Report Number 35

Process Safety Competence

How to Set up a Process Safety Competence Management System

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The European Process Safety Centre

Objectives

1. **Information**
   To provide advice on how to access safety information and whom to consult, what process safety databases exist and what information on current acceptable practices is available.

2. **Research and Development**
   To collect European research and development (R&D) needs and activities in the safety and loss prevention field, to inform members accordingly, to act as a catalyst in stimulating the required R&D and to provide independent advice to funding agencies priorities. "R&D" here includes experimental research and the development and review of models, techniques and software.

3. **Legislation and Regulations**
   To provide technical and scientific background information in connection with European safety legislation and regulations, e.g. to legislative bodies and competent authorities.

4. **Experience Exchange**
   To provide a platform for development of process safety knowledge for its members and to act as a focal point for dissemination of that knowledge to the European process safety community. Involvement in the Centre's groups gives organisations and individuals the opportunity to meet safety professionals from other companies, to discuss areas of common interest and to share knowledge and experience, thus enabling informed comparisons of safety management systems and practice.

Benefits of Membership

- Improved cross-European co-ordination on safety standards
- Identification of areas where manuals and guidelines could be produced
- Improved co-ordination of safety R&D and handling of complex technical research programmes
- Stimulation of R&D in areas where there are gaps in knowledge
- Transfer of knowledge from elsewhere to Europe and between European countries
- Technical input to legislators and standard makers to ensure more realistic legislation
- Sharing and dissemination of information on safety technology and accident prevention
- Access to information from a single source

Contents

Section 1: Introduction 6

1.1 Preface 6

1.2 Scope and structure of the guidance 6

1.3 How to use this guidance 7

1.4 What is Process Safety Competence in the Context of this Guidance? 7

1.5 Why is Process Safety Competence Important? 8

1.6 Challenges 9

1.7 How a Process Safety Competence Management System can help 11

Section 2: Guidance on Creating a Process Safety Competence Management System 12

2.1 The need for a holistic approach 12

2.2 The elements of a Process Safety Competence Management System 12

2.2.1 High Level Policy Statement 13

2.2.2 Facility Minimum PSC Requirements 13

2.2.3 Selection and recruitment of personnel 15

2.2.4 Individual Competence Needs Analysis and managing competence gaps 16

2.2.5 Maintaining competence, training and development 18

2.2.6 Competence assessment and reassessment 20

2.2.7 Special competence requirements for emergency situations 21

2.2.8 Ownership and commitment 22

2.2.9 Continuous improvement 23

2.3 How to implement and maintain a PSC Management System (PSC-MS) 25

2.4 Definition of success 26

Section 3: Appendices 27

3.1 Example of a Process Safety Competence Management System (PSC- MS) and its implementation 27

3.2 How to define and document key roles and PSC requirements 35

3.3 Example of a Checklist for Audits or Self Assessment 38

3.4 Example of a High Level Policy Statement 52

3.5 Example of a PS Competence training matrix 55

3.6 Further reading and links 56

3.7 Glossary 57

3.8 Members of the EPSC Working Group 57

Process Safety Competence

How to Set up a Process Safety Competence Management System

Management Summary

Many incidents happen because necessary knowledge and competence is not available at the right time in the right place. The European Process Safety Centre (EPSC) therefore decided to prepare guidance on how to set up a Process Safety Competence Management System (PSC-MS). The guidance is intended to help to build a PSC-MS or to improve existing systems. It is focused on process safety competencies needed for process plant front line staff and those who lead/support them. However, it could be used for or extended to the management of other competencies.

The guidance is deliberately kept short and written by process safety practitioners for process safety practitioners. It is not meant to be a standard or to define the different process safety competence needs, but will rather provide input for procedures to help with the quality and consistency of managing process safety competence. It takes into account that modules of process safety competence are already covered in different parts of existing management systems. Therefore the guidance has been structured into 9 self contained elements, eg facility minimum Process Safety Competence (PSC) requirements, competence assessment and reassessment, special competence requirements for emergency situations etc. Each element can be used as a standalone tool for gap analysis or to address the gaps. This modular approach allows the alignment of a PSC-MS with existing management systems or even designing it as part of an Integrated Safety Management System. In the appendices examples are given of how to develop and maintain a PSC-MS, how to define and document key roles and PSC requirements and for an audit checklist.

Section 1: Introduction

1.1 Preface

There is no doubt that the issue of PSC has materialised as a key issue for many major hazards businesses in recent times. In 2009 EPSC members expressed concern about the decline of process safety competence within their organisations. EPSC held a member workshop in March 2010 and have been in contact with other organisations discussing the same issue, such as EFCE, DNV, DECHEMA/ProcessNet and CCPS.

At its 38th Technical Steering Committee Meeting in October 2010 EPSC decided to set up a Working Group with the following objective and scope:

The goal of this work is to define an industry accepted framework for process safety competence which can be employed by user companies for such activities as training, development and succession planning. Supporting guidance on the use of the framework shall also be an output of the work. The resulting report may also be used in discussions with national and EU authorities and to demonstrate the existence of a sufficient level of PSC to stakeholders and that certification is not necessary. Options to import good practice from sectors such as nuclear and aviation sectors are also valid.

The framework shall focus on the competence of the PS practitioner at site level from front line operators to supporting functions (e.g. PS experts) within the chemical and process industries. The role of pre-industry education and training, questions posed about the quality of undergraduate students, the unmet needs of industry etc are out of scope.

The members of the Working Group will be found in Appendix 3.8

1.2 Scope and structure of the guidance

This guidance is focused on Process Safety. However, it could be used for or extended to the management of other competencies. To keep this guidance short it is focused on process plant front line staff and those who lead/support them (i.e. Process Operators and Supervisors, Maintenance staff, Production and Process Engineers, Plant and Site Managers). Depending on the risk of the processes and the structure of the company there need to be people with specialised knowledge of Process Safety as a support function (full or part time Process Safety Specialists/Champions). Although this guidance has no specific focus on these roles, they may be essential to the front line operations and should be included into a PSC-MS. Also some other areas such as plant design, senior management etc. are very important for Process Safety and a Competence Management System can easily be set up for or extended to these roles.

This guidance is intended to help to build a PSC-MS to identify and address gaps in an existing system. It is written as a number of self-contained elements. Each element can be used as a standalone tool for gap analysis or to address the gaps. This modular approach

also takes into account that within different companies the elements may fall under different responsibilities and therefore may be found in different parts of the management system. Companies may choose to set up a matrix which links the elements of a PSC-MS to their existing system. The elements of this guidance are composed according to their content. An operational PSC-MS does not have to follow this structure exactly, as demonstrated in Appendix 3.1.

1.3 How to use this guidance

The guidance is not meant to be a standard. It will provide a structure for the Management System, guidance on detail to be included and auditing tools to verify that the system is complete. It is not the purpose of this guidance to define the different Process Safety competencies which are necessary for specific jobs and roles, but rather the way to identify and manage them. However, some examples are given in the elements of section 2 and in appendices 3.1 (Example of a PSC-MS and its Implementation), 3.2 (How to Define and Document Key Roles and PS Competence requirements) and 3.3 (Example of a Checklist for Audits and Self-Assessment). The examples given there can be used to highlight elements that are not currently included in a PSC-MS and allow the owner to decide whether these elements should be added.

Although every element can be used without necessarily having to read the entire document each time, we recommend readers at least to scan the whole document prior to its first use to achieve an overview of the process. The different elements of a PSC-MS will be described as briefly as possible in Section 2 using a standard structure. Examples from practice, templates etc. will be given in the appendices. Additional input is very welcome, please contact lallford-epsc@icheme.org

1.4 What is Process Safety Competence in the Context of this Guidance?

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. PSC 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

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.

1.5 Why is Process Safety Competence Important?

Many incidents happen because necessary knowledge or competence is not available at the right time in the right place. PSC often also has a role in ensuring that the correct actions are taken when an incident occurs and may be critical to reducing the impact of the event and preventing escalation. A brief literature search on some of the more important process industry incidents quickly found links to PSC in every case:

- **Flixborough (UK, 1974)**: Explosion due to release from a temporary bypass assembly of inadequate design **operated by insufficiently competent people** (Health and Safety Executive 1975)[1]

- **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 PTW [Permit to Work] system[2]

- **Longford (Australia, 1998)**: Failure to identify hazards and properly train operators. **Insufficient understanding** led to a critical incorrect valve operation (Hopkins 2000)[3]

- **BP Texas City (USA, 2005)**: 1.5 Key Technical Findings: ... A lack of supervisory oversight and technically trained personnel during the start-up, an especially hazardous period..... The operator training program was inadequate[4]

- **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[5]

Process safety competence plays a vital role in preventing or mitigating process incidents:

- 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

As an example from an EPSC member company, DuPont writes in its "Training and Performance" Process Safety Management element: *"All other key elements of PSM can be in place, but without personnel who are knowledgeable and dedicated to consistently*

[1] Health and Safety Executive, 1975. The Flixborough Disaster: Report of the Court of Inquiry. Formal investigation into accident on 1st June 1974 at the Nypro Factory at Flixborough. HMSO 1975. ISBN 011 361075 0
[2] http://www.hse.gov.uk/humanfactors/topics/supervision.htm
[3] Hopkins, A. Lessons from Longford: The Esso Gas Plant Explosion. CCH Australia Ltd, 2000, ISBM 1-86468-422-2
[4] U.S. Chemical Safety and Hazard Investigation Board, Investigation Report No 2005-04-I-TX Refinery Explosion and Fire, March 2007
[5] Http://www.hse.gov.uk/press/2011/hse-buncefieldreport.htm

following documented policies and procedures, the chances of maintaining safe conditions and preventing incidents is significantly diminished."

