NSW GOVERNMENT | Planning

Hazardous Industry Planning Advisory
Paper No 9

# Safety Management

January 2011

HIPAP 9: Safety Management


23–33 Bridge Street
Sydney NSW Australia 2000

www.planning.nsw.gov.au

ISBN 978-0-73475-871-2
DOP HAZ_012

# Foreword

Since the 1980s, the New South Wales Department of Planning has promoted and implemented an integrated approach to the assessment and control of potentially hazardous development. The approach has been designed to ensure that safety issues are thoroughly assessed during the planning and design phases of a facility and that controls are put in place to give assurance that it can be operated safely throughout its life.

Over the years, a number of Hazardous Industry Advisory Papers and other guidelines have been issued by the Department to assist stakeholders in implementing this integrated assessment process. With the passing of time there have been a number of developments in risk assessment and management techniques, land use safety planning and industrial best practice.

In recognition of these changes, new guidelines have been introduced and all of the earlier guidelines have been updated and reissued in a common format.

I am pleased to be associated with the publication of this new series of Hazardous Industry Advisory Papers and associated guidelines. I am confident that the guidelines will be of value to developers, consultants, decision-makers and the community and that they will contribute to the protection of the people of New South Wales and their environment.

Director General

# Contents

# Executive Summary

## Background

The orderly development of industry and the protection of community safety necessitate the assessment of hazards and risks. The Department of Planning has formulated and implemented risk assessment and land use safety planning processes that account for both the technical and the broader locational safety aspects of potentially hazardous industry. These processes are implemented as part of the environmental impact assessment procedures under the Environmental Planning and Assessment Act 1979.

The Department has developed an integrated assessment process for safety assurance of development proposals, which are potentially hazardous. The integrated hazards-related assessment process comprises:

- a preliminary hazard analysis undertaken to support the development application by demonstrating that risk levels do not preclude approval;
- a hazard and operability study, fire safety study, emergency plan and an updated hazard analysis undertaken during the design phase of the project;
- a construction safety study carried out to ensure facility safety during construction and commissioning, particularly when there is interaction with existing operations;
- implementation of a safety management system to give safety assurance during ongoing operation; and
- regular independent hazard audits to verify the integrity of the safety systems and that the facility is being operated in accordance with its hazards-related conditions of consent.

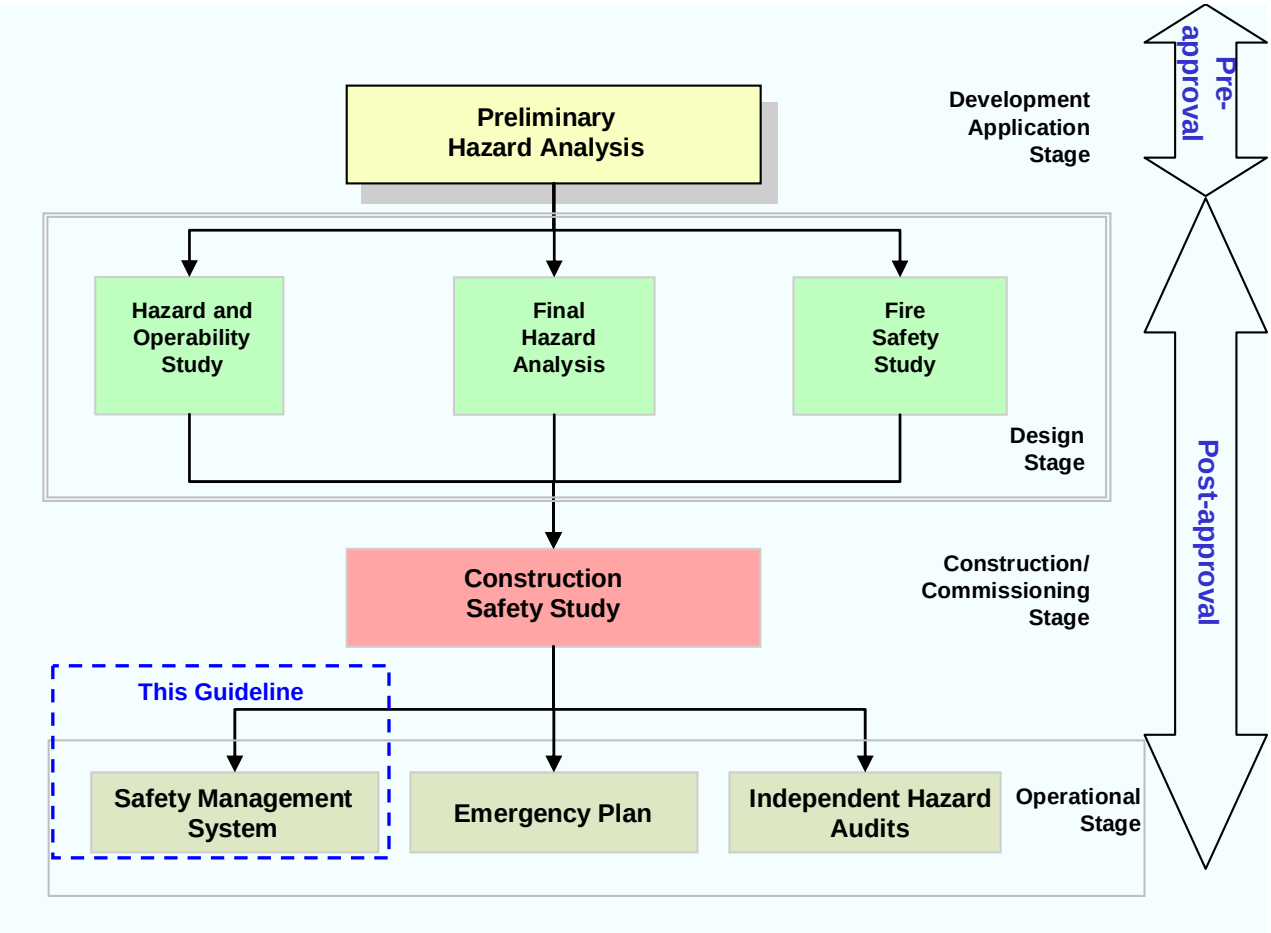
The process is shown diagrammatically in Figure 1.

A number *of Hazardous Industry Advisory Papers (HIPAPS)* and other guidelines have been published by the Department to assist stakeholders in implementing the process. All existing HIPAPs have been updated or completely rewritten and three new titles (HIPAPs 10 to12) have been added.

A full list of HIPAPs is found at the back of this document.

The part of the process covered by this guideline is highlighted in Figure 1.

**Figure 1: The Hazards-Related Assessment Process**




# The Safety Management System

These guidelines describe safety management principles and their implementation in a formal Safety Management System (SMS). Examples, checklists and useful references are included. For operators, proponents and others required to make formal submissions, guidance in preparation of SMS submissions to public authorities is also provided.

These guidelines are complementary to other NSW Department of Planning's Hazardous Industry Planning Advisory Papers (HIPAPs) which describe the elements of the formal risk assessment process. The SMS guidelines describe the extension of safety assurance beyond planning phases to encompass the full operating life of a facility.

For developments involving modifications to existing sites, the SMS also provides a valuable framework for guiding the design and safety assessment of the proposal.

The SMS is described as the comprehensive and integrated system for managing safety at a potentially hazardous facility and which sets out:

- The safety objectives;
- The systems and procedures by which these are to be achieved;
- The performance standards which are to be met; and

- The means by which adherence to these standards is to be maintained.

The model described in this document is based, in part, on the AS 4801 continual improvement model combined with specific operational controls adopted from Process Safety Management (PSM). Process Safety Management elements are included in the US OSHA Process Safety Management Standard 29 CFR 1910, The US EPA Risk Management Program (RMP) 40 CFR 68, the American Petroleum Institute RP750 and CCPS Guidelines for Technical Management of Chemical Process Safety.

Such a model provides two distinct but integrated components comprising generic safety management elements and specific process safety elements as follows:

1. A set of generic management system aspects that provide a systematic process for planning, implementing, monitoring, taking corrective action, and reviewing performance in relation to the hazards and potential major incidents, and their corresponding control measures. These generic management system aspects form a continual improvement cycle, and are similar to those used in management systems for the control of quality, environmental impact, or the overall business. These elements are described further in Section 5 of this document.
2. A set of specific process safety management system elements, which are appropriate to address the nature of the facility, its hazards, potential major incidents and associated risk, and which are therefore the control measures in relation to the potential major accidents.

To the extent that a SMS for a potentially hazardous facility needs to reflect the hazards that are present, and support the actual practices at the facility, the main charachteristics of that SMS should be:

- *Risk Based* and reflects the hazards that are present, and support the actual practices at the facility.
- *Fit for Purpose but comprehensive, comprehensible and integrated*. This means that it should be sufficiently comprehensive to cover the full range of activities at the facility that could have a significant safety impact. It should aim at the careful integration of the component elements of the system. The individual elements must be mutually consistent and complement one another as an integrated whole. It should be relevant, realistic and sufficiently clear to be understood by users and reviewers of the system.
- *Improving through learning and review* where errors, deviations and breakdowns in control measures and corresponding parts of the SMS need to be tracked under the SMS, to provide data on the actual safety performance of the facility.
- Able to *recognise Human Factors and behaviour* when developing systems, procedures and operational controls. Just as tasks need to be designed to take into consideration human capabilities and limitations, Facility operators (Operators) need to take the same consideration in the design, implementation and monitoring of systems and procedures that govern those tasks and make up the overall system.

The guidance provided by this document describes a SMS model that includes the following elements:

- Safety Policy and Commitment to Policy;
- Management and Administration of the SMS;
- Operational Controls that include all the the elements of an efficient Process Safety System; and
- Safety Assurance.

# 1 Introduction

**SECTION SUMMARY**

A safety management systems (SMS) is commonly associated with the management of occupational health and safety in a facility. However, for potentially hazardous facilities, including major hazard facilities (MHF), the SMS needs to be more broadly based.

This section describes the OH&S Management system model typified by AS 4801 and other safety models focusing on process safety. This leads to the approach proposed in these guidelines, which integrates specific process safety elements into the OH&S management framework.

Safety Management in the potentially hazardous facility context is the systematic practice of identifying significant potential for harm, assessing the risks, making decisions on appropriate controls, and implementing and monitoring systems and risk control measures to minimise the risk.

The advisory paper addresses the main elements of a SMS and the detailed requirements necessary to prevent major accidents and losses.

**KEY MESSAGE**

- A key requirement of a SMS is that it be 'fit-for-purpose'. This means that it should not be over-complex but must be sufficiently comprehensive to cover the full range of activities at the facility that could have a significant safety impact.

An integrated approach to the assessment and management of risk from potentially hazardous industry involves the complementary implementation of the three main types of safeguards:

- technical — such as the design and layout of plants and equipment
- operational — such as maintenance of equipment, provision of safety and environmental protection procedures, and training
- locational — such as siting and land use controls, safety separation distances, and control of population densities and surrounding land uses.

Additionally, there must be a means of ensuring the ongoing safety of process plants, storage facilities and related activities through sound management. A comprehensive, well documented and thoroughly implemented safety management system (SMS) provides this assurance. The system will include such diverse aspects as safety policy, organisational structure and responsibilities, procedures for operation, emergency response, document control, change management, and the auditing of compliance with policy and procedures.

The SMS should be tailored to the facility in which it will be used. A simple plant may only require a simple SMS, while a complex or more hazardous plant may need a more extensive one. Each person within a facility has a role in ensuring the SMS is followed.

These guidelines describe safety management principles and their implementation in a formal SMS. Examples, checklists and useful references are included. For operators, proponents and others required to make formal submissions, guidance in preparation of SMS submissions to public authorities is also provided.

These guidelines are complementary to other NSW Department of Planning's Hazardous Industry Planning Advisory Papers (HIPAPs) which describe the elements of the formal risk assessment process. The SMS guidelines describe the extension of safety assurance beyond planning phases to encompass the full operating life of a facility.

For developments involving modifications to existing sites, the SMS also provides a valuable framework for guiding the design and safety assessment of the proposal.

## 1.1 Safety Management Systems Defined

There are various definitions of what constitutes a safety management system (SMS). Consistent with the definition of the SMS in the National Standard for the Control of Major Hazard Facilities, the SMS may be described as the comprehensive and integrated system for managing safety at a major hazard facility and which sets out:

- The safety objectives;
- The systems and procedures by which these are to be achieved;
- The performance standards which are to be met; and
- The means by which adherence to these standards is to be maintained.

These principles may be applied to any potentially hazardous facility (referred to as 'facility' in the remainder of these guidelines.

### 1.1.1 Policy

The safety policy may be defined as a clear and meaningful statement that reflects organisational culture and demonstrates the management leadership, commitment and accountability at the facility and includes the prevention of major accidents. The safety policy communicates the main principles on which actions implementing the organisation's safety commitment are based.

### 1.1.2 Planning

In planning the implementation of the safety management system the following basic information must be established:

- identification of hazards, assessment of associated risks and implementation of control measures;
- identification of legal and other requirements which apply to the organisation;
- establishment of standards, objectives and targets for management and operational work; and
- preparation of a management plan and the a program to achieve the objectives and targets.

