PAMPHLET 85

Recommendations for Prevention of Personnel Injuries for Chlorine Production and Use Facilities

Edition 5
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CHLORINE INSTITUTE PAMPHLET 85
The Chlorine Institute, Inc. 1300 Wilson Boulevard, Suite 525, Arlington, VA 22209

Table of Contents

1. INTRODUCTION

1.1 Scope

The purpose of this pamphlet is to provide useful information to chlor-alkali producers and users to allow their organizations to establish safety programs and practices to prevent injuries to their employees and losses to their facilities and businesses.

The intention of this pamphlet is to outline the core elements of a comprehensive safety program for individuals involved in producing and using chlorine and sodium and/or potassium hydroxide. The pamphlet is written to provide guidance and is not all-encompassing. Producers and users must develop individual parts of their program to deal with the uniqueness of their facility.

The format used to prepare this pamphlet follows the format used by the United States Occupational Safety and Health Administration in its standard (regulation) addressing Process Safety Management of Highly Hazardous Chemicals (PSM standard) (Reference 19.1). The United States Environmental Protection Agency, in its regulation pertaining to Accidental Release Prevention Requirements: Risk Management Program (Reference 19.2) incorporates by reference the OSHA requirements. Beginning with Section 3, the various sections of this pamphlet address specific management steps required by the PSM rule. For example, Section 3 addresses Employee Participation which is the first management practice discussed by the rule. The titles of each section of this pamphlet which cover a specific management practice required by the rule are followed by a letter in parentheses to allow for ready referral to the rule (e.g., 3 EMPLOYEE PARTICIPATION (C)). In addition to the OSHA requirements, certain states within the United States may have additional requirements. Additional sections have been added to discuss the importance of management's commitment to safety, health, and environmental issues, industrial hygiene, and product stewardship.

Section 21 – Appendix 2 of this pamphlet includes the Institute's Chlorine Customers Generic Safety and Security Checklist which was issued as a stand-alone document in November 2003. As discussed in the introduction to this appendix, the checklist was prepared to help evaluate the capability of North American customers of bulk chlorine (larger than a one ton container) to safely unload and otherwise handle chlorine at the facility where the chlorine is used. The checklist is intended only to provide limited information to assist both the supplier of chlorine and its customer. The checklist emphasizes key chlorine specific recommendations as developed by the Chlorine Institute. The checklist is intended to supplement Institute publications, not replace them. It is not meant to incorporate regulatory or other requirements that may be applicable at the facility. In the United States, facilities using or otherwise handling chlorine may be affected by OSHA's Process Safety Management Rule for Highly Hazardous Chemicals (PSM) and/or or EPA's Accidental Release Prevention Requirement; Risk Management Programs (RMP). Canadian and Mexican facilities may have similar or other regulatory requirements.

The user of this pamphlet is strongly encouraged to refer to the process safety management of highly hazardous chemicals standard to get more information pertaining to the standard. Both OSHA (http://www.osha.gov/SLTC/processsafetymanagement/index.html) and EPA (http://www.epa.gov/emergencies/content/rmp/) have information on their respective websites providing much information.

1.2 CHLORINE INSTITUTE STEWARDSHIP PROGRAM

The Chlorine Institute, Inc. exists to support the chlor-alkali industry and serve the public by fostering continuous improvements to safety and the protection of human health and the environment connected with the production, distribution and use of chlorine, sodium and potassium hydroxides, and sodium hypochlorite; and the distribution and use of hydrogen chloride. This support extends to giving continued attention to the security of chlorine handling operations.

Chlorine Institute members are committed to adopting CI's safety and stewardship initiatives, including pamphlets, checklists, and incident sharing, that will assist members in achieving measurable improvement. For more information on the Institute's stewardship program, visit CI's website at www.chlorineinstitute.org.

1.3 ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CAAA	Clean Air Act Amendments
CAER	Community Awareness and Emergency Response
CGA	Compressed Gas Association
EPA	Environmental Protection Agency (United States)
FMEA	Failure Mode and Effects Analysis
HAZOP	Hazard and Operability Study
MOC	Management of Change
NACE	NACE International – The Corrosion Society
NEC	National Electric Code

NIOSH	National Institute of Occupational Safety and Health (United States)
OSHA	Occupational Safety and Health Administration (United States)
PHA	Process Hazard Analysis
PSI	Process Safety Information
PSM	Process Safety Management (OSHA regulation)
PSSR	Pre-Start Up Safety Review
RMP	Risk Management Program (EPA regulation)
SCBA	Self-Contained Breathing Apparatus
WHMIS	Workplace Hazardous Material Information System (Canada)

1.4 DISCLAIMER

The information in this pamphlet is drawn from sources believed to be reliable. The Institute and its members, jointly and severally, make no guarantee, and assume no liability, in connection with any of this information. Moreover, it should not be assumed that every acceptable procedure is included, or that special circumstances may not warrant modified or additional procedures. The user should be aware that changing technology or regulations may require changes in the recommendations contained herein. Appropriate steps should be taken to ensure that the information is current when used. These recommendations should not be confused with federal, state, provincial, municipal, or insurance requirements, or with national safety codes.

1.5 APPROVAL

The Institute's Health, Environment, Safety, and Security Issue Team approved Edition 5 of this pamphlet on November 5, 2010.

1.6 REVISIONS

Suggestions for revisions should be directed to the Secretary of the Institute.

1.6.1 Significant Revisions in Current Edition

The primary revisions to Edition 5 include the addition of process safety plan development information in Appendix 2.

1.7 REPRODUCTION

2. MANAGEMENT COMMITMENT

2.1 SAFETY PHILOSOPHY

The format for Edition 4 of Pamphlet 85, as was Edition 3, is based upon and follows the logic of OSHA's Process Safety Management Standard 29CFR1910.119. While this standard has been in effect since May 26,1992, it is worthwhile to recognize that compliance with the standard is a regulatory requirement and should be viewed as the minimal accepted standard within our industry.

Safety of employees, contractors, visitors and community members must always have the highest priority in our operations and management has the responsibility to provide leadership that challenges, engages and holds each individual accountable for their personal safety and for that of their co-workers and our communities in which we operate.

The involvement of our employees in developing, documenting and training of safe operating and maintenance procedures and processes not only provides the opportunity for education, it stimulates proactive engagement, ownership and a sense of responsibility for performance at all levels within the organization.

Sound safety performance must be based on our belief that our goal of zero injuries and incidents is achievable when it is supported by focused leadership from the highest levels in the organization and supported by a system of sound Procedures and Practices; an Effective Audit Process; Training Processes that produce knowledgeable, competent, confident and highly disciplined operators and technicians; and Behavioral Based Safety as a means for peer coaching and predicting at-risk trends and preventing accidents before they occur, rather than responding after the event.

Safety in our facilities is not only a regulatory requirement, it is clearly an expectation by all employees, contractors, visitors and neighbors. The safety process has evolved over time from programs that were directed by a few, to processes that engage and involve all employees and third parties such as OSHA's VPP Program, the American Chemistry Council’s Responsible Care® Program, and other interested stakeholders who encourage and expect flawless operations and Zero Incidents.

Safety as a Priority, along with Quality, Production and Environmental Stewardship, will prove to be a competitive advantage tomorrow to those who invest wisely today.

2.2 EXPECTATIONS OF LEADERSHIP

Management implements systems to ensure that all employees and contractors think of safety first and everything else second. Creating this mindset leads to great performance.

Management must constantly reinforce a culture that has everyone in the organization striving continuously for zero accidents. This can only be achieved by a sustained and consistent history of management commitment to safety first. Adherence to this culture must be a condition of employment.

2.3 STEPS TO CREATE THE CULTURE

- Set the expectation of safety first and reinforce it with every interaction with your workers.
- Create an effective cross functional Health and Safety committee at the highest level and throughout the organization.
- Benchmark your company's Safety, Health and Hygiene program and performance against similar organizations. Leverage in the knowledge gained to improve your program.
- Work with Benchmarked companies and trade associations (e. g., Chlorine Institute) to develop best management practices in the area of Safety, Health and Hygiene.
- Provide structured, formal, well documented management systems to capture all aspects of the organization's Safety, Health and Hygiene programs.
- Measure the process and set goals. Include an individual's performance under the organization's Safety, Health and Hygiene program in reviews of the employee's overall job performance.
- Assess and improve the organization to achieve the culture. It is recommended that good behaviors are recognized positively and behaviors or acts that do not meet basic expectations are discouraged, up to and including disciplinary action.
- Be involved. Participate in housekeeping audits and job observations as well as meetings on Health and Safety.
- Lead by example, never miss an opportunity to reinforce the standards and correct unsafe acts, conditions or attitude. An observation overlooked can be reinforcement of a lower standard.
- Create the culture of no-fault communications so that everyone is free to express his/her concerns about workplace hazards to their superiors without fear of reprisal.
- Provide employees with adequate personal protective equipment to serve as a last line of defense between the employee and the workplace hazard. Train all employees on the equipment use and its limitations and have them commit to using it every time.
- Utilize Behavioral Safety programs to improve performance. Employees should be observed performing their day-to-day tasks and be coached on identifying and resolving workplace hazards. Provide positive reinforcement as well as corrective actions during these observations. Employees will gain a better understanding of Hazard identification as well as your risk tolerance during these interactions.

- Create a program to encourage employees to maintain healthy lifestyles. Provide routine medical surveillance to alert the organization of any systemic issues in employee health and to provide employees with preventative care.
- Continually reinforce the message of zero accidents.

3. EMPLOYEE PARTICIPATION (C)

3.1 PARTICIPATION

Employee participation called for in the OSHA Process Safety Management (PSM) standard is intended to provide for a cooperative participatory environment where information flows from management to employees and from employees to management. This information flow on process safety is expected to identify potential for hazardous material releases and initiate a process to prevent or mitigate the consequences. Prescriptive language in the Clean Air Act Amendments (CAAA) of 1990, specifically the EPA's Risk Management Program (RMP), Title 40 Part 68, and (Reference 19.2) also requires that PSM information developed by the employer be made available to employees and their representatives. In addition, OSHA and EPA require that an employer carefully consider and structure the plant's approach to employee involvement in the PSM/RMP programs.

To facilitate employee participation, both OSHA and EPA require a written Employee Participation Program to include a plan of action for implementing employee consultation on the development of process hazard analysis and other elements of process hazard management. It is ultimately the responsibility of the employer to consider the appropriate method of employee participation.

3.2 CONSULTATION

Consultation refers to a dialogue between the employer and employee and their representative, if applicable. The employer should elicit and respond to employees concerns and suggestions regarding the elements of PSM and RMP. Consultation is more than a way to inform employees about aspects of process safety; it is a process of seeking advice, critiques, and suggestions from employees.

The Employee Participation Program action plan should establish a method for informing employees and accepting concerns or suggestions from employees. The employer should also establish a mechanism by which they will respond, verbally or in writing, to such concerns and suggestions.

3.3 CONTRACT EMPLOYEES

The host employer should establish a method for informing all contract employees that their participation in the PSM program is welcome. The following non-exclusive examples illustrate circumstances under which the host employer may be required to solicit the advice and suggestions of specific contract employees about specific aspects of PSM:

- Contract employees who function as process operators on covered processes, or perform routine maintenance on covered processes, should be consulted to the same degree as a regular plant employee.
- Contract employees who routinely interface with a host employer's Management of Change program should be consulted on the effectiveness of the program as it relates to their jobs.
- Contract employees who routinely participate in activities pursuant to mechanical integrity should be consulted on the effectiveness of the program as it relates to their jobs. Also, they should be encouraged to identify any deficiencies they observe in the host employer's program.
- Contract employees who have unique experience or knowledge concerning the operation, maintenance, or safe performance of any portion of a covered process should be consulted, as appropriate, on that portion of the process during the Process Hazard Analysis.
- Contract employees who routinely interface with the host employer's safe work practices should be consulted as to the effectiveness of those practices.

The host employer can consult with contract employees directly or through the contract employer. Contract employers share responsibility for ensuring that there is consultation with their employees.

3.4 ACCESS TO INFORMATION

The intent of access under this standard is for the information to be made available for employees in a reasonable manner. Reasonable access may require providing copies or making documents available for review. The trade secret provision of the standard permits the employer to require confidentiality agreements before providing the information.

The employer is required to provide access to process hazard analysis and all other related information covered under the PSM standard and the RMP rule to employees of contractors. This access must be equal to that afforded regular employees if similarly situated. Contract employers share responsibility for assuring that their employees are provided the requested information.

4. PROCESS SAFETY INFORMATION (D)

4.1 INTRODUCTION

The Process Safety Information (PSI) aspect requires employers to maintain written safety information enabling the employer and employees operating the process to identify the hazards involved. A program to communicate this information should be set up and maintained to ensure all involved are properly trained.

