APPENDIX A: RMP EXAMPLES

The purpose of the RMP is to effectively communicate prevention and preparedness information to the community with the intent of stimulating dialogue and developing improved relationships between you, the community, and CCCHSD. Traditionally, the Contra Costa County community has demonstrated an acute awareness and interest in accidental release prevention. A comprehensive format should therefore be adopted to inform and educate the Contra Costa County community about chemical hazards and accidental release prevention programs.

The RMP Guidelines Committee and the RMP Technical Committee developed the following examples (based on three fictitious stationary sources) to depict the level of detail suggested in the narrative sections of the RMP for stationary sources with Program 1 covered processes, Program 2 state-only covered processes, and Program 3 covered processes. These examples include descriptions of mandatory (required by CalARP regulation) and voluntary policies, procedures, and programs. The CalARP regulation does not require you to implement or describe the voluntary policies, procedures, or programs nor does it prescribe a particular method for achieving compliance with the mandatory requirements. Readers should refer to the CalARP regulation for the specific regulatory requirements. Written clarifications and interpretations from federal EPA and OSHA, and Cal/OSHA were used to supplement the mandatory requirements where applicable. In most instances, following the level of detail in the examples will ensure that the expectations of the community and CalARP regulatory requirements will be met or exceeded. However, you must work closely with CCCHSD to determine the appropriate level of documentation for an RMP to comply with Sections 2745.3 through 2745.9 of the CalARP regulation. This level of detail may be more or less depending upon your stationary source and location. CCCHSD representatives can be contacted for additional information by telephone at (925) 646-2286.

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NOTE: This example does not include any Covered Process Data Sheets or Tables 7.4.d-h. However, it does provide an example of the narrative addendum to the five-year accident history.

PROGRAM 1

EXECUTIVE SUMMARY

THE ACCIDENTAL RELEASE PREVENTION AND EMERGENCY RESPONSE POLICIES AT SUNBEAM WATER TREATMENT PLANT

The SunBeam Water Treatment Plant (SunBeam) is committed to being a responsible member of the community in which it operates by giving top priority to operating in a safe and environmentally sound manner. Policy dictates that SunBeam personnel continuously identify methods to reduce the use of hazardous materials and to reduce the risk to the community and environment through implementation of new technology and procedures. This commitment to safe and environmentally sound operations is documented in the policy and compliance manuals, and the mission statement, which are available to all employees. The Accidental Release Prevention Program policy states:

"It is the policy of SunBeam Water Treatment Plant to:

- Comply with all applicable safety, health, and environment laws and regulations;
- Ensure that all unsafe conditions are properly identified and reported, and promptly corrected;
- Provide training to all personnel so that they can consistently and safely perform their duties; and
- Maintain a safe workplace through prevention, detection, and mitigation."

SunBeam management stresses safe and environmentally sound operations in employee training programs, and in written materials available at the plant and sent to employee's homes. SunBeam management mails a quarterly newsletter to the surrounding community that includes information about safety and environmental matters of interest to the community. Safety and environmental programs include monthly safety meetings with all employees, a joint worker/company safety committee and a community advisory panel. There are regularly scheduled internal safety and environmental audits conducted by SunBeam personnel and periodic safety and environmental audits by third-party auditors.

A DESCRIPTION OF SUNBEAM WATER TREATMENT AND THE REGULATED SUBSTANCES HANDLED

Description of Stationary Source

The SunBeam Water Treatment Plant filters and disinfects water that is used by the general public for drinking water and other uses. Disinfection involves the addition of chlorine gas to the water to destroy bacteria, viruses and other pathogens that may cause harm to the public health. In addition, chemicals such

as potassium permanganate, sodium hydroxide, activated carbon and polymer are added to aid the filtering and removal of organics and other particulate matter which may affect the taste and odor of the potable water. Chlorine is the only CalARP regulated substance.

Description of the Chlorination Process

The SunBeam plant treats water taken from the San Juaquin River. The water initially passes through a screen to remove large debris. The water next goes to a sedimentation basin where large particulate matter is settled out and removed. Water is then pumped from the sedimentation basin through activated carbon filters that removes the remaining particulate matter and organics from the water. The raw water from the filters goes to the chlorination system. Chlorinated water from the chlorination system is routed to reservoirs before being distributed to users.

Figure A-2 is a schematic diagram of the chlorination system. Eight 150 pound cylinders containing chlorine are on site. Four of the cylinders are connected to the chlorination system, two of these feeding chlorine with two in reserve. When the pressure in the two active cylinders falls below 20 psig, an automatic switchover system places the reserve cylinders on line while allowing the first two cylinders to depressure to ambient pressure. Then the first two cylinders are replaced with reserve cylinders and the cycle continues. Chlorine gas under pressure flow through tubing to a pressure/vacuum valve that reduces the chlorine pressure to less than atmospheric. Chlorine under vacuum flows through the chlorinators that regulate the chlorine flow rate. Chlorine then flows to the ejectors where it is mixed with the raw water. The chlorine concentration in the water leaving the ejectors is about 2 ppm. The vents shown on the diagram flow to a scrubber that absorbs the chlorine.

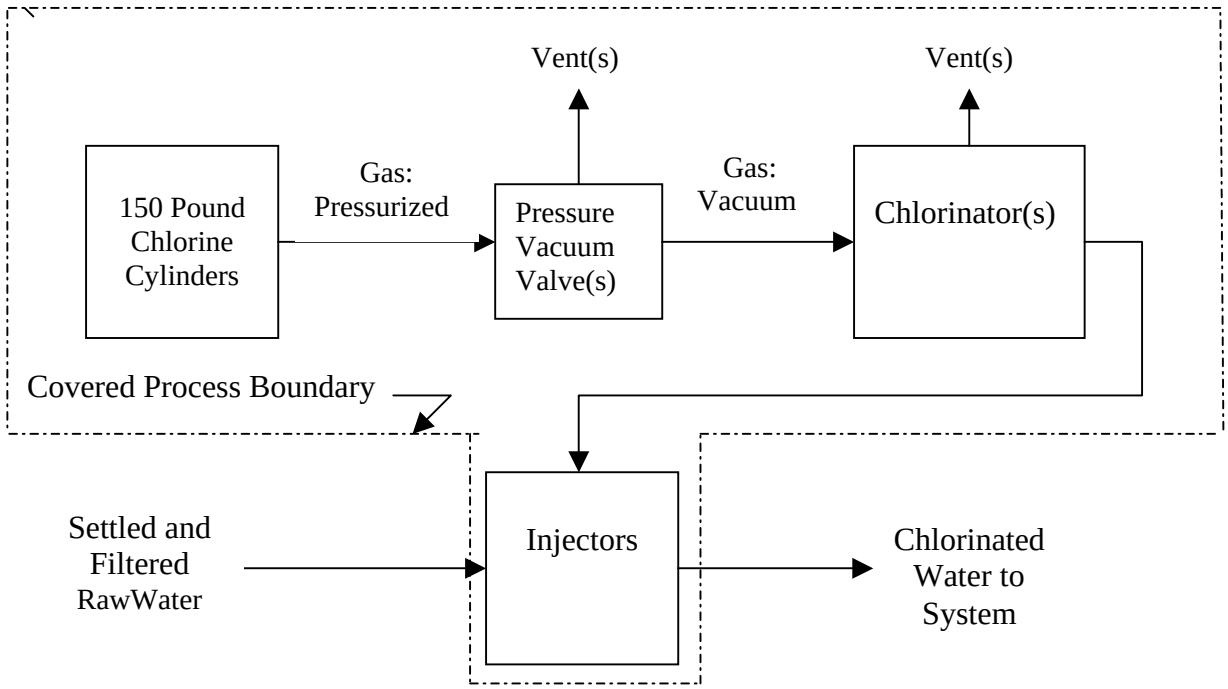

FIGURE A-1:
CHLORINATION SYSTEM

Characteristics and Hazards of Chlorine
The characteristics and hazards of chlorine are discussed in the offsite consequence analysis section of this document.

THE WORST-CASE RELEASE SCENARIO(S)

Well-documented offsite consequence analyses are essential to adequate communication of potential hazards at the stationary source.

The SunBeam Water Treatment Plant conducted an offsite consequence analysis, using the EPA's *RMP Offsite Consequence Analysis Guidelines,* to estimate the offsite consequence of a Worst-Case Scenario (WCS) from our chlorine treatment process.

The WCS associated with toxic substances in the SunBeam Water Treatment Plant is a catastrophic failure of a single chlorine cylinder resulting in a release of the total contents of the cylinder, 150 pounds of chlorine gas, over a ten-minute period. Although there are numerous installed control measures that, in an actual event, would mitigate the release, the only passive mitigation measure taken into account for this scenario was the location of the cylinders. Because the entire process is located within an enclosed space, a mitigation factor of 0.55 was applied to the release rate of the chlorine.

According to the EPA's *RMP Offsite Consequence Analysis Guidelines*, using rural conditions, the maximum distance to the toxic endpoint of 3 ppm (ERPG-2 for chlorine) for this WCS is 1.7 miles. There are no public receptors within 1.7 miles of the chlorine cylinder and the stationary source has not had a release meeting the accident history criteria for five years. Therefore, the SunBeam Water Treatment Plant qualifies for Program 1 under the CalARP regulations.

THE GENERAL ACCIDENTAL RELEASE PREVENTION PROGRAM AND CHEMICAL-SPECIFIC PREVENTION STEPS

SunBeam management realizes that implementation of appropriate administrative and technological safeguards ensures the safety of the workers and the continued safety of public receptors. Those recommendations that are planned for implementation will be discussed in "Planned Changes to Improve Safety". The safeguards shown in Table A-1 include both administrative and technological safeguards that prevent, detect, or mitigate releases of chlorine.

Table A-1 SunBeam Chemical-Specific Prevention Steps

Source	Safeguards	Purpose	Date of Implementation	Comments
Initial Design	The water treatment plant was built to the appropriate design codes including: Uniform Building Codes (1982 and 1995), American National Standards Institute (Code B30.16-1981 overhead hoists) and information from the Chlorine Institute's Chlorine manual	Ensures structural integrity of the chlorination system and the enclosure	6/1/82 through current	
Initial Design	The chlorination system is equipped with a vacuum pressure regulator so that half of the chlorine transfer line is under vacuum	Minimizes the potential for a chlorine release by having a portion of the system under vacuum so that small leaks result in air in rather than chlorine out	6/1/82	
Initial Design	The chlorination room is equipped with a chlorine sensor and detector which alarms in the main control room	Alerts personnel to chlorine releases	6/1/82	
Industry-wide experience	150 lb cylinders are equipped with fusible plug relief at 158 degrees F	Prevent against overpressurization of the cylinder due to excessive heat or flame impingement		
Industry-wide	150 lb cylinders are	Restrict movement	1/1/89	

experience	stored with the protective cap in place and restricted by a welded link chain	during seismic events and to protect against valve damage that may result in a release of chlorine		
Industry-Wide Experience	Operators are required to have approved escape-type respirators with them (i.e., on their belt) when changing cylinders	Protects the operators against chlorine exposure in the event of a serious chlorine release during cylinder changing	7/1/95	
Safety Meeting 3/91	Written operating procedures were written for startup, shutdown, cylinder changes, and emergency procedures	To provide operating personnel with written guidance to ensure that procedures are performed consistently and accurately	8/1/91	
Safety Meeting 8/91	A comprehensive training program was developed to include technical training and safety and environmental training through classroom instruction and on-the-job training	Ensures that the operators can perform and understand the written procedures produced in 3/91	12/1/91	
Incident Investigation II-4	The written operating procedure for changing chlorine cylinders was revised to include a warning to remind operators to retighten the packing nut after the	Prevents leaks of chlorine through the packing nut and minimizes the potential for operator exposure	9/1/93	

	valve is opened for continuous flow			
Incident Investigation II-19	A Preventive/Predictive Maintenance program was developed to ensure that the chlorination system, particularly the "pigtail" was being inspected, tested, and replaced appropriately	Minimize potential interruptions in service and chlorine releases due to excessively corroded or inoperable equipment	8/1/96	
Chlorine Institute Pamphlet 85	An accident/incident investigation procedure was developed and implemented	Ensures that causes of incidents are identified and that corrective actions are taken to minimize the potential for reoccurrence	11/92	

THE FIVE-YEAR ACCIDENT HISTORY

SunBeam Water Treatment Plant compiled a five-year accident history for all accidental releases from the chlorination system that resulted in deaths, injuries, or significant property damage onsite, or known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage. The compilation of this information satisfies the requirements of Section 2750.9 of the CalARP regulation. The five-year accident history allows SunBeam personnel to explain to the community the factors causing or contributing to accidental releases, the onsite and offsite impacts of accidental releases, and the procedural and technological changes made to minimize the likelihood that these accidental release will not occur again. The intent of this information exchange is to create an informed community while also documenting that accidental releases are investigated and concrete changes are made to protect against reoccurrence.

SunBeam personnel reviewed all incident investigation reports from January 1994 to present to identify accidental releases of chlorine and other extremely hazardous substances that resulted in deaths, injuries, or significant property damage onsite, or known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage. Only one accidental release resulting in an onsite injury was identified. The incident occurred when an operator was briefly exposed to chlorine released from a cracked "pigtail" during cylinder changeout. The operator was hospitalized overnight due to labored breathing; however, he did not sustain any long-term health effects. No offsite deaths, injuries, property damage, or environmental damage occurred. Data regarding this incident and the resulting procedural and technological changes are described in the Five-Year Accident History data elements of the RMP.

THE EMERGENCY RESPONSE PROGRAM

Overall safety at the SunBeam Water Treatment Plant is governed not only by our ability to prevent accidental releases of chlorine from occurring, but also by the ability to mitigate any accidental releases of chlorine. We developed an emergency response program to minimize the effects of accidental releases of chlorine to employees (vapor-dispersion modeling demonstrates an inability to impact public receptors). SunBeam management has opted not to respond to releases of chlorine due to limited resources. An emergency response program (ERP) was developed which consists of an emergency action plan (EAP), satisfying the requirements of Title 8 California Code of Regulations (T8 CCR§3220) and coordination with local emergency response personnel and officials, satisfying the requirements of Section 2765.1(b) of the CalARP regulation.