In its recent Guidance for Senior Leaders in High Hazard Industries "Corporate Governance for Process Safety" the OECD[6] dedicates one "essential element" to competence:
CEO and leaders shall *assure their organisation´s competence to manage the hazards of its operations. They*, e.g.:

- *Ensure there are competent management, engineering, and operational personnel at all levels*
- *Ensure continual development of process safety expertise and learning from new regulation and guidance*
- *Provide resource and time …*
- *Defer to the expertise of personnel …*
- *Ensure that the organisation monitors and reviews the process safety competency of contractors and third parties*

1.6 Challenges

PSC has some specific challenges:

- PSC needs specific knowledge and attitudes beyond that which could be expected of new graduates having successfully passed standard curricula in chemistry or chemical engineering
- Some aspects of PSC are technology specific and sometimes facility specific
- Critical tasks have to be identified by risk assessment
- Understanding how low probability hazards with serious consequences can represent the greatest risk for the facility
- There is some information that people must learn and carry as knowledge, such as the hazards of the chemicals they work with, whilst other information, e.g. for non-routine tasks, have to be looked up when they are needed. The latter information must be stored in a readily accessible location, people must know where to find and how to use it and it must be kept up to date
- We must establish an awareness of Process Safety issues within groups such as maintenance, contractors etc. who may not be familiar with operations or chemical hazards
- Well written procedures are a must but creating practical useable procedures that still contain sufficient detail is difficult. Ideally two procedures will exist, a detailed procedure for training and inexperienced users and a more simple checklist for well-trained experienced staff

[6] OECD Environment, Health and Safety Chemical Accidents Program, June 2012

- Automation does not necessarily compensate for a lack of critical competences. When unforeseen situations develop, human competence is often a critical factor in bringing the situation safely back into control. Ironically, the fact that a process is highly automated may be the cause of a lack of process knowledge and thereby competence in the operating staff
- PSC is critical to ensuring that the correct decisions are made when unplanned events occur. People expected to deal with emergencies will require an especially high level of competence to allow them to perform their duties satisfactorily in a stressful situation
- Manual and cognitive skills have to be practised. This often means that drills or simulations are required because the skills may relate to emergencies that we hope will never occur
- Good communication and coordination (especially between different organisational groups) has to be fostered
- Tasks have to be kept within the physical and mental limitations of the people involved
- Support materials have to match the level of competence, e.g. whilst procedures state what must be done training materials should explain why a task is done in a certain way and why some elements are important. Such training materials must be tailored to the academic standards of the students. It should be taken into account that there is an overlap regarding the competencies for process safety and for occupational safety. Safety experts may need both competencies
- Safety critical knowledge has to be defined, kept up to date and readily accessible. It has to include knowledge of the Layers of Protection/Safety Measures
- Process Safety Specialists need not only to be competent, but have to be independent in exercising their competence
- As detailed PSC requirements and knowledge are highly task-specific and may change with time, **management of organisational changes** and **knowledge management** are extremely important
- A good competence management system is not possible without knowledge of the human factors involved. Consequently one of the critical competencies may be human factors expertise

Knowledge management is one of the biggest challenges for maintaining Process Safety Competence. Necessary knowledge for Process Safety has to be defined beforehand, based on hazard identification, risk assessment and by defining scenarios and layers of protection. As people, processes and in particular organisations change, keeping track of all aspects of PSC is crucial for maintaining a sound Process Safety organisation. One of the functions of a PSC-MS is to safeguard the knowledge that a company builds up over time. Also a system has to be in place to capture changes in “external” knowledge like new regulations, lessons learnt or new developments of process safety science. Knowledge management should be a recognised element of how a plant or business is run. Maintaining and keeping up to date the required knowledge should be assigned as a specific responsibility for a function or group within the organisation.

1.7 How a Process Safety Competence Management System can help

The sections above highlighted the critical importance of ensuring that the necessary competence is available at the right time and in the right place. This cannot be left to chance, but must actively be managed. Therefore the benefits of and need for a PSC-MS need no further justification. This could be a separate part of a company´s Safety Management System, or integrated into other (existing) Management System modules (see 2.1).

The benefits of a PSC-MS include:

- Defining the necessary knowledge, experience and skills for specific operations and job roles – both for individuals and teams
- Linking PSC to risk assessment
- Linking PSC to job descriptions
- Linking PSC to management of (organisational) change
- Making sure that new PS knowledge and experience (e.g. "lessons learnt") are integrated into the PSC-MS
- Ensuring that training achieves the transfer of knowledge and skills that is required
- Verifying the continued use and suitability of PSC systems
- Maximising the effectiveness of Process Safety Specialists by providing a structure and processes linking them to operations

A PSC-MS details the process used to ensure that the necessary standards of process safety competence are maintained within the Company. It also fulfils a requirement set up in the Seveso Directive in Annex III for a Safety Management System under c (i) organisation and personnel "*The identification of training needs of such personnel and the provision of the training so identified*".

Discussions of this guidance with EPSC members demonstrated the need of a systematic approach for PSC. Although companies with a well developed Process Safety Management System may have many pieces of a PSC-MS in place, there are frequently gaps which could be identified and filled with the help of this guidance.

The use of this guidance for gap analysis and as a toolbox to fill gaps does not depend on any given type of (formalised) management system. Consequently this guidance can be used by Small and Medium Sized Enterprises (SMEs) that do not necessarily have existing management systems.

In Appendix 3.1 an example is given for a PSC-MS. Figure 3.1 in this appendix demonstrates the steps to implement the system.

Section 2: Guidance on Creating a Process Safety Competence Management System

2.1 The need for a holistic approach

Given the importance of PSC, the organisation's overall Safety Management System has to include a PSC-MS. Competence has links to other areas such as procedures and Human Reliability Assessment (HRA). It should be aligned with the other parts or even designed as part of an Integrated Safety Management System. Such integration is crucial for a successful and sustainable implementation of the PSC-MS. In the following sections elements of a PSC-MS have been described. This represents one of several possible structures for such a system.

2.2 The elements of a Process Safety Competence Management System

A PSC-MS should cover the following topics/processes (elements):

1. High Level Policy Statement
2. Facility Minimum PSC Requirements
3. Selection and recruitment of personnel
4. Individual competence needs analysis and managing competence gaps
5. Maintaining competence, training and development
6. Competence assessment and reassessment
7. Special competence requirements for emergency situations
8. Ownership and commitment
9. Continuous improvement

Due to the modular approach ("toolbox") explained in section 1.2 there are overlaps between the different elements. For each of these elements the following details are given:

a. Objective
b. Key elements
c. Features of a mature system
d. Templates and Tools
e. Records

Examples for audit and self assessment questions for each element can be found in Appendix 3.3 "Example of a Checklist for Audits or Self Assessment". For "Templates and Tools" this first edition of the guidance gives only few details. As this is a "living document" all readers are asked to contribute material from their companies (see section 1.3).

2.2.1 High Level Policy Statement

a. Objective
   Improving and maintaining PSC and its management system needs clear and visible support by top management.

b. Key elements
   - A commitment to achieving and maintaining PSC as part of the organisation´s policy statements
   - Documentation of the high level expectations for PSC
   - Visible support from the top management of the Company
   - Demonstrated commitment by ensuring the necessary resources are always made available
   - …

c. Features of a mature system
   - PSC is included in goals for senior management
   - Leading indicators are used to track PSC performance
   - Engagement of senior leaders at a process level is actively encouraged
   - Monitoring of PSC metrics at a high level in the company
   - …

d. Templates and tools
   - See examples in Appendix 3.4
   - See OECD Guidance referenced in section 1.5
   - ….

e. Records
   - Policy statements of the organisation
   - PSC goals
   - PSC leading indicators
   - PSC metrics
   - Audit records
   - ….

2.2.2 Facility Minimum PSC Requirements

a. Objective
   At any given time there will be a selection of competencies available at a facility. This will tend to vary depending on who is present on the site at the time. The purpose of defining the Facility Minimum PSC Requirements is to state which competencies must be present at a specific time or for a specific operation in order that the safety of the facility is not compromised. For example, if a facility handles reactive chemicals it may be essential that someone with the knowledge of how to handle a runaway reaction is available at all times. In such a case the requirements

should also state whether the expert must be on site or whether availability by phone is adequate. This may depend upon the rate of reaction!

Based on these considerations, PSC requirements for the facility as a whole have to be identified. The minimum knowledge required by the front line staff has to be defined for use in staffing, training and assessment to ensure that this is achieved. Knowledge required may be different for each role (see element 2.2.4). As examples; the correct competencies must be present in each work area and on every shift, the correct competencies must be both considered in Management of Change (MoC) and available in the team responsible for MoC. The competencies required for Emergency Response must always be available. Process Safety Specialists may have multiple roles within the management system, as trainers, advisers, inspectors and a critical part of the knowledge management system. The minimum requirements must include requirements for specialist support, which should be independent from operational and financial pressure.

b. Key elements
   - Documented minimum competence levels in terms of people with specified competencies for each situation or area where significant process safety risks exist
   - Possible legal obligations for minimum PSC requirements are followed
   - The minimum PSC requirements should target the prevention of significant PS events. These events should be identified by examination of the hazard and risk assessments for the facility. Both consequence and risk should be used since, in addition to the high consequence events which are normally considered, the risk assessment may identify relatively high frequency/low consequence events that should also be included. Once the target events are known, the competencies required to prevent or mitigate these should be minimum PSC requirements
   - The minimum PSC requirements should include sufficient process knowledge to aid situation awareness during unplanned events
   - When analysing the competencies required to prevent or mitigate a process safety event, the focus should not be restricted to plant operations, the possibility that this might be caused by maintenance activities, mechanical integrity and even natural events should be considered
   - Assessments made by predefined teams with knowledge of/experience in Process Safety and the roles to be assessed and sufficient independence from operational and financial pressure
   - Keep requirements up to date (knowledge management, see element 2.2.9)
   - Define all roles and responsibilities critical to Process Safety:
     - Operations
     - Engineering
     - Maintenance
     - Support (e.g. EHS- or PS specialist)
     - Management
   - Consider all situations:
     - Normal operations
     - Start ups, shut downs or turnarounds

- Credible unplanned events
- Emergencies
- Variations in the facility population, for example, day, night, weekend, public holidays, vacations, unplanned absence etc

- …

c. Features of a mature system
   - Strong link to/part of risk assessment
   - Mandatory for installations/jobs with safety relevance (e.g. under Seveso)
   - Succession planning and MoC take into account minimum PSC requirements
   - Minimum PSC Requirements are defined for those who are responsible for the approval of MoC
   - People in all impacted roles are aware of their part in the minimum requirements and those of the others they work with and will therefore be immediately aware of any competence gaps
   - People are "multi-skilled" and can fulfil more than one role in the minimum competence requirements. This makes for greater flexibility and makes it easier for the minimum requirements to be maintained when there are resource issues
   - …

d. Templates and Tools
   - See Appendix 3.1 (Example of a Process Safety Competence Management System (PSC-MS) and its implementation, steps 2 & 3), Appendix 3.2 (How to define and document key roles and PSC requirements)
   - Other sources:
     - Cogent/UK PIA: competency/role matrix based on Cogent Gold Standards from www.cogent-prospectus.com [for some jobs competencies are listed]
   - …

e. Records
   - Minimum PSC Requirement Matrices
   - Risk assessments used to define minimum PSC requirements
   - Documentation to maintain the minimum PSC requirements on a day to day basis such as shift requirements, staff requirements and on-call requirements
   - Succession plans
   - MoC process
   - …

2.2.3 Selection and recruitment of personnel

a. Objective

   The objective is to have a process that will attract the correct candidates for jobs within the company and allow the most appropriate candidates to be selected whether from within or outside the company. For front line operator or maintenance roles the recruitment process must select people with the necessary competencies/skills and the aptitude and characteristics that will allow them to

achieve competence given the available help and training. However, the process should also enable the recruitment of more specialised staff and leaders where these are often sourced from outside the company. In such cases the process must allow the examination of education, existing skills, experience and knowledge to identify suitable candidates. The development of specific qualifications for process safety by Institutions such as the IChemE and Universities should be applied where appropriate.

b. Key elements
   - PSC requirements are part of job descriptions
   - Development plans are created for new recruits
   - Turnover in key roles is monitored and addressed if necessary
   - PSC requirements are part of the selection process for contractors
   - Consideration of potentially controversial issues (anti-discrimination laws?)
   - …

c. Features of a mature system
   - HR Department is informed about PSC requirements and takes them visibly and explicitly into account
   - PSC requirements are clearly defined upfront and part of job posting
   - Provide sufficient career opportunities for PS specialists
   - PSC part of contractor assessment
   - Gaps are addressed by an effective individual development plan
   - Consideration of PSC issues in succession planning
   - …

d. Templates and Tools
   - see Appendix 3.2 (How to define and document key roles and PSC requirements)
   - …

e. Records
   - Job descriptions
   - Role Mapping
   - Job advertisement templates
   - Staff turnover analysis
   - …

2.2.4 Individual Competence Needs Analysis and managing competence gaps

a. Objective
   Based on the basic PSC requirements for the company/site/facility (see element 2.2.2) the competence requirements should be fine tuned for each job/role on a plant level. Against these competence needs the people who (shall) perform this job are assessed (see element 2.2.6). Where several people perform the same role ("key roles") these needs may be very similar but an individual assessment is

usually required to allow for slightly different responsibilities and capabilities. The definition of the individual competence needs is the core of any PSC-MS. It forms the basis of the training and assessment programme for the person as well as for the level of supervision. Classification of staff may be considered ("operator level A, B, C"). If a person changes role the Competence Needs Analysis must be updated.