There are three important elements of Process Safety Information. The elements are as follows:

- hazards of the highly hazardous chemicals used in the process;
- information dealing with the technology of the process; and
- information on the equipment in the process.

Chlorine is the primary chemical of concern to most chlorine related facilities as it is identified as “highly hazardous“ by the PSM standard. Any process having chlorine at or above the threshold quantity of 1,500 pounds (federal) is covered unless specifically excluded (see appendix A and paragraph (a) of the standard) (Reference 19.1). Some states may set a threshold quantity for chlorine lower than 1,500 pounds. For facilities in the United Sates not covered by the OSHA standard, but covered under the EPA’s RMP rule, the threshold quantity for chlorine is 2,500 pounds. Safety information should be communicated per normal plant policy and per regulatory requirements (Reference 19.3) and should also address hazards pertaining to sodium and/or potassium hydroxide, hydrogen, sulfuric acid, hydrochloric acid, electrical hazards, and other hazardous or flammable materials used in the process.

4.2 HAZARDS OF THE HIGHLY HAZARDOUS CHEMICALS

Information about the chemical should be readily available to all employees. The Material Safety Data Sheets (MSDS) for Chlorine, while having the basic information, may not provide the detail required by PSM. An MSDS for chlorine should be obtained from the supplier. The information should include but not be limited to:

- toxicity information
- permissible exposure limits
- physical data
- reactivity data
- corrosivity data
- thermal and chemical stability data

Reference 19.4 and Material Safety Data Sheets provide this information.

4.2.1 Hazards of Chlorine

Below are some general warnings to be included on the hazards of chlorine:

- Chlorine reacts violently with hydrocarbon-based substances such as oils, greases, paints, some solvents, etc. It will also react with steel wool, iron filings, or pipe cuttings. It is therefore essential that foreign material be removed from chlorine lines and containers before putting chlorine in them.

- Chlorine and moisture form hydrochloric acid which will corrode steel. It also forms hydrates of iron chloride which can cause plugging of the system. (Reference 19.4)
- Dry chlorine reacts violently with titanium. However, titanium is one of several materials suitable for use in wet chlorine.
- Dry chlorine does not react with steel at normal temperatures, up to 300°F (149°C). Under these conditions steel is suitable for handling and storing dry chlorine.
- Dry chlorine will react violently with hot steel. For this reason welding and hot work should only be done on chlorine lines that have been isolated, depressurized, and decontaminated. Welding leads should not be attached to such lines. (Reference 19.4)
- Chlorine and hydrogen mixtures can react violently. Ultra-violet light or other sources can start this reaction.
- Reactive organic solvents (e.g., methyl chloroform [1,1,1 trichloroethane]) should not be used to clean equipment where chlorine is present.
- Chlorine may react with ammonia and some other nitrogen containing compounds to form nitrogen trichloride. Nitrogen trichloride is a very unstable compound, which detonates very easily. Chlorine Institute Pamphlet 152 (Reference 19.20) covers this subject in detail.

4.2.2 Chlorine Reactivity

The following are common materials that have been found to react violently with chlorine:

- Carbon steel ignites near 483ºF (251ºC)
- Aluminum
- Arsenic
- Gold
- Mercury
- Selenium
- Tellurium
- Tin
- Titanium (Dry)
- Finely divided forms of boron, copper, iron, and phosphorus

- Hydrogen
- Sodium and potassium hydroxide / cell effluent
- Activated Charcoal
- All silicone based greases and oils
- All organic compounds not halogenated:
    - Alcohols
    - Hydrocarbon oils and greases
    - Anti-seize compounds
    - Liquid and paste thread sealants
    - Liquid and paste gasket forming materials
    - Perchloroethylene
    - Drawing wax
    - Dowtherm® (glycol)
    - Detergents and soaps

4.3 INFORMATION DEALING WITH THE TECHNOLOGY OF THE PROCESS

Included in this information should be:

- a flow diagram of the process;
- the process chemistry;
- maximum inventory level;
- safe upper and lower limits for process variables (e.g., pressure, temperature, flow); and
- consequences of deviation.

4.4 INFORMATION ON THE EQUIPMENT IN THE PROCESS

Included in this information should be:

- materials of construction;
- Piping and Instrument Diagrams (P&ID's);
- electrical classification;
- relief valve system design;

- ventilation design;
- design codes used; and
- safety systems clearly defined (e.g., interlocks).

5. PROCESS HAZARD ANALYSIS (E)

A Process Hazard Analysis (PHA) is an organized and systematic effort to identify and analyze the significance of potential hazards associated with the processing or handling of highly hazardous chemicals. PHAs are required to be performed on every covered process or a process that involves the handling of highly hazardous chemicals including chlorine, as outlined in the OSHA PSM standard. A priority should be assigned when dealing with a number of processes based on extent of the hazard, number of affected employees and age of the process.

A methodology must be selected for performing the PHA that is appropriate for determining and evaluating the hazards of the process:

- What-if analysis
- Checklist
- What-if/checklist
- Hazard and Operability Study (HAZOP)
- Failure Mode and Effects Analysis (FMEA)
- Fault Tree Analysis
- Another appropriate equivalent methodology

The PHA should address the following:

- identification of the hazards of the process, such as the type and quantity of highly hazardous chemicals handled;
- identification of any previous incidents which had likely potential for catastrophic consequences in the workplace;
- the engineering and administrative controls to the hazards, including appropriate application of detection methodologies to provide early warning of releases;
- the consequences of the failure of these administrative and engineering controls;
- facility siting - What is surrounding the site and what could be affected?;
- human factors, such as fatigue and inattention of controls;

- an evaluation of the range of possible safety and health effects of failure of controls on employees; and
- a physical inspection of the process as to how work is being done in the process.

The team that conducts the PHA should consist of the following:

- All members should have expertise in engineering and/or process operations.
- At least one member should have expertise and knowledge specific to the process being evaluated.
- At least one member should be knowledgeable in the specific process hazard analysis methodology being used.
- Representatives from both the production and maintenance organizations should be a part of the team.
- Representative from site safety organization should be a part of the team.

The Process Safety Information concerning the process should be distributed to all team members prior to the PHA. This information should be checked for accuracy before distribution.

The entire PHA should be documented including the hazard methodology work and the team's findings and recommendations. A system should be in place to promptly address the team's findings and to assure that these findings are resolved in a timely manner and that the resolution is documented:

- Actions should be clear and specific.
- Actions should be assigned to specific individuals.
- Actions taken to resolve the finding should be documented.
- Actions should be completed as soon as possible.
- A written schedule of when the actions are to be completed should be prepared.
- The actions to be taken and periodic updates on status should be communicated to all operating and maintenance employees concerned with the effected process.

After the initial PHA is completed, it must be updated and reevaluated by a team, similar to what was outlined above, every 5 years to ensure that the PHA is consistent with the current process. The PHA and the reevaluations must be retained for the life of the process.

6. OPERATING PROCEDURES (F)

The employer is required to develop operating procedures that address steps for each operating phase, operating limits, safety and health consideration and safety systems. (References 19.1, 19.2, 19.3, 19.6, 19.7, and 19.8)

Operating procedures must be written for all processes covered by the PSM standard. Procedures should address at a minimum for each operating phase:

- A procedure for initial start-up according to the Pre-Startup Process Safety Review, and items found during the HAZOP;
- A procedure for operating the process under normal conditions;
- A procedure that outlines the steps to make temporary changes to normal procedures;
- A procedure to cover an emergency shutdown, including conditions that would cause a shutdown, and the responsibilities of each operator;
- A procedure that outlines how, why, when, to operate the process in an emergency;
- A procedure that describes a normal controlled shutdown; and
- A procedure that describes a start up after a turnaround or emergency shutdown.

Operating procedures should include operating limits with consequences of deviations and should also include steps to avoid or correct the deviations.

Procedures should also contain any safety and health considerations. As a minimum they should provide precautions to be taken and safety equipment required to perform each task. They should also contain:

- List of chemicals and their properties;
- List of hazards associated with each;
- Precautions necessary to prevent exposure including PPE, engineering controls and administrative controls;
- Control of hazardous chemical inventory levels;

- What to do in case of personnel exposure to the hazard;
- Quality control of raw materials; and
- Spill prevention and clean up.

Procedures should include any safety system and function. Procedures should be consistent with the Process Safety information.

Procedures, including emergency procedures, should be readily available to all employees that operate or maintain a process. Operating procedures for OSHA covered processes must be reviewed on an annual basis by the employees that operate or maintain the process and certified as accurate by a qualified person.

Specific procedures should be developed for the following:

- Lockout/Tagout (Reference 19.7)
- Confined Space Entry (Reference 19.12)
- Line Entry (Reference 19.1 f(4))
- Entry Control Into a facility by maintenance, contractor, laboratory, or other support personnel (Reference 19.1 f(2))

7. TRAINING (G)

7.1 OVERVIEW

All employees, including maintenance and contract employees, involved with hazardous chemicals need to fully understand the safety and health hazards of the chemicals and processes they work with for the protection of themselves, their fellow employees and the citizens of nearby communities. The Hazard Communication standard (Reference 19.3) will help employees to be more knowledgeable about the chemicals they work with as well as familiarize them with reading and understanding MSDS. However, additional training in subjects such as operating procedures and safe work practices, emergency evacuation and response, safety procedures, routine and non-routine work authorization activities, and other areas pertinent to process safety and health will need to be covered by a company's training program.

In establishing their training programs, companies must clearly define the employees to be trained and what subjects are to be covered in their training. Employers need to clearly establish the goals and objectives they wish to achieve with the training that they provide to their employees. The learning goals or objectives should be written in clear measurable terms before the training begins. These goals and objectives need to be tailored to each of the specific training modules or segments. Employers should describe the important actions and conditions under which the employee will demonstrate competence or knowledge as well as what is acceptable performance.

Employers need to periodically evaluate their training programs to see if the necessary skills, knowledge, and routines are being properly understood and implemented by their trained employees. Training program evaluation will help employers to determine the amount of training their employees understood, and whether the desired results were obtained. If, after the evaluation, it appears that the trained employees are not at the level of knowledge and skill that was expected, the employer will need to revise the training program, provide retraining, or provide more frequent refresher training sessions until the deficiency is resolved.

Trainers and trainees should also be consulted as to how best to improve the training process. Careful consideration must be given to assure that employees including maintenance and contract employees receive current and updated training. For example, if changes are made to a process, affected employees must be trained in the changes and understand the effects of the changes on their job tasks prior to start up.

7.2 INITIAL TRAINING

Each employee presently involved in operating a process and each employee before being involved in operating a newly assigned process, should be trained in the following areas:

- An overview of the process
- The operating procedures for the process including
    - safety and health hazards;
    - emergency operations including shutdown; and
    - safe work practices applicable to the employee's job tasks.

See also Section 6.

7.3 REFRESHER TRAINING

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

7.4 TRAINING DOCUMENTATION

The employer should ascertain that each employee involved in operating a process has received and understood the training required by this section. The employer should prepare a record, which contains the identity of the employee, the date of training, and the means used to verify that the employee understood the training.

8. CONTRACTORS (H)

8.1 INTRODUCTION

Employers must keep contractors performing work on, or near, a process informed of the known hazards. Communication of the plant safety requirements and policies is critical to insuring the safety of all involved. This section focuses on the PSM contractor requirements.

8.2 GENERAL ELEMENTS IN A CONTRACTOR SYSTEM

The primary elements of a contractor system can be broken into Communication and Company Policy/Control.

Contractor Communication deals with the method of relaying required safety information to their employees. Good communication of the safety hazards to each employee working in the area is necessary to ensure this requirement is met. Every contract employee entering the plant must receive this information.

Company Policy/Control elements deal with the employer responsibilities. Systems must be set up to ensure that the contract employees are trained, the contractor meets plant safety requirements, and that access to the plant is controlled.

8.3 WHAT CONTRACTORS ARE COVERED?

All contractors performing non-exempt incidental work are covered by the PSM contractor requirements, including:

- maintenance or repair;
- turnaround; and
- specialty work on or around equipment in the process including construction, demolition, and equipment installation.

8.4 WHAT CONTRACTORS ARE EXEMPT?

Contractors performing incidental work that does not involve any aspect of process safety are exempt from PSM requirements

Examples of such work include:

- delivery services;
- janitorial work; or
- food and drink services.

8.5 CONTRACTOR COMMUNICATION

Communication of plant safety rules and policies is extremely important when dealing with contractors. Many plants use a Contractor Orientation meeting to relay this critical information. An orientation video is useful in insuring all the required material is communicated.

