

TMS, INC.

Partners in Progress

**PROCESS SAFETY MANAGEMENT
OF
HIGHLY HAZARDOUS CHEMICALS**

29 CFR 1910.119



TeSeCon, Inc.

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INTRODUCTION

The Purpose of this pamphlet is to assist personnel charged with the responsibility of Process Safety Management (PSM) in better understanding current PSM regulations set forth in 29 CFR 1910.119 and to describe the engineering and technical services available from TMS, Inc.

This document was taken from the original 29 CFR 1910.119(See appendix A). This Federal Regulation has been rewritten to a format that is easier to read and reference to. The portions of this document highlighted in red are areas in which TMS can be of service.

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CFR 1910.119
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.

(a) APPLICATION

(1) This section applies to the following:

- (i) A process which involves a chemical at or above the specified threshold quantities listed in Appendix A of 29 CFR 910.119.
- (ii) A process which involves a flammable liquid or gas on site in one location in a quantity of 10,000 pounds or more. Excluding the following:
 - (A) Hydrocarbon fuels used solely for work place consumption as a fuel.(e.g., propane and gasoline)
 - (B) Flammable liquids stored in atmospheric tanks or transferred which are kept below their normal boiling point without benefit of chilling or refrigeration.

(2) This section does not apply to:

- (i) Retail facilities
- (ii) Oil or gas well drilling or servicing operations
- (iii) Normally unoccupied remote facilities.

(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.) (760mm.). For the purpose 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 distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, 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.

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 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.

(c) EMPLOYEE PARTICIPATION

- (1) Employers shall develop a written plan of action regarding the implementation of the employees participation required by this paragraph.
- (2) Employers shall consult with employees and their representatives on the conduct and the development of the other elements of process safety management in this standard.
- (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.

(d) PROCESS SAFETY INFORMATION

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.

- (1) Information pertaining to the hazards of the highly hazardous chemicals in the process.

This information shall consist of at least the following:

- (i) Toxicity information;
- (ii) Permissible exposure limits;
- (iii) Physical data;
- (iv) Reactivity data;
- (v) Corrosivity data;
- (vi) Thermal and chemical stability data;
- (vii) Hazardous effects of the 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.

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

Information concerning the technology of the process shall include at least the following:

- (A) A block flow diagram or simplified process flow diagram.
- (B) Process chemistry;
- (C) Maximum intended inventory;
- (D) Safe upper and lower limits for such items as temperatures, pressures, flows, or compositions;
- (E) An evaluation of the consequences of deviations, including those effecting 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.

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

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

- (A) Materials of construction;
- (B) Piping and instrument diagrams (P&ID'S)
- (C) Electrical classification;
- (D) Relief system design and design basis;
- (E) Ventilation system design;
- (F) Design codes and standards employed;
- (G) Material and energy balances for processes built after May 26, 1992.
- (H) Safety systems (e.g. interlocks, detection or suppression systems).

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

(e) PROCESS HAZARD ANALYSIS

- (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 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:
 - (i) No less than 25 percent of the initial process hazards analyses shall be completed by May 26, 1994;
 - (ii) No less than 50 percent of the initial process hazards analyses shall be completed by May 26, 1995;
 - (iii) No less than 75 percent of the initial process hazards analyses shall be completed by May 26, 1996;
 - (iv) All initial process hazards analyses shall be completed by May 26, 1997;
 - (v) Process hazard analyses completed after May 26, 1997 which meet the requirements of this paragraph are acceptable as initial process hazard analyses. These analyses shall be updated and revalidated, based on their completion date.
- (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.
 - (i) What-If;
 - (ii) Checklist;
 - (iii) What-If/Checklist;

- (iv) Hazard and Operability Study (HAZOP);
 - (v) Failure Mode and Effects Analysis (FMEA);
 - (vi) Fault Tree Analysis; or
 - (vii) An appropriate equivalent methodology.
- (3) The process hazard analysis shall address:
- (i) The hazards of the process;
 - (ii) The identification of any previous incident which had a likely potential for catastrophic consequences in the workplace;
 - (iii) Engineering and administrative controls applicable to the hazards and their interrelationships such as appropriate application of the 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);
 - (iv) Consequences of failure of engineering and administrative controls;
 - (v) Facility siting;
 - (vi) Human factors; and
 - (vii) A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace.
- (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.
- (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.

