

Process Safety Management Seminar - APCChE 2012

Singapore's Approach to Process Safety Management

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MINISTRY OF
MANPOWER

A Great Workforce A Great Workplace

Presentation Outline

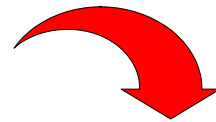
1. Development of Process Safety Management
2. Regulatory framework to engender the adoption of Process Safety Management
3. The way forward
4. Concluding Remarks

Process Safety Management

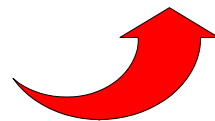
- A holistic management of process safety to prevent process incidents and mitigate their consequences
- The application of management principles and systems to identify, understand and control of process hazards to protect employees, facility assets and the environment.

Development of Process Safety Management

Impetus for the development of Process Safety Management worldwide



Many authorities worldwide re-examine the Management of Process Safety

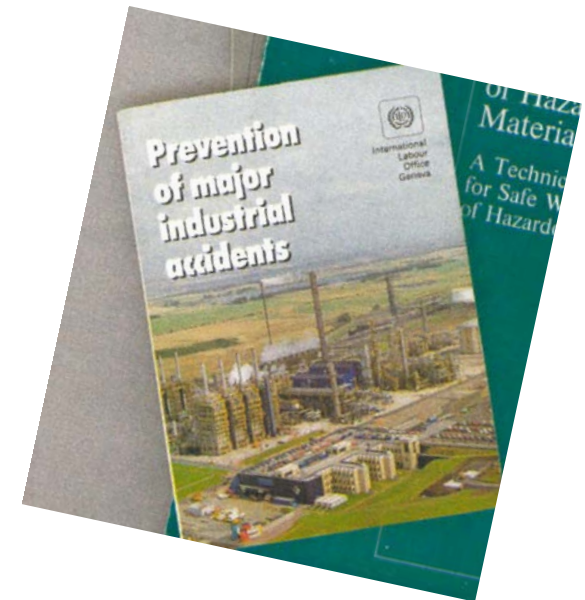


Development of Process Safety Management



International Labour Organisation (ILO)

In 1990, ILO convened a meeting of experts at Geneva to draw up *a Code of Practice on the Prevention of Major Industrial Accidents*



Development of Process Safety Management

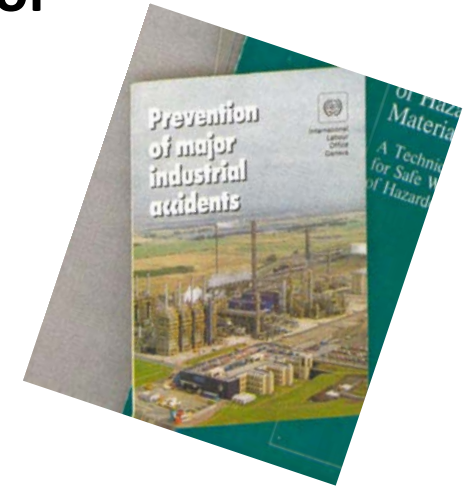
ILO's Code of Practice on the Prevention of Major Industrial Accidents

Authorities

- Establish a national major hazard control system
- Determine causes of major industrial accidents

Management

- Provide high standard of safety
- Carry out assessment of hazards and risks
- Ensure safe design and operation
- Train workers to understand processes and hazards involved
- Plan and provide measures to mitigate potential accidents



Development of Process Safety Management



UNITED STATES
DEPARTMENT OF LABOR

Occupational Safety & Health Administration (OSHA)

- 29 CFR Part 1910.119 - Process Safety Management of Highly Hazardous Chemicals
- Emphasise the management of hazards associated with highly hazardous chemicals and establishment of a comprehensive management program that integrated technologies, procedures, and management practices
- The standard was enacted as law in USA in 1992

Development of Process Safety Management

American Petroleum Institute (API)

