Rightsizing Process Safety: How to get a good fit for lower volumes/risks

- Jeff Foisel, DEKRA Lab Process Safety Specialist
- Michigan Safety Conference April 16, 2025, 9:00 to 10:00

• Outline / Abstract

- Why Implement Process Safety Management (PSM)?
- What are the OSHA Requirements?
- Why are they perceived as cumbersome?
- Approaches – All, Some, or Nothing?
- Where Do I Start?

Abstract:

Process safety as defined by OSHA's standard is scoped for large volumes of hazardous material. But what if you don't fall into the scope? Clearly the hazards do not go away if you only have 9,999 pounds of flammable liquids. The approach needed is to get a process safety program that works for you, your specific hazards, and your risk tolerance. This session will present an approach to right sizing a process safety management system to provide risk management for smaller scale chemical processes in labs/pilot plants/smaller scale operations.

Basis – Where you are starting from

You are using small chemical operations that do not reach the thresholds of the PSM standard. This could be labs, pilot plants, small volume production, or relatively low hazard production.

You care about your people and the community in addition to the bottom line.

You are asking the question, “Should I follow the PSM standard even if my operations are out of scope?”

OSHA PSM

Application – 1910.119(a)

This section applies to the following:

- A process which involves a chemical at or above the specified threshold quantities listed in appendix A to this section;
- A process which involves a Category 1 flammable gas (as defined in 1910.1200(c)) or a flammable liquid with a flashpoint below 100 °F (37.8 °C) on site in one location, in a quantity of 10,000 pounds (4535.9 kg) or more except for:
  - Hydrocarbon fuels used solely for workplace consumption as a fuel (e.g., propane used for comfort heating, gasoline for vehicle refueling), if such fuels are not a part of a process containing another highly hazardous chemical covered by this standard;
  - Flammable liquids with a flashpoint below 100 °F (37.8 °C) stored in atmospheric tanks or transferred which are kept below their normal boiling point without benefit of chilling or refrigeration.

- This section does not apply to:
  - Retail facilities;
  - Oil or gas well drilling or servicing operations; or,
  - Normally unoccupied remote facilities.

OSHA PSM Thresholds

Application – 1910.119(a)

- Limited number of highly hazardous chemicals
- All are >100 lbs.
- Note that mixtures count pure components
- Also, counts as an aggregate storage if they are in the same event

Chemical Name	CAS #	TQ
Acetaldehyde	75-07-0	2500
Acrolein (2-Propenal)	107-02-8	150
Acrylyl Chloride	814-68-6	250
Allyl Chloride	107-05-1	1000
Allylamine	107-11-9	1000
Alkylaluminums	Varies	5000
Ammonia, Anhydrous	7664-41-7	10000
Ammonia solutions (>44% ammonia by weight)	7664-41-7	15000
Ammonium Perchlorate	7790-98-9	7500
Ammonium Permanganate	7787-36-2	7500
Arsine (also called Arsenic Hydride)	7784-42-1	100
Bis(Chloromethyl) Ether	542-88-1	100
Boron Trichloride	10294-34-5	2500
Boron Trifluoride	7637-07-2	250
Bromine	7726-95-6	1500
Bromine Chloride	13863-41-7	1500
Bromine Pentafluoride	7789-30-2	2500
Bromine Trifluoride	7787-71-5	15000
3-Bromopropyne (also called Propargyl Bromide)	106-96-7	100
Butyl Hydroperoxide (Tertiary)	75-91-2	5000
Butyl Perbenzoate (Tertiary)	614-45-9	7500
Carbonyl Chloride (see Phosgene)	75-44-5	100
Carbonyl Fluoride	353-50-4	2500
Cellulose Nitrate (concentration >12.6% nitrogen)	9004-70-0	2500
Chlorine	7782-50-5	1500
Chlorine Dioxide	10049-04-4	1000
Chlorine Pentrafluoride	13637-63-3	1000
Chlorine Trifluoride	7790-91-2	1000
Chlorodiethylaluminum (also called Diethylaluminum Chloride)	96-10-6	5000
1-Chloro-2,4-Dinitrobenzene	97-00-7	5000
Chloromethyl Methyl Ether	107-30-2	500
Chloropicrin	76-06-2	500
Chloropicrin and Methyl Bromide mixture	None	1500
Chloropicrin and Methyl Chloride mixture	None	1500
Cumene Hydroperoxide	80-15-9	5000
Cyanogen	460-19-5	2500
Cyanogen Chloride	506-77-4	500
Cyanuric Fluoride	675-14-9	100
Diacetyl Peroxide (Concentration >70%)	110-22-5	5000
Diazomethane	334-88-3	500
Dibenzoyl Peroxide	94-36-0	7500
Diborane	19287-45-7	100
Dibutyl Peroxide (Tertiary)	110-05-4	5000
Dichloro Acetylene	7572-29-4	250
Dichlorosilane	4109-96-0	2500
Diethylzinc	557-20-0	10000
Diisopropyl Peroxydicarbonate	105-64-6	7500
Dilaluroyl Peroxide	105-74-8	7500
Dimethyldichlorosilane	75-78-5	1000
Dimethylhydrazine, 1,1-	57-14-7	1000
Dimethylamine, Anhydrous	124-40-3	2500
2,4-Dinitroaniline	97-02-9	5000
Ethyl Methyl Ketone Peroxide (also Methyl Ethyl Ketone Peroxide; concentration >60%)	1338-23-4	5000
Ethyl Nitrite	109-95-5	5000
Ethylamine	75-04-7	7500
Ethylene Fluorohydrin	371-62-0	100
Ethylene Oxide	75-21-8	5000
Ethyleneimine	151-56-4	1000
Fluorine	7782-41-4	1000
Formaldehyde (Formalin)	50-00-0	1000
Furan	110-00-9	500
Hexafluoroacetone	684-16-2	5000
Hydrochloric Acid, Anhydrous	7647-01-0	5000
Hydroflouric Acid, Anhydrous	7664-39-3	1000
Hydrogen Bromide	10035-10-6	5000
Hydrogen Chloride	7647-01-0	5000
Hydrogen Cyanide, Anhydrous	74-90-8	1000
Hydrogen Fluoride	7664-39-3	1000
Hydrogen Peroxide (52% by weight or greater)	7722-84-1	7500
Hydrogen Selenide	7783-07-5	150