- (6) At least every five (5) years after the completion of the initial process hazard analysis shall be updated and revalidated by a team meeting the requirements in the paragraph (e)(4) of this section to assure that the process hazard analysis is consistent with the current process.
- (7) Employers shall retain process hazards analyses and updates or revalidation for each process covered by this section, as well as the documented resolution of the recommendations described in paragraph (e)(5) of this section for the life of the process.

(f) OPERATING PROCEDURES

- (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.
 - (i) Steps for each operating phase:
 - (A) Initial startup;
 - (B) Normal operations;
 - (C) Temporary operations;
 - (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.
 - (E) Emergency Operations;
 - (F) Normal Shutdown; and
 - (G) Startup following a turnaround, or after an emergency shutdown.
 - (ii) Operating Limits
 - (A) Consequences of deviation; and
 - (B) Steps required to correct or avoid deviation.

(iii) Safety and Health Considerations

- (A) Properties of, and hazards presented by, the chemicals used in the process;
- (B) Precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment;
- (C) Controls measures to be taken if physical contact or airborne exposure occurs;
- (D) Quality control for raw materials and control hazardous chemical inventory levels; and
- (E) Any special or unique hazards.

(iv) Safety systems and their functions.

- (2) Operating procedures shall be readily accessible to employees who work in or maintain a process.
- (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.
- (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 facility by maintenance, contractor, laboratory, or other support personnel. These safe work practices shall apply to employees and contractor employees.

(g) TRAINING.

(1) Initial training.

- (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.

- (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.
- (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 employees involved in operating the process, shall determine the appropriate frequency of refresher training.
- (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.

(h) CONTRACTORS.

- (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.
- (2) Employer responsibilities.
 - (i) The employer, when selecting a contractor, shall obtain and evaluate information regarding the contract employer's safety performance and programs.
 - (ii) The employer shall inform contract employers of the known potential fire, explosion, or toxic release hazard related to the contractor's work.
 - (iii) The employer shall explain to contract employers the applicable provisions of the emergency action plan required by paragraph (n) of this section.
 - (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.

- (v) The employer shall periodically evaluate the performance of contract employers in fulfilling their obligations as specified in paragraph(h)(3) of this section.
- (vi) The employer shall maintain a contract employee injury and illness log related to the contractor's work in process areas.

(3) Contract employer responsibilities.

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

(i) PRE-STARTUP SAFETY REVIEW

- (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.
- (2) The pre-startup safety review shall confirm that prior to the introduction of highly hazardous chemicals to a process:
 - (i) Construction and equipment is in accordance with design specifications.
 - (ii) Safety, operating, maintenance and emergency procedures are in place and are adequate.

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

(j) MECHANICAL INTEGRITY

- (1) Application. Paragraph (j)(2) through (j)(6) of this section apply to the following process equipment:
 - (i) Pressure vessels and storage tanks
 - (ii) Piping systems (including piping components such as valves)
 - (iii) Relief and vent systems and devices
 - (iv) Emergency shutdown systems
 - (v) Controls (including monitoring devices and sensors, alarms and interlocks)
 - (vi) Pumps
- (2) Written Procedures. The employer shall establish and implement written procedures to maintain the on-going integrity of process equipment.
- (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.
- (4) Inspection and testing.
 - (i) Inspections and tests shall be performed on process equipment.
 - (ii) Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.
 - (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.

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

(k) HOT WORK PERMIT

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

(l) MANAGEMENT OF CHANGE

- (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.
- (2) The procedures shall assure that the following considerations are addressed prior to any changes:
 - (i) The technical basis for the proposed change
 - (ii) Impact of change on safety and health
 - (iii) Modifications to operating procedures
 - (iv) Necessary time period for the change
 - (v) Authorization requirements for the proposed change
- (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.
- (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.
- (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.

