Process Safety Management

Agenda

- **Defining PSM & Why it is Needed**

MODULE 1

- **Technology Elements** Supporting the PSM

MODULE 2

System

MODULE 3

- **Facilities Elements** Supporting the PSM System
- **Personnel Elements** Supporting the PSM Sy

MODULE 1

Defining PSM & Why It is Needed

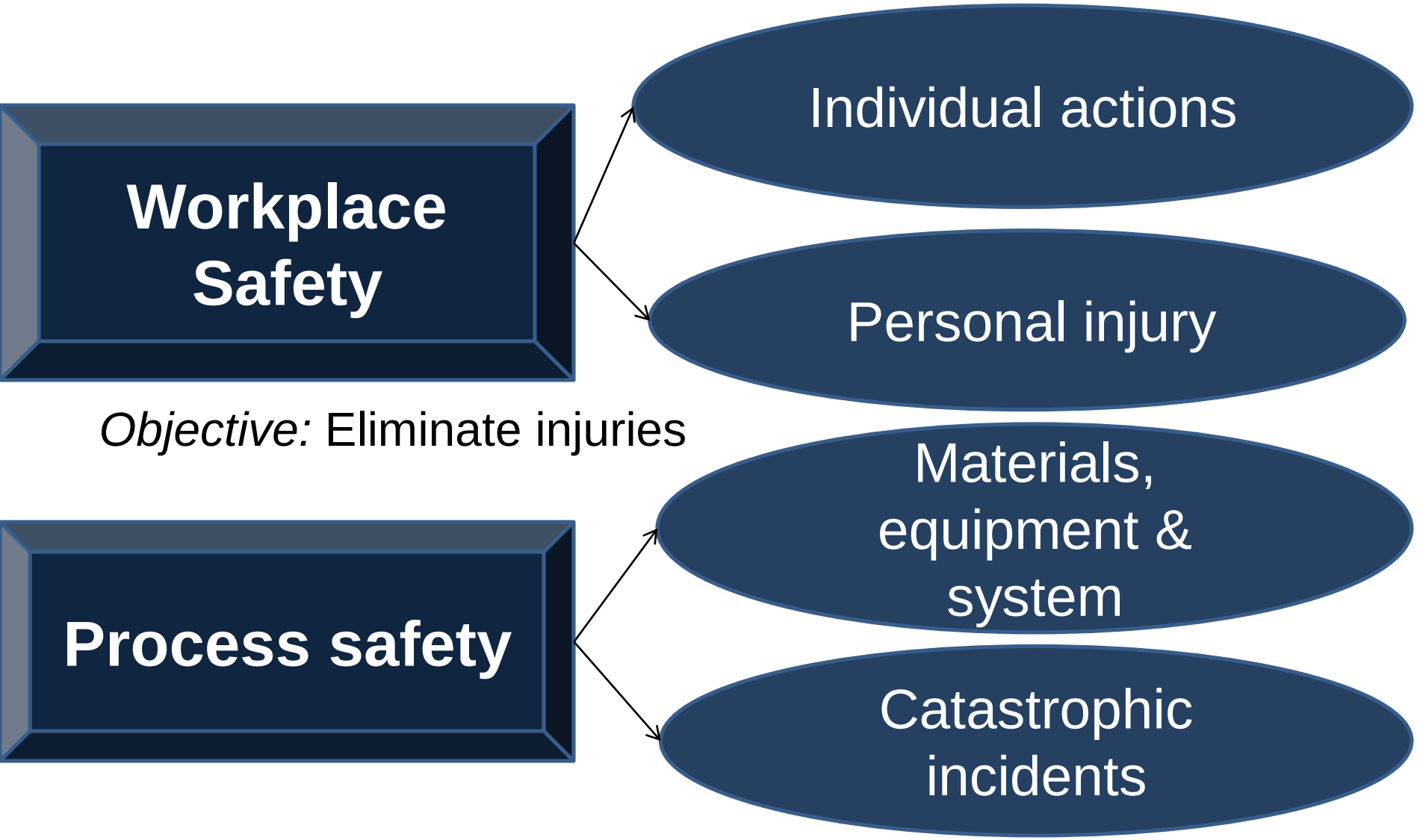
TABLE TIME EXERCISE
PART 1 OF 2

PSM/Workplace Safety Objectives & Purpose

1. Form into groups/teams of three.
2. Using incident examples a. through j. below as reference, **list the differences between what you think is Process Safety Management (PSM) and Workplace Safety incidents.**

Incident Examples

a. Contractor falls of a tank roof
b. Employee hit by a truck on the site
c. Employee overcome when inspecting vessel through the man-hole
d. Massive mine slide with no injuries
e. Process equipment buried in mine slide
f. Community complains about H2S smells
g. Acid release damages shrubs and trees
h. Operator slips on oil spill & injuries hip
i. Mechanic breaks valve stem when opening a valve with a cheater bar
j. Container empties when bottom valve left open



Objective: Eliminate injuries

Objective: Eliminate multiple fatalities, asset damage

Both require management commitment & constancy of purpose

Business Benefits of PSM

- Avoidance of catastrophic events resulting in
  - Loss of facilities, injuries & fatalities, environmental damage and/or human health impacts & ensuing litigation
- Improved
  - Productivity & cost savings through reduced downtime
  - Efficiency through consolidation of safety related activities into cohesive focused effort
  - Quality & customer satisfaction through assurance of continued operation within specified limits
  - Employee & labor relations through active engagement & participation in program implementation
- Sustained
  - “Right to operate” as granted by community, government & other stakeholders
  - Shareholder value & enhanced image in investment community

The PSM System — 14 Elements Connected & Working Together

MODULE 2

Technology Elements

Technology Elements

TECHNOLOGY ELEMENTS

Element 1—**Process Technology (PT)**

Defining Process Technology (PT)

- The process technology (PT) package, formerly called Process Safety Information(PSI), provides:
  - Description of the chemical process or operation
  - Foundation for identifying & understanding the hazards involved, which are the first steps in the process safety management (PSM) effort.
- PT package consists of the following parts
  - Hazards of the Process
  - Process Design Basis
  - Equipment Design Basis
  - Identification of PSM Critical Equipment

What is Process Technology?

It primarily focuses on safety information:

- Material properties
- Process parameters
- Engineering drawings
- Critical equipment

Process Technology is collection and keeping process safety information updated

It involves compiling, cataloguing, and making available data relevant to safety.