In this meeting, the following should be covered:

- communication of known fire potentials in a unit;

  For chlorine producers, this hazard is very real. While chlorine is not flammable under normal conditions, the co-product hydrogen is. Hot Work permits should clearly identify and address hydrogen systems. Appropriate cautions to contractors welding on chlorine lines need to be provided. (See Section 4.2.1) In addition, smoking areas should be strategically placed away from the hydrogen systems.

- communication of known explosion or toxic release hazards related to the contractor's work and the process;

  The work permit should clearly identify these concerns.

- communication of the safety rules and policies of the plant.

  PPE requirements and special work safety requirements should be relayed to the contractor to ensure compliance.

- communication of the Emergency Response Plan and what is required of the contractor.

  It is important for the contractors to know their role in the Emergency Response Plan. Communication of emergency siren sounds and their meaning and how and where to go when such sirens sound, are important to ensure the safety of the contractor.

The standard requires that the contract employer document that each contract employee has received and understood the required training. Testing is a common way to verify that the training has been understood. A method of identifying employees that have taken and passed such a test should be set up to control plant access. Identification cards or hard hat

labels are common in the industry for this means. Periodic refresher training should be provided to contract employees.

8.6 COMPANY POLICY/CONTROL

Each facility must ensure that their contractors are meeting PSM requirements. Systems must be set up and updated regularly. These systems include

- a method to ensure the contract employees are trained in the work practices necessary to perform the job safely;

  Many facilities require the contractor to have passed a Contractor Safety Training Program before going through the contractor orientation.

- an evaluation of contract employees safety performance and programs;

  Contractors frequently working in the plant should maintain an Injury and Illness log. The OSHA 300 Log is an example of such a log. The employer should ensure that contractors working on site maintain a safe working record.

- programs to control the entrance, presence and exit of contract employers and employees in process areas

The facility should restrict access to contractors until orientation requirements are met. A daily roster of all covered contract employees working at the site should be maintained in case of an emergency for personnel accounting purposes.

9. PRE-START UP SAFETY REVIEW (PSSR) (I)

A written procedure system should be established to ensure that new facilities or changes to existing facilities involved in the manufacturing or handling of highly hazardous chemicals are constructed or modified according to this procedure before start-up of the facility. Processes handling highly hazardous chemicals are considered “covered processes,” as outlined in the OSHA standard. This procedure will apply to new facilities or changes to existing facilities significant enough to require a change in the Process Safety Information (PSI). See Section 4.

The PSSR should be performed prior to the introduction of any highly hazardous chemical into the process to ensure the following:

- Process construction and equipment is in accordance with design specifications. All equipment should be checked against the design criteria including all safety systems. Testing and commissioning procedures should also be reviewed. All equipment labeling should be completed. A physical in-plant inspection should also be performed.

- Safety, operating, maintenance and emergency procedures are written, in-place and adequate. These procedures must satisfy the standard's requirements as discussed in Section 6. A start-up plan including at a minimum: leak testing, dry runs and commissioning procedures should also be prepared and reviewed.
- For new facilities and processes, a complete Process Hazard Analysis (PHA), as discussed in Section 5, must be performed with all recommendations resolved or implemented before start-up.
- For any modifications to existing facilities, equipment, procedures, interlocks, and control parameters, all requirements of the Management of Change (MOC) must be met before start-up. MOC is discussed in Section 12.
- Training of all employees involved in the process must be complete prior to the introduction of any chemicals into the process. The training should address:
  - specific safety and health hazards;
  - specific operating, safety, maintenance and emergency procedures; and
  - safe work practices applicable to the employee's job task.

Records must be maintained verifying training for all affected employees on the process. Effectiveness of training should be evaluated by testing for understanding. The training documentation and the effectiveness of the training should be reviewed prior to introduction of any hazardous chemicals to the process.

Good operating practices should also require that a PSSR be performed after any extensive plant shutdown or turnaround prior to the introduction of hazardous chemicals back into the process. Each major piece of equipment or process that has been secured, repaired and/or inspected should be reviewed to ensure it is placed back into service properly and safely. Physical inspections of the equipment, review of the start-up procedures and review of operator training by the PSSR team should be included. A checklist to guide this procedure can be helpful for equipment or processes that are regularly repaired/inspected.

The PSSR team should be made up of representatives of operating and maintenance personnel from the area, technical representatives familiar with the area, a site safety representative, project engineer and management. Some form of hazard analysis procedure should be used to guide the discussion during the review as discussed in Section 5. All recommendations from the PSSR should be implemented or resolved before start-up of the facility or modification.

Documentation of the PSSR must be kept in an accessible location and must be available to operating personnel and to Process Hazard Analysis (PHA) team members when a PHA is being performed.

10. MECHANICAL INTEGRITY (J)

New or existing facilities, which are involved in the manufacture or handling of highly hazardous chemicals, are designed, fabricated, installed and maintained to assure safe and reliable operation of the equipment so that there is minimal chance of injury to personnel, the environment or the population at large. Processes handling highly hazardous chemicals are considered “covered processes,” as discussed in the OSHA PSM standard (Reference 19.1) and EPA’s RMP standard (Reference 19.2) and thus covered by this section.

Process equipment that this section includes (but not limited to):

- integrity of pressure vessels and storage tanks;
- integrity of piping systems and components (including valves);
- reliable operation of relief and vent systems and devices;
- reliable operation of emergency shutdown systems;
- reliable operation of controls, including monitoring devices and sensors, alarms and interlocks; and
- integrity of pumps.

The following are examples of a program that would meet the requirements of the OSHA PSM standard as of the publication date of this document.

Each employee and contractor involved in maintaining the on-going integrity of a process should be trained in an overview of that process and its hazards. Training should also include procedures on how to perform the employee’s job tasks in a safe manner.

Periodic testing and inspections should be performed on all process equipment. They should follow recognized and generally accepted, good engineering practices. In addition, guidelines of technical associations should be reviewed and followed when applicable. The inspection and testing guidelines in various Chlorine Institute pamphlets are good sources (e.g., References 19.4, 19.9, 19.10). Inspections and tests should be performed by trained, competent individuals who are familiar with the inspection/test methods being used and the critical parameters of the equipment being inspected/tested. Depending on the location of the facility, inspections and tests may be required to be performed by certified inspectors (e.g. NACE, ASME). Refer to the attached sub-section dealing with “Piping Systems and Components”. This document lists more detail on program execution, inspection & testing and key performance indicators. It also includes a similar format for “Controls, Sensors, Alarms and Interlocks”. The decision on the frequency of the testing and inspections should be based on:

- applicable manufacturers’ recommendations;
- established recognized engineering practices ;

- prior operating experience;
- technical association guidelines; and
- legal requirements.

The testing and/or inspections should be documented for each individual piece of equipment of a covered process. This documentation should include:

- the date of the inspection or test;
- name of the person who performed the inspection or test;
- serial number, equipment number or some other specific identification of the equipment that was inspected or tested;
- description of the test or inspection that was performed; and
- the results of the inspection or test.

Documentation of each inspection/test should be maintained for each piece of equipment in a covered process in an easily accessible location. Retention time for the inspections/tests on file should be outlined in the Mechanical Integrity procedure. Typically this retention will be for the life of the equipment.

Inspection results should be compared to previous results and the acceptable limits for each inspection parameter. The process safety information on each piece of equipment should contain information on the acceptable limits of each critical parameter. If the periodic inspections/testing shows the result to be outside these limits, the deficiencies should be corrected before further use, or in a safe and timely manner that does not jeopardize the safe operation of the process.

In the construction of new processes or equipment, inspection and testing should be conducted before the equipment/process is placed into service to ensure the following items:

- All equipment is fabricated in a manner suitable for the process application for which it is to be used.
- All equipment is installed properly and consistent with the design specifications and manufacturer's specifications.
- Maintenance materials, spare parts and equipment are suitable for the process application for which it is to be used.

This inspection/test documentation should become part of the process safety information for the process or equipment and maintained in an accessible location.

11. HOT WORK PERMIT (K)

The employer must provide a means to control in a consistent manner, non-routine work in the process area. A minimum requirement is the permitting of Hot Work such as burning and welding. (References 19.1 and 19.11) A hot work permit is a written authorization to allow work involving electrical or gas welding, cutting, brazing, or similar flame or spark-producing operations to proceed in a process area. The permit should be covered by a written procedure which requires certain steps to be accomplished prior to its issuance and other steps to be implemented while it is in effect.

Hot work permits must allow for the following:

- Hot work permits must be issued for all burning and/or welding in the process unit.
- The area must be checked to ensure no combustibles are present prior to issuing a Hot Work Permit. This should be accomplished through the use of a combustible detection meter that is appropriately maintained and calibrated.
- Permits should indicate the date and duration for which the permit is granted.
- Permits should describe the object on which the work is to be performed.
- Permits must consider the impact of any falling sparks.
- Fire watches must be established where needed.
- Timeframes should be established for how long a fire watch must be present after the Hot Work is completed, and is especially important if combustible materials are present.
- Permits must be authorized by the supervisor or designated representative.
- Permits must describe any precautions and identify any hazards associated with material on the floors, walls, partitions, ceilings, or roofs or welding on the same.
- Special consideration should be made when considering authorizing hot work in hazardous areas such as non-sprinklered areas, unauthorized area or while such protection is impaired.
- Permits must require any combustible material be removed or covered with flame proofed covering.
- Permits must provide a means to shut down any hot work-related equipment that may transfer sparks to a combustible area.

- Permits should consider the potential for transmitting heat by radiation or conduction.
- Procedures should establish areas for safe burning or welding.
- Special precautions should be taken when Hot Work is to be performed in a confined space, such as continuous oxygen and combustible gas monitoring. The fire watch must maintain contact with the work being performed.
- Hydrogen is a specific flammable gas present in chlor-alkali production facilities. The following special precautions should be taken when performing Hot Work around hydrogen handling equipment or pipe lines:
    - isolate from hydrogen source;
    - open and vent line or equipment;
    - thoroughly purge the system;
    - check system for explosive atmosphere; and
    - where applicable, continuously monitor for combustible gas while performing work.
- Sulfuric acid equipment or lines can contain hydrogen as a result of corrosion with steel. Verify that no hydrogen is present by venting, purging, and monitoring before performing Hot Work.
- The employer must designate a responsible person for authorizing burning or welding.
- Welders, cutters, and supervisors should be trained in the safe operations of welding equipment.
- The orientation should describe to an outside contractor the site “Hot Work Permit System”.
- Permits should be kept available until the work is completed.

On-site job observations should be conducted to verify compliance with Hot Work Permits as they are issued. The following should be considered in such observations:

- All items on the permit have been addressed.
- All signatures required on the permit are identifiable.
- Fire-fighting equipment is available and working.
- Fire watches are in place and functioning in accordance with the procedure.

12. MANAGEMENT OF CHANGE (L)

A written procedure system must be established to manage changes to a process or facility that is involved in the manufacturing or handling of highly hazardous chemicals. Processes handling highly hazardous chemicals are considered covered processes, as discussed in the OSHA standard. This procedure will apply to changes in process chemicals, technology, equipment or procedures (except for replacement in kind) to all covered processes.

A change is defined as:

- any addition or modification to the facilities;
- any modification involving substitute materials, other than repair or replacement in kind;
- any change in materials used in the process such as raw material or material of construction; or
- any change in operations to conditions outside the established operating procedures.

Changes may be permanent or temporary, in which case the date that the change expires must be clearly documented.

Some examples of changes requiring a Management of Change include, but are not limited to the following:

- operating procedure changes not outlined in the operating procedures (excluding re-issuing of operating procedures);
- addition or deletion of components or hardware, including piping, equipment, instrumentation and electrical facilities;
- altering process design specifications;
- computer control applications/software changes;
- changes to process control system hardware;
- operating parameter set points outside of design basis (e.g., temperatures, pressures, flow rates);
- alarm and interlock set points outside of design basis;
- changes in materials of construction/gaskets;
- changes in raw materials/feedstock/consumables;

- re-rating equipment;
- equipment size changes;
- product quality changes;
- layout and structural changes; and
- inventory changes outside established limits in the operating procedures.

Examples of changes not requiring a Management of Change include:

- replacement in kind of piping, instruments, or electrical components;
- changes in an operating set point that is within the established safe operating procedures;
- equipment, chemicals, etc. that meet the original design specification of the item it is replacing; and
- configuration changes on control loops, such as changes to output limits, gain, reset, and derivative.

The procedure should assure that the following considerations are addressed and documented prior to any change:

Technical Basis - Why the proposed change is technically feasible for application in the process. Technical sources of information should be consulted.

Impact on Safety and Health - Proposed change must be assessed for its impact to personnel in that area. This assessment should consider changes to or need for additional administrative or engineering controls. The proposed change must also be assessed for its impact on the Personal Protective Equipment (PPE) requirements for the operators, maintenance personnel or contractors performing the job.

