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DEPARTMENT OF LABOR
Occupational Safety and Health Administration
AGENCY: Occupational Safety and Health Administration
(OSHA), Labor.

29 CFR Part 1910
Process Safety Management of Highly Hazardous Chemicals

[Docket S-026]
RIN 1218-AB20

55 FR 29150

July 17, 1990

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice contains proposed requirements for the management of hazards associated with processes using highly hazardous chemicals. It establishes procedures for process safety management that would protect employees by preventing or minimizing the consequences of chemical accidents involving highly hazardous chemicals. Employees have been and continue to be exposed to the hazards of toxicity, fire or explosion from major industrial accidents. The requirements in this standard are intended to eliminate or mitigate the consequences of such accidents.

DATES:

DATES: Comments and notices of intention to appear at hearing: Postmarked by October 15, 1990.

Testimony and documentary evidence for the hearing: Postmarked by November 5, 1990.

Public hearing: OSHA will commence a hearing on November 27, 1990, which may continue for more than one day based on the number of notices of intention to appear.

ADDRESSES: Comments. Comments on the proposal should be submitted in quadruplicate to the Docket Officer, Docket S-026, U.S. Department of Labor, Occupational Safety and Health Administration, room N2625, 200 Constitution Avenue, NW., Washington, DC 20210.

Notices of intention to appear, and testimony and documentary evidence. Notices of intention to appear at the hearing, and testimony and documentary evidence which will be introduced into the hearing record, must be submitted in quadruplicate to Mr. Tom Hall, Division of Consumer Affairs, room N3649, U.S. Department of Labor, Occupational Safety and Health Administration, 200 Constitution Avenue NW., Washington, DC 20210.

Public hearing. A hearing will be held in Washington, DC, beginning at 9:30 a.m. on November 27, 1990, in the Auditorium of the Frances Perkins Building, U.S. Department of Labor, 200 Constitution Avenue NW., Washington, DC 20210. FOR FURTHER INFORMATION CONTACT: Proposal. Mr. James A. Foster, U.S. Department of Labor, Occupational Safety and Health Administration, room N3637, 200 Constitution Avenue, NW., Washington, DC 20210, (202) 523-8151.

Public hearing. Mr. Tom Hall, Division of Consumer Affairs, U.S. Department of Labor, Occupational Safety and Health Administration, room N3649, 200

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Constitution Avenue, NW., Washington, DC 20210, (202) 523-8615.

TEXT:

SUPPLEMENTARY INFORMATION:

I. Background

Accidents involving highly hazardous chemicals which have resulted in catastrophic events have provided impetus internationally for authorities to develop legislation and regulations to decrease or eliminate such potential. For example, the European Economic Community (EEC) recognized the need to control these hazards after serious accidents occurred at Flixborough, England (1974, cyclohexane explosion, 29 dead) and Seveso, Italy (1976, dioxin release, extensive area contamination, and unknown long term health effects) (Reference 1).

This recognition led the EEC to the development of the Seveso Directive. The Seveso Directive, which addresses major accident hazards of certain industrial activities, lists the hazardous materials of concern, and is directed toward controlling those activities that could give rise to major accidents in an effort to protect the environment and the safety and health of persons.

Additionally, the World Bank has developed guidelines for identifying, analyzing, and controlling major hazard installations in developing countries (Reference 2), and has developed a hazards assessment manual which provides measures to control major hazard accidents affecting people and the environment. A list of dangerous substances is included. (Reference 3)

More recent incidents (Reference 4) in Mexico City (1984, liquefied petroleum gas explosions, 650+ dead) and Bhopal, India (1984, methyl isocyanate, 2000+ dead) dramatically reinforced the need to control major hazards due to highly hazardous chemicals and caused an increasing number of countries to examine, in greater depth, the potential for similar incidents.

In the United States, Congress, Federal agencies such as the Environmental Protection Agency, state governments, industry, unions, and other interested groups have become actively concerned and involved with protecting the public, employees and the environment from major chemical accidents involving highly hazardous chemicals.

In 1985, the Environmental Protection Agency (EPA), in response to the potential for a catastrophic release in the United States, initiated a program to encourage community planning and preparation relative to serious hazardous materials releases (Chemical Emergency Preparedness Program, Reference 5).

Then in 1986, the Congress passed the framework for emergency planning efforts through Title III of The Superfund Amendments and Reauthorization Act (SARA), also known as the Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11001 et seq.). SARA encourages and supports states and local communities in efforts to address the problems of chemical releases.

Additionally, under section 305(b) of SARA, 42 U.S.C. 11005(b), EPA was tasked by Congress to undertake a study reviewing "emergency systems for monitoring, detecting, and preventing releases of extremely hazardous substances at representative domestic facilities that produce, use, or store them," and to report to Congress on the findings. The final report issued in June 1988

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(Reference 6) contained a variety of findings and recommendations and noted that industry must assume the primary responsibility for preventing accidents, and should take the lead in research on prevention technology and information dissemination; and that the Federal government should act as a catalyst.

Also, section 302 of SARA, 42 U.S.C. 11002, required EPA to publish a list of extremely hazardous substances with threshold planning quantities which would trigger planning in states and local communities (52 FR 13378). The list was not considered all inclusive but rather a first step towards effective emergency response efforts at the community level.

The Occupational Safety and Health Administration (OSHA) in its concern for assuring the safety and health of employees from highly hazardous chemicals in the workplace, decided after the 1984 Bhopal incident, noted above, to examine the nation's chemical plants that produced or used significant quantities of methyl isocyanate, the chemical involved in the Bhopal catastrophe, beginning with an inspection of the Union Carbide plant in Institute, West Virginia. However, inspection activities indicated that while the chemical industry is subject to OSHA's general industry standards, in 29 CFR part 1910, these standards do not presently contain specific coverage for chemical industry process hazards, nor do they specifically address employee protection from significant releases of hazardous materials. Standards do exist for employee exposure to certain specific toxic substances (see subpart Z of part 1910), and hazardous chemicals are covered generally by other OSHA standards such as the Hazard Communication standard, @ 1910.1200. With respect to these standards, while they do address hazardous chemicals, they focus on routine or daily exposures and while in many cases they also address emergencies such as spills, OSHA believes that they do not address the precautions necessary to prevent large uncontrolled releases that could result in catastrophic consequences. Beyond these standards, OSHA must depend on section 5(a)(1) of the Occupational Safety and Health Act, the general duty clause, for other alleged hazardous situations -- using national consensus standards and industry standards to support the citations.

The need to focus on safety and health in the chemical industry was reinforced in August 1985, when a serious chemical accident occurred because of a release of aldicarb oxime and methylene chloride at the Union Carbide facility in Institute, West Virginia. While no deaths occurred, 135 persons were injured (Reference 7).

This experience led OSHA to develop a demonstration program of special inspections in a small segment of the chemical industry (Special Emphasis Program for the Chemical Industry, Chem SEP, 1986 (Reference 7)) to examine industry practices for the prevention of disastrous releases and the mitigation of the effects of releases that do occur, and to consider ways in which OSHA could best protect employees in the industry from these hazards.

The program targeted one process unit contained within each plant which manufactured a specific chemical, and inspections were completed in 40 plants. OSHA determined, based on the results of the program, that chemical plant inspections need a comprehensive inspection approach which includes plant physical conditions and management systems.

Since this program was completed, OSHA has issued several inspection directives that address system safety evaluation of operations with

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catastrophic potential. The scope of facilities to be inspected was broadened beyond chemical manufacturing. One directive noted that "potentially hazardous chemical releases are not limited to chemical manufacturing operations * * *. The precautions used there should also be implemented * * * in all operations in which hazardous chemicals are used, mixed, stored, or otherwise handled" (Reference 8).

Several states have developed or are developing legislation intended to prevent catastrophic events in their communities by requiring employers to take steps to control the highly hazardous chemicals in the workplace. These states include New Jersey, California, and Delaware (Reference 9).

The industry has also taken measures aimed at improving the protection of the public health and safety and ultimately improve chemical process safety to prevent releases. For example, the Chemical Manufacturing Association (CMA) developed the Chemical Awareness and Emergency Response Program (CAER) to foster cooperation, knowledge and response within communities. More recently, the Organization Resources Counselors (Reference 10) and the American Petroleum Institute (Reference 11) have developed recommended practices to address the protection of employees and the public through the prevention or mitigation of the effects of dangerous chemical releases.

Unions (e.g., the Oil, Chemical and Atomic Workers (OCAW) and the United Steelworkers of America (USWA)) also have shown a great deal of interest in controlling major chemical accidents involving highly hazardous chemicals, since they represent employees who are immediately exposed to the resulting dangers. For example, the International Confederation of Free Trade Unions and the International Federation of Chemical, Energy and General Workers' Unions issued a special report on the Bhopal, India, accident (Reference 12). Additionally, the USWA investigated and issued a special report on the May 4, 1988, PEPCON plant oxidizer accident in Henderson, Nevada (ammonium perchlorate explosion, two dead, 350 injured) (Reference 13). USWA, among other interested groups, has urged OSHA to move forward on the development of a standard to address this problem.

II. Agency Action

OSHA believes there is sufficient data and information upon which a standard can be based to reduce the possibility of an accident involving highly hazardous chemicals. Employees in a wide range of industries are exposed to safety hazards associated with the processing of highly hazardous chemicals. These hazardous chemicals encompass a wide variety of materials which are toxic, flammable, explosive, or reactive, or the material may present a combination of these dangerous properties.

OSHA believes that processes handling highly hazardous chemicals, present the potential for accidents, such as spills or other releases, that could have catastrophic results. The term "highly hazardous," as used in this paragraph, refers to those materials which possess toxic, flammable, reactive, or explosive properties and which are specified or defined in the proposed standard. Information available to OSHA indicates that accidents have occurred in these workplaces for many years and that they continue to occur, as evidenced by the October 1989, Phillips Petroleum explosion and fire in Pasadena, Texas. The accident resulted in 23 deaths and more than 130 injuries. Reports of incidents (such as the Phillips explosion) clearly show there is a significant risk to employees and that mandatory standards are necessary and appropriate and will

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reduce deaths and injuries due to accidental releases, fires or explosions. (See Part VI below.) OSHA believes that this proposal will meet the need for such mandatory standards.

OSHA's proposed rule emphasizes the management of hazards associated with highly hazardous chemicals. This approach, the application of management controls to highly hazardous chemicals, was recommended to OSHA by an industry consulting company, Organization Resources Counselors (ORC). ORC observed (Reference 14).

[W]hen OSHA issued its final report on the Special Emphasis Program for the Chemical Industry (Chem SEP), among its findings were that "specification standards * * * will not * * * ensure safety in the chemical industry * * * [because such standards] tend to freeze technology and may minimize rather than maximize employers safety efforts." The Chem SEP report recommended a new approach to the identification and prevention of potentially catastrophic situations. This approach would involve "performance-oriented standards * * * to address the overall management of chemical production and handling systems."

Regarding its recommended standard, ORC noted (Reference 14) that:

The recommendations it contains are a systematic approach to chemical process hazards management which, when implemented, will ensure that the means for preventing catastrophic release, fire, and explosion are understood, and that the necessary preventive measures and lines of defense are installed and maintained.

Other entities have also supported this type of standard including the American Petroleum Institute (API) and the American Institute of Chemical Engineers. At a recent conference (Reference 15) sponsored by the Center for Chemical Process Safety of the American Institute of Chemical Engineers, one participant noted (Reference 16, p. 2):

Such recognition [of management controls] was written about almost twenty-five years ago in safety reports prepared within the British Chemical Industry. Lees devotes a full chapter to his 1980 book [Loss Prevention in the Process Industries] to management systems * * *. Roger Batstone of the World Bank suggested that management systems were the most important factor in preventing major accidents. Recently, the State of Delaware adopted a standard similar to the recommended standard of ORC (Reference 9).

The proposal is based on OSHA's expertise and on information collected from other federal agencies, the states, foreign governments and organizations, industry and unions. OSHA's proposed standard incorporates many of the practices that industry considers basic and essential to reduce the potential for major industrial accidents.

Public comment is invited on any aspect of the proposed rule which is described in Part III of the Preamble below. In addition, specific issues for which OSHA solicits comments are listed in Part IV of this document. Procedures for public participation in this rulemaking are detailed in Part X.