Where the needs analysis highlights a significant gap that cannot be quickly addressed this must be addressed by the plant management. Supervisors have to fulfil an overarching PSC requirement, although they need not necessarily know all of the details. Measures must be put in place to take account of gaps such as ensuring someone with the required competencies is always available to provide assistance, intensifying supervision or changing the duties of the individual. If an individual demonstrates a higher level of PSC than required for the present job, this potential should be documented for future job changes.

The result of the individual competence needs analysis and the gaps to the required PSC must be understood by the individual and his supervisor(s). This avoids over-estimation of one´s own abilities, potentially leading to risk taking behaviour and promotes the acceptance of procedures and training measures.

b. Key elements
   - Define roles and PSC requirements for jobs/roles at a plant level
   - Assessment and documentation of individual PSC (see element 2.2.6)
   - Communication of individual PSC assessment results, option for staff to comment on this
   - Gap analysis against Individual PSC needs for each employee
   - Action is required to address any important competency gaps that are identified, e.g.
     - temporarily fill the competence gap by intensified supervision
     - more detailed operating procedures
     - assigning tasks according to capabilities, replacement as a last resource
     - help the person to quickly acquire the competence needed, e.g. fast track training programme
   - …

c. Features of a mature system
   - Explicit, written guideline for staffing of (clearly defined) hazardous installations/jobs, e.g. in Safety Management System
   - Inclusion of temporary job changes and of contractors in these provisions
   - Periodic review of the Individual Competency Needs Analysis
   - Personal, open, but sympathetic communication of results to individuals ("no-blame culture"), appreciation of individual handicaps
   - Supervisors trained for this specific communication
   - Clearly defined PSC requirements for supervisors
   - Formal system to inform supervisors about the PSC capabilities of their subordinates

- Supervisors are responsible for maintaining the required levels of PSC by
  - Task assignment
  - Team composition
  - Targeted supervision
  - Training measures
- Defined PSC categories (e.g. “operator level A,B,C”)
- Clearly defined responsibilities for PSC and authority to correct deficiencies
- …

d. Templates and Tools
   - see Appendix 3.1 (Example of a Process Safety Competence Management System (PSC-MS) and its implementation, step 5
   - …

e. Records
   - Personal files
   - PSC needs/individual skills matrix
   - Definition of PSC categories
   - “Guideline for Supervisors”
   - …

2.2.5 Maintaining competence, training and development

a. Objective
   Given the great differences in PSC requirements for the different roles, specific training for each role is usually necessary. Refresher training must be provided at an appropriate frequency to maintain the required PSC level over time. Skills and knowledge need to be refreshed especially where they are seldom used. Training content has to be defined individually because each person has different requirements (see element 2.2.4). Although training “on the job” is most important it should be supported by other forms of training, e.g. online, classroom, simulation. Training and procedures should cover when people must request assistance. For example, no operator is likely to have all the knowledge required to deal with a reactive chemical situation so he or she must know to call for help and that help must be available. PSC requirements and knowledge should be kept current by following developments in research and industry experience (see element 2.2.9).

b. Key elements
   - Monitoring of possible changes of PSC requirements
     - Changes of installations/processes (MoC)
     - Changes in Process Safety knowledge (e.g. science, trade associations, lessons learnt etc., see element 2.2.9)
   - Operating procedures kept up to date
   - Monitoring of available PSC capabilities
     - Supervisor constantly observes changes in individual capabilities

    - Organisational and other staff changes
    - Succession planning
- Those who are responsible for MoC have the competence to assess the PS requirements
- Training programme linked to
    - Risk Assessments
    - Control and mitigation measures
    - Procedures
    - PSC gap analysis
    - Competence assessment
    - Emergency plans
- …

c. Features of a mature system
    - PSC is part of MoC and Management of Organisational Change (MoOC) procedures
    - Fluctuation in safety critical roles is limited as far as possible and systems are in place to avoid PSC gaps in such cases
    - Supervisors are trained in monitoring individual PSC capabilities (see element 2.2.6)
    - PSC gap analyses are repeated at specified frequencies (see element 2.2.4)
    - Use of drills and simulations for unusual or emergency situations
    - Training programmes to avoid or correct PSC gaps are:
        - structured
        - well defined (e.g. in Safety Management System)
        - mandatory
        - validated
    - Sufficient resources regarding
        - number of trainers
        - requirements for trainer quality
    - Efficiency control (Does the training provide the required information? Did the person acquire the desired knowledge?)
        - After training sessions
        - After drills
        - Feedback from competence assessment
    - Comprehensive documentation
    - …

d. Templates and Tools
    - An example of a Process Safety training matrix will be found in Appendix 3.5
    - …

e. Records
    - (Link to) MoC/MoOC Guidelines
    - Personal files, individual assessments
    - Facility training programme

- Training Programme/Matrices
- Training material
- Training material evaluation records
- …

2.2.6 Competence assessment and reassessment

a. Objective

Some of the knowledge part of PSC may require (for certain roles) an academic degree or can be acquired by (formalised) vocational training. However, most of the PSC needs are specific to a plant or role so the required knowledge has to be assured through local assessment. Moreover, the only real confirmation of competence is that someone can actually perform the task in all anticipated situations (a car mechanic with an excellent knowledge of the highway code is not necessarily a good driver). Therefore, where possible, people should be evaluated performing the task or in realistic simulations. This could be either a formal process or performed informally during the day to day routine. In either case suitable records of the assessment should be maintained.

Given the importance of competence for Process Safety, PSC has to be reassessed regularly and systematically. Ideally, competence reassessment should not involve people repeatedly sitting through the same training and the same tests. Reassessment should reflect the expectation that people should be knowledgeable on the topic and serve to confirm this.

Consequences of deficiencies identified by (re-) assessment could be a critical Human Resources Management issue. Therefore the methods of (re-) assessment and follow up have to be carefully planned to avoid unnecessary frictions. Trends in competence should be monitored to improve the effectiveness of refresher training. General decay in PSC may signal deficiencies of the management system itself (see element 2.2.9). Ultimately it must be possible to declare people competent for specific requirements.

b. Key elements

- Consideration of pre-qualification (degrees etc.)
- “on-the-job” skill evaluation (when performing the actual tasks)
- Knowledge assessment (online or classroom)
- Assessment of the ability to cope with unusual or emergency situations
- Regular reassessment of PSC capabilities depending on the safety criticality of the task and the anticipated rate of decay for the competency
- Differentiation between different levels of PSC, e.g.
  - Competent with supervision
  - Competent unsupervised
  - Competent to train others
- Feedback on training effectiveness and examination for trends in assessments (see elements 2.2.5 and 2.2.9)

- Corrective measures for gaps in individual or role requirements (see element 2.2.4)
- Supervisors informed of competence assessment results
- Consideration of possible union involvement, labour laws etc
- …

c. Features of a mature system
   - Documented assessment against clearly defined requirements or formal standards
   - Formal certification of competence by an independent internal or external body
   - Use of simulations for unusual or emergency situations
   - Assessment questions must test understanding not just that the person was listening
   - Competent and regularly trained assessors
   - Data base for competency records
   - Define PSC requirements above the mandatory minimum to be used in goal setting systems
   - Linked with goal-setting system
   - Clearly defined follow-up measures
   - Inclusion of Human Resources and workers representatives
   - …

d. Templates and Tools
   - See e.g. RiskTec: "Guidelines for Successful Competence and Training Management" (assessment methods)
   - …

e. Records
   - Personal assessment files
   - Competence assessment material
   - Competence statistics for trend monitoring
   - Assessment result notification
   - Competence expectations
   - …

2.2.7 Special competence requirements for emergency situations

a. Objective
   Abnormal situations are a major challenge with regard to PSC. Whilst start ups, turnarounds and "normal" shut downs can be planned correctly in advance, emergency situations are different. Although many emergency scenarios can and should be anticipated in advance, there will always be some unplanned events. Support by automated systems may not be available or may even prove misleading. To manage unplanned events situational awareness and the ability to cope with stress is important. All actions should reflect a hierarchy of importance with

potential impact to humans first and foremost, then the environment and after this material losses and business interruption. The availability both of general and specialised PSC not only enables adequate reactions in emergencies but also reduces stress. Systems must be in place to have competencies for emergencies available at all times even though we hope that they will be seldom, if ever used.

b. Key elements
   - Define PSC requirements for emergency situations in advance
   - Ensure the PSC defined in the minimum PSC requirements is available at all times by use of back up and contingency plans
   - Have specific PS information for emergencies readily available
   - Define actions for situations in which the necessary PSC is not available
   - Train for emergency situations by realistic drills or simulations
   - The success of drills and simulations should be assessed upon completion to ensure that any opportunities for improvement are adopted
   - …

c. Features of a mature system
   - PSC requirements are comprehensively considered in Emergency Planning
   - Availability of PSC (including back-up) and actions in case of PSC deficiencies are part of the Emergency Management System
   - PSC issues are part of regularly performed drills and simulations
   - Structured feedback from drills/simulations and real emergencies especially regarding possible PSC issues
   - Emergency processes take account that people will be under stress and may not perform at their optimum level
   - …

d. Templates and Tools
   - Job aids such as checklists or flow diagrams to assist managing emergencies
   - …

e. Records
   - Emergency Management System
   - Emergency drill schedule and requirements
   - Emergency drill reports
   - Emergency and unplanned event reports
   - …

2.2.8 Ownership and commitment

a. Objective
   High standards of Process Safety can only be achieved if everyone understands their role in maintaining this standard and feels personally responsible for their contribution to success or failure. People at all levels must feel ownership of the

Process Safety requirements if the highest levels of Process Safety performance are to be achieved. This is an important part of Process Safety Culture.