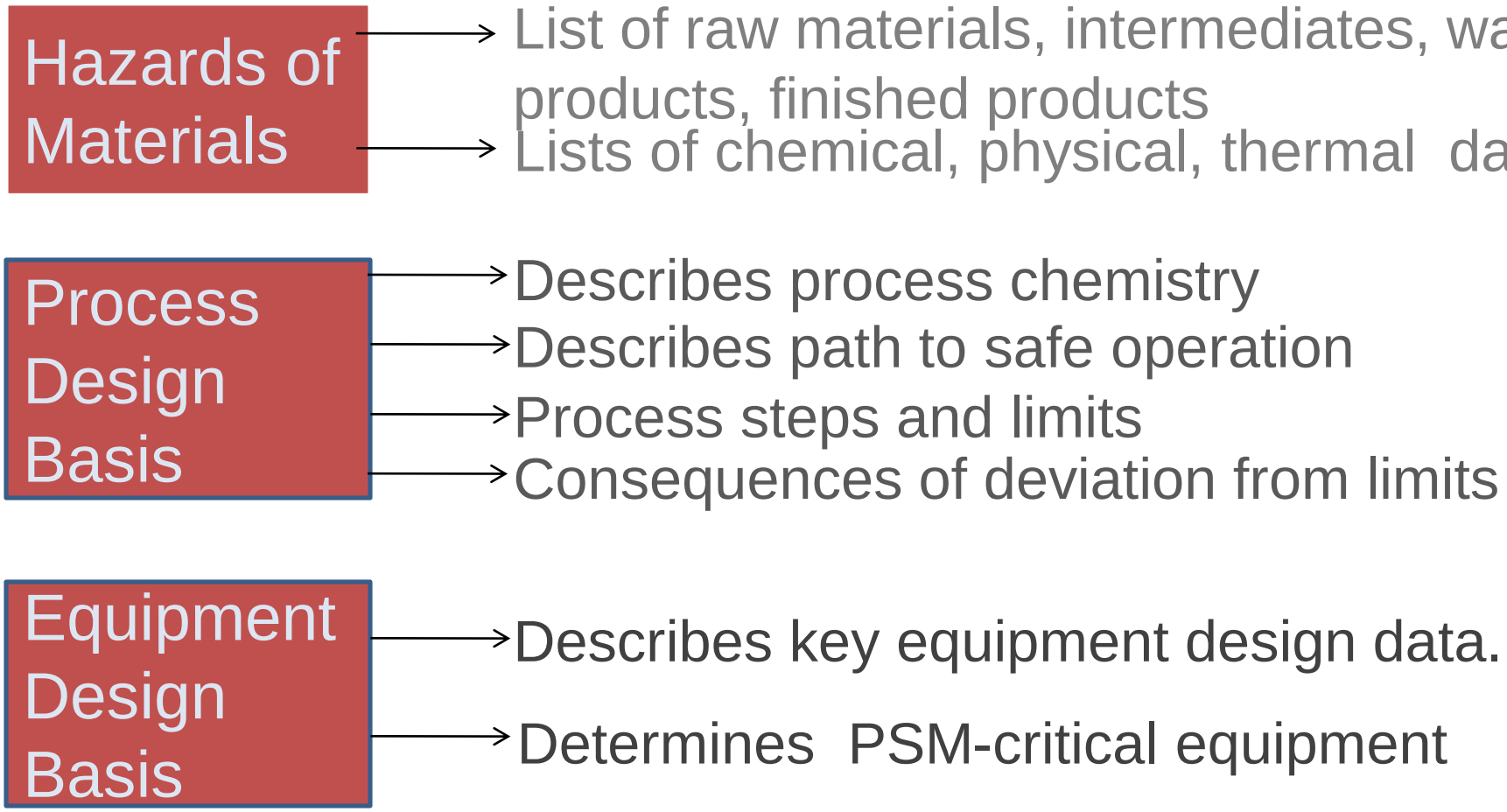
Process knowledge answers “What?” questions:

- What are the hazardous materials
- What is the SOC and SOL level
- What is the set point for PSV release

By contrast, Process Technology answers “Why?” questions:

- Why materials are hazardous?
- Why is the PSV set at that point?
- Why SOC and SOL to be maintained?

Features


Hazards of Materials
List of raw materials, intermediates, waste products, finished products
Lists of chemical, physical, thermal data
Process Design Basis
Describes process chemistry
Describes path to safe operation
Process steps and limits
Consequences of deviation from limits
Equipment Design Basis
Describes key equipment design data.
Determines PSM-critical equipment

Hazards of Materials

- Chemical, Physical & Thermal Properties
- Occupational Health & Toxicity Data
- Fire & Explosion Properties
- Interactions between chemicals
- Interactions between chemicals and materials of constructions, auxiliary materials etc.
- Thermal data of reaction
- Side reactions, Heat Accumulation Conditions
- Thermal Stability
- Summary of Thermal Hazards

Process Design Basis

- Process Description, PFD
- Chemical Reactions
- P&ID
- Mass Balance
- Energy Balance
- Utility Requirements
- SOP, Emergency Shutdown, Process Interruption
- SOC - Deviations
- Inventory
- Process / Equipment Changes
- Process Incidents

Equipment Design Basis

- Equipment List
- Equipment Data-sheet
- Hazardous Area Classification
- Instrument Details

Why is PSI important?

- Risk understanding depends on knowledge..
- Quality of output depends on quality of input.
- PHA, OP, MOC, PSSR, MI depend on process knowledge.
- Underpins entire concept of process safety management.
- PSM can not be applied without an understanding of risk.
- Knowledge is the corner stone for procedure training, auditing.
- Good hazard analysis start with good information about process

Equipment Design Basis

Key Issues

- Determine Components, Equipment and Systems that might be designated as PSM Critical

PSM Critical

Definition
Components, equipment, or systems whose failure could result in, allow, or contribute to the release of, or exposure to, sufficient quantities of hazardous substances or their energy that could result in death property damage, or significant environmental harm.

PSM Critical

- “PSM Critical” triggers the following:
  - Maintenance Procedures
  - Maintenance Training (Qualification)
  - Appropriate Inspections and Tests
  - Rigorous Quality Assurance (Plant

PSM Critical

PSM Critical Equipment Application

- *Pressure vessels*
- *Pressure relief and vent systems and devices*
- *Controls, interlocks, alarms, instruments, and sensors*
- *Emergency devices, e.g shutdown and isolation system*
- *Fire protection systems and equipment*

TECHNOLOGY ELEMENTS

Element 1 — Process Technology

- Process Technology(PT) package provides
  - Description of process or operation
  - Foundation for identifying & understanding hazards involved
    - First steps in process safety management effort
- Definitive PT package must be developed
  - In written form
  - Maintained current by system that reviews & updates information on regular basis
- PT package generally consists of three parts
  - Hazards of materials
  - Process design basis
  - Equipment Design Basis