Modifications to Operating Procedures - The operating procedures must be modified to clearly explain the proposed change prior to the implementation or start-up of the change.

Necessary Time Period for Change - An initial start date for the change must be established and, if temporary, the length of time the change will be in effect.

Authorization Requirements - An approval sequence should be established for the authorization of changes. Approvals should include representatives from the operators and maintenance personnel in the affected area, technical representatives familiar with the area, a site safety representative and management.

Training - All employees involved in operating the process, maintenance of the process and/or contract employees whose job task will be affected by the change shall be informed of and trained in the change prior to the implementation and start-up of the change. The training should also be documented.

Pre-startup Safety Review - If the process change results in any modification to the Process Safety Information (PSI), then a Pre-startup Safety Review (PSSR) must be performed prior to the implementation or start-up of the change. PSI is discussed in Section 4 and PSSR is discussed in Section 9.

The facility may want to use a form to facilitate the processing of changes through the Management of Change procedure. This form could contain how all the above outlined items were addressed as well as the following:

- documentation of changes to operating procedures was completed;
- modifications to maintenance procedures were completed;
- changes to PSI were completed;
- all training was completed;
- pre-startup inspection documented;
- duration of change; and
- approvals.

Copies of all documentation regarding the change should be kept in an accessible location available to operating personnel and to Process Hazard Analysis (PHA) team members when a PHA is being performed. PHA is discussed in Section 5.

13. INCIDENT INVESTIGATION (M)

The standard requires the employer to investigate each incident which resulted in, or could reasonably have resulted in, a catastrophic release of a highly hazardous chemical in the workplace.

The investigation should begin as soon as possible to avoid loss of critical information, but must be initiated not later than 48 hours after the incident. The Institute recommends that all accidents/incidents be investigated. Investigation of minor incidents can result in the prevention of a more serious accident/incident that could possibly release a large quantity of hazardous chemicals.

Use an investigation team made up of a cross section of plant personnel. One member of the team should be knowledgeable in the process. Utilize each department as appropriate. Depending on the incident, the investigation team could include as few as two but typically involves more. Rotate the personnel to assure complete plant involvement. Rotating personnel will also help to satisfy the PSM Employee Participation Section as discussed in Section 3.

The accident/incident report should include the following:

- date and time of the incident;
- date of investigation;
- description of the incident;
- contributing factors;
- recommendations resulting from investigation (action items); and
- persons responsible for follow-up on action items.

A procedure should be in place to promptly address and resolve incident findings. All actions to correct the causes and the dates completed should be documented. The incident report should be circulated to all department heads as appropriate. Steps should be taken to ensure that appropriate training on the incident and the preventive measures are implemented.

Incident Investigations should be maintained for 5 years along with the OSHA 300 log in accordance with Reference 19.1 Section (m).

14. EMERGENCY PLANNING AND RESPONSE AND COMMUNITY AWARENESS (N)

(EMERGENCY RESPONSE AND EVACUATION PLAN)

An Emergency Response Plan presents the actions to be taken by the producer/user, governmental agencies, and the general public to minimize the effect of an accidental chlorine release. The Institute's Pamphlet 64 (Reference 19.5), "Emergency Response Plans (ERPs) for Chlorine Facilities" provides more complete information on establishing an emergency response plan (sometimes called emergency action plans) for facilities producing, handling, or otherwise using chlorine. In the United States, Reference 19.13 specifies ERPs requirements for affected facilities.

The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 (Reference 19.14) requires all facilities in the United States that meet the minimum threshold inventory quantities for hazardous substances have an adequate plan to deal with emergencies. For chlorine, this quantity is 100 pounds.

It is required by law that all producers and users of chlorine have a written emergency response plan and that the plan should be communicated to the area community. The degree of complexity of the ERP will depend on the size of the facility and its proximity to populated areas.

Community Awareness is an outreach program to provide the public with information on chemicals manufactured or used at a specific plant site beyond what is required by law or regulation.

An emergency response plan outlines specific actions which plant personnel are to follow to mitigate the consequences of the emergency. An emergency is any event where serious personal injury, property damage, business interruption, or an environmental incident could occur or is occurring. Some key objectives of an emergency response plan are:

- Describe the known hazards and evaluate the risks associated with the incident and with each activity conducted.
- List key personnel and their back-ups responsible for site emergency response operations and for protection of the public. Key personnel must be properly trained in order to participate in an emergency response.
- Establish procedures to control site access (refer to section 14.2 on Site Security).
- Establish procedures for the use of Emergency Response Equipment and for its inspection, testing, and maintenance.
- Address emergency medical care for injuries and toxicological problems.
- Describe requirements for an environmental surveillance program.
- Specify notification procedures for the affected public (including the media) and specified government agencies.

14.1 COMMUNITY OUTREACH

The Chlorine Institute encourages its members to reach out to the surrounding communities to keep them informed about the operations and to address their concerns.

The overall goal is to improve the protection of public health and safety in the community. The specific objectives are:

- Provide information to the public on chlorine and other chemicals being produced or used.
- Involve members of the local community in the development and implementation of overall emergency response planning. This should include routine training with local fire departments and police agencies that would respond to the plant site.

- Integrate the facility's emergency response plan with the Local Emergency Planning Committee (LEPC) or other involved groups to form an overall plan for handling emergencies.
- The establishment of a community advisory panel should be considered.

14.2 SITE SECURITY PLAN

Every site handling chlorine in excess of Federal DOT or DHS threshold values is required by law to have a Security Plan to control access into the plant (Reference 19.21). Although the specific elements of a Site Security Plan will vary depending on plant size and location, the following key items should be considered:

- controlling site and asset access (e.g., fencing, barriers, security guards);
- good lighting throughout the facility;
- use of surveillance systems where appropriate;
- a procedure for handling plant visitors and contractors, including personnel accountability within the facility;
- procedures and awareness training for plant personnel on how to respond to site security issues (unknown person on site, bomb threat, etc.);
- conducting regular drills on potential site security issues; and
- having in place a formal communication system with local emergency response agencies. This should include the appropriate actions to be taken at different threat levels of the Department of Homeland Security's Homeland Security Advisory System (Reference 19.21).

15. COMPLIANCE AUDITS (O)

Employers must certify that they have evaluated their overall Process Safety Management (PSM) program at least every three (3) years. The tool used for this verification is the compliance audit. This audit is important in the fact that it will highlight problem areas that require more attention in the PSM system. The system frequently used in compliance audits is the "checklist system." This section will focus on using this technique. Other techniques are equally effective and can be used if desired. OSHA has issued a compliance guideline document titled Process Safety Management OSHA 3132.

In order to perform a compliance audit, several steps should be undertaken. These include the gathering of team members, the development of audit checklists, the conducting of the actual compliance audit, the preparation of the report of the audit findings, the documentation of the responses and corrective actions, and follow through to completion.

It is recommended that the audit team include individuals who are familiar with the auditing process and PSM requirements. The regulation requires the audit team include a member who is knowledgeable in the process (Reference 19.1, 29CFR1910.119(o)(2)). If possible, your team should be independent of the area to be audited. Consideration should be given to the periodic use of an outside auditor. It will be beneficial for another set of eyes to review the systems you have in place.

A checklist for each standard should be developed detailing the critical aspects of the PSM/RMP rule. Sources of example audit checklists can be found in published literature as well as through the Internet. The Chlorine Institute publishes a sample RMP Audit Checklist in Pamphlet 162: Generic Risk Management Plan for Chlorine Packaging Plants & Sodium Hypochlorite Production Facilities. Checklists are critical and an important tool used in auditing. Checklists should mirror the standard that is being audited (unless the company has made special previsions of accountability under that section of the standard).

In addition to the PSM/RMP standards, the use of the Chlorine Institute Generic Chlorine Customer Checklist (Section 21 - Appendix 2) should be considered.

Some key points to consider in conducting an effective audit include the following:

- pre-schedule time with sufficient notification;
- compile necessary pre-audit documentation;
- conduct an opening meeting to discuss the scope, duration, and protocol of the audit;
- auditors should include a wide range of employees and contractors in interviews;
- conduct a daily update meeting to discuss that day’s findings;
- conduct a final closing meeting to discuss the overall findings of the audit; and
- if you see something out of the scope of the audit that needs attention inform management during the closing meeting or right away if a hazard is present.

A report should be developed within a reasonable length of time and submitted to the Plant Management for distribution.

Personnel responsible for an audited area should take the Report of Findings and develop a written plan of actions needed (Corrective Actions) to achieve compliance. Specific individuals and due dates should be assigned to ensure areas of responsibility are clear. Ensure all individuals involved in the process are notified of the actions to be taken.

It is critical that an individual is assigned to oversee that the Corrective Actions are completed in a timely manner. Willful violations can be charged to the employer if Corrective Actions are ignored or dropped. These recommendations are important keys to improving the performance of your overall PSM/RMP program.

In addition to PSM/RMP mandated audits, audits are a useful tool to perform in other areas. Below are areas where other audit programs may be beneficial:

- plant safety policies and routine jobs
- housekeeping
- industrial hygiene
- regulatory (i.e. OSHA/EPA/State required audits)
- hazardous materials
- reactive chemicals
- training
- procedures and policies

The frequency and depth of these audits are left up to each individual employer as deemed necessary.

16. TRADE SECRETS (P)

Facilities must provide to employees and contractors necessary information to allow them to compile and/or develop the necessary information required by the OSHA PSM rule. However, facility management is allowed and should take appropriate steps to ensure that employees receiving and utilizing proprietary information safeguard it. Parts (i) and (n) of (Reference 19.1) prescribe steps that the employer can take to protect trade secrets.

17. INDUSTRIAL HYGIENE

The OSHA PSM/EPA RMP rules do not specifically address industrial hygiene. However, in order to comply with various sections of the rule (e.g., Operating Procedures), facilities producing and/or using chlorine need to have an industrial hygiene program. This section provides basic information for establishing an industrial hygiene program. CI Pamphlets 63, 65, 125, and 137 are useful Chlorine Institute references (References 19.17, 19.16, 19.19, and 19.18, respectively). *Fundamentals of Industrial Hygiene* (Reference 19.22) is an excellent general reference.

Each chlor-alkali production or use facility should have a formal industrial hygiene program in place to anticipate, recognize, evaluate and control health hazards that may exist in the workplace. These hazards may be chemical, physical, biological or ergonomic agents.

The industrial hygiene program established at the facility should:

- recognize and identify chemical, physical, and biological agents that can adversely affect potentially exposed personnel;
- measure and document levels of exposure to specific hazardous agents;
- evaluate the significance of any exposure to the affected personnel;
- establish appropriate controls (engineering and administrative) to reduce exposures and monitor the effectiveness of such controls; and
- implement appropriate corrective actions to reduce exposures.

The following are typical agents that personnel are potentially exposed to in a chlor-alkali production facility:

- Chlorine
- Sodium hydroxide
- Hydrogen chloride
- Sulfuric acid
- Electricity
- Electro-magnetic force
- Heat stress
- Noise

In some facilities, personnel are potentially exposed to the following:

- Asbestos
- Mercury

In addition to the above agents, personnel may be exposed to other agents. A comprehensive review should be undertaken to determine what additional agents give rise to potential exposure.

The Chlorine Institute recommends a medical surveillance program be implemented for employees working in chlor-alkali production and/or use facilities and who are potentially exposed to chlorine (Reference 19.17).

Some government agencies also require surveillance for employees potentially exposed to asbestos, mercury, noise, hexachlorobenzene, and/or other agents that may be encountered in chlorine production or use facilities. The Institute has several publications that address some of these materials (References 19.17, 19.18, and 19.19).

18. PRODUCT STEWARDSHIP

The Chlorine Institute and its members believe that producers, distributors, and packagers must take the necessary steps to ensure that users of chlorine handle it in a safe and environmentally sound manner. Some ways to meet this obligation include the following:

- Verify facilities using chlorine are suitably designed, properly maintained and safely operated.
- Verify user employees have been appropriately trained in the safe handling of chlorine.
- Verify facilities that handle chlorine have effective emergency response plans that are appropriate for their operations.

Appendix 2 (Section 21) provides a tool to ensure that the user has such capabilities.

Successful implementation is a shared responsibility. All employers are responsible for providing a safe workplace, and all who use and handle products must follow safe and environmentally sound practices.

19. REFERENCES

Most of the government documents referenced include a web link. For those that do not have web access, the following address is provided:

U.S. Government Printing Office (http://bookstore.gpo.gov/)
732 N. Capitol Street, NW
Washington, DC 20401
Phone: (202) 512-1800

Chlorine Institute publications can be ordered on-line at the following link: http://www.chlorineinstitute.org/Bookstore/SearchBrowse.cfm . Many of these publications can be downloaded electronically for free.