(m) INCIDENT INVESTIGATION.

- (1) The employer shall investigate each incident which resulted in, or could reasonably have resulted in a catastrophic release of highly hazardous chemicals in the workplace.
- (2) An incident investigation shall be initiated as promptly as possible, but not later than 48 hours following the incident.
- (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.

- (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
 - (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 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), 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 person 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.

Following is a summary of citations to an affiliate of a client company regarding violations of 1910.119 (PSM) requirements.

1. **INSPECTION AND TEST PROCEDURES:**

- a. Thickness testing points were not identified on pressure vessels.
- b. Thickness data, such as increasing wall thickness, were not resolved.
- c. UT reports were not maintained.
- d. No program to detect cracking in vessels.
- e. Inspectors performing and evaluating NDT results were not certified to ANST Level II or equivalent.
- f. Boiler inspectors were not certified by National Board of Boiler and Pressure Vessel Inspectors.

(1910.119(j)(4)(ii) - Willful - \$70,000)

2. **PHA did not address the following:**

- a. All the hazards of the process
- b. Past incidents
- c. Engineering and administrative controls applicable to the hazards, i.e. automatic shutdown controls, corrosion monitoring.
- d. Failure of engineering and administrative controls such as level controllers, RV seal failure, flange gasket failures, pump seal failures, corrosion in tubes, etc.
- e. Facility siting.
- f. Human factors such as board operator error, line breaking mistakes, improper lockout and isolation of process equipment.

(1910.119(e)(1)(v) - Serious - \$5000)

3. **No OI's for:**

- a. No startup\shutdown OI and did not contain specific instructions for each step, including procedures for safety and health.
- b. Use and calibration of air sampling equipment.
- c. Sampling.

(1910.119(f)(1) - Serious - \$5000)

4. No OI's for all process operations, i.e. producing of waste.
(1910.119(f)(1)(iii)(E) - Serious - \$5000)
5. OI's were not current - were dated 1975 and 1981.
(1910.119(f)(3) - Serious - \$5000)
6. Inadequate or no safe work practices for:
 - a. Line breaks
 - b. Confined space entry
 - c. Use and calibration of gas detectors(1910.119(f)(4) - Serious - \$5000)
7. Employees not trained in an overview of the process and OI's.
(1910.119(g)(1)(i) - Serious - \$2500)
8. Company certified employees as qualified operators of processes other than those to which they were currently assigned as of 5/26/92.
(1910.119(g)(1)(ii) - Serious - \$2500)
9. Employer did not periodically evaluate the performance of contractors for:
 - a. Effective respiratory program
 - b. Effective Hazcom program
 - c. Contractor did not have a lockout/tagout or confined space program(1910.119(h)(2)(v) - Serious - \$5000)
10. Pump vibration program did not include definable criteria to remove pumps from service.
(1910.119(j)(2) - Serious - \$5000)

11. Operators performing maintenance duties such as installing blinds, working on valve packing, installing flanges, etc., and maintenance personnel were not trained in an overview of the process.

(1910.119(j)(3) - Serious - \$2500)

12. No documentation of equipment inspections and test calculations and tracking the remaining tube life of fired heaters.

(1910.119(j)(4)(iv) - Serious - \$5000)

13. Employer did not correct deficiencies in equipment outside acceptable limits before further use or in a safe and timely manner, i.e. leaking sight glass, leaking packing, broken gauge, cooling water line corroded, alarms activated while operating, etc.

(1910.119(j)(5) - Serious - \$5000)

14. Company did not have QA program for new equipment, but relied upon the contractor program.

(1910.119(j)(6)(i) - Serious - \$5000)

15. Appropriate checks and inspections were not performed to assure that equipment was installed properly, i.e. RV not threaded to the nut, thereby reducing the strength of the assembly.

(1910.119(j)(6)(ii) - Serious - \$5000)

16. Company did not assure that piping was suitable for the process application, i.e., stored pipe was not color coded according to the color coding system.