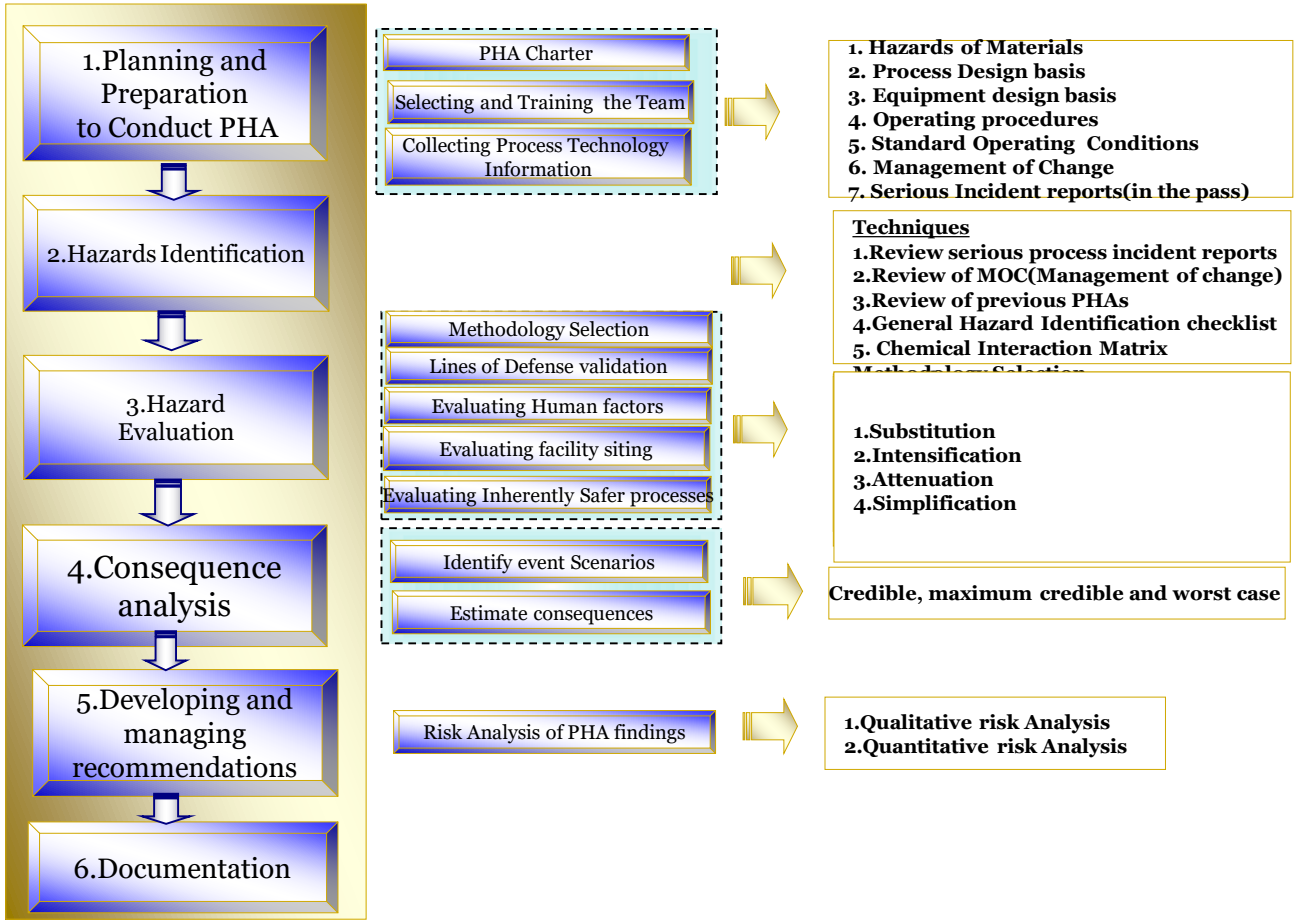
- **PT is foundational to all PSM elements**

TECHNOLOGY ELEMENTS

Element 2 — **Process Hazards Analysis**

What is Process Hazard Analysis?

- ***Organized, methodical*** approach which combines science, skill and engineering judgment ***to identify, evaluate & develop methods to control*** process hazard.
- A PHA consists of ***two parts***:
  - process hazard review
  - consequence analysis
- The study approach seek to achieve a ***multi-disciplined*** consensus on hazard control.
- Documents results for future ***use***.
  - Hazard identification
  - Hazard evaluation
  - Consequence analysis
  - Inherently safer process evaluation
  - Facility siting evaluation
  - Human factors
  - Risk Assessment
  - Development of recommendations


1.Planning and Preparation to Conduct PHA
2.Hazards Identification
3.Hazard Evaluation
4.Consequence analysis
5.Developing and managing recommendations
6.Documentation
PHA Charter
Selecting and Training the Team
Collecting Process Technology Information
1. Hazards of Materials
2. Process Design basis
3. Equipment design basis
4. Operating procedures
5. Standard Operating Conditions
6. Management of Change
7. Serious Incident reports(in the pass)
Techniques
1.Review serious process incident reports
2.Review of MOC(Management of change)
3.Review of previous PHAs
4.General Hazard Identification checklist
5. Chemical Interaction Matrix
Methodology Selection
Lines of Defense validation
Evaluating Human factors
Evaluating facility siting
Evaluating Inherently Safer processes
1.Substitution
2.Intensification
3.Attenuation
4.Simplification
Identify event Scenarios
Estimate consequences
Credible, maximum credible and worst case
Risk Analysis of PHA findings
1.Qualitative risk Analysis
2.Quantitative risk Analysis

	F1 Never heard of	F2 Heard of in industry	F3 in the organization	F4 once in the site	F5 more than once in site
C0 No injury	No action required	No action required	No action required	No action required	No action required
C1 Minor injuries	No action required	No action required	No action required	Action required unless risk ALARP	Action required unless risk ALARP
C2 Major injuries	No action required	Action required unless risk ALARP	Action required unless risk ALARP	Action required at first opportunity	Action required at first opportunity
C3 Serious injuries in battery limit	Action required unless risk ALARP	Action required unless risk ALARP	Action required at first opportunity	Action required at first opportunity	Immediate action required
C4 Onsite fatality	Action required unless risk ALARP	Action required at first opportunity	Action required at first opportunity	Immediate action required	Immediate action required
C5 Offsite fatality	Action required unless risk ALARP	Action required at first opportunity	Immediate action required	Immediate action required	Immediate action required

	F1 Never heard of	F2 Heard of in industry	F3 in the organization	F4 once in site	F5 more than once in site
C0 No damage	No action required	No action required	No action required	No action required	No action required
C1 Minor damage < Rs 1 lakhs	No action required	No action required	No action required	Action required unless risk ALARP	Action required unless risk ALARP
C2 Major damage Rs 1-<10 lakhs	No action required	Action required unless risk ALARP	Action required unless risk ALARP	Action required at first opportunity	Action required at first opportunity
C3 Rs 10-<25 lakhs	Action required unless risk ALARP	Action required unless risk ALARP	Action required at first opportunity	Action required at first opportunity	Immediate action required
C4 Rs 25-<50lakhs	Action required unless risk ALARP	Action required at first opportunity	Action required at first opportunity	Immediate action required	Immediate action required
C5 >Rs 50 lakhs	Action required unless risk ALARP	Action required at first opportunity	Immediate action required	Immediate action required	Immediate action required

Risk Matrix

F-1	3	2	2	1	1
F-2	3	3	2	1	1
F-3	4	3	3	2	1
F-4	4	3	3	3	2
F-5	4	4	4	3	3
	C-1	C-2	C-3	C-4	C-5
	Minor injury	Medical treatment	Lost Time Injury	Fatal injury/ irreversible health effects	Multiple fatalities

Risk Definitions		
1	Intolerable	Develop recommendations to reduce risk to category 3
2	Undesirable	Develop recommendations to reduce risk to category 3
3	Tolerable with Control	Team may make recommendations to reduce risk
4	Tolerable as is	Opportunity for improvement