Chemical Name	CAS #	TQ
Hydrogen Sulfide	7783-06-4	1500
Hydroxylamine	7803-49-8	2500
Iron, Pentacarbonyl	13463-40-6	250
Isopropylamine	75-31-0	5000
Ketene	463-51-4	100
Methacrylaldehyde	78-85-3	1000
Methacryloyl Chloride	920-46-7	150
Methacryloyloxyethyl Isocyanate	30674-80-7	100
Methyl Acrylonitrile	126-98-7	250
Methylamine, Anhydrous	74-89-5	1000
Methyl Bromide	74-83-9	2500
Methyl Chloride	74-87-3	15000
Methyl Chloroformate	79-22-1	500
Methyl Ethyl Ketone Peroxide (concentration >60%)	1338-23-4	5000
Methyl Fluoroacetate	453-18-9	100
Methyl Fluorosulfate	421-20-5	100
Methyl Hydrazine	60-34-4	100
Methyl Iodide	74-88-4	7500
Methyl Isocyanate	624-83-9	250
Methyl Mercaptan	74-93-1	5000
Methyl Vinyl Ketone	78-94-4	100
Methyltrichlorosilane	75-79-6	500
Nickel Carbonly (Nickel Tetracarbonyl)	13463-39-3	150
Nitric Acid (94.5% by weight or greater)	7697-37-2	500
Nitric Oxide	10102-43-9	250
Nitroaniline (para Nitroaniline	100-01-6	5000
Nitromethane	75-52-5	2500
Nitrogen Dioxide	10102-44-0	250
Nitrogen Oxides (NO; NO2; N204; N203)	10102-44-0	250
Nitrogen Tetroxide (also called Nitrogen Peroxide)	10544-72-6	250
Nitrogen Trifluoride	7783-54-2	5000
Nitrogen Trioxide	10544-73-7	250
Oleum (65% to 80% by weight; also called Fuming Sulfuric Acid)	8014-95-7	1,000
Osmium Tetroxide	20816-12-0	100
Oxygen Difluoride (Fluorine Monoxide)	7783-41-7	100
Ozone	10028-15-6	100
Pentaborane	19624-22-7	100
Peracetic Acid (concentration >60% Acetic Acid; also called Peroxyacetic Acid)	79-21-0	1000
Perchloric Acid (concentration >60% by weight)	7601-90-3	5000
Perchloromethyl Mercaptan	594-42-3	150
Perchloryl Fluoride	7616-94-6	5000
Peroxyacetic Acid (concentration >60% Acetic Acid; also called Peracetic Acid)	79-21-0	1000
Phosgene (also called Carbonyl Chloride)	75-44-5	100
Phosphine (Hydrogen Phosphide)	7803-51-2	100
Phosphorus Oxychloride (also called Phosphoryl Chloride)	10025-87-3	1000
Phosphorus Trichloride	7719-12-2	1000
Phosphoryl Chloride (also called Phosphorus Oxychloride)	10025-87-3	1000
Propargyl Bromide	106-96-7	100
Propyl Nitrate	627-3-4	2500
Sarin	107-44-8	100
Selenium Hexafluoride	7783-79-1	1000
Stibine (Antimony Hydride)	7803-52-3	500
Sulfur Dioxide (liquid)	7446-09-5	1000
Sulfur Pentafluoride	5714-22-7	250
Sulfur Tetrafluoride	7783-60-0	250
Sulfur Trioxide (also called Sulfuric Anhydride)	7446-11-9	1000
Sulfuric Anhydride (also called Sulfur Trioxide)	7446-11-9	1000
Tellurium Hexafluoride	7783-80-4	250
Tetrafluoroethylene	116-14-3	5000
Tetrafluorohydrazine	10036-47-2	5000
Tetramethyl Lead	75-74-1	1000
Thionyl Chloride	7719-09-7	250
Trichloro (chloromethyl) Silane	1558-25-4	100
Trichloro (dichlorophenyl) Silane	27137-85-5	2500
Trichlorosilane	10025-78-2	5000
Trifluorochloroethylene	79-38-9	10000
Trimethyoxysilane	2487-90-3	1500

Imperial Sugar

Food processing facility

14 deaths, 38 injuries

Initial explosion in a belt conveyor with newly installed steel panels contained the sugar dust. Likely an overheating bearing

Sugar is not a PSM covered material

University of Hawaii

Bio Lab – generating a feed gas

Loss of researcher arm

Mixture of 70% H_2, 25% O_2, and 5% CO_2 in a new 49L “air compressor tank” with a new electronic pressure gauge – not intrinsically safe. Prior explosion on 3.8 L tank the week before

Volumes of hazardous materials are well below the PSM thresholds

T2 Laboratories

Gasoline additive manufactured

4 deaths, 32 injuries

2450-gallon tank. Runaway reaction likely from cooling failure. Earlier lab work had indications of the exotherm. Multiple scale ups

Materials were not covered by the PSM – neither listed chemicals, nor were the materials flammable when tested

Optima Belle

Toll Manufacturing of Sodium Dichloroisocyanurate

1 death, 3 injuries.

<8810 lbs. added to the dryer. Runaway reaction in a dryer. Likely from cooling failure. Equipment not designed for NaDCC.

Materials were not covered by the PSM – neither listed chemicals, nor volumes

Why Implement PSM?

Catastrophic events **are** happening.

No one involved with these incidents believed there would these events would occur prior to their occurrence.

Could implementation of PSM elements have helped prevent these?