The expectations for each individual who can contribute to process safety must be clearly communicated. These expectations include ownership and commitment. Whilst there is no test for the ownership and commitment felt by an individual this can be usually assessed by the presence of the key elements listed below.

b. Key elements
   - Commitment and support from senior managers
   - Engagement in the field from local managers
   - Operators continually work to optimise procedures
   - Reinforcement of good behaviours
   - Discouraging poor behavioural traits
   - …

c. Features of a mature system
   - Mandatory communication of individual PSC expectations
   - Staff feel comfortable to comment on all PS issues
   - "No blame" culture
   - Incentive system for optimisation of procedures
   - Expectations linked with salary and goal-setting system
   - Culture surveys
   - …

d. Templates and Tools
   - …

e. Records
   - Personal files
   - Culture survey results and actions
   - Culture trends
   - Documented 'No blame' policy
   - …

2.2.9 Continuous improvement

a. Objective
   The long term effectiveness of the PSC-MS requires a periodic Management System Review. Individual PSC capabilities may deteriorate because they are seldom used, for personal reasons or as a consequence of deficiencies in process safety culture. This is covered by elements "Maintaining Competence …(2.2.5)" and "Competence (Re-) Assessment (2.2.6)". Changes in PSC knowledge and requirements, both from internal or external sources, need to be monitored. Furthermore the effectiveness of the PSC-MS itself has to be reviewed regularly by audits and/or self assessment (see Appendix 3.3 "Example of a Checklist for Audits or Self Assessment").

Monitoring trends in PSC reassessment results may give an early warning that competence in a given area is deteriorating, allowing countermeasures e.g. in training programmes or supervision. General decay of PSC may also signal problems with process safety culture. Audit/self assessment findings and incident reports may also reflect the efficiency of the PSC-MS.

b. Key elements
   - A Management System Review attended by the key people in the PSC-MS is scheduled periodically. Minutes and action points are available for review
   - Monitoring of possible changes of Process Safety knowledge (e.g. science, trade associations, lessons learnt etc.)
   - Examining the results of competence assessments and audits/self assessments of the PSC-MS for trends or signs of deterioration
   - Review results are used to improve the PSC-MS itself as well as training systems and methods
   - …

c. Features of a mature system
   - Monitoring of changes in Process Safety knowledge are included in a Knowledge Management System and clearly assigned, e.g. to Engineering or HSE department
   - Comprehensive and structured evaluation of the results of PSC assessments and reassessments as part of the Process Safety Management System Review
   - Process Safety incidents and near misses ("lessons learnt") are analysed such that any PSC issues are highlighted and rectified. Repeat failures would indicate a weakness in the PSC-MS
   - Explicit feedback loop to all other elements of the PSC-MS
   - …

d. Templates and Tools
   - Example of an audit/self assessment checklist see Appendix 3.3
   - …

e. Records
   - Information system for changes in PS knowledge
   - Audit and review checklist
   - Evaluation/Review of assessment results
   - Evaluation/Review of unplanned and near miss events
   - Management System Review records
   - Overall trends in management system performance
   - …

2.3 How to implement and maintain a PSC Management System (PSC-MS)

As outlined in section 2.1, a PSC-MS is part of the organisation's overall Safety Management System. It should be aligned with the other parts or even designed as part of an Integrated Safety Management System. The PSC-MS should be integrated into existing processes such as the Safety Management System and incorporate existing procedures and organisational structures where possible. For long term maintenance the PSC-MS requires similar procedures to the rest of the Safety Management System, in particular a comprehensive review process.

For all Management Systems successful implementation and maintenance relies heavily upon its practicability and the explicit and constant support of senior management. Line management and experienced staff should be involved in setting up a PSC-MS. A special feature of a PSC-MS is its potential to have a strong impact on the individual employee. Especially the results of competence assessments may influence job opportunities. Therefore, where applicable, a strong and early involvement of employee representatives is recommended. It is also important to ensure that contractors are adequately included in the PSC-MS.

Many PSC activities may already be in place for other reasons, so that the effort to build up a PSC-MS is reduced. The elements described in section 2.2 can be used to analyse and fill gaps. A matrix which links the existing activities/procedures to the elements of this guidance may help. This is an option by which even SMEs with limited resources may benefit from this guidance.

An example of a comprehensive PSC-MS and its implementation is given in **Appendix 3.1**. In **Appendix 3.2** examples are given how to define and document key roles and PSC requirements.

Implementing a comprehensive PSC-MS has advantages far beyond process safety. It will help to improve operability and reliability. However, as a "quick start" a company may choose to concentrate on those steps which are considered essential for the prevention of major incidents. As a minimum it is suggested that these processes are essential to maintaining high PS standards:

1. Define the process areas where high levels of PSC are essential to prevent major incidents. Risk assessments should be used to highlight high hazard areas. The degree of automation should be considered. Processes that require manual operation or manual intervention may be higher priority than totally automated systems. However, in the latter case, the people operating with automated systems need sufficient process safety background knowledge to handle unforeseen situations
2. Document those competencies required in the areas defined above to prevent the potential incidents. The competencies can normally be defined in terms of procedures for actions and knowledge for decision making

3. Ensure that the essential systems are in place for the competencies documented above:
   a. Procedures
   b. Training (include drills and simulations if possible)
   c. Competency evaluation tests or processes
4. Link competencies to roles and, if necessary, individuals
5. Define minimum staffing levels based on the need to have PSC available. The minimum staffing level should be communicated to and understood by all staff who have a role in the PSC system
6. Examine staffing levels, operating hours and shift systems to ensure that minimum staffing levels can be maintained during times of vacation and unplanned absence

2.4 Definition of success

If you do not know where you are going you are unlikely to get there (and you won't know it if you do!). What are the essential features that identify that the PSC-MS has been set up correctly? What should we look for to assure the on-going quality of a mature system? In **Appendix 3.3 examples for audit/self assessment questions** are given. Good scores in audits, especially based on shop floor interviews, may indicate a successful system, but are not sufficient (see Longford accident!). Finally a successful PSC-MS contributes to less incidents and accidents, as measured by the respective key performance indicators.

Performance Indicators for the implementation of a PSC-MS could be e.g.

- % roles assigned
- % roles trained
- % competence assessment completed
- Scores obtained in competence assessments
- % task observations with competence deficits
- % incident reports with competence deficits as one of the causes
- A reduction in the frequency of unplanned events, near misses and incidents where PSC is identified as one of the contributing factors

However, some of these indicators may be ambiguous. Considering competence issues in task observations and incident analysis as such is positive. Negative trends in these observations/analyses certainly are warning signals.

Section 3: Appendices

3.1 Example of a Process Safety Competence Management System (PSC-MS) and its implementation

3.2 How to define and document key roles and PSC requirements

3.3 Example of a Checklist for Audits or Self Assessment

3.4 High Level Policy Statement Examples

3.5 Example of a PSC training matrix

3.6 Further reading and links

3.7 Glossary

3.8 Members of the EPSC Working Group

3.1 Example of a Process Safety Competence Management System (PSC-MS) and its implementation

In this section an example is given how to develop and maintain a PSC-MS. It is in line with existing systems especially from EPSC member companies and approaches found in a literature search. It is in no way binding and should be understood as one of multiple ways to proceed. In practice it is strongly recommended to make as much use as possible of existing structures and practices.

The example describes the sequence of steps for designing and implementing a PSC-MS.

1. Ensure senior management commitment
2. Identify key roles
3. Define PSC requirements for key roles
4. Define PSC requirements for specific jobs
5. Individual competence needs analysis and managing competence gaps
6. Special competence requirements for emergency situations
7. Training and development
8. Competence reassessment and management of change
9. Measuring performance, audit and review

The following flowchart illustrates the procedure:

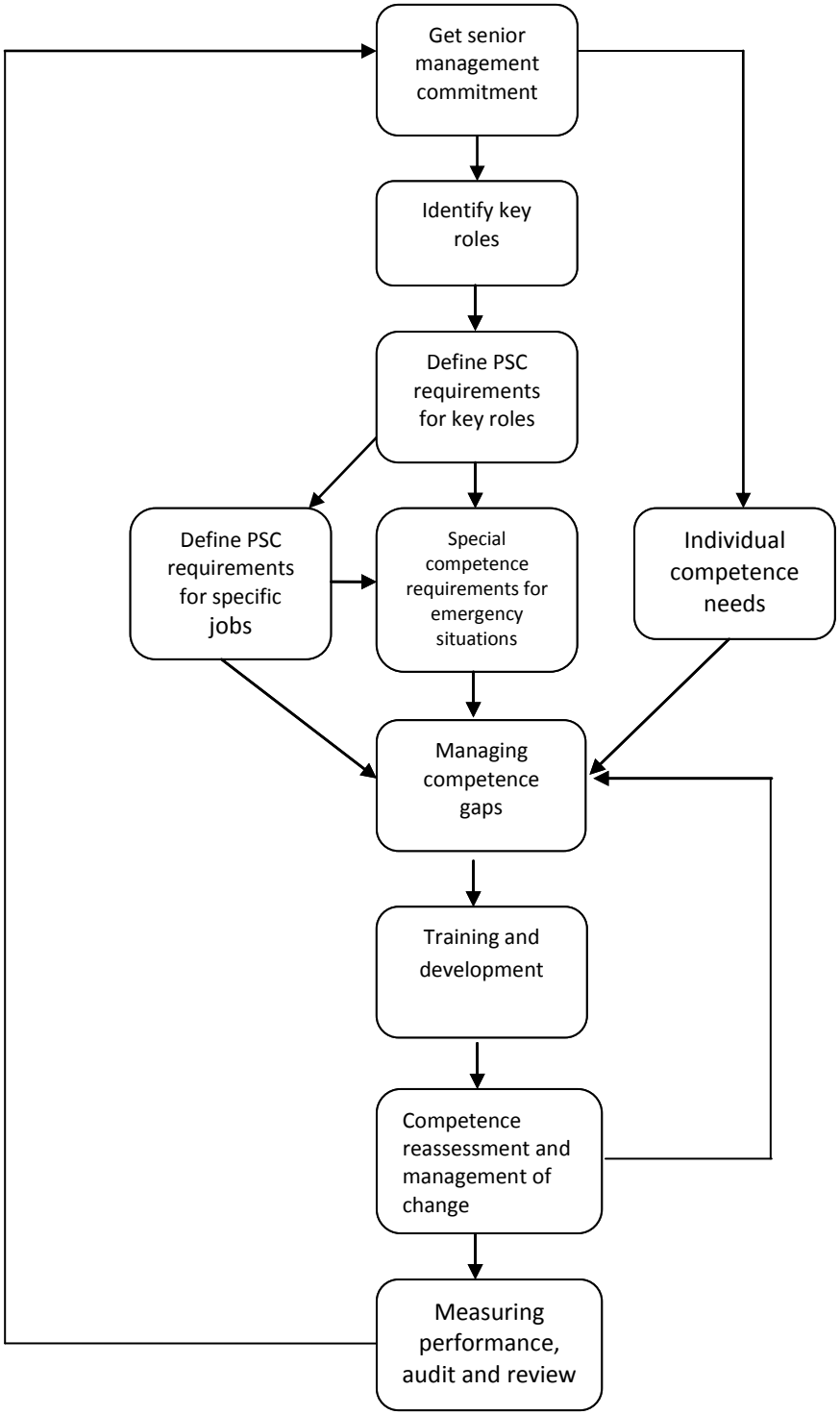


Figure 3.1: Sequence of steps for designing and implementing a PSC MS

Each step is structured into

(a) Objective

(b) Examples

(c) Implementation

Reference is made to the Elements described in section 2.2, in which additional information may be found. It should be noted that the elements are composed according to their content. The sequence of steps to implement a PSC-MS, which is the subject of this example, may not follow the structure of section 2.2 completely.