Likelihood of Event		
Description	**Frequency (events per year)**	**Frequency Category**
Very likely to occur	> 1 to 10^-1	F-1
Likely to occur atleast once in the lifetime of the process	10^-1 to 10^-2	F-2
Unlikely to occur in the lifetime of the process, but possible	10^-2 to 10^-3	F-3
Very unlikely - not expected	10^-3 to 10^-4	F-4
Extremely unlikely - not realistically expected to occur	< 10^-5	F-5

Safeguard	Score		
Administrative/Procedural/ Operator action	1	Valid only if operator has 5 minutes at the least to detect, decide and act/actuate.	
Active(Control logics,Relief valves)	2		
Passive(Bund,Dikes,Blast wall)	3		
	Risk	**Risk Score**	**Safeguard combination**
Thumb rules for determining frequencyfor calculating Risk	F-1	1	Administrative/ Operator action
	F-2	2	1. One active or 2.Two administrative
	F-3	3	1.One passive or 2.One active+One administrative or 3.Three administrative
	F-4	4	1.Two active or 2.One passive+one administrative
	F-5	5	1.Two active+One adminstrative or 2.One passive+One active

Consequence Category	Consequence Description				
	C1 - Minor	**C2 – Moderate**	**C3 – Significant**	**C4 – Severe**	**C5 - Extreme**
On-site safety and health	No significant injury or health impact to people on-site.	Nothing worse than RWC injuries or reversible health effects, for which full recovery is expected	LTI injuries and/or a small number (i.e., 10 or fewer) of LWC injuries for which full recovery is expected. Includes injuries involving minor irreversible health effects (e.g., non-incapacitating loss of appendages or minor impairment of the function provided by a body organ).	Not more than 1 t fatality. Multiple LWC injuries (i.e., more than 10) or injuries involving major irreversible health effects (e.g., those having significant, life-altering impact, such as loss of a major limb, organ, or bodily or sensory function).	more than 1 to 10 fatalities. Multiple LWC injuries (i.e., more than 10) or injuries involving major irreversible health effects (e.g., those having significant, life-altering impact, such as loss of a major limb, organ, or bodily or sensory function).
Off-site safety and health	No significant injury or health impact to people off-site	Nothing worse than minor injuries or reversible health effects, for which minor medical treatment is indicated. (Potential for precautionary shelter in place.)	Injury or moderate health effects, for which emergency medical intervention and/or short-term hospitalization is indicated.	Any fatality and/or injuries requiring extended hospitalization. Includes any injuries involving major irreversible health effects.	Any fatality and/or injuries requiring extended hospitalization. Includes any injuries involving major irreversible health effects.
Environmental	No significant environmental impact.	Discharges to air, land, and/or water that impact only on-site areas and only have very short-term (i.e., a day or less) impact on plants, wildlife, soil, or water. Only limited on-site remediation efforts required. Exceedance of site environmental permit limit and/or results in release of a reportable quantity of a chemical, but not enough to cause effects warranting a higher consequence category classification.[a]	Discharges to air, land, and/or water that impact on-site areas and some limited off-site areas that are not deemed environmentally sensitive and have short-term (2 to 7 days) impact on plant, wildlife, soil, or water. Moderate remediation efforts required.	Discharges to air, land, and/or water having moderate- to long-term (i.e., 1 to 6 months) impact on the plant, wildlife, soil, or water for a large area; or shorter term (i.e., less than a month) on environmentally sensitive areas. Includes shorter duration events having severe community impact (e.g., adverse impact on local drinking water supply or other essential services).	Discharges to air, land, and/or water having moderate- to long-term (i.e. more than 6 months) impact on the plant, wildlife, soil, or water for a large area; or shorter term (i.e., less than a month) on environmentally sensitive areas. Includes shorter duration events having severe community impact (e.g., adverse impact on local drinking water supply or other essential services).
				Effects reversible in the long-term.	Effects reversible in the long-term.
				Extensive on-site or off-site remediation efforts required.	**Extensive on-site or off-site remediation efforts required.**
Property Damage	Upto INR 1000000 Minor	10-50 Lakhs	50 Lakhs - 10 Crore	10 to 30 Crores	INR 30 Crore and above
Business Interuption	•1-2 Minor interruptions.	•Frequent minor interruptions Upto	•Short run disruption (1 day)	•Continuity threatened (1 week)	•No continuity (> 1 month)

PHA Content/Activities

1. Identify Hazards
2. Field Tour
3. Consequence Analysis
4. Hazards Evaluation
   - —Identify Hazardous Events, Lines of Defense & Integrity of each Line of Defense
5. Interlock Evaluation
6. Human Factors Analysis
7. Facility Siting Study
8. Inherently Safer Processing
9. Development & Management of Recommendations
   - —Risk Analysis of PHA findings
10. Documentation

Consequence Analysis done in the PHA provides the basis for the Emergency Planning and Response program.

TECHNOLOGY ELEMENTS

Element 2 — PHA Recap

- PHA is a critical element in PSM.
- Composition of PHA team is crucial.
- PHA assures that all process hazards have been identified and adequately addresses.
- Many tools are available to assess process hazards.
  - 95% can be addressed using qualitative tools and critical, analytical thinking.

TECHNOLOGY ELEMENTS

Element 3 — **Operating Procedures & Safe Practices**

Defining Operating Procedures (Ops) & Safe (Work) Practices (SPs)

Operating Procedures & Safe Practices are used for operator & mechanic training.

- **Operating Procedures**
  - Provide clear understanding of parameters for safe process operation for operators
  - Clearly explain safety, health & environmental consequences of operation outside process limits
  - Describe steps to be taken to correct and/or avoid deviations

- **Safe Work Practices**
  - Provide carefully planned system of procedures
  - Provide permits involving checks & authorizations prior to doing non-routine work in process areas

TECHNOLOGY ELEMENTS

Element 3 — Operating Procedures & Safe Practices Recap

- **Operating procedures** provide clear understanding of parameters for safe operation for those who are operating the process. Operating procedures must be written, accessible to people that use them, and *updated* whenever there are changes.
- **Safe practices** provide a carefully planned system of procedures *and/or* permits involving checks and authorizations – prior to doing non-routine work in process areas.
- Everyone including operators, engineers and first line supervisors are engaged in writing and implementing operating procedures and safe practices.
- In addition to normal operation, **written procedures** should include emergency operation, emergency shut down, temporary operations and assignment of emergency activities to qualified personnel.