III. Summary and Explanation of the Proposal

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OSHA proposes to add a new @ 1910.119 to subpart H, Hazardous Materials, of 29 CFR part 1910, titled, "Process hazards management of highly hazardous chemicals." The new section would contain requirements intended to eliminate the incidence or mitigate the consequences of highly hazardous chemical releases, fires, and explosions.

The proposal would accomplish its goal by requiring a comprehensive management program: A holistic approach that integrates technologies, procedures, and management practices. The proposal would require that a management system address:

- Process safety information -- paragraph (d)
- Process hazard analysis -- paragraph (e)
- Operating procedures -- paragraph (f)
- Training -- paragraph (g)
- Contractors -- paragraph (h)
- Pre-startup safety review -- paragraph (i)
- Mechanical integrity -- paragraph (j)
- Hot work permits -- paragraph (k) .
- Management of change -- paragraph (l)
- Incident investigations -- paragraph (m)
- Emergency planning and response -- paragraph (n)
- Compliance safety audit -- paragraph (o)

In paragraph (a) OSHA identifies the purpose of the proposed standard. Workplaces proposed to be included in this standard are those which process highly hazardous chemicals (as specified in paragraph (b)). Process is defined as: Any activity conducted by an employer that involves a highly hazardous chemical including any use, storage, manufacturing, handling, processing, or movement, or any combination of these activities. Accidents involving these highly hazardous chemicals in the quantities specified, have the potential of not only placing employees in grave and imminent danger but also could endanger employees throughout the workplace and even the general public. Workplaces that process such materials include (but are not limited to) chemical plants, refineries, food and beverage manufacturers, paper mills, and explosives manufacturing plants. (See part VI of this Preamble for information concerning industries affected by this standard.)

Paragraph (b) addresses the application of the proposed standard. Paragraph (b)(1) specifies those highly hazardous chemicals covered by this proposed standard.

Paragraph (b)(1)(i) proposes to cover any process involving a chemical, at or above the specified threshold quantity, listed in mandatory Appendix A of the proposed standard. Appendix A is a compilation of highly hazardous chemicals that can cause a serious chemical accident, by toxicity, or reactivity, and a consequent serious danger to the employees in a workplace. Appendix A is based on information drawn from a variety of sources including among others, the Environmental Protection Agency, the Department of Transportation, the World Bank, the National Fire Protection Association, the Health and Safety Commission of the United Kingdom, and the States of Delaware and New Jersey. Every chemical in Appendix A is on at least one list compiled by these agencies and organizations as warranting a high degree of management control due to its extremely hazardous nature. Most of the chemicals are on several lists. OSHA realizes that these lists vary in chemicals as well as quantities. Based on a review of these sources, OSHA has sought to include those toxics and reactives

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it believes are most significant in potentially becoming a catastrophic event. OSHA has also sought to develop a reasonable listing of threshold quantities based on a review of the data available, that would sufficiently address potential catastrophic amounts of chemicals. (See Issue 1 in Part IV of this Preamble.)

Paragraph (b)(1)(ii) proposes to include processes involving flammable liquids or gases in quantities of 10,000 pounds or more. It has been suggested that OSHA cover flammable gases or liquids with a potential release of five (5) tons of gas or vapor (References 10 and 11). However, OSHA believes that assessing the variables inherent in determining whether five tons of gas or vapor could be released (temperature, pressure, rate of release, etc.) would be an unnecessary burden on compliance personnel and employers; and, more importantly, substances could go in and out of coverage based on these variables. Therefore, OSHA has determined to use a worst case approach and assume that the entire five (5) ton quantity of highly hazardous chemical could be released into gas or vapor. However, OSHA is not proposing to cover: (A) hydrocarbon fuels used solely for workplace consumption as a fuel, or (B) flammable liquids stored or transferred which are kept below their atmospheric boiling point without benefit of chilling or refrigeration. These uses are not being covered because the Agency believes that they do not have the same potential for a major accident as those being proposed to be covered.

Paragraph (b)(1)(iii) proposes to include the manufacture of explosives. While OSHA has an existing standard for explosives (@ 1910.109), the standard does not address the hazards presented during their manufacture. OSHA believes that the requirements of this standard should be applied to the manufacturing process because of their potential for producing a major accident during that activity; and, addresses a gap that exists in the Agency's current explosives standards.

In paragraph (b)(1)(iv), OSHA is proposing to include the manufacture of pyrotechnics including fireworks and flares. Once again, while OSHA has an existing standard which covers pyrotechnics (@ 1910.109, Explosives and blasting agents), the standard does not address the hazards presented during their manufacture. OSHA believes that the requirements of this standard should be applied to the manufacturing process because of their potential for producing a major accident during that activity; and, addresses a gap that exists in the Agency's current explosives standards.

In paragraph (b)(1)(v), OSHA is proposing a means for assuring that newly developed toxic chemicals introduced into a process are evaluated for their degree of hazard and included in the standard when their hazard meets certain specified criteria. The proposed Substance Hazard Index will assure that employers examine the hazards of new toxic chemicals used in their processes on a continuing basis. (See Issue 2 in Part IV of this Preamble.) Such a mechanism is unnecessary for the other types of chemicals covered by this standard because newly developed chemicals would be covered by paragraph (b)(1)(ii) if flammable and in the quantity of 10,000 pounds; by paragraph (b)(1)(iii) if used in the manufacture of explosives; and by paragraph (b)(1)(iv) if used in the manufacture of pyrotechnics.

Paragraph (b)(2) contains certain exclusions, in addition to those in (b)(1)(ii). OSHA does not believe that retail facilities or normally unmanned remote facilities present the same degree of hazard to employees as those

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workplaces in (b)(1), that would require a comprehensive hazard analysis and management system. Certainly, highly hazardous chemicals may be present in both types of work operations. However, regarding retail facilities, chemicals are in smaller volume packages, containers and allotments, making a massive release unlikely. In normally unmanned remote facilities, as defined in proposed paragraph (c), the likelihood of an uncontrolled release injuring or killing employees is effectively reduced by isolating the process from employees. OSHA believes that the present standards, such as those contained in @ 1910.106, flammable and combustible liquids and in part 1910, subpart Z, toxic and hazardous substances, adequately address the chemical hazards presented in these work operations. OSHA is also proposing to exclude oil and gas well drilling and servicing operations because OSHA has already undertaken rulemaking with regard to these activities and believes these operations should be covered in a standard designed to address their uniqueness such as the standard already proposed by OSHA at 48 FR 57202.

In paragraph (c), OSHA proposes definitions for the following terms: facility, highly hazardous chemicals, hot work, normally unmanned remote facilities, process, and substance hazard index (SHI). These definitions would clarify the meaning and intent of certain terms contained in the proposed standard. Comment is solicited on the adequacy of these definitions and whether other terms used in the proposal need clarifying definitions.

In paragraph (d), OSHA is proposing that the employer develop and maintain certain important information about his or her processes, and that this process safety information be communicated to those employees who are involved in the processes. This information is intended to provide a foundation for identifying and understanding the hazards involved in the process.

The information required by paragraph (d)(1) pertains to the hazards of the chemicals used in the process. OSHA is proposing that this information include at least the following: Toxicity information; permissible exposure limits; physical data; reactivity data; corrosivity data; thermal and chemical stability data; and, hazardous effects of inadvertent mixing of different materials that could foreseeably occur. Most, if not all, of the information required to be compiled by this paragraph should be readily available from the chemical's material safety data sheet (MSDS) that is already required to be maintained by the hazard communication standard, 29 CFR 1910.1200(g), and the MSDS would be acceptable in meeting this proposed requirement.

In paragraph (d)(2), OSHA is proposing that the employer develop and maintain information pertaining to the technology of the process itself. Paragraph (d)(2)(i) specifies the information that would be required and would include, where applicable, at least the following: a block flow diagram or simplified process flow diagram; process chemistry; maximum intended inventory; safe upper and lower limits for such factors as temperatures, pressures, flows and compositions; and, the consequences of any deviations in the process including those affecting the safety and health of employees.

OSHA realizes that it may be difficult to obtain technological information for older, existing processes. In paragraph (d)(2)(ii), therefore, OSHA is proposing to permit process technology information, to be developed from a hazard analysis conducted in accordance with paragraph (e), for processes initiated before January 1, 1980. A properly conducted process hazards analysis should systematically identify technical information regarding the process and

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allow for adequate estimation of safe parameters for the process.

The final type of information proposed to be required by paragraph (d) of this section pertains to the equipment in the process. Since the equipment used in a process can have a significant adverse impact on the facility and employee safety, OSHA wants to assure that the equipment is appropriate for the operation, that its integrity is maintained, and that it meets appropriate standards and codes such as those published by the American Society of Mechanical Engineers, the American Petroleum Institute, the American Institute of Chemical Engineers, the American National Standards Institute, the American Society of Testing and Materials, and the National Fire Protection Association, where they exist, or recognized and generally accepted engineering practices.

OSHA is proposing in paragraph (d)(3)(i) that information compiled concerning equipment used in the process describe: materials of construction; piping and instrument diagrams (P&IDs); electrical classification; relief system design and design basis; ventilation system design; design codes employed; material and energy balances for processes built after the effective date of this standard; and safety systems (such as interlocks, detection, monitoring and suppression systems).

In paragraph (d)(3)(ii), OSHA is proposing that the process equipment be consistent with applicable consensus codes and standards, where they exist; or, be consistent with recognized and generally accepted engineering practices.

OSHA is proposing in paragraph (d)(3)(iii) that the employer determine and document that existing equipment which was designed and constructed in accordance with codes, standards, or practices that are no longer in general use, is designed, installed, maintained, inspected, tested and operated in such a way that safe operation is assured.

There are many instances where process equipment has been in use for many years. Sometimes the codes and standards to which the equipment was initially designed and constructed are no longer in general use. For this type of situation, OSHA wants to ensure that the existing, older equipment still functions safely, and is still appropriate for its intended use. OSHA is not requiring a specific method for this documentation. The employer is permitted to use one of several methods, such as: Documenting successful prior operating procedures; documenting that the equipment is in accordance with the latest edition of codes and standards (specified in (d)(2)(ii)); or, performing an engineering analysis to determine that the equipment is appropriate for its intended use.

In paragraph (e)(1), OSHA is proposing to require the employer to perform a process hazard analysis. OSHA believes that a process hazard analysis is the cornerstone of any effective program for managing hazards because it is a thorough, orderly, systematic approach for identifying, evaluating, and controlling processes involving highly hazardous chemicals. By performing a hazard analysis, the employer can determine where problems may occur, take corrective measures to improve the safety of the process, and preplan the actions that would be necessary if there were a failure of safety controls (e.g., failure of redundant systems).

★ The proposed standard does not specify a period of time by which the initial process hazard analysis must be completed. The Agency has received several

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suggestions with respect to an appropriate time period, but is seeking more information and comments on this issue. (See Issue 3 in Part IV of this Preamble.)

OSHA is proposing a performance-oriented requirement with respect to the process hazard analysis so that the employer will have the flexibility to choose the type of analysis that will best address a particular process. Consequently, in paragraph (e)(1), OSHA is proposing that the employer use one or more of the listed methodologies to perform a process hazard analysis. The Agency is not proposing that the employer use a specific methodology. There are several types of analyses from which the employer may choose: what-if; checklist; what-if/checklist; failure mode and effects; hazard and operability study; and fault tree. A more detailed discussion of the various types of process hazards analyses is contained in nonmandatory Appendix D of this proposed standard. (See Issue 4 in Part IV of this Preamble.)

It is also proposed in paragraph (e)(2) that the process hazard analysis must address the hazards of process; engineering and administrative controls applicable to the hazards and their interrelationships; the consequences of failure of these controls; and a consequence analysis of the effects of a release on all workplace employees.

It is OSHA's position that in order to conduct an effective, comprehensive process hazard analysis, it is imperative that the analysis be performed by competent persons, knowledgeable in engineering and process operations, and familiar with the process being evaluated. Some employers may have staff with expertise to perform a process hazard analysis. This staff already will be familiar with the process being evaluated. However, some companies, particularly smaller companies, may not have the staff expertise to perform such an analysis. The employer, therefore, may hire an engineering or consulting company to perform the analysis. In these situations, the company performing the process hazard analysis must include in its work team at least one employee from the facility who is intimately familiar with the process.