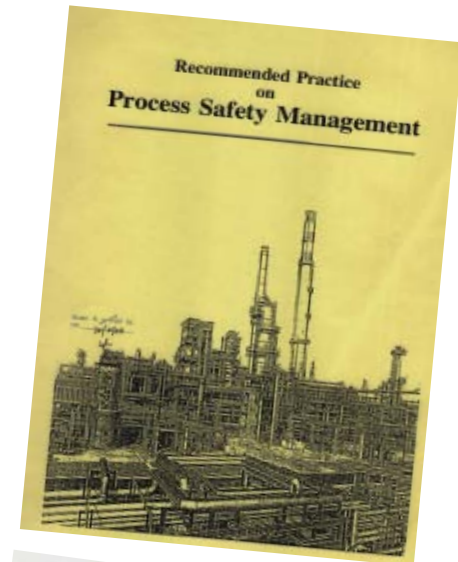


- In Jan 1990, **API RP 750 " Management of Process Hazards"** was developed for refineries, petrochemical operations, and major processing facilities
- The Recommended Practice addresses the management of process hazards in design, construction, start-up, operation, inspection, maintenance, and modification of facilities with the potential for catastrophic release
- The **API RP 750** addresses the management of process hazards through the implementation of elements of control similar to that of OSHA

Development of Process Safety Management

Recommended Practice on Process Safety Management

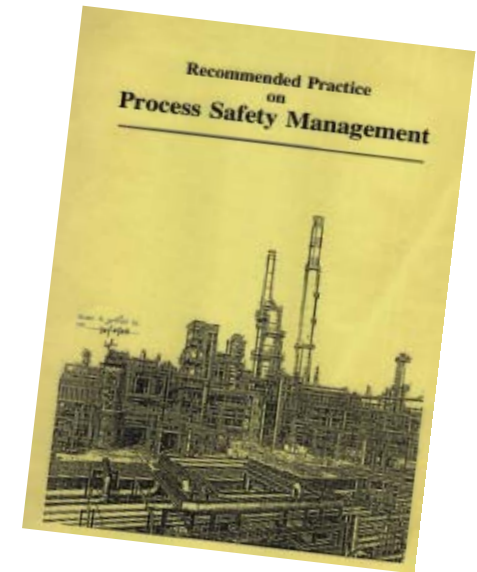
- Ministry of Manpower (MOM), in consultation with the major refineries and the petrochemical plants, established the *Recommended Practice on Process Safety Management* in 1993
- The Recommended Practice (RP) modeled closely to the OSHA's 29 CFR Part 1910.119 and API RP 750
- The objective was intended to eliminate or mitigate the consequences of large accidental releases involving hazardous substances
- Refineries & petrochemical plants were advised to implement the Recommended Practice on Process Safety Management



Development of Process Safety Management

Elements of the Recommended Practice on Process Safety Management (1993)

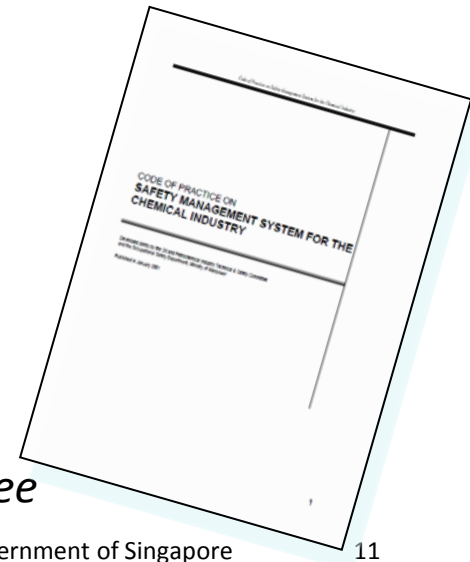
1. Safety Policy & Work Practices
2. Process Safety Information
3. Process Hazard Analysis
4. Management of Change
5. Operating Procedure
6. Mechanical Integrity
7. Training
8. Pre-start up Review
9. Incident Investigation & General Plant Inspection
10. Emergency Planning & Response



Development of Process Safety Management

A work group comprising MOM and OPITSC* was formed in 2000 to develop a code of practice on safety management system for the chemical industry -

- Consisting 14 elements as stipulated under the Factories Act
- Containing elements for managing **Safety and Health at work**
- Containing elements for managing **Process Safety** to eliminate or mitigate consequences of large release of hazardous substances
- Incorporating elements from the MOM's **Recommended Practice on Process Safety Management (1993)**



*OPITSC - Oil and Petrochemical Industry Technical & Safety Committee

Development of Process Safety Management

MOM's Recommended Practice on Process Safety Management System (2001)

