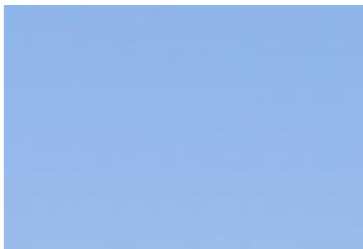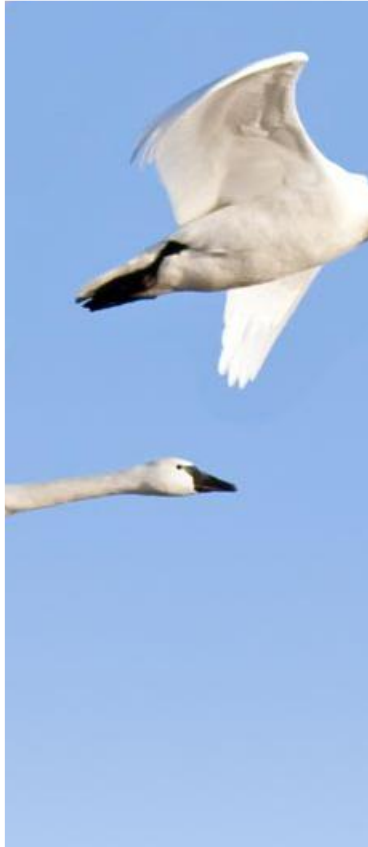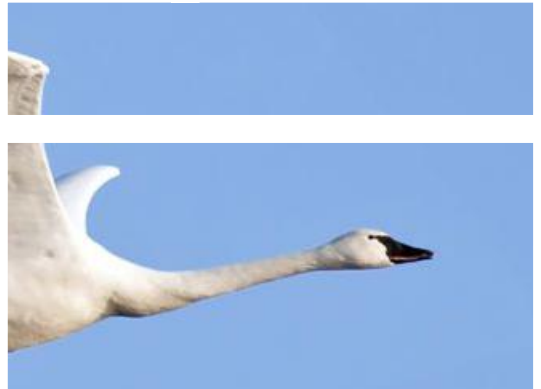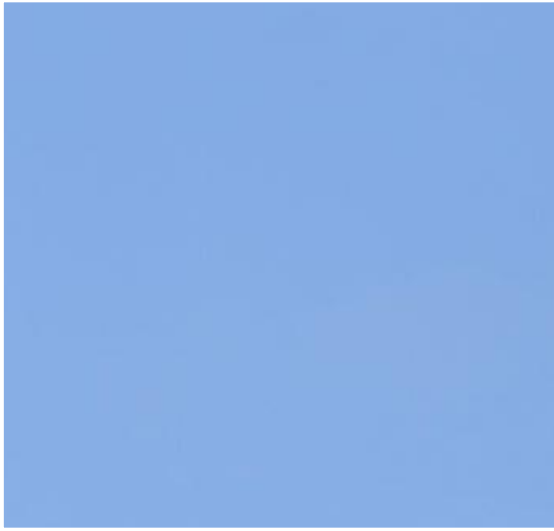# IChemE Safety Centre Guidance

Process Safety Competency –
a Model
2015
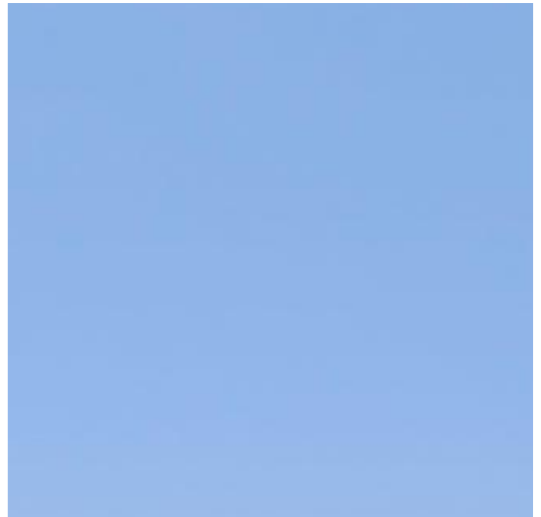
# Preface

The IChemE Safety Centre (ISC) is an industry-funded and led organisation, focussed on improving process safety through sharing information and learnings. ISC members can nominate specific areas of focus, and ISC leads the development work in these areas, working with personnel from member companies.

Process safety competency was identified as an initial area of work for ISC. Once a specific need was defined by the ISC Advisory Board and the project sponsor, the team set about the project. This consisted of reviewing the current guidance material available on this topic. There are several different organisations that have published guidance on how to establish a process safety competency framework. However, these documents stop short of actually defining different levels of competency for different roles – ie, developing the framework in a generic sense. ISC's guidance document takes the step to create the generic framework, for different types of roles in an organisation.

This guidance does not address how to establish competency or define certification processes. ISC anticipates further work in establishing how competency can be achieved, once a gap analysis is carried out on the current programmes available against the competency topics defined in this document. Organisations should have their own competency assessment programmes; this document informs the organisation of the process safety competence requirements for each role, so that it can be incorporated into their existing competence framework.

ISC believes that a functional approach to process safety is important to increase people's understanding of their requirements. This premise is that effective management of process safety requires leadership across six functional elements in an organisation. These are:

- **knowledge and competence,**
- **engineering and design,**
- **systems and procedures,**
- **assurance,**
- **human factors, and**
- **culture**

These elements can be thought of as a chain of safety, rather than applied to James Reason's Swiss Cheese Model[1]. This is because we do not need failures in all elements to have an incident, but rather multiple failures in one element could result in an incident. The integrity of the chain is in the multiple layers behind it, hence demonstrated knowledge and competency in all elements is required across an organisation.