OSHA also believes that the team approach is the best approach for performing a process hazard analysis. This is because no one person will possess all the knowledge and experience necessary to perform an effective process hazard analysis. Additionally, when more than one person is performing the analysis, different disciplines, opinions, and perspectives will be represented, and additional knowledge and expertise will be contributed to the analysis. In fact, OSHA is aware that some companies include an individual on the team who does not have any prior experience with the particular process being analyzed to help insure that a fresh view of the process is integrated into the analysis (e.g., Reference 11, p. 10). (See Issue 5 in Part IV of this Preamble.)

Accordingly, in paragraph (e)(3), OSHA is proposing that the process hazard analysis be performed by a team with members who are knowledgeable in engineering and process operations, and that the team have at least one employee who has experience and knowledge specific to the process being evaluated.

OSHA is proposing in paragraph (e)(4) that the employer establish a system to address the findings and recommendations of the team, to document actions taken, inform employees whose work assignments are in the facility who are affected by the recommendations or actions. The employer is also required to assure that recommendations are implemented in a timely manner. OSHA wants to assure that

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the results of a process hazard analysis are fully utilized to improve process safety.

In paragraph (e)(5), OSHA is proposing that the process hazard analysis be updated and revalidated at least every five years, by a team required in paragraph (e)(3), to assure that the process hazard analysis is consistent with the current process. The Agency believes that this five year interval is a reasonable timeframe, particularly, in consideration of the long life span (without change) of many processes. OSHA believes that safeguards exist, should a process be changed, in the proposed provisions contained elsewhere in the standard including those in paragraph (d), process safety information, and (1), management of change. Consequently, OSHA is proposing in paragraph (e)(5) that the hazard analysis be reviewed and updated at least every five years, by a team specified in paragraph (e)(3). (See Issue 3 concerning "timeframes" in Part IV of this Preamble.)

The Agency also believes that it is important to detect any adverse patterns that may be developing with respect to the process. Therefore, in paragraph (e)(6), OSHA is proposing that the employer retain the two most recent analyses and/or updates for each process covered by this section, as well as the documented actions required in paragraph (e)(4).

OSHA is proposing certain requirements in paragraph (f) concerning a facility's operating procedures. To have an effective process safety management program, OSHA believes that tasks and procedures directly, and indirectly, related to the process must be appropriate, clear, consistent, and, most importantly, communicated to employees.

Many different activities are necessary during a process, such as initial startup, handling special hazards, normal operation, temporary operation, and emergency shutdown. The appropriate and consistent manner in which the employer expects these tasks and procedures to be performed constitutes the facility's operating procedures, sometimes referred to as standard operating procedures (SOP's).

It is also important to have written operating procedures so that they can be communicated to employees in the most effective manner. Such written procedures comprise the employer's policy with respect to what is to be accomplished, and how it is to be accomplished safely. This will ensure that employees will perform like tasks and procedures in a consistently safe manner, and employees will know what is expected of them. These procedures will also be available for ready reference and review during production to make sure things run properly.

As discussed below, communicating the written operating procedures to employees is an important element contained in OSHA's proposed training requirements.

Accordingly, in paragraph (f)(1), OSHA is proposing that the employer develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each process.

In paragraph (f)(1)(i), OSHA is proposing that the operating procedures address steps for each operating phase, including initial startup, normal operation, temporary operations, emergency operations, normal shutdown, and, startup following turnaround or emergency shutdown.

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In paragraph (f)(1)(ii), OSHA is proposing that the operating procedures address the process operating limits, including the following: consequences of deviation; steps required to correct and/or avoid deviation; and safety systems (including detection and monitoring equipment) and their functions.

In paragraph (f)(1)(iii), OSHA is proposing that the operating procedures address safety and health considerations regarding the process, including the following: properties of, and hazards presented, by the chemicals used; precautions necessary to prevent exposure; control measures to be taken if physical contact or airborne exposure occurs; safety procedures for opening process equipment (such as pipe line breaking); quality control for raw materials and control of hazardous chemicals inventory levels; and, any special or unique hazards.

It is important that employees are thoroughly familiar with the operating procedures and the activities they are required to perform with respect to these procedures. Therefore, OSHA is proposing in paragraph (f)(2), that a copy of the procedures be readily accessible to employees.

In paragraph (f)(3), OSHA is proposing that the operating procedures be reviewed to assure that they reflect current operating practice and any changes made to the process or facility.

OSHA is proposing training requirements in paragraph (g). OSHA believes that the implementation of an effective training program is one of the most important steps that employers can take to enhance employee safety. There have been instances where release of highly hazardous chemicals have been the result of inadequately trained operators. OSHA agrees with the Environmental Protection Agency's assessment that "[t]he best equipment can be extremely dangerous in the hands of untrained workers." (Reference 6, p. 17.) The Agency believes that an effective training program will help employees understand the nature and causes of problems arising from process operations, and will increase employee awareness with respect to the hazards particular to a process.

Paragraph (g)(1) addresses initial training and OSHA is proposing that employees presently involved in a process, and employees before working in a newly assigned process, be trained in an overview of the process, and the operating procedures specified in paragraph (f)(1) with emphasis on the specific safety and health hazards, procedures, and safe practices applicable to their job tasks.

Paragraph (g)(2) addresses refresher and supplemental training, and OSHA is proposing that refresher and supplemental training be provided to employees at least annually to assure that they understand and adhere to the current operating procedures of the process.

In paragraph (g)(3), OSHA is proposing that the employer certify that employees have received and successfully completed the required training. The certification shall identify the employee, the type of training completed, and the date of the training. OSHA believes this certification is necessary as a tracking mechanism for the type of training employees receive and when the employees received the training. (See Issue 6 in Part IV of this Preamble.)

OSHA is proposing in paragraph (h) that the employer inform contractors performing work on, or near, a process, of the known potential fire, explosion

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or toxic release hazards related to the contractor's work and the process; ensure that contract employees are trained in the work practices necessary to safely perform their job; and inform them of any applicable safety rules of the facility. OSHA is also proposing that the employer explain to contractors the applicable provisions of the emergency action plan. The purpose of these proposed requirements is to assure that contractors are aware of both the hazards associated with the work being performed; and, the actions to be taken during emergencies. Finally, OSHA is proposing that contract employers assure that their employees follow all applicable work practices and safety rules of the facility. (See Issue 7 in Part IV of this Preamble.)

In paragraph (i)(1), OSHA is proposing that the employer perform a pre-startup review. The review would be required for new facilities, and for modified facilities for which the modification required a change in the process safety information.

Before a highly hazardous chemical is introduced into a process, OSHA wants to assure that important considerations have been addressed. Consequently, in paragraph (i)(2), OSHA is proposing that: Construction is in accordance with design specifications; safety, operating, maintenance, and emergency procedures are in place and are adequate; process hazard analysis recommendations have been addressed and actions required for startup have been completed; and, and training of operating personnel has been completed.

Paragraph (j) contains proposed requirements concerning maintaining the mechanical integrity of process equipment. OSHA considers a mechanical integrity program to be a major and necessary element in a process hazard management program because of its importance in ensuring equipment integrity; eliminating potential ignition sources; and, for determining that equipment is designed, installed, and operating properly.

In paragraph (j)(1) OSHA is proposing that the provisions for mechanical integrity apply to at least the following process equipment: Pressure vessels and storage tanks; piping systems (including piping components such as valves); relief and vent systems and devices; emergency shutdown systems; and controls, alarms, and interlocks. (See Issue 8 in Part IV of this Preamble.)

In paragraph (j)(2)(i), OSHA is proposing that the employer establish and implement written procedures to assure that process equipment receives appropriate, regularly scheduled maintenance.

Although OSHA is proposing training requirements for employees involved in a process (proposed paragraph (g)), those requirements do not apply to employees who perform maintenance on process equipment. Therefore, in paragraph (j)(2)(ii), OSHA is proposing that the employer assure that employees involved in maintaining the on-going integrity of the process equipment are trained in the procedures applicable to their tasks.

In paragraph (j)(3)(i), OSHA is proposing inspection and testing requirements for at least the equipment specified in proposed paragraph (j)(1) because of the potential safety and health hazards that could result if such equipment malfunctioned.

In paragraph (j)(3)(ii), OSHA is proposing that inspection and testing procedures follow commonly accepted consensus standards and industry codes

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since the ones used by the employer must reflect the particular equipment being inspected or tested.

Examples of codes and standards that the employer may use to comply with this proposed provision include those developed and published by: The American Society of Mechanical Engineers (ASME); the American Petroleum Institute (API); the American Institute of Chemical Engineers (AIChE); American National Standards Institute (ANSI) Standards; the American Society for Testing of Materials (ASTM); and the National Fire Protection Association (NFPA).

In paragraph (j)(3)(iii), OSHA is proposing that the frequency of inspections and tests be consistent with commonly accepted standards and codes; or, as determined by prior operating records if these records indicate a need for more frequent tests and inspections.

This is a performance-oriented requirement to provide the employer with the flexibility to choose the frequency which will provide the best assurance of equipment integrity. OSHA believes that the employer, and employees working with the equipment, certainly, are familiar with the particular equipment used, and with guidance from engineering and safety codes and equipment manufacturer's recommendations, are in a good position to choose the appropriate frequency for inspection and testing.

In paragraph (j)(3)(iv), OSHA is proposing that a certification system be implemented for identifying each inspection and test performed. The certification shall identify the date of the inspection or test; the name of the person who performed the inspection or test; and the serial number or other identifier of the equipment that is being inspected or tested. This information, along with manufacturers' recommendations for effective equipment operation, will assist the employer in determining the appropriate interval for preventive maintenance.

OSHA believes that when certain potentially hazardous conditions are detected, prompt corrective action is necessary. Consequently, in paragraph (j)(4), OSHA is proposing that the employer correct equipment deficiencies which are outside acceptable limits, before further use.

OSHA believes that quality assurance is an important and integral part of any effective program for assuring the integrity of process equipment. Therefore, OSHA is proposing in paragraph (j)(5) that equipment as fabricated meets design specifications; that appropriate checks and inspections be performed to assure that equipment is installed properly and consistent with design specifications and manufacturer's instructions; and that maintenance materials, spare parts and equipment, meet design specifications.

In paragraph (k), OSHA is proposing that the employer issue a permit for hot work operations performed in, or near, processes or facilities. The purpose of the permit is to assure that the employer is aware of the hot work being performed, and that appropriate safety precautions have been taken prior to beginning the work.

Since welding shops authorized by the employer are locations specifically designated and suited for hot work operations, OSHA believes it unnecessary to require a permit for these locations. Additionally, OSHA does not believe that a permit is necessary in those circumstances where the employer, or an

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individual to whom the employer has assigned the authority to grant hot work permits, is present during the work procedure. OSHA believes that a permit is unnecessary in these circumstances because the employer or employer's representative who would normally authorize the permit would be present to assure that the work be accomplished in compliance with OSHA regulations.

Consequently, OSHA is proposing in paragraph (k)(1) that the employer issue a permit for all hot work except where the employer or employer's representative is present while the hot work is being performed, and except in welding shops authorized by the employer.

In paragraph (k)(2), OSHA is proposing that the permit certify that the requirements contained in § 1910.252(a), regarding fire prevention and protection, have been implemented prior to beginning hot work operations. It is also being proposed that the permit be kept on file until completion of the hot work operations. Even though employers are currently required to comply with these safety precautions, OSHA believes it appropriate to reference § 1910.252(a) in this particular standard to emphasize the importance of these safety precautions when working on, or near, processes involving highly hazardous chemicals capable of creating a catastrophic accident.

OSHA also wants to make it clear that the permit is a certification by the employer authorizing the work to be performed safely, rather than a recordkeeping burden.

Proposed paragraph (l) addresses the management of change to process chemicals, technology, and equipment; and changes to facilities. OSHA believes it important to thoroughly evaluate all contemplated changes involving the technology of the process as well as facility changes in order to assure that the impact on safety and health is analyzed, and to determine what modifications to operating procedures may be necessary.

