and fire generation is involved in the hot work activity.

Hence it is important to have a trained person performing the activity and should comply with all the points mentioned in the permit without failure.

- **Management of Change**

In the process, if the process department wants to change for the optimization or modify the piping or equipment for a change in process, it should proceed to pass through management of change form. This is a written and documented process where the change in process is approved by various departments such as the process, maintenance and safety departments to check if there is any risk or hazard involved in the change. Management of changes included change in process, chemicals, raw materials, equipment, piping and process flow, technology or procedures.

- **Incident Investigation**

Incidents occur in industries as the risk involved in the work can't be eliminated but can reduce. OSHA states that organizations should have to do the investigation of the situation that had or could have resulted in major accidents and it should be well documented. This investigation could help us to take learning and in future, it can be referred to avoid such situation.

- **Emergency planning and response**

Risk is involved in every job and these risks can lead to major accidents in industry. It is important to have emergency planning and it should be available to the workers and the persons working in the organization should be trained. In the fire safety in the workplace section, we had discussed why Fire Emergency Plan is mandatory to reduce the damage that can be occurred due to fire. Hence emergency planning and response plan should be available which can be executed in case of an emergency and to fight against hazards occurred due to highly hazardous chemicals.

- **Compliance Audits**

Employers in order to evaluate all the procedures are being followed according to the standard, should have a compliance certificate at least every three years and based on this element, it is required to 2 most recent audit reports with them.

- **Trade Secrets**

It is observed that the organization or the management doesn't share the process used in the manufacturing with the employees to protect the process as a trade secret. According to the PSM, it is mandatory to share the details of the process which can affect the health of employees and they have the right to know.

Appendix B - CCPS 20 Elements of Risk-Based Process Safety

The 20 CCPS RBPS elements are described below:

Element 1 - Process Safety Culture:
A positive environment in which employees at all levels are committed to process safety. This starts at the highest levels of the organization and is shared by all. Process safety leaders nurture this process.

Element 2 - Compliance with Standards:
Applicable regulations, standards, codes, and other requirements issued by national, state/provincial, and local governments; consensus standards organizations; and the company itself. Interpretation and implementation of these requirements. Includes development activities for corporate, consensus, and governmental standards.

Element 3 - Process Safety Competency:
Skills and resources that the company needs to have in the right places to manage its process hazards. Verification that the company collectively has these skills and resources. Application of this information in succession planning and management of organizational change.

Element 4 - Workforce Involvement:
Broad involvement of operating and maintenance personnel in process safety activities, to make sure that lessons learned by the people closest to the process are considered and addressed.

Element 5 - Stakeholder Outreach:
A process for identifying, engaging, and maintaining good relationships with appropriate external stakeholder groups. This would include the surrounding community, suppliers of raw materials, customers, government agencies and regulators, professional societies, contractors, and more.

Element 6 - Process Knowledge Management:
The assembly and management of all information needed to perform process safety activities. Verification of the accuracy of this information. Confirmation that this information is correct and up-to-date. This information must be readily available to those who need it to safely perform their jobs.

Element 7 - Hazard Identification and Risk Analysis:
Identification of process safety hazards and their potential consequences. Definition of the risks posed by these hazard scenarios. Recommendations to reduce or eliminate hazards, reduce potential consequences, and reduce frequency of occurrence. Analysis may be qualitative or quantitative, depending on the level of risk.

Element 8 - Operating Procedures:
Written instructions for a manufacturing operation that describes how the operation is to be carried out safely, explaining the consequences of deviation from procedures, describing key safeguards, and addressing special situations and emergencies.

Element 9 - Safe Work Practices:
Procedures to safely maintain and repair equipment, such as permits to work, line breaking, and hot work permits. This applies to nonroutine operations.

Element 10 - Asset Integrity and Reliability:
Activities to ensure that important equipment remains suitable for its intended purpose throughout its service. Includes proper selection of materials of construction; inspection, testing, and preventive maintenance; and design for maintainability.

Element 11 - Contractor Management:

Practices to ensure that contract workers can perform their jobs safely, and that contracted services do not add to or increase facility operational risks.

Element 12 - Training and Performance Assurance:
Practical instruction in job and task requirements and methods for operation and maintenance workers, supervisors, engineers, leaders, and process safety professionals. Verification that the trained skills are being practiced proficiently.

Element 13 - Management of Change:
Process of reviewing and authorizing proposed changes to facility design, operations, organization, or activities prior to implementing them, and ensuring that the process safety information is updated accordingly.

Element 14 - Operational Readiness:
Evaluation of the process before start-up or restart to ensure the process can be safely started. Applies to restart of facilities after being shut down or idled as well as after process changes and maintenance. Also applies to start-up of new facilities.

Element 15 - Conduct of Operations:
Means by which the management and operational tasks required for process safety are carried out in a deliberate, faithful, and structured manner. Managers ensure workers carry out the required tasks and prevent deviations from expected performance.

Element 16 - Emergency Management:
Plans for possible emergencies that define actions in an emergency; resources to execute those actions; practice drills; continuous improvement; training or informing employees, contractors, neighbours, and local authorities; and communications with stakeholders if an incident does occur.

Element 17 - Incident Investigation:
Process of reporting, tracking, and investigating incidents and near misses to identify root causes; taking corrective actions; evaluating incident trends; and communicating lessons learned.

Element 18 - Measurement and Metrics:
Leading and lagging indicators of process safety performance, including incident and near-miss rates as well as metrics that show how well key process safety elements are being performed. This information is used to drive improvement in process safety.

Element 19 - Auditing:
Periodic critical review of process safety management system performance by auditors not assigned to the site to identify gaps in performance and identify improvement opportunities, and track closure of these gaps to completion.

Element 20 - Management Review and Continuous Improvement:
The practice of managers at all levels of setting process safety expectations and goals with their staff and reviewing performance and progress toward those goals. May take place in a staff or “leadership team” meeting or on a one-on-one basis. May be facilitated by process safety leader but is owned by the line manager.

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