The aim of the planning process is to establish the risk profile of the organisation. This will enable the facility to focus its resources on those areas that are most important to the successful achievement of its objectives. The planning process is a continuous one which identifies changes such as new activities, materials and legal requirements.

### 1.1.3 Implementation

The implementation stage puts in place the organisational structure, accountabilities, responsibilities, resources and support mechanisms necessary for effective management of the SMS. The SMS assigns of accountabilities and responsibilities for all employees at the facility, as well as outline associated training, awareness and competence requirements. The implementation stage also establishes processes for internal and external communication, SMS document and data control and the implementation of safety critical operational controls.

### 1.1.4 Measurement and Evaluation

It is important to ensure that arrangements are in place for the measurement and evaluation of a facility's safety performance. Typical measurement and evaluation

techniques include inspections, the active monitoring of premises, plant, equipment, controls, incident reporting and investigation and audits.

Summaries of key findings from measurement and evaluation processes are a valuable source of information for management review.

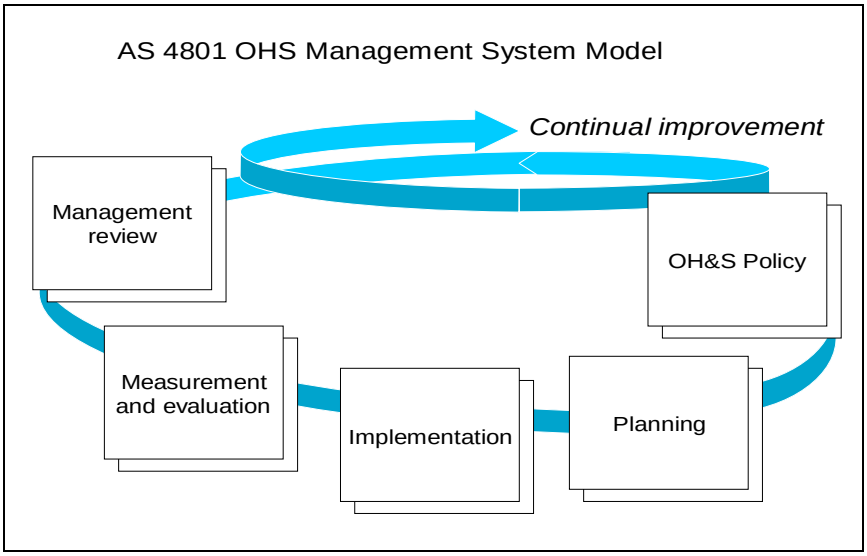
### 1.1.5 Management Review

Management with executive responsibility of the facility and the SMS must confirm the continuing suitability and effectiveness of the safety management system. Reviews should be carried out at least annually and should take into account the level of implementation of the safety management system, key results and trends from monitoring and auditing activities and opportunities for improvement from sources such as lessons learned from internal and external incidents.

## 1.2 The AS 4801 OH&S Management System Model

The SMS model that is most frequently used to describe the continual improvement process of safety management system is the policy, planning, implementation, measurement and evaluation and management review model. This model is compatible with AS4801, OHSAS 18001 and ISO14001. The recommended model as shown in Figure 2 illustrates an iterative process that defines the requirements of the safety policy, safety objectives and the continual improvement commitments of senior management. This model is consistent with AS 4801- *Occupational Health and Safety Management System* which is also characterised by the commitments to prevent loss, comply with all relevant legislation and continually improve the safety management system.

**Figure 2: AS 4801 OH&S Management System Model**




## 1.3 Other SMS Models

The Centre for Chemical Process Safety (CCPS) approach is similar to the AS4801 model by describing planning, organising, implementing and controlling as the basic functions of a SMS. The HSE UK also describes safety management systems as containing six key functions: policy, organising, planning and implementing, measuring and reviewing performance, and auditing. The feedback control loops that connect these functions are based on the concept of continuous improvement. These functional elements are also highlighted in AS 4801, API, HSG 65 and CCPS/OSHA. To enable

consistency in approach and comparison between standards and integration of systems this guideline has been structured to reflect the framework of these standards. Table 1 illustrates the similarity in the structure and intent of the AS 4801, HSE and CCPS models.

**Table 1: Comparison of AS 4801, HSG65 and CCPS Safety Management System Standards**

| AS 4801 | HSE HSG65 | CCPS |
|---|---|---|
| OH&S Policy | Policy | |
| Planning | Organising | Planning |
| Implementation and Operation | Planning and Implementing | Organising Implementing |
| Checking and corrective action | Measurement and Performance Review | Controlling |
| Management review | Auditing | |

## 1.4 Other Management System Models and the Issue of Integration

The continual improvement theme of the safety management system standards is also seen in ISO 14001 Environmental Management Systems and ISO 9001:2000 Quality Management Systems. ISO 14001 was the first ISO standard to use the continual improvement model as used by AS 4801 and OHSAS 18001 and has the process of environmental aspect identification and impact assessment at its core. ISO 9001:2000 has a strong business process focus, aimed at satisfying operational and customer needs. These models are broadly similar in approach. AS 4801 and other management system models provide useful frameworks for the development, review and verification of an SMS

Existing management system elements functioning as part of occupational health and safety, quality and/or environmental management systems can complement the SMS developed for the prevention of major accidents. The comprehensive integration of process safety and major accident prevention requirements into existing and proven systems is a key opportunity for the operator of the facility to rationalise and integrate their systems of control.

The following elements are common across quality and environmental management systems and have the greatest scope for integration with the SMS for the prevention of major accidents.

- Facility policies;
- The development of objectives and targets;
- Operational controls and documentation;
- Communication and reporting;
- Responsibilities and accountabilities;
- Training and development;
- Organization and accountabilities;
- Incident reporting, investigation and analysis;
- Measuring and monitoring processes;
- Internal audit process; and
- Management review and improvement.

## 1.5 The NSW Approach to SMS for the Prevention of Major Accidents

This advisory paper is aimed at major accident prevention through the implementation of a comprehensive and effective SMS. The SMS must provide a systematic means of ensuring safe operation which is fit for purpose, simple, understood, used, implemented, maintained, comprehensive and integrated. The preferred model for an effective SMS in NSW is based, in part, on the AS 4801 continual improvement model combined with specific operational controls adopted from Process Safety Management (PSM). Process Safety Management elements are included in the US OSHA Process Safety Management Standard 29 CFR 1910, The US EPA Risk Management Program (RMP) 40 CFR 68, the American Petroleum Institute RP750 and CCPS Guidelines for Technical Management of Chemical Process Safety.

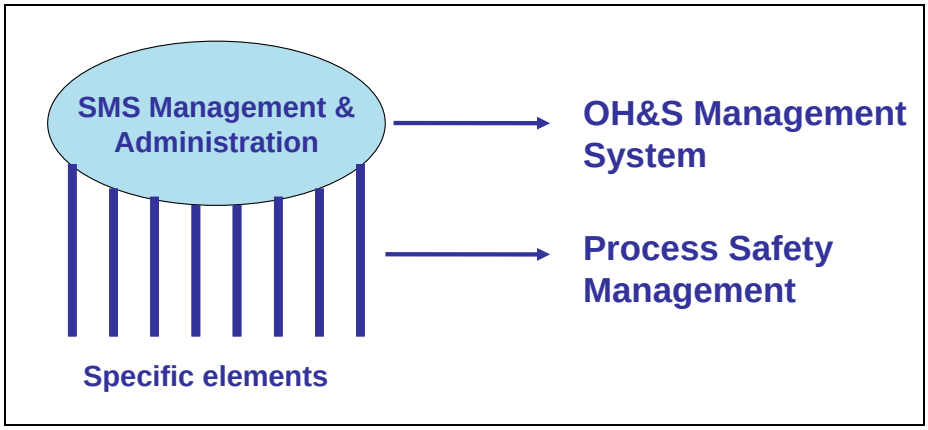
As noted by the CCPS, Process Safety is the operation of facilities that handle, use, process or store hazardous materials in a manner free from episodic or catastrophic incidents. Process safety management is the application of management systems to the identification, understanding, and control of process hazards to prevent process-related injuries and incidents.

Such a model provides two distinct but integrated components comprising generic safety management elements and specific process safety elements as follows:

3. A set of generic management system aspects that provide a systematic process for planning, implementing, monitoring, taking corrective action, and reviewing performance in relation to the hazards and potential major incidents, and their corresponding control measures. These generic management system aspects form a continual improvement cycle, and are similar to those used in management systems for the control of quality, environmental impact, or the overall business. These elements are described further in Section 5 of this document.
4. A set of specific process safety management system elements, which are appropriate to address the nature of the facility, its hazards, potential major incidents and associated risk, and which are therefore the control measures in relation to the potential major accidents.

Figure 3 provides an illustration of the preferred integrated model.

**Figure 3: Integrated Safety Management Systems**




Ultimately the management system must demonstrate that the major hazards aspects of the operation are clearly and effectively addressed.

# 1.6 Characteristics of Safety Management Systems

Safety Management in the potentially hazardous facility context is the systematic practice of identifying all significant potential for harm, assessing the risks, making decisions on appropriate controls, and implementing and monitoring systems and risk control measures to minimise the risk.

A sound SMS will have a positive effect on the safety of employees in the organisation and also offers other benefits, such as increased productivity and reduced losses. Some characteristics are discussed below.

## 1.6.1 Risk Based Focus

The SMS needs to reflect the hazards that are present, and support the actual practices at the facility. An SMS that fails to focus on the specific requirements for safe operation will not meet regulatory requirements. The SMS should be founded on the recognition that there is a potential for major accidents at the facility, on an understanding of what may cause or contribute to such incidents, and on a commitment to effectively manage and minimise the associated risk. Management and employees need to participate in, and understand the SMS. Each Operator needs to implement a workable system appropriate to the particular facility, the identified hazards, the adopted control measures, and the resultant levels of risks.

## 1.6.2 Fitness for Purpose

A key requirement of a SMS is that it be 'fit-for-purpose'. This means that it should not be over-complex but must be sufficiently comprehensive to cover the full range of activities at the facility that could have a significant safety impact. A key factor is the careful integration of the component elements of the system. The individual elements must be mutually consistent and complement one another as an integrated whole. The SMS should be relevant, realistic and sufficiently clear to be understood by users and reviewers of the system alike.

The SMS must be documented, and needs to be accessible and comprehensible to those who use it, to ensure that it is followed correctly and is understood. Documentation of the SMS will also enable the operator to test its implementation and assure its performance, and will enable an auditor to test the adequacy of the system, its implementation and its effectiveness. The SMS should incorporate processes to identify, select, define, implement, monitor, maintain, review and improve the range of control measures on which safe operation depends.

## 1.6.3 Improvement through Learning and Review

Errors, deviations and breakdowns in control measures and corresponding parts of the SMS need to be tracked under the SMS, to provide data on the actual safety performance of the facility. Performance standards must be used to facilitate this process and systems should also be in place to learn from the experience of parties external to the operator of the facility.

## 1.6.4 Recognition of Human Factors and Behaviour

When developing systems, procedures and operational controls it is essential that the human factors that contribute to them be fully considered. Just as tasks need to be designed to take into consideration human capabilities and limitations, Operators need to take the same consideration in the design, implementation and monitoring of systems and procedures that govern those tasks and make up the overall system. In particular, implementation and maintenance of the SMS must be within the practical capabilities of the facility's employees.

The promotion and control of safe behaviours at work is an essential ingredient for a successful SMS. It is the behaviour of everyone involved with facility activities whether

they are an employee, a contractor or a visitor that transforms the facility policy standards and procedures into action and performance. Techniques can be used by facilities to promote the effective use of risk control mechanisms to ensure that risk is minimised. Examples of effective programs include:

- Active managerial involvement in safety
- Consultative and Co-operative approach to all activities
- Dynamic information flows and follow-up practices
- Briefing at all levels of the facility
- Supervisors serving as role models, being visibly committed
- Leadership by management to improve safety
- Consistency of current facility safety practices

## 1.7 Overview

The following sections of this advisory paper address the main elements of a safety management system and the detailed requirements necessary to prevent major accidents and losses.

- The purpose and scope of the safety policy for the facility is introduced in section 2. Guidance is provided on how the policy should be developed, what it should contain and how it should be communicated and managed to drive continual improvement.
- The core management and administrative activities of a SMS are detailed in section 3. The common management and administrative components of the plan, do, check and act model are introduced which sets out to define the structure of an Operator's SMS. Activities in this section include the management aspects of the SMS including, safety plan preparation, the definition of key accountabilities and responsibilities, training assessment and records management.
- The operational controls required to be implemented by the operator are defined in section 4. Process controls such as process design, process technology, operational and maintenance activities and procedures, non-routine activities and procedures, emergency preparedness plans and procedures, training and competence programs, and other elements which impact the process and operation will be considered.
- The final stage, as represented by the continual improvement SMS model and which provides guidance on key management review activities, is given in section 5. These activities aim to maintain the robustness of system and operational activities as well as maximise the benefits of learning from reactive and proactive measures This vital component of the SMS enables the collection of system and operational data that has been captured by the SMS. Review of information such as incident data, audit reports, internal suggestions, change and external requirements is reviewed by top management for the purpose of feedback and improvement.