1) Get senior management commitment

(a) Objective

Senior management has to be involved in the formulation of a high level PSC policy statement (see **Element 2.2.1 High Level Policy Statement**) to ensure their commitment and demonstrate this to others. It has to be ensured upfront that the importance of PS and the cultural and behavioural expectations around PS are understood by everyone at the plant.

(b) Examples

Examples for a high level policy statement are given in **Appendix 3.4**. **High Level Policy Statement Examples.** The OECD Guidance referenced in section 1.5 can also be helpful.

(c) Implementation

First of all it may be necessary to make senior management (especially those without an operations or engineering background) aware of the importance and needs of PS. For this purpose EPSC has produced the tool **"Process Safety Pays"** (see www.epsc.org). It consists of a short film as opener and a template for a company-specific presentation which should follow the film. In section 1.5 of this Guidance ("Why is PSC important?") some incidents are described which also highlight the importance of Process Safety and therefore the need for competence in this area. Having achieved the commitment of senior management, existing high level policy statements should be checked to see if they adequately cover PSC. If these are not adequate, they should be amended (see **Appendix 3.4 High Level Policy Statement Examples**).

2) Identify key roles

(a) Objective

In this step key process safety roles for the organisation (in this example: company or site) should be identified. The roles should be defined in generic terms but with sufficient detail that PS competence minimum requirements can be linked to them in the next step for purpose of e.g. staffing and recruiting (see **Element 2.2.3 Selection and Recruitment of Personnel**) as well as for training programs (see **Element 2.2.5 Maintaining Competence,**

Training and Development). The reason for the role being included as a 'key' role should be recorded and these aspects of the job should be the main focus of the competence activities. The fine tuning for the specific needs of the individual facilities is performed in step 4 ("Define PSC requirements for specific jobs").

(b) Examples

Key roles are e.g. Process Operators and Supervisors, Maintenance staff, Production and Process Engineers, Plant and Site Managers, HAZOP chair/team member etc. A further differentiation could be made for specific operations, e.g. chemical production (Seveso and non-Seveso), warehouse, tankfarm etc. See **Appendix 3.2 How to define and document key roles and PSC requirements.**

(c) Implementation

It is recommended to use existing roles, e.g. defined in job descriptions, salary systems etc. as far as possible. The task of identifying the key roles should be performed by people with a thorough knowledge of the role and its potential process safety impact. Typically this might include line management, process safety expertise, plant and process expertise and at least one person who actually performs the role.

3) Define PSC requirements for key roles

(a) Objective

For the different (generic) roles defined in step (2) PSC requirements should be defined, preferably with more than one level of competence to acknowledge the minimum requirement for someone new to the job and the expectations after gaining sufficient experience. This should be based on risk assessment. The principles of **Element 2.2.2 Facility Minimum PSC Requirements** should be taken into account.

(b) Examples

One approach is to define "capability areas" (e.g. compliance, risk assessment etc.), which are then linked to specific roles. For these capabilities different levels may be defined (e.g. "responsive – active – pro-active – role model", "aware – practitioner – expert" or "operator level A, B, C"). In **Appendix 3.2** an example is given how to define key roles for PS and to develop PS competence standards for them, focused on the needs of specific companies/sites. This is in no way binding and may differ in practice according to risk assessment.

(c) Implementation

It is anticipated that this step will be implemented at a company or site level. It is usually necessary to use a team for the definitions in order to achieve a thorough understanding of the role and the risks associated with it. Part of the team should be Process Safety Experts who are sufficiently independent in their advising role. Existing risk assessment (e.g. from Safety Report) and job descriptions should be used as far as possible. For some roles there may be legal/industry guidance on professional education or training which has to be taken

into account. The results should be documented in updated job descriptions and/or in a role/competence matrix (see **Appendix 3.2 - How to define and document key roles and PSC requirements**).

4) Define PSC requirements for specific jobs

(a) Objective

The PSC requirements for key roles must be fine tuned for the specific jobs in each facility. The knowledge required may be different for jobs even when they belong to the same "key role". A detailed examination of the PSC needs of the facility is required to ensure that the correct competences are always available where and when they are required. As examples; the correct competencies must be present in each work area and on every shift, the correct competencies must be involved in MoC and, in particular, the competencies required for Emergency Response must always be available. The principles of **Element 2.2.2 Facility Minimum PSC Requirements** should be taken into account.

(b) Examples

At a key role level for a "Process Supervisor" there may be a PSC requirement for an understanding of reactivity risks. Then at a specific job level, further detail would be added to state the actual chemicals, reactions and potential consequences that need to be understood and how these relate to the plant.

(c) Implementation

This step has to be performed at a plant level based on the key role requirements and the risk assessment for specific processes (e.g. HAZOP) with strong involvement of line management. There should be a feedback between this step and steps (2) and (3) to achieve the correct balance between the more generic roles/requirements and the need for these specific requirements.

5) Individual competence needs analysis and managing competence gaps

(a) Objective

The specific requirement for a job (step 4) has to be matched as closely as possible by the person(s) performing the job. Therefore the PS competencies of the individuals have to be known. The assignment of jobs should be based as far as possible on knowledge of the competence requirements of specific jobs and the competencies (abilities) of the individuals. Some of the knowledge part of PSC may require (for certain roles) an academic degree or can be acquired by (formalised) vocational training. However, as the PSC needs are so different, in many cases the required knowledge for PSC has to be assured through online or classroom tests or actually performing the task. The individual competence needs analysis is also the basis for managing competence gaps, e.g. by increased supervision, team composition, training or job changes.

The result of the individual competence needs analysis and the gaps to the required PSC requirements have to be communicated to supervisors and the staff members. This avoids

over-estimation of one´s own skills, potentially leading to risk taking behaviour, and promotes the acceptance of procedures and training measures. If an individual demonstrates a higher level of PSC than required for the present job, this potential should be documented for future job changes.

(b) Examples

The job as Maintenance Engineer in a specific unit may require a thorough knowledge of the hazardous properties of substances used there. An engineer who could be assigned to that job may not have that knowledge yet. His supervisor should provide appropriate training for him. Until the necessary knowledge has been proved the gap may be filled by working in a team with someone who has this knowledge, by increased supervision and/or more detailed procedures. If the competence gap is very large it may be best for all concerned to seek a different candidate.

(c) Implementation

The first step should be to check which parts of PSC are covered by existing qualifications (university degrees, job certification and other pre- and on-the-job qualifications). However, an individual assessment is necessary to make sure that the actual PS competence meets the requirement for the specific job. This assessment may result in a specific competence level (e.g. operator A, B, C). It must be linked to the training and assessment programme (development plan) for the person. Where the needs analysis highlights a significant gap that cannot be quickly addressed this has to be communicated to supervisors. Measures must be put in place to take account of gaps such as ensuring someone with the required competence is always available to provide assistance, more detailed operating procedures, intensifying supervision or changing the duties of the individual. This analysis must be documented to provide evidence that the Company is meeting its obligations around competence. The result of a PSC assessment may have consequences for an individual´s job opportunities, the Human Resources department should be involved. The individual should be involved in the process. He or she must be in agreement about the gaps or there is no hope of correcting them. If a person changes role the Competence Needs Analysis must be updated. More details are given for competence assessment in **Element 2.2.6 Competence Assessment and Reassessment**, for individual competence needs analysis in **Element 2.2.4 Individual Competence Needs Analysis and Managing Competence Gaps**.

6) Special competence requirements for emergency situations

(a) Objective

Many emergency scenarios can and should be anticipated in advance, covered by procedures and therefore included in the Individual Competence Needs Analysis (step 5). However, there will always be the potential for “surprises”, events that were not predicted or that unfold in ways that were not anticipated. Support by automated systems may not be available or may even prove misleading. To manage unplanned events situational awareness and the ability to cope with stress is important. Availability both of general and specialised PSC not only enables adequate reactions but also reduces stress. Systems must

be in place to have competences available at any time which are seldom, if ever used. Two different types of competence are required to prepare people for emergency situations:

1. Staff must be prepared for the anticipated emergency scenarios. Procedures should exist for how to deal with the situation, staff should be aware of their role should the event occur and trained in how to complete their duties. Realistic drills are particularly helpful in preparing people for such events.
2. Staff must have the knowledge required to deal with emergency situations that have not been anticipated or cannot be addressed as planned. In such situations situational awareness is of utmost importance. People making decisions around response to the incident must have adequate background knowledge of the process and the hazards to take the correct actions.

(b) Examples

Understanding of chemical reactions may be necessary to identify deviations which are not (yet) detected by an automated system. Managing emergencies needs special skills for the different roles.

(c) Implementation

In addition to the PSC requirements for specific jobs (step 4) and the Individual Competence Needs Analysis (step 5) it has to be verified that the specific knowledge and skill requirements for emergency situations are covered, included in training programmes and (for this purpose especially important) in realistic drills. Important sources are Emergency Plans and the major hazard scenarios given in the Safety Report. More details are given in **Element 2.2.7 Special Competence Requirements for Emergency Situations**.

7) Training and development

(a) Objective

Given the great differences in PSC requirements for the different roles, specific training is necessary in most cases. Training is also necessary to keep the required PSC level over time, as people's skills and knowledge need refreshing (especially those which are seldom used). Therefore a system to define and implement PS training has to be put in place (see **Element 2.2.5 Maintaining Competence, Training and Development**). Training content has to be defined individually because each person has different requirements (see step 5). Changes in PSC requirements and knowledge over time (see step 8) has to be taken into account. Clear rules should be given for the competence of trainers and the class size.

(b) Examples

Although training "on the job" is most important it should be supported by other forms of training e.g. online, classroom, simulation. Knowledge and skills which are seldom used (e.g. in emergencies only) should be trained in drills or by simulation. Training and procedures should cover when people must request assistance. For example, no operator is likely to have all the knowledge required to deal with a reactive chemical situation so he or she must know to call for help and that help must be available.

