

INTRODUCTIONS

- PSM/RMP Covered Process?
 - Types:
 - Ammonia
 - Chlorine
 - Flammables
 - Chemical
 - Oil/Gas
- What do we want to cover?

BORDERS ICE CREAM, HOUSTON, TEXAS– DECEMBER 12, 1983



Brandworthy Food Solutions



At approximately 1:20 p.m. on March 23, 2005, a series of explosions occurred at the BP Texas City refinery during the restarting of a hydrocarbon isomerization unit. Fifteen workers were killed and 180 others were injured. Many of the victims were in or around work trailers located near an atmospheric vent stack. The explosions occurred when a distillation tower flooded with hydrocarbons and was overpressurized, causing a geyser-like release from the vent stack.

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On the night of December 2-3, 1984, a sudden release of about 30 metric tons of methyl isocyanate (MIC) occurred at the Union Carbide pesticide plant at Bhopal, India. The accident was a result of poor safety management practices, poor early warning systems, and the lack of community preparedness. The accident led to the death of over 2,800 people (other estimates put the immediate death toll as high as 8000) living in the vicinity and caused respiratory damage and eye damage to over 20,000 others. At least 200,000 people fled Bhopal during the week after the accident. Estimates of the damage vary widely between \$350 million to as high as \$3 billion.

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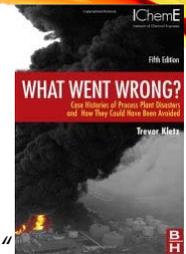
WEST, TEXAS



Brandworthy Food Solutions

TREVOR KLETZ, 1922-2013

- *"Safety is something a lot of people learn by accident"*
- *"There's an old saying that if you think safety is expensive, try an accident. Accidents cost a lot of money. And, not only in damage to plant and in claims for injury, but also in the loss of the company's reputation."*
- *"For a long time, people were saying that most accidents were due to human error and this is true in a sense but it's not very helpful. It's a bit like saying that falls are due to gravity."*



OVERVIEW

- Process Safety Management – 29 CFR 1910.119
 - Worker Protection
 - 10,000 pounds of listed chemical or flammables
 - 14 Elements
 - Performance Standard
- Risk Management Plan – 40 CFR part 68
 - Community/Environment Protection
 - File with EPA

TOP 17 PARTS OF PSM CITED

- 1. Written MI Procedures
- 2. Perform an initial PHA
- 3. Written procedures to manage change
- 4. Document RAGAGEP compliance
- 5. Written Employee Participation Plan
- 6. Develop and Implement SOPs
- 7. Correct deficiencies outside limits
- 8. Trained in SOPs
- 9. System to Promptly address PHA findings & recommendations
- 10. Emergency Planning and Response
- 11. Annual SOP Certification
- 12. Inspections/tests on equipment
- 13. Training means used to verify
- 14. 3 year compliance audit certification
- 15. Steps for each operating phase
- 16. P&IDs
- 17. Safe Work Practices

PROCESS SAFETY INFORMATION (PSI)

Information pertaining to the HAZARDS OF THE HIGHLY HAZARDOUS CHEMICALS in the process shall consist of at least the following:

- Toxicity information
- Permissible exposure limits
- Physical data
- Reactivity data
- Corrosivity data
- Thermal and chemical stability data
- Hazardous effects of inadvertent mixing of different materials that could foreseeably occur

Note: Material 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 (PSI)

Information concerning the TECHNOLOGY OF THE PROCESS includes at least the following:

- A block flow diagram or simplified process flow diagram
- Process chemistry (**Does this apply to NH3 refrigeration????**)
- Maximum intended inventory
- Safe **UPPER** and **LOWER** limits for such items as temperatures, pressures, flows or compositions
- An evaluation of the consequences of deviations, including those affecting the safety and health of employees.
- Where the original technical information no longer exists, such information may be developed in conjunction with the process hazard analysis in sufficient detail to support the analysis.