# 2 Commitment to Safety and Safety Policy

**SECTION SUMMARY**

An effective SMS requires a team effort led by committed senior management. The commitment must be visible and directed towards building up the organisation's safety culture.

There must be a safety policy, which includes prevention of major accidents. The policy must clearly communicate safety accountabilities and responsibilities, set out meaningful safety objectives and commit to adequate resourcing of safety management.

The section outlines a suggested approach for:

- policy development;
- policy communication; and
- policy maintenace and review.

**KEY MESSAGE**

- Effective safety management demands commitment from the top.

## 2.1 Commitment and Leadership

Safety performance and the activities within a SMS must be the product of a team effort, beginning at the most senior level of the organisation and permeating through to every manager, supervisor and employee. If each plays his or her part, and everyone has roles, activities and responsibilities clearly identified from the outset, the goals of a facility's safety policy become achievable.

While managers may agree that management commitment to safety is essential, they may see positive commitment solely as doing some training and having an occasional audit, etc. Commitment also means that when an employee identifies a major adverse hazard posing an imminent risk, the management, even the employee, have the authority to halt production to address that risk. Commitment is exhibited when supervisors are given time to carry out work-site inspections, or when employees are given adequate time to attend safety meetings. Management commitment also means understanding, and leading in a visible and open way.

Effective leadership and visible management commitment are critical to the successful implementation and improvement of the SMS as well as the cultivation of the organisation's safety culture. Some examples indicating management participation include involvement in the setting and achievement of performance standards, objectives and targets and the encouragement of active consultation and communication activities with internal and external stakeholders. It is through the application of these activities that senior management may develop, approve and maintain a safety policy. The safety policy of a facility is therefore a statement from the facility's top management which guides administration, reflects management's attitudes and commitment to the prevention of major accidents and defines the authority and respective relationships required to accomplish the objectives of that policy.

Top management has a key role to play in building awareness and motivating employees by explaining the organization's safety values, communicating commitment to the safety policy and encouraging all members of the organization to accept the

importance of achieving objectives and targets and the overall goal of the prevention of major accidents.

## 2.2 The Safety Policy

The safety policy establishes the principles of action for an organization. It sets the goal as to the standards of safety performance to be achieved by the organization, against which all subsequent actions will be judged. The safety policy is at the foundation of an SMS. The policy is the driver for implementing and improving the Operator's SMS and must be current in terms of how it addresses the major hazards. The policy is the clear statement of top management's explicit commitment to the prevention of major accidents. This policy commitment goes beyond the more generalized safety commitments typically found in health safety and environmental policy statements. The safety policy must reflect the risk profile of the organisation's activities and be responsive to change. In demonstrating management commitment to the prevention of major accidents, a number of aspects need to be covered by the facility when developing and maintaining its policy. A safety policy of a facility should include:

- A definition of key management responsibilities and accountabilities for hazards issues
- Commitment from senior executive management to the control of hazards and the prevention of major accidents
- Explicit reference to major hazards and the prevention of major accident in the safety policy (i.e. documented recognition that facilities with a major hazard potential need a special focus and commitment to reducing and controlling the risk of major accidents);
- A framework for the provision of adequate resources and the setting of measurable and trackable improvement objectives
- Management support for a safety culture and how that culture is driven down throughout the organisation
- Commitment to compliance with relevant regulations, codes and standards
- Communication and training requirements
- A clear definition of scope with respect to nature scale and risks of activities
- Long term objectives

## 2.3 Policy Development

In order to develop a meaningful safety policy statement, organisations need to know the nature of the process hazards, their associated risks and control measures and the resources, systems and programs in place to enable safe operation. Other requirements that will influence the development and content of the policy include legal requirements, corporate standards, voluntary programs and management directives.

For organisations that already have safety, environmental or quality policies, decisions on the development of a stand alone safety management policy or an integrated policy will have to be made. There are no specific requirements for either of these, so organisations should consider which approach will suit their specific needs, systems and culture the best whilst taking into account the long term goals set for the future. The same type of decision making will also have to be applied when determining the need to implement a corporate or site specific policy. Regardless of these issues the safety policy must be a clear, concise statement of commitment to the prevention of major accidents that characterises the commitment, goals and resources allocated by top management.

The policy must be developed with care and attention to the unique requirements of the Operators process and systems. Policy development is far more likely to be successful

when top management appreciate the qualities and effectiveness of a good safety policy.

To ensure the relevance of the policy to the specific requirements of the facility, consultation with employee representatives and employees during the development of the policy is crucial. It should be noted that consultation refers to a meaningful and open dialogue between management and employees prior and during the development phase, not simply the communication of the policy once developed by senior management.

## 2.4 Policy Communication

Effective communication of the safety policy is critical if the intent, vision and goals of the facility are going to be understood by employees, contractors and external stakeholders alike. The facility should consider the tools available to communicate, promote and reinforce this important statement. Most operators choose a range of activities to communicate the safety policy to internal and external parties. The following are examples of a number of common methods:-

- Safety committees
- OH&S representatives
- Inductions and Training (employees, contractors, visitors)
- Media publications
- Notice boards
- Internet/Intranet
- Manuals
- Meetings
- Annual reports

## 2.5 Policy Maintenance and Review

The safety policy should reflect the current status of process operations and systems and reflect the overall safety based goals of the organisation. In order to maintain its value, the safety policy should be reviewed as goals are met, risks change and systems improve. Regular review of the policy will ensure that an organisation or facility is using a policy that best fits the scale and scope of operations and the culture of major accident prevention and SMS improvement. Typically, the policy is best reviewed as part of a management review and at least once a year. Information such as audit summaries, incident analyses and trends, risk information, change and improvement information can be used to judge whether the policy is still appropriate.

**Note 1: Additional safety policy guidance**

For those desiring to develop and/or improve their safety policy the following resources may be helpful:

- U.S. OSHA guidance 3132/3133, Process Safety Management
- API Recommended Practice 750, Management of Process Hazards
- API Publication 9100, Model Environmental Health and Safety Management System and Guidance
- AIChE, CCPS, Guidelines for Implementing Process Safety Management Systems
- UK Health and Safety Executive HSG65, Successful Health and Safety Management

# 3 Management and Administration of the SMS

**SECTION SUMMARY**

The content of this section is based on the Australian Standard/NZ Standard AS/NZS 4801 "Occupational Health and Safety Management Systems". Permission to summarise and paraphrase the content of that Standard was granted by Standards Australia. For complete details, the reader is encouraged to obtain and refer to the original Standard AS/ANZ 4801.

An effective SMS combines a general safety management framework with specific elements that address the safety issues specific to the facility to which the SMS applies.

The section covers:

- planning the SMS, including relevant statutory requirements, codes and standards, identifying hazards that need to be managed, putting SMS plans in place and setting safety performance standards; and
- implementation of the SMS: management structure and resources, setting accountabilities and responsibilities, training, consultation, documentation and records management.

**KEY MESSAGE**

- The SMS cannot be generic. It must be tailored to address the specific safety issues at the facility being managed.

## 3.1 Introduction

An effective SMS is one that combines all the generic management system elements and supports all the operational control measures in proportion to their influence on safe operation. Section 3.2 described how safety management systems need to incorporate two overall aspects.

1. Generic SMS management aspects that provide a framework for planning, implementing, checking and correcting and reviewing measures for preventing major incidents.
2. Specific SMS elements which address the facility, its hazards, potential major incidents and associated risk, and which are therefore the control measures in relation to the potential major incidents.

The following sections of safety management detail the core management and administration activities of the system that represent the generic SMS aspects.

# 3.2 Planning the SMS

## 3.2.1 Identification of Legal Requirements, Industry Codes of Practice and Relevant Standards

As part of the risk management process all facilities should have procedures in place to identify and have access to relevant legal and other requirements. These include:

- legal requirements
- codes of practice
- Guidelines and best practice documents
- national and international standards
- agreements with public authorities

Facilities should have systems in place to identify and interpret such requirements and implement controls to keep the information up to date and monitor and assess compliance.

## 3.2.2 Identification of Hazards, Assessment and Control of Risks

**Note 2: The role of hazard identification, risk assessment and risk control**

The process of identifying hazards and assessing risks is an important aspect for the effective planning for the development and implementation of the SMS. The following section provides an overview of the process to ensure that the SMS is adequate and "fit for purpose".

The people who can best identify loss exposures, evaluate the risks associated with each, develop plans to control significant risks, implement the required changes and monitor the system are the management team and employees of the organisation. While there may be external sources of specific expertise, it is the managers and employees who know the hazards and risks associated with their specific organisation.This section outlines the general requirements for the organisation to implement and maintain procedures to:

- identify hazards,
- assess risks
- control the risks related to the full scope of activities including design, construction, normal, abnormal and emergency situations) products and services of the organisation.
- periodically evaluate the effectiveness the controls

The operator of a facility should ensure that, where it has been assessed that a risk remains unacceptable or where there is scope for further practicable risk reduction measures, all efforts should be made to minimise that risk so far as practicable.

Practicable means practicable having regard to the:

(a) severity of the hazard or risk in question;

(b) state of knowledge about the hazard or risk and any ways of removing or mitigating that hazard or risk;

(c) availability and suitability of ways to remove or mitigate that hazard or risk; and

(d) cost of removing or mitigating that hazard or risk

### 3.2.3 Safety Objectives, Targets and Plans

Procedures for the setting, completion and review of improvement objectives should be implemented and maintained by the facility. The concept of an objective being an overall long-term goal and a target being the specific improvement step required as the means for achieving objectives should be given.

Facilities should set SMART (Specific, Measurable, Appropriate, Reasonable and Timebound) targets for the completion of objectives and should consider the merits of mixture of input and output based.

Requirements for the consideration of the following in the setting of objective and targets should be included as part of the objective setting and review procedures.

- Unacceptable risks
- Opportunities for further risk reduction measures
- Legal requirements
- Technological options

### 3.2.4 SMS Plans

Facilities should establish and maintain a documented management program for the controlled execution of long term objectives and short term targets. The management programs should include the following for the achievement of the objectives:

- the designation of responsibility at each organisational unit within the facility
- the resources required
- the means and timeframe

An action planning (database) process should be used to allocate, track, and verify actions for the continual improvement process.

### 3.2.5 Safety Performance Standards

Mandatory standards for the performance of work done by all within the scope of the SMS should be established and maintained by the Operator. As a minimum, standards should define the responsibility, the frequency and the nature of the work that has to be done to obtain appropriate levels of performance. Standards can include any documents or concepts used as the basis for ensuring safe operation. These should be consistent with the safety policy and can include technical, engineering or management principles developed or applied by the operator. These include principles for management of human factors, standards for development or implementation of operating procedures, design principles for control rooms and alarm systems, engineering design and planned inspection systems.

Examples of performance standards against which the implementation of the SMS can be measured may include:

- Number of independent audits of the whole or part of the SMS carried out per year;
- % of audit recommendations implemented;
- % of hazard identification and risk assessments carried out;
- % of job descriptions incorporating identified competencies.

The systems by which the organisations compliance with standards should be enforced (measured, assessed and corrected/commended) should also be documented.

## 3.3 Implementation and Operation

### 3.3.1 Management Structure and Resources

Management and organisational structure and arrangements as well as human resources should be defined, documented and communicated by the Operator. Although there may be little variation in handling and processing particular materials, the manner in which tasks are organised can differ significantly between facilities. The resources requirements of developing and implementing a SMS should be considered by the Operator with appropriate planning and budgeting. It is important that organisations describe how the dynamics of human resources within the management structure inter-relate and how change to the structure or the human resources may impact operations.

### 3.3.2 Accountabilities and Responsibilities

Responsibility for safety lies with the person who is ultimately in charge of the facility, such as a Managing Director or the Chief Executive Officer. Just as authority is delegated down through the organisational structure to ensure that the objectives of the organisation are efficiently fulfilled, safety needs to be delegated and persons held responsible. Those who are accountable for the safety of workers in a particular area must have the authority to redesign work processes in that area.

The authority delegated to carry safety responsibilities must operate in the same way as other management functions. It begins at the top level with an approved set of written standards, procedures or instructions that include an appraisal system to measure and evaluate compliance and personal accountability. Key Performance Indicators (KPIs) are an effective way of integrating annual safety based performance objectives into skill and career development activities. It is essential that any KPI set for an individual is consistent with strategic and long terms goals of the facility. It is also important when setting KPIs that they are limited to an achievable number, are meaningful and that they reflect major focus areas of the facility SMS. KPIs may be documented in SMS standards, position descriptions.

Examples of KPIs for an operational manager may include:

- Accidents and near misses reported and investigated in a timely manner;
- % of staff reporting to manager trained in accordance with their identified competencies;
- Emergency plan reviewed once a year;
- Implement recommendations of a SMS audit or review in a timely manner.