SunBeam personnel developed and implemented an EAP that includes employee evacuation routes, headcounting procedures, and EAP training for employees. This EAP also includes a "Notification Matrix" which provides the telephone

numbers of agencies and individuals to contact in the event of one of several pre-identified emergencies (e.g., fire, employee injury, employee fatality). The agencies and individuals represent local emergency responders (e.g., Fire Department), public notification and regulatory reporting requirements (e.g., CCCHSD), and internal notification (e.g., Plant Manager). The "Notification Matrix" requires that designated personnel make the notifications and document when the telephone calls were placed and the name and position of the person contacted. Completed "Notification Matrices" are maintained for five years.

SunBeam personnel work closely with the Fire Department to prevent fires from occurring and to quickly mitigate fires. Annually, the Fire Department provides fire extinguisher training for incipient fires and performs walk-throughs of the processes. SunBeam personnel also work closely with Contra Costa County Health Services (CCCHSD) for any necessary response to chlorine releases. This pre-planning ensures that employees of SunBeam are aware of the preferred method of notifying the fire department (e.g., activation of any of the manual pull switches or sprinkler system automatically sounds an audible alarm and alerts the fire department) and CCCHSD (via the procedure in the notification policy). The second day of the pre-planning activity is a "tabletop exercise" where the responding agencies (e.g., fire department, CCCHSD) and representatives from the stationary source work together to resolve the given scenario (e.g., release of chlorine or fire threatening the integrity of the 150lb. cylinders). This pre-planning activity ensures that the members of the responding agencies are familiar with the plant, the hazards of chlorine, the resources available at the plant (e.g., A Kit) and the locations of the resources. Copies of the tabletop exercise records, including all recommendations and critiques, are maintained with the ERP.

The emergency response program is reviewed annually to ensure that it remains accurate and current. Employees are trained on the emergency response program when initially hired, when the emergency response plan is revised, and when employees' responsibilities are changed.

PLANNED CHANGES TO IMPROVE SAFETY

As a Program 1 stationary source, we certified that no additional measures are necessary to prevent offsite impacts from accidental releases. However, we are continually developing recommendations as a result of equipment inspections, safety meetings, review of industry experience, technology improvements, and employee suggestions. Once formulated, recommendations are reviewed and corresponding action items are developed to implement each recommendation. Communication of these action items or planned activities informs the public of measurable improvements for safety that are being incorporated at the SunBeam plant.

Personnel reviewed the following documents and compiled the following list of action items that were not yet complete at the time of the RMP submittal:

- 1995 Safety Audit;
- What-If Analysis report from 1995;
- Incident investigation reports from 1994;
- Safety meeting minutes since 1994; and
- Recommendations stemming from industry-wide experience since 1994.

Summaries of the action items are depicted in Table A-2. Table A-2 includes the source of the action item, the action item summary, the purpose of the action item, and the projected completion date of the specific action item or the generalized group. It also includes a comments column for any additional information. This column will be used to document the progress of each action item during the five-year RMP update.

Source	Planned Changes	Purpose	Projected Completion Date	Comments
Incident Investigation II-19	Add "pigtail" replacement to the operating procedures per the manufacturers recommendations or the Chlorine Institute guidance	Inspection of the "pigtail" does not always identify small cracks, therefore the "pigtail" should be replaced on a regular basis	6/1/99	
Incident Investigation II-19	Ensure that the written procedure on 150 lb cylinder changing includes a warning or caution note to alert operators that "once the "pigtail" is connected, pressurize the line but then close the valve on the cylinder and inspect for leaks"	Prevents the possibility of a large chlorine release and employee exposure in the event of "pigtail" leaks.	6/99	
1995 What-If analysis	Revise the existing chlorination system to move the vacuum regulator directly on the 150 lb. cylinder	Ensures that the entire chlorine transfer line is under vacuum so that small leaks will result in the ingress of air other than the egress of chlorine	6/1/99	

What-If Analysis recommendation task group	Develop a procedure to manage proposed modifications which significantly increase the volume of chlorine or the risk of chlorine release (consider using the management of change and prestartup procedure identified in the CalARP regulation as a template)	To satisfy Section 2745.11 of the CalARP regulation and to ensure that any modifications to the chlorination system are scrutinized by personnel with the appropriate expertise	5/1/98	
Safety Audit 1995	Consider installing a caustic scrubber to the chlorination system NOTE: This is still a recommendation- not an action item (i.e., it is being considered by SunBeam management)	Currently, there is sufficient distance between SunBeam and the nearest public receptors so that they would not be impacted during a worst-case release scenario. However, SunBeam should be prepared to install the scrubber in the future to minimize the potential for public receptor impact from a chlorine release, if public receptors do move closer	Undetermined	

Safety Audit 1995	Ensure that all new radios purchased have man-down capabilities	Prevents escalation of incidents by immediately alerting personnel to situations	7/1/99	
Safety Meeting 1/99	Plan an emergency response exercise with Contra Costa County Health Services Department and the City Fire Department	Ensure that local emergency responders are familiar with the SunBeam facility, the hazards of chlorine, and the available resources	9/99	

OFF-SITE CONSEQUENCE ANALYSIS

CHARACTERISTICS AND HAZARDS OF CHLORINE

Chlorine is a dense, greenish yellow gas with a pungent, suffocating odor, which, at the SunBeam Water Treatment Plant, is used to purify water. It is extremely toxic by inhalation and is slightly soluble in water. Chlorine reacts explosively or forms explosive compounds with many common chemicals. It is normally shipped as a pressurized liquid in cylinders or railroad tankcars. Contact with liquid chlorine should be avoided as it can cause frostbite. The liquid readily vaporizes to a gas. Chlorine does not burn but will support combustion of other articles. Long term exposure to low concentrations or short-term exposure to high concentrations may result in adverse health effects from inhalation. Chlorine vapors are much heavier than air and tend to settle in low areas.

HEALTH HAZARDS

Chlorine is poisonous and may cause death or permanent injury after very short exposures to very high concentrations. Contact may cause burns to skin and eyes, bronchitis or chronic lung conditions. Persons with asthma, subnormal pulmonary functions, or cardiovascular disease are at a greater risk.

Effects of chlorine exposure may be delayed. Chlorine is corrosive and may be converted to hydrochloric acid to the lungs. Signs and symptoms of acute chlorine exposure may include: rapid heart rate, high blood pressure followed by low blood pressure, and cardiovascular collapse. Pulmonary edema and pneumonia are often seen. Eyes, nose, throat, and chest may sting or burn following exposure. There could be cough with bloody sputum, a feeling of suffocation, dizziness, agitation anxiety, nausea, and vomiting. Skin exposure may result in sweating, pain, irritation, and blisters.

Table A-3
Properties and Hazards of Chlorine

PROPERTY	VALUE	COMMENTS
Odor threshold	0.021 to 3.4 ppm	
ERPG-1	1 ppm	Definition: The concentration that nearly all individuals could be exposed to for one hour without experiencing other than mild transient health effects or perceiving a clearly defined objectionable odor.
ERPG-2	3 ppm	Definition: The concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
ERPG-3	20 ppm	Definition: The concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening

PROPERTY	VALUE	COMMENTS
		effects
Vapor specific gravity	2.4	Chlorine is heavier than air. When pressurized liquid chlorine is released, it initially forms a heavy cold cloud of chlorine mist. A pool of liquid chlorine may form beneath the release point from which additional chlorine will evaporate.
Boiling point	-30.3°F	At 760mm of mercury pressure
Ignition temperature		Not flammable

WORST CASE SCENARIO

Selection Criteria & Scenario Description

The Worst-Case Scenario (WCS) for the SunBeam Water Treatment Plant is the release of total the contents of a single 150 lb. chlorine (Cl_2) cylinder in 10 minutes. This scenario is the WCS as defined in the CalARP regulations, sections 2750.3(a)(2)(A) and (c)(1).

The cylinder is contained in a 700 cu. ft. process space, which is contained within the 12,000 cu. ft. storage building on site. The results for the WCS were generated from the EPA's *RMP Offsite Consequence Analysis Guidelines*. In accordance with these guidelines, a mitigation factor of 0.55 was applied to the analysis because the release occurs within an enclosure.

The release results were determined assuming the following conditions for a WCS:

- Dense gas;
- Ten-minute release;
- Rural conditions;
- F stability class; and
- Wind speed of 1.5 meters per second.

Results Summary
The following table contains the results for the WCS:

Table A-4
Chlorine WCS Results

RELEASE SCENARIO	MATERIAL	AMOUNT	ENDPOINT	DISTANCE	
Toxic	Cl_2	150 lbs.	3 ppm (ERPG-2)	1.7 mi.	9,000 ft.

Figure A-1 shows the area affected by this WCS on a map of the area.

FIGURE A-1 WORST CASE RELEASE SCENARIO

COVERED PROCESSES DATA SHEET

This guidance document does not provide examples of completed data sheets except for the following example of five-year accident history information. This is included as an example because CCCHSD is requesting that additional information be provided to clarify the data element entries.

FIVE –YEAR ACCIDENT HISTORY

Unit: Chlorination system
6.1 Date October 10, 1998
6.2 Time 6:00 a.m.
6.3 Release duration 1 minute
6.4 Chemical Chlorine
6.5 Quantity released (lbs.) < 1 lb.

6.6 Release event

a. ✔ _Gas release
c. Liquid spill/evaporation
b. Fire
c. Explosion

6.7 Release Source

a. Storage vessel
b. ✔ Piping
c. Process vessel
d. Transfer hose
e. Valve
f. Pump

6.8 Weather conditions as time of event (if known)
a. Wind speed/direction_____
b. Temperature_____
c. Stability class_____
d. Precipitation present
e. Unknown

6.9 Onsite impacts
a. Deaths (number)
b. Injuries 1 (number)
c. Property damage ($)0

6.10 Known offsite impacts
a. Deaths (number)
b. Hospitalizations (number)
c. Other medical treatment (number)
d. Evacuated (number)
e. Sheltered (number)
f. Property damage ($)

g. Environmental damage (specify type)

6.11 Initiating event (check all that apply)

a. ✔ Equipment failure
b. Human error
c. Weather condition

6.12 Contributing factors

a. Equipment failure
b. Human error
c. Improper procedures
d. Overpressurization
e. Upset condition
f. By-pass Condition
g. ✔ Maintenance activity/Inactivity
h. Process design
i. Unsuitable equipment
j. Unusual weather condition
k. Management error

6.13 Offsite responders notified a Yes b. _✔__ No

6.14 Changes introduced as a result of the accident

a. ✔ Improved/upgrade equipment
b. ✔ Revised maintenance
c. ___ Revised training
d. ___ Revised operating procedures
e. ___ New process controls
f. ___ New mitigation systems
g. ___ Revised emergency response plan
h. ___ Changed process
i. ___ Reduced inventory
j. ___ Other
k. ___ None

6.0 FIVE-YEAR ACCIDENT HISTORY ADDENDUM

6.9 Operator was exposed to a small (the volume in the transfer tubing to the eductor) chlorine release. He was hospitalized overnight due to labored breathing but was released the next day with no long term health effects.

6.10 There were no offsite consequences of the small chlorine release

6.11 The "pigtail" for the chlorination system experienced a small crack that went undetected due to inadequate maintenance (inspection and replacement) procedures. The operator followed written procedures that require that the line is pressurized and the main valve on the 150 lb. cylinder be closed to check for

leaks. The volume of chlorine in the line was released and the operator inhaled the fumes before donning his escape pack and exiting the room.

6.12 The leak in the "pigtail" was not previously identified because of improper inspection and replacement procedures (i.e., maintenance activity)

6.13 The leak was identified by the operator while changing cylinders. The proper practical and regulatory notifications were made as outlined in the "Notification Matrix" including Bay Area Air Quality Management District and CCCHSD.

6.14 SunBeam developed a predictive/preventive maintenance program that includes regular inspection and replacement of the "pigtail" at an interval specified by the Chlorine Institute. SunBeam management also included a note in the written procedures "WARNING" personnel to pressurize the line, close the main valve on the 150 lb cylinder, and check for leaks. The operator involved in the incident was very experienced and did follow procedure. He was therefore only exposed to the volume in the "pigtail". The incident could have been much more serious if the operator had not followed procedure.

TABLE OF CONTENTS – PROGRAM 2

NOTE: This example does not include any Covered Process Data Sheets or Tables 7.4.d-h. However, it does provide an example of the narrative addendum to the five-year accident history.

PROGRAM 2

EXECUTIVE SUMMARY

THE ACCIDENTAL RELEASE PREVENTION AND EMERGENCY RESPONSE POLICIES AT ROYCE WATER TREATMENT PLANT

The Royce Water Treatment Plant is committed to being a responsible member of the community in which it operates by giving top priority to operating in a safe and environmentally sound manner. Policy dictates that Royce personnel continuously identify methods to reduce the use of hazardous materials and to reduce the risk to the community and environment through implementation of new technology and procedures. This commitment to safe and environmentally sound operations is documented in the policy and compliance manuals, and the mission statement, which are available to all employees. The Accidental Release Prevention Program policy states:

"It is the policy of Royce Water Treatment Plant to:

- Comply with all applicable safety, health, and environment laws and regulations;
- Ensure that all unsafe conditions are properly identified and reported, and promptly corrected;
- Provide training to all personnel so that they can consistently and safely perform their duties; and
- Maintain a safe workplace through prevention, detection, and mitigation."

Royce management stresses safe and environmentally sound operations in employee training programs, and in written materials available at the plant and sent to employee's homes. Royce management mails a quarterly newsletter to the surrounding community that includes information about safety and environmental matters of interest to the community. Safety and environmental programs include monthly safety meetings with all employees, a joint worker/company safety committee and a community advisory panel. There are regularly scheduled internal safety and environmental audits conducted by Royce personnel and periodic safety and environmental audits by third-party auditors.

A DESCRIPTION OF ROYCE WATER TREATMENT PLANT AND THE REGULATED SUBSTANCES HANDLED

Description of Stationary Source

The Royce Water Treatment Plant filters and disinfects water that is used by the general public for drinking water and other uses. Disinfection involves the addition of chlorine gas to the water to destroy bacteria, viruses and other pathogens that may cause harm to the public health. In addition, chemicals such

as potassium permanganate, sodium hydroxide, activated carbon and polymer are added to aid the filtering and removal of organics and other particulate matter which may affect the taste and odor of the potable water. Chlorine is the only CalARP regulated substance.