Lastly, this is a living document and we expect that competency systems will evolve over time. If you have an established process safety competency system that is working well, and differs from the framework described here, please share your example, so we can continue to improve this guidance for everyone.

## Contact the ISC

email: safetycentre@icheme.org

**www.ichemesafetycentre.org**

# Contents

# Organisational roles

Organisational roles in companies and industries vary significantly. For this reason, we have attempted to provide a list of generic organisational roles that may apply across multiple industries. This means that while your specific job titles may not appear in the list, you should be able to draw a parallel with them.

Roles have been categorised into areas of an organisation and then into more specific applications. See below for role descriptions.

Table 1: Organisational roles

| Area | Role | Description |
| --- | --- | --- |
| Front line | Operator | Front-line worker, usually on shift. Responsible for operating the facility. Sometimes called a process operator or process technician. |
| | Maintainer | Front-line worker, usually on shift. Responsible for performing maintenance on the facility. |
| | Supervisor | Front-line supervisor, usually on shift. Responsible for managing operators or maintainers on a day-to-day basis. |
| Engineer | Integrity | Specialist role responsible for maintaining the integrity of facilities, such as corrosion management, rotating equipment, fixed equipment, etc. |
| | Reliability | Specialist role responsible for maintaining the reliability of facilities. |
| | Other technical | A technical specialist role, such as human factors, safety instrumented systems, risk management, etc. |
| | Project | An engineer involved in projects for the organisation, may be in a design house, at a facility, as well as conducting site supervision for installation works. |
| Support | PS advisor | Process safety specialist, responsible for advising organisations on process safety related matters. |
| | PS lead | Most senior process safety specialist in an organisation, responsible for advising organisations on process safety related matters. |
| | HSE site | Site based health, safety and environment specialist, responsible for advising organisations on their HSE requirements. |
| | HSE corporate | Corporate-level health, safety and environment specialist, responsible for advising organisations on their HSE requirements. |
| | Quality assurance | Workers responsible for maintaining quality-based systems in an organisation, such as management systems or document control systems. |
| | Human resources | Workers responsible for recruitment and training processes in an organisation. |
| Management | Manager/ superintendent | Managers responsible for day-to-day operations or for part of an organisation. |
| | GM/site manager | Most senior leader at a facility, or a part of an organisation. |
| Executive | Leaders/MDs | Executive manager or director, responsible for the operations and strategy of an organisation. |
| | Directors | Non-executive directors appointed to a board, responsible for governing an organisation. |
| | Board chair | The chair of the board, or president, responsible for setting organisational direction and leadership. |
| | Safety committee chair | Board member delegated the authority to lead the safety committee of the board, similar to the finance director, they chair a specific committee focussed on the safety of the organisation. |
| | Process safety specialist board member | Board members with specific process safety competence. This role has been recommended following several incidents, as it is important to have a person on the board who fully understands process safety, similar to having financially-trained people on a board. |

# Developing the matrix

## Establishing Competency

In order to establish a competency framework, it is necessary to determine the topics of competency.

## Competency topics

Twenty one topics were defined as requiring specific process safety competency, based on the following guidelines:

- Centre for Chemical Process Safety Guidelines for Risk Based Process Safety[2]
- Energy Institute Process Safety Management Elements[3]
- Cogent and UKPIA Guidelines for Competency Management Systems for Downstream and Petroleum Sites[4]
- European Process Safety Centre Process Safety Competence, How to set up a Process Safety Competence Management System[5]

These topics were then mapped against the six functional elements. Some topics exist across more than one element, therefore the most significant element has been chosen as the primary one.

Table 2: Competency topics

| Elements | Topic |
| --- | --- |
| Knowledge & competence | Process safety concepts |
| | Hazard identification and risk assessment |
| | Hazard awareness and characterisation associated with the system being operated and the product processed |
| | Project management |
| | Management of major emergencies and emergency preparedness |
| Engineering & design | Safety in design, including systems |
| | Asset integrity – inspection and maintenance |
| | Management of change |
| Systems & procedures | Safe systems analysis |
| | Systems, manuals and drawings |
| | Process and operational status monitoring and handover |
| | Management of operational interfaces |
| | Contractor and supplier selection and management |
| | Defect identification, elimination and root cause analysis |
| | Management of safety critical elements |
| | Incident reporting and investigation |
| Assurance | Legislation and regulations |
| | Codes and standards |
| | Audit, assurance, management review and intervention |
| Human factors | Human factors |
| Culture | Safety leadership commitment, responsibility and workplace culture |

Some of these elements have both technical and management aspects to them. Where this is the case, these aspects have been labelled in the competency definition in Appendix 2

# Competency definitions

Competency was also defined across a 4-tier scale, based on a combination of the tiers used by both Woodside and Santos. This allows a more granular determination of the competency required across a varied workforce. These tiers are defined below:

## Awareness

Has knowledge of 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

Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others.

## Skilled application or proficiency

Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternative options.

## Mastery or expert

Advanced experience in the particular 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 subject matter expert.

For each topic defined, the specific requirements at each level of competency were developed. Some of these were specified as 'management', and others 'technical'. Where no split was made, the competency was seen to be encompassing. See Appendix 2 for the specific requirements.

An additional category called technical authority (TA) was also added to the matrix. This was to recognise in many organisations there is an individual or group of individuals who are the defined authority for a specific topic. These topics include areas such as rotating equipment, pressure piping, corrosion etc. These authorities are responsible for approving the standards for these topics as well as deviations from these standards.

The requirements for each competency level also assume that the requirements for the lower levels are met and upheld, or are capable of being achieved.

# How to use this guidance

This document provides an example of what a competency management framework looks like for process safety. It is up to each individual organisation to determine the best method of implementation. Recommended steps on how to implement the framework are detailed below:

**1.** Determine the scope

a.   is the framework to be applied organisation wide or for individual facilities?