Line managers and supervisors must accept, as an integral part of their duties, the functional responsibility for implementing and administering safety procedures at the workplace. Line managers and supervisors, however, must have the authority to match their responsibility in order to act effectively.

In order to enable the strongest possible framework for SMS development, top level management of the facility could consider the appointment of a specific management representative for co-ordinating the establishment, implementation and maintenance of the SMS. The management representative should report directly to senior management on SMS performance, effectiveness and potential improvement opportunities.

### 3.3.3 Training Needs Assessment

The procedures should take into account process knowledge and internal process needs, risk and the knowledge, skills and capability of the individual. The goal is to derive a comprehensive listing of the training required to enable each employee to perform his or her job properly, which means performing in compliance with all SMS requirements. This type of control applies essentially to all knowledge and skill training,

but will also need to be applied to leadership training as the loss control system expands to cover all activities. The following aspects of safety should also be covered:

- Induction
- Risk management
- Training and certification as required by regulation
- Communications and leadership
- Emergency preparedness and response
- Competence identification testing and assurance
- Trainer competence

### 3.3.4 Consultation and Communications

Many facilities have already established means and methods to keep employee representatives and employees informed about relevant safety issues. Employers may be able to adapt these practices and procedures to meet their obligations. Safety committees, with employees and management representatives, can facilitate the establishment, implementation and maintenance of a SMS as well contribute to the ability of the Operators to meet their legal obligation.

A successful SMS will require employee awareness of issues, support and motivation (both to work safely and to assist with the reporting and investigation of unsafe situations). The use of a common system and technical vocabulary by all employees of an organization is a key component in the control of major accidents. Personnel need to be able to have a common understanding of key words and terms used in the SMS. Such requirements should be addressed by the organization during induction and training review and refreshing activities.

Areas that would benefit from employee consultation include:

- Development, implementation and review of policies and procedures;
- Proposed changes to the workplace;
- Arrangements for employee representation; and
- Training of OH&S arrangements at the workplace.

Communication external to the facility is a key process which should be addressed by defined management controls within the SMS. Procedures must define the type and level of interaction with external parties such as regulatory bodies, community groups, emergency services and the general public.

### 3.3.5 Safety Management System Documentation

Overall a facility should provide information in paper or electronic form to describe the following:

- the core requirements of the SMS and their interaction;
- a concise description of facility activities, products and services;
- guidance on accessing information within the SMS; and
- SOP's, Work Instructions, Guidelines and SMS Forms such incident reports and Work Permits.

### 3.3.6 Document and Data Control

Facilty operators should implement processes for the control of all SMS related documentation. All documents should be:

- readily located;

- periodically reviewed, revised as necessary and approved for adequacy by authorised personnel;
- in the current version and obsolete versions removed from all points of issue and points of use or otherwise assured against unintended use;
- obsolete versions suitably identified, if retained for legal and/or knowledge preservation purposes

### 3.3.7 Records Management

SMS records document the actions arising from the procedures and protocols that form part of the SMS. Records of operational and SMS performance provide a snapshot of outputs at a given time under given circumstances.

The main difference between controlled documents and records is that while SMS documents are periodically reviewed and revised, records constitute the evidence of the completion of an activity, and, as such, are not revised or altered.

Table 2 gives examples of documented parts of the SMS and relevant records, showing how they relate:

**Table 2: SMS Documentation and Associated Records**

| SMS Documentation | Relevant Records |
|---|---|
| • Policies, procedures and protocols for Hazard identification and risk assessments | • Details of Hazard identification and risk assessment activities of a specific process |
| • Policies and procedures for consultation and communication with stakeholders | • Internal and External communication records including meeting minutes, letters, emails and notices |
| • Documented program for training and education | • Records of training activities and records of attendance and assessment of personnel |
| • Description of the Permits to Work system and documented procedures for its application. | • Records of completed forms issued providing permit for an individual to carry certain work on a given day. |
| • Policies, procedures and protocols for carrying out Safety audits. | • Safety Audit reports conducted by internal and external independent auditors. |

Good safety records management will involve systematic and consistent means of record storage and retrieval and should include:

- identification
- collection
- indexing
- maintenance
- filing
- retrieval and retention
- storage
- protection and security

# 4 Operational Control

**SECTION SUMMARY**

Having addressed preparation of the overall SMS framework, the focus moves on to the operational controls that are particularly relevant to the safety management of potentially hazardous facilities.

The section covers:

- identification of hazards and risk assessment;
- operating procedures;
- process safety information;
- contractor management;
- pre start-up safety reviews;
- equipment integrity;
- safe work practices;
- management of change;
- accident/incident reporting and investigation;
- training and education;
- procurement;
- emergency planning;
- security and access control; and
- auditing of the safety management system.

**KEY MESSAGE**

- The SMS must include control measures to address all hazards or failures that could give rise to a significant risk.

## 4.1 Introduction

Operational controls may be defined as any systems, procedures, and operational hardware and software, that are intended to eliminate hazards, prevent or reduce the likelihood of incidents from occurring, or reduce/mitigate the severity of consequences of any incidents that do occur. Operational controls are the primary tools which the Operator utilises to deliver a safe operation at the facility.

Operational Controls may be pro-active, in that they eliminate, prevent or reduce the likelihood of incidents, or they may be reactive, in that they reduce or mitigate the consequences of such incidents that do occur. Both types of operational controls are essential for an effective Safety Management System.

The controls adopted by the facility should address the findings of hazard identification and risk assessments, using the most effective practicable combination of measures available, taking into account staff capabilities, technological options, best practice and organisational objectives.

The following sections of this part of the advisory paper provide relevant information on a range of proactive and reactive operational controls that are typically applicable for the prevention and mitigation of major accidents at potentially hazardous facilities. In the main, these controls mirror the established elements of *Process Safety Management (PSM)* under the USA OSHA Process Safety Management Standard 29

CFR 1910, American Petroleum Institute RP750 and CCPS Guidelines for Technical Management of Chemical Process Safety.

## 4.2 Identification of Hazards and Risk Assessment

Undertaking a systematic and comprehensive hazard identification and risk assessment process will assist operators to manage their facility in a manner that minimises risks to people, property and the environment. It is the risk assessment process that develops the full scope and level of controls necessary to prevent major accidents. The risk management process sets out to:

- Develop a detailed understanding of major accident risks associated with the facility
- Provide a transparent and robust basis for making decisions on control measures, management systems and other resources for safe operation of the facility
- Identify critical controls measures and link these controls to the identified hazards

### 4.2.1 Scope of Hazard Identification and Risk Assessment

- It is important that hazard identification and risk assessment are based upon a comprehensive and accurate understanding of operations throughout the entire lifecycle of the facility. This requires that relevant hazard identification, risk assessment and risk control techniques be applied to the range of hazard types identified for modes of operation across the life cycle of the facility including the design, commissioning, start-up, operation, shutdown, modification and decommissioning phases.
- There is no single definitive method of hazard identification. The methods adopted depend on the purpose of the hazard analysis and the information available at the time. Some of the more frequently used techniques are discussed in HIHAP No. 6 –*Hazard Analysis*. Techiques include:
  - Hazard Identification Word Diagrams;
  - Hazard and Operability Study (HAZOP);
  - Failure Modes and Effect Analysis (FMEA);
  - Fault Tree Analysis;
  - Event Tree Analysis; and
  - Various human factor hazard identification techniques analogous to engineering techniques, such as Task Analysis.
- A systematic, transparent and comprehensive hazard identification process should be used, based on a detailed and accurate description of the facility. The hazard identification should consider all operating modes of the facility and all expected activities that could involve significant hazards. It is necessary to consider human system as well as engineering issues.

**Note 3: Comprehensive hazard identification**

Hazard identification should be carried out with an open mind, without pre-judging the effectiveness of technical and procedural controls. The emphasis is on identifying, as completely as possible what can go wrong, recognising that controls can fail. Hazards should not be overlooked or ignored just because it is thought that adequate safeguards are already in place.

- Locational and land use factors should be taken into account in considering possible consequences, particular the potential for harm to sensitive receptors and possible 'knock-on' effects. Sensitive receptors may include vulnerable people, eco-systems and areas or items of significant heritage value.

- Identification of the scale and type of credible major accident scenarios for emergency planning.
- Human factors need to be considered when identifying major accident scenarios. It is important employees with experience in the specific area being studied participate in identifying hazards. The role of each employee in the various steps of the assessment process needs to be clearly defined and understood.
- Security issues, including theft of materials or sabotage activities, need to be considered when identifying likely major accidents scenarios.
- Operators should develop an approach to hazard identification in which there is an active role for all appropriate employees to participate. This should include operations, engineering and maintenance personnel, who understand how specific areas of the facility function and how procedures, systems or equipment could fail. The consultative mechanisms used, including details of participants in the various hazard identification activities, should be thoroughly documented.

HIPAP No. 6 – *Hazard Analysis* describes in more detail the objectives and outcomes of these processes that should be demonstrated by the operator of the facility.

## 4.3 Operating Procedures

The objective of written operating procedures is to provide clear instructions for all site operations as a basis for ensuring that activities are conducted methodically, reproducibly and safely. The Operator should identify which work methods, processes, or critical tasks that have significant potential safety and environmental risks and develop safe operating procedures to prevent associated incidents.

### 4.3.1 Scope of Operating Procedures

For operating procedures to be effective and comprehensive, there is a need to cover the following issues:

- documented procedures for start-up, normal operation, temporary operations, emergency shutdown, normal shutdown, start-up following emergency shutdown and start-up following a turnaround;
- safe operating limits consistent with the process safety information;
- Critical Operating Parameters (COPs), including:
  - consequences of deviations from limits; and
  - actions required to correct deviations;
- procedures for responding and managing abnormal conditions;
- instructions to ensure that corrective actions are implemented in a timely manner;
- clear lines of authority to take corrective actions;
- occupational health and safety information and procedures, covering:
  - physical and chemical properties;
  - special/unique hazards; and
  - precautions to take during normal operations and emergencies;
- review of operating procedures to ensure that they reflect current best practice;
- safety systems, their functions and their operation, including the operation of 'safety critical equipment', including isolation, venting and automatic shutdown; and
- emergency procedures and notification protocols.

# 4.4 Process Safety Information

The SMS must be supported by accurate and up to date information on materials, processes, equipment and facilities. This information is used as the basis of decisions within the SMS and the risks and controls relating to people and the working environment of the facility. The objective of process safety information is to ensure that the Operator and employees have access to relevant and accurate information that will allow them to identify and understand the hazards involved in the process and analyse and manage the risks.

**Note 4: The Importance of Process Safety Information**

Detailed understanding of the processes at a facility is essential for the safe design, maintenance and operation of that facility. Without comprehensive understanding of the processes, it is not practical to implement an effective SMS. Such understanding is critical for:

- Managing change;
- Conducting hazard analysis and risk assessment;
- Implementing effective control measures;
- Implementing a program for equipment integrity;
- Introducing and implementing safe work practices; and
- Developing effective work procedures.
- Developing a training program
- Introducing improvement

## 4.4.1 Scope of Process Safety Information

Aspects of process safety information that need to be covered include:

- process/technology;
- equipment;
- chemicals stored and processed;
- the design basis, including human factor considerations, and the design limits;
- materials of construction, equipment and piping specifications, relevant design codes and design base of any pressure relief or vent system;
- Hazardous area classification;
- details of 'safety critical equipment';
- Piping & Instrumentation diagrams(PIDs), Engineering Line Diagrams (ELDs) or equivalent, which reflect the current system status;
- methodology for monitoring the process, such as temperature and pressure charts, alarm systems, and process controls; and
- mechanisms for documenting and disseminating acquired knowledge and experience, including the maintenance of a technical library as a basis for maintenance and enhancement of skills and knowledge.

Information may be stored in a wide variety of forms including engineering drawings, data sheets, registers, photographs, manuals. The SMS should consider how the format in which the information is stored can impact on how and why the information is used and should also consider quality control in terms of accuracy and information accessibility.

**Note 5: Process information and corporate memory**

Specific process knowledge is often obtained from practical operational experience and from mistakes and accidents. Operating procedures adopted as a result of this enhanced knowledge need to be documented and referred to, to ensure that current and future employees, including supervisors are aware of the history of the operation. An effective system of documenting knowledge ensures that corporate memory is maintained and the experience gained by senior operators, managers and engineers is disseminated to current and future facility personnel.

## 4.5 Contractor Management

Contractors can introduce unsafe conditions, processes, practices, standards, and/or materials and need to be subject to safety controls to ensure their practices do not jeopardise facility safety.