Description of the Chlorination Process

The Royce plant treats water taken from the San Joaquin River. The water initially passes through a screen to remove large debris. The water next goes to a sedimentation basin where large particulate matter is settled out and removed. Water is then pumped from the sedimentation basin through activated carbon filters that removes the remaining particulate matter and organics from the water. The raw water from the filters goes to the chlorination system. Chlorinated water from the chlorination system is routed to reservoirs before being distributed to users.

Figure A-2 is a schematic diagram of the chlorination system. Eight 150 pound cylinders containing chlorine are on site. Four of the cylinders are connected to the chlorination system, two of these feeding chlorine with two in reserve. When the pressure in the two active cylinders falls below 20 psig, an automatic switchover system places the reserve cylinders on line while allowing the first two cylinders to depressure to ambient pressure. Then the first two cylinders are replaced with reserve cylinders and the cycle continues. Chlorine gas under pressure flows through tubing to a pressure/vacuum valve that reduces the chlorine pressure to less than atmospheric. Chlorine under vacuum flows through the chlorinators that regulate the chlorine flow rate. Chlorine then flows to the ejectors where it is mixed with the raw water. The chlorine concentration in the water leaving the ejectors is about 2 ppm. The vents shown on the diagram flow to a scrubber that absorbs the chlorine.

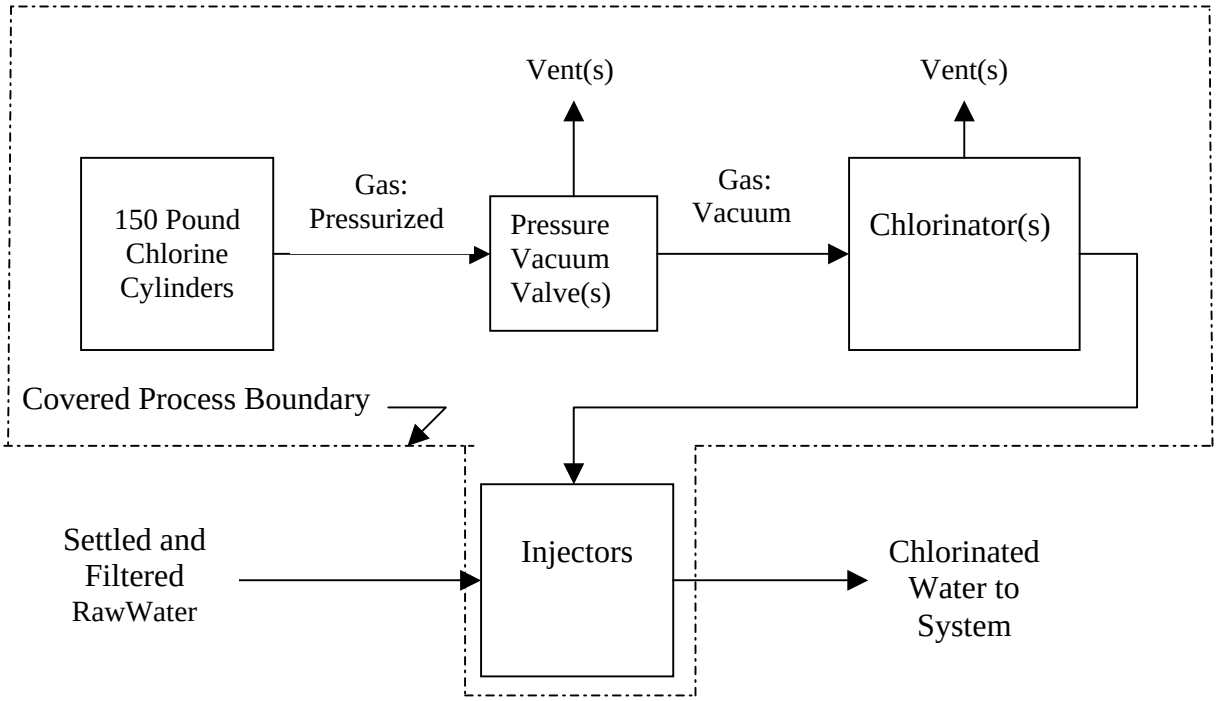

FIGURE A-2:
CHLORINATION SYSTEM

Characteristics and Hazards of Chlorine

The characteristics and hazards of chlorine are discussed in the offsite consequence analysis section of this document.

THE WORST-CASE RELEASE SCENARIO(S) AND THE ALTERNATIVE RELEASE SCENARIO(S)

Well-documented offsite consequence analyses are essential to adequate communication of potential hazards at the stationary source. The Royce Water Treatment Plant conducted offsite consequence analyses, using the EPA's *RMP Offsite Consequence Analysis Guidelines* for the Worst-Case Scenario (WCS), and using ALOHA as the dispersion model for the Alternative Release Scenario (ARS).

Offsite consequence analysis is also a tool used by the stationary source to assist the CCCHSD Incident Response Team in emergency response planning. To do this, the Royce Water Treatment Plant developed an ARS to represent a reasonable "outer bound" for our emergency response planning and for explaining potential hazards to the community.

Following are the results from the OCA.

Worst-Case Scenario

The Worst-Case Scenario (WCS) for toxic substances in the Royce Water Treatment Plant is the release of the total contents of a single 150-lb. chlorine (Cl_2) cylinder in 10 minutes. Although there are numerous installed control measures that, in an actual event, would mitigate the release, the only credit for passive mitigation measures taken into account for this scenario was that the cylinders are located within an enclosure. The results for the WCS were generated from the EPA's *RMP Offsite Consequence Analysis Guidelines*. In accordance with these guidelines, a mitigation factor of 0.55 was applied to the analysis because the release occurs within an enclosure.

The maximum distance to the toxic endpoint of 3 ppm (ERPG-2 for Cl_2) for this WCS is 1.7 miles. Using census data from LandView III, the estimated population within the worst-case scenario circle is 7,200. No Program 1 or Program 3 processes containing regulated toxic substances were identified at this facility.

Alternative Release Scenario

The ARS for Cl_2 is failure of the "pigtail" for the chlorination system, resulting in a release of 100 pounds of Cl_2 gas over a 20-minute period. The 20-minute release duration is the approximate time necessary for emergency responders to don protective gear and repair the leak. Other mitigation systems taken into account in this scenario included the cylinders' location within an enclosure. The maximum distance to the toxic endpoint of 3 ppm (ERPG-2) is 0.7 miles, and for 20 ppm (ERPG-3) is 0.2 miles. Using census data from LandView III, the estimated population within the ARS ERPG-2 circle is 1,600. Because the distance to the ARS toxic endpoint is less than one mile, the vulnerability zone for this release scenario is one mile. Four schools are within the vulnerability zone, as well as two child day care facilities and one adult care facility.

Mitigated Release Scenario

One way to effectively mitigate the effects of the ARS would be to install a scrubber system or similar treatment device to the storage building ventilation system. This mitigation item was identified during the hazard review, and is scheduled for implementation by mid-1999. The amount of chlorine released to the atmosphere would be reduced by a minimum of 90% (the calculated efficiency of the scrubber system). For this scenario, The maximum distance to the toxic endpoint of 3 ppm (ERPG-2) is 0.2 miles, and for 20 ppm (ERPG-3) is 0.07 miles. Using census data from LandView III, the estimated population within the mitigated release scenario circle is 70. These distances would not reach a public receptor.

THE GENERAL ACCIDENTAL RELEASE PREVENTION PROGRAM AND CHEMICAL-SPECIFIC PREVENTION STEPS

Management System

The Royce Water Treatment Plant has developed a simplified management system based on *CCPS Plant Guidelines for Technical Management of Chemical Process Safety* to plan, organize, implement and control the risk management program elements. This management system satisfies the requirements of Section 2735.6 of the CalARP regulation and ensures that the risk management program elements are developed and continually improved. All records associated with the prevention program elements are retained for a minimum of five years unless otherwise specified in the CalARP regulation. The management system activities are further discussed below.

- **Planning** – The Royce plant has an overall risk management program policy that clearly identifies the goals and objectives of the risk management program.

- **Organizing** – The Plant Manager is responsible for ensuring that written procedures for each risk management program element are developed to meet identified goals and objectives. The Plant Manager and operators hold monthly meetings for the purpose of integrating and coordinating each risk management program element.

- **Implementing** – The Plant Manager provides training to all operators regarding initiating the program elements, implementing the program elements, and documenting the program elements during the monthly meetings. Personnel are provided with initial training on the applicable risk management procedures. Refresher training is provided on an as-needed basis but is conducted at a minimum following any changes to the program elements or following reauthorization.

- **Controlling** – The Plant Manager is responsible for conducting internal reviews or audits of each risk management program elements against the goals and objectives of the element. Annually, the procedures are reviewed, revised, and reauthorized to ensure that they remain accurate and reflect the current practices.

Chemical-Specific Prevention Steps

The prevention programs described in the following section represent integrated administrative controls intended to ensure the safety of workers, the public, and the environment. Many of these prevention programs (e.g., hazard reviews, compliance audits, incident investigation) result in the development and

implementation of additional safeguards (administrative and engineering controls). Those recommendations that are planned for implementation at the Royce Water Treatment Plant will be discussed in "Planned Changes to Improve Safety". Those applicable safeguards that have already been implemented or that were part of the original design are described in Table A-4. These safeguards prevent, detect, or mitigate accidental releases of chlorine.

Table A-4 Royce Chemical-Specific Prevention Steps

Source	Safeguards	Purpose	Date of Implementation	Comments
Inherently Safer Design Features	The chlorination system is located within a containment building. Corrosion proof materials are used throughout the system. The 150 lb. cylinders are located in close proximity to the water eductor to minimize piping	Containment of chlorine releases minimizes the potential impact offsite and onsite. Use of corrosion proof materials minimizes the need for maintenance personnel to replace equipment. The proximity of the 150 lb. cylinders minimizes the impact of a release of chlorine due to "pigtail" failure		
Initial Design	The water treatment plant was built to the appropriate design codes including: Uniform Building Codes (1982 and 1995), American National Standards Institute (Code B30.16-1981 overhead hoists) and information from the Chlorine Institute's Chlorine manual	Ensures structural integrity of the chlorination system and the enclosure	6/1/82 through current	
Initial Design	The chlorination system is equipped with a vacuum pressure regulator so that half of the chlorine transfer line	Minimizes the potential for a chlorine release by having a portion of the system under vacuum so that small leaks result in	6/1/82	

Source	Safeguards	Purpose	Date of Implementation	Comments
	is under vacuum	air in rather than chlorine out		
Initial Design	The chlorination room is equipped with a chlorine sensor and detector which alarms in the main control room	Alerts personnel to chlorine releases	6/1/82	
Industry-wide experience	150 lb cylinders are equipped with fusible plug relief at 158 degrees F	Prevent against overpressurization of the cylinder due to excessive heat or flame impingement		
Industry-wide experience	150 lb cylinders are stored with the protective cap in place and restricted by a welded link chain	Restrict movement during seismic events and to protect against valve damage that may result in a release of chlorine	1/1/89	
Industry-Wide Experience	Operators are required to have approved escape-type respirators with them (i.e., on their belt) when changing cylinders	Protects the operators against chlorine exposure in the event of a serious chlorine release during cylinder changing	7/1/95	
Safety Meeting 3/91	Written operating procedures were written for startup, shutdown, cylinder changes, and emergency procedures	To provide operating personnel with written guidance to ensure that procedures are performed consistently and accurately	8/1/91	
Safety Meeting 8/91	A comprehensive training program was developed to include technical	Ensures that the operators can perform and understand the written	12/1/91	

Source	Safeguards	Purpose	Date of Implementation	Comments
	training and safety and environmental training through classroom instruction and on-the-job training	procedures produced in 3/91		
Incident Investigation II-4	The written operating procedure for changing chlorine cylinders was revised to include a warning to remind operators to retighten the packing nut after the valve is opened for continuous flow	Prevents leaks of chlorine through the packing nut and minimizes the potential for operator exposure	9/1/93	
Incident Investigation II-19	A Preventive/Predictive Maintenance program was developed to ensure that the chlorination system, particularly the "pigtail" was being inspected, tested, and replaced appropriately	Minimize potential interruptions in service and chlorine releases due to excessively corroded or inoperable equipment	8/1/96	
Chlorine Institute Pamphlet 85	An accident/incident investigation procedure was developed and implemented	Ensures that causes of incidents are identified and that corrective actions are taken to minimize the potential for reoccurrence	11/92	

Prevention Program Elements

Safety Information: Safety information development, dissemination, and use is vital to the effective operation of the Royce Water Treatment Plant. Personnel use information regarding chemical hazards, equipment specifications, and operating limits in daily and strategic decision making. Accurate and complete information is therefore a basic component of the prevention program.

The Royce Water Treatment Plant compiled safety information, satisfying the regulatory requirements of Section 2755.1 of the CalARP regulations, to enable personnel (e.g., owner, operator, employees involved in operating the process) to identify and understand the hazards posed by those processes involving chlorine. This safety information will be maintained for the life of the unit. The following safety information is available through, and maintained accurate by, the Lead Operator:

- **Information pertaining to the hazards of the regulated substances in the process** - The following information is available in the material safety data sheets (MSDSs) maintained for each regulated substance: toxicity information, permissible exposure limits, physical data, reactivity data, corrosivity data, and thermal and chemical stability data;

- **Information pertaining to the process** – The following information is maintained: the maximum intended inventory and a table including safe upper and lower limits for temperatures, pressures, flows, and composition; and

- **Information pertaining to the equipment in the process** – The following information is maintained: equipment specifications and codes and standards used to design, build, and operate the process.

Personnel from the Royce Water Treatment Plant verify that the equipment complies with recognized and generally accepted good engineering practices by reviewing codes and standards published by the following organizations: the American Society of Mechanical Engineers, American National Standards Institute, National Fire Protection Association, etc.

Hazard Review: By systematically examining each process and identifying hazards associated with the design and operation of a covered process, the Royce Water Treatment Plant has been able to plan and take appropriate action to secure the safety of our employees, the community, and the environment. The Program 2 covered process at the Royce Water Treatment Plant is the chlorination process for the treatment of drinking water. For this process, the Royce Water Treatment Plant developed and used its own hazard review methodology to identify hazards, determine if existing safeguards are adequate, and where existing safeguards are inadequate, identify additional recommendations/action items that can be taken to

mitigate the hazard. For the purposes of the hazard review, "hazard would be considered anything that could result in an accidental release of a regulated substance or extremely hazardous substance.