Element 1 - Safety Policy

Element 2 - Safe Work Procedures

Element 3 - Safety Training

Element 4 - Group Meetings

Element 5 - Incident Investigations &
Analysis

Element 6 - In-house Rules

Element 7 - Safety Promotion

Element 8 - Contractors Selection,
Evaluation & Control

Element 9 - Safety Inspection

Element 10 - Maintenance Regime

Element 11 - Hazard Analysis

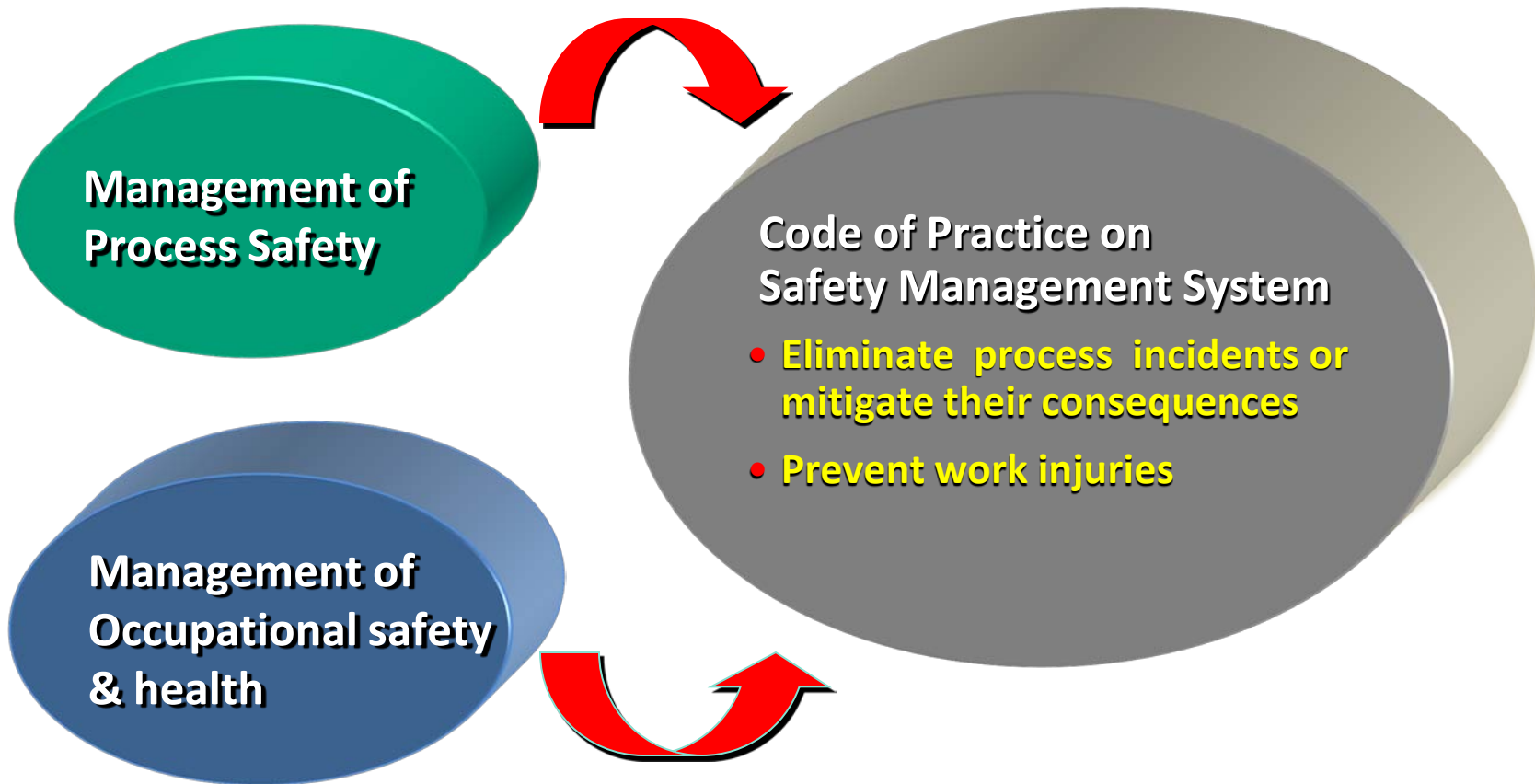
Element 12 - Hazardous Substances

Element 13 - Occupational Health

Element 14 - Emergency Preparedness

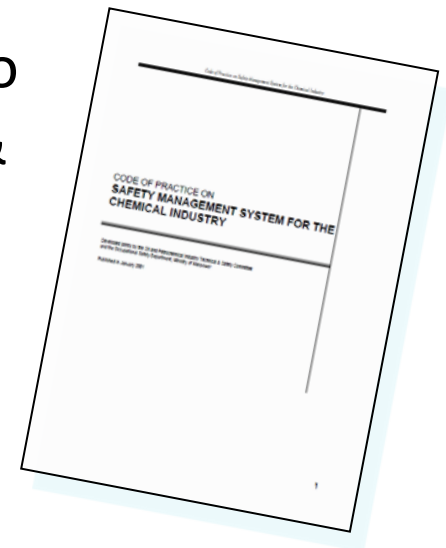
Development of Process Safety Management