### 4.5.1 Scope for Managing Contractors

Effective management of contractors at a site should cover:

- A contractor selection system to ensure appropriate contractor selection processes. Such a system would include:
  - Contractor safety and environmental performance records and history
  - Review of the contractor safety management system
  - Review of the contractor's ability to provide qualified and experienced employees and supervision.
  - Review of the contractor's systems for ensuring that contractor employees will comply with the facility safety management system and all relevant procedures;
- site induction for contractors;
- nomination of a specific employee responsible for the management of the contractor(s) while at the site;
- general responsibilities of contractors while at the site;
- general facility safe procedures/practices for entrance, presence at and exit from work areas;
- job-specific contractor education in relevant hazards and safe work practices;
- emergency plan requirements and expected responses in case of an emergency;
- safety record-keeping requirements; and
- ongoing evaluation of safety practices and performance of individual contractors;

## 4.6 Pre Start-up Safety Reviews

The SMS should include procedures for pre start-up safety reviews to ensure that new facilities, plants or processes are checked against safe design, construction and process specifications before operation is allowed to commence. This refers to inspections and checks that are undertaken before bringing a plant on line following downtime for maintenance, breakdown, or other reasons. These procedures should assess the work undertaken during the shut down period, and ensure that all temporary changes are reversed so that the plant is in an appropriate state before operations are commenced. The pre-start-up safety review should be a formal and systematic documented procedure.

### 4.6.1 Scope for the Pre-Start-up Safety Review

Pre Start-up safety reviews should include procedures for confirming in writing that:

- equipment has been fabricated, installed and constructed in accordance with the design specifications, and that the overall facility adheres to the intended design;
- written procedures, including safety, operating, maintenance and emergency procedures are in place;
- all pre-commissioning procedures, including physical inspections and leak and pressure testing, have been completed and the results have been carried out and documented;
- all agreed measures arising out of HAZOPs and other hazard identification studies, as well as other pre-construction and pre-commissioning safety studies, have been implemented;
- new processes and significant modifications to existing processes have been carried out in accordance with the management of change procedures;
- employees have been appropriately involved in the review process; and
- the qualification and training of relevant employees is adequate for safe operation.
- Pre start-up checks and checklists should ensure that the control system has not been corrupted or inadvertently modified during shut down, and that temporary bypasses of trips and other safety equipment are all reversed. They should consider relevant issues such as (but not limited to) the following:
  - Isolation/de-isolation of protective equipment;
  - Drain and vent valve positions;
  - Slip plates and blinds installed/removed;
  - Leak checks;
  - Pressure checks;
  - Ventilation checks;
  - Purging requirement checks; and
  - Insulation checks.

## 4.7 Equipment Integrity

The objective of this element of the SMS is to ensure the facility has a system to monitor and maintain the integrity of the process and all plant and equipment, where failure could contribute to a loss of control, major accident or near-miss. An equipment integrity program should focus on the maintenance of existing plant and equipment as well as ensuring that newly installed equipment meets the design criteria and standards.

### 4.7.1 Scope of Equipment Integrity

The process and equipment integrity systems should specifically take into account identified hazards and their associated risks.

**Note 6: Integrity needs to be maintained at all times**

The greatest challenge to process and equipment integrity often comes outside period of normal operation, such as commissioning, start-up and shutdown.

For this reason the systems need to consider how to ensure integrity through a range of circumstances from initial design, fabrication, installation and construction through to normal operation and shutdown. Tracking and checking of fabrication and installation stages must be included.

Elements to be considered in an equipment integrity program include:

- identification of equipment to be tested/inspected/maintained, such as:
  - pressure vessels;
  - storage tanks;
  - critical piping systems;
  - relief and vent systems and devices;
  - control systems ( monitoring devices, sensors, alarms, interlocks); and
  - emergency shut-down systems;
- identification of 'safety critical equipment' and definition of associated monitoring requirements;
- arrangements for planned maintenance;
- procedures for undertaking equipment repairs;
- documented procedures for maintaining integrity of key equipment;
- skills, experience and knowledge required for maintenance activities;
- frequency of inspection and testing;
- inspection and testing records and documentation;
- monitoring and reporting of equipment defects, faults and degradation;
- maintenance of equipment integrity during periods of construction (particularly when construction is carried out while the facility is operating;
- QA procedures for spare parts; and
- materials and equipment design specifications.

**Note 7: Analysis of trends of maintenance and inspection records**

The ability of an organisation to analyse maintenance and inspection records and recognise trends can strongly influence process integrity. Such analysis may indicate the need to change materials, design of the equipment or change operational procedures. Trend analysis can also provide a valuable basis for decision making in relation to the frequency of maintenance and inspection, and as an effective “early warning” system for potential failures caused by such factors as corrosion and equipment fatigue

## 4.8 Safe Work Practices

Safe work practices need to be defined to ensure that all facility activities are conducted in a manner that will minimise the risk of major accidents or near misses at the facility. Safe work practices extend to all facility activities that could have a safety impact, including process operation, warehousing and storage, maintenance and distribution, and control of staff, contractors and visitors. Safe work practices include an effective and comprehensive Permit To Work (PTW) system.

### 4.8.1 Scope of Safe Work Practices

A system of safe work practices established at the site should be relevant to that site and dependant on the hazards identified. This would include specific checks of the job location in preparation for the work, including isolation of materials and energy sources prior to commencement and at the conclusion of the task, the complete and full reestablishment of conditions prior to handover and operations. Examples of specific work practices include:

- permits and procedures for maintenance and construction, including::
  - hot work;
  - confined spaces;
  - excavation work;
  - use of heavy equipment;
  - tagging of equipment for example, portable electrical equipment;
  - lock out and tag out; and
  - isolation and recommissioning of plant and equipment, including utilities;
- communication of work programs/maintenance status;
- hand-over between shifts
- relieving arrangements;
- supervision of safe work practices;
- procedures for hazardous plant and processes as identified in the Occupational Health and Safety Regulation 2001, such as rigging, scaffolding, cranes and load shifting equipment;
- working at heights procedures;
- classification and definition of hazardous areas;
- internal site traffic control and movement of vehicles; and
- control of access to hazardous areas and processes.

## 4.9 Management of Change

A formal system for the management of change at the facility is required to ensure that changes are not introduced which could inadvertently compromise the safety of the facility and impact on employees, the community, and the environment. This element of the SMS requires the establishment of mechanisms to ensure that proposed technological, facility or organisational changes are reviewed and implemented following strict procedures for identifying the impact on safety, assessing the risk, and taking the necessary action to manage that risk.

The careful, systematic and critical examination of any proposed changes is required to understand their process safety implications. In this context, changes could be organisational, procedural or technical, temporary or permanent. Changes in technology may include process or equipment, introduction of new materials, changes in operating conditions, procedural changes through to adjustments in the order of addition of materials.

**Note 8: Management of Major Projects**

Major projects are often managed by stand-alone teams with a limited interface to operating personnel. It is vital that major projects be recognised as a modification to the facility as a whole, even when no direct modifications are being made to existing equipment. This will ensure that facility safety is not compromised by failure to consider interactions between existing and new equipment and systems.

### 4.9.1 Scope of the Management of Change

There should be formal, written management of change procedures, which should include a clear description of the type and magnitude of changes that will cause the procedures to be invoked. Attention should be given to the handling of major projects.

For each type of change, the procedures should define:

- overall responsibilities for management of change;
- documentation requirements for the proposed change, including:
  - a description of the proposed change and its need;
  - whether the modification is temporary, and if so, its duration, or permanent;
  - the technical, procedural and organisational basis for the change, including the design basis for the change;
  - employee consultation in formulating the proposed change;
  - the identified impact of the change and the basis on which those impacts have been assessed (e.g. HAZOP, formal risk assessment, review of human factors, etc); and
  - any necessary procedural and documentation changes;
- the evaluation and authorisation levels for the various types of change;
- safety reviews which must be carried out before and after the change;
- construction safety;
- procedures for informing/training employees about the change. The training should include:
  - The principles of change management
  - Risk assessment processes (such as HAZOP, FMEA and structured group What-If processes)
  - The facility's specific change management system and procedures, including authorisation procedures.
- mechanisms for updating the Process Safety Information before implementation, including updating Process Flow drawings and Piping and Instrument diagrams, as applicable;
- mechanisms for updating the operating procedures before implementation;
- mechanisms for updating emergency plans and procedures before implementation;
- mechanisms for pre-start-up safety review after the change; and
- mechanisms for keeping up-to-date with legal requirements, new Standards, new technology and industry best practice.

**Note 9: Management of organisational change**

The possible effects of organisational change are often overlooked but are critically important to effective change management within the SMS. Organisational changes may include substitution of personnel, elimination of positions, reduction in staffing levels or changes to lines of reporting and management. These may have adverse effects on safety. Some impacts of inappropriate or unassessed organisational changes include:

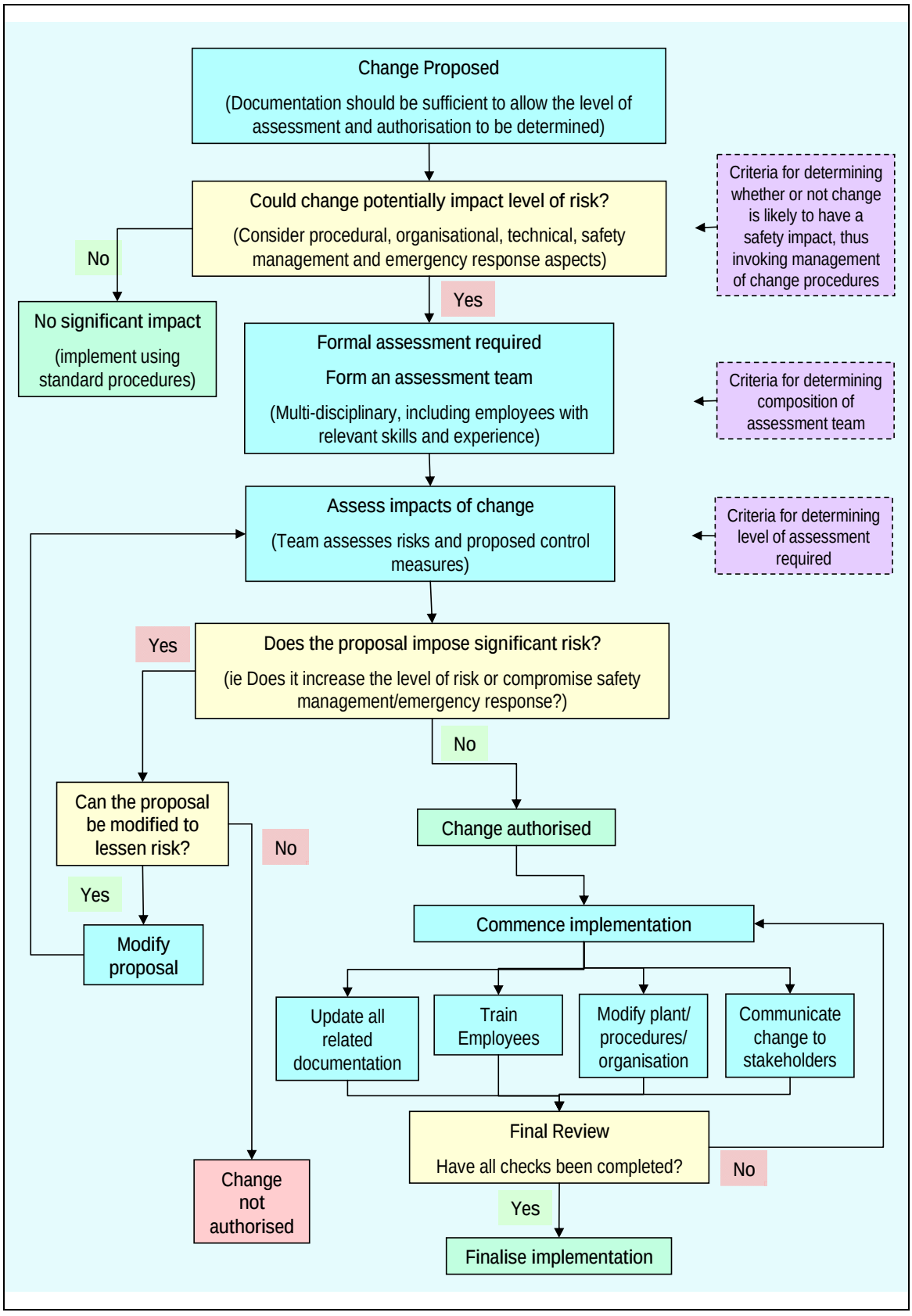
- insufficient people to operate the process safely, particularly during process disturbances;
- people with insufficient skills or experience in the full range of operating modes;
- unclear responsibility and accountability for safety aspects;
- weakening of the organisational safety culture; and
- unworkable emergency procedures

- Management of change should apply to:
  - All capital projects
  - All modifications of existing facilities
  - The design, modification and installation of “vendor package” equipment
  - All changes of operating conditions outside the standard working parameters
  - All instrument changes such as control valve trim adjustments and changes of control parameters, set points and alarm settings.
  - Any maintenance activity that does not involve replacing “in kind” equipment, parts etc.
  - Mothballing, decommissioning, abandonment, demolition and site clean up.
- It is a common good practice to have a change management form that prompts a risk assessment process, provides checklists of possible updates required, as well as requiring signed authorisation by the predetermined technical experts and managers.
- The management of change system should be referenced in other appropriate systems such as:
  - Accident/Incident system so that any accidents/Incidents, related to a change undertaken, result in a review of the change management system.
  - Inspection and maintenance systems, so that recurring problems are identified and appropriate changes initiated in an appropriate way.