19.1 CODE OF FEDERAL REGULATIONS. TITLE 29. PART 1910.119 PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS. (HTTP://WWW.OSHA.GOV/SLTC/PROCESSSAFETYMANAGEMENT/INDEX.HTML). THE OSHA HOME PAGE IS HTTP://WWW.OSHA.GOV/.

19.2 CODE OF FEDERAL REGULATIONS, TITLE 40. PART 68 ACCIDENTAL RELEASE PREVENTION REQUIREMENTS: RISK MANAGEMENT PROGRAMS. (HTTP://ECFR.GPOACCESS.GOV/CGI/T/TEXT/TEXT-IDX?C=ECFR&TPL=/ECFRBROWSE/TITLE40/40CFR68_MAIN_02.TPL)

19.3 CODE OF FEDERAL REGULATIONS, TITLE 29. PART 1910.1200 HAZARD COMMUNICATION (HTTP://WWW.OSHA.GOV/PLS/OSHAWEB/OWADISP.SHOW_DOCUMENT?P_TABLE=STANDARDS&P_ID=10099)

19.4 *CHLORINE BASICS*, ED. 7, PAMPHLET 1, THE CHLORINE INSTITUTE , INC., ARLINGTON, VA 2008

19.5 *EMERGENCY RESPONSE PLANS FOR CHLORINE FACILITIES*, ED.6R-1, PAMPHLET 64, THE CHLORINE INSTITUTE, INC., ARLINGTON, VA 2008

19.6 CODE OF FEDERAL REGULATIONS, TITLE 29, PART 1910.120 HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE (HTTP://WWW.OSHA.GOV/SLTC/EMERGENCYPREPAREDNESS/INDEX.HTML)

19.7 CODE OF FEDERAL REGULATIONS, TITLE 29, PART 1910.147 THE CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT) (HTTP://WWW.OSHA.GOV/PLS/OSHAWEB/OWADISP.SHOW_DOCUMENT?P_ID=9804&P_TABLE=STANDARDS)

19.8 CODE OF FEDERAL REGULATIONS, TITLE 29, PART 1910.1000 AIR CONTAMINANTS (HTTP://WWW.OSHA.GOV/SLTC/PEL/INDEX.HTML)

19.9 *PIPING SYSTEMS FOR DRY CHLORINE*, ED.15, PAMPHLET 6; THE CHLORINE INSTITUTE, INC. ARLINGTON, VA 2005.

19.10 *BULK STORAGE OF LIQUID CHLORINE*, ED. 7; PAMPHLET 5; THE CHLORINE INSTITUTE, INC. ARLINGTON, VA 2005

19.11 CODE OF FEDERAL REGULATIONS, TITLE 29, PART 1910.252 (A) GENERAL REQUIREMENTS - FIRE PREVENTION AND PROTECTION (HTTP://WWW.OSHA.GOV/SLTC/FIRESAFETY/INDEX.HTML)

19.12 CODE OF FEDERAL REGULATIONS, TITLE 29, PART 1910.146 PERMIT REQUIRED CONFINED SPACES (HTTP://WWW.OSHA.GOV/SLTC/CONFINEDSPACES/INDEX.HTML)

19.13 CODE OF FEDERAL REGULATIONS, TITLE 29, PART 1910.38 EMPLOYEE EMERGENCY PLANS AND FIRE PREVENTION PLANS (HTTP://WWW.OSHA.GOV/SLTC/EMERGENCYPREPAREDNESS/INDEX.HTML)

19.14 CODE OF FEDERAL REGULATIONS, TITLE 40, PART 355 - EMERGENCY PLANNING AND NOTIFICATION (HTTP://WWW.EPA.GOV/SUPERFUND/PROGRAMS/ER/INDEX.HTM)

19.15 OSHA INSTRUCTION CPL2-2.45A CH-1, COMPLIANCE GUIDELINES AND ENFORCEMENT PROCEDURES - PSM STANDARD, SEPTEMBER, 1994. (HTTP://WWW.OSHA.GOV/PLS/OSHAWEB/OWADISP.SHOW_DOCUMENT?P_TABLE=DIRECTIVES&P_ID= 1559)

19.16 *PERSONAL PROTECTIVE EQUIPMENT FOR CHLOR-ALKALI CHEMICALS*, ED. 5; PAMPHLET 65, THE CHLORINE INSTITUTE, INC. ARLINGTON, VA 2008

19.17 *FIRST AID, MEDICAL MANAGEMENT/ SURVEILLANCE, AND OCCUPATIONAL HYGIENE MONITORING PRACTICES FOR CHLORINE*, ED. 7; PAMPHLET 63, THE CHLORINE INSTITUTE, INC. ARLINGTON, VA 2003

19.18 *GUIDELINES: ASBESTOS HANDLING FOR THE CHLOR-ALKALI INDUSTRY*, ED. 5; PAMPHLET 137, THE CHLORINE INSTITUTE, INC. ARLINGTON, VA 2005

19.19 *GUIDELINES: MEDICAL SURVEILLANCE AND HYGIENE MONITORING PRACTICES FOR CONTROL OF WORKER EXPOSURE TO MERCURY IN THE CHLOR-ALKALI INDUSTRY*, ED. 4; PAMPHLET 125, THE CHLORINE INSTITUTE, INC. ARLINGTON, VA 2004

19.20 *SAFE HANDLING OF CHLORINE CONTAINING NITROGEN TRICHLORIDE*, ED. 2; PAMPHLET 152, THE CHLORINE INSTITUTE, INC. ARLINGTON, VA 2005

19.21 DEPARTMENT OF HOMELAND SECURITY, HOMELAND SECURITY ADVISORY SYSTEM, (HTTP://WWW.DHS.GOV/DHSPUBLIC/DISPLAY?THEME=29)

19.22 *FUNDAMENTALS OF INDUSTRIAL HYGIENE*, 5TH EDITION, NATIONAL SAFETY COUNCIL, ITASCA, IL, 2002 (HTTP://SHOP.NSC.ORG/EMPLOYEE-SAFETY-C64.ASPX)

19.23 *ACCIDENT PREVENTION MANUAL*, ADMINISTRATION AND PROGRAMS, 13TH EDITION, NATIONAL SAFETY COUNCIL, ITASCA, IL 2010 (HTTP://SHOP.NSC.ORG/REFERENCE-C62.ASPX)

20. APPENDIX 1 – PAMPHLET 85 CHECKLIST

This checklist is designed to emphasize major topics for someone who has already read and understood the pamphlet. Taking recommendations from this list without understanding related topics can lead to inappropriate conclusions.

Place a check mark (✓) in the appropriate box below:

Yes	No	N/A		
❒	❒	❒	1. Does the facility demonstrate the management leadership and take steps to create a culture of zero incidents?	{2.1}
❒	❒	❒	2. Does the facility have a written Employee Participation Program?	{3.1}
❒	❒	❒	3. Does the employer consult with employees?	{3.2}
❒	❒	❒	4. Does the employer consult with contract employees?	{3.3}
❒	❒	❒	5. Does the facility maintain written PSM safety information?	{4.1}
❒	❒	❒	6. Does the facility make PSM safety information available to employees?	{4.2}
❒	❒	❒	7. Has the facility conducted PHAs?	{5}
❒	❒	❒	8. Has the facility developed the appropriate operating procedures?	{6}
❒	❒	❒	9. Does the facility comply with HazCom requirements?	{7.1}
❒	❒	❒	10. Do the training programs appropriately define the subject matter?	{7.1}
❒	❒	❒	11. Has the appropriate refresher training been conducted?	{7.3}
❒	❒	❒	12. Has the facility verified that the training has been understood?	{7.4}
❒	❒	❒	13. Are contractors informed of hazards?	{8.1}
❒	❒	❒	14. Have contract employees received and understood training?	{8.5}

❒	❒	❒	15. Do contractors meet PSM requirements?	{8.6}
❒	❒	❒	16. Does the facility have the required PSSR in place?	{9}
❒	❒	❒	17. Does the facility have the required mechanical integrity systems in place?	{10}
❒	❒	❒	18. Does the facility have the required hot work permit system in place?	{11}
❒	❒	❒	19. Does the facility have the required management of change system in place?	{12}
❒	❒	❒	20. Does the facility investigate each incident as required by the rule?	{13}
❒	❒	❒	21. Does the facility maintain incident reports as required by the rule?	{13}
❒	❒	❒	22. Does the facility have a written ERP in place?	{14}
❒	❒	❒	23. Has the ERP been communicated with the potentially affected community?	{14}
❒	❒	❒	24. Has the facility evaluated and certified that it has evaluated its PSM program in the last three years?	{15}
❒	❒	❒	25. Has the facility taken appropriate steps to communicate with affected employees needed proprietary information and ensured that such Information is safeguarded?	{16}
❒	❒	❒	26. Does the facility have a formal industrial hygiene program?	{17.2}
❒	❒	❒	27. If the facility is a chlor-alkali production or use facility, does it have a medical surveillance plan in place?	{17.9}
❒	❒	❒	28. Have steps been taken to verify that users of your chlorine handle it in a safe and environmentally sound manner?	{18}

REMINDER:

Users of this checklist should document exceptions to the recommendations contained in this pamphlet.

21. APPENDIX 2 - PIPING SYSTEMS AND COMPONENTS

PROGRAM EXECUTION

A. Identify and document all applicable piping systems. P&IDs, pipe specifications, valve specifications, and basic design data shall be accurate and part of this documentation.

B. Establish and maintain a central database (electronic or paper) for process safety information (PSI) to document and track piping line ID number, pipe spec, P&ID number, and other design information.

C. Assign classification (risk-based) to each applicable piping system. It is suggested that this classification process be conducted in a manner similar to a PHA to ensure that appropriate representatives from operations, maintenance, technical, etc. are involved in the evaluation process.

Note: When classifying piping systems the team must consider all modes of operation (e.g. normal, startup, shutdown, and emergency).

D. Establish and maintain testing, inspection, and/or replacement frequencies (e.g. for devices such as pressure gauges, rupture discs, etc.) based on service conditions, criticality, prior history, and any manufacturer's recommendations.

E. Establish and maintain inspection procedures, Q/A Q/C procedures for fabrication and repairs, and guidelines for acceptance criteria. Establish criteria for evaluating fitness for service (e.g., minimum thickness, etc.).

F. Ensure that all inspectors and welders involved in inspection, testing and repair activities have training and qualifications supported by appropriate documentation.

G. Establish and maintain formal documentation and recordkeeping systems for all inspection and test results. Establish criteria for setting and adjusting inspection frequencies based on site experience, corrosion rate, changing operating conditions, and calculated remaining life (fitness for service).

H. Establish and maintain a system to track all inspection activities, with frequencies and due dates.

I. Establish and maintain a system to document and correct piping system deficiencies that are outside accepted limits, in a timely manner, to ensure safe operation. This is generally referred to as a Corrective Action System. It may be helpful to classify deficiencies as integrity-related or other, to aid in prioritization ('other' being deficiencies such as repaint, adjust pipe support, etc.).

J. Update site MOC procedure to require classification assignment to all new piping systems and to ensure that changes/additions/deletions to piping systems are documented and communicated throughout the inspection systems mentioned above.

INSPECTION & TESTING

Written procedures shall be established, covering the installation, inspection, and testing of all applicable piping systems. The following items shall be addressed in these procedures:

A. QUALITY ASSURANCE / QUALITY CONTROL
   i. Use of proper materials of construction, fittings, and arrangements
      a. Use of piping and valve specifications
      b. Reference Chlorine Institute Pamphlet 6 – *Piping Systems for Dry Chlorine*
   ii. Q/A, Q/C of piping fabrication and repairs
      a. Reference API 570 and ASME B31.3

B. INSPECTION AND TESTING
   i. Inspector qualifications
   ii. Inspection methods and frequencies
      a. Reference API 570
   iii. Acceptance criteria
      a. Reference API 570 and ASME B31.3
      b. API 579 - *Fitness for Service*
   iv. Special / High Risk – Corrosion Under Insulation (CUI)
      a. Reference NACE RP0198-2004, *Control of Corrosion Under Thermal Insulation and Fireproofing Materials – A Systems Approach*

(NACE description: Provides current technology and industry practices for mitigating corrosion under thermal insulation and fireproofing materials. Adopts a systems approach. Contains sections on corrosion mechanisms, mechanical design, protective coatings, insulation materials, and inspection and maintenance. Product number 21084-SG)

C. CORRECTIVE ACTION SYSTEM
   i. Tracking deficiencies from inspection through correction
   ii. Methods for setting 'Repair By' dates, and system for handling overdue deficiencies, such as a Process Hazard Analysis (PHA)

KEY PERFORMANCE INDICATORS (KPIs)

1. ***Number (or percent) of overdue inspections.*** A high number (or rate) of overdue inspections may indicate resource constraints or that equipment is not being made available for scheduled maintenance.