PROCESS SAFETY INFORMATION (PSI)

Information pertaining to the **EQUIPMENT IN THE PROCESS** shall include:

- Materials of Construction
- Piping and Instrument Diagrams (P&ID's)
- Electrical classification
- Relief system design and design basis
- Ventilation system design
- Design codes & standards employed
- Material and energy balances for processes built after May 26, 1992
- Safety systems (e.g. interlocks, detection or suppression systems)
- Document that equipment complies with **RECOGNIZED AND GENERALLY ACCEPTED GOOD ENGINEERING PRACTICES (RAGAGEP)**.
- 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 SAFETY INFORMATION (PSI)

Recognized **A**nd **G**enerally **A**ccepted **G**ood **E**ngineering **P**ractices (RAGAGEP) are engineering, operation, or maintenance activities based on **ESTABLISHED** codes, standards, published technical reports or recommended practices (RP) or a similar document.

RAGAGEPs detail generally approved ways to perform specific engineering, inspection or mechanical integrity activities, such as fabricating a vessel, inspecting a storage tank, or servicing a relief valve.

PROCESS HAZARD ANALYSIS (PHA)

- Perform an initial PHA (hazard evaluation)
- PHA MUST be appropriate to the complexity of the process and **identify, evaluate,** and **control the hazards** involved in the process.
- Use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed
 - What-If
 - Checklist
 - What-If/Checklist
 - Hazard and Operability Study (HAZOP)
 - Failure Mode and Effects Analysis (FMEA)
 - Fault Tree Analysis
 - An appropriate equivalent methodology

PROCESS HAZARD ANALYSIS (PHA)

- PHA MUST address:
 - hazards of the process
 - identification of any previous incident which had a likely potential for catastrophic consequences in the workplace
 - 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
 - Consequences of failure of engineering and administrative controls
 - Facility siting
 - Human factors
 - A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace
- PHA MUST be performed by a team with expertise in engineering and process operations
- Team MUST include at least:
 - One employee who has experience and knowledge specific to the process being evaluated.
 - One member of the team must be knowledgeable in the specific process hazard analysis methodology being used.

PROCESS HAZARD ANALYSIS (PHA)

- Establish a system to:
 - **PROMPTLY ADDRESS** 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
- **AT LEAST EVERY FIVE (5) YEARS** after the completion of the initial PHA, update/revalidate using a team meeting the requirements stated early, to assure that the PHA is consistent with the current process
- Retain PHA(s) and **UPDATES/REVALIDATIONS** for each process, as well as the documented resolution of recommendations for the **LIFE OF THE PROCESS**

OPERATING PROCEDURES (SOPS)

- Develop and implement **WRITTEN OPERATING PROCEDURES** that provide clear instructions for safely conducting activities involved in each covered process consistent with the PSI and address at least the following elements:
 1. Steps for each operating phase
 - Initial startup
 - Normal operations
 - Temporary operations
 - 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.
 - Emergency Operations
 - Normal shutdown
 - Startup following a turnaround, or after an emergency shutdown
 2. Operating limits
 - Consequences of deviation and Steps required to correct or avoid deviation

OPERATING PROCEDURES (SOPS)

3. Safety and health considerations:

- Properties of, and hazards presented by, the chemicals used in the process
- Precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment
- Control measures to be taken if physical contact or airborne exposure occurs

4. Quality control for raw materials and control of hazardous chemical inventory levels

5. Any special or unique hazards

6. Safety systems and their functions

- SOPs MUST be **READILY ACCESSIBLE** to employees who work in or maintain a process.
- SOPs 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.
- **CERTIFY ANNUALLY** that SOPs are current and accurate.
- Develop and implement safe work practices to provide for the control of hazards during operations such as LOTO, CSE, 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.