(c) Implementation

First verify which parts of PSC are already covered by existing training activities. Review on a case by case basis whether PSC requirements have to be added to existing training courses or new training activities have to be initiated. More details can be found in **Element 2.2.5 Maintaining Competence, Training and Development.** The implementation of training is often linked to procedures. Generally procedures are written first and then training is developed from them. Consequently the list of procedures in place or required is a good source of information on the training that will be necessary. Use of the procedures should ensure that the important routine tasks and the anticipated unplanned events are considered. It is then necessary to define the knowledge required to facilitate reliable operations and appropriate responses to unanticipated events. This should be defined by people knowledgeable on the process, the operation of the plant, the likely nature of the unanticipated events and the potential hazards. This knowledge seldom exists in any one individual so a team is normally required to define these requirements.

8) Competence reassessment and management of change

(a) Objective

Both the individual competencies as well as the competence needs may change. Although the PSC of individuals should be maintained by training (see step 7), it has to be reassessed regularly and systematically. The results of reassessments should be analysed to improve the effectiveness of refresher training. General decay in PSC may signal other deficiencies (see **element 2.2.9 Continuous Improvement**). Ultimately it must be possible to declare people competent for specific requirements.

PSC requirements will change over time. This could be caused by changes in processes and equipment making a strong link to MoC important. In addition, changes to PS knowledge and regulations must be monitored (e.g. as part of a Knowledge Management System) and fed into the training activities. Organisational change will also impact the competence available and required making a strong management of the organisational change process essential to maintaining the required competence levels.

(b) Examples

Reassessment should reflect the expectation that people should be knowledgeable on the topic and serve to confirm this. Ideally, competence reassessment should not involve people repeatedly sitting through the same training and the same tests.

(c) Implementation

PSC reassessment for individuals should be scheduled on a routine basis, taking into account the risk assessment of the respective job and the responsibilities of the individual. Reassessment may also be necessary after a longer period of absence. Reassessment must be documented to provide evidence that the Company has met its obligations around competence. The potential consequences of deficiencies identified by reassessment could be a critical Human Resources Management issue. Therefore the methods of reassessment and follow up have to be carefully planned to avoid unnecessary friction. PSC must be included in the Management of Organisational Change System. PS knowledge and

regulations may change so this should be systematically monitored and linked to PSC training and reassessment. More details are in **elements 2.2.6 Competence Assessment and Reassessment and 2.2.9 Continuous Improvement**.

9) Measuring performance, audit and review

(a) Objective

As for every management system it is important to measure the effectiveness of the system and to improve it continuously by self assessment, audit and review. Good scores in audits, especially based on shop floor interviews, may demonstrate a successful system, but are not sufficient. **Appendix 3.3** gives **examples of audit and self assessment questions**. Finally a successful PSC-MS contributes to less incidents and accidents, as measured by the respective key performance indicators. Audit findings and incident reports may also reflect the efficiency of the PSC-MS. Monitoring trends in PSC reassessment results may give an early warning that competence in a given area is deteriorating, allowing countermeasures e.g. in training programs or supervision. General decay of PSC may signal deficiencies of the management system itself and beyond that possibly problems with process safety culture.

(b) Examples

Leading Performance Indicators for the implementation of a PSC-MS could be e.g. "% roles assigned" and "% roles trained" etc. (see **section 2.4 Definition of Success**). In Appendix 3.3 an example of an audit/self assessment checklist is given.

(c) Implementation

It is recommended that the PSC audit and review is integrated into an existing audit and review systems where they exist. In Appendix 3.3 audit points are mentioned for the different elements of the PSC-MS. Details are also given in **element 2.2.9 Continuous Improvement.**

3.2 How to define and document key roles and PSC requirements

The definition of roles (jobs) and the requirements for PSC differ considerably between companies, sites, facilities and plants. Operators may "only" run the operations, e.g. a chemical reaction or a warehouse. They may in addition be responsible for (minor) maintenance of e.g. piping, pumps or even instruments and some. They may or may not also perform equipment inspections. The roles also take into account regional differences. For instance, the vocational training in Germany for chemical workers or maintenance technicians is regulated by the Government and may provide PS competencies which are different from training in other countries. This may also lead to a different design of roles. These roles have often existed for many years and are strongly linked with organisational and salary issues. Any PSC-MS should build on these existing roles and should avoid if possible inventing a new system. This Guidance therefore does not define key roles, but provides a process which can be used for their definition.

These guidelines focus on the technical, scientific and organisational features of the processes. However, the success of the system will also be influenced by cultural and social

issues, fatigue, distraction, stress and similar factors. These "human factors" are not the focus of this guidance but must not be ignored, consequently the requirement to address them is mentioned but without the detail of the other sections.

It is generally possible to define competence areas which may be used company or facility-wide for the different processes and roles (see **Element 2.2.2 Facility minimum PSC requirements**). Each role has different requirements for those areas. For instance an operator has to understand the labels of hazardous substances, but need not understand all details of a MSDS. Therefore the competence areas have to be divided into different levels. In **Figure 3.2.a** a few examples are given.

These competence areas with their different levels have to be linked with the roles. This can be done e.g. as a matrix. An example is given in **Figure 3.2.b**. The complete information (role, competence areas and –levels) can also be combined in one table and/or diagram. **Figure 3.2.c** gives an example.

Figure 3.2.a Example of core competencies/competence areas

Core competencies	Level 1	Level 2	Level 3
Chemical reaction	• has basic understanding of the chemical reactions in his/her area of responsibility • Fully understands the operating procedures and that any deviation needs approval • Knows what to do in case of deviations (e.g. loss of utilities, temperature too high etc.)	• Fully understands the chemical reactions in his/her area of responsibility (including thermochemical properties etc.) • Understands the safe margins of the reactions • Knows what to do when the reaction is off the safety margins	• Fully understands the chemical reactions in his/her area of responsibility (including thermochemical properties etc.) • Knows how safe margins are defined
Hazardous substances	• Understands the description of hazardous properties in the operating procedures • Understands labels	• Understands structure and content of MSDS • Has basic knowledge of the properties of all substances in his/her area of responsibility to understand possible risks by operating errors	• Knows the properties of all substances in his/her area of responsibility • Fully understands the meaning of all terms in a MSDS
Process equipment	• Fully understands the equipment and its function in his/her area of responsibility • Knows how to react in case of a malfunction	• Understands P&I diagrams • Understands maintenance and inspection methods	• Understands the design criteria for the equipment in his/her area of responsibility • Understands material properties etc.
instrumentation	• Understands the controls/alarms in his/her area of responsibility	• Understands the controls/alarms in his/her area of responsibility and the interfaces to other areas	• Understands the design of the instrumentation and control system
compliance	• Knows the operating procedures and that they may implement corporate or legal requirements	• Knows the relevant corporate/legal requirements for in his/her area of responsibility	• Knows the corporate/legal requirements for Process Safety
Attitude and behaviour	• Can communicate with team and supervisor • Shows commitment for safety	• Shows clearly that he/she expects keeping to the procedures • Encourages reporting of deviations	• Demonstrates clear commitment to Process Safety • Acts as role model

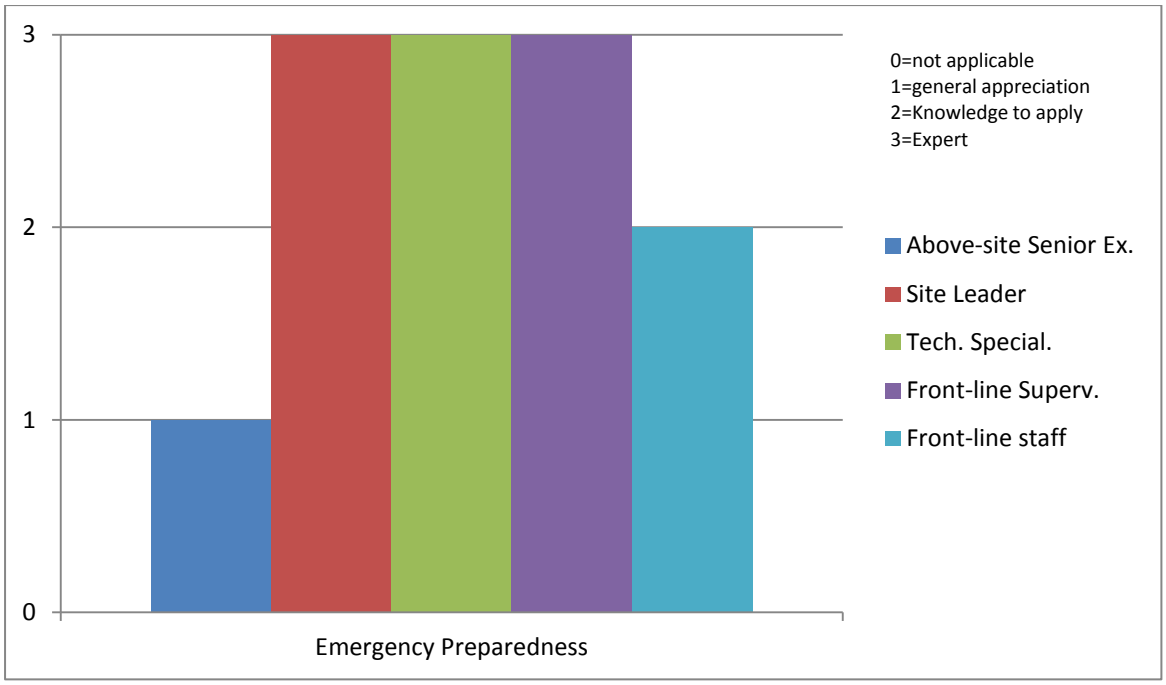
Figure 3.2.b Example of a Role/Competence Matrix

Key roles	Chemical reaction	Hazardous substances	Process equipment	instrumentation	compliance	Human Factors competence	xxx
Process Operator	**1**	**1**	**1**	**1**	**1**	**1**	
Process Supervisor	**2**	**2**	**2**	**2**	**2**	**2**	
Maintenance staff	**n/a**	**1**	**2**	**2**	**1**	**1**	
Plant Manager	**1**	**2**	**2**	**2**	**3**	**3**	
PS Specialist	**3**	**3**	**3**	**3**	**3**	**2**	
xxx							

(1, 2, 3 = levels of competence, see Figure 3.2.a)

Figure 3.2.c Example of a Competence/Role/Competence Level Table and Diagram

Competence Area	Key Role	Competence Level	Expectations
Emergency Preparedness	Above-site Senior Executives	1	Review emergency response (ER) Plans to identify and address issues
	Site Leadership	3	Identify required emergency procedures for emergency scenarios. Develop effective ER Plans. Document ER Plans and ensure clear communication. Review ER Plans to identify and address issues. Knowledge of emergency preparedness to understand and follow arrangement.
	Technical Specialists		
	Front-line Supervisors		
	Front-line Staff	2	Knowledge of ER Plans and ensure clear communication. Knowledge of emergency preparedness to understand and follow arrangement.