2. ***Number of emergency/unplanned repair work hours per month.*** One of the primary objectives of the mechanical integrity element is to reduce unplanned/breakdown maintenance work. Although many unplanned failures may not involve equipment included in the scope of the mechanical integrity program, an increase in this metric may be a leading indicator of an overall slip in the effectiveness of the maintenance program at the facility. An alternative measurement could be the ratio of emergency work to planned work.

3. ***Total number of temporary repairs in-service and integrity-related deficiencies in-service that will be addressed at the next turnaround.*** Note that this metric will often increase linearly over time until the next maintenance shutdown, when it drops off sharply. However, the rate of increase could be a leading indicator of risk.
4. ***Incidents.*** Tracking piping system and component incidents such as leaks, safety, fugitive emissions, non-conformance, etc.

CONTROLS, SENSORS, ALARMS AND INTERLOCKS

PROGRAM EXECUTION

A. Identify and document all applicable devices. P&IDs, loop drawings, control schematics, instrument specifications, and basic design data shall be accurate and part of this documentation.

B. Establish and maintain a central database (electronic or paper) for device process safety information (PSI) to document and track device make, model, P&ID number, set points, and other information.

C. Assign classification to each applicable device. It is suggested that this classification process be conducted in a manner similar to a PHA to ensure that appropriate representatives from operations, maintenance, technical, etc. are involved in the evaluation process.

Note: When classifying devices the team must consider all modes of operation (e.g. normal, startup, shutdown, and emergency).

D. Establish and maintain testing, inspection, and/or replacement frequencies (e.g. for devices such as pressure gauges, rupture discs, etc.) based on service conditions, criticality, prior history, and any manufacturer's recommendations.

E. Establish and maintain formal routine maintenance testing and inspection procedures for each applicable device. Establish criteria for acceptable test results for each device.

F. Establish and maintain formal function check testing and inspection procedures for each applicable device. Establish criteria for acceptable test results for each device and/or system.

G. Incorporate formal routine maintenance and function check testing and inspection procedures and developed frequencies into an appropriate preventive maintenance (PM) program.

H. Ensure that all technicians who perform inspection, testing and repair activities have training and qualifications supported by appropriate documentation.

I. Establish and maintain formal documentation and recordkeeping systems for all inspection and testing results, including "as-found" and "as-left" data. Establish and maintain formal system to set future PM frequencies based on mean-time-between-failure (MTBF) data, "as-found" data, site experience, and other conditions that may impact device reliability.

J. Establish and maintain a system to track all inspection, testing, and repair activity to completion. Ensure that any non-routine or emergency work is documented.

K. Establish and maintain a system to correct device or system deficiencies that are outside accepted limits before further use or to ensure that necessary measures are taken to assure safe operation.

L. Update site MOC procedure to require classification assignment to all new devices and to require development of routine maintenance and function check testing and inspection procedures and associated frequencies for each device and/or loop.

INSPECTION & TESTING

Written procedures shall be established to perform the inspection and testing of all applicable devices. The following items shall be addressed in these procedures:

A. All test equipment that is used for these purposes shall be periodically calibrated in accordance with the manufacturers' recommendation and shall be certified and traceable to the National Institute of Standards and Technology (NIST).

B. Personnel working on these devices shall be properly trained and qualified to perform testing, inspection, and repair on these systems. Training shall also be provided and documented for personnel involved in executing the program to ensure that they understand the procedures, safe practices, and the proper use and application of special equipment or unique tools that may be required.

C. Procedures shall be written to prove the integrity of all devices within each loop, from the initial sensing element to the final control element. Furthermore, the procedures shall verify that all applicable devices function together and properly as a system.

D. Function Test procedures shall include (where applicable and feasible), but not be limited to, verifying the following:

1. Operation of all input devices including primary sensors and input modules
2. Logic associated with each input device
3. Logic associated with combined inputs
4. Trip initiating values (set-points) of all inputs
5. Alarm functions
6. Operating sequence of the logic program
7. Function of all final control elements and output modules
8. Function of the manual trip to bring the system to its safe state
9. Function of the user diagnostics
10. Complete system functionality
11. QA/QC verification that the device or loop is operational after testing activities have been completed and prior to unit startup

E. The criteria for acceptable test results shall be defined in order to provide consistent evaluation and implementation of the program. Examples are provided below.

1. Failure – The device does not function properly, or is greater than X% from desired set point.

2. Acceptable – The entire loop functions properly, and the set points are within Y% of desired set point. No adjustment is necessary.

3. Discrepancy – Any deviation from set point that exceeds Y%, but is less than X% of desired set point. Equipment or instruments in this category should be adjusted and the discrepancies documented. However, these items need not be classified as a failure.

RECORDKEEPING

A. Each inspection and test shall be documented, whether performed by in-house or contractor personnel. The documentation shall include:

1. The date of the inspection or test

2. The name of the person who performed the inspection or test

3. The serial number, tag number, or other identifier of the equipment on which the inspection or test was performed

4. A description of the inspection or test performed

5. The results of the inspection or test (including condition and set-point of the device "as found" and "as left"

6. Description of any adjustments, alterations, or repairs performed to re-establish the integrity of the device

Note: Each facility should consider including in their testing program the documentation of the serial number or other identifier of the major test equipment used to perform the test.

B. In addition, each facility shall keep the following records for checks and inspection to ensure that new or replaced equipment is installed properly and in accordance with design specifications and appropriate manufacturers' instructions.

1. Initial calibration or test documentation as described above

2. Data sheet information for each device, where applicable
   a) Manufacturer, tag and model number
   b) Size and connections
   c) Material of construction
   d) Device set-point range and calibration
   e) Special features, or any accessories
   f) Fail-safe mode, or specific action

3. Documentation that qualified personnel are used for any fabrication or installation procedures

4. Verification of applicable inspection and testing performed
   a) Equipment installed and connected as shown on the documentation and in accordance with job construction specifications
   b) Devices visually checked after installation to verify nameplate data and proper orientation
   c) Equipment tested and calibrated per applicable manufacturers' recommendations
   d) Equipment meets vendor's published specifications
   e) Wire and cable tested electrically for continuity and insulation (grounds)
   f) Installation inspected for proper craftsmanship, good connections, and the use of appropriate connectors, sealants, wire gauge, fuses, etc.
   g) Software loaded and functioning as intended
   h) Devices function together and properly as a system as well as individually

   Note: Each facility shall consider including in their inspection program the documentation to verify that any flushing or testing of the equipment or associated process piping is completed in such a fashion that will protect the integrity of the device.

KEY PERFORMANCE INDICATORS (KPIs)

1. ***Number (or percent) of overdue inspections.*** A high number (or rate) of overdue inspections may indicate resource constraints or that equipment is not being made available for scheduled maintenance.

2. ***Number (or percent) of inspections that uncover a failure.*** Clearly, one objective of the mechanical integrity element is to discover and correct hidden failures before they lead to catastrophic accidents. However, an increase in this metric may indicate that risk associated with equipment failure is gradually increasing.

3. ***Number of devices included in the mechanical integrity program.*** Although this number has very little meaning in isolation, it could be used as a basis to compare mechanical integrity programs, particularly if the company operates similar processes at multiple facilities.

4. ***Number of inspection work orders (per month or quarter) that apply to devices that are no longer present at the facility.*** A higher than expected number may indicate a weak link between the mechanical integrity and management of change (MOC) elements. If the inspection plan and preventive maintenance work orders in the CMMS are not updated when equipment is removed from service, it is quite likely that they are not updated when new equipment is installed.

5. ***Number of inspectors/maintenance employees holding each type of required certification.*** A decline in this metric may be a leading indicator of skill gaps or a higher than acceptable backlog for inspection tasks.

6. ***Number of emergency/unplanned repair work orders per month.*** One of the primary objectives of the mechanical integrity element is to reduce unplanned/breakdown maintenance work. Although many unplanned failures may not involve equipment included in the scope of the mechanical integrity program, an increase in this metric may be a leading indicator of an overall slip in the effectiveness of the maintenance program at the facility.

7. ***Work order backlog for the inspection group, in other words, planned activities that are not yet past due.*** Similar to the number of past-due inspection tasks, a backlog may indicate resource constraints. However, this metric may be a better leading indicator than the number of past due inspection tasks.
8. ***Total time charged to inspection tasks each month/quarter.*** A decline in the amount of time that is charged to these activities may indicate a change in focus for the maintenance department. Note that changes could be cyclical by design or could be an intended result (e.g., an effort to rationalize redundant or unnecessary calibration activities should result in a decline in time spent on inspection tasks).
9. ***Total number of deferred repairs, such as known deficiencies that will be addressed at the next turnaround.*** Note that this metric will often increase linearly over time until the next maintenance shutdown, when it drops off sharply. However, the rate of increase could be a leading indicator of risk.
10. ***Average time to address/correct deficiencies.*** This can be another leading indicator of risk and may help indicate if a step change has occurred in the ability to quickly repair equipment. However, at a continuous plant, this metric may be heavily influenced by a few deficiencies that are scheduled to be repaired at the next turnaround. Facilities may need to exclude “turnaround jobs” from this metric to provide a meaningful trend line.
11. ***Equipment reliability (or availability).*** Similar to the previous metric, a decrease in reliability (or availability) may indicate that risk associated with equipment failure is gradually increasing.

22. APPENDIX 3 – CUSTOMER'S CHECKLIST

CHLORINE CUSTOMERS GENERIC SAFETY AND SECURITY CHECKLIST

Edition 2
June 2007

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose and Use

This checklist has been prepared to help evaluate the capability of North American customers of bulk chlorine (larger than a one ton container) to safely unload and otherwise handle chlorine at the facility where the chlorine is used. The checklist is intended only to provide limited information to assist both the supplier of chlorine and its customer. The checklist emphasizes key chlorine specific recommendations as developed by the Chlorine Institute. The checklist is intended to supplement Institute publications, not replace them. It is not meant to incorporate regulatory or other requirements that may be applicable at the facility. In the United States, facilities using or otherwise handling chlorine may be affected by OSHA's Process Safety Management Rule for Highly Hazardous Chemicals (PSM) and/or or EPA's Accidental Release Prevention Requirement; Risk Management Programs (RMP). Canadian and Mexican facilities may have similar or other regulatory requirements.

This checklist should be completed by either representative(s) of the chlorine customer facility or by representative(s) of the chlorine supplier. Both the customer and the supplier should agree in advance who will complete the checklist and how it will be used. The completed checklist should be kept confidential between the parties unless it is mutually agreed to release it to other parties. The chlorine supplier and customer should have a record retention policy for this checklist and should advise the other party what the policy is. The Institute recommends the checklist be completed and used as follows:

(1) Complete the information as indicated in Section 2.

(2) For Sections 3-11, answer each question with a yes, no, or not applicable (N/A) response. A N/A response is indicated, when the item is not applicable to the facility. For example, the facility may not have a vaporizing system (Section 9.1) or a storage system (Section 9.2).

(3) Each item in Sections 3-11, includes a space for comments. It is not intended that each item in the completed checklist has a comment written in this section. It is expected that most answers will not require that comments be included. Comments should be included where necessary to clarify a response. Such clarification may be helpful to a subsequent reviewer if the response is negative. Comments should be fact-based.

(4) Each item includes a reference where the item is discussed in more detail in specific Chlorine Institute publications. Section 12 provides a complete listing of such references. It is recommended that the pamphlets referenced be consulted when completing the checklist to insure the item is fully understood.

(5) Upon completion of the checklist, the chlorine supplier and customer should discuss it and agree to any needed actions that would enhance the capability of the chlorine customer to safely unload and otherwise handle chlorine at the involved facility.

1.2 Chlorine Institute Stewardship Program

The Chlorine Institute, Inc. exists to support the chlor-alkali industry and serve the public by fostering continuous improvements to safety and the protection of human health and the environment connected with the production, distribution and use of chlorine, sodium and potassium hydroxides, and sodium hypochlorite; and the distribution and use of hydrogen chloride. This support extends to giving continued attention to the security of chlorine handling operations.

Chlorine Institute members are committed to adopting CI's safety and stewardship initiatives, including pamphlets, checklists, and incident sharing, that will assist members in achieving measurable improvement. For more information on the Institute's stewardship program, visit CI's website at www.chlorineinstitute.org.