Therefore, in paragraph (l)(1), OSHA is proposing that the employer establish and implement written procedures to manage changes to process chemicals, technology, equipment and, facilities prior to implementation of such changes. It is also proposed in paragraph (l)(2) that these procedures address the technical basis for the proposed changes; impact of the changes on safety and health; modification of the operating procedures; time period necessary for the change; and, authorization for the proposed change.

In paragraph (l)(3) OSHA is proposing that employees involved in the process be informed of, and trained in, the changes as early as practicable prior to its implementation. OSHA believes that early notice of planned changes will allow employees greater time in which to learn new operating procedures and safety considerations associated with the change.

In order to assure that the necessary information and documentation is maintained, OSHA is proposing in paragraph (l)(4) that if changes in the process or operating procedures result in changes to the process safety information (paragraph (d)), such information shall be appended and/or updated in accordance with the requirements of paragraph (d).

To assure that employees are apprised of any changes in operating procedures, OSHA is proposing in paragraph (l)(5) that if changes in process result in changes to operating procedures, such procedures shall be appended and/or

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updated in accordance with paragraph (f).

Proposed paragraph (m) contains requirements concerning incident investigations. OSHA believes that an important part of any process safety management program is the thorough investigation of major, or potentially major, incidents. Such an investigation would be invaluable for identifying the chain of events leading to the incident and for determining causal factors. This information will be extremely important for the development and implementation of corrective measures.

Accordingly, OSHA is proposing in paragraph (m)(1) that the employer investigate every incident which results in, or could reasonably have resulted in a major accident in the workplace.

It is important that the investigation be initiated promptly so that the events can be recounted as clearly as possible, and so that there is less likelihood that the scene will have been disturbed. Due to the potential emergency nature of the incident, OSHA realizes that circumstances may not facilitate an immediate investigation. Therefore, in paragraph (m)(2), OSHA is proposing that the incident investigation be initiated as promptly as possible, but no later than 48 hours following the incident.

In paragraph (m)(3) OSHA is proposing that the investigation be performed by a team consisting of persons knowledgeable in the process involved, and other appropriate specialties as necessary.

OSHA is proposing in paragraph (m)(4), that a report be prepared at the conclusion of each investigation and that the report contain, at a minimum the following information: the date of the incident; the date the investigation began; a description of the incident; the factors that contributed to the incident; and, any recommendations resulting from the investigation.

Information contained in the report may be critical in preventing similar incidents, and it is important that the information is disseminated to affected employees. In paragraph (m)(5), therefore, OSHA is proposing that the report be reviewed with all operating, maintenance, and other personnel whose work assignments are within the facility where the incident occurred.

One of the most important aspects of the report is that it would contain recommendations resulting from the investigation. Consequently, OSHA is proposing in paragraph (m)(6) that the employer establish a system to address the report's recommendations and to implement them in a timely manner.

Finally, in paragraph (m)(7), OSHA is requiring that investigation reports be retained for five years in order to determine if an incident pattern develops or exists.

Paragraph (n) of the proposal addresses emergency planning and response. Emergencies involving the processing of highly hazardous chemicals can result in catastrophic consequences if not handled properly. To prevent such occurrences, and for the employee's own safety, it is imperative that employees know what the procedures are for emergency shutdown; evacuation; notifying emergency response (or fire department) personnel; notifying other employees of the emergency; and procedures for controlling the emergency (fire suppression, etc.). OSHA believes that it is equally important that these procedures be communicated effectively

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to employees, and that employees be thoroughly trained in such procedures.

It is OSHA's position that the best means of addressing emergency response and control is by implementing an emergency action plan in accordance with @ 1910.38(a). That section requires the plan to be written except for facilities with ten or fewer employees. OSHA believes that a written plan for larger facilities is the most effective means of communicating information to employees. That rule also specifies certain minimum elements to be addressed in the emergency plan. These include the establishment of an employee alarm system; the development of evacuation procedures; the development of procedures to account for all employees after emergency evacuation has been completed; and, the training of employees in those actions they are to take during an emergency. (See Issue 9 in Part IV of this Preamble.)

OSHA believes that @ 1910.38(a) contains elements necessary for effective emergency planning and response. In paragraph (n), therefore, OSHA is proposing that the employer establish and implement an emergency action plan in accordance with @ 1910.38(a).

It is important to note that, if applicable, the employer may also have to comply with @ 1910.120 (a), (p), and (q), concerning hazardous waste operations and emergency response.

In paragraph (o)(1), OSHA is proposing to require the employer to evaluate compliance with the provisions of this section, at least every three (3) years. OSHA believes that a compliance safety audit provides an important function in assuring that an effective process safety management system is in place and working. The compliance safety audit will verify, for example, that the training program is adequate and that employees are being trained, and that the safety information package has been compiled and communicated to employees involved in the process. The safety audit, through its systematic analysis of compliance with the provisions of this standard, can identify problem areas and assist the employer in directing attention to process safety management weaknesses.

OSHA is proposing in paragraph (o)(2) that the compliance safety audit be performed by a team which includes at least one person knowledgeable in the process.

In paragraphs (o)(3) and (o)(4), OSHA is proposing that a report of the findings of the audit be developed and that the employer document the appropriate response to the findings and certify that deficiencies have been corrected.

The Agency believes that employers must retain the two (2) most recent compliance safety audit reports and the documented actions in order to focus on areas of continuing concern surfaced through the audits. Therefore, OSHA is proposing such a requirement as paragraph (o)(5).

OSHA is also proposing to include six (6) appendices to be included in the standard. Two (2) of these appendices, Appendix A and B are mandatory, and the remaining four (4), Appendices C through F are nonmandatory. Appendix A and B are made mandatory through the application requirements (paragraph (b)) of the proposed standard.

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The nonmandatory appendices are intended to provide helpful additional information to assist employers and employees in complying with certain requirements of this standard.

Appendix A contains the list of highly hazardous chemicals, and their threshold quantities, that are proposed to be covered by the requirements of the standard. This Appendix was discussed in greater detail previously in this notice.

Appendix B provides a method through the use of a formula for employers to evaluate newly developed chemicals which they introduce into processes in their workplaces. This mechanism provides a means of including additional highly hazardous materials within the application of the standard when they demonstrate the potential of creating a catastrophic release.

Appendix C contains an example of a block flow diagram and a simplified process flow diagram. A block flow diagram, or a simplified process flow diagram, is required to be developed by paragraph (d) of the standard.

Appendix D presents greater detail to employers on conducting a process hazard analyses required by paragraph (e) of the proposal.

Appendix E contains guidance on conducting incident investigations which are required to be conducted under paragraph (m) of the proposed standard and also contains guidance on how an employer can establish an effective emergency control center which would assist employers in effectively responding to failures of process components.

Finally, Appendix F lists sources of additional information (and the address of the organization) which an employer or employee may obtain concerning the management of process hazards.

IV. Issues

OSHA invites comments on any aspect of the proposed standard for process hazards management. However, this part of the Preamble contains a series of issues concerning requirements and Appendices contained in the proposed standard which are of significant concern to OSHA, and therefore, OSHA is including them in a separate part in order to highlight them. For additional explanations regarding the provisions at issue, please refer to the Summary and Explanation, part III of this Preamble. The Agency invites comments, views and data on the following issues:

1. In paragraph (b)(1) of the standard, OSHA is proposing to cover certain highly hazardous chemicals, in specified quantities, that are listed in Appendix A of the proposal. As previously noted, Appendix A is a compilation of toxic chemicals selected from a variety of lists. OSHA has also developed a threshold quantity which would trigger inclusion in the standard. The threshold quantity was also developed based on information contained in the variety of chemical lists reviewed by OSHA. While OSHA believes that Appendix A represents a reasonable and appropriate listing of chemicals and threshold quantities, OSHA invites discussion regarding the list by asking the following questions. Is mandatory Appendix A sufficient compilation of toxic and reactive highly hazardous chemicals that should be covered by this standard? Are there chemicals that should be deleted or added to this list? If so, why, in what industries are they used in, and what costs and benefits could be expected by their addition

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or deletion from Appendix A? OSHA would also like comment with respect to the threshold quantities specified in this Appendix.

Additionally, OSHA invites comment on the threshold quantity listed in paragraph (b)(1)(ii) of 10,000 pounds or more of a flammable liquid or gas. Is there a different approach OSHA should take with regard to the manner in which flammable liquids and gases are included in the standard?

2. In paragraph (b)(1)(v), OSHA is proposing a mechanism, the Substance Hazard Index (SHI), described in mandatory Appendix B, for evaluating and including newly developed toxic chemicals which are introduced into a process. Based on the evaluation of their hazard, new toxic chemicals could be included in the coverage of this standard if they meet the specified criteria. Without such a mechanism in the standard, OSHA must look to rulemaking activities to include additional toxic highly hazardous materials. A variation of this evaluation method was in fact used by the State of Delaware in its regulation (Reference 9). However, OSHA realizes that there may be shortcomings in using the proposed approach. For example, an important part of the SHI formula relies on the availability of the American Industrial Hygiene Association's (AIHA) computation of levels of hazard contained in its Emergency Response Planning Guidelines (ERPG) for individual chemicals. At this time there are only a few ERPG's and depending on whether AIHA can accelerate the program, it may not be responsive enough. OSHA invites comments on the appropriateness of including this mechanism in the standard. OSHA invites suggestions on other ways to include newly developed toxic chemicals in the coverage of this standard. OSHA would also like comment with respect to the proposed 500 pound threshold quantity for newly developed toxic chemicals.

★ 3. In proposed paragraph (e), OSHA is requiring a process hazard analysis to be performed, but is not proposing a timeframe within which the initial analysis must be completed.

Process hazard analyses have existed for many years, and the value of these analyses is well known. OSHA notes that many facilities, especially larger facilities, have experience in performing a process hazard analysis, and may already be in compliance with proposed paragraph (e). Others, which may not have performed such analyses, currently have the technical expertise to comply with the proposed provisions within a very short timeframe.

However, OSHA has received comments indicating that because of limited availability of resources (such as technical expertise), it would be difficult for some facilities to perform a process hazard analysis within a short timeframe. As a result, it has been suggested that a one-, two-, three- or even five-year delayed effective date be specified as the timeframe for completion of an initial process hazard analysis.

OSHA welcomes comments suggesting what timeframe, if any, should be specified for completion of the initial process hazard analysis. ★ OSHA seeks comment on what timeframe is feasible, with particular focus on whether adequate resources, such as persons or organizations who have the expertise to conduct process hazard analyses, are available.

Proposed paragraph (e)(5) requires the process hazard analysis to be updated and revalidated every five (5) years. OSHA invites comment on whether the five (5) year update and revalidation cycle is appropriate or whether a longer or

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shorter time period is necessary. Should OSHA allow a longer period of time before update and revalidation or should OSHA consider requiring that the process hazard analysis be updated and revalidated whenever a change in process occurs?

4. In paragraph (e) of the proposal, OSHA is requiring that a process hazard analysis be conducted. OSHA includes a list of acceptable methodologies from which an employer can choose. Should OSHA limit the methodologies to only those listed, since variations of these may exist and new methodologies may be developed that may be as equally as effective in assessing process hazards? It has been suggested that OSHA should consider accepting those methodologies recognized by the American Institute of Chemical Engineers (AIChE). Are the methodologies specified in the proposal sufficient? Should OSHA accept those methodologies recognized by the AIChE now, as well as those recognized by AIChE in the future?

With respect to the required methodologies, OSHA has included nonmandatory Appendix D, which contains information on how to conduct the methodologies. In order to assure that the process hazard analysis methodologies are conducted in a similar fashion, using minimum criteria, should OSHA make Appendix D a mandatory Appendix?

5. OSHA is requiring in paragraph (e), process hazard analysis, that a team be used to conduct the analysis. The team must be comprised of personnel with expertise in engineering and process operations, and must include at least one employee who has experience and knowledge specific to the process being evaluated. OSHA would like to know if the specified team is adequate or should modifications be made to the team membership, such as including other areas of expertise?