3.3 Example of a Checklist for Audits or Self Assessment

How to use this checklist:

1. The checklist is not meant to be exhaustive. It may serve as a template and a "first start" and should be adapted to the needs of the company. This checklist uses a **4-step rating ("above expectations (1)– meets expectations (2)– meets expectations partly (3)– does not meet expectations (4)– not applicable (NA)")**. Any other rating is possible, too. However, a simple "yes/no" approach is not advisable due to the rather complex issues to be audited.
2. As the checklist follows the "toolbox" approach of this guidance the different elements of the checklist may be used separately. Therefore some overlap of the questions has been accepted.
3. The Objective section lists the conceptual aims of this part of the process (what the process is intended to achieve) and some indicators that could be used to assess whether the process is working as it should. The Objective section typically highlights elements that are cultural or subjective. They are important as indications for the overall success of the process, but do not lend themselves to a yes/no answer and consequently cannot cause a non-conformance. They should be investigated as part of the audit and where applicable comments added regarding the overall health of the process in the Audit/Assessment Overview section at the end of the form.
4. Anything that allows a rated answer (1 to 4) goes in the questions and can cause a non-conformity that needs to be corrected which goes in the Opportunities for Improvement section.
5. Investigate each numbered question and complete the check box for the rating (1 to 4 or NA) as appropriate.
6. Qualify the answers with comments in the comments column where this will improve the understanding of the audit findings.
7. Questions rated (3) or (4) require a follow up action. In some cases it may be possible to verify that the requirement has been achieved by other means but where this is not the case a plan should be agreed to achieve compliance with the requirement.

Audit/Self Assessment Details:

Date of audit/self assessment	
Person completing this audit/self assessment	
Area being assessed (e.g. plant, site, organisation)	
Audit/self assessment scope	
People interviewed	
Documents reviewed	

Element 1: High Level Policy Statement

Objective:
Verify clear and visible support for the Process Safety Competence Management System (PSC-MS) from the top management of the company. Investigate the following possible indicators that this element of the PSC-MS is effective:

- The high level expectations of the PSC-MS are known by the local owners of the system
- Indicators of the PSC-MS performance are reported to senior management
- Inclusion of PSC-MS in goals or bonus parameters
- In interviews confirm that people at all levels are aware of the commitment to the PSC-MS from the top management of the company

Id.	Question	Compliance	Comments
1	Does a policy statement exist for the PSC-MS (separate statement or part of a broader statement)?	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	
2	Is the policy statement from a source at a suitable level in the company? Note: Ideally this would be at the level of CEO or similar.	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Does the wording of the statement adequately convey the importance of the PSC-MS?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Does the statement adequately define the expectations of top management for the PSC-MS?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
5	Is the policy statement included in documents or displayed such that the people who need to be aware of it will see it?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 2: Facility Minimum PSC Requirements

Objective:
Identify Process Safety Competence (PSC) requirements for the facility as a whole. Define the minimum knowledge and skills required by the front line staff and ensure that these are always available at the time and place where they are potentially required. Investigate the following possible indicators that this element of the PSC-MS is effective:

- Verify that the potential hazards identified in the process risk assessment are adequately addressed in the Facility Minimum PSC requirements
- Examine links between the Facility Minimum PSC requirements and personnel planning such as the organisational structure and succession planning
- Verify that competencies regarding Human Factors in Process Safety are considered

Id.	Question	Compliance	Comments
1	Can it be verified that the Process Risk Assessment was used in the definition of the Facility Minimum PSC requirements	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Can it be verified that the Facility Minimum PSC requirements are documented and this includes:	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
2a	• All required roles	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
2b	• Cover all times e.g. shifts, weekends, vacations and unplanned absence of personnel	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
2c	• All potential events e.g. normal operations, start up, shut down, turnarounds, unplanned events and emergencies	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Can it be verified that the Facility Minimum PSC requirements are being met at the time of the audit/assessment	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Can it be verified that a continued link exists between the Process Risk Assessment and the Facility Minimum PSC requirements e.g. through the MoC process	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
5	Can it be verified that a link exists between the Process Risk Assessment and the Knowledge Management Process such that it is kept up to date as new information becomes available e.g. through the MoC process	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
6	Can it be verified that the Facility Minimum PSC requirements are reviewed as part of the Management System Review process	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 3: Selection and Recruitment of Personnel

Objective:
Verify that PSC needs are an integral part of the selection and recruitment of personnel. Investigate the following possible indicators that this element of the PSC-MS is effective:

- Human Resources Department is informed about the basic competencies, aptitudes and skills necessary for the different roles/jobs and takes account of these requirements in the processes of hiring and job changes
- Measures are in place to minimise turnover in key Process Safety roles

Id.	Question	Compliance	Comments
1	Are PSC requirements part of relevant (esp. higher risk) job descriptions?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Does a formal initial training and development plan exist for new recruits?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Are PSC requirements parts of relevant contractor agreements?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Is PSC part of contractor assessment?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
5	Are PSC requirements incorporated into succession planning for relevant roles/jobs?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 4: Individual Competence Needs Analysis and Managing Competence

Objective:
Verify that the PSC requirements are fine tuned for each job/role on plant level and that the people who perform this job are assessed against these requirements. Verify that training and assessment programmes exist and are based on these specific requirements. Investigate the following possible indicators that this element of the PSC MS is effective:

- Verify that the staffing arrangements appear adequate to meet the PSC requirements for the specific jobs/roles
- In interviews confirm that people are aware of their role in providing the specific PSC requirements
- Supervisors are familiar with PSC needs for the different jobs/roles and the PSC capabilities of their staff
- Gaps in PSC capabilities are met by training, and/or intensified supervision or job changes
- PSC requirements are considered in succession planning

Id.	Question	Compliance	Comments
1	Are PSC requirements for different jobs/roles are documented?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Are PSC capabilities of individuals documented?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Are PSC capabilities and deficiencies of individuals communicated to those individuals and the responsible supervisor?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Are specific PSC requirements being met at the time of the audit/assessment?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
5	Does Management of Organisational Change take explicit account of PSC needs and individual capabilities?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
6	Are PSC requirements and capabilities explicitly considered in temporary job changes?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
7	Are PSC requirements and capabilities explicitly considered beyond normal operations (shut downs, maintenance, etc.)?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
8	Are PSC requirements and capabilities considered in vacation planning etc.?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
9	Is performance assessment based on Individual Competence Needs Analysis?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
10	Is PSC included in the criteria for selection and promotion of personnel?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	

11	Are training programmes based on Individual Competence Needs Analysis?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
12	Do operating procedures take into account PSC capabilities of the persons doing the job?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
13	Can it be verified by interviews that operating procedures provide sufficient guidance on hazardous tasks?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 5: Maintaining Competence, Training and Development

Objective:
Verify that maintaining PS Competence is understood by all stakeholders as top priority. Verify that assessment and training is based upon Facility Minimum PSC requirements (element 2) and Individual Competence Needs Analysis (element 4). Investigate whether assessment methods are effective in identifying PSC gaps and training effectively addresses them. Investigate the following possible indicators that this element of the PSC MS is effective:

- PSC is considered in changes of jobs, processes and equipment
- Supervisors consider observation of PSC capabilities (including temporary issues like fitness for work) of their staff as an important part of their responsibilities
- Supervisors are informed about changes in PS knowledge in a structured way
- Training plans are customized to the PSC needs of the roles or individuals
- Training program is structured and sufficiently resourced
- Fluctuation in safety critical roles is kept to a minimum
- PSC requirements are considered in succession planning

Id.	Question	Compliance	Comments
1	Is PSC incorporated into Management of (Organisational) Change?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Are operating procedures regularly reviewed, taking into account changes in PS knowledge and PSC needs?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Can it be verified by interviews that fitness for work is properly taken into account by supervisors?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Is a training program for PSC in place?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
5	Are gaps between PSC requirements and individual capabilities communicated to the individual and his or her supervisor?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
6	Is the responsibility to initiate training clearly assigned?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
7	Is the effectiveness of PSC training regularly assessed?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
8	Can it be verified by interviews that PSC training is effective?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
9	Are drills/simulations performed for unusual or emergency situations where the correct response is important?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 6: Competence Assessment and Reassessment

Objective:
Verify that necessary PSC is initially proven by e.g. academic degree, formal training, training on the job, tests etc. and that systems are in place to assure that the required PSC is maintained over time. Investigate the following possible indicators that this element of the PSC-MS is effective:

- Those who perform safety critical jobs/roles have to meet well defined PSC criteria according to element 4 (Individual Competence Needs Analysis)
- Results in (re-) assessments are considered in goal setting and incentive systems
- Trends of the level of PSC are monitored

Id.	Question	Compliance	Comments
1	Are PSC capabilities assessed prior to assignment of jobs/roles?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Are PSC capabilities regularly reassessed?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Are the results of (re-) assessment documented?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Do assessment and reassessment (frequency, content) take account of the risk profile of jobs/roles?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
5	Can it be verified that the people performing safety critical tasks have received prior assessment and regular reassessment of their PSC capabilities?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
6	Can it be verified by interviews that operators are aware of critical process parameters?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
7	Are the results of reassessment communicated to those who are responsible for training?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
8	Have assessors to meet specific competence requirements and are they specifically trained?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
9	Does (re-) assessment include observation on the job and/or simulations/drills?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 7: Special Competence Requirements for Emergency Situations

Objective:
Verify that reasonable efforts have been made to assure necessary PSC for emergencies, especially

- Knowledge of processes and equipment to cope with unplanned situations
- Situational awareness
- Ability to cope with stress

Investigate the following possible indicators that this element of the PSC-MS is effective:

- Assessment of emergency scenarios include PSC needs and availability
- Emergency plans, drills and exercises cover PSC issues

Id.	Question	Compliance	Comments
1	Is availability of PSC capabilities (including back-up) covered in emergency plans?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Do drills/exercises include scenarios in which sufficient PSC capabilities are (temporarily) not available?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Are PSC issues explicitly included in review of drills and real emergencies?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Can it be verified by interviews that staff, supervisors and emergency responders are aware of PSC issues in emergencies?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
5	Can it be verified by interviews that there are always sufficient experienced operators and supervisors available to cope with abnormal and emergency events?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 8: Ownership and Commitment

Objective:
Verify that the importance of PSC is understood at all levels of the organisation and that all stakeholders know that they have to play an active role in maintaining and promoting PSC. Investigate the following possible indicators that this element of the PSC-MS is effective:

- PSC is regarded as one of the drivers of Process Safety
- People on all levels of the organisation feel responsible for PSC regarding themselves and those who report to them
- Where incentive systems are used these include recognition for improvements in Process Safety
- Performance regarding PSC is considered in all relevant performance assessment schemes
- Individual PSC capabilities and expectations included in salary and goal-setting systems

Id.	Question	Compliance	Comments
1	Can it be verified that operating procedures are adhered to or deviations are clearly regulated.	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Are individual PSC expectations communicated to the individuals and their supervisors?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Can it be verified by interviews that supervisors, local and senior managers demonstrate their commitment to constantly improve PSC?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

Element 9: Continuous Improvement

Objective:
Verify that a continuous improvement cycle exists for the PSC-MS. Investigate the following possible indicators that this element of the PSC-MS is effective:

- The effectiveness of the PSC-MS is continuously monitored
- Identified deficiencies are corrected within a reasonable timeframe
- Changes in PS knowledge are systematically monitored and fed into the improvement cycle of the PSC-MS

Id.	Question	Compliance	Comments
1	Are findings from (other) audits, incident and accident reports are assessed regarding possible PSC deficiencies?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
2	Are results from PSC (re-) assessments evaluated as an indicator for the effectiveness of the PSC-MS?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
3	Is review of PS literature, regulations, lessons learnt etc. clearly assigned and linked to PSC-MS?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
4	Is the effectiveness of the PSC-MS part of the management review of the overall Safety Management System?	**1**:☐ **2**: ☐ **3:** ☐ **4:**☐ NA: ☐	
…	…	**1:**☐ **2:** ☐ **3:** ☐ **4:**☐ **NA:** ☐	

Audit/Assessment Overview:
Good Practices that might be valuable elsewhere:
Opportunities for improvement:
Additional Comments:

1	Above expectations	**2**	Meets expectations	**3**	Partially meets expectations
4	Does not meet expectations	**(N/A)**	Not applicable		

3.4 Example of a High Level Policy Statement

Process Safety Competence should be incorporated into the High Level Policy Statement for the Company. This policy should be known by employees and ideally published in public reports, such as Environmental Policy/Report, Sustainability Policy/Report or Responsible Care®Policy/Report. Some examples have been chosen to demonstrate how Process Safety Competence could be integrated.