TECHNOLOGY ELEMENTS

Element 4— **Management of Change-Technology (MOC-T)**

Management of Technology Change

- A Technology change is a change involving

1. Process Technology
2. Mechanical integrity
3. Baseline PHA

and it potentially invalidates prior hazard assessments and creates new hazards

Examples of Process Technology Change

- Addition of new process e.g. all CAPEX
- Changes in documented Process Technology
  - Change in raw material specifications
  - Change in operating capacity
  - Change in operating window conditions
  - Change of trip/interlock philosophy/settings
- Project involving extension of facility
- Change in Material of Construction

TECHNOLOGY ELEMENTS

Element 4 — Management of Change – Technology Recap

- Process changes potentially invalidate prior hazard assessments and create new hazards
  - All process changes to the documented technology must be reviewed
  - Need clear understanding by all involved personnel of what constitutes change
- All process changes should be
  - Reviewed by knowledgeable personnel
  - Authorized by responsible management
- Many serious incidents occur within six months of some significant change
- Changes to operating procedures must be documented
  - Personnel trained before operational change implemented

MODULE 3

Facilities Elements

Facilities Elements

FACILITIES ELEMENTS

Element 6— Pre-Startup Safety Reviews

PRE START-UP SAFETY REVIEW

- **PSSR is a formal review of a manufacturing process to verify that critical areas of the affected process have been assessed and addressed prior to using the process.**

- Using the process could include:
  - Commissioning,
  - Introducing hazardous chemicals or
  - Introducing Energy

PURPOSE

- A final checkpoint for new & modified equipment / facility.
- The facility is SAFE to start up.
- All elements of PSM are addressed satisfactorily.
- Construction & equipment are in accordance with design.
- Risks and emergency actions are identified and documented.

What is Pre-Start Up Safety Review? Why is it important?

- Essentially a pre-start-up safety review (PSSR)
  - verifies before a plant is restarted that the plant is in a safe condition to be restarted
- Start-ups typically follow construction, maintenance, turn-arounds, extended outages, where equipment has been unsafe to operate
- Experience shows that incidents are more frequent during process transitions such as start-ups
- It is therefore important to verify that the equipment has been restored to a safe-to-run state.

What are the key aspects of a PSSR?

- Written Pre-Start up Safety Review programme
- Detailed standard checklists for restart of each unit
- More extensive and formal reviews in HHP:
- Initial start-up, high hazard process, extensive maintenance/turnaround work, severe weather outage
- Training
- Consistent implementation
- Assigning a person responsible for PSSR for start-up
- Periodic auditing of PSSR’s conducted
- Track all issues to their resolution
- Resistance to start-up before PSSR is complete and identified issues resolved

PSSR connection to PSM

Process technology – equipment design, electrical classification drawing, identify of PSM critical equipment

Operating procedures – new or modified procedures, SOC's, safety systems

PHA's – are all PHA recommendations addressed

Quality Assurance – have all QA checks been conducted

Mechanical integrity – is equipment in the MI program for periodic testing; maintenance procedures been written

Training – are all operators training and qualified on the modified or new equipment

Emergency Response - have the ER plans been updated

MOC Technology and Subtle – have all change items been addressed

CAUTION

- PSSR reviews **Safety and Operability Analyses** and it does NOT review the **Technical Aspects.**
- PSSR makes sure that the routine checking processes are in place and followed.
- Not a last minute hazards analysis.
- PSSR team checks that hazard analysis was carried out on the proposed changes & all the findings were implemented or closed.

FACILITIES ELEMENTS

Element 6 — Pre-Startup Safety Reviews Recap

- Final check of process safety elements
- Ensures all safe process management systems in place before introducing material to process
- Performed on new or modified facilities when PSI changes
- Conducted by teams of manufacturing (including operator), technical, design, maintenance personnel, appropriate safety representatives as needed

Principles of Quality Assurance(QA)

Purpose

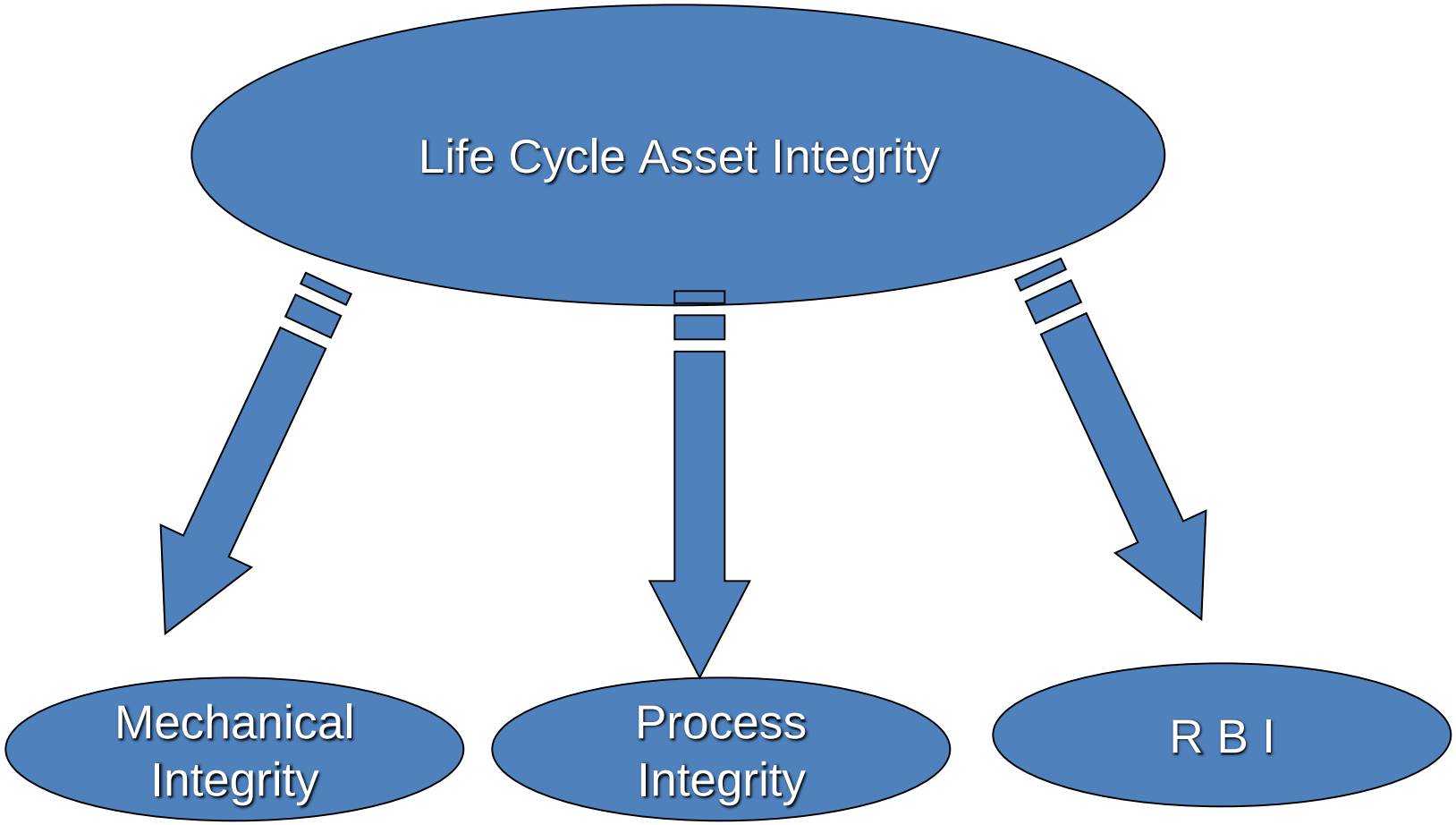
- Quality assurance efforts focus on ensuring process equipment is
  - Fabricated in accordance with design specifications
  - Assembled and installed properly

Features

- Design bases and criteria documented and communicated to vendor and operating/maintenance personnel
- Written quality control procedures address fabrication
- Appropriate checks and inspections ensure critical equipment is fabricated and installed consistent with design specifications

What is Mechanical Integrity?