OPERATING PROCEDURES (SOPS)

- 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
 - Control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel
- Safe work practices apply to **EMPLOYEES AND CONTRACTOR EMPLOYEES.**

TRAINING

- Initial training
 - Each employee presently involved in operating a process, and each employee before being involved in operating a newly assigned process, **MUST BE** trained in
 - an overview of the process and
 - in the SOPs and SWPs
 - Training must **EMPHASIS** the:
 - specific safety and health hazards,
 - emergency operations including shutdown, and
 - safe work practices applicable to the employee's job tasks
- Refresher training
 - **MUST** be provided **AT LEAST every three (3) 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 SOPs and SWPs of the process
 - In consultation with the employees involved in operating the process, determine the appropriate frequency of refresher training
- Training documentation
 - Ascertain that **each employee involved in operating a process** has received and **UNDERSTOOD** the training
 - Prepare a record which contains:
 - the identity of the employee,
 - the date of training
 - the means used to **VERIFY THAT THE EMPLOYEE UNDERSTOOD** the training

PRE-STARTUP SAFETY REVIEW (PSSR)

- Perform a pre-startup safety review for
 - new facilities and
 - modified facilities when the modification is significant enough to require a change in PSI
- PSSRs confirm that prior to the introduction of HHC to a process:
 - Construction and equipment is in accordance with design specifications
 - Safety, operating, maintenance, and emergency procedures are in place and are adequate
 - For new facilities, a PHA has been performed and recommendations have been resolved or implemented **before startup**
 - Modified facilities meet the requirements contained in the MOC
 - Training of each employee involved in operating/maintaining a process has been completed

MECHANICAL INTEGRITY (MI)

- Applies to the following process equipment:
 - Pressure vessels and storage tanks
 - Piping systems (including piping components such as valves (including drain/vent valves), gaskets, thread dope)
 - Relief and vent systems and devices (PSV, Hydrostats, Rupture Disc)
 - Emergency shutdown systems
 - Controls (including monitoring devices and sensors, alarms, and interlocks)
 - Pumps
- Establish and implement **WRITTEN PROCEDURES** to maintain the on-going integrity of process equipment
- **TRAIN** each employee involved in maintaining the on-going integrity of process equipment in:
 - an overview of that process
 - its hazards
 - 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 (MI)

Inspection and Testing...

- Inspections and tests **MUST** be performed on process equipment
- Inspection and testing procedures shall follow RAGAGEPs
- Frequency of inspections and tests of process equipment **MUST** be consistent with applicable **MANUFACTURERS' RECOMMENDATIONS** and RAGAGEPs, and **more frequently if determined to be necessary by prior operating experience**
- Document each inspection and test that has been performed
- Documentation must 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
 - the results of the inspection or test
- RAGAGEP OSHA Definition - https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=30785

MECHANICAL INTEGRITY (MI)

Equipment deficiencies

- **Correct deficiencies in equipment that are outside acceptable limits** (defined by the PSI) before further use or in a safe and timely manner when necessary means are taken to assure safe operation

Quality assurance

- In the construction of new plants and equipment, **assure that equipment as it is fabricated** is suitable for the process application for which they will be used
- Appropriate checks and inspections must be performed to assure that equipment is **installed properly** and **consistent with design specifications** and the **manufacturer's instructions**
- The employer shall assure that **maintenance materials, spare parts and equipment are suitable for the process application** for which they will be used

INCIDENT INVESTIGATION (II)

- Investigate each incident which resulted in, **or could reasonably have resulted in**, a catastrophic release of HHC in the workplace
 - "Catastrophic release" means a major uncontrolled emission, fire, or explosion, involving one or more highly hazardous chemicals, that presents serious danger to employees in the workplace.
- Initiate the investigation as **promptly as possible, but not later than 48 hours following the incident**
- Establish a team to do the investigation and this team must consist of at least one (1) person **knowledgeable in the process involved** and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident
 - Team **MUST** include a contractor if the incident involved work of the contractor **WARNING!** Do not forget about involving the contractor if the equipment that failed was fabricated and/or installed by a contractor!
- A report **MUST** be prepared at the conclusion of the investigation which includes, at a minimum:
 - Date of incident
 - Date investigation began
 - A description of the incident
 - The factors that contributed to the incident
 - Any recommendations resulting from the investigation