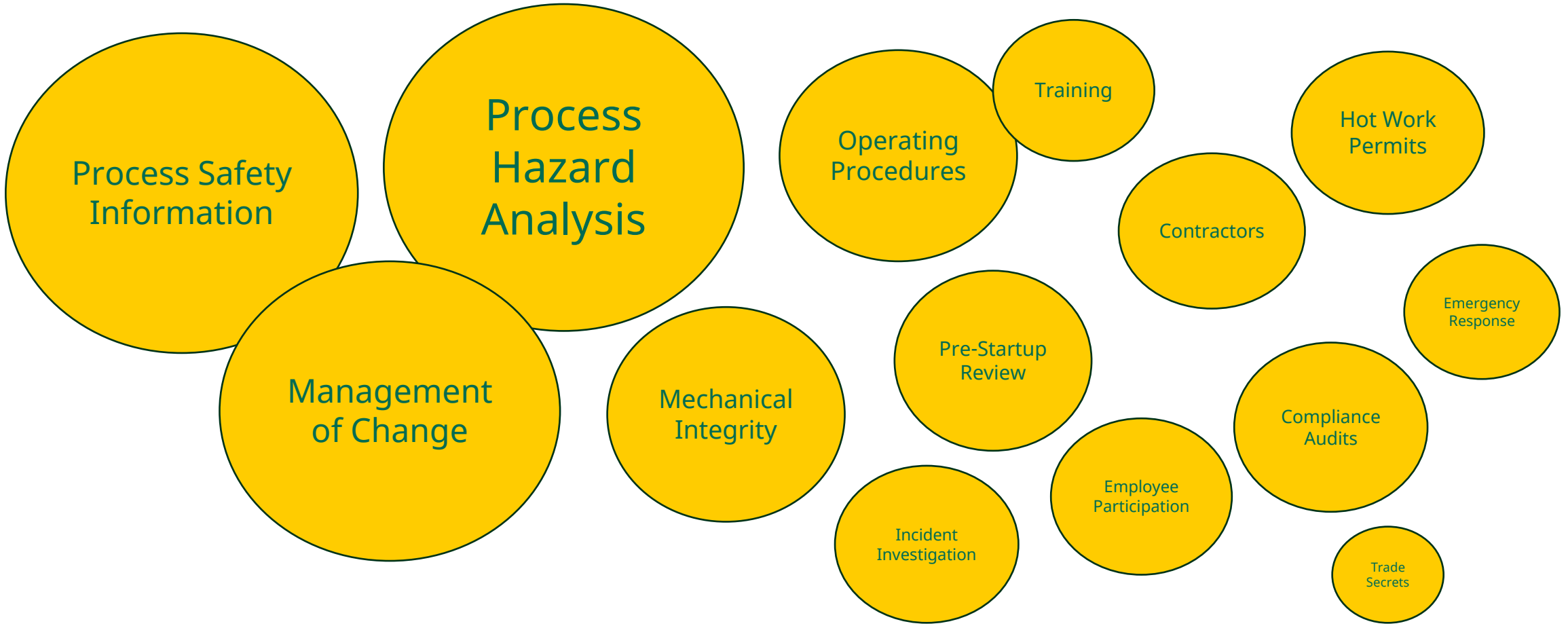
Requirements of OSHA PSM

C. Employee Participation
D. Process Safety Information [1,2,3,4]
E. Process Hazard Analysis [1,2,3,4]
F. Operating Procedures
G. Training
H. Contractors
I. Pre-Startup Review
J. Mechanical Integrity [1,2,4]
K. Hot Work Permit
L. Management of Change [1,2,3,4]
M. Incident Investigation [2,3]
N. Emergency Response
O. Compliance Audits
P. Trade Secrets

1 – Imperial Sugar
2 – U of H
3 – T2 Labs
4 – Optima Belle

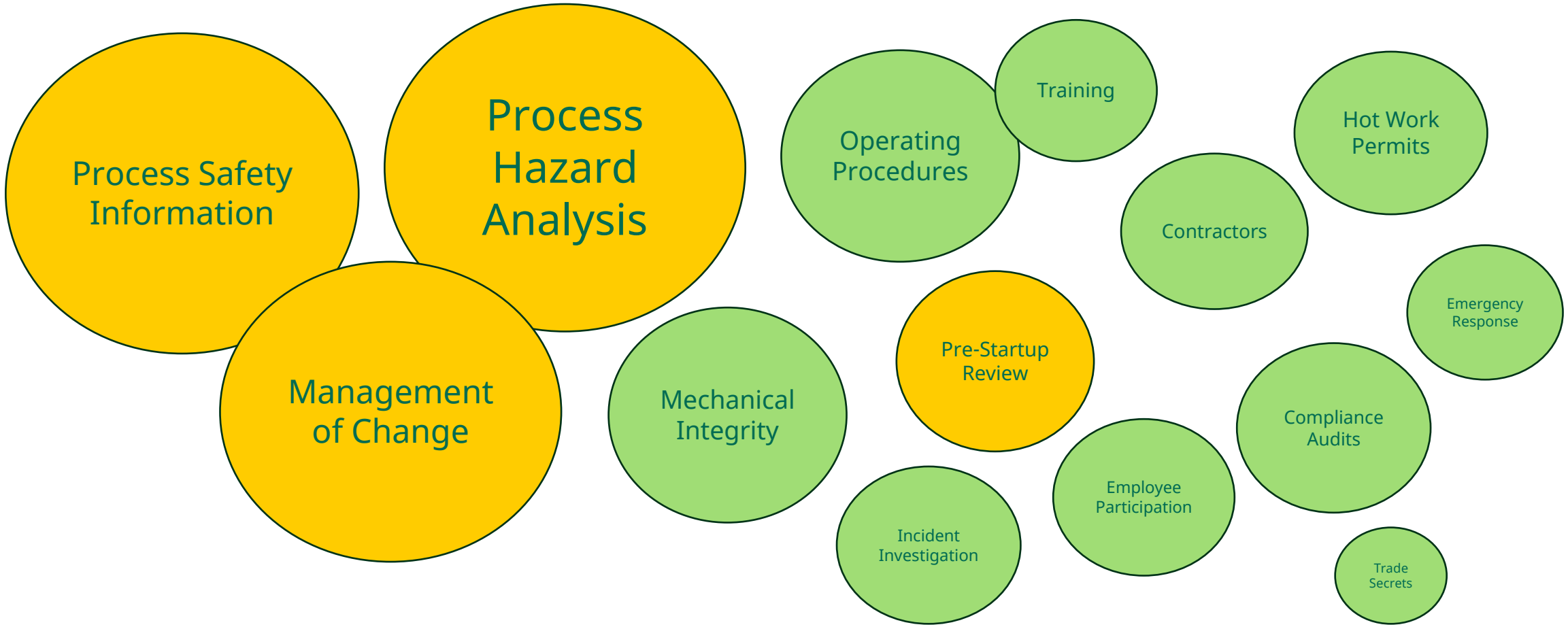
Perceived Pain of Requirement

How much effort is perceived to be required (relatively)



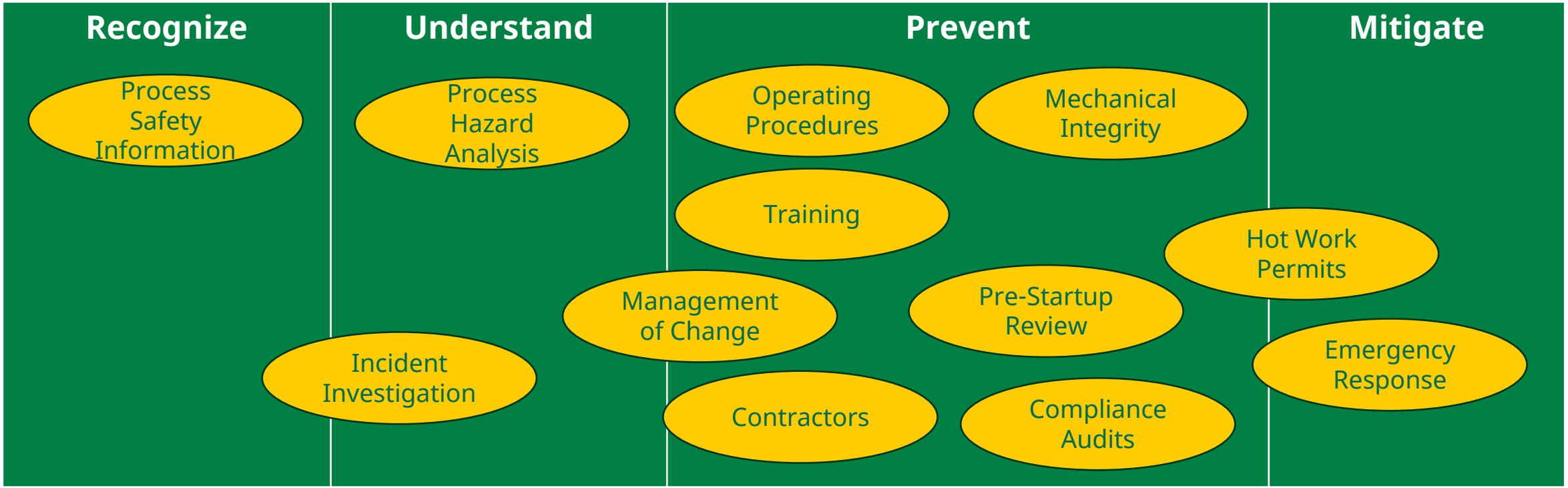
Perceived Pain of Requirement

Some of these are likely already addressed to some degree in other management systems (quality, environmental, operational) or regulations (OSHA, Fire Code, EPA…)