Also, with regard to the team, it has been suggested that an employee representative be required to be on the process hazard analysis team, as well as on the incident investigation team required in paragraph (m), to assist in developing a cooperative participatory environment and the necessary flow of information from management to employees and from employees to management. OSHA is interested in knowing what interested persons think about requiring an employee representative on the process hazard analysis team and the incident investigation team?

6. In paragraph (g), OSHA requires that employees receive initial training, refresher and supplemental training, and that the employer certify that employees received the training. OSHA requests information on whether the standard should require a mechanism that would validate that employees have successfully absorbed training. For example, should OSHA require that employees be given a test at the end of training, or perhaps require that the employer validate the training by questioning employees while they are performing their job tasks? Are there any other suggested ways to validate training?

OSHA would also like information regarding whether a minimum amount of training (for example 40 hours of initial training, and 8 hours of refresher training) should be specified in order to better assure that employees are able to fully assist management in the prevention and mitigation of catastrophic accidents.

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7. In paragraph (h), OSHA requires that contractors be informed of known potential hazards related to the contractor's work, applicable safety rules, and applicable provisions of the workplace emergency action plan. OSHA is aware that some contractors may actually work at a plant, and perhaps on a process, a significant amount of their work time. Should OSHA consider requiring a greater amount of training, such as the training required in paragraph (g), for contract employees if in fact the majority of their time is spent at one plant and their exposure to the hazards of a process are as frequent as regular process employees? In addition should the standard specifically require contractors to inform the plant's employer of the hazards presented by the contractor's work, or, will the contract itself reveal that information. Additionally, should the contractor be required to inform the employer of any hazards found by the contractor's work?

8. In paragraph (j), OSHA addresses the mechanical integrity of process equipment. Recommended standards and practices available to OSHA (References 10 and 11) indicate that OSHA's concern for mechanical integrity should be exclusive to "critical" process equipment. OSHA would like to know whether the listing of equipment in paragraph (j) includes equipment that does not impact the safety of a process, or whether additional equipment should be covered?

9. OSHA is proposing in paragraph (n) that employers develop and implement an emergency action plan according to @ 1910.38(a). Requirements in @ 1910.38(a) do not provide for drills or simulated exercise that would provide practical experience to employees in responding to emergencies. OSHA would like to know if it should require employers to perform drills or simulated exercises to further assure that employees respond correctly to procedures established for emergency action? If so, how often should such drills or simulated exercises be conducted? Should such drills or exercises be conducted in conjunction with SARA Title III exercises and drills under local community plans?

★ 10. As indicated above (Issue 3), OSHA is requesting information on an appropriate timeframe in which a process hazard analysis must be conducted. OSHA is interested in comment regarding whether other provisions should be delayed or phased-in, as well as the reason for any recommended delay.

★ Additionally, OSHA would also like information on whether it is necessary for all of the covered industries to meet all of the proposed provisions. For example, OSHA realizes that the standard may have a significant impact on smaller businesses and is interested in determining what forms of relief could be given to smaller businesses without decreasing employee safety and health.

11. It has been suggested that OSHA institute a requirement that facilities which are covered by this standard (those with the specified quantities of highly hazardous chemicals) be required to notify the local OSHA Area Office of their location. Other countries which regulate potentially catastrophic workplaces require notifying the regulating entity. The States of Delaware and New Jersey also require notification. Should employers be required to notify OSHA (i.e., the Area Office) of their location when the employer has the threshold quantity of highly hazardous chemical as specified by the standard?

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VI. Summary of the Preliminary Regulatory Impact and Regulatory Flexibility Analysis, the International Trade Impact Analysis, and the Environmental Impact Assessment

Introduction

OSHA is proposing the creation of a new standard within subpart H, Hazardous Materials, to deal with the risks involved with the storage, handling and processing of highly hazardous materials. The proposed standard -- referred to as process safety management, or PSM -- emphasizes the application of management controls rather than specific engineering guidelines when addressing the risks associated with handling or working near highly hazardous chemicals. Implementation of process safety management programs and procedures will enable affected establishments to prevent the occurrence, and minimize the consequences, of significant releases of toxic substances as well as fires, explosions and other types of catastrophic accidents. The benefits of implementing PSM include the prevention of accidental fatalities, injuries and illnesses, and the avoidance of physical property damage.

Additional benefits important to both employers and workers, are the economic and health/safety dividends expected months and years after the initiation of process safety management. The economic benefits of PSM include enhanced productivity due to fewer process disruptions and accidental shutdowns; decreased labor turnover as a result of a safer work environment; more efficient utilization of space, labor and equipment in the wake of programmatic plant reviews; an integrated approach to process design, construction, operation, and maintenance, with process safety as the central focus of concern; and greater consistency of product quality. All of these areas are expected to offset any direct costs of compliance. OSHA also anticipates significant improvements in ergonomic and other chronic health and safety problems -- including low-level exposure to toxic substances -- through compliance with the proposed standard.

Executive Order 12291 (46 FR 13197) requires that a regulatory impact analysis be prepared for any proposed regulation that meets the criteria for a "major rule"; that is, that would be likely to result in an annual impact on the economy of \$100 million or more; a major increase in cost or prices for consumers, individual industries, federal, state or local government agencies, or geographic regions; or, significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets. In addition, the Regulatory Flexibility Act (5 U.S.C. 601, et seq.) requires analysis of whether a regulation will have a significant economic impact on a substantial number of small entities.

Consistent with these requirements, OSHA has prepared this Preliminary Regulatory Impact and Regulatory Flexibility Analysis, for proposed @ 1910.119, process safety management of highly hazardous chemicals. As a result of this analysis OSHA has made a preliminary determination that proposed @ 1910.119 will constitute a major rule.

Affected Industries and Current Compliance

Based on a preliminary report prepared by Kearney/Centaur [1] OSHA has determined that approximately 27,775 establishments employing 2.2 million workers in 95 industry subgroups will be affected by the proposed standard. The population at risk is found throughout manufacturing, particularly in Standard Industrial Classification (SIC) code 28, Chemicals and Allied Products, and SIC 29, Petroleum Refining and Related Industries. In addition, workers in

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farm-product warehousing (SIC 4221), wholesale trade (SICs 50 and 51), natural gas liquids (SIC 1321), and electric and water service (SIC 49) are at risk. The extent of the impact will vary by industry depending on current practice, the number of processes, and the quantities of highly hazardous materials on site.

Kearney/Centaur compared current practices with the provisions of the proposed rule by SIC group using OSHA survey data and survey data compiled by a major chemical engineering magazine. For all industries affected by the proposed rule, none were judged to be currently in full compliance, although compliance appears to be at or near 100 percent among some establishments for some specific provisions. Generally, larger firms have a higher current compliance rate than smaller firms, but for many industries the compliance-rate differences by establishment size are not substantial.

Nonregulatory Environment

The primary objective of OSHA's process safety management proposal is to reduce the number of employee fatalities and injuries associated with catastrophic releases of hazardous substances. OSHA believes that the proposed standard will eliminate to a considerable degree the risks which workers experience in the establishments falling within the scope of the rule. The Agency examined the nonregulatory approaches for promoting the implementation of safety management programs, including (1) economic forces generated by the private market system, (2) incentives created by workers' compensation programs or the threat of private suits, and (3) related activities of private agencies. Following this review, OSHA determined that the need for government regulation arises from the significant risk of job-related injury or death caused by inadequate practices for preventing catastrophic accidents which currently exist in the industry. Private markets fail to provide enough safety and health resources due to the lack of risk information, the immobility of labor, and the externalization of part of the social costs of worker injuries and deaths. Workers' compensation systems do not offer an adequate remedy because the premiums do not reflect specific workplace risk, and liability claims are restricted by statutes preventing employees from suing their employers. While certain voluntary standards exist, their scope and approach fail to provide adequate protection for all workers. Thus, OSHA has determined that a federal standard is necessary.

Costs of Compliance

The proposed standard for the management of process hazards contains provisions addressing four general elements of process safety: The technology of plant, process and materials; personnel training, preparedness and response to incidents; the maintenance of, alteration to, and quality assurance of equipment and facility; and emergency response and control. Most of the activities required by the proposed standard involve personnel time to develop programs and procedures, train employees, and carry out inspection activities. Capital costs will be incurred by firms conducting process hazards analyses and pre-startup safety reviews which result in a determination that process redesign or equipment innovation is necessary to mitigate risks. OSHA estimates that \$637.7 million in direct annualized costs will be required to comply with the proposed standard. Over half of this cost involves expenditures for recurring activities within the PSM program; a little over a third of the annual costs represent annualized capital costs to remedy equipment deficiencies.

★ OSHA has estimated adjusted costs of compliance based upon the assumption that implementation of process safety management will generate economic

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benefits in the form of reduced incidence of property damage and lost production, as well as reduced employee turnover. Based on an analysis performed by OSHA's contractor, Kearney/Centaur, OSHA estimates that the value of PSM-related economic benefits will be \$404.5 million for an 80 percent safety-effectiveness rate. Subtracting the value of the economic benefits from the annualized direct costs gives adjusted compliance costs of \$233.4 million. OSHA believes the true economic cost of the proposal is best reflected by the adjusted costs. Furthermore, the estimate may understate the true cost savings of the proposal, in that insurance, administrative, productivity improvements, and other costs savings associated with accident prevention are not included in the assessment.

Benefits

OSHA anticipates that full compliance with the proposed standard will lead to fewer catastrophic fires, explosions, releases of hazardous substances and other types of serious accidents. It is expected that many minor incidents will be prevented as well. OSHA estimated the baseline number of fatalities and injuries/illnesses linked to the proposed standard for the period 1983-87 using Kearney/Centaur's review of reports within the OSHA Integrated Management Information System database and data from other sources. For the five-year period, an average of 265 fatalities and 901 injuries/illnesses per year are associated with major accidents involving hazardous materials. Using a risk-reduction estimate of 80 percent, OSHA estimates that 212 fatalities will be avoided by compliance with the proposal, while at least 721 injuries and illnesses (including 315 lost-workday injuries) per year from catastrophic accidents will be avoided.

In addition to the health and safety benefits from preventing catastrophic incidents, reductions in injuries and illnesses related to minor industrial mishaps are anticipated, as well as the long-run risks posed by occasional releases of toxic vapors and gases and by the physical hazards of poor process design.

Economic Impact and Regulatory Flexibility Analysis

★ OSHA has assessed the potential economic impact of the proposed standard and has made a preliminary determination that none of the major industry groups would experience a significant economic burden as a result of the proposed standard. If affected companies added the entire cost of compliance to the price of their final good, OSHA estimates that the average price increase would not exceed 0.03 percent, based on the ratio of adjusted compliance costs to the value of industry shipments and an 80 percent effectiveness rate. The maximum price increase in any industry would be 0.22 percent for the same effectiveness rate. On the other hand, if all costs were absorbed by affected firms, OSHA estimates that the average reduction in profits would not exceed 2.7 percent. While a few industry groups would be expected to experience profit reductions above three percent under the no-cost-pass-through scenario, the impact on the majority of affected industries would be less than 2.0 percent of profit.

As required by the Regulatory Flexibility Act of 1980, OSHA assessed the economic burden faced by small establishments relative to that expected for large firms and the industry as a whole. Under the worst-case assumptions, the average ratio of cost to revenue for firms with fewer than twenty employees would be approximately 0.35 percent. Although this average price increase exceeds the average for all affected establishments, none of the small-firm price increases are expected to exceed 3.7 percent. If small firms were to

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absorb the costs of regulation in full, some small establishments could experience profit reductions in excess of 30 percent under worst-case assumptions (no offsetting economic benefits from the proposed rule). Since some small firms may have difficulty financing the programs required by the proposal, the Agency solicits public comment on ways to reduce this burden without jeopardizing overall safety.

International Trade

The standard is not likely to have a significant effect on international trade because of the small magnitude of any price increase that would be required for passing forward compliance costs. As shown above, the maximum price increases generated from the proposed standard would be less than 1.0 percent for the majority of affected establishments. Further, none of the compliance requirements affect the demand for foreign-made safety equipment. It can be concluded, therefore, that there will be no measurable impacts on foreign trade.