(1910.119(j)(6)(iii) - Serious - \$2500)

17. Deficient hot work permits i.e.:

- a. No air sampling completed
- b. Not properly authorized
- c. Not signed off upon return
- d. Permit extended, but not re-authorized
- e. No oxygen levels were taken

- f. No isolation/blind list completed
- g. Permits were pre-signed prior to issuance

(1910.119(k)(1) - Serious - \$2500)

18. Process technology was not updated after changes.

(1910.119(l)(4) - Serious - \$5000)

19. Operating procedures were not changed to reflect changes in process piping.

(1910.119(l)(2) - Serious - \$2500)

20. Management of change documents did not address training employees on the change.

(1910.119(l)(3) - Serious - \$5000)

21. Emergency Response Plan:

- a. Could not readily account for all personnel
- b. Could not be heard in all plant areas above ambient noise levels
- c. Radio announcements could not be heard as all personnel do not have radios
- d. Plan called for all non-working employees in certain types of alarms to report to the plant, but alarm could not be heard in all plant areas (even noted some employees live out of state - point of citation is to have a reasonable plan that can work)
- e. Alarm did not distinguish between different types of emergencies.
- f. Plan did not describe all potential evacuation situations, i.e. who opens locked gates
- g. No emergency back-up power supply for emergency alarm
- h. Drills were not conducted as the plan specified

(1910.119(n) - Serious - \$5000)

22. Employee Participation Plan incomplete; did not include mechanism for employees to participate in the PSM program. In addition, during development of the PSM program, employees were notified of the implementation, but not consulted.

(1910.119(c)(1 & 2) - other - no fine)

23. Employees were not informed of the results of the PHA and provided access to the information

(1910.119(c)(3) - other - no fine)

24. Company did not have a compilation of all written process safety information for each covered process in the refinery.

(1910.119(d) - other - no fine)

TMS can provide Technical Writers to assist by Writing the procedures that are requested by 29 CFR 1910.119:

- PSM Employee Participation Plan
- MSDS Control Procedures
- Operating Procedures
- PHA and PHR Procedures
- Employee Training Plans
- Contract Employee Injury and Illness Log
- Pre-Startup Safety Review Procedures
- Maintenance Training Procedures
- Quality Assurance of Parts and Equipment
- Incident Reporting Procedures
- Emergency Action Plan
- Audit Procedures
- Inspection and Testing Procedures
- Management of Change Procedures

TMS can update or generate Process Safety Information:

- Block Flow Diagram
- Maximum Intended Inventory
- Safe Upper and Lower Limits
- Consequences of Process Deviation Evaluation
- Piping and Instrumentation Diagrams
- Electrical Classification Drawings
- Safety Systems Diagrams and Drawings

TMS can Set-up and maintain a Mechanical Integrity program:

- On-going of Mechanical Integrity Procedure
- Inspection and Testing
- Inspection and Testing Documentation
- Correcting Deficiencies In Equipment

APPENDIX

catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards.

(a) *Application.* (1) This section applies to the following:

(i) A process which involves a chemical at or above the specified threshold quantities listed in Appendix A to this section:

(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:

(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:

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

(2) This section does not apply to:

(i) Retail facilities;

(ii) Oil or gas well drilling or servicing operations; or.

(iii) Normally unoccupied remote facilities.

(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, 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.

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.

§ 1910.119 Process safety management of highly hazardous chemicals.

Purpose. This section contains requirements for preventing or minimizing the consequences of

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.

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

(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.

(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.

(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.

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

- (i) Toxicity information;
- (ii) Permissible exposure limits;
- (iii) Physical data;
- (iv) Reactivity data;
- (v) Corrosivity data;
- (vi) Thermal and chemical stability data; and
- (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.

(2) *Information pertaining to the technology of the process.* (i) Information concerning the technology of the process shall include at least the following:

- (A) A block flow diagram or simplified process flow diagram (see Appendix B to this section);
- (B) Process chemistry;
- (C) Maximum intended inventory;
- (D) Safe upper and lower limits for such items as temperatures, pressures, flows or compositions; and,
- (E) An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

(ii) 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.