1.3 Description of the Question Format

All items in this checklist are important for enhancing safety, health, environmental protection and security. To help facilitate continuous improvement, the Chlorine Institute's Customer Stewardship Issue Team wanted to provide guidance to checklist users by highlighting certain items to focus attention in the event deficiencies are found. **Checklist items marked with an asterisk (*) are considered a higher priority because greater potential risk might exist for offsite impact or substantial loss if the item is not adequately addressed.** Any checklist item not marked with an asterisk is still important and as is good practice with all deficiencies, a time line for compliance with these items should be established by the bulk chlorine user.

1.4 Approval

The Institute's Customer Stewardship Issue Team approved this checklist on March 20, 2007.

1.5 Revisions

Suggestions for revisions should be directed to the Secretary of the Institute.

2. GENERAL CUSTOMER INFORMATION

Company Name: _____

Facility Address: _____

_____

_____

_____

Contact Name: _____

Phone: _____

E-mail: _____

Checklist completed by: _____ Date: _____

2.1 Does this facility participate in Responsible Care ®?

_____

If not, list any comparable initiatives in which the facility participates.

_____

_____

_____

Items 2.2, 2.3 and 2.4 are applicable only to facilities located in the United States.

2.2 Is this facility an OSHA, VPP Star, or Merit site? Has this facility received any other recognition for safety or environmental performance?

_____

_____

_____

2.3 Does this facility meet the requirements of OSHA Process Safety Management (PSM)? **Ci Pamphlet 85**

_____ YES _____ NO _____ N/A

Comments

2.4 Does this facility meet the requirements of the EPA Risk Management Plan (RMP) and section 313 SARA Title III release reporting?
Ci Pamphlets 64 & 162

_____ YES _____ NO _____ N/A

Comments

Checklist Items	***Ci Pamphlet #(s) Other References***	***Yes***	***No***	***N/A***	***Comments***
3. Personnel Safety and Training					
1. Does the facility have a chlorine specific training program on safe use and handling of chlorine that is documentation for employees, new hires, contractor.	**Ci Pamphlet 1** Section 5: Employee Training & Safety **Ci Pamphlet 65** Section 12: Training in the use of personal protective equipment **Ci Pamphlet 155** Section 9: Employee Training, Safety, and Personal Protective Equipment.				
2. Are accidents and incidents investigated and reviewed with operating personnel?	**Ci Pamphlet 85** Section 12: Incident Investigation				
3. Is a current MSDS available for chlorine?	**Ci Pamphlet 1** Section 5: Employee Training & Safety				
4 Are warning signs, Chlorine Wall Charts, and/or other safety information used and visible?	**Ci Pamphlet 1** Section 5: Employee Training & Safety **Ci Pamphlet 85** Section 12: Incident Investigation				
**5 Does the facility have a Personnel Protective Equipment (PPE) policy for chlorine loading and unloading?*	**Ci Pamphlet 1** Section 5: Employee Training & Safety **Ci Pamphlet 85** Section 12: Incident Investigation				
**6 Does the facility have a policy for respiratory protection in all aspects of chlorine handling and emergency response?*	**Ci Pamphlet 1** Section 5: Employee Training & Safety **Ci Pamphlet 85** Section 12: Incident Investigation				
7 Are safety showers and eyewash stations adequately located and easily accessible from all areas of the unloading site?	**Ci Pamphlet 1** Section 5: Employee Training & Safety				
**8 Are the safety showers and eyewash stations periodically inspected for proper operation?*	**Ci Pamphlet 1** Section 5: Employee Training & Safety				

Checklist Items	***Ci Pamphlet #(s) Other References***	***Yes***	***No***	***N/A***	***Comments***
4. Emergency Response					
**1 Is there a site emergency response plan (ERP) which includes chlorine that is up to date and reviewed annually?*	**Ci Pamphlet 1** Section 4: Emergency Measures **Ci Pamphlet 64** Section 2: Organizational planning				
**2 Have emergency responders received training in accordance with local, state or provincial, and national requirements?*	**Ci Pamphlet 64** Section 3: Planning for handling the emergency				
**3 Are periodic drills performed by emergency responders?*	**Ci Pamphlet 64** Section 3: Planning for handling the emergency				
**4 Do some drills include the LEPC and other appropriate outside agencies?*	**Ci Pamphlet 64** Section 3: Planning for handling the emergency				
5 Is the ERP coordinated with federal, state, and local emergency groups?	**Ci Pamphlet 64** Section 4: Planning for coordination with outside agencies				
**6 Are the appropriate emergency kit(s) on-site, complete, inspected, and located in an appropriate location?*	**Ci Pamphlet 1** Section 4: Emergency Measures **Ci pamphlet 17** Section 8: Chlorine Emergencies **Ci Pamphlet 49** Section 3: Emergency Response **Ci Pamphlet 66** Section 3: Emergency Response				
**7 Is the emergency responder equipment (SCBA, suits, etc.) inspected regularly and maintained in suitable condition?*	**Ci Pamphlet 65** Section 11: Maintenance of Personal Protective Equipment				
**8 Are wind socks or other means of determining wind direction appropriately located and easily visible from all areas of the plant?*	**Ci Pamphlet 1** Section 4: Emergency Measures **Ci Pamphlet 64** Section 3: Planning for handling the emergency				
9 Does the ERP appropriately address communication with outside agencies, the media, and the general public?	**Ci Pamphlet 64** Section 4: Planning for coordination with outside agencies				

**10 Has the facility assessed the need for process and perimeter chlorine monitoring, and implemented as appropriate?*	**Ci Pamphlet 64** Section 3: Planning for handling the emergency				
11 Has the facility installed chlorine monitoring equipment by the T.C unloading site?	**Ci Pamphlet 64** Section 3: Planning for handling the emergency				
5. Security					
**1 Has the facility conducted a vulnerability assessment using the Sandia, CCPS, or other equivalent methodology?*	Vulnerability Assessment Methodology (VAM) for Chemical Facilities, Sandia Laboratories Guidelines for Analyzing and Managing the Security Vulnerabilities of Fixed Chemical Sites, Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE) **Ci Publication** – Site Security Guidance for Chlorine Facilities				
**2 Has the facility developed a security plan based on the vulnerability assessment? (49 CFR 772.800)*	Responsible Care® Value Chain Implementation Guidance: Transportation of PIH Materials by Rail; Ci's Security Management Plan for the Transportation and On-Site Storage and Use of Chlorine Cylinders, Ton Containers and Cargo Tanks; Ci's Chlorine Barge Security Management Plan				
**3 Have employees had security awareness training?*	See references immediately above.				
6. Bulk Containers Securement / Preparation					
**1 Are railcars protected by derails or locked switches that are located at least 50 feet from the car?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 66** Section 6: Tank Car Receiving & Spotting				
**2 Are bulk container brakes set prior to connecting to the transfer piping?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 49** Section 9: Receiving and spotting chlorine tanks **Ci Pamphlet 66** Section 6: Tank Car Receiving & Spotting				

**3*	*Are bulk container wheels chocked prior to connecting to the transfer piping?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 49** Section 9: Receiving and spotting chlorine tanks **Ci Pamphlet 66** Section 6: Tank Car Receiving & Spotting				
**4*	*Are off-loading signs / lights utilized and placed at the derail?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 66** Section 6: Tank Car Receiving & Spotting				
5	Do facility procedures verify that tank cars are properly placarded when received?	**Ci Pamphlet 66** Section 9: Tank Car Unloading				
6	Is adequate access and egress provided to the chlorine container for all anticipated activities including emergencies?	Article I.**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 49** Section 8: Responsibilities **Ci Pamphlet 66** Section 6: Tank Car Receiving & Spotting	Article	Article	Article	Article V.
7	Is lighting or emergency lighting provided to allow for safe operation and emergency response?	Article VI. **Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 49** Section 8: Responsibilities **Ci Pamphlet 66** Section 6: Tank Car Receiving & Spotting	Article	Article	Article	Article X.
7. Bulk Containers Unloading System / Procedures						
**1*	*Do facility procedures verify that the bulk container's protective housing cover is closed and sealed when received?*	**Ci Pamphlet 66** Section 9: Tank Car Unloading				
**2*	*Is a checklist or other procedure used to assist with the performance of pre-unloading, post unloading, and pre-release inspections?*	**Ci Pamphlet 49** Section 11 : Tank Unloading Procedures **Ci Pamphlet 66** Section 9: Tank Car Unloading				
**3*	*Are workers performing higher risk activities like line breaks or disconnections being appropriately monitored?*	**Ci Pamphlet 85** Section 2: Management Commitment				

*4	*Is respiratory protection used to connect and disconnect tank cars consistent with CI recommendations?*	**Ci Pamphlet 65** Section 5: Personal Protective Equipment Selection - Chlorine				
*5	*Are unloading lines and air padding lines purged, evacuated, disconnected, and capped immediately when not in use to minimize moisture entry into the piping system?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 49** Section 11 : Tank Unloading Procedures **Ci Pamphlet 66** Section 9: Tank Car Unloading **Ci Pamphlet 79** Section: Chlorine Unloading Operation				
*6	*Are piping leak checks conducted prior to unloading?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers and Section 4: Emergency Measures **Ci Pamphlet 49** Section 11 : Tank Unloading Procedures **Article XI.** **Ci Pamphlet 66** Section 9: Tank Car Unloading	Article	Article	Article	Article XV.
*7	*Do operating procedures require leaks to be repaired before allowing operations to begin or continue?*	**Ci Pamphlet 1** Section 4: Emergency Measures **Ci Pamphlet 49** Section 11 : Tank Unloading Procedures Article XVI. **Ci Pamphlet 66** Section 9: Tank Car Unloading	Article	Article	Article	Article XX.
*8	*Are liquid angle valves completely open when unloading is in progress?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 49** Section 11 : Tank Unloading Procedures Article XXI. **Ci Pamphlet 66** Section 9: Tank Car Unloading	Article	Article	Article	Article XXV.
*9	*Is the tank car disconnected, lines capped, and protective housing cover closed and sealed after unloading has ceased for the day? If not, does the facility have a written procedure for shutting down and clearing chlorine from the lines and piping?*	Article XXVI. **Ci Pamphlet 66** Section 9: Tank Car Unloading	Article	Article	Article	Article XXX.
*10	*Are piping connections purged to a scrubber, process application, or containment prior to piping disconnection?*	**Ci Pamphlet 49** Section 11 : Tank Unloading Procedures **Ci Pamphlet 66** Section 9: Tank Car Unloading				

**11 Are tank cars attended or monitored by another means during unloading?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 66** Section 9: Tank Car Unloading				
**12 Are personnel who unload bulk containers trained per DOT requirements?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers				
**13 Is PTFE tape or non-reactive pipe dope used on threaded connections?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 6** Section 3: Pipe and Piping components				
**14 Are procedures in place to prevent PTFE tape from interfering with angle valve closure?*					
**15 Have lubricants being used in the chlorine supply system been confirmed to be compatible for chlorine use?*	**Ci Pamphlet 6** Section 3: Pipe and Piping components				
**16 Is there a remotely operated or automatically actuated emergency shutoff valve system in place which can safely isolate both ends of transfer hoses / flexible piping?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 57** Section 3: System Description **Ci Pamphlet 66** Section 9: Tank Car Unloading				
**17 Is the emergency shut-off system tested routinely?*	**Ci Pamphlet 57** Section 3: System Description				
**18 Are there at least two remote emergency stop buttons strategically placed to close shutoff valves on both sides of transfer hoses?*	**Ci Pamphlet 57** Section 3: System Description				
**19 Is there a tank car motion detector that closes shutoff valves on both sides of transfer hoses?*	**Ci Pamphlet 57** Section 3: System Description				
**20 When bulk containers are padded, is either dry air or inert gas maintained at a dewpoint of –40^{o} F (–40^{o} C) or below?*	**Ci Pamphlet 1** Section 3: Bulk Shipping Containers **Ci Pamphlet 49** Section 7: Loading/Unloading/Facilities Issues				