Environmental Assessment

The proposed standard has been reviewed in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.), the regulations of the Council on Environmental Quality (CEQ) (40 CFR part 1500), and DOL NEPA procedures (29 CFR part 11). The provisions of the standard focus on the reduction and avoidance of incidents involving toxic releases, fires and explosions. Consequently, no major negative impact is foreseen on air, water or soil quality, plant or animal life, the use of land or other aspects of the environment. OSHA believes that compliance with the proposal may result in positive environmental effects in the form of fewer releases of toxic liquids, solids and gases into the air, soil and water.

VII. Federalism

This proposed regulation has been reviewed in accordance with Executive Order 12612 (52 FR 41685, October 30, 1987), regarding Federalism. This Order requires that agencies, to the extent possible, refrain from limiting state policy options, consult with states prior to taking any actions which would restrict state policy options, and take such actions only when there is clear constitutional authority and the presence of a problem of national scope. The Order provides for preemption of state law only if there is a clear Congressional intent for the Agency to do so. Any such preemption is to be limited to the extent possible.

Section 18 of the Occupational Safety and Health Act (OSH Act) expresses Congress' clear intent to preempt state laws relating to issues on which Federal OSHA has promulgated safety and health standards. Under the OSH Act, a state can avoid preemption only if it submits, and obtains Federal approval of a plan for the development of such standards and their enforcement. Occupational safety and health standards developed by such Plan-States must, among other things, be at least as effective in providing safe and healthful employment and places of employment as the Federal standards. Where such standards are applicable to products distributed or used in interstate commerce, they may not unduly burden commerce and must be justified by compelling local conditions (see section 28(c)(2) of the OSH Act).

The Federal proposed standard on process safety management of highly hazardous chemicals addresses hazards that are not unique to any one state or region of the country. Nonetheless, states with occupational safety and health plans approved under section 18 of the OSH Act will be able to develop their

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own state standards to deal with any special problems which might be encountered in a particular state. Moreover, because this standard is written in general, performance-oriented terms, there is considerable flexibility for state plans to require, and for affected employers to use, methods of compliance which are appropriate to the working conditions covered by the standard.

In brief, this proposed rule addresses a clear national problem related to occupational safety and health in general industry. Those states which have elected to participate under section 18 of the OSH Act are not preempted by this standard, and will be able to address any special conditions within the framework of the Federal Act while ensuring that the state standards are at least as effective as that standard. State comments are invited on this proposal and will be fully considered prior to promulgation of a final rule.

VIII. State Plan States

The 25 states and territories with their own OSHA approved occupational safety and health plans must adopt a comparable standard within six months of the publication date of a final standard. These 25 states and territories are: Alaska, Arizona, California, Connecticut (for state and local government employees only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York (for state and local government employees only), North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming. Until such time as a state standard is promulgated, Federal OSHA will provide interim enforcement assistance, as appropriate, in these states.

IX. Public Participation

Comments. Interested persons are invited to submit written data, views, and arguments with respect to this proposal. These comments must be postmarked by October 15, 1990, and submitted in quadruplicate to the OSHA Docket Officer, Docket S-026, U.S. Department of Labor, Occupational Safety and Health Administration, Room N2625, 200 Constitution Avenue NW., Washington, DC 20210. The telephone number of the Docket Office is (202)523-7894, and its hours of operation are 8:15 a.m. to 4:45 p.m., Monday through Friday. Comments limited to 10 pages or less may also be transmitted by facsimile to (202)523-5046, provided that the original and four copies of the comment are sent to the Docket Officer immediately thereafter.

Written submissions must clearly identify the issues or specific provisions of the proposal which are addressed and the position taken with respect to each issue or provision. The data, views and arguments that are submitted will be available for public inspection and copying at the above address. All timely submissions received will be made a part of the record of this proceeding. The preliminary regulatory impact assessment and the exhibits cited in this document will be available for public inspection and copying at the above address. OSHA invites comments concerning the conclusions reached in the regulatory impact assessment.

OSHA recognizes that there may be interested persons who, through their knowledge of safety or their experience in the operations involved, would wish to endorse or support certain provisions in the standard. OSHA welcomes such supportive comments, including any pertinent accident data or cost information which may be available, in order that the record of this rulemaking will present a balanced picture of the public response on the issues involved.

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Public hearing. OSHA will hold an informal public hearing to begin at 9:30 a.m. on November 27, 1990. The hearing will be held in the Auditorium of the Frances Perkins Building, U.S. Department of Labor, 200 Constitution Avenue NW., Washington, DC, 20210.

Notice of intention to appear. Any interested person desiring to participate at the hearing, including the right to question witnesses, must file, in quadruplicate, a notice of intention to appear. The notice of intention to appear must be postmarked by October 15, 1990, and addressed to Mr. Tom Hall, Division of Consumer Affairs, Room N3649, U.S. Department of Labor, Occupational Safety and Health Administration, 200 Constitution Avenue NW, Washington, DC 20210, (202)523-8615. The notice of intention to appear also may be transmitted by facsimile to (202)523-5986 provided that the original and four copies of the notice are sent to the above address immediately thereafter.

The notice of intention to appear must contain the following:

1. The name, address, and telephone number of each person to appear;
2. The capacity in which the person will appear;
3. The approximate amount of time required for the presentation;
4. The specific issues that will be addressed; and
5. A statement of the position that will be taken with respect to each issue addressed.

Filing of testimony and evidence before the hearing. Any party requesting more than 10 minutes for presentation at the hearing or who will present documentary evidence, must provide in quadruplicate, the complete text of its testimony, including all documentary evidence to be presented at the hearing. These materials must be postmarked no later than November 5, 1990, and sent to Mr. Tom Hall, Division of Consumer Affairs, at the address given above.

Each submission will be reviewed in light of the amount of time requested in the notice of intention to appear. In instances where the information contained in the submission does not justify the amount of time requested, a more appropriate amount of time will be allocated and the participant will be notified of that fact. Any party who has not substantially complied with the above requirements, may be limited to a 10 minute presentation and may be requested to return for questioning at a later time. Any party who has not filed a notice of intention to appear may be allowed to testify, as time permits, at the discretion of the Administrative Law Judge who presides at the hearing.

Notices of intention to appear, testimony and evidence, will be available for inspection and copying at the Docket Office, Docket S-026, Room N2625, 200 Constitution Avenue NW., Washington, DC 20210.

Conduct and nature of the hearing. The hearing is scheduled to commence at 9:30 a.m. on November 27, 1990. At that time, any procedural matters relating to the proceeding will be resolved. The informal nature of the rulemaking hearing to be held is established in the legislative history of section 6 of the Act and is reflected by the OSHA hearing regulations (see 29 CFR 1911.15(a)). Although the presiding officer is an Administrative Law Judge and questioning by

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interested persons is allowed on crucial issues, it is clear that the proceeding shall remain informal and legislative in type. The intent, in essence, is to provide an opportunity for effective oral presentation by interested persons which can be carried out expeditiously and in the absence of rigid procedures which might unduly impede or protract the rulemaking process.

The hearing will be conducted in accordance with 29 CFR part 1911. The presiding officer, an Administrative Law Judge, will have the powers necessary or appropriate to conduct a full and fair informal hearing as provided in 29 CFR part 1911, including the powers:

1. To regulate the course of the proceedings;
2. To dispose of procedural requests, objections and comparable matters;
3. To confine the presentation to the matters pertinent to the issues raised;
4. To regulate the conduct of those present at the hearing by appropriate means;
5. In the Judge's discretion, to question and permit the questioning of any witness, and to limit the time for questioning; and
6. In the Judge's discretion, to keep the record open for a reasonable stated time to receive written information and additional data, views, and arguments from any person who has participated in the oral proceedings.

Following the close of the hearing, the presiding Administrative Law Judge will certify the record of the hearing to the Assistant Secretary of Labor for Occupational Safety and Health. The Administrative Law Judge does not make or recommend any decisions as to the content of a final standard.

The proposal will be reviewed in light of all written submissions and testimony received as part of the rulemaking record. Decisions on the provisions of a final standard will be made by the Assistant Secretary based on the entire record of the proceeding.

List of Subjects in 29 CFR Part 1910

Explosives, Flammable liquids and gases, Hazard analysis, Highly hazardous chemicals, Hazardous materials, Occupational safety and health, Safety, Process hazard analysis, Pyrotechnics.
Authority

This document has been prepared under the direction of Gerard F. Scannell, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue NW., Washington, DC 20210.

Accordingly, pursuant to sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 1-90 (55 FR 9033); and 29 CFR part 1911, it is proposed to amend 29 CFR part 1910 as set forth below.

Signed at Washington, DC, this 11th day of July 1990.

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Gerard F. Scannell,

Assistant Secretary of Labor.

PART 1910 -- OCCUPATIONAL SAFETY AND HEALTH STANDARDS

1. The authority citation for subpart H of 29 CFR part 1910 would be amended to read as follows:

Authority: Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), or 1-90 (55 FR 9033), as applicable.

Sections 1910.103, 1910.106, 1910.107, 1910.108, and 1910.109, also issued under 29 CFR part 1911.

Section 1910.110 is also issued under 5 U.S.C. 553 and 29 CFR part 1911.

Sections 1910.111 and 1910.119 are also issued under 29 CFR part 1911.

Section 1910.120 is also issued under Sec. 126, Superfund Amendments and Reauthorization Act of 1986 as amended (29 U.S.C. 655 note), 5 U.S.C. 553, and 29 CFR part 1911.

2. Part 1910 of title 29 of the Code of Federal Regulations would be amended by adding to subpart H a new @ 1910.119 and appendices A through F to @ 1910.119 to read as follows:

@ 1910.119 Process safety management of highly hazardous chemicals.

(a) Purpose. This section contains requirements for preventing or minimizing the consequences of catastrophic releases of toxic, flammable or explosive chemicals.

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

(i) Processes which involve chemicals at or above the specified threshold quantities listed in mandatory appendix A to this section;

(ii) Processes which involve flammable liquids or gases (as defined in @ 1910.1200(c) of this part) onsite in one location, in quantities of 10,000 pounds or more except for:

(A) Hydrocarbon fuels used solely for workplace consumption as a fuel (e.g., propane or oil used for comfort heating); and,

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

(iii) Manufacture of explosives as defined in paragraph (a)(3) of @ 1910.109 of this part;

(iv) Manufacture of pyrotechnics as defined in paragraph (a)(10) of @ 1910.109 of this part including fireworks and flares; and

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(v) Processes which involve a chemical developed after the effective date of the standard, when the chemical has a substance hazard index (SHI) greater than 5,000 and at least 500 pounds of the substance is in the workplace.

(2) This section does not apply to:

(i) Retail facilities;

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

★ (iii) Normally unmanned remote facilities.

(c) Definitions. Facility means the buildings, containers or equipment which contain a process.

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

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

Normally unmanned remote facility means a facility which is operated, maintained and serviced by employees who visit the unmanned facility only periodically to check the operation and perform necessary operating or maintenance tasks. No employees are permanently assigned. Facilities meeting this definition must be remote from other facilities.

Process means any activity conducted by an employer that involves a highly hazardous chemical including any use, storage, manufacturing, handling, or movement of a highly hazardous chemical, or combination of these activities.

Substance hazard index (SHI) means a calculated number assigned to a newly developed toxic substance to determine its degree of hazard. Appendix B to this section, which is mandatory, explains the method for calculating the SHI.

★ (d) Process safety information. The employer shall develop and maintain a compilation of written safety information to enable the employer and the employees operating the process to identify and understand the hazards posed by processes involving highly hazardous chemicals. This safety information must be communicated to employees involved in the processes, and shall include information pertaining to hazards of the highly hazardous chemicals used in the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

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

(i) Toxicity information;

(ii) Permissible exposure limits;

(iii) Physical data;

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- (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 meet the information provisions.

(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 C to this section);

(B) Process chemistry;

(C) Maximum intended inventory;

(D) Safe upper and lower limits for such items as temperatures, pressures, flows and/or compositions; and,

(E) The consequences of deviations, including those affecting the safety and health of employees.

(ii) For processes initiated before ^{Present} January 1, 1980, the information concerning the technology of the process may be developed from a process hazards analysis conducted in accordance with paragraph (e) of this section.

(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 ^{basis} codes employed;

(G) Material and energy balances for processes built after the effective date of standard; and,

(H) Safety systems (such as interlocks, detection and suppression systems, etc.).