INCIDENT INVESTIGATION (II)

- **Establish a system** to promptly address and resolve the incident report findings and recommendations
- **Resolutions and corrective actions shall be documented**
- The report shall be reviewed with **all affected personnel whose job tasks are relevant to the incident findings** including contract employees where applicable
- Incident investigation reports shall be retained for five (5) years
 - Can anyone tell us why 5 years??????

EMERGENCY PLANNING AND RESPONSE

- Establish and implement an emergency action plan (EAP) 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 may also be subject to the hazardous waste and emergency response provisions contained in 29 CFR 1910.120 (a), (p) and (q)

Elements of an EAP

- Procedures for reporting a fire or other emergency
- Procedures for emergency evacuation, including type of evacuation and exit route assignments
- Procedures to be followed by employees who remain to operate critical plant operations before they evacuate
- Procedures to account for all employees after evacuation
- Procedures to be followed by employees performing rescue or medical duties; and
- The name or job title of every employee who may be contacted by employees who need more information about the plan or an explanation of their duties under the plan.

Elements of an ERP

- Pre-emergency planning and coordination with outside parties..
- Personnel roles, lines of authority, training, and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Site security and control.
- Evacuation routes and procedures.
- Decontamination.
- Emergency medical treatment and first aid.
- Emergency alerting and response procedures.
- Critique of response and follow-up.
- PPE and emergency equipment.

COMPLIANCE AUDITS

- Employers shall certify that they have evaluated compliance **at least every three (3) years** to verify that the **procedures and practices developed are adequate and are being followed**
- The compliance audit shall be conducted by at least one (1) person knowledgeable in the covered process
- A report of the findings of the audit shall be developed
- **Promptly determine and document an appropriate response** to **EACH OF THE FINDINGS** of the compliance audit, and **document that deficiencies have been corrected**
- Retain the two (2) most recent compliance audit reports

INTER-RELATIONSHIP OF ELEMENTS

- During a routine inspection of equipment (Mechanical Integrity) or an incident investigation, the maintenance worker discovers a valve that no longer meets the applicable code and must be changed. Because the type of valve is no longer made, a different type of valve must be selected and installed (**Management of Change**). The type of valve selected may mandate different steps for the operators (**Operating Procedures**) who will require training and verification in the new procedures (**Training**). The rationale for selecting the type of valve must be made available for review by employees and their representatives (**Employee Participation**).
- When the new valve is installed by the supplier (**Contractors**), it will involve shutting down part of the process (**Pre-startup Safety Review**) as well as brazing some of the lines (**Hot Work Permit**). The employer must review the response plan (**Emergency Planning**) to ensure that procedures are adequate for the installation hazards.
- Although **Management of Change** provisions cover interim changes, after the new valve is in place the **Process Safety Information** will have to be updated before the **Process Hazard Analysis** is updated or revalidated, to account for potential hazards associated with the new equipment. Also, inspection and maintenance procedures and training will need to be updated (**Mechanical Integrity**).
- These elements shall be cross checked to see if they show that the changes have been followed through to completion.
- In summary, 11 PSM elements can be affected by changing one valve.
- A CSHO would check a representative number of these 11 elements to confirm that the required follow-up activities have been implemented for the new valve.
- Three key elements shall be routinely reviewed to verify that changes have been implemented.
- They are:
 - * Operating Procedures;
 - * Process Hazard Analysis; and
 - * Training.