How to look at the elements

Essentially: Recognize the Hazards, Understand the Risk, Prevent an Incident, Minimize the Impact of an Incident



Employee Participation and Trade Secrets are in all areas

How to look at the elements

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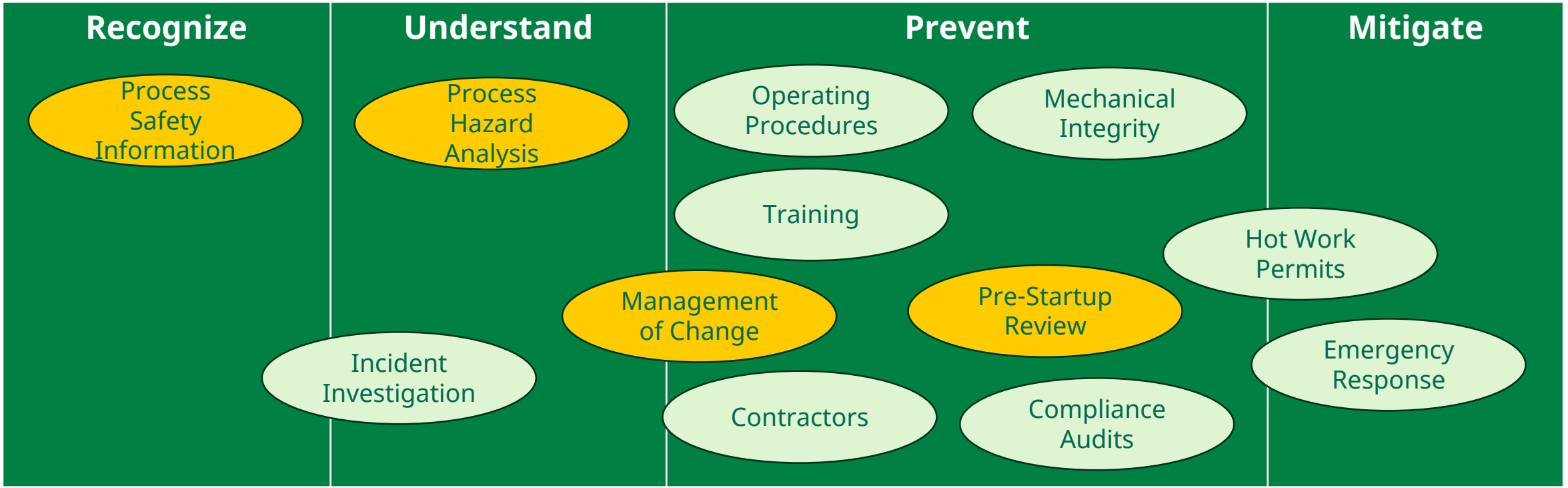


Employee Participation and Trade Secrets are in all areas

What approach to use - All, Some, None?

None – No.

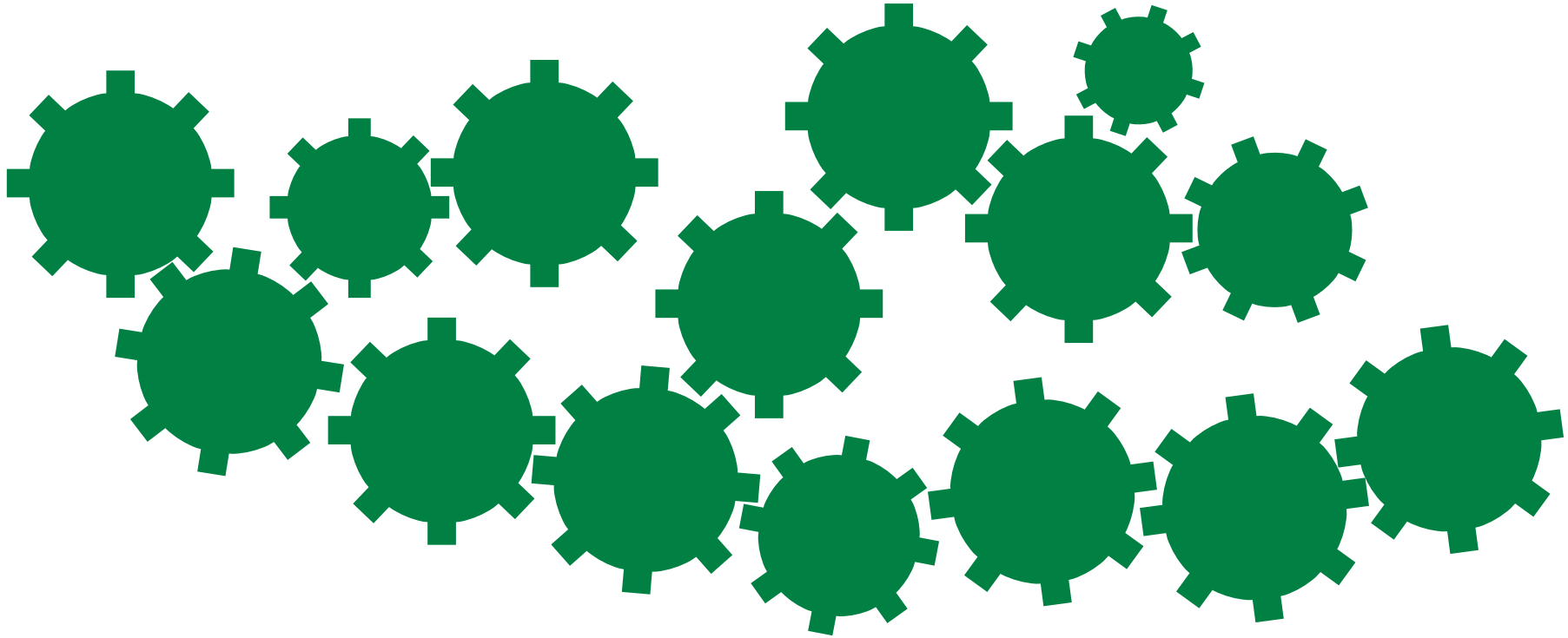
Hazards and Risks are there regardless of if you manage them

Some – Better than nothing

Key aspects may be missed

All – Yes

A management SYSTEM needs to have all the parts working together



Right Sizing

Putting in place all the elements needs to have the size of the elements tailored to the specific needs.

There is not/should not be a one size fits all approach.

What do your existing system provide and what needs to be added.

Manage the Risks!

Where to get started in PSM?

All elements are important.

Start with:

1. Process Safety Knowledge – If you do not know what you have, you can't identify a problem.
2. Hazard Identification and Risk Analysis – You need to understand what could happen and what controls are needed/valuable.
3. Management of Change – You need to understand the impact of changes and the related potential changes in risks.