MOM's Code of Practice on Safety Management System for the Chemical Industry (2001)



Development of Process Safety Management

- The MOM's **Code of Practice on Safety Management System for the Chemical Industry (2001)** was a reference document for mandatory implementing and auditing OSH Management System for the Oil & Petrochemical industries
- Other chemical plants could also make reference to this document for managing Occupational Safety & Health and Process Safety



Development of Process Safety Management

Singapore Standard SS 506 Part 3

- In 2006, SPRING Singapore launched a national standard on OSH for the Chemical Industry
- Singapore Standard, SS506: Part 3: 2006 - Occupational Safety and Health (OSH) Management System – Requirements for the Chemical Industry

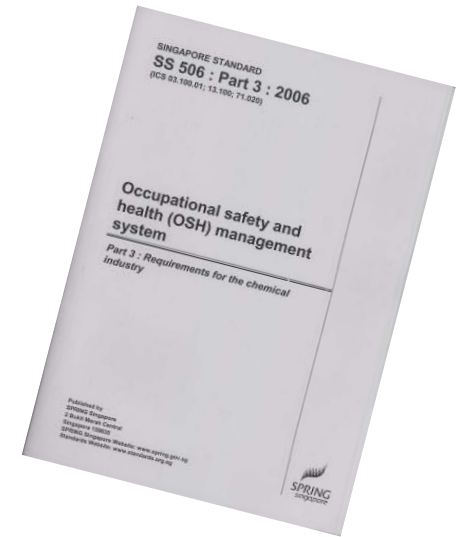


With this launch, MOM withdrew the *Code of Practice on Safety Management System for the Chemical Industry*

Development of Process Safety Management

Singapore Standard SS 506 Part 3

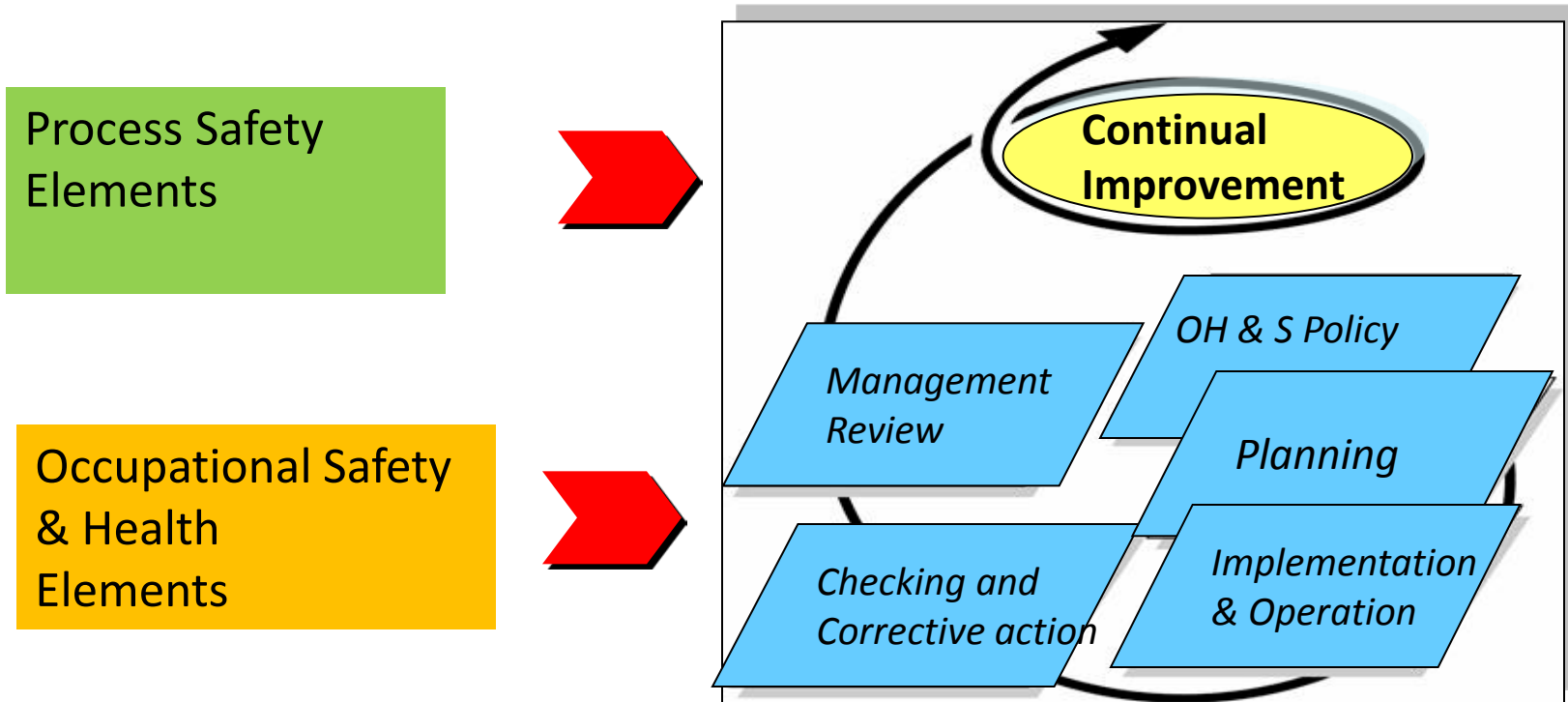
- Develop based on Singapore Standard, SS 506 Part 1's framework
- SS 506 Part 1 – Specification for Occupational Safety & Health (OSH) Management System (*A full adoption of OHSAS 18001*)
- Draw technical reference from MOM's Code of Practice on Safety Management System for Chemical Industry