Procurement systems for materials and services, so that new or changed materials or services go through the same approval processes.

Figure 4 shows the key elements of the management of change process and associated information flows and decision-making steps.

**Figure 4: The Change Management Process**



# 4.10 Accident/Incident Reporting and Investigation

The primary objective of this element is to contribute to accident prevention through a formal system of prompt reporting and investigation of accidents and near misses, and the dissemination of relevant information. Learning from accidents can greatly contribute to the reduction of risks. An effective system for reporting and investigating accidents and incidents will ensure that corrective actions are implemented to prevent the recurrence of unsafe acts or unsafe conditions.

**Note 10: Reporting incidents and learning the lessons**

There should be a supportive and non-punitive approach to comprehensive reporting of accidents and near misses. Lessons can only be learned from effective investigation, and investigation needs the accident or near miss to have first been reported. A well-developed culture of near miss reporting can be invaluable in preventing major accidents

## 4.10.1 Scope of Accident/Incident Reporting and Investigation

In summary, the system for accident and near-miss reporting investigation should cover:

- procedures for internal and external accident and near-miss reporting, including statutory requirements;
- The reporting procedures should be clearly documented, including appropriate report forms that clearly indicate:
  - Reporting structure (who reports to whom)
  - Reporting time frames (by when) for major accidents, minor accidents and near miss. For example, a major accident may require immediate reporting to senior management and/or external agencies, while a minor accident may be reported through standard weekly or monthly reporting systems.
  - Reporting procedures (communication channels such as standardized reporting forms, regular meetings, computerized systems etc)
- Report formats should be such as to provide appropriate records of the events, with complete information about the events, people involved, plant conditions at the time of the event, and timings. The formats should also guide the identification of immediate causes, such as the substandard conditions and behaviours, and root causes including systems deficiencies and lack of compliance with statutory requirements and standards
- responsibilities and procedures for investigation of accidents and near misses;
- employee consultation during accident and near-miss investigation and follow-up;
- development of skills in accident and near-miss investigation, including root cause analysis;
- establishment of a system for acting on recommendations, including tracking and ensuring the completion of corrective measures;
- availability of accident reports to relevant employees;
- accident and near-miss documentation requirements;
- dissemination of lessons learnt from accidents (internally and externally); and
- procedures for the prompt reporting of investigation outcomes in accordance with statutory requirements.

# 4.11 Training and Education

A comprehensive training program for all employees must be implemented to ensure a minimum acceptable level of employee competence and to develop an appropriate level of process knowledge and understanding. Effective training will ensure that employees are fully aware of the hazards associated with the processes and are competent in the use of adopted control measures. Training will also cultivate a safety culture and reduce human errors that may lead to major accidents.

**Note 11: Training in context**

Training must not be seen as an end in itself. The key objective is to build up, maintain and verify that employees and contractors have the necessary competencies to operate the facility safely.

## 4.11.1 Scope of the Training and Education

To develop and implement an effective training and education program, the following elements need to be addressed:

- develop criteria and processes for recruiting employees and contractors with appropriate skills;
- induction of new employees and contractors;
- properties of dangerous goods handled at the facility;
- plant and process understanding;
- safe working practices;
- detailed plant operation, including:
  - startup and shutdown;
  - normal operation;
  - managing process excursions and abnormal conditions: and
  - emergency conditions;
- practices and procedures for major accident prevention;
- emergency procedures to be followed in the event of a major accident; and
- SMS implementation and responsibilities.

The training should be specifically tailored to the needs of particular groups of employees and be regularly monitored for effectiveness. Records of all training carried out should be kept.

The Operator must, consistent with guidelines and appropriate to the hazards and risks at the facility, develop appropriate competency standards for key positions.

The Operator should ensure steps are in place for:

- establishing and monitoring employees' understanding of the process(es);
- maintenance and monitoring of competencies, linked to refresher training as required;
- training of managers and supervisors;
- training of engineers and other professionals;
- specialised training for OH&S and Risk professionals;
- training all people that have specific OH&S or SMS responsibilities for example emergency controllers, internal inspectors and auditors;

- training of office and other support staff in basic safety working and emergency procedures;
- evaluating external and internal training and trainers. As far as may be practicable, experienced employees and leaders are trained and used as trainers
- developing new or modifying existing courses;
- maintaining training record documentation;
- setting competencies for key positions or tasks;
- ensuring established competencies are actually met; and
- employee consultation is establishing and meeting training needs.

**Note 12: Training required at all levels**

Professional or trade qualifications are often mistakenly thought to be a substitute for training. All employees, irrespective of their qualifications need to be able to demonstrate competencies that match the specific requirements of their duties at the facility. The competencies of all people at the facility should be regularly evaluated as part of a program of training that will develop and maintain the relevant competencies.

## 4.12 Procurement

An excellent opportunity to control workplace losses resulting from substandard equipment, materials, and services exists at the time of procurement. The facility should have systems in place to ensure that purchasing related hazards are controlled prior to goods and services being delivered to the site.

Procurement of new equipment, materials and services should be captured under the Management of Change element (see 6.9), and as such these two systems should be cross referenced in this regard. Written procedures should exist for purchasing new chemical substances, machinery/equipment, and services.

### 4.12.1 Scope of Procurement

The facility's overall procurement system should include:

- Procedures to ensure that suppliers provide all relevant safety information about their products including the provision of Material Safety Data Sheets (MSDSs). The system should also ensure that suppliers are aware of the relationship between their products or services and the hazards associated with the processes of the facility.
- The purchase procedures for all supplies and services critical to the nature of the facility's business should ensure that purchase documents contain, where applicable:
  - Precise identification of product/service to be delivered.
  - Product acceptance criteria.
  - Specific references to drawings, specifications, standards etc, which should be used as part of the contract.
- Specific reference to approvals and/or qualifications of product, processes, equipment or personnel, including appropriate verifications where relevant.
- Appropriate methods of receipt, storage, transfer, handling and waste disposal for all materials procured (where relevant).
- Types and size of containers or packaging.
- Records of quantities of chemicals and other hazardous substances are maintained.

- Checking compliance of delivered products and services to procurement specifications.
- Documentation, segregation and disposal of nonconforming products.
- Provision of safe storage and handling facilities for all hazardous materials and equipment.
- An inspection system for all materials and equipment stored, to ensure that these are not issued in a deteriorated or unserviceable condition.

## 4.13 Emergency Planning

Emergency planning is essential to allow people at the facility to appropriately respond to accidents and to mitigate their effects. The operator of the facility must prepare an Emergency Plan to address the on-site and off-site consequences of major incidents and to help in limiting the damage caused by an accident to people, property and the environment.

Emergency planning is dealt with in detail in HIHAP No. 1 – *Emergency Planning*.

### 4.13.1 Scope of Emergency Planning

The main requirements for emergency planning at a facility are summarised below:

- There must be a formal on-site emergency plan. It must cover:
  - definitions of what constitutes an emergency for the purpose of invoking the plan;
  - type of emergencies and their extent;
  - defined roles and responsibilities during an emergency;
  - arrangement for providing early warning of a major accident and internal communication arrangements;
  - arrangements for an emergency control centre that is appropriately resourced;
  - arrangements for the notification of emergency services and other relevant public authorities;
  - arrangements for the notification of neighbours;
  - procedures for the evacuation of, and accounting for, employees on site and the location of assembly points;
  - alarm systems for site notification
  - response actions to control and contain accidental releases;
  - arrangements for providing assistance to the emergency services;
  - resources available, and their location, for the early response to an emergency; and
  - arrangements for training of personnel in emergency procedures.
- There should also be an off-site emergency plan, developed in collaboration with the Local Emergency Management Committee (LEMC), and covering:
  - defined roles and responsibilities during emergencies with off-site impacts;
  - arrangements for warning systems and off- site notification;
  - arrangements for coordinating activities and resources for off-site emergency response;
  - arrangements for providing assistance to, and cooperating with, emergency services;
  - arrangements for off-site actions to mitigate the impact of the accident;

– arrangements for the provision of information to the public and the neighbours.

The scope of emergency planning also incudes:

- employee consultation in plan development, testing and revision;
- emergency exercises and drills for major accidents;
- emergency exercises for minor specific accidents (minor spill, gas release, localised fire, confined space rescue);
- testing of fire fighting systems and equipment;
- procedures relating to the emergency management of visitors on site; and
- procedures for managing, reviewing and amending the plan document, including the currency of lists of contact names and numbers and incorporating lessons learned from drills, accidents/incidents at the facility or from external sources.
- procedures for review and amendments of the plan as part of the procedures for management of change.

For detailed requirements and guidelines for emergency planning, please refer to Hazardous Industry Advisory Paper No 1 – *Industry Emergency Planning Guidelines.*

## 4.14 Security and Access Control

Operators should ensure that systems and facilities are in place to monitor and control security and legitimate access to the site, as well as to prevent all forms of non-legitimate access to the site. Operators should pay particular attention to the physical security of the facility, chemical storage areas, and chemical processes. All facilities should have appropriate security in place to minimise crime and to protect people, property and the environment. This is especially true for facilities that handle extremely hazardous substances, or that operate high hazard processes, or store and handle materials that can be used in criminal activities.

Threats may come in different forms and from different sources. Threats from outside the facility could affect people and the facility itself, and may involve trespassing, unauthorised entry, theft, burglary, vandalism, bomb threats, or terrorism.

Threats from inside the facility may arise from inadequate designs, management systems, staffing or training, or other internal problems. These may include theft, substance abuse, sabotage, disgruntled employee or contractor actions and workplace violence.

**Note 13: Physical security, materials security and information security**

Threats are not restricted to people and property, but could also involve sensitive facility information. Both facility outsiders and employees or contractors could pose threats to data storage and data transmission of, for example, confidential information, privacy data, and contract information. They could also pose a threat to computer-controlled equipment. These threats may include breaches in data access and storage, uncontrolled dissemination of information, destruction of information or threats to automated information systems.

In establishing a security program, operators should consider the following:

- Best practice in maintaining secure facilities is by developing and implementing a Security Plan
- Consistency with the Security Plan provisions for high consequences dangerous goods proposed by the United Nations, where applicable to fixed facilities; and
- Integration of the facility security program with the facility's Environmental and OH&S program.

### 4.14.1 Basic Security Requirements

The basic security requirements for a facility should be as follows:

- the Operator should take all practicable precautions to protect against action from unauthorised persons.
- Security should be considered for all elements that affect safe operation e.g. plant safety, documentation and IT;
- the Operator should control access of all persons at all times.

### 4.14.2 Integrating Security Management with the Facility's Safety Management System

Security Management shares many commonalities with existing Process Safety Management and other Environmental and OH&S programs. When implementing PSM and EHS programs, security is an essential element that needs to be integrated into these programs. Similarly, when implementing a security program, the impact of security aspects on the safety and environmental performance of the plant need to be addressed.

For example, the loss of control of a process and the release of a large quantity of a hazardous material could be as a result of an operational failure or a malicious act. In both cases, the consequences of the release may be the same, mitigation measures are the same and response plans are also the same. As a result, it would be beneficial to integrate the management, allocation of responsibilities of both aspects. Ideally, hazard identification, accident/incident investigation, monitoring and review tasks of a given process should also incorporate issues relevant to security related vulnerability.

Table 3 highlights the commonalities between Process Safety Management (PSM) and Security Management:

**Table 3: Management of Process Safety and Security**

| P S M | Security |
|---|---|
| Hazard Identification & Risk Assessment & Risk Control | Vulnerability analysis, identifying counter measures for the prevention of security breaches. |
| Process & Equipment Integrity | Testing and maintenance of security critical equipment, such as fences, closed circuit TV, etc... |
| Training & Education | establishing competency standards for security related positions, training of security personnel and incorporating security aspects training for all employees. |
| Management of Change | Any changes to security arrangements, equipment or procedures need to be controlled by MOC procedures, as applicable to process, technology or materials changes. |
| Accident Investigation | Investigating security related incidents, identifying the root causes and corrective actions and documenting and disseminating lessons learned. |

| P S M | Security |
|---|---|
| Emergency Planning | Need to liaise with emergency services and law enforcement agencies, identification of necessary resources and the need for notification procedures. |
| Managing Contractors | Security screening of contractors as well as their OH&S performance and monitoring and controlling their activities at the site. |

## 4.14.3 Development of a Security Plan

#### 4.14.3.1 What is a Security Plan

A Security Plan is a document that identifies the organisation's security policy and procedures, establishes roles and responsibilities and details a program for the prevention of, preparedness for, response to and recovery from a security breach.

As with an emergency plan, the security plan must be linked to, and based on the vulnerability analysis undertaken and the specific vulnerabilities identified. The security Plan is continuously monitored, regularly tested, audited and reviewed.