**21 Does the design of the padding gas system include backflow protection to prevent the backflow of chlorine into the padding gas?*	**Ci Pamphlet 49** Section 7: Loading/Unloading/Facilities Issues				
**22 Is the padding gas pressure limited to prevent bulk container over-pressurization?*	**Ci Pamphlet 49** Section 7: Loading/Unloading/Facilities Issues				
**23 Before releasing a tank car, are all angle valve plugs wrench tight? Note: DO NOT tighten excessively!*	**Ci Pamphlet 49** Section 11 : Tank Unloading Procedures **Ci Pamphlet 66** Section 9: Tank Car Unloading				
**24 Are 4 intact placards on the tank cars before the car is released for shipment (UN #1017)?*	Article XXXI. **Ci Pamphlet 66** Section 9: Tank Car Unloading	Article	Article	Article	Article XXXV.
**25 Are empty tank car protective housing covers sealed prior to return shipment?*	**Ci Pamphlet 66** Section 9: Tank Car Unloading				
8. Process Piping (liquid & gaseous service)					
**1 Do piping and all components comply with recommendations of CI, such as metallurgy, schedule, welding requirements, etc?*	**Ci Pamphlet 6** Section 2: General				
**2 Do the chlorine hoses used meet the CI recommendations, including the certification of materials of construction?*	**Ci Pamphlet 6** Appendix A, A. Design, Construction, & Testing				
**3 Are chlorine hoses tested or replaced on a preventive maintenance basis?*	**Ci Pamphlet 6** Appendix A, B. Installation & Maintenance				
**4 Is the piping system inspected routinely or piping replaced as recommended in CI Pamphlet #6.*	**Ci Pamphlet 6** Section 12: Routine & Periodic Inspection & Maintenance				
5 Is the piping system well marked and clearly visible?	**Ci Pamphlet 6** Section 10: Piping Layout Design Considerations				
**6 Is the piping system adequately supported / braced with pipe shoes or other support?*	**Ci Pamphlet 6** Section 10: Piping Layout Design Considerations				

**7* *Is the piping system protected from vehicular traffic?*	**Ci Pamphlet 6** Section 10: Piping Layout Design Considerations				
**8* *Is new or replacement piping properly cleaned and inspected for chlorine service?*	**Ci Pamphlet 6** Section11: Preparation for Use				
**9* *Are the gaskets used compatible with liquid and gaseous chlorine?*	**Ci Pamphlet 95** Section 3: Acceptable Gasket Materials				
**10* *Are there properly designed expansion chambers in place wherever liquid chlorine can be trapped between closed valves?*	**Ci Pamphlet 6** Section 5: Other Components, and DWG. 136				
**11* *Is the expansion chamber isolated from the pipe line with a rupture disk, and is it being monitored?*	**Ci Pamphlet 6** Section 5: Other Components, and DWG. 136				
**12* *Are valves for liquid chlorine service designed to prevent chlorine from being trapped in the valve body?*	**Ci Pamphlet 6** Section 4: Valves				
**13* *Is a barometric loop or other backflow protection used to prevent backflow of liquid process materials?*	**Ci Pamphlet 9** Section 4: Controls & Indicators, and Section 5: Safety				
If an underground chlorine piping system is in use, please answer Section 8, questions 14-15. Otherwise skip to Section #9.					
**14* *Is underground piping system continuously monitored for leaks? How?*	**Ci Pamphlet 60** Section 3: Design				
15 Has cathodic protection, used for underground piping, been considered?	**Ci Pamphlet 60** Section 3: Design				
9. Process Equipment					
Article XXXVI. ***9.1 Vaporizing System***		*Article*	*Article*	*Article*	*Article XL.*
**1* *Is the vaporizer heating medium non-organic based?*	**Ci Pamphlet 9** Section 3 : Design				
**2* *Is the vaporizer heating medium limited to less than 250^{o} F (121^{o} C)?*	**Ci Pamphlet 9** Section 3 : Design				

*3	*Is the heating medium pressure lower than the chlorine supply pressure?*	**Ci Pamphlet 9** Section 3 : Design				
4	Is the vaporizer designed with a low temperature alarm/shut down at -40^{o} F (-40^{o} C)?	**Ci Pamphlet 9** Section 3 : Design				
*5	*Is the vaporizer outlet equipped with a pressure relief valve?*	**Ci Pamphlet 9** Section 4 : Controls and Indicators				
*6	*Has the facility investigated the potential for nitrogen trichloride to accumulate?*	**Ci Pamphlet 9** Section 5 : Safety **Ci Pamphlet 152** Section 5: Control and monitoring of NCl3 and NCl3 sources; Section 7: Limiting Levels of Nitrogen Trichloride; and Section 8: Design/Operating Concerns and considerations				
7	Does the facility have a program in place to monitor nitrogen trichloride levels in areas where it can accumulate?	**Ci Pamphlet 9** Section 5 : Safety Article XLI. **Ci Pamphlet 152** Section 5: Control and monitoring of NCl3 and NCl3 sources; Section 7: Limiting Levels of Nitrogen Trichloride; and Section 8: Design/Operating Concerns and considerations	Article	Article	Article	Article XLV.
*8	*Is there adequate backflow protection for the vaporizer?*	Article XLVI. **Ci Pamphlet 9** Section 5: Safety	Article	Article	Article	Article L.
*9	*Does the facility have a scheduled and routine inspection program for the vaporizer?*	Article LI. **Ci Pamphlet 9** Section 8: Maintenance	Article	Article	Article	Article LV.
9.2 Storage Systems						
*1	*Is the chlorine storage tank protected with a pressure relief device?*	**Ci Pamphlet 5** Section 5 : Tank Appurtenances				
*2	*Has an emergency shut-off device been installed on the liquid lines of the chlorine storage tank?*	**Ci Pamphlet 5** Section 5 : Tank Appurtenances				
*3	*Is the chlorine storage tank scheduled for periodic inspection?*	**Ci Pamphlet 5** Section 8 : Commissioning and Maintenance				

**4*	*Has a pressure sensing device been installed on every chlorine storage tank?*	Article LVI. **Ci Pamphlet 5** Section 5 : Tank Appurtenances	Article	Article	Article	Article LX.
**5*	*Are pressure relief devices scheduled for periodic inspection?*	Article LXI. **Ci Pamphlet 5** Section 9 : Inspection and Test of Appurtenances	Article	Article	Article	Article LXV.
**6*	*Is there a reliable measurement to ensure the storage tank is not overfilled (95% full by volume at a chlorine temperature of 122ºF (50ºC)).*	Article LXVI. **Ci Pamphlet 5** Section 5 : Tank Appurtenances	Article	Article	Article	Article LXX.
**7*	*Are all tank openings (nozzles) on the top of the storage tanks?*	Article LXXI. **Ci Pamphlet 5** Section 4 : Tank Design and Construction	Article	Article	Article	Article LXXV.
8	Do the storage tanks have suitable spill containment	Article LXXVI. **Ci Pamphlet 5** Section 6 : Spill Containment	Article	Article	Article	Article LXXX.
	9.3 Process Area Considerations / Other Equipment					
**1*	*Are process areas, especially buildings, routinely monitored for chlorine-in-air (e.g. alarms, warning lights)?*	**Ci Pamphlet 1** Section 7: Engineering Design & Maintenance				
**2*	*Are indoor chlorine use and handling areas properly ventilated?*	**Ci Pamphlet 1** Section 7: Engineering Design & Maintenance				
**3*	*Are process vessels equipped with relief devices (prevent excessive pressure build-up and backflow into the chlorine piping system)?*	**Ci Pamphlet 9** Section 5 : Safety				
	Article LXXXI. ***9.4 Scrubbing Equipment***		*Article*	*Article*	*Article*	*Article LXXXV.*
1.	Is there a means available to process vent gases and the emergency evacuation of equipment containing chlorine?	Article LXXXVI. **Ci Pamphlet 89** Section 1: Introduction; and section 4: System Design	Article	Article	Article	Article XC.
If the system utilizes a scrubber, complete section 9.4 #2 to #8. **A scrubber is defined as "a device for removal of chlorine from a stream via reaction adsorption or absorption.**						

**2*	*Is the scrubber capacity designed to process the facility's most probable release scenario?*	Article XCI. **Ci Pamphlet 89** Section 3: Process Considerations	Article	Article	Article	Article XCV.
**3*	*Does the scrubber have 'passive' scrubbing capability or is it equipped with emergency stand-by power sources?*	Article XCVI. **Ci Pamphlet 89** Section 4: System Design	Article	Article	Article	Article C.
**4*	*Are the materials of construction adequate?*	Article CI. **Ci Pamphlet 89** Section 4: System Design; and Appendix C Typical Materials used for scrubbing system	Article	Article	Article	Article CV.
**5*	*Are adequate scrubbing media used? Identify.*	Article CVI. **Ci Pamphlet 89** Section 2: Chemical Considerations; and Appendix B Alternative Scrubbing Media	Article	Article	Article	Article CX.
**6*	*Is the scrubbing solution either designed or monitored / analyzed to confirm required minimum capability?*	Article CXI. **Ci Pamphlet 89** Section 2: Chemical Considerations; and Section 4: System Design	Article	Article	Article	Article CXV.
7	Is the scrubbing vent monitored to detect chlorine breakthrough?	Article CXVI. **Ci Pamphlet 89** Section 4: System Design	Article	Article	Article	Article CXX.
**8*	*Is there adequate backflow p*revention?	Article CXXI. **Ci Pamphlet 89** Section 4: System Design	Article	Article	Article	Article CXXV.
10. Packaging/ Processing						
**1*	*Are chlorine detectors present in packaging and process areas that are interfaced into an alarm system with appropriate detection limits being utilized for the alarm set points?*	**Ci Pamphlet 1** Section 7: Engineering Design and maintenance				
2	Are cylinders and ton containers segregated between full and empty?	**Ci Pamphlet 17** Section 2: Packaging Plant Design and Maintenance				
**3*	*Are cylinders and ton containers segregated as defined in the applicable fire and building codes from other chemicals and gases?*	**Ci Pamphlet 17** Section 2: Packaging Plant Design and Maintenance				
**4*	*Are full ton containers stored so that each end is accessible in case a Kit B is needed?*	**Ci Pamphlet 17** Section 2: Packaging Plant Design and Maintenance				

**5 Are cylinders properly secured?*	**Ci Pamphlet 17** Section 2: Packaging Plant Design and Maintenance				
**6 Are written operating procedures available and being utilized by employees that address the appropriate steps for evacuating and filling cylinder and ton containers?*	**Ci Pamphlet 162** Section 6: Prevention Program (Program 3)				
**7 Do procedures exist for testing for leaks prior to filling each cylinder and ton container?*	**Ci Pamphlet 17** Section 3: Cylinder and Ton Containers				
**8 Do procedures exist for proper evacuation of lines before disconnecting?*	**Ci Pamphlet 17** Section 3: Cylinder and Ton Containers				
**9 Do procedures exist for inspection of cylinders and ton containers?*	**Ci Pamphlet 17** Section 3: Cylinder and Ton Containers				
**10 Do procedures exist for inspection and change out of valves?*	**Ci Pamphlet 17** Section 4: Valves				
**11 Do procedures exist for appropriate torque settings of valves and packing nuts?*	**Ci Pamphlet 17** Section 4: Valves				
**12 Do procedures exist for proper labeling and marking of cylinders and ton containers?*	**Ci Pamphlet 17** Section 3 : Cylinder and Ton Containers				
**13 Are written operating procedures available and being utilized by employees that address the appropriate steps for handling chlorine in facilities that produce sodium hypochlorite?*	**Ci Pamphlet 162** Section 6 :Prevention Program (Program 3)				
**14 Do the materials of construction of the sodium hypochlorite process piping conform to the Ci recommendations?*	**Ci Pamphlet 96** Section 4 : Overview of Production Methods for Sodium Hypochlorite				

11. Warehousing/ Storage Areas						
1.	Does the facility include a warehouse/storage area(s) wholly or partially dedicated to the storage of chlorine cylinders and/or ton containers?	**Ci Pamphlet 1** Section 2 : Cylinders and Ton Containers **Ci Pamphlet 17** Section 2 : Packaging Plant Design and Maintenance				
**2*	*Does the warehouse/storage area segregate as defined in the applicable fire and building codes chlorine from other chemicals stored?*	**Ci Pamphlet 17** Section 2 : Packaging Plant Design and Maintenance				
**3*	*Is the warehouse storage area free from debris and flammable materials?*	**Ci Pamphlet 1** Section 2 : Cylinders and Ton Containers **Ci Pamphlet 17** Section 2 : Packaging Plant Design and Maintenance				
4	Are safety showers and eye wash stations readily available?	**Ci Pamphlet 1** Section 5: Employee Safety and Training				
**5*	*Are chlorine detectors present in the area that are interfaced into an alarm system with appropriate detection limits being utilized for the alarm set points?*	**Ci Pamphlet 1** Section 7 : Engineering Design and Maintenance				
**6*	*Are stored cylinders secured?*	**Ci Pamphlet 1** Section 2 : Cylinders and Ton Containers **Ci Pamphlet 17** Section 2 : Packaging Plant Design and Maintenance				
**7*	*Are ton containers secured to prevent them from rolling?*	**Ci Pamphlet 1** Section 2 : Cylinders and Ton Containers **Ci Pamphlet 17** Section 2 : Packaging Plant Design and Maintenance				
**8*	*Are appropriate lifting devices being utilized to move ton containers?*	**Ci Pamphlet 1** Section 2 : Cylinders and Ton Containers **Ci Pamphlet 17** Section 2 : Packaging Plant Design and Maintenance				

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12.3 Other References

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