Development of Process Safety Management

Singapore Standard SS 506 Part 3

Amalgamation of *Process Safety* elements with that of *Occupational Safety and Health* (OSH) and arranged in Plan-Do-Check-Act framework as in SS 506 Part 1 or OHSAS 18001



Development of Process Safety Management

Breakdown of Elements of SS 506 Part 3

Process Safety Elements	
4.3.1.1	Process safety information (PSI)
4.3.1.2	Hazard identification, risk assessment and risk control
4.4.2	Training, awareness and competence
4.4.6.2	Operating procedures and Safe Work Practices
4.4.6.3	Management of change
4.4.6.4	Pre-Start-up Safety
4.4.6.5	Contractors
4.4.6.6	Mechanical integrity and reliability
4.4.6.7	Control of hazardous substances
4.4.8	Emergency preparedness and response
4.5.3	Incidents, accidents, nonconformity, corrective action and preventive action

OSH Policy & Structure Elements	
4.2	OSH Policy
4.3.2	Legal and other requirements
4.3.3	Objectives and targets
4.3.4	OSH management programme(s)
4.4.1.1	Structure, responsibility and authority
4.4.1.2	In-house OSH rules and regulations
4.4.3	Consultation and communication
4.4.4	Documentation
4.4.5	Control of document
4.5.1	Performance measurement and monitoring
4.5.2	Evaluation of compliance
4.5.2.3	OSH inspection
4.5.4	Control of records
4.5.5	Internal audit
4.6	Management review

Occupational Health Elements	
4.4.7.1	Medical surveillance
4.4.7.2	Hearing conservation
4.4.7.3	Respiratory protection

Development of Process Safety Management

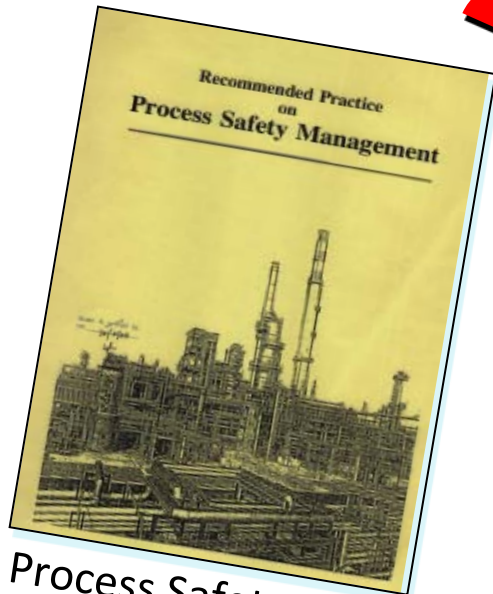
Singapore Standard SS 506 Part 3

- A systematic way of managing
 - Occupational Safety and Health risks
 - Process Safetyof the chemical industry through Plan-Do-Check-Act cycle
- Reference document for mandatory audit of management of safety and health system in the oil and petrochemical industry
- Could be used for Certification (SS 506 or OHSAS 18001)