**2.** Map current roles to the matrix in Appendix 1

a.   review the corporate structure to see where roles align with those identified in Table 2.

**3.** Determine any role gaps

a.   identify if all roles are covered adequately.

b.   roles may be assessed as part of recruitment processes or development planning.

**4.**   Conduct gap analysis for existing role competencies against the matrices in Appendices 1 and 2. This is best done as a combined activity with the process safety lead in an organisation and the human resources organisational development specialist. This is because the gap assessment needs to address both the technical aspects as well as how the competency framework is administered in an organisation.

a.   Identify lack of competencies and the required improvements.

**5.** Develop action plans to address role and competency gaps. Competency gaps may be addressed by one or more of the following improvement options:

a.   Formal training course

b.   Implementing a procedure/system

c.   Being part of a process/activity

d.   Audit of a procedure/system

e.   Closing a system gap

f.   Developing a link with another site

g.   Finding and working with a mentor

h.   Reviewing a best practice system

**6.** Revise the process during organisational changes or periodically at defined intervals

a.   maintenance of a framework is vital to ensure it stays relevant and accurate.

b.   use metrics to monitor the implementation and health of the framework (refer to IChemE Safety Centre Guidance *Lead Process Safety Metrics – selecting, tracking and learning*[6]).

# Appendix 1: Competency matrix

| | | | |
|---|---|---|---|
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. | T | Technical elements |
| 2. Basic application | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. | M | Management elements |
| 3. Skilled application/ Proficient | Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternatives and opportunities. Builds networks with others skilled in application or mastery. | TA | Technical authority role responsibilities |
| 4. Mastery/expert | Advanced experience in the particular 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 subject matter expert. | | |
| NA | Not applicable or no role requirement. | | |

| Competency element | Front line | | | Engineering | | | | Support functions | | | | | | Management | | Executives | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Operator | Maintainer | Supervisor | Integrity | Reliability | Other tech | Project | PS advisor | PS lead | HSE site | HSE Corp | QA | HR | Manager / superintendent | GM/site manager | Leaders/ MD | General board member | Board chair | Safety committee chair | Process safety specialist board member |
| Process safety concepts | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 4 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 4 |
| Hazard identification and risk assessment | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 4 TA | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| Hazard awareness and characterisation associated with the system being operated and product processed | 2 | 2 | 2 | 3 | 3 | 4 TA | 3 | 3 | 4 TA | 1 | 3 | 1 | 1 | 3 | 2 | 2 | 1 | 2 | 2 | 3 |
| Project management | 1 | 1 | 2 | 3 | 3 | 4 | 4 | 3 | 4 | 1 | 3 | 1 | NA | 2 | 2 | 2 | 1 | 2 | 1 | 3 |
| Management of major emergencies and emergency preparedness | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 4 | 3 | 4 | 1 | 1 | 4 | 3 | 3 | 1 | 3 | 3 | 3 |
| Safety in design including systems | 1 | 1 | 1 | 3 | 3 | 4 TA | 3 | 1 | 2 | 1 | 2 | 1 | NA | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Asset integrity – inspection and maintenance | 1 | 2 | 3 | 4 | 4 | 4 TA | 2 | 2 | 2 | 2 | 2 | 1 | NA | 3T | 2 | 1 | 1 | 1 | 1 | 4 |
| Management of change | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 3 |

| Competency element | Front line | | | Engineering | | | | Support functions | | | | | | Management | | Executives | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Operator | Maintainer | Supervisor | Integrity | Reliability | Other tech | Project | PS advisor | PS lead | HSE site | HSE Corp | QA | HR | Manager / superintendent | GM/site manager | Leaders/ MD | General board member | Board chair | Safety committee chair | Process safety specialist board member |
| Safety systems analysis | 1 | 1 | 2 | 3 | 3 | 4 TA | 3 | 2 | 3 | 1 | 3 | 1 | NA | 2 | 2 | 2 | 1 | 1 | 1 | 2 |
| Systems, manuals and drawings | 1 | 1 | 3 | 4 | 4 | 4 | 4 | 2 | 3 | 1 | 3 | 4 TA | NA | 1 | 1 | NA | NA | NA | NA | 1 |
| Process & operational status monitoring & handover | 2 | 2 | 3 | 2 | 2 | 4 | 1 | 1 | 1 | 1 | 1 | NA | NA | 3 | 1 | 1 | 1 | 1 | 1 | 1 |
| Management of operational interfaces | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 3 | 4 | NA | NA | 4T | 4 M | 4 M | 1 | 1 | 3 | 3 |
| Contractor & supplier selection and management | 1 | 1 | 2 | 3 | 3 | 4 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 |
| Defect identification, elimination and RCA | 1 | 2 | 2 | 3 | 3 | 4 TA | 2 | 2 | 3 | 2 | 3 | NA | NA | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Management of safety critical elements | 2 | 2 | 3 | 4 | 4 | 4 TA | 3T | 3 | 4 | 2 | 3 | 3 T | NA | 1 | 1 | 1 | 1 | 1 | 1 | 3M |
| Incident reporting and investigation | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 4 TA | 4 | 2 | 1 | 3 | 4 | 1 | 1 | 1 | 1 | 4 |
| Legislation and regulations | 1 | 1 | 2 | 2 | 2 | 3 TA | 2 | 3 | 4 | 2 | 4 | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| Codes and Standards | 1 | 1 | 2 | 2 | 2 | 3 TA | 2 | 3 | 4 | 2 | 4 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 3 |
| Audit, assurance, management review and intervention | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 4 |
| Human factors | 2 | 2 | 3 | 1 | 1 | 4 TA | 2 | 3 | 3 | 3 | 4 | 1 or NA | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 4 |
| Safety leadership commitment, responsibility and workplace culture | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 4T | 3 | 4M | 2 | 2 | 3 | 4M | 4M | 4M | 4M | 4M | 4M |