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impracticable
(ii) The employer shall document that equipment complies with applicable codes and standards, such as those published by the American Society of Mechanical Engineers, the American Petroleum Institute, the American Institute of Chemical Engineers, the American National Standards Institute, the American Society of Testing and Materials, and the National Fire Protection Association, where they exist; or, recognized and generally accepted 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 operated in such a way that safe operation is assured.

* (e) Process hazard analysis. (1) The employer shall perform a hazard analysis for identifying, evaluating, and controlling hazards involved in the process, using at least one of the following methodologies. (See Appendix D to this section for more detailed description of these methodologies):

(i) What-If;

(ii) Checklist;

(iii) What-If/Checklist;

(iv) Hazard and Operability Study (HAZOP);

(v) Failure Mode and Effects Analysis (FMEA); or,

(vi) Fault Tree Analysis.

(2) The hazard analysis shall address:

(i) The hazards of the process;

(ii) Engineering and administrative controls applicable to the hazards and their interrelationships;

(iii) Consequences of failure of these controls; and,

(iv) A consequence analysis of the effects on all workplace employees *document*

(3) 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.

(4) The employer shall establish a system to promptly address the team's findings and recommendations; document actions taken; communicate them to operating, maintenance and other employees whose work assignments are in the facility, and who are affected by the recommendations or actions; and assure that the recommendations are implemented in a timely manner.

(5) At least every five (5) years, the process hazard analysis shall be updated and revalidated, by a team meeting the requirements in paragraph (e) (3) of this section, to assure that the process hazard analysis is consistent with the current process.

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(6) Employers shall retain the two (2) most recent analyses and/or updates for each process covered by this section, as well as the documented actions described in paragraph (e)(4) of this section.

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

(i) Steps for each operating phase:

(A) Initial startup;

(B) Normal operation;

(C) Temporary operations as the need arises;

(D) Emergency operations, including emergency shutdowns, and who may initiate these procedures;

(E) Normal shutdown; and,

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

(ii) Operating limits:

(A) Consequences of deviation;

(B) Steps required to correct and/or avoid deviation; and,

(C) Safety systems and their functions.

(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 administrative controls, engineering controls, and personal protective equipment;

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

(D) Safety procedures for opening process equipment (such as pipe line breaking);

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

(F) Any special or unique hazards.

(2) A copy of the operating procedures shall be readily accessible to employees who work in or maintain a process.

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(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.

* (g) Training -- (1) Initial training. Each employee presently involved in a process, and each employee before working in 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, procedures, and safe practices applicable to the employee's job tasks.

(2) Refresher and supplemental training. Refresher and supplemental training shall be provided to each employee at least annually to assure that the employee understands and adheres to the current operating procedures of the process.

(3) Training certification. The employer shall certify that each of these employees has received and successfully completed training as specified by this paragraph. The employer, after the initial or refresher training shall prepare a certification record which contains the identity of the employee, the date of training, and the signature of the person doing the training.

* (h) Contractors. (1) The employer shall inform contractors performing work on, or near, a process of the known potential fire, explosion or toxic release hazards related to the contractor's work and the process, and ensure that contract employees are trained in the work practices necessary to safely perform their job. The employer shall also inform contractors of any applicable safety rules of the facility.

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

(3) Contract employers shall assure that each of their employees follow all applicable work practices and safety rules of the facility.

* (i) Pre-startup safety review. (1) The employer shall perform a pre-startup safety review for new facilities and for modified facilities for which the modification necessitates 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 is in accordance with design specifications;

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

(iii) Process hazard analysis recommendations have been addressed and actions necessary for startup have been completed; and,

(iv) Operating procedures are in place and training of each operating employee has been completed.

* (j) Mechanical integrity -- (1) Application. Paragraphs (j)(2) through (j)(5) of this section apply to the following process equipment:

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- (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; and,
 - (v) Controls (including monitoring devices and sensors), alarms, and interlocks.
- (2) Written procedures. (i) The employer shall establish and implement written procedures to maintain the on-going integrity of process equipment.
- (ii) The employer shall assure that each employee involved in maintaining the on-going integrity of the process equipment is trained in the procedures applicable to the employee's job tasks.
- (3) Inspection and testing. (i) Inspections and tests shall be performed on process equipment.
- (ii) Inspection and testing procedures shall follow applicable codes and standards, such as those published by the American Society of Mechanical Engineers, the American Petroleum Institute, the American Institute of Chemical Engineers, the American National Standards Institute, the American Society of Testing and Materials, and the National Fire Protection Association, where they exist; or, recognized and generally accepted engineering practices.
- (iii) The frequency of inspections and tests shall be consistent with applicable codes and standards; or, more frequently if determined necessary by prior operating experience.
- (iv) The employer shall have a certification record that each inspection and test has been performed in accordance with this paragraph. The certification shall identify the date of the inspection; the name of the person who performed the inspection and test; and the serial number or other identifier of the equipment.
- (4) Equipment deficiencies. The employer shall correct deficiencies in equipment which are outside acceptable limits, before further use.
- (5) Quality assurance. (i) The employer shall assure that equipment as fabricated meets design specifications.
- (ii) Appropriate checks and inspections shall be performed as necessary to assure that equipment is installed properly and consistent with design specifications and manufacturer's instructions.
- (iii) The employer shall assure that maintenance materials, and spare parts and equipment, meet design specifications.
- ★ (k) Hot work permit. (1) The employer shall issue a permit for all hot work, with the following exceptions:

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(i) Where the employer or the employer's representative, designated as responsible for authorizing hot work operations, is present while the hot work is being performed; and,

(ii) In welding shops authorized by the employer.

(2) The permit shall certify that the fire prevention and protection requirements contained in 29 CFR 1910.252(a) have been implemented prior to beginning the hot work operations; indicate the date(s) authorized for hot work, and identify the equipment or facility on which hot work is to be done. The permit shall be kept on file until completion of the hot work operations.

✱ (1) Management of change. (1) The employer shall establish and implement written procedures to manage changes (except for "replacements in kind") to process chemicals, technology, and equipment; and changes to facilities.

(2) The procedures shall assure that the following 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 the process shall be informed of, and trained in, the change in the process as early as practicable prior to its implementation.

(4) If a change covered by this paragraph results in a change to the process safety information, such information shall be appended and/or updated in accordance with paragraph (d) of this section.

(5) If a change covered by this paragraph results in a change to the operating procedures, such procedures shall be appended and/or updated in accordance with paragraph (f) of this section.

✱ (m) Incident investigation. (2) The employer shall investigate every incident which results in, or could reasonably have resulted in, a major accident in the workplace. (See Appendix E to this section for guidelines on conducting incident investigations.)

(2) Incident investigations shall be initiated as promptly as possible, but no later than 48 hours following the incident.

(3) An incident investigation team shall be established and consist of persons knowledgeable in the process involved and other appropriate specialties as necessary.

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

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- (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 report shall be reviewed with all operating, maintenance, and other personnel whose work assignments are within the facility where the incident occurred.

(6) The employer shall establish a system to promptly address the report findings and recommendations and shall implement the report recommendations in a timely manner.

(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 in accordance with the provisions of 29 CFR 1910.38(a).

Note: 29 CFR 1910.120 (a), (p) and (q) may also be applicable.

(o) Compliance Safety Audits. (1) Employers shall certify that they have evaluated compliance with the provisions of this section, at least every three years.

(2) A team shall conduct the compliance safety audit and shall be comprised of 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 certify that deficiencies have been corrected.

(5) Employers shall retain the two (2) most recent compliance safety audit reports, as well as the documented actions described in paragraph (o)(4) of this section.

Appendix A to @ 1910.119 -- List of Highly Hazardous Chemicals (Mandatory)

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

Chemical name	CAS 1	To 2
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	1500
Alkylaluminums	None	5000
Ammonia, Anhydrous	7664-41-7	5000

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Ammonia solutions (>44% ammonia by weight)	7664-41-7	10000
Ammonium Perchlorate	7790-98-9	7500
Ammonium Permanganate	7787-36-2	7500
Arsine (also called Arsenic Hydride)	7784-42-1	100
Bis(Chloromethyl) Ether	542-88-1	100
Boron Trichloride	10294-34-5	2500
Boron Trifluoride	7637-07-2	250
Bromine	7726-95-6	1500
Bromine Chloride	13863-41-7	1500
Bromine Pentafluoride	7789-30-2	2500
Bromine Trifluoride	7787-71-5	15000
3-Bromopropyne (also called Propargyl Bromide)	106-96-7	7500
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
Dilauroyl Peroxide	105-74-8	7500
Dimethyl Sulfide	75-18-3	100
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

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Formaldehyde (concentration >90%)	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 more)	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
Isopropyl Formate	625-55-8	500
Isopropylamine	75-31-0	5000
Ketene	463-51-4	100
Methacrylaldehyde	78-85-3	1000
Methacryloyl Chloride	920-46-7	150
Methacryloyloxyethyl Isocyanate	30674-80-7	100
Methyl Acrylonitrile	126-98-7	250
Methylamine, Anhydrous	74-89-5	1000
Methyl Bromide	74-83-9	2500
Methyl Chloride	74-87-3	15000
Methyl Chloroformate	79-22-1	500
Methyl Disulfide	624-92-0	100
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 (also called Peroxyacetic Acid)	79-21-0	5000
Perchloric Acid (concentration >60%)	7601-90-3	5000
Perchloromethyl Mercaptan	594-42-3	150
Perchloryl Fluoride	7616-94-6	5000

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Peroxyacetic Acid (Concentration >60%; also called Peracetic Acid)	79-21-0	5000
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	7500
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	7500
Thionyl Chloride	7719-09-7	250
Trichloro(chloromethyl) Silane	1558-25-4	100
Trichloro(dichlorophenyl) Silane	21737-85-5	2500
Trichlorosilane	10025-78-2	5000
Trifluorochloroethylene	79-38-9	10000
Trimethyloxysilane	2487-90-3	1500

1 Chemical Abstract Service Number

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

Appendix B to @ 1910.119 -- Substance Hazard Index (Mandatory)

This appendix contains the method for calculating the Substance Hazard Index (SHI). It is important to note that calculating an SHI is necessary only for a newly developed toxic substance to determine its degree of hazard.

The substance hazard index (SHI) is calculated as follows:

$$\text{SHI} = \frac{\text{EVC}}{\text{ERPG-3}}$$

EVC is the equilibrium vapor concentration at 20 degrees C, defined as the substance vapor pressure at 20 degrees C in millimeters of mercury multiplied by 10 to the sixth divided by 760.

ERPG-3 (Emergency Response Planning Guidelines, Level 3) is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects. ERPG's are published by the American Industrial Hygiene Association.

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Appendix C to @ 11910.119 -- Block Flow Diagram and Simplified Process Flow Diagram (Nonmandatory)

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Appendix D to @1910.119 -- Process Hazard Analysis Methodologies (Nonmandatory)

This appendix contains a brief description of the methodologies specified in @1910.119(e)(1). The employer must use one or more of these methodologies to perform a hazard analysis.

1. What-If. For relatively uncomplicated processes, the process is reviewed from raw materials to product. At each handling or processing step, "what if" questions are formulated and answered, to evaluate the effects of component failures or procedural errors on the process.

2. Checklist. For more complex processes, the "what if" study can be best organized through the use of a "checklist," and assigning certain aspects of the process to the committee members having the greatest experience or skill in evaluating those aspects. Operator practices and job knowledge are audited in the field, the suitability of equipment and materials of construction is studied, the chemistry of the process and the control systems are reviewed, and the operating and maintenance records are audited. Generally, a checklist evaluation of a process precedes use of the more sophisticated methods described below, unless the process has been operated safely for many years and has been subjected to periodic and thorough safety inspections and audits.

3. What-If/Checklist. The what-if/checklist is a broadly based hazard assessment technique that combines the creative thinking of a selected team of specialists with the methodical focus of a prepared checklist. The result is a comprehensive hazard analysis that is extremely useful in training operating personnel on the hazards of the particular operation.

The review team is selected to represent a wide range of disciplines, production, mechanical, technical, and safety. Each person is given a basic information package regarding the operation to be studied. This package typically includes information on hazards of materials, process technology, procedures, equipment design, instrumentation control, incident experience, previous hazard reviews, etc. A field tour of the operation is conducted also at this time.