Development of Process Safety Management

1993

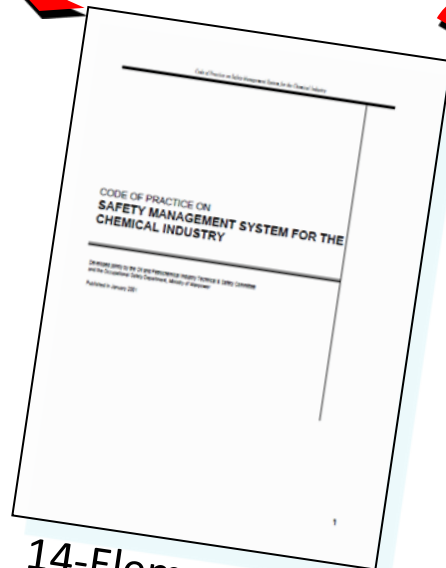
Recommended Practice on Process Safety Management



Process Safety Focused

2001

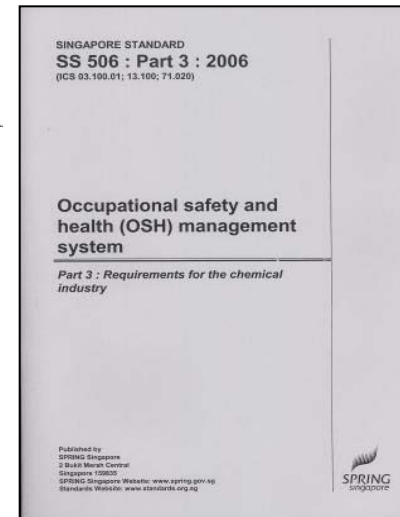
Code of Practice on Safety Management System for the Chemical Industry



14-Element format comprising Process Safety and OSH elements

2006

Singapore Standard SS 506 Part 3



PDCA Format - Certifiable Standard Comprising Process Safety and OSH elements

Regulatory Framework to Engender PSM Adoption

Workplace Safety and Health (Registration of Factories) Regulations

- Oil Refineries and Petrochemical Plants
- Bulk Terminals storing toxic or flammable liquid having storage capacity $\geq 5000\text{m}^3$
- Any plant engaged in the manufacture of Fluorine, Chlorine, Hydrogen Fluoride or Carbon Monoxide
- Any plant engaged in the manufacture of synthetic polymers

Intended occupiers of these installations are required to register the premises as factories, subject to conditions that the Commissioner may specify

Registration is renewal once in every 5 years

Regulatory Framework to Engender PSM Adoption

Workplace Safety and Health (Registration of Factories) Regulations

- Registration Requirements
 - Quantitative Risk Assessment (QRA)
 - Process Hazard Analysis* (PHA) studies
 - Safety Management System Audit based on SS 506 Part 3
- Renewal Requirements
 - Update PHA* once every 5 years

*PHA includes Hazard and Operability Analysis (HAZOP), Failure Modes and Effects Analysis (FMEA) or any equivalent methods.

Regulatory Framework to Engender PSM Adoption

WSH (Safety & Health Management System & Auditing) Regulations

The following installations are required to implement safety and health management system :

- Oil Refineries and Petrochemical Plants
- Pharmaceutical Plants
- Bulk Terminals storing toxic or flammable liquid having storage capacity $\geq 5000\text{m}^3$
- Any plant engaged in the manufacture of Fluorine, Chlorine, Hydrogen Fluoride or Carbon Monoxide
- Any plant engaged in the manufacture of synthetic polymers

SS 506 Part 3 will be used as a reference document for the Safety & Health Management System and audit (conducted once in every 2 years)

The Way Forward

The next phase of Process Safety Management –

- Implementing measurement of effectiveness of Process Safety Management
- Tracking, trending, monitoring of process safety performance and intervention