#### 4.14.3.2 Criteria for an effective Security Plan

- Focus on prevention by reducing the vulnerability of the facility to security breaches to complement response
- Comprehensive and integrated with the facility management system
- Systematic identification of security scenarios and linkage to critical vulnerabilities and protective counter-measures

#### 4.14.3.3 Elements of a Security Plan

- Specific allocation of responsibilities for security;
- Assessment of operations and vulnerabilities;
- Implementation of control and counter measures including policies, operating procedures, equipment and resources to reduce security risks;
- Procedures for reporting and responding to security threats;
- Procedures for the evaluation and testing of security plans for periodic review and revision

## 4.14.4 Scope of Security and Access Control

An effective security and access control system at a facility should address the following:

- A comprehensive and integrated Security plan must be developed for the facility

- An appropriate survey, or security vulnerability analysis (SVA), should be conducted to consider the extent of the needs for security measures, systems, and for services that may be required. This survey should include:
  - the identification of all information, materials, products and equipment etc that may be a security risk;
  - the proper on-site and off-site storage of these materials and products;
  - the delivery, site transport, and off site transport;

– the identification of individuals who have legitimate access to the above, and how this is controlled.

**Note 14: Identifying and analysing potential vulnerabilities**

The first step in managing security issues at a facility is to identify and analyse the potential vulnerabilities of the facility. To assist in that respect, the following questions have been proposed: *

- What specific threats does the site face that might lead to a catastrophic event?
- What factors exist that might lead {someone} to find a particular target more attractive than another?
- What vulnerabilities in the security system could be exploited to undertake an attack?
- How significant could the effects of the incident become?
- Are existing countermeasures sufficient given the threat?
- What enhanced countermeasures are appropriate?
- At what point is supplemental security provided under federal or state auspices required?

** (source: CCPS: "Guidelines for analysing and managing the security vulnerability of fixed chemical sites" – August 2002)*

- Security system requirements should be clearly defined for all roles in an organization. This is particularly important for leadership roles, and they should be included in both site training and induction programs, for both management and employees, to a degree appropriate for the roles and responsibilities of the individuals.

  Human resources and procurement systems and procedures should include:

  – employee screening
  – media communications and information control
  – contractor and contracting security
  – vendor selection
  – loss reporting (internal and external), investigation and records
- Employee consultation is an integral part of developing and maintaining effective security arrangements.
- Security system inspections and audits

#### 4.14.4.1 Legitimate Safe Access Control

The facility should consider developing systems and facilities to provide and control appropriate safe access to the site such as the following:

1. Vehicle access systems such as:
   – Physical entry controls (e.g. booms, gates and fences)
   – Safe routes signposted within the facility
   – Speed limitation
   – Safe parking
2. Employee access systems such as:
   – Employee identification systems
   – Turnstile entry with computer records
   – Induction system for unaccompanied access

  - Accompanied access for non-inducted people
  - Security monitoring

3. Contractor and visitor access systems with specific considerations given to various classes of contractors such as:
  - Full time on-site contractors (similar to employees)
  - Regular contractors e.g. technicians, engineers (should consider specific relevant induction)
  - Occasional or “one time” contractors and visitors (should consider accompanied access only)

#### 4.14.4.2 Prevention of Non Legitimate Access (Security)

The facility should have security systems that prevent both intentional and unintentional non legitimate access to the site. As a minimum, the following should be considered:

- Perimeter fencing
- Minimizing and guarding access points
- Gates or booms at roadway access points
- Gates or turnstiles for pedestrian access
- Signposting access restrictions
- Security lighting
- Incident reporting system

Sites whose materials or products have high intrinsic value, or have special significance to terrorists, to criminals intending to carry out prohibited activities, should also consider more sophisticated systems such as the following:

- Video monitoring of all boundaries
- Proximity sensing and monitoring
- Full time trained security staff
- Communication connections to Emergency Services and Law Enforcement agencies.

#### 4.14.4.3 Limiting Damage

In addition to protecting a facility from intruders, it is important to limit the damage that an intruder (whether physically at the site or "hacking" into the company's computers) or an employee could do. Most of the steps to limit damage are part of good process safety management, because they also limit the loss of chemicals if management systems or equipment fails or an employee makes a mistake. These steps can be related to either the design of the facility and its processes or to procedures implemented.

***Facility Design***

A well-designed facility, by its layout, limits the possibility that equipment will be damaged and, by its process design, limits the quantity of chemical that could be released. Facility and process design (including chemicals used) determine the need for safety equipment, facility security, buffer zones, separation distances to boundaries and mitigation planning. Eliminating or attenuating to the extent practicable any hazardous characteristic during facility or process design is generally preferable to simply adding on safety equipment or security measures.

***Procedures and Policies***

The facility's policies and procedures can also limit the damage caused by a release. As with design issues, the procedural steps routinely taken to operate safely also help protect the facility from attacks. Open negotiations, workplace policies emphasising that violence and substance abuse are not tolerated, and adequate training and resources

to support these policies are important considerations. The goal is to develop a workforce and management capacity to identify and solve problems by working together.

**Note 15: Hazardous Materials Transportation Security**

While the scope of this advisory paper is limited to potentially hazardous facilities, the issue of security and vulnerability of hazardous materials transportation from, and to, the facility must also be addressed in any vulnerability analysis.

Further information on Facility Security and Access Control may be obtained from:

- Reference No 1: American Chemistry Council (2001): Site Security Guidelines for the US Chemical Industry.
- Reference No 6: Centre for Chemical Process Safety (CCPS) (2002): Guidelines for Analysing and Managing the Security Vulnerabilities of Fixed Chemical Sites.
- Reference No 8: Intelligence Outcomes Group Pty Ltd (2003) Tool for the Critical Infrastructure Risk Management (available through the NSW State Emergency Management Committee – SEMC)

## 4.15 Auditing of the Safety Management System

An audit program provides independent assurance of the integrity of both the safety management system and the technical elements of process safety management within that SMS. An effective audit program will help ensure that all the management and technical elements of the SMS are in place and are functioning effectively.

The main objective of this audit program is to establish procedures for the periodic monitoring, regular auditing and review of the SMS and its operation to ensure that it functions effectively, and to identify possible changes for improved performance.

**Note 16: Audit independence**

Audits should be carried out by appropriately trained and experienced people who are independent of the system being audited. This means people who are outside the span of control of the employee responsible for the procedure or system being audited. For individual SMS elements, the auditing could be carried out by facility employees who do not have direct responsibilities linked to that element. However, when the SMS as a whole is being audited, the auditor should be independent of the facility

### 4.15.1 Scope of Auditing of the SMS

An effective audit program should meet the following criteria:

- audits should be carried out by an independent person or persons;
- audit results should be reported to a higher level of authority than the person responsible for the system or element being audited;
- audits should be planned according to a systematic schedule that determines both their frequency and scope;
- audits should primarily focus on those elements that are most critical to the success of the system as a whole.
- The effective auditing of the SMS and its operational aspects should include regular in-depth audits that critically examine all levels of the SMS, including:
  - the overall management of the system and the robustness of its implementation;
  - the technical adequacy of the system in relation to 'fit-for-purpose' criteria; and
  - the compliance aspects of the system in relation to the match between actual operation of the SMS and its elements and the system documentation.

- The audits should pay particular attention to:
  - systems and procedures critical to safe operation of the facility;
  - systems for ensuring that plant, equipment and associated technical controls are adequate for safe operation;
  - systems for minimising the consequences of accidents and near misses; and
  - systems for ensuring that all employees have the necessary competencies required for safe facility operation.
- Audits should incorporate an effective system of performance measurement, using qualitative and quantitative techniques for performance rating and benchmarking against best practice.

In addition to the comprehensive audit of the whole Safety Management System, there should be periodic and random sub-system audits of key elements or a component of the system to provide ongoing assurance.

Refer to HIPAP No 5: *Hazard Audit Guidelines* for further detailed information on the auditing program.

# 5 Safety Assurance

**SECTION SUMMARY**

A low accident rate is not necessarily synonymous with effective safety management, since major accidents are statistically unlikely. This section covers system elements designed to ensure the ongoing relevance and integrity of the SMS. Important aspects are:

- systematic programs for monitoring and measuring performance of safety-related systems (includng the SMS itself) against targets;
- programs for investigating non-conformances and taking corrective action; and
- periodic audits and management reviews of the integrity of the SMS

**KEY MESSAGE**

- Safety assurance is a product of an effective SMS that is regularly monitored, updated and audited.

## 5.1 Introduction

A low incident rate over a period is no guarantee that risks are being effectively controlled at a facility. The probability of a major accident may be low but the consequences may be extremely serious. Arrangements for proactive monitoring are therefore essential for operators of potentially hazardous facilities. Operators should implement and maintain procedures to ensure that safety performance is monitored and compared with the objectives set by the SMS. This section sets out to describe the main SMS activities that can be classed as checking, monitoring and corrective controls. These are:

- Monitoring and measurement
- Incident and nonconformity investigation
- Safety auditing
- Corrective and preventive action

## 5.2 Monitoring and Measurement

An organization should have a systematic approach for measuring and monitoring performance against planned arrangements which include policy, safety critical operational controls, SMS objectives and targets, on a regular basis. Measurement and monitoring activities provide data and information about the organization's safety performance, including:

- performance of the SMS;
- monitoring equipment, data quality assurance and system requirements
- monitoring compliance to applicable regulations, codes and standards
- monitoring of performance against set objectives and targets.
- performance with respect to the commitments in the facility safety policy and internal performance criteria

An essential part of the facility SMS is to constantly monitor the system and follow-up on issues that are raised. Measurement provides a clear indication of performance against specified targets, aims and objectives. The monitoring process should measure the control aspects; measurements of outputs alone have limited value.

Facilities must determine what management controls need to be measured and what purpose the measurement will serve in the achievement of desired goals. The timely measurement and evaluation of work performed to standards provides management (at all levels) with information needed to correct performance and produce desired results. This measurement, more than any other, applies the principles and skills of professional management.

Monitoring activities within the facility SMS should include the systematic inspection of premises, plant, equipment, instrumentation and control systems which are important in relation to major accident prevention and mitigation, to ensure the ongoing effective application of risk controls. Monitoring activities should also include systematic observation of the work and activities of employees and contractors to assess compliance with the procedures, standards and rules which the facility SMS has deemed safety critical. Operators should also determine the need to carry out periodic quality assessments of the monitoring work that is being carried out under the SMS.

To ensure that the SMS is working effectively, operators of the facility should carry out periodic checks on a wide range of activities at the facilities. Some of these include:

- Isolation procedures
- Work procedures
- Lifting equipment certification
- Location and condition of safety equipment
- Personnel training
- Fire fighting/rescue systems
- First aid/medical equipment
- Materials leaks and releases
- Accidents/incidents records
- Personal protective equipment
- Locked open/locked closed valve register
- Interlock override register
- Material Safety Data Sheets

## 5.3 Incident and Non-conformity Investigation and Corrective and Preventive Action

Operators should implement systematic mechanisms to find and correct problems. The philosophy of "learning from mistakes and the mistakes of others" is central to this activity. Incidents relating to safety and the breakdown of management system activities such as planning, reporting, monitoring or review should be treated with corrective and preventive actions.

Nonconformity may be defined as a non-fulfilment of a requirement of the SMS including policies, standards and procedures such as a part of the system not functioning as intended. The facility should have a clear and defined process within the SMS for identifying nonconformities and developing and taking corrective and preventive action. The key management roles and responsibilities with respect to these activities should be defined. Such a process would draw from the following sources:

- Incident and accidents
- Inspections and observations
- Maintenance activities
- Audits

- Improvement suggestions
- Stakeholder feedback
- Hazard Reports and Risk Assessments

Once an instance of nonconformity is identified it should be investigated to determine the cause, so that action can be focused on the SMS. When planning action the facility should consider:

- mitigation
- correction of the situation and the elimination of causes
- prevention of recurrence

The type of such actions should be appropriate to the nature and scale of the nonconformity. The Operator should ensure that corrective and preventive actions are implemented and that there is systematic follow-up to ensure their effectiveness.

When actions taken result in changes to the SMS, the process should ensure that all related documentation, training and records are updated and approved and that changes are communicated to all who need to know. Clear allocation of resources for the completion of actions and the management responsibilities and accountabilities necessary for their control must also be addressed. Treatment of the basic causes of non-conformance is critical to the implementation of successful completion of corrective actions and preventive actions.

## 5.4 Safety Auditing

Audit activities involve the verification of performance of the SMS against the standards and planned arrangements of the facility. Audit is the non-routine but frequent process of checking that the overall established SMS is understood and is being used and that the management framework is being implemented and is effective. It should be noted that some operator's use the term "auditing" to refer to activities such as safety tours, physical conditions inspections and behaviour observation carried out by line managers as part of their active performance monitoring activities. These types of monitoring activities address some aspects of the SMS but do not involve the fundamental assessment of the validity and reliability of the SMS itself.

In general there are three main types of audit activity that may be utilised by the facility. These are 1st, 2nd and 3rd Party audits. 1st Party audits are carried out internally by facility employees and are based on assessing compliance of the facility SMS against the policies and standards of the facility. 2nd Party audits are carried out by organizations on their suppliers and 3rd party audits are carried out by external agencies such as regulators or certification bodies and are completely independent of the facility. Audits are essential in assessing the level of implementation of the SMS and its effectiveness and the following notes refer to the auditing carried out by the Operator, which are 1st Party audits.