EPA'S CLEAN AIR ACT GDC

- Covers a WIDE array of EHS/HHC
- Does **NOT** have to be a listed RMP chemical
- Facilities with 9,000#'s of NH₃ and 4,675 gallons of FLAGS have been cited:
 - *Failed to provide protections consistent with applicable industry codes and standards*
 - *No hazard analysis performed using industry recognized hazard assessment techniques*
 - *Failure to meet Recognized and Generally Accepted Good Engineering Practice (RAGAGEP)*
 - *Inadequate signs and labels*
 - *Lack of Documentation*

NEW RMP RULES EFFECTIVE 2/19/19

- Emergency Planning Coordination with emergency responders
 - 1 notification exercise per year
 - 1 tabletop exercise every 3 years
 - 1 field exercise every 10 years
- Information sharing upon request with 45 days
- Root Cause analysis – incident investigations
- Safety Technology and Alternatives Analysis - Inherently Safer Design
- Third Party Audits if reportable incident or if required



BEST PRACTICES AND WATCH OUTS



DON'T FORGET THESE ITEMS

- SCOPE of Audit Matters!
 - Fall Protection
 - Fixed Industrial Stairs
 - PPE Hazards Assessments
 - Respiratory Protection (Op's, Maint, ERT)
 - Egress labeling, lighting
 - Fire Protection Systems
 - Fixed and Portable/Personal meters
 - PRCs Rescue Team
 - PIT in HAZLOCs

TAKE A LOOK HERE ALSO

Emergency Planning & Response

- ERP meets 1910.120(q) (Review OSHA CPL on 1910.120)
- Verify Training records of responders
- Verify Medical Evals, Fit testing (OSHA Respirator Physical is NOT enough)
- ERT equipment inspection program
 - Level A's being pressure tested per manufacturer's frequency/protocol
 - SCBA's being inspected/tested per manufacturer's frequency/protocol
 - Bottle Hydro's meet DOT
- EAP meets 1910.38
 - Contractors know how to report emergency, what the alarms sound like, what each tone means, where they go with each alarm
 - Actual head count procedure
 - Procedures for those operators who delay their evac to operate critical equipment

Even those site who do not have a response team **NEED TO COORDINATE** emergency activities with their community responders.

A LOT has changed since the 2009 economic crash... Local FDs have paired back the specialized services they provide.

PAY ATTENTION TO DETAIL

PSI

- RAGAGEPs Listed?
- Walkdown P&ID(s) to validate their accuracy
- Inspect HAZLOC's for proper equipment
- Ventilation design matches engineering documentation?
- Relief System design matches engineering documentation?

A "Design Basis" is more than formulas and calculations!

PAY ATTENTION TO DETAIL

SOP(s)

- **ALL PHASES** of operation covered?
- Safe Upper and Lower Limits defined (same as PHA?)
- Consequences of Deviation stated (same as PHA?)
- **ACTUAL** steps to correct/avoid deviations?
- Walk-Down some critical SOPs to see if they are accurate (you may be surprised)
 - Triggers for activation of ESD
- PPE in SOP obtained from "certified PPE Hazard Assessment(s)" (1910.132(d))

Take the time to PHYSICALLY WALK-DOWN a Safety Critical Procedure such as RCar/Tanker Unloading or Emergency Shutdown Procedure!

PAY ATTENTION TO DETAIL

Training

- Done **AT LEAST** every 3-years
 - Have operators walk-down an SOP to demonstrate they can find the equipment and operate the equipment
- Means to **VERIFY KNOWLEDGE?**
- Training is on **EACH SOP** and **SWP** applicable to the job
 - 3rd party course help but are often times **NOT** process specific
- Look at the training Doc's
 - *Training on 150 SOPs done in 6 hours once every 3 years leads one to a lot of QUESTIONS*

Training is a NEVER ENDING process in process safety. We have three (3) years to get it all done – NOT a 2 year, 11 month, 3 Week, 6 day, 16 hr training break!!