Asset Integrity and Reliability and Incident Investigations would be next on the list. Many other elements may only need a tweak to align into the PSM.

Each element must be right sized, well implemented, and connected into the Management System.

Process Safety Knowledge

Three main categories:

- Equipment
- Chemistry
- Process

Need to be sure key information is captured.

Can be formal files/folders.

Can be compiled into a summary workbook with three (or more) tabs.

The level of detail in each tab can vary.

Process Safety Knowledge

Equipment:

What to document:

- Pressure Rating
- Temperature Rating
- Materials of Construction
- Other Key Information (mixing, cooling/heating capacity, electrical classification, surface temperature…)
- Past contents/uses

Where to get information:

- Get from vendor - especially if equipment has a serial number
- Prior Experiments / Production Runs

Can use different tabs for different types of equipment

			Vessel/Trim				Electrical				Safety			Use	
Name	Serial Number	Description/Notes	Volume	MAWP	MAWT	Materials of Contstruction	Wattage	Max RPM	Max Torque	Electrical Rating	Safety Devices	Relief Orifice Size	Relief Pressure Set	Past uses	Reference
Reactor		Lab Reactor	1	800	400	Hasteloy, Kalrez,	NA	500	Unk	Standard				HCl, Solve	https://Parr.com
Heater	12345	Jacket on Reactor	NA	NA	700	Stainless	1200	NA	NA	Standard	Fuse - 20A				
Relief 1		Relief on Reactor		700	300	Hasteloy, Kalrez	NA			NA		0.25	600		

Process Safety Knowledge

Chemicals:

Chemical	Isopropanol	70% Nitric Acid	Heptane	3
Isopropanol				
70% Nitric Acid	R			
Heptane	G	R		
3				

What to document:

- Molecular Weight / Chemical Structure / Compatibility / Reactivity
- Freeze Point / Boiling Point / Vapor Pressure / Specific Gravity
- Flammable Range and Auto Ignition Temperature
- GHS H-codes (other hazards)

Where to get information?

- Most is on SDS
- NIH PubChem - https://pubchem.ncbi.nlm.nih.gov/
- Published internal/external reports

May need testing on specific chemicals

Chemical	Moiety	MW	Freeze Pt	Boiling Pt	Viscosity	Density	Vapor Press	Heat Cap (l)	Heat Cap (g)	LEL	UEL	AIT	LC50	STEL	Incompatibilities	Decomp Temp	GHS	SDS
Isopropanol	OH	60.1	-89	82	2.3	0.8	40	2.68	1.54	2	13	399	16000	1225	Oxidizers	Unk	H225,H302, H319, H336	https://ChemSource.com/IPA
70% Nitric Acid	H	63	-41	NA	UNK	1.4	48	Unk	Unk	NA	NA	NA	2500	4	Organics, Bases	NA	H272, H314	Nitric Acid 70% 3744.pdf
Heptane		100.2	-91	98		0.683	36	2.24	1.996	1.05	6.07	215	18375	500	Oxidizers	Unk	H225, H304,H315,H336,H410	Heptane SDS
3																		
4																		

Process Safety Knowledge

Process:

What to document:

- Intended Reactions and Unintended Reactions
- Mass Balances
- Enthalpies of Reactions / Adiabatic Temperature Rise
- Volumes
- Desired Pressure / Temperature / Flows
- Interfaces (analysis, maintenance, waste handling)

Where to get information?

- Published Reports
- Prior Experiments
- Similar work (similar moieties)

Caution – Highlight any uncertainty with data sources

May need testing on specific reactions

Hazard Identification and Risk Analysis

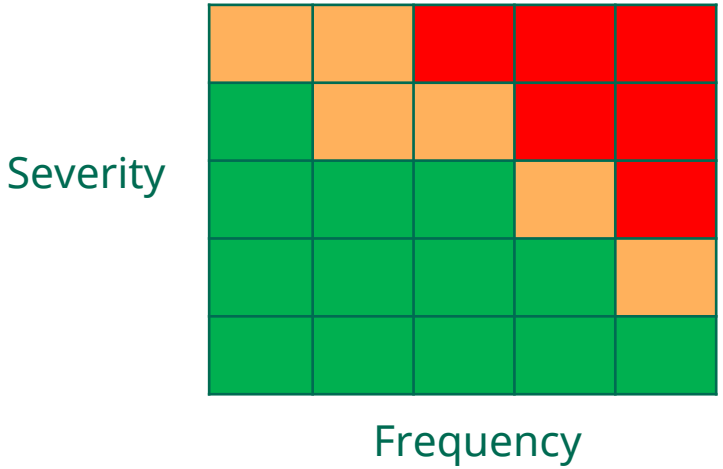
Approaches:

- LOPA
- HAZOP
- What-If
- How / Why
- Checklists

Keys:

- The Right People
- Balance
  - Complexity of the Process
  - Significance of Hazard
  - Robustness of Approach
  - Effort for HIRA

A Risk Matrix is useful to communicate and prioritize recommendations.



Hazard Identification and Risk Analysis

Right size to the risk

Approach	Effort	Knowledge Required	Robustness	Concerns
HAZOP	Large	Medium / Varied	Very	Effort can be very large
What-If (How / Why)	Medium	Large	Focused	Relies on good hazard recognition and experience
Checklist	Small	Small	Limited	Can limit thought to only the prompts on the checklist

Often a Checklist or What-If (How / Why) will work

Management of Change

Use for all changes that are not like for like (within parameters)

Evaluate the impact of the change (HIRA)

Risk Based/Progressive Approach

Can use risk banding to aid in approach selection and reviewers

Can also use MOC review levels for initial reviews

Approach =➔ Who =➔	High-Level Review Extra Experts	Medium-Level Review Extra Experts	Medium-Level Review Peer	Low-Level Review Peer
Flammable Liquid	>5L	1L-5L	0.1L to 1 L	<100 mL
Pressure*V	>50 bargL	10-50 bargL	0-10 bargL	Ambient
Acutely Toxic	10g	0-10g		
Experience of operators	Not Applicable	First 2 experiments	3-5 experiments	>5 experiments
Heat of reaction	50 cal/g	10 cal/g	0-10 cal/g or endothermic	0 cal/g
…				

Example for a lab setting with chemists and co-ops

Management of Change

Understand what is the impact of the change.