The review team methodically examines the operation from receipt of raw materials to delivery of the finished product to the customer's site. At each step the group collectively generates a listing of "what-if" questions regarding the hazards and safety of the operation. When the review team has completed listing its spontaneously generated questions, it systematically goes through a prepared checklist to stimulate additional questions.

Subsequently, answers are developed for each question. The review team then works to achieve a consensus on each question and answer. From these answers,

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a listing of recommendations is developed specifying the need for additional action or study. The recommendations, along with the list of questions and answers, become the key elements of the hazard assessment report.

4. Hazard and Operability Study (HAZOP). HAZOP is a formally structured method of systematically investigating each element of a system for all of the ways in which important parameters can deviate from the intended design conditions to create hazards and operability problems. The hazard and operability problems are typically determined by a study of the piping and instrument diagrams (or plant model) by a team of personnel who critically analyze effects of potential problems arising in each pipeline and each vessel of the operation.

Pertinent parameters are selected, for example, flow, temperature, pressure, and time. Then the effect of deviations from design conditions of each parameter is examined. A list of key words, for example, "more of," "less of," "part of," are selected for use in describing each potential deviation.

The system is evaluated as designed and with deviations noted. All causes of failure are identified. Existing safeguards and protection are identified. An assessment is made weighing the consequences, causes, and protection requirements involved.

5. Failure Mode and Effect Analysis (FMEA). The FMEA is a methodical study of component failures. This review starts with a diagram of the operation, and includes all components that could fail and conceivably affect the safety of the operation. Typical examples are instrument transmitters, controllers, valves, pumps, rotometers, etc. These components are listed on a data tabulation sheet and individually analyzed for the following:

- a. Potential mode of failure, i.e., open, closed, on, off, leaks, etc.
- b. Consequence of the failure: effect on other components and effect on whole system.
- c. Hazard class, i.e., high, moderate, low.
- d. Probability of failure.
- e. Detection methods.
- f. Compensating provision/remarks.

Multiple concurrent failures are also included in the analysis. The last step in the analysis is to analyze the data for each component or multiple component failure and develop a series of recommendations appropriate to risk management.

6. Fault Tree Analysis. A fault tree analysis can be either qualitative or a quantitative model of all the undesirable outcomes, such as a toxic gas release or explosion, which could result from a specific initiating event. It begins with a graphic representation (using logic symbols) of all possible sequences of events that could result in an incident. The resulting diagram looks like a tree with many branches, each branch listing the sequential events (failures) for different independent paths to the top event. Probabilities (using failure rate data) are assigned to each event and then used to calculate the probability of

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occurrence of the undesired event.

This technique is particularly useful in evaluating the effect of alternative actions on reducing the probability of occurrence of the undesired event.

Appendix E to @ 1910.119 -- Recommendations (Nonmandatory)

This appendix contains important recommendations that the employer should consider implementing. It neither adds to nor detracts from the requirements of the standard.

1. Incident investigation guidelines.

Outlined below are guidelines for conducting incident investigations. Because of the variety of incidents investigated and the diversity of operations, no attempt is made to provide a mandatory format for use in all situations. Rather, these guidelines represent an example of an effective investigation procedure. The guidelines address the following areas:

Incident reporting.

Preplanning.

Management responsibilities.

Initial response.

Incident investigation team.

Determining the facts.

Determining the cause.

Recommending corrective and preventive actions.

Follow-up system.

Communicating results.

a. Incident reporting. Incidents cannot be investigated if they are not reported. A common reason that incidents go unreported is that, in some organizations, the incident investigation tends to be a search for the "guilty" rather than a search for the facts. When incident investigations are handled as a search for facts, the entire organization is more likely to work together to report incidents and to correct deficiencies, be they procedural, training, human error, managerial, or other.

It must be realized that when this approach is adopted, there will likely be an increase in the number of incidents reported. This is good. The objective is to get the situation into the open so the entire organization can work to correct deficiencies and prevent recurrence. With time, one would not necessarily expect a reduction in the frequency of incidents, but certainly a reduction in the frequency of serious incidents.

For reporting purposes, an incident should be viewed as anything that occurs that is unusual or out of the ordinary. Initially, the information to be reported should be limited to what happened (date, time, description, size, impact, etc.) and the action taken. Initial reporting should not be limited to apparently serious or potentially serious incidents because the seriousness cannot always be assessed at the time of occurrence. When all incidents are reported, those that are indeed serious or potentially serious can then be selected for further investigation.

b. Preplanning. Effective incident investigation starts before an incident occurs with the establishment of a well thought-out incident investigation

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procedure. The importance of preplanning is clearly evident when one understands that the quantity and quality of relevant information begins to diminish immediately following the incident. By establishing the essential stages and steps of an incident investigation ahead of time, the loss of relevant information, through cleanup efforts or possible blurring of people's recollections, can be minimized or eliminated.

c. Management responsibilities. The initial response to incidents such as fires, releases, and explosions emergencies should include: (1) Providing medical and other safety and health help to personnel, (2) bringing the incident under control, and (3) directing activities related to the investigation in a way that preserves relevant information and evidence.

Activities to preserve information should include: securing and barricading the scene, initiating the collection of transient information, interviewing personnel, etc. Remember that information will begin to disappear or diminish immediately following the incident and the initial response should acknowledge and address this problem. Prompt establishment of incident investigation leadership with priority over operation, maintenance, and construction is vital at this stage.

e. Incident investigation team. Prompt establishment of the incident investigation organization is of major importance to the incident investigation. The makeup of the investigation team is another important factor affecting the quality of the investigation. The appointment of competent employees reflects management's commitment and helps ensure prompt and effective action during the investigation. The team chairperson should be someone who can effectively:

- Control the scope of team activities by identifying which lines of investigation should be pursued, referred to another group for study, or deferred;
- Call and preside over meetings;
- Assign tasks and establish timetables;
- Ensure that no potentially useful data source is overlooked; and,
- Keep site management advised of the progress of the investigation.

Although team membership will vary according to the type of incident, a typical team investigating an operating area incident might include:

- A third-line or higher supervisor from the section where the incident occurred;
- Personnel from an area not involved in the incident;
- An engineering and/or maintenance supervisor;
- The safety supervisor;
- A first-line supervisor from the affected area;
- Occupational health/environmental personnel;
- Appropriate wage personnel (i.e., operators, mechanics, technicians); and
- Research and/or technical personnel.

It is also appropriate to consider and include other specialists and/or consultants either on a part-time or full-time basis.

f. Determining the facts. A thorough and comprehensive search for the facts is a necessary step in the incident investigation. During the fact-finding phase of the investigation, team members should:

- Visit the incident scene before the physical evidence is disturbed;

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- Sample unknown spills, vapors, residues, etc., noting conditions which may have affected the sample;
- Prepare visual aids, such as photographs, field sketches, missile maps, and other graphical representations with the objective of providing data for the investigation.
- Obtain on-the-spot information from eyewitnesses, if possible. Interviews with those directly involved and others whose input might be useful should be scheduled soon thereafter. The interviews should be conducted privately and individually, so that the comments of one witness will not influence the responses of others.
- Observe key mechanical equipment as it is disassembled.
- Review all sources of potentially useful information. These may include as-built drawings, operating logs, recorder charts, previous reports, procedures, equipment manuals, oral instructions, change of design records, design data, records indicating the previous training and performance of the employees involved, computer simulations, laboratory tests, etc.
- Determine which incident-related items should be preserved. When a preliminary analysis reveals that an item may have failed to operate correctly, was damaged, etc., arrangements should be made to either preserve the item or carefully document any subsequent repairs or modifications.
- Carefully document the sources of information contained in the incident report. This will be valuable should it subsequently be determined that further study of the incident or potential incident is necessary.

g. Determining the cause. Establishing the basic cause of an incident is crucial to development of effective recommendations to correct and prevent a recurrence. Many methods can be used to sort out the facts, inferences, and judgments assembled by the investigation team. Even for incidents for which the cause appears obvious, formal analysis is recommended as protection against oversight or making premature and erroneous judgments. Outlined below is one approach that can be used to develop the cause and effect relationships.

- Develop the chronology of events which occurred before, during, and after the incident. The focus of the chronology should be solely on what happened and what actions were taken. List alternatives when the status cannot be definitely established because of missing or contradictory information.
- List conditions or circumstances which deviated from normal, no matter how insignificant they may seem.
- List all hypotheses of the causes of the incident based on these deviations.
- A "cause tree" approach similar to a "fault tree" can be somewhat helpful in depicting the many different failures that led to the incident under investigation. The "cause tree" helps ensure that failures are reduced to more basic or fundamental initiating events.

Another source to consult for help in focusing on the cause(s) of an incident is the National Safety Council's Corrective Action Identification Procedure.

h. Recommending corrective and preventive actions. Usually, recommendations for corrective and preventive actions follow in a rather straightforward manner from the cause(s) after they have been determined. A recommendation for corrective action has three important parts. The first is the recommendation itself, which describes the actions to be taken to prevent a recurrence of the incident. The second is the name of the person or position responsible for completing the recommendation. The third is the timing for completion of the recommendation.

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A number of recommendations may be prerequisites for safe operation, and thus will require completion prior to resuming operations. Others will involve areas needing additional work or study or may involve problems not directly related to the incident. For these timing would extend beyond resumption of operations.

i. Follow-up system. To ensure follow-up and closure of open recommendations from an incident investigation, it is important to develop and implement a system to address open recommendations and to document actions taken to close out recommendations. Such a system should include periodic status reports to site management.

j. Communicating results. Two additional essential steps in the effort to prevent recurrence of an incident are (1) documentation of the incident investigation findings and (2) review of the results of the investigation with appropriate personnel.

The standard requires the incident documentation to address the following topics:

- Description of the incident (including date, time and location);
- Facts determined during investigation (including chronology as appropriate);
- Statement of causes; and
- Recommendations for corrective and preventive action (including timing and responsibility for completion).

Results of the incident investigation must be reviewed with appropriate operating, maintenance, and other personnel whose work assignments are within the facility where the incident occurred. Also, depending on the seriousness of the incident, consideration should be given to reviewing results with other similar facilities to prevent occurrence there.

2. Emergency control center. The employer should consider the establishment of an emergency control center. An emergency control center location should be equipped with:

- a. Plant layout and community maps;
- b. Utility drawings, including fire water;
- c. Emergency lighting;
- d. Emergency communications (e.g., phones with separate power supply or emergency radios);
- e. Appropriate reference materials, such as government agency notification list, company personnel phone list, and technical materials (e.g., Material Safety Data Sheets, procedures manual);
- f. A listing, including location, of emergency response equipment and mutual aid information; and
- g. Access to meteorological conditions data. In addition to the above, dispersion modeling data is recommended.

Appendix F to @ 1910.119 -- Sources of Further Information (Nonmandatory)

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1. Center for Process Safety, American Institute of Chemical Engineers, 345 East 47th Street, New York, NY 10017, (212) 705-7319.

2. "Review of Emergency Systems," June 1988; U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response, Washington, DC 20460.

3. "Technical Guidance for Hazards Analysis, Emergency Planning for Extremely Hazardous Substances," December 1987; U.S. Environmental Protection Agency (EPA), Federal Emergency Management Administration (FEMA) and U.S. Department of Transportation (DOT), Washington, DC 20460.

4. "Loss Prevention in the Process Industries," Volumes I and II; Frank P. Lees. Butterworth: London 1983.

5. "Safety and Health Guide for the Chemical Industry," 1986; U.S. Department of Labor, Occupational Safety and Health Administration, OSHA 3091.

6. "Emergency Response Planning Guidelines," American Industrial Hygiene Association; 475 Wolf Ledges Parkway, Akron, OH 44311-1087.

7. "Guidelines for Hazard Evaluation Procedures," American Institute of Chemical Engineers; 345 East 47th Street, New York, NY 10017.

8. "Evaluating Process Safety in the Chemical Industry," Chemical Manufacturers Association; 2501 M Street NW., Washington, DC 20037.

9. "Safe Warehousing of Chemicals," Chemical Manufacturers Association; 2501 M Street NW., Washington, DC 20037.

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