In accordance with Section 2755.2 of the CalARP regulations, the Royce Water Treatment Plant consulted with CCCHSD and determined that the approach best suited for the hazard review of the chlorination process was for the Royce Water Treatment Plant to perform its own "What-If" analysis.[1] This approach was chosen because the chlorination process did not match the standard checklist used by the Chlorine Institute. The Royce Water Treatment Plant believes this individualized approach provided the most detailed and applicable level of analysis.

The "What-If" methodology was used to identify the following:

- Hazards of the substance and of the process;
- Applicable external events (including seismic events) that could lead to a release;
- Possible equipment failures or human errors that could lead to a release;
- Safeguards used to prevent or mitigate failures or errors;
- Steps needed to detect or monitor releases; and
- Recommendations/action items to mitigate the hazard.

The hazard review team was composed of qualified personnel, including two senior operators, with a total of 27 years of operating experience between them, and a contract engineer from Smith and Van Ness Engineering, qualified in leading the "What-If" analysis. Over a two-week period the team identified and evaluated hazards of the process as well as accident prevention and mitigation measures, and made suggestions for additional prevention, detection, and/or mitigation measures when such measures were necessary. The results of the analysis were recorded in tabular form and will be maintained by the Royce Water Treatment Plant for the life of the plant. A similar team will be conducting the revalidation of the hazard reviews every five years and updating the reviews as necessary, in conjunction with the RMP updates.

The Royce Water Treatment Plant conducted a seismic assessment of the chlorination process. The objective of the seismic assessment was to provide reasonable assurance that loss of primary containment of chlorine would not occur as the result of a seismic event.

(1) The "What-If" analysis technique is a creative, brainstorming approach in which a team of experienced people familiar with the subject process ask questions, voice concerns, and develop scenarios for possible undesired events. The purpose is to identify hazardous situations or specific accident scenarios that could result in an accidental release of regulated substance or extremely hazardous substance.

The seismic assessment consisted of a review to identify site-specific seismic hazards (ground acceleration, fault rupture, liquefaction, subsidence, landslide, tsunami) followed by an evaluation of the process area equipment relative to these identified hazards. The method used to review these hazards is outlined in CCCHSD RMP Seismic Assessment Guidelines.

The nearest major fault to the Royce Water Treatment Plant site is the Hayward fault, located approximately 15 miles east of the facility. Due to the site's soil type and location, the only site-specific seismic hazard of concern is ground acceleration.

A structural engineer with over 15 years of experience performed the seismic assessment. He conducted a systematic walk-through of equipment, piping, and supporting structures to identify areas that could be vulnerable to damage during an earthquake. Where appropriate, engineering calculations were performed to verify the adequacy of existing installations.

Specific items reviewed during the walk-down assessment included:

- general maintenance issues such as missing nuts or bolts or concrete repair;
- interaction between structures, equipment or piping that could cause damage or failure;
- adequacy of supports;
- piping or valves that could rupture during earthquake motion;
- adequacy of the structure; and
- construction flaws.

The only recommendations that were generated from the seismic assessment dealt with improving the anchors and supports for the vertically mounted 150# chlorine cylinders in the process area.

The hazard review team findings were forwarded to the Plant Manager for resolution. Implementation of recommendation/action items in response to hazard review findings is based on a relative risk ranking assigned by the hazard review team.[2] All approved recommendations/action items being implemented in response to hazard review team findings are tracked until they are complete. The final resolution of each finding is documented and retained.

The process hazards identified during the hazard review and seismic assessment include:

(2) The relative risk ranking is determined by a four-by-four matrix comparing the severity of the consequence of the accident scenario with the likelihood of the event occurring. There are specific definitions for severity and risk that must be applied to each scenario. The resultant risk is used to prioritize any action items generated during the hazard review.

- equipment failure (including cracks, failure due to corrosion, weld failures, disk failures, ruptures, pump/gauge/control system failures, etc.);

- earthquakes (severe ground movement); and

- flooding (water damage due to severe yearly rains and rising rivers).

Any of these process hazards could lead to a toxic release of chlorine.

Recommendations/action items to limit these process hazards, identified during the hazard review and seismic assessment, are documented in the "Planned Changes to Improve Safety" section of this document.

Operating Procedures: Clearly written standard operating procedures ensure that both experienced and inexperienced employees are given clear, consistent instructions for safely conducting activities involving the covered process. The Royce Water Treatment Plant developed a written operating procedures program, satisfying the requirements of Section 2755.3 of the CalARP regulation, to ensure that the written procedures/practices are developed, implemented, and updated as necessary:

The Royce Water Treatment Plant uses operating procedures developed internally and operating procedures and instructions developed by equipment manufacturers, the Chlorine Institute, and the *Handbook of Chlorination and Alternative Disinfectants.* All developed and updated procedures are reviewed and authorized by the Lead Operator and Plant Manager before being finalized.

The operating procedures are available in the control room (hard copies) of each process and include the following sections and appendices:

- Steps for each operating phase with "**NOTE**" and "**WARNING**" used to highlight specific safety issues:
  - Initial startup;
  - Normal operations;
  - Temporary operations;
  - Emergency shutdown;
  - Emergency operations;
  - Normal shutdown;
  - Startup following a normal or emergency shutdown or a major change that requires a hazard review; and
  - Equipment inspections.

- A table including safe operating limits and consequences of deviating outside those operating limits; and

- A troubleshooting guide explaining the steps to correct or avoid the consequences of deviating outside the identified operating limits, including initiation of emergency shutdown.

The Lead Operator and applicable employees review and update the operating procedures whenever a major change occurs prior to startup of the changed process.

Training: The Royce Water Treatment Plant believes that employees who clearly understand how to safely operate the chlorination system can significantly decrease the number and severity of incidents, and increase efficiency. Therefore, a thorough training program focused on specific procedures is a key element of an effective prevention program.

The Royce Water Treatment Plant developed a written training program, satisfying the requirements of Section 2755.4 of the CalARP regulation that is comprised of the following:

- Initial employee training;
- Certification for employees operating the process before June 21, 1999;
- Refresher training; and
- Training in updated or new procedures.

All operators receive training specific to the operations of the chlorination system prior to being assigned to the system. This training is conducted by knowledgeable in-house personnel and by equipment vendors. The training criteria are documented in job scope documents that list the knowledge required (e.g., safe operating limits, safety system setpoints) and skills to demonstrate (e.g., emergency shutdown procedures). Various means are used to verify competency, including written and oral examinations, demonstrations, and on-the-job training. Documentation of the training is filed and tracked by the Plant Manager. The Plant Manager also included job scope documents and certification letters in the training files of all employees involved in operating the process before June 1999.

Refresher training on specific operating procedures (e.g., normal operations, cylinder changing) is conducted during the monthly safety meetings, special training classes, and drills. The current schedule was developed with employee consultation and allows refresher training to be conducted at a minimum of every three years. Training documentation, including meeting minutes, attendees, instructor, refresher content, and hands-on-training used to verify competency is provided to the Plant Manager for filing and tracking.

Training may also be required as a result of changes to the operating procedures. The Lead Operator is responsible for ensuring that the necessary training is

conducted prior to implementation of the change. These training records are also submitted to the appropriate members of management for filing and tracking.

Maintenance: A well-established preventive/predictive maintenance program ensures that equipment critical to process safety is maintained in a safe operating condition. It also allows employees to identify and correct equipment deficiencies to avoid associated incidents and interruptions in service. The Royce Water Treatment Plant has therefore developed a preventive/predictive maintenance program, satisfying the requirements of Section 2755.5 of the CalARP regulation, which is comprised of the programs and procedures described below. The maintenance program applies to all of the equipment in the chlorine system and additional equipment deemed by personnel to be important to process safety (i.e., water pump for the eductor)

- **Written maintenance procedures for process equipment-** Written procedures (including step-by-step instruction, applicable warnings or hazards, and required personal protective equipment) were compiled for maintaining process equipment. A majority of the procedures were obtained from equipment vendors and manuals and Chlorine Institute guidance. These procedures developed internally are reviewed annually by the Lead Operator and Plant Manager for thoroughness and accuracy. The Lead Operator ensures that maintenance procedures are obtained or developed for all new equipment prior to startup. The Lead Operator also reviews and revises existing maintenance procedures whenever changes are made to equipment or the technology. Hard copies of these procedures are available in the Lead Operator's office. The regularly scheduled maintenance (preventive maintenance) requests are generated through the work order system (i.e., computer generated work orders at specified frequencies) and distributed to employees by the Lead Operator. Non-preventive maintenance activities are performed through the work order system (i.e., operators submit work order requests to the Lead Operator who then distributes them to appropriate employees). The employee completes the preventive maintenance or work order documentation and submits it to the Lead Operator for review and filing.

- **Maintenance employee training-** The Royce Water Treatment Plant relies heavily on contract employees to perform equipment maintenance. The Lead Operator and Plant Manager and other members of management carefully assess each applicant (employees and contract employees) to ensure that they understand how to avoid or correct unsafe conditions and the procedures applicable to the employee's job tasks. Additional and acceptable skills training is available through a local community college or trade organizations. The Training Department maintains documentation of skills training (e.g., union training program, community college training, specialty equipment training) for maintenance employees.

Maintenance employees are provided with training on the hazards associated with the chlorination system during initial employee and contract employee training and annual refresher training. The Training Department maintains initial and annual training records including content of training, instructor, and means used to verify competency for maintenance employees.

- **Inspection and testing procedures for equipment-** Inspection and testing procedures and frequency for process equipment were developed and documented by the Lead Operator and Plant Manager. The procedures and frequency are based upon the manufacturer's recommendations, good engineering practice, and operating history. The inspection and testing requests are distributed to employees at the established frequency. Completed inspection and test documentation including employee signature, date of the inspection or test, serial number of the equipment, inspection and test procedures, and the results of the inspection or test are returned to the Lead Operator for review and filing. The Lead Operator reviews the results of each inspection or test to determine if the frequency of the inspections or tests should be increased/decreased, ascertains whether the equipment is within the acceptable limits, and reviews the results with the Plant Manager. Equipment outside of the acceptable limits is shutdown unless protective measures and continuous monitoring can be appropriately performed to allow safe operation until the deficiencies are corrected. Completed documentation is maintained for the life of the equipment.

  The Royce Water Treatment Plant is currently compiling all the maintenance information (e.g., preventive maintenance documentation, quality assurance, the work order system, inspection and tests) on a computer program. This program will allow the preventive maintenance procedures and inspection and test procedures to be automatically distributed. The computer program will be used to develop and disseminate maintenance reports for delinquent preventive maintenance, work orders, and test and inspections. Finally, the computer program will contain all of the purchasing documents for new, modified, used, or spare part for easy access by all appropriate personnel.

Compliance Audit: The Royce Water Treatment Plant believes that ensuring that the prevention program elements are functioning properly (i.e., that they meet the regulatory intent and that they are properly implemented) is vital to the continuous improvement of the prevention program. Contract personnel will perform internal compliance audits at least every three years to review and evaluate the written documentation/records and implementation of the prevention program. Potential areas that can be improved within the prevention program elements are identified and recommendations are formulated and implemented to ensure an effective and improved overall prevention program. The developed compliance audits program satisfies the regulatory requirements of Section 27655.6 of the California Accidental Release Prevention (CalARP) regulation.

The Plant Manager will hire experienced and qualified contractor personnel to perform compliance audits of the prevention program elements. This will ensure that an objective, third party review of the prevention program elements is conducted. The contracted audit team is responsible for conducting the audit and issuing a final report including the audit protocol, the responses, the findings, and recommendations.

The contracted audit team will utilize an audit protocol to perform:

- An assessment of the written prevention program elements;
- A review of records (e.g., completed hot work permits, incident investigations) to assess implementation of the written prevention program elements;
- Employee interviews to assess fundamental level of understanding for applicable programs (e.g., maintenance personnel have a basic understanding of the mechanical integrity program); and
- Interviews with key personnel (those with primary responsibility for each prevention program element).

The contracted audit team members will formulate findings and recommendations for improvement. The results of the compliance audit will be communicated to all interested personnel, affected personnel, and personnel responsible for implementing recommendations (e.g., Plant Manager, Lead Operator, employees) during a closing meeting. The Plant Manager and Lead Operator will then be responsible for reviewing the recommendations, determining appropriate resolution of each recommendation, and assigning responsibility for each recommendation. The Lead Operator will also be responsible for compiling status reports for the recommendations and maintaining them with the compliance audits. The Royce Water Treatment Plant will retain no fewer than the two most recent compliance audit reports. Personnel will track to final disposition the recommendations formulated during risk management program compliance audits.

Incident Investigation: The Royce Water Treatment Plant believes incident investigation to be vital to the overall prevention program. Therefore, the Royce Water Treatment Plant developed an incident investigation procedure, satisfying the requirements of Section 2755.7 of the CalARP regulation, to investigate each incident that resulted in, or could reasonably have in catastrophic releases of chlorine. Personnel identify underlying cause(s) and develop and implement corrective actions to prevent reoccurrence of the incident, or similar incidents.

The Lead Operator conducts incident investigations. Employees (including contract employees if they were involved) knowledgeable in the operation, design, and maintenance of the process may participate in the investigation depending upon the severity and complexity of the incident. The Lead Operator is

responsible for initiating the investigation as soon as possible but definitely within 48 hours of the time of the incident or near miss.

The Lead Operator provides training, during monthly safety meetings, to employees regarding the importance of reporting all near-miss situations. A near miss is an incident that could reasonably have resulted in a catastrophic release. An example of a near miss would be a 150lb cylinder transported without its protective cap that is dropped, but sustains no valve damage. Employees are reminded that the root cause(s) of minor incidents and "near misses" could result in major incidents if uncorrected. Employees are encouraged to report minor incidents and "near misses" to the Lead Operator either verbally or anonymously. Written near miss reports are generated and discussed with appropriate personnel.

The incident investigation team prepares a written summary at the conclusion of the investigation that includes:

- Date and time of the incident or "near miss";
- Date and time the investigation was initiated;
- Team members and expertise;
- Description of the incident or "near miss";
- Factors that contributed to the incident or "near miss"; and
- Recommendations formulated as a result of the investigation.