# Appendix 2:
# Competency definitions across 21 competency topics

| Proficiency rating | Description |
|---|---|
| **1. Awareness** | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
| **2. Basic application** | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. |
| **3. Skilled Application/ proficient** | Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternatives and opportunities. Builds networks with others skilled in application or mastery. |
| **4. Mastery/ expert** | Advanced experience in the particular 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 subject matter expert. |

| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/Expert |
|---|---|---|---|---|---|
| **Knowledge & competency** | Process safety concepts | Aware of process safety concepts, eg 6 pillars.<br><br>Aware of the similarities and differences between process safety, personal safety and their hazards. | Applies process safety concepts into daily work activities. | Mentors others in process safety.<br><br>Communicates process safety concepts with target audiences and stakeholders.<br><br>Identifies learnings from past process safety events. | Process safety subject matter expert.<br><br>Designs process safety awareness sessions for various levels within company.<br><br>Communicates process safety issues and programmes with leadership/management team and gains their support.<br><br>Links learnings from past events to process safety framework. |

| Proficiency rating | Description |
|---|---|
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
| 2. Basic application | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. |
| 3. Skilled Application/ proficient | Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternatives and opportunities. Builds networks with others skilled in application or mastery. |
| 4. Mastery/ expert | Advanced experience in the particular 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 subject matter expert. |

| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/ Expert |
|---|---|---|---|---|---|
| Knowledge & competency | Hazard identification and risk assessment | Aware of basic hazard identification processes (eg Step Back 5x5, JHA, etc) and where they are used.

Aware of where to locate risk registers/safety case.

Aware of the terms, hazard, risk, control, as low as reasonably practicable (ALARP).

Aware of the safe systems of work tools – PTW, isolations, safe work method statements. | Participates in risk assessment processes.

Understands the way process safety hazards are controlled, and what those controls are and how effective they are.

Understands the terms safety case, loss of containment (LOC), hazard identification (HAZID), hazard and operability study (HAZOP) and layers of protection (LOPA).

Implements safe systems of work including PTW, isolation procedures and safe work method statements into every day work activities. | Mentors other in conducting risk assessments.

Identifies who needs to be involved in the development of hazard identification processes.

Facilitates risk assessment processes such as HAZID, HAZOP, QRA, LOPA, bow tie, fault tree and event tree.

Manages the risk assessment process, including:

- Agreeing the purpose and scope of the HAZID/HAZOP/ QRA;

- Identifying appropriate personnel and HAZID/HAZOP/ QRA tools;

- Ensuring sufficient resources and time are allocated;

- Clearly defining reporting processes and study boundaries according to the purpose and scope;

- Collating appropriate background information and studies, such as historical incident data; | Subject matter expert for hazard identification and risk control.

Identifies where safe system of work need to be developed.

Engages with leadership team to provide resources for identification and assessment.

Mastery in consequence modelling concepts and details.

Develops risk criteria.

Develops control strategies – eg from inherently safer design through to emergency response. |

| Knowledge & competency | | | | |
|---|---|---|---|---|
| Hazard awareness and characterisation associated with the system being operated and product processed | Applies to specific hazards of facility or organisation.<br><br>Aware of the relevant processes occurring in area of plant/equipment.<br><br>Aware of the risks associated with the process occurring in the area/equipment. | Applies to specific hazards of facility or organisation.<br><br>Understands the performance indicators that govern the safety of the process.<br><br>Understands the triggers for action, the importance to act, and what action is required.<br><br>Lists and implements all operating procedures.<br><br>Able to describe and apply tools available. | - Agreeing the interpretation of major accident event (MAE) that is consistent with the Regulations and relevant to the facility.<br><br>Reads, interprets, reviews, and corrects cause and effect diagrams and SAFE charts (safety analysis function evaluation chart).<br><br>Facilitates the development of safe systems of work.<br><br>Applies the pros and cons of each assessment method in selecting the correct method.<br><br>Able to demonstrate understanding and application of reducing public risk as it applies to process safety. | Applies to specific hazards of facility or organisation.<br><br>Able to interpret what performance indicators mean in terms of the safety of the process.<br><br>Able to make or authorise changes to correct the situation.<br><br>Able to troubleshoot problems.<br><br>Able to develop and recommend procedures.<br><br>Recognises the physical and chemical properties of the materials that are being processed.<br><br>Able to train and mentor others. | Applies to specific hazards of facility or organisation.<br><br>Mastery in describing the process physics and chemistry and how they are controlled and influenced.<br><br>Mastery in defining the basis of safety for the facility including understanding previous incidents. |

| Proficiency rating | Description |
|---|---|
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
| 2. Basic application | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. |
| 3. Skilled Application/proficient | Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternatives and opportunities. Builds networks with others skilled in application or mastery. |
| 4. Mastery/expert | Advanced experience in the particular 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 subject matter expert. |

| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/ Expert |
|---|---|---|---|---|---|
| Knowledge & competency | Project management | Aware of own deliverables and role in achieving the project outcomes.<br><br>Delivers on allocated tasks and responsibilities within required timeframes.<br><br>Aware of that there is a project management process. | Understands team dynamics and how this affects working relationships at different stages of project.<br><br>Builds constructive relationships with team members.<br><br>Understands the performance criteria that the project is due to deliver on – understanding scope of project.<br><br>Understands process safety stages of the project – eg risk assessments, siting studies etc. | Recognises the roles and relationships of the project manager, project team and other stakeholders and is able to competently manage those relationships.<br><br>Builds constructive relationships with internal and external vendors ensuring clear roles and responsibilities.<br><br>Initiates and maintains contractual conditions and relationships.<br><br>Recognises the gating/project stages process with respect to including inherently safer design input.<br><br>Recognises when to apply relevant risk management processes. | Defines project management process and how it aligns with process safety needs.<br><br>Able to identify and engage subject matter experts when required for process safety aspect. |
| Knowledge & competency | Management of major emergencies and emergency preparedness | Aware of escape routes, muster points and emergency evacuation procedures.<br><br>Aware of own role in an emergency.<br><br>Aware of major incident scenarios.<br><br>Aware of how to initiate emergency response – eg raise alarm. | Able to play a role in emergency response as nominated.<br><br>Understands how to escalate emergency alarm, eg calling emergency services/response.<br><br>Able to plan and undertake emergency exercises. | Ensures team members are aware of emergency response plan and their individual roles and that of the emergency response team.<br><br>Able to decide on response actions and direct people. | Develop emergency response plan based on major incident scenarios and results of consequence modelling.<br><br>Able to monitor effectiveness of response activities.<br><br>Engage with external emergency services and third parties. |

| Engineering & design | Safety in design including systems | Aware that there are laws, codes, and regulations pertaining to safe process/facility design, construction, and operation. | Applies laws, codes, and regulations pertaining to safe process/facility design, construction, and operation in design. | Develops shutdown/control logic for simple facilities.<br><br>Applies cost effective instrumentation to achieve the necessary redundancy and independence of controls and safety systems.<br><br>Develops and sizes depressuring systems that account for failure modes and effects.<br><br>Assists with fire and explosion analysis to determine consequence of pool and jet fires and potential to escalate.<br><br>Develops fire protection requirements for simple facilities.<br><br>Develops designs for evacuation of facilities.<br><br>Conducts simple dispersion analysis to provide input for detailed dispersion modelling.<br><br>Instrumentation specialists in design of the optimum fire/gas/toxic detection systems.<br><br>Mitigates likelihoods via mechanical integrity through materials selection, maintenance and inspection practices, operational practices including corrosion inhibition, and instrumentation (LOPA) and shutdown/depressuring systems.<br><br>Designs simple systems in the absence of laws, codes and regulations.<br><br>Applies SIL methodology to control measures to inform criticality and criteria. | Leads, evaluates, and delivers solutions for any of the safety system design elements for complex facilities.<br><br>Designs facilities using understanding of relative value of mitigating the likelihood of an event versus mitigating the consequence.<br><br>Uses risk assessments to decide how to mitigate consequences eg via facility siting, plant layout, scrubbing and dispersion devices, egress and evacuation design, fire protection, fire and explosion analysis and detection.<br><br>Develops company design standards.<br><br>Determines adequacy of control – ALARP, defining process to be followed.<br><br>Designs complex systems in the absence of laws, codes and regulations.<br><br>Provides comprehensive safety systems design solutions for single unit facilities offshore and medium complexity units onshore – eg simple single train gas treating/processing facility. |
| --- | --- | --- | --- | --- | --- |

| Proficiency rating | Description |
|---|---|
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
| 2. Basic application | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. |
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| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/ Expert |
|---|---|---|---|---|---|
| Engineering & design | Asset integrity – inspection and maintenance. | Aware that assets require inspection and maintenance to ensure integrity.<br><br>Aware of which assets form critical controls.<br><br>Supports condition monitoring regimes. | Able to track and report performance criteria, and when assets are not meeting criteria.<br><br>Understands importance of design standards eg quality flange management, small-bore tubing requirements etc.<br><br>Understands how reliability and maintainability combine to predict availability.<br><br>Understands/can explain reliability, availability and maintainability (RAM) study metrics.<br><br>Performs routine maintenance on plant and equipment (where qualified). | **Technical elements**<br><br>Able to supervise maintenance and inspection activities.<br><br>Reviews maintenance and inspection results and trends.<br><br>Develop how in-field performance is measured.<br><br>**Management elements**<br><br>Able to schedule maintenance and inspection activities.<br><br>Conduct periodic reviews of asset performance and risk levels.<br><br>Promotes asset integrity. | Identifies risks to asset integrity.<br><br>Defines maintenance and inspection regime.<br><br>Defines specific maintenance and inspection procedures and specifications.<br><br>Interprets maintenance and inspection data and makes decision based on it, eg corrosion, fixed equipment, rotating equipment.<br><br>Subject matter experts in their field.<br><br>Authorises life extensions or changes to inspection programmes. |

| | | | | | |
|---|---|---|---|---|---|
| **Engineering & design** | Management of change | Aware of the need to manage change.<br><br>Aware of what is covered by management of change procedure: policies, procedures, work methods, personnel etc.<br><br>Able to recognise what a change is and initiate the process. | Understands own role in change management.<br><br>Contributes to implementation of change management.<br><br>Able to initiate change management process.<br><br>Prepares management of change (MOC) documents.<br><br>Understands the change and is able to update information systems eg drawings, manual, procedures etc. | Recognises theory of implementing change; how changes will affect the risk equation.<br><br>Communicates changes as required.<br><br>Actively implements change management procedures.<br><br>Identifies both the overt and covert culture of the organisation and its influence on the change.<br><br>Authorises change in their area/competency or is a reviewer on the change. | Subject matter expert across relevant cross-functional areas including hazard identification and risk control, human factors, systems etc.<br><br>Develops change management process.<br><br>Actively involved in organisational changes and how they are managed. |
| **Systems & procedures** | Safety systems analysis | Aware that controls have performance criteria and they need to be monitored.<br><br>Aware that some controls are more important – eg critical controls.<br><br>Aware of the hierarchy of controls, and what impacts a controls effectiveness, eg human factors, design etc. | Able to track and report performance criteria, and when controls are not meeting criteria.<br><br>Identify control improvements or new controls for risk reduction. | Conduct periodic reviews of control effectiveness and risk levels.<br><br>Develop how in-field performance is measured.<br><br>Implement new or improved controls for risk reduction. | Develop acceptability criteria for control performance.<br><br>Designing the assurance framework for control performance – eg feedback loops for leading and lagging indicators of controls.<br><br>Benchmark industry practice for management of controls. |
| **Systems & procedures** | Systems, manuals and drawings | Aware of how to accurately interpret piping and instrumentation diagrams (P&ID).<br><br>Aware of how to interpret operations and equipment manuals.<br><br>Aware of how to interpret cause & effect charts and process flow diagrams.<br><br>Aware of how to locate appropriate documents. | Understand how the document control system works and how to make suggestions for improvement.<br><br>Understands how to use process safety information in emergency situations. | Contributes to the development and review of P&ID, cause and effect charts, process flows, manuals and other operational documentation.<br><br>Uses MOC for communicating document changes.<br><br>Updating documents.<br><br>Able to use process safety information to explain actual process performance issues. | Defines what documents are required.<br><br>Defines authorisation process.<br><br>Defines document management system and its use in training. |