Example 1: Sustainability Report
Processes that enhance our sustainability efforts

Sustainability is an integral part of strategy development at XXX. Of course, it is also an integral part of our innovation and business development processes. At XXX, we want to get the most out of our sustainability potential. To achieve this, we have put in place a number of projects. ***One of its aims at maintaining a high level of competence in Process Safety, as competent people are one of the prerequisites for safe processes****.*

Example 2: Policy Statement - Environment
Policy Principles

In implementing the Policy the following key principles will be demonstrated:

1. Management systems
Effective environmental and energy management systems will be implemented and maintained, and these will ensure the environmental awareness of the workforce, encouraging every employee to act in an environmentally responsible manner.

2. Continuous improvement
The environmental impact of processes and products will be assessed and continuous improvement objectives and targets will be established to prevent and reduce emissions and releases, minimise waste and control noise. This will be achieved through process optimisation, ***improving the competence of our workforce regarding safe operations*** *and through research, development and deployment of new technologies where opportunities present themselves.*

Example 3: Sustainability Policy Statement
Sustainable Operation and Processes

We take initiatives to reduce environmental, safety and health risks in production, storage, distribution and usage of our products and the disposal of waste. This includes the efficient use of energy and resources and the continuous improvement of our processes ***as well as the competence of our workforce*** *to minimise the impact of our activities on the environment.*

Example 4: Environmental Policy Statement

The world's natural resources of air, water and land are finite and must be conserved and protected. Life and health are precious and must be safeguarded. These beliefs compel us to conduct our business in a manner that protects the environment and protects the health and safety of our employees and the public.

Therefore, it is the policy of XXX to:

- *Conduct all operations, including the sale and distribution of products and services in compliance with the letter and spirit of all applicable environmental laws and regulations*
- *Provide employees with the **competence,** training, tools and equipment necessary to safely operate and maintain facilities in compliance with applicable environmental laws and regulations, and company standards*
- *Extend knowledge by conducting or supporting research on the health, safety and environmental effects of our products, processes and waste materials*

It is the obligation of every employee of XXX to adhere to the spirit as well as the letter of this policy.

Example 5: Responsible Care® Statement

Our industry creates products and services that make life better for people around the world - both today and tomorrow. The benefits of our industry are accompanied by enduring commitments to Responsible Care® in the management of chemicals worldwide. We will make continuous progress toward the vision of no accidents, injuries or harm to the environment and will publicly report our global health, safety and environmental performance. We will lead our companies in ethical ways that increasingly benefit society, the economy and the environment while adhering to the following principles:

- *To lead our companies in ethical ways that increasingly benefit society, the economy and the environment*
- *To design and operate our facilities in a safe, secure and environmentally sound manner*
- *To instil a culture throughout all levels of our organisations to continually identify, reduce and manage process safety risks **and to promote the competence of our workforce to reach this goal***
- *To support education and research on the health, safety, environmental effects and security of our products and processes*

Example 6: Responsible Care® Statement
Plant safety and hazard prevention

Plant safety must be continually improved. Every employee is called upon to participate actively in this process, contributing ideas and suggestions. ***We enable this by constantly improving the competence in plant and process safety for our employees.*** *Existing facilities must be adapted as necessary in line with technical advances. Technical equipment must be designed for safe operation. Processes must be selected so as to minimise hazard potentials and risks. Technical equipment must be maintained carefully. Safety concepts must be drawn up for all technical equipment. These must include regular inspections. In addition to the installations required for safe operation, technical measures must be taken to ensure that any malfunctions can be properly dealt with and their effects localised. Detailed emergency response plans must be drawn up for all plant units. These plans are to be incorporated into the safety concepts agreed with the authorities.*

Example 7: High Level Policy Statement as part of the Process Safety Competence Management System itself

It may be beneficial to include a high level policy statement in the written PSC-MS. Such a statement makes clear the importance of the system and that following it is a mandatory requirement. An example of such a statement is included below:

The Importance of Process Safety Competence
High standards of process safety are a necessity in the chemical industry. Harm to people or the environment through process incidents is unacceptable to the Company and all other stakeholders in the industry. As such, avoiding process incidents should be regarded as part of the Company license to operate.

Process safety competence plays a vital role in preventing or mitigating process incidents:

- *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*

This management system details the process used to ensure that the necessary standards of process safety competence are maintained within the Company. It is the duty of every employee to follow these guidelines and to support others where they require assistance to perform their part in maintaining this system.

Example 8: Process Safety Competence as part of a policy statement for Management of Change

Recognising that people are the essential ingredient that is interwoven through all the elements of PSM, it is important to maintain a minimum level of (1) specific direct process experience and (2) knowledge and skill in managing process safety within the site line and

support organisations. Loss of minimum levels of experience and knowledge through personnel movements and organisational change, like changes to technology or facilities, potentially invalidates prior hazard assessments, which were based on knowledgeable people being present and in charge.

3.5 Example of a PS Competence training matrix

As the competence requirements for specific roles are frequently displayed as a matrix (see e.g. App. 3.2), this is also done for training needs. An example is provided below:

Course Ref. #	GVP (Level 3)	Any level 4 VP or director level (Ops / Mfg. / Bus.) with Manufacturing reporting relationship	Operations Manager / Site Manager	Technology Manager	Operations Engineer	First-Line Supervisors (incl. Shift Leaders, etc.)	Operating Technicians	EHS Hub Manager / Team Leader	EHS "Safety" Specialist	EHS Process Safety Specialist	EHS "Environmental" Specialist	Process Engineer (Engineering Organization)	TES / Engineering Manager	Maintenance Engineers; Supervisors; Coordinators	Project Engineer / Project Manager	I&E Engineers	Science Manager / Director	R&D; Product Development Specialist; PhD PDP	Process Development Specialist	QA / QC Supervision	PDP (Engineering degree)
Process Safety Fundamentals		M	M	M	M			R	R	M		M	R	R	R			M	M		M
Process Safety Fundamentals "Light"	M					M	M	M	M				M	M	M	R	M			R	
Capital Project Review Process			R	R	M			M	M	M	M	M	M	R	M	R		R	R		M
Control of Exothermic Reactions			M	M	M	R	R	R	R	M		M						M	M		R
Exothermic Reaction Control "Light"						M	M	R					R				M				
Risk-Based Decision Making		R	R		R	R		R	R	M	R	R	R	R	R	M			R		R
Root Cause Analysis			M	R	M	M	R	M	M	M	M	M	R	R	R	R					R
Root Cause Analysis Executive Overview (CBT)	M	M		M									M				M	R	R	R	
PHA for Team Leaders / PHA Facilitator					R				R	R											
Inherently Safer Design				R	R			R	R	R		M						R	R		R
PS Corp. Proc. (CBT)		R	M		M	M	M	M	M	M	R	R	M	M	R				R		R

(M = mandatory, R = recommended)

3.6 Further reading and links

- Atkinson, N., IChemE (www.tcetoday.com, September 2012): "Assuring process safety competency"
- OECD Environment, Health and Safety Chemical Accidents Programme, June 2012: Guidance for Senior Leaders in High Hazard Industries "Corporate Governance for Process Safety"
- COMAH Competent Authority: Inspection of Competence Management Systems at COMAH Establishments (Dec. 2011)
- National Skills Academy Process Industries et al.: The UK strategy for skills in Process Safety Management 2012-2014
- Cogent, National Skills Academy Process Industries; UK PIA: Guidelines for Competency Management Systems for Downstream and Petroleum Sites (June 2011)
- German Commission on Process Safety (Kommission fuer Anlagensicherheit – KAS) 2011: Guidance for Competencies regarding Human Factors in the Context of Process Safety (Leitfaden Kompetenzen bezueglich menschlicher Faktoren im Rahmen der Anlagensicherheit) – www.kas-bmu.de/publikationen/kas/KAS_20.pdf
- Cummings, D.E.; 6th Global Congress on Process Safety, San Antonio/Tx 2010: Are you tired of Playing "Whack a Mole" with your Process Safety Results – if so, it´s Time for a Change
- Burtonshaw-Gunn, S.; Davis, M. (Risktec Solutions Ltd.): Guidelines for Successful Competency and Training Management (2008)
- Baker, J.P.; Durrant, P.; Rail Professional Development Ltd. 2008: Competence Management Systems for railway Safety Critical Work
- Office of Rail Regulation, Railway Safety Publication 1 (2002/2007): Developing and Maintaining Staff Competence
- Health and Safety Executive (2007): Managing competence for safety-related systems (Part 1: Key guidance, Part 2: Supplementary material)
- Michael Wright, David Turner and Caroline Horbury (Greenstreet Berman Ltd): Competence assessment for the hazardous industries; Health and Safety Executive Research Report 086 (2003)
- Lisanne Bainbridge: Ironies of automation (http://www.ise.ncsu.edu/nsf_itr/794B/papers/Bainbridge_1983_Automatica.pdf)

3.7 Glossary

PS	Process Safety
PSC	Process Safety Competence
PSC-MS	Process Safety Competence – Management System
MoC	Management of Change
MoOC	Management of Organisational Change

3.8 Members of the EPSC Working Group

Name	Company
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Herman van Lochem, AnnCharlott Oberg	AkzoNobel
Franz-Josef Mueseler, Hans Schwarz	BASF
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Charles Cowley	Charles Cowley & Associates
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Matthias Burkhardt, Vicente da Cunha	DSM
Albert Walrave, Klaus Wischnewski	DuPont
Christian Jochum	EPSC (Staff Support)
Norbert Baron	ExxonMobil
Martin de Zeeuw	LyondellBasell
Robert Robinson	Marsh
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