PAY ATTENTION TO DETAIL

Mechanical Integrity

- Refer to PHA(s) to identify those items listed as “safeguards”
 - NOTE: EVERY Mechanical SAFEGUARD listed in PHA should be in the MI inspection/Testing program!
- MI procedures for PM's
 - Does the data in the MI procedures MATCH the PSI data (i.e. SIS set points?)
- PM's meet or exceed the manufacturer's frequency (or RAGAGEP)
- Refer to W.O.'s for those who perform the work - verify TRAINING
- Inspections on Vessels/Piping meet a RAGAGEP (listed in PSI?)
- Inspection/Testing documentation meets (j)(4)
- Equipment found to be outside established limits – removed (e.g. vibration analysis)

LOPC is often times the FIRST domino to fall in a fatal release of the HHC/EHS!

PAY ATTENTION TO DETAIL

Management of Change

- Scope of changes included in the process?
 - Changes to SWPs (PPE, LOTO, PRCS), SOP/MI procedures, EAP/ERP?
 - Changes to personnel or staffing levels, roles and responsibilities?
 - Look for CHANGES that are NOT on the process BUT do impact the process
- Use CMMS and Capital Project to ID changes
- Pay attention during field work to identify “new equipment”
- Pay attention during interviews with operators/mechanics for hints of changes
- Look at dates on ISO controlled documents & P&IDs that indicate document was “changed”
- MOC “paper work” is **NOT** managing changes!
- Are updates being made to PSI, SOPs, MI, EAP/ERP?
- Is facility addressing identified needs from the HAZ Assessment from the MOC

MOCs are MUCH MORE than a paper trail required by OSHA/EPA... they are meant to be a **TOOL to MANAGE CHANGES** that can impact our covered process(s).

PAY ATTENTION TO DETAIL

PSSR

- Ask for “Capital Projects” over the past 3-5 years
- Match new equipment with MOCs and PSSRs
- Don't be fooled by a piece of Paper with dates and signatures!
- Verify (DETAILS!!!)
 - SOPs were in place BEFORE the process started
 - Equipment was in MI CMMS and MI procedures in place
 - PSI was updated (P&IDs, RV Calcs, etc.)
 - Training for Ops and MI

An MOC is asking for permission and working through the details of a “change” - the PSSR is VERIFICATION that the “change” was done as designed/permitted!!

POTENTIAL CHANGES - OSHA PSM

[HTTPS://WWW.OSHA.GOV/DSG/PSM/INDEX.HTML](https://www.osha.gov/dsg/psm/index.html)

- Clarifying Atmospheric Storage Tank Exemption – known as Meer decision
- CCPS – Risk Based Process Safety
- Adding definition to RAGAGEP
- Requiring evaluation of RAGAGEP
- Management of Organizational Change
- Adding chemicals
- Updating Ammonium Nitrate rules
- Expand Mech Integrity to Safety critical equipment
- Third Party Compliance Audits



REFERENCES

- Safety Case http://www.csb.gov/assets/1/7/WorkingPaper_87.pdf
- Overview of Risk Based Process Safety
<http://www.aiche.org/ccps/resources/publications/books/guidelines-risk-based-process-safetyccps/documents/overview>
- Center for Chemical Process Safety (CCPS) <http://www.aiche.org/ccps>
- Mary K O'Connor Process Safety Center – Texas A&M <http://process-safety.tamu.edu/>
- Chemical Safety Board <http://www.csb.gov/videos/>
- OSHA - <https://www.osha.gov/SLTC/processsafetymanagement/>
- EPA - <https://www.epa.gov/rmp>
- Chemical Safety Executive Order - <https://www.osha.gov/chemicalexecutiveorder/>



QUESTIONS



Interrelationship of PSM Elements

During a routine inspection of equipment (Mechanical Integrity) or an incident investigation, the maintenance worker discovers a valve that no longer meets the applicable code and must be changed. Because the type of valve is no longer made, a different type of valve must be selected and installed (**Management of Change**). The type of valve selected may mandate different steps for the operators (**Operating Procedures**) who will require training and verification in the new procedures (**Training**). The rationale for selecting the type of valve must be made available for review by employees and their representatives (**Employee Participation**).