- *Mechanical integrity* is implementation of activities, such as inspection and tests necessary to ensure that important equipment will be suitable for application throughout its life.
- Activities related to element focus:
  1. Preventing a catastrophic release of hazardous material or sudden release of energy and
  2. Ensuring high availability of critical safety or utility systems that prevent or mitigate the effects of the events.



Asset Integrity Management is a balancing process designed to achieve best Life Cycle Performance at Optimum Cost

Overview

- Mechanical integrity ensures that equipment is properly designed, installed in accordance with specifications, and remains fit for use until it is decommissioned.

Mechanical Integrity

- The facility has to establish and implement through written procedures the on-going mechanical integrity i.e. inspection, tests and preventive maintenance.
- It has to follow Recognized And Generally Accepted Good Engineering Practices.
- Inspection & test must be documented
- Deficiencies that were found outside acceptable limits defined by the process safety information/data sheet are corrected before further use.

Requirements of MI programme

- Equipment is designed, fabricated, procured, installed, operated and maintained properly
- Designates equipment based on defined criteria
- Prioritises equipment to help allocate resources
- Helps a plant staff perform planned maintenance
- Helps a plant staff recognise when equipment deficiencies occur and includes controls to help ensure avoid accidents.
- Incorporates accepted good engineering practice.
- Ensure that personnel assigned to inspect/test/ maintain/procure/ fabricate/install/decommission/ commission equipment are appropriately trained.
- Maintains records to provide accurate information.

FACILITIES ELEMENTS

Element 8 — Management of Change-Facilities(Subtle)

- Definition: modification to facility of any cost (other than replacement in kind)
- Address impact on PSM elements
  - Management of Technology Change
  - Operating Procedures/PHA
  - Training and Communication
  - PSSR/Field Inspection
- Review & authorization appropriate to change
- **Small changes can cause big incidents!!**

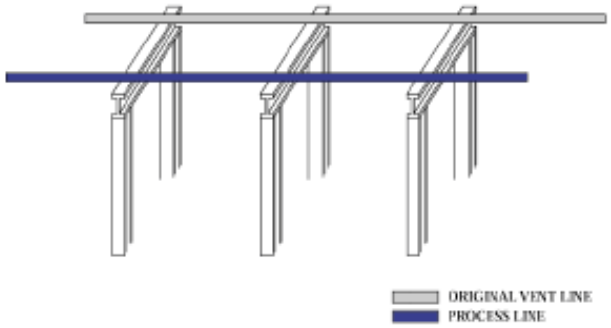
Change or Replacement-in-kind?

- Replacement that satisfies the design specifications.
- Examples
  - raising reactor temp. within safe operating envelope
  - replacing equipment or piping meeting the same specifications as the original
- Are these replacement-in-kind?

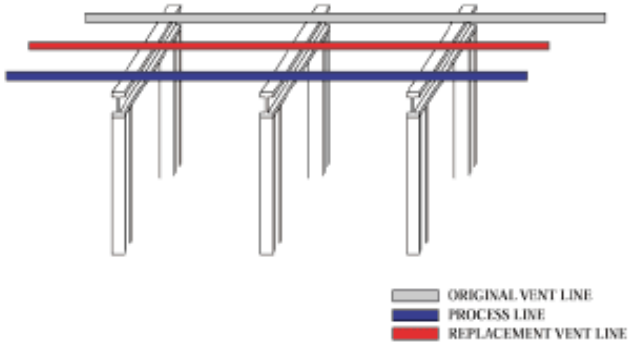
1. Changing metallurgy of a piping system.
2. Recalibrating instruments
3. Operating with a heat exchanger out of service
4. Replacement of gate valves with ball valves (within the plant valve specifications)

Subtle Change

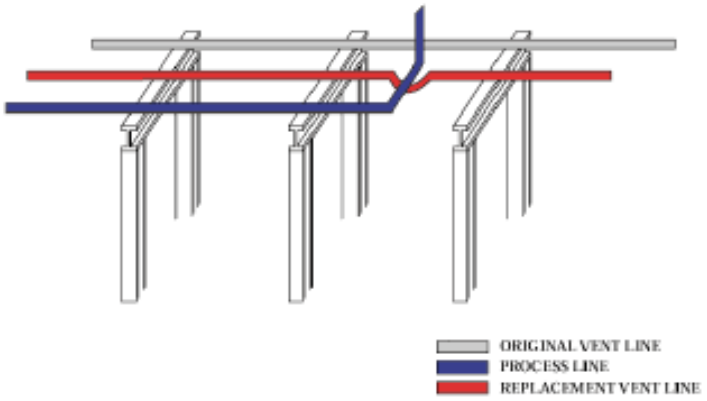
TASK - REPLACE VENT LINE



REPLACEMENT IN KIND



A "SUBTLE" CHANGE



Process equipment changes

- Changing piping from carbon steel to stainless steel
- Pitting corrosion due to presence of chlorides.
- Replacing reactor with one of equal volume with different Length/Dia ratio
- Mixing and heat transfer characteristics.
- Changing a vessel's service to a higher specific gravity material
- Additional weight on vessel support structure
- Changing a pump impeller to a larger diameter to increase head/capacity
- Overpressure downstream, operate above PSV pressure, cavitation

Process equipment changes

- Repairing a process leak via an engineered clamp
- Adequacy of pressure rating of temporary change
- Replacing metal gasket with teflon gasket
- Fire resistance
- Connecting cooling system of new reactor with existing CT
- Impact of increased load on the tower.
- Substituting plastic pipe for steel pipe
- Generation of static electricity, lack of support failure
- A centrifugal pump with positive displacement pump
- Need for relief path in down stream piping

Subtle Changes

- 316ss pipe/flange/etc. replaced with 304ss
- Gasket replaced with another type
- Original pump rotor replaced with a different size
- Section of piping replaced by a hose
- Changing a vendor without analyzing for differences for the equipment involved
- Piping change made in field not documented in the corresponding P&ID and applicable PT documents
- Plugging a leaking heat exchanger tube with an incorrect material
- Changing the trim of a valve
- Changing a field pressure gauge with another type
- Replacing cracked glass segment in a sight glass with a thinner section

MODULE 4

Personnel Elements

Personnel Elements

Implementing Training & Performance Principles

Training programs should include:

- Adequate budget/funding
- Qualified instructors
- Adequate personnel to conduct & receive training
- Basic knowledge and skills, task-specific skills, regulatory requirements
- Classroom training, field training & skill demonstration
- Qualification testing
- Records of training

Training and Performance Assurance

- Training is practical instruction in job and task.
- Its objective is to enable workers meet some minimum initial performance standards, to maintain proficiency, or to qualify for promotion.
- Performance assurance is the demonstration that training have been understood.
- Performance assurance is an ongoing process to ensure that workers meet performance standards.
- A consistently high level of human performance is a critical aspect of any process safety programme: indeed, a less than adequate level of human performance will adversely impact operations.