(3) *Information pertaining to the equipment in the process.* (i) Information pertaining to the equipment in the process shall include:

- (A) Materials of construction;
- (B) Piping and instrument diagrams (P&ID's);
- (C) Electrical classification;
- (D) Relief system design and design basis;
- (E) Ventilation system design;
- (F) Design codes and standards employed;
- (G) Material and energy balances for processes built after May 26, 1992; and,
- (H) Safety systems (e.g. interlocks, detection or suppression systems).

(ii) The employer shall document that equipment complies with recognized

and generally accepted good engineering practices.

(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.

(e) *Process hazard analysis.* (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:

- (i) No less than 25 percent of the initial process hazards analyses shall be completed by May 26, 1994;
- (ii) No less than 50 percent of the initial process hazards analyses shall be completed by May 26, 1995;
- (iii) No less than 75 percent of the initial process hazards analyses shall be completed by May 26, 1996;
- (iv) All initial process hazards analyses shall be completed by May 26, 1997.

(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 reevaluated, based on their completion date, in accordance with paragraph (e)(6) of this section.

(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.

- (i) What-If;
- (ii) Checklist;
- (iii) What-If/Checklist;
- (iv) Hazard and Operability Study (HAZOP);
- (v) Failure Mode and Effects Analysis (FMEA);
- (vi) Fault Tree Analysis; or
- (vii) An appropriate equivalent methodology.

(3) The process hazard analysis shall address:

- (i) The hazards of the process;

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

(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.);

(iv) Consequences of failure of engineering and administrative controls;

(v) Facility siting;

(vi) Human factors; and

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

(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.

(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.

(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.

(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.

(f) *Operating procedures* (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.

(i) *Steps for each operating phase:*

(A) Initial startup;

(B) Normal operations;

(C) Temporary operations;

(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.

(E) Emergency Operations;

(F) Normal shutdown; and,

(G) Startup following a turnaround, or after an emergency shutdown.

(ii) *Operating limits:*

(A) Consequences of deviation; and

(B) Steps required to correct or avoid deviation.

(iii) *Safety and health considerations:*

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

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

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

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

(E) Any special or unique hazards.

(iv) *Safety systems and their functions.*

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

(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.

(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.

(g) *Training.* (1) *Initial training.* (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.

(ii) In lieu of initial training for those employees already involved in operating a process on May 28, 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.

(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.

(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.

(h) *Contractors.* (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.

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

(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.

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

(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.

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

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

(3) *Contract employer responsibilities.*

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

(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.

(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.

(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.

(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.

(i) *Pre-startup safety review.* (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.

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

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

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

(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).

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

(j) *Mechanical integrity.* (1)

Application. Paragraphs (j)(2) through

(j)(6) of this section apply to the following process equipment:

(i) Pressure vessels and storage tanks;

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

(iii) Relief and vent systems and devices;

(iv) Emergency shutdown systems;

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

(vi) Pumps.

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

(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.

(4) *Inspection and testing.* (i) Inspections and tests shall be performed on process equipment.

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

(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.

(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.

(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.

(6) *Quality assurance.* (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.

(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.

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

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

(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.

(l) *Management of change.* (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.

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

(i) The technical basis for the proposed change;

(ii) Impact of change on safety and health;

(iii) Modifications to operating procedures;

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

(v) Authorization requirements for the proposed change.

(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.

(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.

(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.

(m) *Incident investigation.* (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.

(2) An incident investigation shall be initiated as promptly as possible, but not

later than 48 hours following the incident.

(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.

(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.

(a) *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).