When the new valve is installed by the supplier (**Contractors**), it will involve shutting down part of the process (**Pre-startup Safety Review**) as well as brazing some of the lines (**Hot Work Permit**). The employer must review the response plan (**Emergency Planning**) to ensure that procedures are adequate for the installation hazards.

Although **Management of Change** provisions cover interim changes, after the new valve is in place the **Process Safety Information** will have to be updated before the **Process Hazard Analysis** is updated or revalidated, to account for potential hazards associated with the new equipment. Also, inspection and maintenance procedures and training will need to be updated (**Mechanical Integrity**).

These elements shall be cross checked to see if they show that the changes have been followed through to completion.

In summary, 11 PSM elements can be affected by changing one valve.

A CSHO would check a representative number of these 11 elements to confirm that the required follow-up activities have been implemented for the new valve.

Three key elements shall be routinely reviewed to verify that changes have been implemented.

They are:

- * Operating Procedures;
- * Process Hazard Analysis; and
- * Training.

- Standard Number: [1910.119](#)
- Title: Process safety management of highly hazardous chemicals.

Purpose. This section contains requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards.

[1910.119\(a\)](#)

Application.

[1910.119\(a\)\(1\)](#)

This section applies to the following:

[1910.119\(a\)\(1\)\(i\)](#)

A process which involves a chemical at or above the specified threshold quantities listed in Appendix A to this section;

[1910.119\(a\)\(1\)\(ii\)](#)

A process which involves a flammable liquid or gas (as defined in 1910.1200(c) of this part) on site in one location, in a quantity of 10,000 pounds (4535.9 kg) or more except for:

[1910.119\(a\)\(1\)\(ii\)\(A\)](#)

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;

[1910.119\(a\)\(1\)\(ii\)\(B\)](#)

Flammable liquids stored in atmospheric tanks or transferred which are kept below their normal boiling point without benefit of chilling or refrigeration.

[1910.119\(a\)\(2\)](#)

This section does not apply to:

[1910.119\(a\)\(2\)\(i\)](#)

Retail facilities;

[1910.119\(a\)\(2\)\(ii\)](#)

[1910.119\(a\)\(2\)\(ii\)](#)

Oil or gas well drilling or servicing operations; or,

[1910.119\(a\)\(2\)\(iii\)](#)

Normally unoccupied remote facilities.

[1910.119\(b\)](#)

Definitions.

"Atmospheric tank" means a storage tank which has been designed to operate at pressures from atmospheric through 0.5 p.s.i.g. (pounds per square inch gauge, 3.45 Kpa).

"Boiling point" means the boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (p.s.i.a.) (760 mm.). For the purposes of this section, where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, the 10 percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, which is incorporated by reference as specified in Sec. 1910.6, may be used as the boiling point of the liquid.

"Catastrophic release" means a major uncontrolled emission, fire, or explosion, involving one or more highly hazardous chemicals, that presents serious danger to employees in the workplace.

- Standard Number: [1910.119](#)
- Title: Process safety management of highly hazardous chemicals.

"Facility" means the buildings, containers or equipment which contain a process.

"Highly hazardous chemical" means a substance possessing toxic, reactive, flammable, or explosive properties and specified by paragraph (a)(1) of this section.

"Hot work" means work involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations.

"Normally unoccupied remote facility" means a facility which is operated, maintained or serviced by employees who visit the facility only periodically to check its operation and to perform necessary operating or maintenance tasks. No employees are permanently stationed at the facility. Facilities meeting this definition are not contiguous with, and must be geographically remote from all other buildings, processes or persons.

"Process" means any activity involving a highly hazardous chemical including any use, storage, manufacturing, handling, or the on-site movement of such chemicals, or combination of these activities. For purposes of this definition, any group of vessels which are interconnected and separate vessels which are located such that a highly hazardous chemical could be involved in a potential release shall be considered a single process.