The written summary is forwarded to the Plant Manager for review. The Plant Manager addresses each recommendation (i.e., identify the most appropriate solution and schedule completion of each recommendation). The Lead Operator or designee tracks the recommendation resolution status using a computer database.

The investigation results, including the disposition of all formulated recommendations, are reviewed with employees (including contract employees) whose job tasks are relevant to the findings. The Plant Manager retains copies of the investigation summaries for a minimum of five years to be used during hazard review revalidations. The results are also shared with other companies using the same or similar process, when appropriate, to the extent that proprietary information is not divulged.

THE FIVE-YEAR ACCIDENT HISTORY

The Royce Water Treatment Plant compiled a five-year accident history for all accidental releases from the chlorination system that resulted in deaths, injuries, or significant property damage onsite, or known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage. The compilation of this information satisfies the requirements of Section 2750.9 of the CalARP regulation. The five-year accident history allows Royce personnel to

explain to the community the factors causing or contributing to accidental releases, the onsite and offsite impacts of accidental releases, and the procedural and technological changes made to minimize the likelihood that these accidental release will not occur again. The intent of this information exchange is to create an informed community while also documenting that accidental releases are investigated and concrete changes are made to protect against reoccurrence.

Royce personnel reviewed all incident investigation reports from January 1994 to present to identify accidental releases of chlorine and other extremely hazardous substances that resulted in deaths, injuries, or significant property damage onsite, or known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage. Only one accidental release resulting in an onsite injury was identified. The incident occurred when an operator was briefly exposed to chlorine released from a cracked "pigtail" during cylinder changeout. The operator was hospitalized overnight due to labored breathing; however, he did not sustain any long term health effects. No offsite deaths, injuries, property damage, or environmental damage occurred. Data regarding this incident and the resulting procedural and technological changes are described in the Five-Year Accident History data elements of the RMP.

THE EMERGENCY RESPONSE PROGRAM

Overall safety at the Royce Water Treatment Plant is governed not only by our ability to prevent accidental releases of chlorine from occurring, but also by the ability to mitigate any accidental releases of chlorine. We developed an emergency response program to minimize the effects of accidental releases of chlorine to employees (vapor-dispersion modeling demonstrates an inability to impact public receptors). Royce management has opted not to respond to releases of chlorine due to limited resources. An emergency response program (ERP) was developed which consists of an emergency action plan (EAP), satisfying the requirements of Title 8 California Code of Regulations (T8 CCR§3220) and coordination with local emergency response personnel and officials, satisfying the requirements of Section 2765.1(b) of the CalARP regulation.

Royce personnel developed and implemented an EAP that includes employee evacuation routes, headcounting procedures, and EAP training for employees. This EAP also includes a "Notification Matrix" which provides the telephone numbers of agencies and individuals to contact in the event of one of several pre-identified emergencies (e.g., fire, employee injury, employee fatality). The agencies and individuals represent local emergency responders (e.g., Fire Department), public notification and regulatory reporting requirements (e.g., CCCHSD), and internal notification (e.g., Plant Manager). The "Notification Matrix" requires that designated personnel make the notifications and document when the telephone calls were placed and the name and position of the person contacted. Completed "Notification Matrices" are maintained for five years.

Royce personnel work closely with the Fire Department to prevent fires from occurring and to quickly mitigate fires. Annually, the Fire Department provides fire extinguisher training for incipient fires and performs walk-throughs of the processes. Royce personnel also work closely with Contra Costa County Health Services (CCCHSD) for any necessary response to chlorine releases. This pre-planning ensures that employees of Royce are aware of the preferred method of notifying the fire department (e.g., activation of any of the manual pull switches or sprinkler system automatically sounds an audible alarm and alerts the fire department) and CCCHSD (via the procedure in the notification policy). The second day of the pre-planning activity is a "tabletop exercise" where the responding agencies (e.g., fire department, CCCHSD) and representatives from the stationary source work together to resolve the given scenario (e.g., release of chlorine or fire threatening the integrity of the 150lb. cylinders). This pre-planning activity ensures that the members of the responding agencies are familiar with the plant, the hazards of chlorine, the resources available at the plant (e.g., A Kit) and the locations of the resources. Copies of the tabletop exercise records, including all recommendations and critiques, are maintained with the ERP.

The emergency response program is reviewed annually to ensure that it remains accurate and current. Employees are trained on the emergency response program when initially hired, when the emergency response plan is revised, and when employees' responsibilities are changed.

PLANNED CHANGES TO IMPROVE SAFETY

Studies associated with prevention program elements such as hazard reviews (including external events analysis and seismic analysis), incident investigation, and compliance audits are regularly conducted at the Royce Water Treatment Plant to verify designs and to identify potential hazards. Recommendations may be developed as a result of these studies and as a result of equipment inspections, safety meetings, review of industry experience, technology improvements, and employee suggestions. Once formulated, recommendations are reviewed and corresponding action items are developed to implement each recommendation. Communication of these action items or planned activities informs the public of measurable improvements for safety that are being incorporated at the Royce Water Treatment Plant.

Personnel reviewed the following technical studies (i.e., hazard review, seismic analyses) to identify all action items not yet implemented which were formulated to reduce the risk (severity or likelihood) of an incident which could have reasonably resulted in an offsite consequence (i.e., exceeding the ERPG-2 for chlorine):

- 1996 Chlorination System What-If analysis;
- 1999 What-If analysis revalidation; and

- 1998 Stationary-source wide seismic analysis.

Thirty-one action items meeting the selection criteria were identified. Seventeen of those action items are complete and the major items are included in the "chemical-specific prevention steps" section of the RMP. Eleven of the seventeen outstanding action items are scheduled for completion prior to their assigned due date. The Plant Manager and Lead Operator rejected two of the seventeen outstanding action items based on factual errors in the What-If Analysis. Two of the seventeen outstanding action items and due dates were revised as a result of a detailed engineering study.

Personnel also reviewed numerous other action items generated during various activities including the following to identify action items not yet implemented that have a reasonable likelihood of resulting in offsite consequences:

- 1995 Safety Audit;
- 1998 Safety Audit;
- Incident investigation reports from 1994;
- Safety meeting minutes since 1994; and
- Recommendations stemming from industry-wide experience since 1994.

Summaries of the action items (from technical studies and other activities) meeting the selection criteria are depicted in Table A-5. Table A-5 includes the source of the action item, the action item summary, the purpose of the action item, and the projected completion date of the specific action item or the generalized group. It also includes a comments column for any additional information. This column will be used to document the progress of each action item during the five-year RMP update.

Source	Planned Changes	Purpose	Projected Completion Date	Comments
Incident Investigation II-19	Add "pigtail" replacement to the operating procedures per the manufacturers recommendations or the Chlorine Institute guidance	Inspection of the "pigtail" does not always identify small cracks, therefore the "pigtail" should be replaced on a regular basis	6/1/99	
Incident Investigation II-19	Ensure that the written procedure on 150 lb cylinder changing includes a warning or caution note to alert operators that "once the "pigtail" is connected, pressurize the line but then close the valve on the cylinder and inspect for leaks"	Prevents the possibility of a large chlorine release and employee exposure in the event of "pigtail" leaks.	6/99	
1995 What-If analysis	Revise the existing chlorination system to move the vacuum regulator directly on the 150 lb. cylinder	Ensures that the entire chlorine transfer line is under vacuum so that small leaks will result in the ingress of air other than the egress of chlorine	6/1/99	

What-If Analysis recommendation task group	Develop a procedure to manage proposed modifications which significantly increase the volume of chlorine or the risk of chlorine release (consider using the management of change and prestartup procedure identified in the CalARP regulation as a template)	To satisfy Section 2745.11 of the CalARP regulation and to ensure that any modifications to the chlorination system are scrutinized by personnel with the appropriate expertise	5/1/98	
Safety Audit 1995	Ensure that all new radios purchased have man-down capabilities	Prevents escalation of incidents by immediately alerting personnel to situations	7/1/99	
Safety Audit 1995	Install a caustic scrubber to the chlorination system .	Minimize the potential for public receptor impact from a chlorine release.	Undetermined	
Safety Meeting 1/99	Plan an emergency response exercise with Contra Costa County Health Services Department and the City Fire Department	Ensure that local emergency responders are familiar with the Royce facility, the hazards of chlorine, and the available resources	9/99	

OFF-SITE CONSEQUENCE ANALYSIS

CHARACTERISTICS AND HAZARDS OF CHLORINE

Chlorine is a dense, greenish yellow gas with a pungent, suffocating odor, which, at the Royce Water Treatment Plant, is used to purify water. It is extremely toxic by inhalation and is slightly soluble in water. Chlorine reacts explosively or forms explosive compounds with many common chemicals. It is normally shipped as a pressurized liquid in cylinders or railroad tankcars. Contact with liquid chlorine should be avoided as it can cause frostbite. The liquid readily vaporizes to a gas. Chlorine does not burn but will support combustion of other articles. Long term exposure to low concentrations or short-term exposure to high concentrations may result in adverse health effects from inhalation. Chlorine vapors are much heavier than air and tend to settle in low areas.

HEALTH HAZARDS

Chlorine is poisonous and may cause death or permanent injury after very short exposures to very high concentrations. Contact may cause burns to skin and eyes, bronchitis or chronic lung conditions. Persons with asthma, subnormal pulmonary functions, or cardiovascular disease are at a greater risk.

Effects of chlorine exposure may be delayed. Chlorine is corrosive and may be converted to hydrochloric acid in the lungs. Signs and symptoms of acute chlorine exposure may include: rapid heart rate, high blood pressure followed by low blood pressure, and cardiovascular collapse. Pulmonary edema and pneumonia are often seen. Eyes, nose, throat, and chest may sting or burn following exposure. There could be cough with bloody sputum, a feeling of suffocation, dizziness, agitation anxiety, nausea, and vomiting. Skin exposure may result in sweating, pain, irritation, and blisters.

Table A-6
Properties and Hazards of Chlorine

PROPERTY	VALUE	COMMENTS
Odor threshold	0.021 to 3.4 ppm	
ERPG-1	1 ppm	Definition: The concentration that nearly all individuals could be exposed to for one hour without experiencing other than mild transient health effects or perceiving a clearly defined objectionable odor.
ERPG-2	3 ppm	Definition: The concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
ERPG-3	20 ppm	Definition: The concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing

PROPERTY	VALUE	COMMENTS
		life-threatening effects
Vapor specific gravity	2.4	Chlorine is heavier than air. When pressurized liquid chlorine is released, it initially forms a heavy cold cloud of chlorine mist. A pool of liquid chlorine may form beneath the release point from which additional chlorine will evaporate.
Boiling point	-30.3°F	At 760mm of mercury pressure
Ignition temperature		Not flammable

WORST CASE SCENARIO

Selection Criteria & Scenario Description

The Worst-Case Scenario (WCS) for the Royce Water Treatment Plant is the release of total contents of a single 150-lb. chlorine (Cl_2) cylinder in 10 minutes. This scenario is the WCS as defined in the CalARP regulation sections 2750.3(a)(2)(A) and (c)(1).

The cylinder is contained in a 700 cu. ft. process space, which is contained within the 12,000 cu. ft. storage building on site. The results for the WCS were generated from the EPA's *RMP Offsite Consequence Analysis Guidelines*. In accordance with these guidelines, a mitigation factor of 0.55 was applied to the analysis because the release occurs within an enclosure.

The release results were determined assuming the following conditions for a WCS:

- Dense gas;
- Ten-minute release;
- Rural conditions;
- F stability class; and
- Wind speed of 1.5 meters per second.

Results Summary

The following table contains the results for the WCS:

Table A-7
Chlorine WCS Results

RELEASE SCENARIO	MATERIAL	AMOUNT	ENDPOINT	DISTANCE	
Toxic	Cl_2	150 lbs.	3 ppm (ERPG-2)	1.7 mi.	9,000 ft.

Figure A-3 shows the area affected by this worst-case release scenario on a map of the area. Using census data from LandView III, the estimated population within the worst case scenario circle is 7,200.

ALTERNATIVE RELEASE SCENARIO

To assist in emergency response planning, the Royce Water Treatment Plant developed an Alternative Release Scenario (ARS) to represent a reasonable "outer bound" for our emergency response planning and for explaining potential hazards to the community.

Selection Criteria & Scenario Description

Distances to endpoints of chlorine were generated using ALOHA (Areal Locations of Hazardous Atmospheres), a computer program designed to model chemical accidental releases for emergency planning and training. ALOHA predicts the rates at which chemical vapors may escape into the atmosphere, and predicts how a gas cloud might disperse in the atmosphere. ALOHA takes into account the release conditions, the physical characteristics of the release site, and the meteorological conditions at the time of the release.

At the Royce Water Treatment Plant, eight 150-lb. chlorine (Cl_2) cylinders are maintained for chlorination of drinking water. To determine the most appropriate scenario for the ARS, the following steps were taken:

- Using the "What-If" analysis performed on the system, as well as reviewing the five-year accident history, a set of upset conditions was identified that could lead to a chlorine release;
- A conservative set of release conditions, physical characteristics of the release site, and meteorological conditions at the time of the release were identified for each upset condition; and
- An analysis of the distance to each endpoint was performed to determine which release scenario had the highest likelihood of resulting in the greatest offsite impact.

Based on the above process, the failure of the "pigtail" for the chlorination system was determined to be the most appropriate release scenario for the ARS.

The cylinders and the chlorination system are contained within a 700 cu. ft. walled process space, which is contained within the 12,000 cu. ft. storage building on site. The storage building is equipped with chlorine detectors with alarms in the control room. The building is also equipped with a ventilation system that discharges to the top of the building, at an elevation of 47 feet.

The failure of the "pigtail" results in a release of 100 pounds of Cl_2 gas over a 20-minute period. The 20-minute release duration is the approximate time necessary for an emergency responder to don protective gear and repair the leak.

Refer to Table A-10 for OCA modeling input.

Mitigation systems included the following:

- Chlorine detectors are in the area with alarms in the control room;
- The cylinder is contained in a 700 cu. ft. process space, which is contained within the 12,000 cu. ft. storage building on site; and
- Emergency responders on-site with protective gear and leak-repair kits.