(b) *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.....	814-68-3	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.....	7787-38-2	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).....	106-98-7	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 > 12.5% nitrogen).....	9004-70-0	2500
Chlorine.....	7782-50-5	1500
Chlorine Dioxide.....	10049-04-4	1000

CHEMICAL name	CAS*	TQ**
Chlorine Pentafluoride.....	13637-63-3	1000
Chlorine Trifluoride.....	7790-91-2	1000
Chlorodiethylaluminum (also called Diethylaluminum Chloride).....	96-10-8	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.....	334-89-3	500
Dibenzoyl Peroxide.....	94-35-0	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.....	105-84-6	7500
Dilaluroyl Peroxide.....	105-74-3	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.....	75-34-7	7500
Ethylene Fluorohydrin.....	371-82-0	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.....	884-16-2	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.....	74-90-3	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.....	7803-49-3	2500
Iron, Pentacarbonyl.....	13463-40-8	250
Isopropylamine.....	75-31-0	5000
Ketene.....	463-51-4	100
Methacrylaldehyde.....	78-85-3	1000
Methacryloyl Chloride.....	920-46-7	150
Methacryloyloxyethyl Isocyanate.....	30874-80-7	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.....	79-84-4	100
Methyltrichlorosilane.....	75-79-6	500
Nickel Carbonyl (Nickel Tetracarbonyl).....	13463-39-3	150

CHEMICAL name	CAS*	TQ**	CHEMICAL name	CAS*	TQ**	CHEMICAL name	CAS*	TQ**
Nitric Acid (94.5% by weight or greater)	7697-37-2	500	Perchloryl Fluoride	7816-94-8	5000	Sulfuric Anhydride (also called Sulfur Trioxide)	7448-11-9	1000
Nitric Oxide	10102-43-9	250	Peroxyacetic Acid (concentration > 60% Acetic Acid; also called Peroxyacetic Acid)	79-21-0	1000	Tellurium Hexafluoride	7783-80-4	250
Nitroaniline (para Nitroaniline)	100-01-6	5000	Phosgene (also called Carbonyl Chloride)	75-44-5	100	Tetrafluoroethylene	116-14-3	5000
Nitromethane	75-52-5	2500	Phosphine (Hydrogen Phosphide)	7803-51-2	100	Tetrafluorohydrazine	10036-47-2	5000
Nitrogen Dioxide	10102-44-0	250	Phosphorus Oxychloride (also called Phosphoryl Chloride)	10025-87-3	1000	Tetramethyl Lead	75-74-1	1000
Nitrogen Oxides (NO; NO ₂ ; N ₂ O ₄ ; N ₂ O ₃)	10102-44-0	250	Phosphorus Trichloride	7719-12-2	1000	Thionyl Chloride	7719-09-7	250
Nitrogen Tetroxide (also called Nitrogen Peroxide)	10544-72-6	250	Phosphoryl Chloride (also called Phosphorus Oxychloride)	10025-87-3	1000	Trichloro (chloromethyl) Silane	1558-25-4	100
Nitrogen Trifluoride	7783-54-2	5000	Propargyl Bromide	106-96-7	100	Trichloro (dichlorophenyl) Silane	27137-85-5	2500
Nitrogen Trioxide	10544-73-7	250	Sarin	107-44-8	100	Trichlorosilane	10025-78-2	5000
Oleum (65% to 80% by weight; also called Fuming Sulfuric Acid)	8014-94-7	1000	Selenium Hexafluoride	7783-79-1	1000	Trifluorochloroethylene	79-38-9	10000
Osmium Tetroxide	20816-12-0	100	Silbina (Antimony Hydride)	7803-52-3	500	Trimethylarsylane	2487-90-3	1500
Oxygen Difluoride (Fluorine Monoxide)	7783-41-7	100	Sulfur Dioxide (liquid)	7446-09-5	1000			
Ozone	10028-15-6	100	Sulfur Pentafluoride	5714-22-7	250			
Pentaborane	19624-22-7	100	Sulfur Tetrafluoride	7783-60-0	250			
Peroxyacetic Acid (concentration > 60% Acetic Acid; also called Peroxyacetic Acid)	79-21-0	1000	Sulfur Trioxide (also called Sulfuric Anhydride)	7446-11-9	1000			
Perchloric Acid (concentration > 60% by weight)	7601-90-3	5000						
Perchloromethyl Mercaptan	594-42-3	150						