| Proficiency rating | Description |
| --- | --- |
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
| 2. Basic application | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. |
| 3. Skilled Application/ proficient | Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternatives and opportunities. Builds networks with others skilled in application or mastery. |
| 4. Mastery/ expert | Advanced experience in the particular 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 subject matter expert. |

| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/ Expert |
| --- | --- | --- | --- | --- | --- |
| Systems & procedures | Process & operational status monitoring & handover | Aware that safe operating envelopes exist. Aware of the process and what can go wrong. Aware of what is required to keep the process under control. Aware of what to do in an abnormal/emergency situation. | Utilises P&ID, cause and effect charts, process flow diagrams, and operations manuals to troubleshoot minor issues. Able to safely operate the facility within the safe operating envelope. Able to maintain a shift log. | Recognises how to recover from an abnormal situation and manages startups and shutdowns. Able to conduct effective shift handover. Able to interpret weak signals, eg shift log details. Able to mentor new operators. | Understands and alters operating parameters. Monitors and or manages simultaneous operations. Develops operations training materials and framework for competency. Effectively leads people. |
| Systems & procedures | Management of operational interfaces | Aware of where site/facility sits with respect to third-party interfaces/sites. | Able to engage with (third party) interfaces, eg maintaining communications. | Supervises management of existing interfaces. | **Technical elements** Establishes new interfaces, including safety requirements and responsibilities. **Management elements** Collaborates with third parties. |

| Systems & procedures | Contractor & supplier selection and management | Aware of the process of contractor selection and management. Aware of why specific types of contractors are engaged – eg technical experts. | Contributes to the contractor performance evaluation and onsite supervision. Able to provide basic supervision to contractors. | Develops work scope information required to undertake and review work (scope of work, contract requirements, legislative requirements, competency of contractors). Makes evidence-based decisions regarding process safety competency of company and suitability for project. Reviews or assesses contractor competencies. Manages contract meetings. Evaluates and verifies the adequacy of the management systems with the client's system requirements. | Establishes contractor and supplier selection processes/criteria in terms of process safety performance criteria. Establishes system/criteria for evaluating contractor competencies (technical, safety attitude, relevant experience etc). Defines workplace requirements based on the provisions of workplace health and safety acts, regulations and codes of practice relevant to the workplace including legal responsibilities of principal contractors, sub-contractors, manufacturers, suppliers, employees and other parties with legal responsibility. |
| Systems & procedures | Defect identification, elimination and root cause analysis (RCA) | Aware of the purpose, process and outcome of root cause failure analysis. | Able to describe the potential failure mechanisms. Able to research and document the events prior to the failure. Able to assist in the inspection and root cause analysis of failed equipment. | Apply root cause analysis methods to recommend and implement required modifications to equipment and procedures. Lead equipment failure investigations, when required. | Trains and mentors others to dismantle, inspect and perform root cause analyses on equipment. Defines the RCA methodologies used. Performs benchmarking for failure mechanism(s). |

| Proficiency rating | Description |
|---|---|
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
| 2. Basic application | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. |
| 3. Skilled Application/ proficient | Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternatives and opportunities. Builds networks with others skilled in application or mastery. |
| 4. Mastery/ expert | Advanced experience in the particular 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 subject matter expert. |

| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/ Expert |
|---|---|---|---|---|---|
| Systems & procedures | Management of safety critical elements (SCEs) | Aware of safety critical equipment and the effect of these not being operational. Aware of safety critical tasks and the likely effects should these not be carried out. Aware of safety case major incident scenarios and what controls are safety critical. | Implements safety critical tasks on a routine basis. Completes visual inspection/ monitors safety critical equipment for availability. Identifies failure modes. Understands vulnerability, failure to safety, and redundancy. | **Technical elements** Identifies potential failure modes of critical elements. Assesses failure effects and determines criticality. **Management elements** Undertakes regular auditing of effectiveness of SCEs. | Determines lead and lag indicators for performance of SCEs. Develops the control strategy. Establishes the data collection and reporting system. Engages senior management in the development and review of indicators. Designs formal management system performance standards. Conducts formal review of SCEs including: - change and the accumulative effects of other changes, - management and maintenance and testing of safety critical equipment. |