Results Summary

The following table contains the results for the ARS:

Table A-8
Chlorine ARS Results

RELEASE SCENARIO	MATERIAL	AMOUNT	ENDPOINT	DISTANCE	
Toxic	Cl_2	100 lbs.	3 ppm (ERPG-2)	0.7 mi.	3630 ft.
			20 ppm (ERPG-3)	0.2 mi.	1120 ft.

Figure A-4 shows the areas affected by this ARS on a map of the area. Using census data from LandView III, the estimated population within the ARS ERPG-2 circle is 1,600.

Because the distance to the ARS toxic endpoint is less than one mile, the vulnerability zone for this release scenario is one mile. Following is a list of public receptors within the vulnerability zone for this release scenario:

Table A-4
Public Receptor List

	RECEPTOR NAME	ADDRESS	CITY	PHONE #	DISTANCE FROM FENCELINE
1	De Anza High School	5000 Valley View Rd.	Richmond	(510) 223-3811	5,250 ft.
2	Olinda Elementary School	5855 Olinda Rd.	Richmond	(510) 223-2800	3,900 ft.
3	Valley View Elementary School	3416 Maywood Dr.	Richmond	(510) 223-6363	4,500 ft.
4	Ellerhorst Elementary School	3501 Pinole Valley Rd.	Pinole	(510) 758-1000	4,950 ft.
5	Hope Pre-School	3301 Morningside Dr.	Richmond	(510) 222-9222	3,960 ft.
6	Maloney's Child Care Center	3505 Morningside Dr.	Richmond	(510) 222-1025	2,600 ft.
7	May Valley Community Center	3530 Morningside Dr.	Richmond	(510) 620-6890	2,680 ft.

MITIGATED RELEASE SCENARIO

One way to effectively mitigate the risks associated with the operation of the chlorination system would be to install a scrubber system or similar treatment device to the storage building ventilation system. This mitigation item was identified during the hazard review, and is scheduled for implementation by mid-1999. The amount of chlorine released to the atmosphere would be reduced by a minimum of 90% (the calculated efficiency of the scrubber system). Assuming the scrubber system is of good design and is maintained and tested regularly, the distance to the toxic endpoint would not reach a public receptor.

The modeling results for a release, using the same ARS parameters, but including the mitigating factor of the scrubber, is shown in Table A-9 below:

Table A-9
Mitigated Chlorine Release Results

RELEASE SCENARIO	MATERIAL	AMOUNT	ENDPOINT	DISTANCE	
Toxic	Cl_2	10 lbs.	3 ppm (ERPG-2)	0.2 mi.	1095 ft.
			20 ppm (ERPG-3)	0.07 mi.	370 ft.

Figure A-5 shows the area affected by this mitigated release scenario on a map of the area. Using census data from LandView III, the estimated population within the mitigated release scenario circle is 70. There are no public receptors within this release scenario circle.

TABLE A-10
ROYCE WATER TREATMENT PLANT MODEL INPUT

	WCS		ARS		ADDITIONAL SCENARIOS	
	TOXIC	**FLAMMABLE**	**TOXIC**	**FLAMMABLE**	**TOXIC**	**FLAMMABLE**
CHEMICAL NAME	Chlorine	N/A	Chlorine	N/A	Chlorine	N/A
PHYSICAL STATE	Dense Gas		Dense Gas		Dense Gas	
MODEL/REFERENCE USED*	EPA Guidelines		ALOHA		ALOHA	
SCENARIO	Toxic Gas Release		Toxic Gas Release		Toxic Gas Release	
QUANTITY RELEASED	150 lbs.		100 lbs.		10 lbs.	
RELEASE RATE	15 lbs./minute		5 lbs./minute		0.5 lbs./minute	
RELEASE DURATION	10 minutes		20 minutes		20 minutes	
AMBIENT TEMPERATURE	N/A		68°		68°	
PROCESS/STORAGE TEMPERATURE	N/A		68°		68°	
PROCESS/STORAGE PRESSURE	N/A		N/A		N/A	
POOL DEPTH/AREA	N/A		N/A		N/A	
RELEASE HEIGHT	N/A		3 meters		3 meters	
SURFACE TYPE	N/A		N/A		N/A	
WIND SPEED	1.5 meters/sec.		1.5 meters/sec.		1.5 meters/sec.	
RELATIVE HUMIDITY	N/A		50%		50%	
CLOUD COVER	N/A		5 tenths		5 tenths	
STABILITY CLASS	'F'		'F'		'F'	
TOPOGRAPHY	Rural		Rural		Rural	
ROUGHNESS FACTOR	N/A		Open Country		Open Country	
ENDPOINTS USED	ERPG-2		ERPG-2, ERPG-3		ERPG-2, ERPG-3	
PASSIVE MITIGATION	Cylinder located inside building (0.55 mitigation factor)		Cylinder located inside building (0.55 mitigation factor)		Cylinder located inside building (0.55 mitigation factor)	
ACTIVE MITIGATION	N/A		-Chlorine detectors are in the area with alarms in the control room. -Emergency responders on-site with protective gear and leak-repair kits.		Chlorine scrubber on building ventilation system (est. 90% efficiency)	

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INSERT WCS MAP – PROGRAM 2

INSERT ARS MAP – PROGRAM 2

INSERT MITIGATED RELEASE MAP – PROGRAM 2

COVERED PROCESSES DATA SHEET

This guidance document does not provide examples of completed data sheets except for the following example of five-year accident history information. This is included as an example because CCCHSD is requesting that additional information be provided to clarify the data element entries.

FIVE–YEAR ACCIDENT HISTORY

Unit: Chlorination system
6.1 Date October 10, 1998
6.2 Time 6:00 a.m.
6.3 Duration 15 minutes
6.4 Chemical Chlorine
6.5 Quantity released (lbs.) 100 lb.

6.6 Release event

a ✔ _ Gas release
b. Liquid spill/evaporation
c. Fire
d. Explosion

6.7 Release Source

a. Storage vessel
b. ✔ Piping
c. Process vessel
d. Transfer hose
e. Valve
f. Pump

6.8 Weather conditions as time of event (if known)
a. Wind speed/direction_____
b. Temperature_____
c. Stability class_____
d. Precipitation present
e. Unknown

6.9 Onsite impacts
a. _Deaths (number)
b. Injuries 1 (number)
c. Property damage ($)0

6.10 Known offsite impacts
a. Deaths (number)
b. Hospitalizations (number)
c. Other medical treatment (number)
d. Evacuated (number)
e. Sheltered (number)
f. Property damage ($)
g. Environmental damage (specify type)

6.11 Initiating event

a ✔ Equipment failure
b. Human error
c. Weather condition

6.12 Contributing factors (check all that apply)

a. Equipment failure
b. Human error
c. Improper procedures
d. Overpressurization
e. Upset condition
f. By-pass Condition
g. ✔ Maintenance activity/Inactivity
h. Process design
i. Unsuitable equipment
j. Unusual weather condition
k. Management error

6.13 Offsite responders notified a. Yes b. ✔ No

6.14 Changes introduced as a result of the accident

a. ✔ Improved/upgrade equipment
b. ✔ Revised maintenance
c. Revised training
d. Revised operating procedures
e. New process controls
f. New mitigation systems
g. Revised emergency response plan
h. Changed process
i. Reduced inventory
j. Other
k. None

6.0 *FIVE-YEAR ACCIDENT HISTORY ADDENDUM*

6.1 Operator was exposed to a small (the volume in the transfer tubing to the eductor) chlorine release. He was hospitalized overnight due to labored breathing but was released the next day with no long term health effects.

6.2 There were no offsite consequences of the small chlorine release

6.3 The "pigtail" for the chlorination system experienced a small crack that went undetected due to inadequate maintenance (inspection and replacement) procedures. The operator followed written procedures that require that the line is pressurized and the main valve on the 150 lb. cylinder be closed to check for leaks. The volume of chlorine in the line was released and the operator inhaled the fumes before donning his escape pack and exiting the room.

6.4 The leak in the "pigtail" was not previously identified because of improper inspection and replacement procedures (i.e., maintenance activity)

6.5 The leak was identified by the operator while changing cylinders. The proper practical and regulatory notifications were made as outlined in the "Notification Matrix" including Bay Area Air Quality Management District and CCCHSD.

6.6 Royce personnel began developing a predictive/preventive maintenance program that includes regular inspection and replacement of the "pigtail" at an interval specified by the Chlorine Institute. Royce management also included a note in the written procedures "WARNING" personnel to pressurize the line, close the main valve on the 150 lb cylinder, and check for leaks. The operator involved in the incident was very experienced and did follow procedure. He was therefore only exposed to the volume in the "pigtail". The incident could have been much more serious if the operator had not followed procedure.

TABLE OF CONTENTS – PROGRAM 3

D. Prevention Program
E. Emergency Response Program

V. Tables 7.4.d-h from Appendix H of guidance document

NOTE: This example does not include any Covered Process Data Sheets or Tables 7.4.d-h. However, it does provide an example of the narrative addendum to the five year accident history.

PROGRAM 3

EXECUTIVE SUMMARY

THE ACCIDENTAL RELEASE PREVENTION AND EMERGENCY RESPONSE POLICIES AT AAA AMMONIA STORAGE FACILITY

The AAA Ammonia Storage Facility is part of Westlake Corporation. Westlake Corporation is committed to being a responsible member of any community in which it has operations by giving top priority to operating in a safe and environmentally sound manner. Corporate policy dictates that facilities continuously identify methods to reduce the use of hazardous materials and to reduce the risk to the community and environment through implementation of inherently safer technology and procedures. This commitment to safe and environmental sound operations is documented in the corporate policy and compliance manuals, and the corporate mission statement, which are available to all employees. The stationary source stresses safe and environmentally sound operations in employee training programs, and in written materials available at the stationary source and sent to employee's homes. A copy of our Accidental Release Prevention Program policy is included as Figure A-6. Stationary source safety and environmental programs include monthly safety meeting of all employees and a joint worker/company safety committee and a community advisory panel. Westlake Corporation has an environmental handbook that covers general environmental best practices and compliance topics such as proper hazardous waste handling. Each employee at AAA has an environmental and safety handbook that covers topics specific to the AAA Ammonia Storage Facility. There are regularly scheduled internal safety and environmental audits conducted by AAA personnel and periodic safety and environmental audits of the stationary source conducted by Westlake corporate personnel.

A DESCRIPTION OF AAA AMMONIA STORAGE FACILITY AND THE REGULATED SUBSTANCES HANDLED

Description of Stationary Source

The AAA Ammonia Storage Facility receives and stores anhydrous ammonia produced at the adjacent Venus Chemical Manufacturing Company. AAA pumps ammonia back to Venus Chemical to meet Venus's processing requirements. Ammonia in excess of Venus Chemical needs is loaded into tank trucks and sold to outside customers. The tank trucks are loaded at loading racks that are part of the covered process. The system is designed so that the ammonia tank trucks can be unloaded into the storage vessels should the need arise.

FIGURE A-6 AAA Ammonia Storage Facility Accidental Release Prevention Program Policy

We affirm to all our employees, customers, and the community, that we will conduct our business with respect and care for the environment. We will implement those accidental release prevention strategies that build successful businesses and achieve the greatest benefit without compromising the ability of future generations to meet their needs. We will continuously improve our program in light of advances in technology and new understandings in safety, health and environmental science.

Highest Standards of Performance, Business Excellence

We will adhere to the highest standards for the safe operation of our stationary source and the protection of our environment, our employees, our customers, and the surrounding community.

We will strengthen our businesses by making safety, health and environmental issues an integral part of all business activities and by continuously striving to align our businesses with community expectations.

Goal of Zero Incidents

We believe that all safety and environmental incidents are preventable, and our goal for all of them is zero.

We will assess the environmental impact of each modification we propose to perform and will operate and maintain all our stationary source and transportation equipment so they are safe and acceptable to local communities and protect the environment.

We will be prepared for emergencies and will provide leadership to assist our local community to improve their emergency preparedness. We will perform hazard assessments and work with the local community to prepare accordingly.

Continuously Improving Processes, Practices and Products

We will make, use, handle. package, transport and dispose of our materials safely and in an environmentally responsible manner.

We will develop and implement prevention program elements (e.g., mechanical integrity programs, training, management of change) at our stationary source to ensure the safe operation and continual development of our accidental release prevention program.

We will work with our suppliers, carriers, distributors and customers to achieve similar product stewardship, and we will provide information and assistance to support their efforts to do so.

Communication with the Community

We will promote open discussion with our employees, customers, and the community about the materials we make, use and transport and the impacts of our activities on their safety, health and environment.

We will build alliances with governments, policy makers, businesses and advocacy groups to develop sound policies, laws, regulations and practices that improve safety, health and the environment.

Management and Employee Commitment, Accountability

The Board of Directors will be informed about pertinent safety, health and environmental issues and will ensure that policies are in place and actions taken to achieve this policy.

Compliance with this policy and applicable laws is the responsibility of every employee and contractor acting on our behalf and a condition of their employment or contract. Management in each business is responsible to educate, train and motivate employees to understand and comply with this policy and applicable laws.

We will deploy our resources, including research, development and capital, to meet this policy and will do so in a manner that strengthens our business.

ammonia. Ammonia is continuously pumped back to Venus Chemical by P-2 Transfer Pump for further processing by Venus. Tank cars are loaded by P-1 Loading Pump. Tank trucks are unloaded using K-1 Compressor. K-1 compresses ammonia vapors from the storage vessels into the vapor space of a tank trucks; the increased pressure in the tank truck vapor space pushes ammonia from the tank truck into the storage vessels. K-1 is designed so that it is incapable of overpressuring a tank truck.