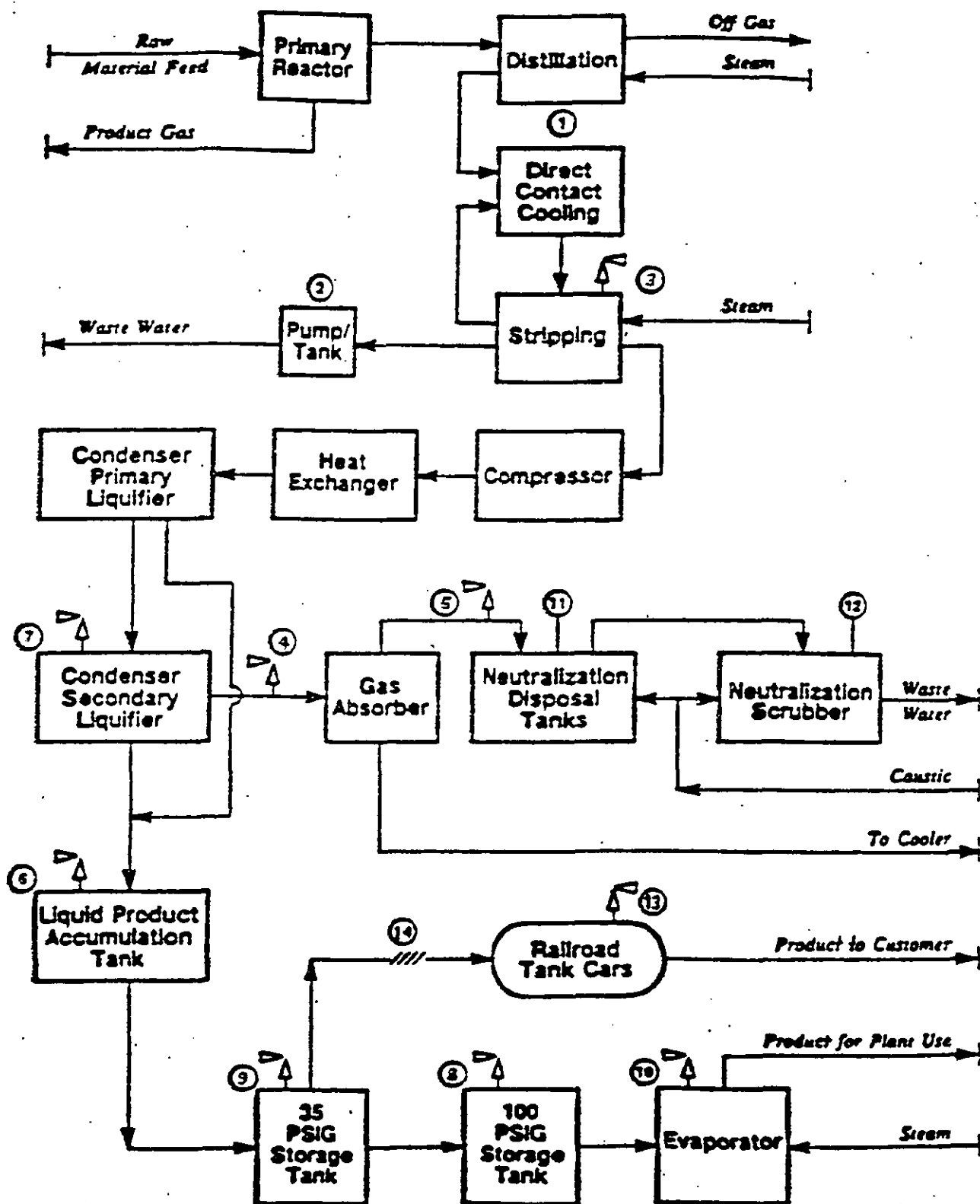
*Chemical Abstract Service Number.

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

Appendix B to § 1910.119—Block Flow Diagram and Simplified Process Flow Diagram (Nonmandatory)

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EXAMPLE OF A BLOCK FLOW DIAGRAM



EXAMPLE OF A PROCESS FLOW DIAGRAM