The Way Forward

Measurement of effectiveness of PSM



Europe

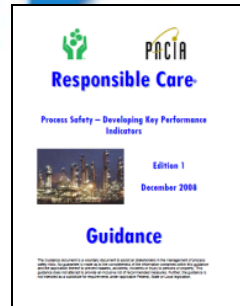
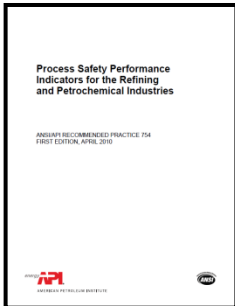
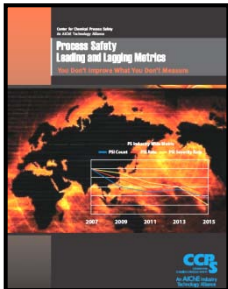
- Developing Process Safety, *HSE UK (2006)*
- Guidance on Developing Safety Performance Indicators – *OECD (2008)*

USA

- Process Safety leading and Lagging Metrics *CCPS (2008)*
- ANSI/API RP 754 - Process Safety Performance Indicators for the Refining and Petrochemical Industries (2010)

Australia

Process Safety – Developing Key Performance Indicator-*Plastic and Chemical Industries Assoc (2008)*



The Way Forward

Examples of Measurement Indicators

Leading Indicator	Lagging Indicator
<ul style="list-style-type: none"> • % of employees trained in process hazard awareness and risk assessment 	<ul style="list-style-type: none"> • Number of times workplace safety critical tasks are not being carried out safely
<ul style="list-style-type: none"> • % of safety critical equipment inspections and maintenance completed to schedule 	<ul style="list-style-type: none"> • No. of failures of equipment and piping due to corrosion, wear or damage
<ul style="list-style-type: none"> • % of work conducted in accordance with permit conditions 	<ul style="list-style-type: none"> • No. of incidents where plant/equipment could be damaged due to failure to control high-risk maintenance activity
<ul style="list-style-type: none"> • % of functional tests of safety critical instruments and alarms completed to schedule. 	<ul style="list-style-type: none"> • no. of safety critical instrumentation/alarms that fail to operate as designed either in use or during testing.

The Way Forward

Measurement leads to confidence

Early warning before **catastrophic failure** - Avoided discovering weaknesses through **costly incidents**



Stopped collecting and reporting performance info which was no longer relevant – **cost savings**



Benefits of adopting Process Safety Performance Indicators

Demonstrated the **effectiveness and suitability** of their risk control systems



An **increased assurance** on risk management and protected reputation



The Way Forward

Monitoring of Process Safety Performance

Companies

- Should establish or adopt a set of process safety performance indicators to monitor their process safety management performance.

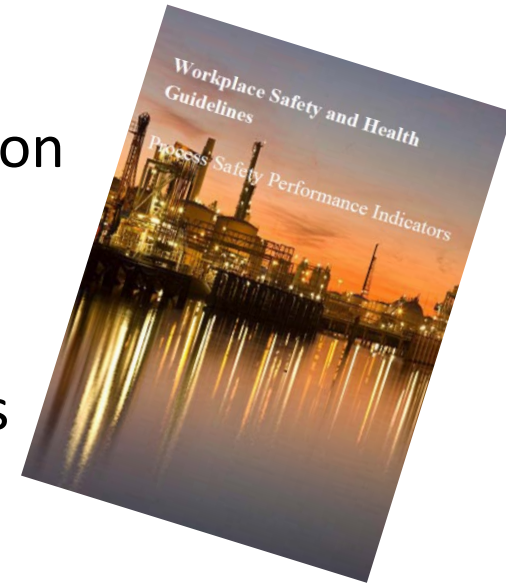
Authority

- Could consider monitoring process safety performance of the process industry by requesting key process safety performance indicators from process plants periodically
- Initiate appropriate intervention if the companies show deteriorating trend in their process safety performance

The Way Forward

Implementation of Process Safety Performance Indicators

- MOM and Workplace Safety and Health Council (Chemical Industries) Committee have embarked on a project to produce WSH Guidelines on Process Safety Performance Indicators
- The initiative is to help process plants/companies (especially SMEs) to improve process safety performance in Singapore
- MOM has also begun working with a number of chemical companies to pilot the implementation and submission of process safety performance indicators



Concluding Remarks

- Process Safety Management System enables the process industry to manage the process safety in a structured and systematic way
- Process Safety Performance Indicators (PSPI) help companies to measure and monitor their process safety management performance
- PSPI can be an avenue for regulating authorities to monitor the process Industry's safety performance and implement appropriate and timely interventions