- Equipment
- Process
- Product
- Facility
- Other Nearby Activity
- Communications

Generate and CLOSE actions

Update documentation

MOC does not need to be excessively complicated

Management of Change

Title:	
Requestor:	
Date:	
Location:	

Score/Level:

Highlight Change in each category

		Level 1	Level 2	Level 3
Chemistry	Flammable	>5L	100ml - 5L	<100 ml
	Toxic	10g	0-10g	None
	Corrosive	>10L	1-10L	<1L
	Asphyxiant	Cryogen Liquids	Cylinders	None
	Reactive	50 cal/g	10 to 50 cal/g	<10 cal/g or endothermic
Equipment	Heaters			
	Vessels			
	Pipe/Tube			
	Chillers			
Process	Pressure			
	Temperature			
	Order/Procedure			
Environment	Ventilation			
	Electrical in Area			
	Walls/Furniture			
People	New Operator			
Procedure	Amount of Change	New Steps/Procedures	Values within parameters	Edit only

Detailed Description:

Alternatives:

Approvals:

	Name	Date
Author:		
Manager:		
Reviewer:		
Role:		
Role:		
Role:		
Role:		

Completion

	Completed By	Date	Comment
Procedures Updated			
Drawings Updated			
Process Safety Info Updated			
Maintenance Updated			
Training Complete:			
Communication Complete:			
Pre Start Up Safety Review:			

Where to get started in PSM

All elements are important

Start with:

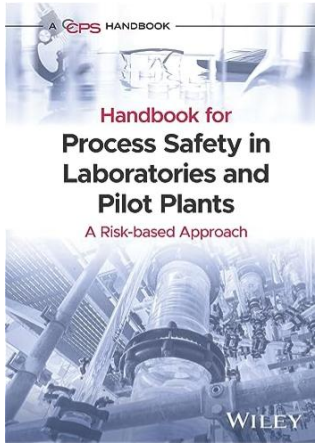
1. Process Safety Knowledge – If you do not know what you have, you can’t identify a problem.
2. Hazard Identification and Risk Analysis – You need to understand what could happen and what controls are needed/valuable.
3. Management of Change – You need to understand the impact of changes and the related potential changes in risks.

Additional Resources

- Process Safety Management - Hazard Recognition | OSHA.gov | Occupational Safety and Health Administration - OSHA
- Risk Based Process Safety – AIChE
- Process Safety Media Center - DEKRA Process Safety - DEKRA

• Jeff Foisel

Lab Process Safety Specialist



Contact Information:

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For Reference –
OSHA PSM
(not including the date driven requirements)

Employee Participation

1910.119(c) Employee participation.

1910.119(c)(1) Employers shall develop a written plan of action regarding the implementation of the employee participation required by this paragraph.

1910.119(c)(2) Employers shall consult with employees and their representatives on the conduct and development of process hazards analyses and on the development of the other elements of process safety management in this standard.

1910.119(c)(3) Employers shall provide to employees and their representatives access to process hazard analyses and to all other information required to be developed under this standard.

Process Safety Information

1910.119(d) Process safety information.

In accordance with the schedule set forth in paragraph (e)(1) of this section, the employer shall complete a compilation of written process safety information before conducting any process hazard analysis required by the standard. The compilation of written process safety information is to enable the employer and the employees involved in operating the process to identify and understand the hazards posed by those processes involving highly hazardous chemicals. This process safety information shall include information pertaining to the hazards of the highly hazardous chemicals used or produced by the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

1910.119(d)(1) Information pertaining to the hazards of the highly hazardous chemicals in the process. This information shall consist of at least the following:

1910.119(d)(1)(i) Toxicity information;

1910.119(d)(1)(ii) Permissible exposure limits;

1910.119(d)(1)(iii) Physical data;

1910.119(d)(1)(iv) Reactivity data:

1910.119(d)(1)(v) Corrosivity data;

1910.119(d)(1)(vi) Thermal and chemical stability data; and

1910.119(d)(1)(vii) Hazardous effects of inadvertent mixing of different materials that could foreseeably occur.

Note: Safety data sheets meeting the requirements of 29 CFR 1910.1200(g) may be used to comply with this requirement to the extent they contain the information required by this subparagraph.

Process Safety Information (Continued)

1910.119(d)(2) Information pertaining to the technology of the process.

1910.119(d)(2)(i) Information concerning the technology of the process shall include at least the following:

1910.119(d)(2)(i)(A) A block flow diagram or simplified process flow diagram (see appendix B to this section);

1910.119(d)(2)(i)(C) Maximum intended inventory;

1910.119(d)(2)(i)(D) Safe upper and lower limits for such items as temperatures, pressures, flows or compositions; and,

1910.119(d)(2)(i)(E) An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

Process Safety Information (Continued)

1910.119(d)(3) Information pertaining to the equipment in the process.

1910.119(d)(3)(i) Information pertaining to the equipment in the process shall include:

1910.119(d)(3)(i)(A) Materials of construction;

1910.119(d)(3)(i)(B) Piping and instrument diagrams (P&ID's);

1910.119(d)(3)(i)(C) Electrical classification;

1910.119(d)(3)(i)(D) Relief system design and design basis;

1910.119(d)(3)(i)(E) Ventilation system design;

1910.119(d)(3)(i)(F) Design codes and standards employed;

1910.119(d)(3)(i)(G) Material and energy balances for processes built after May 26, 1992; and,

1910.119(d)(3)(i)(H) Safety systems (e.g. interlocks, detection or suppression systems).

1910.119(d)(3)(ii) The employer shall document that equipment complies with recognized and generally accepted good engineering practices.

1910.119(d)(3)(iii) For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the employer shall determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner.

Process Hazard Analysis

1910.119(e) Process hazard analysis.

1910.119(e)(1) The employer shall perform an initial process hazard analysis (hazard evaluation) on processes covered by this standard. The process hazard analysis shall be appropriate to the complexity of the process and shall identify, evaluate, and control the hazards involved in the process. Employers shall determine and document the priority order for conducting process hazard analyses based on a rationale which includes such considerations as extent of the process hazards, number of potentially affected employees, age of the process, and operating history of the process.

1910.119(e)(2) The employer shall use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed.

1910.119(e)(2)(i) What-If;

1910.119(e)(2)(ii) Checklist;

1910.119(e)(2)(iii) What-If/Checklist;

1910.119(e)(2)(iv) Hazard and Operability Study (HAZOP);

1910.119(e)(2)(v) Failure Mode and Effects Analysis (FMEA);

1910.119(e)(2)(vi) Fault Tree Analysis; or

1910.119(e)(2)(vii) An appropriate equivalent methodology.

Process Hazard Analysis (Continued)

1910.119(e)(3) The process hazard analysis shall address:

1910.119(e)(3)(i) The hazards of the process;

1910.119(e)(3)(ii) The identification of any previous incident which had a likely potential for catastrophic consequences in the workplace;

1910.119(e)(3)(iii) Engineering and administrative controls applicable to the hazards and their interrelationships such as appropriate application of detection methodologies to provide early warning of releases. (Acceptable detection methods might include process monitoring and control instrumentation with alarms, and detection hardware such as hydrocarbon sensors.);

1910.119(e)(3)(iv) Consequences of failure of engineering and administrative controls;

1910.119(e)(3)(v) Facility siting;

1910.119(e)(3)(vi) Human factors; and

1910.119(e)(3)(vii) A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace.

Process Hazard Analysis (Continued)

1910.119(e)(4) The process hazard analysis shall be performed by a team with expertise in engineering and process operations, and the team shall include at least one employee who has experience and knowledge specific to the process being evaluated. Also, one member of the team must be knowledgeable in the specific process hazard analysis methodology being used.