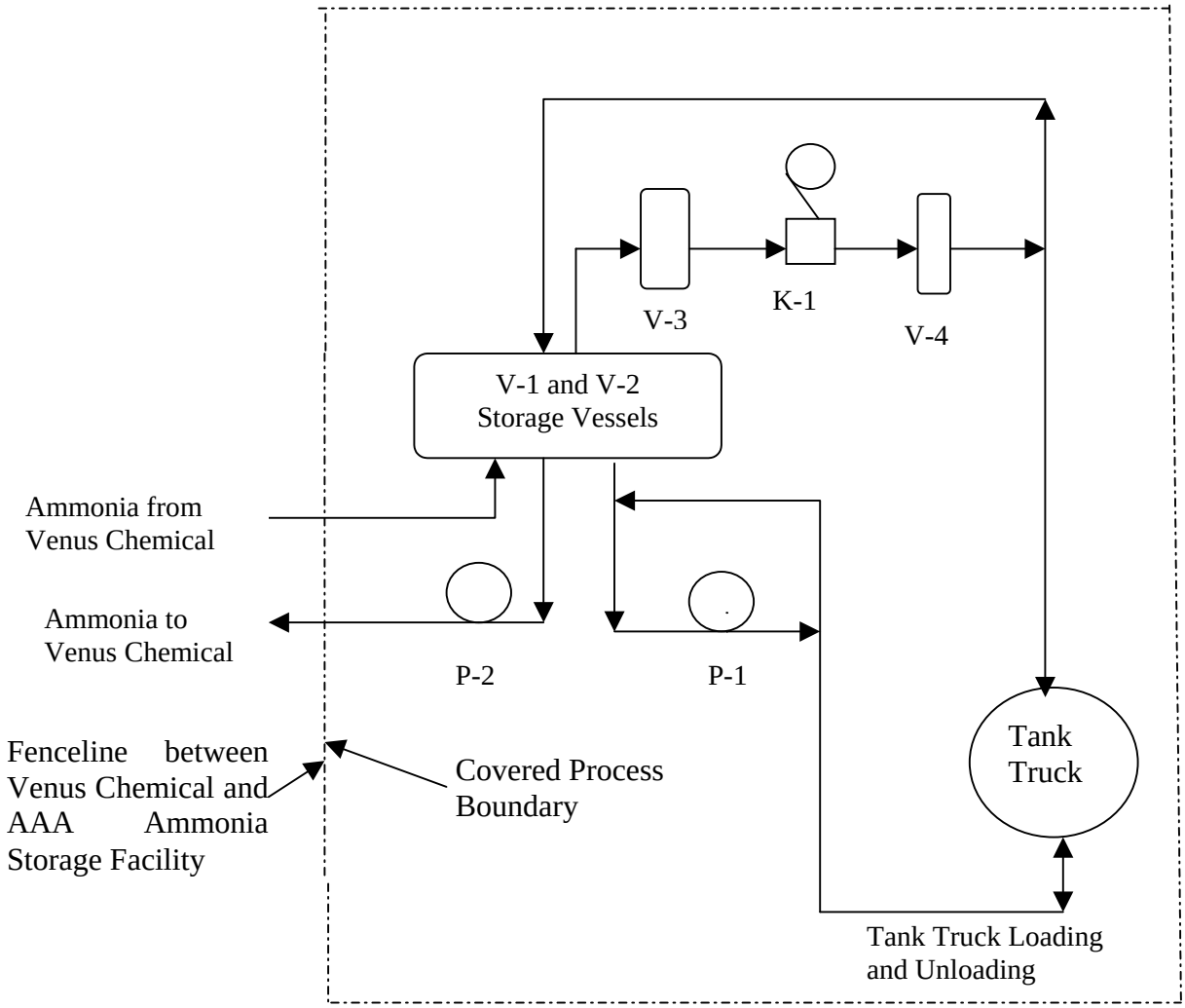


FIGURE A-7: AAA AMMONIA
STORAGE FACILITIES

Characteristics and Hazards of Anhydrous Ammonia The characteristics and hazards of anhydrous ammonia are included in the offsite consequence analysis section of this document.

THE WORST-CASE RELEASE SCENARIO(S) AND THE ALTERNATIVE RELEASE SCENARIOS

Well-documented offsite consequence analyses are essential to adequate communication of potential hazards at the stationary source. The AAA Ammonia Storage Facility conducted offsite consequence analyses, using the EPA's *RMP Offsite Consequence Analysis Guidelines* for the Worst-Case Scenario (WCS), and using ALOHA as the dispersion model for the Alternative Release Scenario (ARS).

Offsite consequence analysis is also a tool used by the stationary source to assist the CCCHSD Incident Response Team in emergency response planning. To do this, the AAA Ammonia Storage Facility developed an ARS to represent a reasonable "outer bound" for our emergency response planning and for explaining potential hazards to the community.

Following are the results from the OCA.

Worst-Case Scenario

The Worst-Case Scenario (WCS) for toxic substances at the AAA Ammonia Storage Facility is the release of the total contents of a single 200-ton ammonia (NH_3) vessel in 10 minutes. Although there are numerous installed control measures that, in an actual event, would mitigate the release, no credit for mitigation measures was taken into account for this scenario. The results for the WCS were generated from the EPA's *RMP Offsite Consequence Analysis Guidelines*.

The maximum distance to the toxic endpoint of 25 ppm (ERPG-2 for NH_3) for this WCS is over 25 miles. Using census data from LandView III, the estimated population within the worst-case scenario circle is 310,000. No Program 1 or Program 2 processes containing regulated toxic substances were identified at this facility.

Alternative Release Scenario

The ARS associated with the release of toxic substances at the AAA Ammonia Storage Facility is a 2" line being severed on the loading pump P-1 discharge, resulting in a five-minute release of approximately 772 pounds of ammonia. Five minutes was the time determined for the release to be detected, the system remotely isolated, and the pump remotely shut down upon detection of the leak. The maximum distance to the toxic endpoint of 25 ppm (ERPG-2) is 1.4 miles, and for 200 ppm (ERPG-3) is 0.5 miles. Using census data from LandView III, the estimated population within the ARS ERPG-2 circle is 4,000. Because the distance to the ARS toxic endpoint is less than one mile, the vulnerability zone for

this release scenario is one mile. Four schools are within the vulnerability zone, as well as two child day care facilities.

Mitigated Release Scenario

One way to effectively mitigate the effects of the ARS would be to install automatic water curtains, initiated immediately upon detection of an ammonia release. This mitigation item was identified during the hazard review, and is scheduled for implementation by mid-1999. The amount of ammonia released to the atmosphere would be reduced by a minimum of 75% (the calculated efficiency of the water curtain). For this scenario, the maximum distance to the toxic endpoint of 200 ppm (ERPG-2) is 0.8 miles, and for 20 ppm (ERPG-3) is 0.3 miles. Using census data from LandView III, the estimated population within the mitigated release scenario circle is 1,900. The mitigated release scenario for ERPG-2 would still impact one of the child day care facilities.

THE GENERAL ACCIDENTAL RELEASE PREVENTION PROGRAM AND CHEMICAL-SPECIFIC PREVENTION STEPS

Management System

The AAA Ammonia Storage Facility has developed a formal management system based on *CCPS Plant Guidelines for Technical Management of Chemical Process Safety* to plan, organize, implement and control the risk management program elements. This management system satisfies the requirements of Section 2735.6 of the CalARP regulation and ensures that the risk management program elements are developed and continually improved. All records associated with the prevention program elements are retained for a minimum of five years unless otherwise specified in the CalARP regulation. The management system activities are further discussed below.

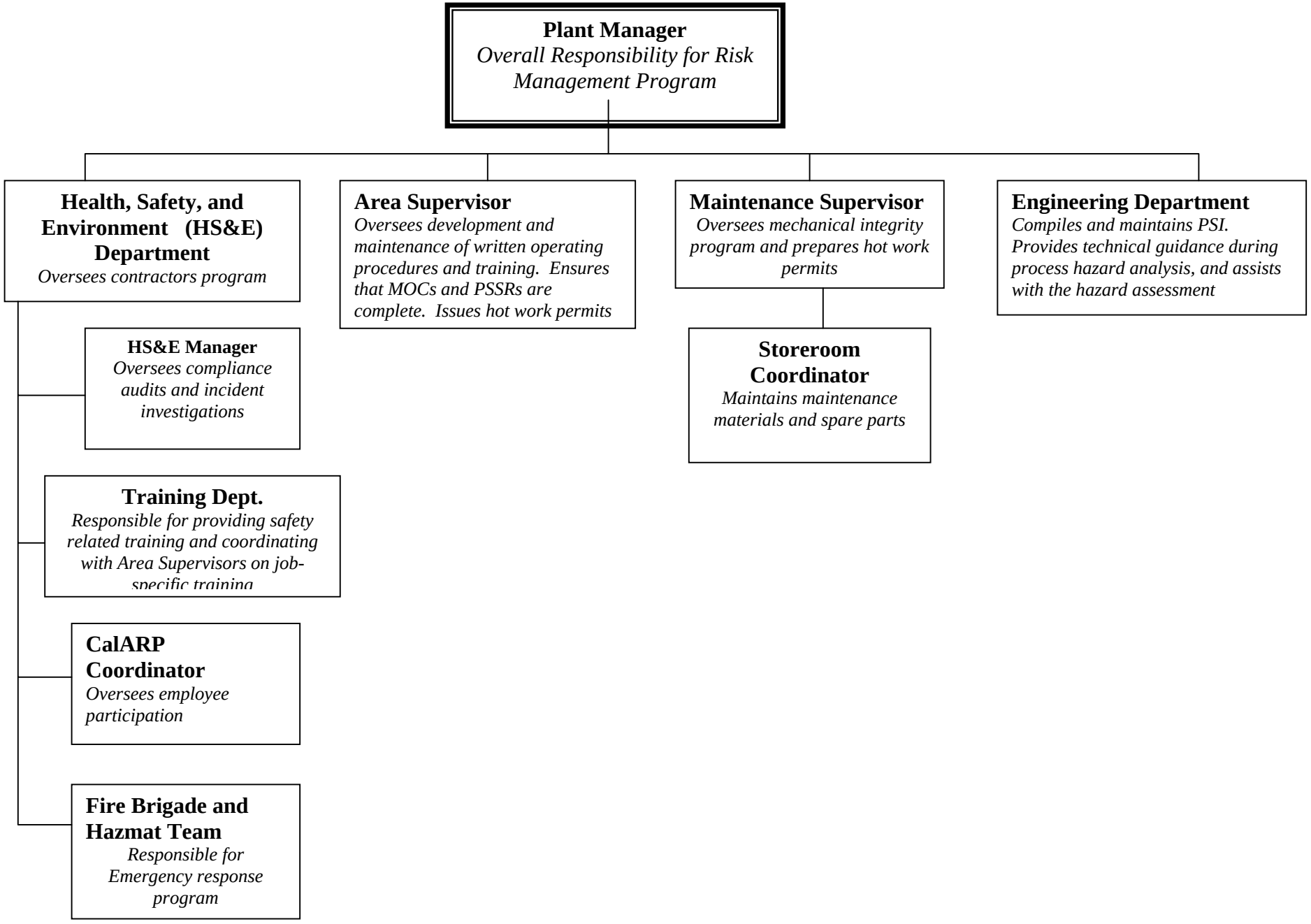
- **Planning** – The AAA Ammonia Storage Facility has an overall risk management program policy that clearly identifies the goals and objectives of the risk management program.

- **Organizing** – Individuals responsible for each risk management program element were designated. These individuals and the lines of authority are defined on the organizational chart below. These individuals were responsible for developing written procedures for each risk management program element that met the previously identified goals and objectives. Members of management and responsible individuals hold monthly meetings for the purpose of integrating and coordinating each risk management program element.

- **Implementing** – Each responsible individual provides training to all applicable persons regarding initiating the procedure, implementing the procedure, and documenting the procedure. Personnel are provided with

initial training on the applicable risk management procedures. Refresher training is provided on an as-needed basis but is conducted at a minimum following any changes to the procedure or following reauthorization.

- **Controlling** – Members of management and the individuals responsible for each risk management prevention program element periodically conduct internal reviews or audits against the goals and objectives of the element. Annually, the procedures are reviewed, revised, and reauthorized to ensure that they remain accurate and reflect the current practices.


Plant Manager
Overall Responsibility for Risk Management Program
Health, Safety, and Environment (HS&E) Department
Oversees contractors program
HS&E Manager
Oversees compliance audits and incident investigations
Training Dept.
Responsible for providing safety related training and coordinating with Area Supervisors on job-specific training
CalARP Coordinator
Oversees employee participation
Fire Brigade and Hazmat Team
Responsible for Emergency response program
Area Supervisor
Oversees development and maintenance of written operating procedures and training. Ensures that MOCs and PSSRs are complete. Issues hot work permits
Maintenance Supervisor
Oversees mechanical integrity program and prepares hot work permits
Storeroom Coordinator
Maintains maintenance materials and spare parts
Engineering Department
Compiles and maintains PSI. Provides technical guidance during process hazard analysis, and assists with the hazard assessment

Chemical-Specific Prevention Steps

The prevention programs described in the following section represent integrated administrative controls intended to ensure the safety of workers, the public, and the environment. Many of these prevention programs (e.g., PHAs, compliance audits, incident investigation) result in the development and implementation of additional safeguards (administrative and engineering controls). Those recommendations that are planned for implementation at AAA Ammonia Storage Facility will be discussed in "Planned Changes to Improve Safety". Those applicable safeguards that have already been implemented or that were part of the original design are described below. These safeguards prevent, detect, or mitigate accidental releases of regulated substances.

All covered processes have control systems designed to maintain operating parameters (temperature, pressures, flow, level) within allowable limits. The covered processes are also equipped with alarms to alert personnel when the operating parameters exceed the allowable limits. The stationary source developed procedures and conducts training of personnel to familiarize them with the consequences of exceeding allowable limits (safety and operability) to ensure the correct response to the alarms. The following chemical-specific safeguards also exist at the stationary source.