The SMS should emphasize the valuable role of internal auditing and the presentation of objective and factual evidence to senior management for system review and improvement activities. Audit principles and systems should allow benchmarking of SMS performance over time or across operations. Auditing involves the following processes:

- Audit planning and scheduling
- Audit preparation
- Audit conduct including document and record verification, interviews and tours
- Audit reporting and follow up

The frequency of audits should be guided by the nature of the facility operation in terms of its major hazards and the controls in place to prevent major accidents. The results of previous audits should be considered in determining audit frequency. A clear

demonstration of such a risk based approach to auditing should be evident in the audit schedule of the facility. Preparing for an audit requires timely communication of audit requirements to all auditees within the facility. Careful planing of resources in terms of timing of meetings and interviews locations, records, SMS information and data and access to areas of the facility needs to be made. Procedures for the approved conduct of SMS audits should be developed by the facility. Such information should include:

- roles and responsibilities for auditors audit teams and auditees
- definitions for audit findings such major and minor non-conformities and observations
- verification standards,
- audit trail development
- sampling techniques
- opening and closing meetings
- audit reporting

The SMS should cater for the training requirements relating to the completion of audit activities. Both quality control and quality assurance are necessary as part of these processes and require defined technical understanding of operational processes and risk, system knowledge and interpersonal skills. Procedures should be developed that define the planned arrangements for the processes listed above. The SMS must also provide support for the documentation and communication of audit findings. In practice this means the provision of audit report templates, audit schedules, corrective and preventive action reports, action tracking registers and forums for the communication and review of audit findings.

## 5.5 Management Review

This activity enables the closure of the continual improvement loop. The management review process should:

- identify the key systems and operational processes and their continued suitability.
- assess system and operational control performance using a complete suite of performance monitoring and safety management systems
- review the facility safety policy for adequacy in light of risk management activities, operational change and system improvement.

The intention of the reviews is for management with executive responsibility of the facility and the SMS to confirm periodically the continuing suitability and effectiveness of the management system. A number of key inputs and outputs can be identified as being crucial to the successful completion of the management review process. Reviews should be carried out at least annually. Inputs for the management review process should include:

- follow up actions from previous management reviews;
- performance levels compared against established performance standards and the OH&S policy;
- implementation of the safety management system based on audit results;
- monitoring results;
- opportunities for improvement
- incident investigations
- specific recommendations arising from audit reports
- specific recommendations arising from inspections
- training needs assessments

- monitoring of safety critical controls
- employee suggestions
- legislative change

Outputs for the management review process should include decisions and actions on:

- improvement of the effectiveness of the safety management system and its processes
- improvement of major hazard controls and accident prevention
- resources needed to take action

Management review thus becomes the process that collects data and makes decisions with respect to the safety management system and key safety critical controls. It provides the Operator with formal and systematic opportunities to learn about the effectiveness of the systems in place. Action plans that reflect lessons learned provide a meaningful and effective basis for continual improvement of the SMS.

# Appendix 1

## Typical SMS Elements Relevant to Potentially Hazardous Facilties

It should be noted that the following list does not represent a comprehensive range of SMS topics but rather those aspects that are likely to have a bearing on major hazards control.

1. **Management Aspects of the SMS**
   - Safety Management Policy
   - Objectives
   - Roles and responsibilities for implementation
   - Consultation
   - Records and documentation management
   - Performance targets
   - Reviews and audits

2. **Hazard Identification and Risk Assessment**
   - All hazards identified for the design, commissioning, operation, modification and decommissioning phases.
   - Using established techniques for Hazard Identification and Risk Assessment.
   - Based on detailed description, knowledge and understanding of the facility.
   - Takes into account facility locational and land use factors.
   - Takes into account human factors hazards

3. **Operating Procedures**
   - Documented procedures for all phases of operation
   - Start-up shut down and emergency shut down procedures.
   - Safe operating limits
   - Critical Operating Parameters
   - Authority and procedures for corrective actions
   - Procedures for operating safety critical equipment

4. **Process Safety Information**
   - Information about materials, process, technology and equipment
   - Design basis and limits
   - Details of safety critical equipment
   - PIDs and ELDs
   - Monitoring process parameters
   - Documentation and updating of information
   - Enhancement of competencies

5. **Managing Contractors**
   - Contractor selection criteria
   - Site Induction
   - Responsibility for contractors management on site
   - Safety procedures while on site
   - Job specific training and safe work practices.
   - Emergency response procedures
   - Evaluation of safety performance

**6. Pre-Start up Review**

- QA of design specifications
- Up to date procedures
- Pre-commissioning testing
- HAZOPs carried out
- Implemented in accordance with MOC procedures
- Employees consultation
- Relevant qualification and skills of employees

**7. Equipment Integrity**

- Identification of all equipment and systems requiring testing and maintenance
- Testing of safety critical equipment
- Arrangements for planned maintenance
- Procedures for undertaking repairs
- Maintenance of skills of personnel
- Frequency of testing and maintenance
- Testing and maintenance records management and analysis.
- QA on parts, materials and design specifications.

**8. Safe Working Practices**

- Work permits system
- Communication of work program
- Hand-over between shifts
- Relieving arrangements
- Special work procedures (rigging, scaffolding, cranes, working at heights, confined spaces, etc.)
- Identification and classification of hazardous areas.
- Access control to hazardous areas and processes.

**9. Management of Change**

- Responsibility for proposing and authorising change
- Documentation of proposed change
- Safety review, hazard identification and risk assessment of change
- Procedures for informing and training employees about the change
- Updating PSI, Ops, PIDs and ELDs
- Keeping up to date with standards, codes, new technology, etc.

**10. Accident/Near-miss Reporting and Investigation**

- Internal and external reporting mechanisms
- Responsibilities and procedures for accident investigation
- Employee consultation
- Training and skill development in accident investigation
- Mechanisms for acting on and tracking completion of recommendations
- Recording and documentation of accident and investigation results
- Dissemination of lessons learnt
- Mechanisms for reporting of accidents to authorities

**11. Training and Education**

- Procedures for recruitment of qualified personnel
- Induction training
- Competencies relating to materials, technology, the process and equipment
- Emergency response training

- SMS roles and responsibilities
- Monitoring and review of level of understanding
- Refresher training
- Training of engineers, supervisors and managers
- Specialised OH&S and Risk Assessment training
- Training of office and support staff
- Evaluation of internal and external training courses
- Maintaining training records
- Setting relevant competencies
- Employees consultation

**12. Procurement**

- Procedures for obtaining safety information for materials, plants and services purchased.
- Records of quantities of materials purchased and stored
- Safe storage and management of purchased raw materials and finished products.
- Compliance of purchase products and services with specifications.

**13. Emergency Planning**

- On-site and Off-site Emergency Plans
- Definition and classification of emergencies
- Defined roles and responsibilities
- Early warning system and internal communications
- Arrangements for notification to local emergency services and other authorities
- Arrangements for notification of neighbours
- Evacuation procedures and accounting for personnel
- Alarm systems
- Response actions for different scenarios
- Arrangements for assisting emergency services
- Availability and location of resources
- Training in emergency response
- Arrangements for communicating with the public and the media
- Consultation with employees, emergency services and the community
- Exercises and drills
- Testing of fire fighting equipment
- Managing visitors safety during emergencies
- Reviewing and amending the emergency plans

**14. Security**

- Access of unauthorised personnel to the site
- Protection of the site boundary
- Protection documents, computer software and hardware
- Security of equipment and systems
- Security of materials and inventory control

**15. Auditing**

- Checks of adequacy of SMS against 'fit-for-purpose' criteria
- Verification of overall management of the SMS and its implementation against documented requirements
- In-depth review of systems critical to safe operation (hardware, procedures and competencies)

- Sampling checks for testing and verification
- Qualitative and quantitative performance measures and benchmarking.

# Definitions

**Community**

*a. Persons who reside in; and*

*b. persons who are owners or managers of land in; and*

*c. persons in management and control of workplaces, or of places where persons gather for recreational, cultural or sporting purposes in;*

*the area within which a major accident may cause harm.*

*In determining the extent of this area, the operator of a major hazard facility must consider the area defined by the emergency plan for the facility and the area included in the emergency services evacuation plan, and choose whichever is greater.*

**Emergency Services**

*Any combat agency identified in the NSW State Disaster Plan and includes but is not limited to the:*

*a. Ambulance Service of New South Wales,*

*b. Fire and Rescue NSW,*

*c. NSW Rural Fire Service,*

*d. Police Service,*

*e. Roads and Traffic Authority,*

*f. State Emergency Service,*

*g. Environment Protection Authority,*

*h. New South Wales Volunteer Rescue Association Incorporated.*

**Environment**

*Components of the earth, including:*

*a. land, air and water, and*

*b. any layer of the atmosphere, and*

*c. any organic or inorganic matter and any living organism, and*

*d. human-made or modified structures and areas,*

*and includes interacting natural ecosystems that include components referred to in paragraphs (a)–(c).*

**Facility**

*The whole area under the control of an operator upon or within which a potentially hazardous activity takes place.*

**Hazard**

*An intrinsic property of a material or a physical situation with the potential to cause harm to people or the environment.*

**Incident**

*All undesired events, including major accidents and near misses.*

**Major Accident**

*An occurrence (including a major emission, loss of containment, fire, explosion or release of energy or projectiles) resulting from uncontrolled developments in the course*

*of the operation of a facility and leading to serious danger or harm, whether immediate or delayed, to people or the environment.*

**Modification**

*Modification to a facility, means any:*

*a. change to plant, processes, materials, operating conditions, operating procedures or quantities of materials;*

*b. introduction of new plant, processes, materials, operating conditions, operating procedures or quantities of materials; or*

*c. change to the safety management system, in particular, organisational change;*

*that may alter the likelihood, extent or severity of a potential accident at the facility.*

**Near Miss**

*Any occurrence which, but for mitigation effects, actions or systems, could have escalated to a major accident.*

**Operator**

*An employer, occupier or person who has management or control of a facility.*

**Risk**

*The likelihood of an undesired event with specified consequences occurring within a specified period or in specified circumstances.*

**Safety Management System**

*The organisational structure, responsibilities, procedures and resources for implementing safety management.*

# References and Bibliography[1]


1. American Chemistry Council (2001): Site Security Guidelines for the US Chemical Industry.
2. American Institute of Chemical Engineers, Center for Chemical Process Safety (1994): Guidelines for Implementing Process Safety Management Systems.
3. American Petroleum Institute (1990): API RP750, Management of Process Hazards.
4. API Publication 9100, Model Environmental Health and Safety Management System and Guidance
5. AIChE, CCPS, Plant Guidelines for Technical Management of Chemical Process Safety.
6. AIChE, Centre for Chemical Process Safety (CCPS) (2002): *Guidelines for Analysing and Managing the Security Vulnerabilities of Fixed Chemical Site.*
7. Health and Safety Executive HSG65, Successful Health and Safety Management
8. Intelligence Outcomes Group Pty Ltd (2003) *Tool for the Critical Infrastructure Risk Management* (available through the NSW State Emergency Management Committee – SEMC)
9. ISO 9004:2000, Quality Management Systems – Guidelines for Performance Improvements
10. ISO 14004:1996, Environmental management systems — General guidelines on principles, systems and supporting techniques.
11. Kenney, W.F. 1993, Process Risk Management Systems, VCH Publishers Inc.
12. Lees, F.P. 1996, Loss Prevention in the Process Industries, 2nd edn, Butterworth-Heinemann
13. Office of the Australian Safety and Compensation Council, National Standard for the Control of Major Hazard Facilities [NOHSC:1014(2002)] – October 2002
14. UK HSE (1998): HSG65, Successful Health and Safety Management.
15. Standards Australia, Occupational health and Safety Management Systems – Specifications with guidance for use – AS 4801.
16. U.S. Department of Labour, OSHA guidance 3132/3133, Process Safety Management
17. US Department of Labour. OSHA Standard CFR 29 1910.119, Process Safety Management.
18. WorkSafe Victoria Major Hazards Division, MHF Regulations Guidance Note 12, Safety Management Systems.


[1] These are in addition to the Departmental publications listed at the end of this guideline.

# Additional Information

## Relevant DoP Publications

### Hazardous Industry Planning Advisory Papers (HIPAPs):

No. 1 - Emergency Planning
No. 2 - Fire Safety Study Guidelines
No. 3 - Risk Assessment
No. 4 - Risk Criteria for Land Use Safety Planning
No. 5 - Hazard Audit Guidelines
No. 6 - Hazard Analysis
No. 7 - Construction Safety
No. 8 - HAZOP Guidelines
No. 9 - Safety Management
No. 10 - Land Use Safety Planning
No. 11 - Route Selection
No. 12 - Hazards-Related Conditions of Consent

### Other Publications:

Applying SEPP 33: Hazardous and Offensive Development Application Guidelines

Multi-level Risk Assessment

Locational Guideline: Liquefied Petroleum Gas Automotive Retail Outlets

Locational Guideline: Development in the Vicinity of Operating Coal Seam Methane Wells

Electronic copies of some of these publications are available at:
**www.planning.nsw.gov.au**