Determining training needs

- Training is based on needs analysis that define the minimum acceptable knowledge, skills, and abilities (KSAs) required for a worker in a specific position.
- These also include any requirements imposed by codes regulations, industry standards, or company policies.
- The training program should then be developed to bridge the gap between what is demanded of a qualified job applicant (e.g., basic reading and writing skills) and what is required to succeed in a specific job.

Determining Knowledge, Skills, Abilities

- Knowledge:
  - Knowledge of engineering, technology, science
- Skills:
  - Application of scientific rules, active listening, critical thinking, reading comprehension, problem solving,
  - Abilities:
  - Recognizing problems, trouble shooting, arrange things or actions, deductive reasoning emergency actions taking

Implementing Contractor Rules & Principles

The Site should:

- Evaluate contractor's safety performance in selection process & periodically thereafter
- Assure that compliance with site safety requirements is an integral part of the contra
- Establish clear lines of communication betwe site contract administrator & contractor
- Inform contractors of process hazards
- Inform contractors of safety rules, procedures & practices
- Explain Emergency Response & Control Plan
- Maintain a contractor employee injury & illness log

MOC-P Site Requirements

Some usual **General Duties** include:

1. Understanding the essential features of all 14 PSM Elements
2. Safety Procedures & Occupational Health Procedures
3. Incident Investigation
4. Hazard Analysis and Communication Procedures
5. Emergency Response Procedures
6. MOC – Technology
7. Complete all assigned regulatory training

Some **Process Specific Knowledge** that is usually included

1. Major Process Hazards
2. Technical Standards
3. Equipment Files, Engineering Standards & Pipe Codes
4. P&ID / Loop Sheets
5. Operating Procedures
6. Safety Devices
7. Electrical Classification
8. Contamination Prevention

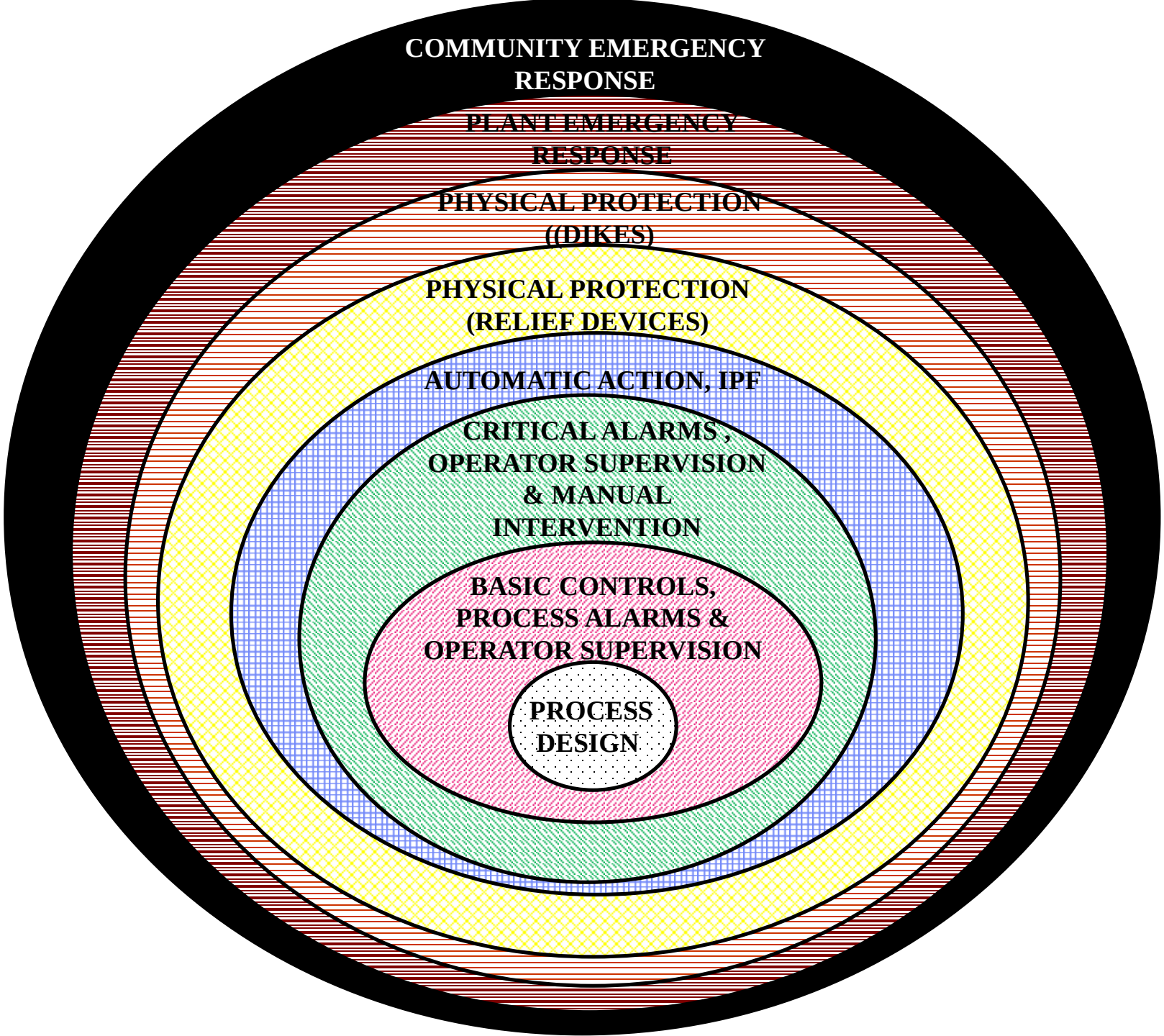
Emergency Planning & Response

Purpose

In-depth planning for potential emergencies is required so timely and effective response by the site, along with the community, can mitigate the impact on people, the environment and facilities during an emergency.

Why emergency planning

- Chemicals are widely used in industries
- Many of the chemicals that are used are toxic, explosive, flammable or corrosive.
- Loss of containment of such hazardous chemicals will harm people, plant and environment
- Despite safety system loss of containment of chemicals have taken place and Emergency response planning is the final layer of protection from effect of chemicals


COMMUNITY EMERGENCY RESPONSE
PLANT EMERGENCY RESPONSE
PHYSICAL PROTECTION ((DIKES)
PHYSICAL PROTECTION (RELIEF DEVICES)
AUTOMATIC ACTION, IPF
CRITICAL ALARMS , OPERATOR SUPERVISION & MANUAL INTERVENTION
BASIC CONTROLS, PROCESS ALARMS & OPERATOR SUPERVISION
PROCESS DESIGN

Chemical vis -a vis Natural Disaster

- Affected zone is comparatively smaller.
- They are caused by human error leading to uncontrolled release of chemicals.
- In chemical releases scenario can be foreseen and emergency plan can be focused.
- Emergency plan has to be specific based on consequence analysis and risk analysis of installation handling hazardous chemical.