1910.119(e)(5) The employer shall establish a system to promptly address the team's findings and recommendations; assure that the recommendations are resolved in a timely manner and that the resolution is documented; document what actions are to be taken; complete actions as soon as possible; develop a written schedule of when these actions are to be completed; communicate the actions to operating, maintenance and other employees whose work assignments are in the process and who may be affected by the recommendations or actions.

1910.119(e)(6) At least every five (5) years after the completion of the initial process hazard analysis, the process hazard analysis shall be updated and revalidated by a team meeting the requirements in paragraph (e)(4) of this section, to assure that the process hazard analysis is consistent with the current process.

1910.119(e)(7) Employers shall retain process hazards analyses and updates or revalidations for each process covered by this section, as well as the documented resolution of recommendations described in paragraph (e)(5) of this section for the life of the process.

Operating Procedures

1910.119(f) Operating procedures.

1910.119(f)(1) The employer shall develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information and shall address at least the following elements.

1910.119(f)(1)(i) Steps for each operating phase:

1910.119(f)(1)(i)(A) Initial startup;

1910.119(f)(1)(i)(B) Normal operations;

1910.119(f)(1)(i)(C) Temporary operations;

1910.119(f)(1)(i)(D) Emergency shutdown including the conditions under which emergency shutdown is required, and the assignment of shutdown responsibility to qualified operators to ensure that emergency shutdown is executed in a safe and timely manner.

1910.119(f)(1)(i)(E) Emergency Operations;

1910.119(f)(1)(i)(F) Normal shutdown; and,

1910.119(f)(1)(i)(G) Startup following a turnaround, or after an emergency shutdown.

Operating Procedures (Continued)

1910.119(f)(1)(ii) Operating limits:

1910.119(f)(1)(ii)(A) Consequences of deviation; and

1910.119(f)(1)(ii)(B) Steps required to correct or avoid deviation.

1910.119(f)(1)(iii) Safety and health considerations:

1910.119(f)(1)(iii)(A) Properties of, and hazards presented by, the chemicals used in the process;

1910.119(f)(1)(iii)(B) Precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment;

1910.119(f)(1)(iii)(C) Control measures to be taken if physical contact or airborne exposure occurs;

1910.119(f)(1)(iii)(D) Quality control for raw materials and control of hazardous chemical inventory levels; and,

1910.119(f)(1)(iii)(E) Any special or unique hazards.

1910.119(f)(1)(iv) Safety systems and their functions.

Operating Procedures (Continued)

1910.119(f)(2) Operating procedures shall be readily accessible to employees who work in or maintain a process.

1910.119(f)(3) The operating procedures shall be reviewed as often as necessary to assure that they reflect current operating practice, including changes that result from changes in process chemicals, technology, and equipment, and changes to facilities. The employer shall certify annually that these operating procedures are current and accurate.

1910.119(f)(4) The employer shall develop and implement safe work practices to provide for the control of hazards during operations such as lockout/tagout; confined space entry; opening process equipment or piping; and control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel. These safe work practices shall apply to employees and contractor employees.

Training

1910.119(g) Training

1910.119(g)(1) Initial training.

1910.119(g)(1)(i) Each employee presently involved in operating a process, and each employee before being involved in operating a newly assigned process, shall be trained in an overview of the process and in the operating procedures as specified in paragraph (f) of this section. The training shall include emphasis on the specific safety and health hazards, emergency operations including shutdown, and safe work practices applicable to the employee's job tasks.

1910.119(g)(2) Refresher training. Refresher training shall be provided at least every three years, and more often if necessary, to each employee involved in operating a process to assure that the employee understands and adheres to the current operating procedures of the process. The employer, in consultation with the employees involved in operating the process, shall determine the appropriate frequency of refresher training.

1910.119(g)(3) Training documentation. The employer shall ascertain that each employee involved in operating a process has received and understood the training required by this paragraph. The employer shall prepare a record which contains the identity of the employee, the date of training, and the means used to verify that the employee understood the training.

Contractors

1910.119(h) Contractors -

1910.119(h)(1) Application. This paragraph applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process. It does not apply to contractors providing incidental services which do not influence process safety, such as janitorial work, food and drink services, laundry, delivery or other supply services.

1910.119(h)(2) Employer responsibilities.

1910.119(h)(2)(i) The employer, when selecting a contractor, shall obtain and evaluate information regarding the contract employer's safety performance and programs.

1910.119(h)(2)(ii) The employer shall inform contract employers of the known potential fire, explosion, or toxic release hazards related to the contractor's work and the process.

1910.119(h)(2)(iii) The employer shall explain to contract employers the applicable provisions of the emergency action plan required by paragraph (n) of this section.

1910.119(h)(2)(iv) The employer shall develop and implement safe work practices consistent with paragraph (f)(4) of this section, to control the entrance, presence and exit of contract employers and contract employees in covered process areas.

1910.119(h)(2)(v) The employer shall periodically evaluate the performance of contract employers in fulfilling their obligations as specified in paragraph (h)(3) of this section.

1910.119(h)(2)(vi) The employer shall maintain a contract employee injury and illness log related to the contractor's work in process areas.

Contractors (Continued)

1910.119(h)(3) Contract employer responsibilities.

1910.119(h)(3)(i) The contract employer shall assure that each contract employee is trained in the work practices necessary to safely perform his/her job.

1910.119(h)(3)(ii) The contract employer shall assure that each contract employee is instructed in the known potential fire, explosion, or toxic release hazards related to his/her job and the process, and the applicable provisions of the emergency action plan.

1910.119(h)(3)(iii) The contract employer shall document that each contract employee has received and understood the training required by this paragraph. The contract employer shall prepare a record which contains the identity of the contract employee, the date of training, and the means used to verify that the employee understood the training.

1910.119(h)(3)(iv) The contract employer shall assure that each contract employee follows the safety rules of the facility including the safe work practices required by paragraph (f)(4) of this section.

1910.119(h)(3)(v) The contract employer shall advise the employer of any unique hazards presented by the contract employer's work, or of any hazards found by the contract employer's work.

Pre-Startup Review

1910.119(i) Pre-startup safety review.

1910.119(i)(1) The employer shall perform a pre-startup safety review for new facilities and for modified facilities when the modification is significant enough to require a change in the process safety information.

1910.119(i)(2) The pre-startup safety review shall confirm that prior to the introduction of highly hazardous chemicals to a process:

1910.119(i)(2)(i) Construction and equipment is in accordance with design specifications;

1910.119(i)(2)(ii) Safety, operating, maintenance, and emergency procedures are in place and are adequate;

1910.119(i)(2)(iii) For new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup; and modified facilities meet the requirements contained in management of change, paragraph (l).

1910.119(i)(2)(iv) Training of each employee involved in operating a process has been completed.

Mechanical Integrity

1910.119(j) Mechanical integrity

1910.119(j)(1) Application. Paragraphs (j)(2) through (j)(6) of this section apply to the following process equipment:

1910.119(j)(1)(i) Pressure vessels and storage tanks;

1910.119(j)(1)(ii) Piping systems (including piping components such as valves);

1910.119(j)(1)(iii) Relief and vent systems and devices;

1910.119(j)(1)(iv) Emergency shutdown systems;

1910.119(j)(1)(v) Controls (including monitoring devices and sensors, alarms, and interlocks) and,

1910.119(j)(1)(vi) Pumps.