| Systems & procedures | | | | |
|---|---|---|---|---|
| Incident reporting and investigation | Aware of the incident reporting requirements and knows how to report an incident.<br><br>Aware of why incidents are investigated.<br><br>Aware of media policies and procedures (for major or prominent incidents).<br><br>Ensures that incidents are reported. | Contributes to the incident investigation process.<br><br>Understands importance of preservation of site and evidence.<br><br>Ensures that incidents are reported.<br><br>Understands what a process safety incident is. | Undertakes immediate post-incident response.<br><br>Plans investigation of incident.<br><br>Leads basic investigation.<br><br>Analyses and uses root cause analysis to improve systems performance.<br><br>Identifies potential consequences of incidents.<br><br>Implements systems to encourage reporting. | Leads major incident investigations.<br><br>Demonstrates consistent and visible leadership in supporting the reporting and investigation of incidents.<br><br>Analyses incident statistics to predict trends.<br><br>Communicates knowledge and organisation's values in incident prevention and recording where they occur.<br><br>Ensures learning from incident investigations across the organisation/project/site to avoid the same or similar risk exposure.<br><br>Engages with legal counsel.<br><br>Determines investigation methodologies used. |

| Assurance | | | | |
|---|---|---|---|---|
| Legislation and regulations | Aware that there are laws, codes, and regulations pertaining to safe process/ facility design, construction, and operation. | Able to access relevant legislation, regulations and standards.<br><br>Able to comply with relevant legislation, regulations and standards in work activities. | Mentors others in implementing the relevant legislation, regulations and standards.<br><br>Informs relevant personnel of the impact of changes to legislation and regulations. | Provides feedback to regulators as required.<br><br>Interprets legislation in expert field.<br><br>Liaises with regulators and industry bodies.<br><br>Recognises when new legislation/codes necessitate updated risk assessments, plant design, operations, etc. |

| Proficiency rating | Description |
|---|---|
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
| 2. Basic application | Performs fundamental and routine tasks. Requires occasional supervision. Increases functional expertise and ability. Works with others. |
| 3. Skilled Application/ proficient | Independent contributor. Integrates work with other disciplines. Frequently mentors or coaches others. Assesses and compares alternatives and opportunities. Builds networks with others skilled in application or mastery. |
| 4. Mastery/ expert | Advanced experience in the particular 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 subject matter expert. |

| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/ Expert |
|---|---|---|---|---|---|
| Assurance | Codes and Standards | Aware that standards, company/industry reference documents and their business unit (BU) equivalents exist – for example:<br>- Process design guidelines<br>- Pressure relieving system<br>- Piping<br>- process pressure vessels, and storage tanks<br>- Shell and tube heat exchangers<br>- Air cooled heat exchangers<br>- Fired heaters<br>- Control valves<br>- Process emergency shutdown systems<br>- Process controls/ instrumentation<br>- Process pumps<br>- Process rotating equipment<br>- Electrical generation & distribution equipment<br>- Uninterruptible power supply<br>- Emergency power supply equipment | Understands how to assimilate relevant company/industry reference documents into work efforts – for example:<br>- The International Society of Automation (ISA) standards<br>- International Organization for Standardization (ISO) standards<br>- International and Electro technical Commission (IEC)<br>- American Society of Mechanical Engineers (ASME)<br>- Relevant national and regional standards<br>- Electrical<br>- Civil, architectural, & onshore structural<br>- Process/facility design and loss prevention<br>- Onshore layout (equipment spacing) standard<br>- Onshore fire protection standards<br>- Onshore facility<br>- Pressure relieving systems | Proficient with company/ industry reference documents affecting process safety across multiple disciplines as appropriate, eg instrumentation & electrical, mechanical, civil/ structural, etc.<br><br>Develops/modifies existing industry or plant standards for large projects.<br><br>Acts as engineering lead interfacing with outside contractors in use of, and deviations to, the company standards.<br><br>Implements systems to ensure compliance to codes and standards.<br><br>Uses industry reference documents and engineering tools to develop process/facility design. | Company and/or industry leader in one or more aspects of design (eg fractionation, heat exchangers, etc).<br><br>Contributes expertise throughout the company and industry in area of specialisation.<br><br>Leverages knowledge and acts as a contributing member of industry bodies, eg API, ASME, ISC, PIP, NORSOK, ISO, etc; especially in developing industry reference documents that fulfil company's needs.<br><br>May serve as technical authority in field of expertise.<br><br>Designs systems to ensure compliance to codes and standards. |

| Assurance | | | | |
|---|---|---|---|---|
| Audit, assurance, management review and intervention | - Fire protection equipment<br>- Still-relevant heritage company documents: company relevant black books, etc; manuals: process safety codes; safety case requirements; business unit requirements. | - Heat exchangers<br>- Insulation, refractory, & fireproofing<br>- Materials, welding, inspection, & corrosion control<br>- Corrosion under insulation avoidance standard<br>- A&OI standard<br>- Piping standard<br>- Pipelines standard<br>- Rotating equipment standard<br>- Offshore structures standard<br>- Subsea standard<br>- Tanks standard. | | |
| | Aware there is an assurance process.<br>Participates in assurance activities where required. | Participates in audits under supervision of lead auditor.<br>Understand why there are assurance processes. | Undertakes role as a lead auditor.<br>Leads a management review of systems. | Schedules audits on the basis of risk.<br>Develops audit tools and criteria.<br>Designs the governance framework.<br>Defines new policy and systems as dictated by audit findings. |

| Proficiency rating | Description |
|---|---|
| 1. Awareness | Has knowledge of theory and displays conceptual understanding. Actively participates in discussions regarding the skill. Performs routine tasks with significant supervision. Learns how to do things. |
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| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/ Expert |
|---|---|---|---|---|---|
| **Human factors** | Human factors | Aware of what human factors are.<br><br>Aware of how human factors influence human and safety performance.<br><br>Manages self (fatigue, fit-for-work, at-risk behaviours). | Manages self (fatigue, fit-for-work, at-risk behaviours) and monitors others.<br><br>Identifies and responds to observed at-risk behaviours in self and others.<br><br>Provides feedback on poor job and equipment design and suggests improvements. | Recognises that human factors are concerned with task requirements and its characteristics, the individual's competence and workplace culture and the link to safety.<br><br>Intervenes when at-risk behaviours are observed.<br><br>Provides input into job design taking into account human factors.<br><br>Communicates human factors to the wider workplace.<br><br>Seeks to solve poor job and equipment design and welcomes suggested improvements.<br><br>Recognises the impact of contractors on the workforce with respect to safety. | Comprehends how human factors links to process safety.<br><br>Ensures plant and equipment designs and tasks are designed to take account of both human limitations and strengths. This includes matching the job to the physical and the mental strengths and limitations of people.<br><br>Communicates how an individual's competence, skills, personality, attitude, and risk perception affect safety.<br><br>Promotes how work patterns, the workplace culture, resources, communications, leadership etc have a significant influence on individual and group behaviour.<br><br>Subject matter expert for human factors.<br><br>Ability to manage the impact of contractors in the workforce with respect to safety. |