Objectives

The overall objectives of an Emergency plan are:

- To localise the emergency and, if possible, eliminate it;
- To minimise the effects of the accident on people and property.

Elimination will require prompt action by operators.

Minimising the effects may include rescue, first aid, evacuation.

Defining Incident Investigation

- Serious incidents will recur unless key factors are identified and corrected
- Aggressive, persistent investigation of all real *and* potential incidents is necessary to continuously improve safety performance
- Incidents include an occurrence that caused or could have caused
  - Employee injury or illness
  - Significant environmental or health impact
  - Unfavorable public impact
  - Significant property damage
  - Business interruption

What is Incident Investigation? What is it not?

- ***What it is***
- A formal process of studying an incident to determine its cause and lessons learned that can be used to prevent similar incidents
- Includes resolving issues identified in the investigation and communicating lessons learned
- Near misses should also be investigated
- ***What it is not***
- Incident investigation is NOT a means to determine the person or persons to blame or punish for the incident

What is included in an Incident Investigation Program?

- A consistent approach across the company, including a policy on which incidents to investigate
- To decide which incident investigation method to use, i.e. root cause analysis, apparent cause analysis
- Encouragement of all personnel to report incidents and near-misses
- Investigation checklists to remind investigators what types of data to collect
- Training of investigators
- Recommendations effective , tracked to completion
- Incident reports (preliminary ,final) and trend data
- Means to monitor quality of incident investigations
- Communication of findings across the company and outside of the company

PSM Incident Classification and Reporting

1. Hazards & Materials involved - material released
2. Actual quantity (size) of release
3. System inventory with Potential quantity of release
4. Degree of control by site during incident
5. Functionality of lines of defense/layers of protection
6. Actual on site impact (injuries, evacuation)
7. Potential on site impact
8. Actual off site impact (injuries, media attention)
9. Potential off site impact
10. Actual monetary loss in equipment damage & lost revenue

PSM Incident Classification and Reporting

	Process	Fire [a]	Distribution[b]	Environment
Applicable criteria	1 to 10	1, 2, 3, 4, 6, 8, 10	1, 2, 8	1, 2, 6, 8

Type of incident	Classification score and automatic criteria
Process	
▪ Category A	≥ 130 points or automatic designation from criteria 6, 8, or 10
▪ Category B	≥ 75 points to ≤ 125
▪ Category C	≥ 5 to ≤ 70 points
Environment	
▪ Category A	≥45 points or automatic designation from criterion 8
▪ Category B	≥ 30 to ≤40 points
▪ Category C	≥ 5 to ≤25 points

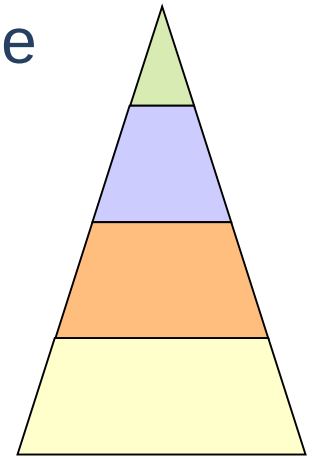
Fire	
▪ Category A	Automatic designation from criteria 6, 8, or 10
▪ Category B	≥ 45 points
▪ Category C	≥ 5 to ≤ 40 points
Distribution	
▪ Category A	Meets "distribution incident" definition and scores≥55 points or automatic designation from criterion 8
▪ Category B	Meets "distribution incident" definition and scores ≤50 points
▪ Category C	DINS Category C incidents or prevention opportunities (see Section 4; do not score)

Definitions

- Process incident—an incident involving the release of hazardous substances or involving the release of the energy of hazardous substances that directly involves or could involve process equipment and materials, including on-site storage and handling of process materials.
- Process safety incident— a process incident having a score of >75 and above as per the scoring method
- Serious Process Incident - a process incident having a score of >130 and above as per the scoring method
- Process safety near miss-an event having the potential for the release of hazardous substances or release of energy that directly involves process equipment, on-site storage and handling of process materials.

Management Responsibilities

- Ensure that all incidents are reported
- Create an atmosphere of trust and respect that leads to openness
- Establish systems and procedures
- Communicate value of conducting incident investigation
- Provide resources and priority
- Implement follow-up systems to prevent recurrence
- Ensure system for communication is effective



Incident Investigation process

- Make initial response and prepare report
- Form investigation team
- Determine the facts
- Determine the key factors
- Determine the systems to be strengthened
- Recommend corrective, preventive actions
- Document and communicate the findings
- Follow up

Implementing Auditing Concepts & Principles

When & How?

- **AUDIT 1ST PARTY – by Site personnel for Site**
  - Audit of elements in PSM program by line organization
  - Knowledgeable in process, members from PSM committee
  - All elements covered in 24-month period
- **AUDIT 2ND PARTY – by Off-Site Personnel for Site**
  - System, overview of area performance by PSM committee
  - Once every three years
- **AUDIT 3rd PARTY - by corporate or outside resource**
  - **Determine** compliance with audit program
  - **Find** strengths to share between sites
  - **Identify** areas for improvement
  - Suggested every four years

What is Process Safety Auditing?

- An audit is a formal evaluation of whether the process safety management system is performing as intended and in conformance with standards

.

Why is Auditing Important?

- Audits provide assurance to senior management that expected process safety programs are functioning as expected
- Experienced auditors bring a fresh perspective and knowledge of what works and doesn't work in other facilities. This helps auditors see deficiencies that may be hidden from plant employees
- Audits help uncover systemic problems so they can be resolved before incidents occur

What are result Process Safety Auditing

- Audits may result in:
  - Findings: Deficiencies in implementation, as demonstrated by one or more exceptions to management systems, regulations, or standards
  - Observations: Notably good examples worth sharing with other plants in the organization, or opportunities for the plant to improve .
  - Recommendations: Remedial activities suggested to address findings (and some cases, observation)

What is included in an Auditing Program?

- Team with expertise spanning all systems and hazards to be encountered
- Leader, and team members with defined roles and responsibilities
- A determination of applicable requirements
- An auditing protocol based on applicable requirements
- Opening conference, explaining how audit will progress
- Evaluation and collection of evidence based on 1. records, 2. observation, and 3. interviews with key personnel at all levels
- Stoppage of any operation deemed Immediately Dangerous to Life and Health
- Periodic briefing with findings
- Closing conference explaining preliminary findings
- Final report with all findings
- A response by the plant indicating timing and responsibility for follow-up
- Tracking recommendations to completion
- Communicating lessons learned to others
- Periodic review of the auditing program to identify improvement opportunities

What are some keys to success?

- An overall corporate audit leader
- Consistent implementation
- Experienced auditors, with qualification requirements for new auditors
- Polite and friendly treatment of plant personnel
- Audit teams with enough knowledge of plant and process to understand documents and hazards
- Audit teams that in general do not come from the same plant or business unit.
- Third party auditors may be useful, if they have enough plant/process knowledge
- Auditing regularly; typically every 3 years but +/- based on risk and past performance

Thanks