"Replacement in kind" means a replacement which satisfies the design specification.

"Trade secret" means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix D contained in 1910.1200 sets out the criteria to be used in evaluating trade secrets.

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.

..1910.119(d)

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

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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: Material 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.

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)

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)(B)

Process chemistry;

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.

1910.119(d)(2)(ii)

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Where the original technical information no longer exists, such information may be developed in conjunction with the process hazard analysis in sufficient detail to support the analysis.

[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)

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.

..1910.119(e)

[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. The process hazard analysis shall be conducted as soon as possible, but not later than the following schedule:

1910.119(e)(1)(i)

No less than 25 percent of the initial process hazards analyses shall be completed by May 26, 1994;

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1910.119(e)(1)(ii)

No less than 50 percent of the initial process hazards analyses shall be completed by May 26, 1995;

1910.119(e)(1)(iii)

No less than 75 percent of the initial process hazards analyses shall be completed by May 26, 1996;

1910.119(e)(1)(iv)

All initial process hazards analyses shall be completed by May 26, 1997.

1910.119(e)(1)(v)

Process hazards analyses completed after May 26, 1987 which meet the requirements of this paragraph are acceptable as initial process hazards analyses. These process hazard analyses shall be updated and revalidated, based on their completion date, in accordance with paragraph (e)(6) of this standard.

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)

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.

[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)

1910.119(e)(3)(iv)

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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.

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)

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.

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;

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..1910.119(f)(1)(i)(D)

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.

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)

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.

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)

1910.119(f)(4)

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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.

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)(1)(ii)

In lieu of initial training for those employees already involved in operating a process on May 26, 1992, an employer may certify in writing that the employee has the required knowledge, skills, and abilities to safely carry out the duties and responsibilities as specified in the operating procedures.

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)

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.

[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)

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- Title: Process safety management of highly hazardous chemicals.

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)

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.

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)

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.

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)

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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)

1910.119(i)(2)(iv)

Training of each employee involved in operating a process has been completed.

[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)

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.

1910.119(j)(4)

Inspection and testing.

1910.119(j)(4)(i)

Inspections and tests shall be performed on process equipment.

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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)

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.

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.

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)

[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.

1910.119(l)

Management of change.

1910.119(l)(1)

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- Title: Process safety management of highly hazardous chemicals.

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)

[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.

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;

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..1910.119(m)(4)(ii)

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.

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.

..1910.119(n)

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).

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.

..1910.119(p)

1910.119(p)

Trade secrets.

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- Title: Process safety management of highly hazardous chemicals.

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.

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of the contractor, and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident.

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

- (i) Date of incident;
- (ii) Date investigation began;
- (iii) A description of the incident;
- (iv) The factors that contributed to the incident; and,

(v) Any recommendations resulting from the investigation. (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.

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

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

(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(a). 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).

(o) *Compliance Audits.* (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.

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

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

(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.

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

(p) *Trade secrets.* (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.

(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.

(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.

APPENDIX A TO § 1910.119—LIST OF HIGHLY HAZARDOUS CHEMICALS, TOXICS AND REACTIVES (MANDATORY)

This appendix contains a listing of toxic and reactive highly hazardous chemicals which present a potential for a catastrophic event at or above the threshold quantity.

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

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CHEMICAL name	CAS*	TQ**
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 Pentafluoride	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
Hydrofluoric 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
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

CHEMICAL name	CAS*	TQ**
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	79-84-4	100
Methyltrichlorosilane	75-79-6	500
Nickel Carbonyl (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; NO ₂ ; N ₂ O ₄ ; N ₂ O ₃)	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)	8014-94-7	1000
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 Peroxyacetic 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
Trimethoxysilane	2487-90-3	1500

*Chemical Abstract Service Number.
 **Threshold Quantity in Pounds (Amount necessary to be covered by this standard).