| Culture | | | | | Technical elements / Management elements |
|---|---|---|---|---|---|
| | Safety leadership commitment, responsibility and workplace culture | Aware of the importance of visible safety leadership.<br><br>Aware of and participates in the company safety programmes.<br><br>Demonstrates knowledge of workplace safety culture.<br><br>Engaged and owns safety responsibilities and accountabilities.<br><br>Reports safety incidents and understands the importance of accurate reporting. | Understands the importance of visible safety leadership.<br><br>Has the communication skills necessary to hold an effective safety intervention.<br><br>Understands human factors and their relationship to safety performance.<br><br>Understands the concept of process safety.<br><br>Engages with others including supervisors.<br><br>Participates in safety related conversations and suggests improvements.<br><br>Initiates safety conversations.<br><br>Able to communicate:<br>- why safety is important to the individual and the company;<br>- what behaviours the individual is expected to consistently adopt.<br><br>Ensures that their communication and behaviour consistently send a message that safety is embedded as a personal core value. | Identifies and clearly articulates behavioural requirements to workforce, contractors and subcontractors.<br><br>Identifies and publicly recognises individuals who display the desired safety behaviours and attitudes.<br><br>Identifies and privately discusses undesired behaviours and attitudes.<br><br>Identifies at-risk behaviour activators.<br><br>Discusses causes and potential risk of behaviours and attitudes.<br><br>Sends clear and consistent messages about the importance of process safety.<br><br>Identifies and implements safety improvements.<br><br>Creates the systems to facilitate this improvement.<br><br>Holds regular in-field safety conversations with front-line workers.<br><br>Undertakes regular in-field verification of controls and lessons learned from significant incidents.<br><br>Engages in meaningful safety discussions with all team/work group members. | **Technical elements**<br><br>Mastery in designing and implementing safety leadership programmes.<br><br>Measures and assesses culture.<br><br>Designs and implements cultural change programmes.<br><br>Designs and implements improvement plans.<br><br>Develops culture definitions and norms in an organisation.<br><br>**Management elements**<br><br>Ensures leadership team is aware and committed to the provision of adequate levels of staffing and supervision to ensure an effective safety culture – financial resources to support safety.<br><br>Monitors HSE metrics to review effectiveness of the leadership programme (leadership time in-field, levels of supervision, behavioural-based interactions) and the link to adverse events.<br><br>Acts to motivate and inspire others to work towards achieving a particular goal or outcome by sending clear and consistent messages about the importance of process safety. |

| Proficiency rating | Description |
| --- | --- |
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| 4. Mastery/expert | Advanced experience in the particular 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 subject matter expert. |

| Element | Competency required | Competency level 1 – awareness | Competency level 2 – Basic application | Competency level 3 – Skilled application/proficient | Competency level 4 – Mastery/Expert |
| --- | --- | --- | --- | --- | --- |
| Culture | | | | Ensures that their communication and behaviour consistently sends a message that safety is embedded as a core value. Involves their team and behaves in a manner that builds positive relationships within the workforce. Understands and applies resourcing requirements to manage process safety. Able to recognise change and implement it effectively. | Ensures that they gain involvement from their workforce and behave in a manner that builds positive relationships within the workforce. Exhibits leader behaviours which will increase the likelihood of copied and reciprocated safety behaviours. Demonstrates safety leadership as defined above. |

# Appendix 3: References and further information

[1]  Reason, J, *Managing the risks of organisation accidents*, Ashgate Publishing Limited, Hampshire, 1997

[2]  Centre for Chemical Process Safety, *Guidelines for Risk Based Process Safety*, CCPS, USA, 2007

[3]  Energy Institute, *High level framework for process safety management*, Energy Institute, UK, 2010

[4]  Cogent and UKPIA, *Guidelines for Competency Management Systems for Downstream and Petroleum Sites*, Cogent, UK, 2011

[5]  European Process Safety Centre, *Process Safety Competence – How to set up a Process Safety Competence Management System*, EPSC, UK, 2013

[6]  IChemE Safety Centre, *Lead Process Safety Metrics – selecting, tracking and learning*, ISC, Aust, 2015

[7]  Kletz, T. *An engineer's view of human error*, IChemE, Rugby, 2001

# Appendix 4: Acronyms

| | |
|---|---|
| ALARP | As low as reasonably practicable |
| GM | General manager |
| HAZID | Hazard identification study |
| HAZOP | Hazard and operability study |
| HR | Human resources |
| HSE | Health, safety and environment |
| JHA | Job hazard analysis |
| LOPA | Layers of protection analysis |
| MOC | Management of change |
| P&ID | Piping and instrumentation diagram |
| PS | Process safety |
| PTW | Permit to work |
| QA | Quality assurance |
| QRA | Quantitative risk assessment |
| RCA | Root cause analysis |
| SCE | Safety critical element |
| SIL | Safety integrity level |

"It is not, of course, sufficient to have knowledge. It is necessary to be able to apply it to real-life problems."[7]

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