1910.119(j)(2) Written procedures. The employer shall establish and implement written procedures to maintain the on-going integrity of process equipment.

1910.119(j)(3) Training for process maintenance activities. The employer shall train each employee involved in maintaining the on-going integrity of process equipment in an overview of that process and its hazards and in the procedures applicable to the employee's job tasks to assure that the employee can perform the job tasks in a safe manner.

Mechanical Integrity (Continued)

1910.119(j)(4) Inspection and testing.

1910.119(j)(4)(i) Inspections and tests shall be performed on process equipment.

1910.119(j)(4)(ii) Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.

1910.119(j)(4)(iii) The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and good engineering practices, and more frequently if determined to be necessary by prior operating experience.

1910.119(j)(4)(iv) The employer shall document each inspection and test that has been performed on process equipment. The documentation shall identify the date of the inspection or test, the name of the person who performed the inspection or test, the serial number or other identifier of the equipment on which the inspection or test was performed, a description of the inspection or test performed, and the results of the inspection or test.

1910.119(j)(5) Equipment deficiencies. The employer shall correct deficiencies in equipment that are outside acceptable limits (defined by the process safety information in paragraph (d) of this section) before further use or in a safe and timely manner when necessary means are taken to assure safe operation.

Mechanical Integrity (Continued)

1910.119(j)(6) Quality assurance.

1910.119(j)(6)(i) In the construction of new plants and equipment, the employer shall assure that equipment as it is fabricated is suitable for the process application for which they will be used.

1910.119(j)(6)(ii) Appropriate checks and inspections shall be performed to assure that equipment is installed properly and consistent with design specifications and the manufacturer's instructions.

1910.119(j)(6)(iii) The employer shall assure that maintenance materials, spare parts and equipment are suitable for the process application for which they will be used.

Hot Work Permit

1910.119(k) Hot work permit.

1910.119(k)(1) The employer shall issue a hot work permit for hot work operations conducted on or near a covered process.

1910.119(k)(2) The permit shall document that the fire prevention and protection requirements in 29 CFR 1910.252(a) have been implemented prior to beginning the hot work operations; it shall indicate the date(s) authorized for hot work; and identify the object on which hot work is to be performed. The permit shall be kept on file until completion of the hot work operations.

Management of Change

1910.119(l) Management of change.

1910.119(l)(1) The employer shall establish and implement written procedures to manage changes (except for "replacements in kind") to process chemicals, technology, equipment, and procedures; and, changes to facilities that affect a covered process.

1910.119(l)(2) The procedures shall assure that the following considerations are addressed prior to any change:

1910.119(l)(2)(i) The technical basis for the proposed change;

1910.119(l)(2)(ii) Impact of change on safety and health;

1910.119(l)(2)(iii) Modifications to operating procedures;

1910.119(l)(2)(iv) Necessary time period for the change; and,

1910.119(l)(2)(v) Authorization requirements for the proposed change.

1910.119(l)(3) Employees involved in operating a process and maintenance and contract employees whose job tasks will be affected by a change in the process shall be informed of, and trained in, the change prior to start-up of the process or affected part of the process.

1910.119(l)(4) If a change covered by this paragraph results in a change in the process safety information required by paragraph (d) of this section, such information shall be updated accordingly.

1910.119(l)(5) If a change covered by this paragraph results in a change in the operating procedures or practices required by paragraph (f) of this section, such procedures or practices shall be updated accordingly.

Incident Investigations

1910.119(m) Incident investigation.

1910.119(m)(1) The employer shall investigate each incident which resulted in, or could reasonably have resulted in a catastrophic release of highly hazardous chemical in the workplace.

1910.119(m)(2) An incident investigation shall be initiated as promptly as possible, but not later than 48 hours following the incident.

1910.119(m)(3) An incident investigation team shall be established and consist of at least one person knowledgeable in the process involved, including a contract employee if the incident involved work of the contractor, and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident.

1910.119(m)(4) A report shall be prepared at the conclusion of the investigation which includes at a minimum:

1910.119(m)(4)(i) Date of incident;

1910.119(m)(4)(ii) Date investigation began;

1910.119(m)(4)(iii) A description of the incident;

1910.119(m)(4)(iv) The factors that contributed to the incident; and,

1910.119(m)(4)(v) Any recommendations resulting from the investigation.

Incident Investigations (Continued)

1910.119(m)(5) The employer shall establish a system to promptly address and resolve the incident report findings and recommendations. Resolutions and corrective actions shall be documented.

1910.119(m)(6) The report shall be reviewed with all affected personnel whose job tasks are relevant to the incident findings including contract employees where applicable.

1910.119(m)(7) Incident investigation reports shall be retained for five years.

Emergency Response

1910.119(n) Emergency planning and response. The employer shall establish and implement an emergency action plan for the entire plant in accordance with the provisions of 29 CFR 1910.38. In addition, the emergency action plan shall include procedures for handling small releases. Employers covered under this standard may also be subject to the hazardous waste and emergency response provisions contained in 29 CFR 1910.120 (a), (p) and (q).

Compliance Audits

1910.119(o) Compliance Audits.

1910.119(o)(1) Employers shall certify that they have evaluated compliance with the provisions of this section at least every three years to verify that the procedures and practices developed under the standard are adequate and are being followed.

1910.119(o)(2) The compliance audit shall be conducted by at least one person knowledgeable in the process.

1910.119(o)(3) A report of the findings of the audit shall be developed.

1910.119(o)(4) The employer shall promptly determine and document an appropriate response to each of the findings of the compliance audit, and document that deficiencies have been corrected.

1910.119(o)(5) Employers shall retain the two (2) most recent compliance audit reports.

Trade Secrets

1910.119(p) Trade secrets.

1910.119(p)(1) Employers shall make all information necessary to comply with the section available to those persons responsible for compiling the process safety information (required by paragraph (d) of this section), those assisting in the development of the process hazard analysis (required by paragraph (e) of this section), those responsible for developing the operating procedures (required by paragraph (f) of this section), and those involved in incident investigations (required by paragraph (m) of this section), emergency planning and response (paragraph (n) of this section) and compliance audits (paragraph (o) of this section) without regard to possible trade secret status of such information.

1910.119(p)(2) Nothing in this paragraph shall preclude the employer from requiring the persons to whom the information is made available under paragraph (p)(1) of this section to enter into confidentiality agreements not to disclose the information as set forth in 29 CFR 1910.1200.

1910.119(p)(3) Subject to the rules and procedures set forth in 29 CFR 1910.1200(i)(1) through 1910.1200(i)(12), employees and their designated representatives shall have access to trade secret information contained within the process hazard analysis and other documents required to be developed by this standard.

References

1910.119 - Process safety management of highly hazardous chemicals. | Occupational Safety and Health Administration