Source	Safeguards	Purpose	Date of Implementation	Comments
Inherently Safer Design	The tank truck unloading system compressor is designed to be incapable of overpressuring the storage vessels or the tank trucks. The piping is designed for auto-refrigeration. P-304 loading pump is a canned design eliminating any possible ammonia vapors from being released	Inherently safer design ensures that the system will remain in a nonhazardous situation after the occurrence of nonacceptable deviations from normal operating conditions.	4/88	
Initial Design	The storage vessel is equipped with an 1800 gpm water deluge system. The tank truck overhead is equipped with a 700 gpm water deluge system	The deluge systems can be used to cool the equipment in the event of fire or to knock down or absorb ammonia vapors	6/88	
Industry-wide experience	The original ammonia storage vessel was replaced with one that had more compatible metallurgy and it was relocated to minimize potential public receptors	Vessels (with similar metallurgy) at other sites had experienced cracking and catastrophic failure. The new metallurgy will prevent cracking and failure	7/94	
Industry-wide experience	P-101A/B transfer pumps are equipped with tandem mechanical shaft seals. The outer seal is equipped with a high-pressure alarm and is vented to the recovery system.	The tandem seal provides a zone filled with diesel fluid to reduce the chance of an ammonia leak due to seal failure. The ammonia will leak into the diesel fluid that is circulated through a pot with a high pressure alarm. The presence of ammonia will sound the alarm. Excess pressure in the pot is vented to	2/94	

		the degasser.		
Industry-wide experience	A "double circle" ammonia leak detection system including audible and visual alarms was installed. The detectors are tested and calibrated monthly	To alert personnel to possible ammonia leaks in the area	10/95	
Incident Investigation II171-14	The storage vessel nozzles and tanktruck loading arms are equipped with excessive flow valves (EFV's) (i.e., spring loaded, self actuating valves)	The EFV's provide immediate and automatic shutoff for flows higher than the design intent. They were installed to prevent large ammonia releases due to line rupture	6/93	
Incident Investigation II70-4 "near miss"	The written unloading procedure and documentation requires that the operator verify that the tank car contains ammonia by checking the shipping papers and placards	Prevents unloading a material other than ammonia into the storage vessel	11/92	
1993 PHA	The storage area is encircled by a firewater-monitor fog system with adjustable pattern 500 gpm nozzles	Water will be used to mitigate ammonia releases that could pose hazards for areas outside of the storage area	9/93	
1993 PHA	Each of the six arms at the loading stations is equipped with emergency shutdown valves (ESDs) to isolate piping. The ESD can be remotely actuated from the control center.	Piping can be isolated and the compressors stopped (remotely) to minimize leaks.	8/94	
Seismic study	The approved design includes the depth of piles, reinforced concrete foundations, and structural steel supports. All equipment is pile supported.	Ensure structural integrity of the system following a seismic event	3/93	

Prevention Program

Process Safety Information: Process safety information (PSI) development, dissemination, and use is vital to the effective operation of a stationary source. Personnel use information regarding chemical hazards, equipment specifications, and operating limits in daily and strategic decision making. Accurate and complete information that is readily accessible to personnel is therefore a basic component of the prevention program.

Established procedures ensured that the original PSI was compiled prior to the original process hazard analyses (PHAs) conducted in 1992. These procedures ensure that the PSI is maintained current via the management of change (MOC) and pre-startup review (PSR) programs. Hard copies of all of the PSI are maintained in the PSM file cabinet. An electronic copy of much of the information is also available. Personnel have access to the both the PSM file cabinet and electronic copies on a 24-hour basis. Accurate PSI is maintained for the life of the facility.

The AAA Ammonia Storage Facility compiled process safety information (PSI), satisfying the regulatory requirements of Section 2760.1 of the CalARP regulations, to enable personnel (e.g., owner, operator, employees involved in operating the process) to identify and understand the hazards posed by those processes involving anhydrous ammonia. The following PSI is particularly important to the prevention program:

- **Information pertaining to the hazards of the regulated substances in the process** - The following information is available in the material safety data sheets (MSDSs) maintained for each regulated substance: toxicity information, permissible exposure limits, physical data, reactivity data, corrosivity data, and thermal and chemical stability data;

- **Information pertaining to the technology of the process** – The following information is available in the "PSI: technology" file: a process flow diagram for each continuous and batch process, and the process chemistry. A table including safe upper and lower parameter limits (e.g., temperature, pressure), and an evaluation of the consequences of deviations from those parameter limits is included in the "PSI:technology" file; and

- **Information pertaining to the equipment in the process** – The following information is maintained in the "PSI:equipment" file: accurate or redlined piping and instrumentation diagrams (P&IDs), and a table listing the various safety systems (e.g., alarms, interlocks, shutdowns, suppressions systems, materials of construction, relief system) for the processes.

Personnel from the AAA Ammonia Storage Facility verify that the equipment complies with recognized and generally accepted good engineering practices. Appropriate personnel also verify that all equipment is designed, maintained, inspected, tested, and operated in a safe manner even if the codes or standards are no longer in use.

Process Hazard Analysis: By systematically examining each process and identifying hazards associated with the operation of a covered process, the AAA Ammonia Storage Facility has been able to plan and take appropriate action to improve the safety of our employees, the community, and the environment. The AAA Ammonia Storage Facility performed a Process Hazard Analysis (PHA) on the ammonia storage bullets with the objective of: identify hazards; identify credible human errors and/or equipment failures that could lead to an accidental release; evaluate the likelihood and/or consequence of various scenarios; determine if existing chemical specific prevention steps/controls are adequate; and, where existing controls are inadequate, identify additional steps that can be taken to control the hazard.

In accordance with Section 2760 of the CalARP regulations, the AAA Ammonia Storage Facility consulted with CCCHSD and determined that the Hazard and Operability Study (HAZOP)[3] methodology was the approach best suited for the PHA of the ammonia storage bullets. This methodology was chosen due to the relatively complex design of the ammonia storage and transfer system, as well as the AAA Ammonia Storage Facility's belief that HAZOPs provide a high level detail for analysis of this system.

The following objectives were addressed by the HAZOP:

- Identify the hazards of the substance and of the process;
- Identify the applicable external events (including seismic events) that could lead to a release;
- Identify possible equipment failures or human errors that could lead to a release;
- Evaluate the consequences and likelihood of the accident scenarios;
- Evaluate safeguards used to prevent or mitigate failures or errors;
- Consider steps needed to mitigate the risks, including changes needed to equipment design, operating procedures, process conditions, etc.; and
- Propose recommendations/action items to mitigate the hazard.

The HAZOP was conducted by a multi-disciplinary team that systematically identified hazards and operability problems by searching for deviations from the design intent of each portion of the process. The team considered the causes and consequences of these deviations to identify hazardous conditions and their

(3) The HAZOP is a rigorous, systematic study into the consequences of process deviations from the design intent of a process that may cause undesirable hazards or operability problems.

consequences, list existing safeguards, and made recommendations for changes where appropriate. A similar team will be conducting the revalidation of the PHAs every five years, and updating the PHAs as necessary, in conjunction with the RMP updates.

The HAZOP team was composed of qualified personnel including a team leader with 12 years of experience at AAA Ammonia Storage Facility, a project engineer (5 years), a process engineer (4 years), a loss prevention engineer (10 years), a unit foreman (22 years), an operator (8 years), and other specialists (e.g., control systems engineer, corrosion specialist, unit inspector, heat transfer equipment specialist, rotating equipment specialist, etc.) when needed. As per AAA Ammonia Storage Facility policy, the team leader had training and experience in conducting HAZOPs, as well as a general knowledge of the process. Required qualifications for other team members include a minimum of 18 months of any specialty experience. For example, a corrosion specialist must have 18 months of experience dealing with corrosion issues for the unit/area being reviewed. In this case, each of the specialists had over 5 years of experience in their respective fields.

The team identified and evaluated hazards of the process as well as accident prevention and mitigation measures, and made suggestions for additional prevention and/or mitigation measures when they such measures are necessary. The HAZOP was documented on worksheets containing a description of each process node and its design intent, a list of possible deviations, causes of deviations, consequences, safeguards, and required action items/investigations/questions for further study. This documentation will be maintained for the life of the Plant. A similar team will be conducting the revalidation of the PHAs every five years, and updating the PHAs as necessary, in conjunction with the RMP updates.

The AAA Ammonia Storage Facility conducted a seismic assessment of ammonia bullets. The objective of the seismic assessment was to provide reasonable assurance that loss of primary containment of ammonia would not occur as the result of a seismic event.

The seismic assessment consisted of a review to identify site-specific seismic hazards (ground acceleration, fault rupture, liquefaction, subsidence, landslide, tsunami) followed by an evaluation of the process area equipment relative to these identified hazards. The method used to review these hazards is the Southern California Fire Chiefs Association (SCFC) Guidelines, which is outlined in CCCHSD RMP Seismic Assessment Guidelines.

The nearest major fault to the AAA Ammonia Storage Facility site is the Hayward fault, located approximately 15 miles east of the facility. Due to the site's soil type and location, the only site-specific seismic hazard of concern is ground acceleration.

The seismic review team consisted of three structural engineers from S&B Earthquake Engineers, with over 30 years of combined experience. These reviewers conducted a systematic walk-through of equipment, piping, and supporting structures to identify areas that could be vulnerable to damage during an earthquake. Where appropriate, engineering calculations were performed to verify the adequacy of existing installations.

Specific items reviewed during the walk-down assessment included:

- General maintenance issues such as missing nuts or bolts or concrete repair;
- Interaction between structures, equipment or piping that could cause damage or failure;
- Adequacy of supports;
- Piping or valves that could rupture during earthquake motion;
- Adequacy of structural framing to resist lateral loads; and
- Construction flaws.

The preliminary review indicated that some pieces of equipment might have low seismic capacities for both the supporting structures and the foundations. As a result of this finding, detailed engineering calculations, based on site-specific data and the thresholds established in the SCFC methodology, were performed to assess the seismic adequacy of the equipment, associated piping and structural supports.

The most common vulnerabilities identified during the seismic assessment can be grouped into two main categories. These are:

- Insufficient transverse reinforcement; and
- Insufficient anchorage of the equipment or structure to the foundation.

In most cases, identified vulnerabilities were easily corrected and have already been acted upon. In a few cases, detailed engineering review of strengthening options is required and is underway. The main area for improvement was in strengthening pipe supports and adding bracing in pipeways. The seismic assessment will be revalidated at the same time as the PHA. Furthermore, "seismic walkthroughs" are performed by the lead operator and process engineer following each major shutdown, prior to startup.

The team findings for all PHAs and seismic assessments are forwarded to local and corporate management for resolution. Implementation of recommendations/action items in response to PHA findings is based on a relative risk ranking assigned by the PHA team.[4] This ranking helps ensure that potential

(4) The relative risk ranking is determined by a four-by-four matrix comparing the severity of the consequence of the accident scenario with the likelihood of the event occurring. There are specific definitions for severity and risk

accident scenarios assigned the highest risk receive immediate attention. All approved recommendations/action items being implemented in response to PHA team findings are tracked by the process supervisor, and reviewed quarterly by the plant manager, until they are complete. The final resolution of each finding is documented and retained.

The process hazards identified during the PHA and seismic assessment include:

- Fire (process upsets, leaks, equipment failure, etc., from a nearby process could result in a fire);
- Equipment failure (including cracks, failure due to corrosion, weld failures, disk failures, ruptures, pump/gauge/control system failures, etc.);
- Earthquakes (severe ground movement); and
- Flooding (water damage due to severe yearly rains and rising rivers).

Any of these process hazards could lead to a toxic release of ammonia.

Recommendations/action items to limit these process hazards, identified during the PHA and seismic assessment, are documented in the "Planned Changes to Improve Safety" section of this document.

Operating Procedures: Current, clearly written standard operating procedures and safe work practices ensure that both experienced and inexperienced employees (including contract employees) will respond in a safe, consistent and prescribed manner. AAA Ammonia Storage Facility developed a written operating procedures program, satisfying the requirements of Section 2760.3 of the CalARP regulation, to ensure that written procedures/practices are developed, reviewed, implemented, and annually certified as reflective of current plant practice.

Personnel from the Health, Safety, and Environment (HS&E) Department finalized SOP-1, *Writing Standard Operating Procedures,* and SAF-1, *Writing Safe Work Practices,* to ensure that operating procedures and safe work practices are consistent and that they meet the intent of the CalARP regulation. The safe work practices are included in the AAA Ammonia Storage Facility Health and Safety Handbook provided to each employee.

The operating procedures are available in the control room (hard copies and electronically) for each process and include the following sections and appendices:

that must be applied to each scenario. The resultant risk is used to prioritize any action items generated during the HAZOP.

- Steps for each of the following operating phase with "**NOTE**" and "**WARNING**" used to highlight specific safety issues:
  - Initial startup;
  - Normal operations;
  - Temporary operations;
  - Emergency shutdown;
  - Emergency operations;
  - Normal shutdown;
  - Startup following a turnaround; and
  - Safe work (e.g., lockout/tagout, confined space entry, line and equipment opening , etc.). Note: Permits have been developed for many of the safe work practices including: confined space entry, lockout/tagout, excavation and shoring, and line and equipment opening.

- Tables including safe operating limits (i.e., minimum and maximum pressure temperature, flow, composition) and consequences of deviating outside those operating limits;
- A troubleshooting guide explaining the steps to correct or avoid the consequences of deviating outside the identified operating limits, including initiation of emergency shutdown;
- A health and safety section which provides a brief description of the chemicals and the associated hazards (including special or unique); the engineering and administrative precautions (e.g., ventilation, personal protective equipment (PPE) used to prevent exposures); the control measures to be taken if physical contact or airborne exposure occurs; and quality control for raw materials and control of hazardous chemical inventory levels; and
- A list of all safety systems (e.g., alarms, interlocks, emergency systems and shutdowns), their functions, and their setpoints.

Members of the engineering staff and operations staff developed initial operating procedures for the AAA Ammonia Storage Facility in conjunction with the engineers from the process design firm. Operating procedures were prepared based on a careful review of each operating mode, recognition of the hazards involved, and the appropriate sequence of safe operating steps. Operators and the Area Supervisor revised the initial operating procedures to reflect the current procedures and the prescribed format. The revised operating procedures were then routed to the applicable supervisors (e.g., engineering, maintenance, operations) for comment prior to finalization.

The operating procedures are maintained current and accurate through management of change (MOC) reviews and annual certification. The MOC procedure is also used to manage temporary operating procedures. The MOC review is dependent upon the complexity of the change and is performed as described in the MOC description. Operators and the Area Supervisor perform an annual review of the operating procedures. The Area Supervisor incorporates the

changes and the revised documents are routed to the appropriate supervisors for review and certification.

Training: The AAA Ammonia Storage Facility believes that employees who clearly understand how to safely operate a process can significantly decrease the number and severity of incidents, and increase efficiency. Therefore, a thorough training program focused on specific operating procedures and safe work practices is a key element of an effective prevention program.

The AAA Ammonia Storage Facility Training Department developed a written training program to provide employees (those involved with operating the process) with an understanding of the types and causes of potential incidents or deviations within the process, and the hazards associated with the process. The training program also instructs personnel how to operate the process within safe operating limits, and how to handle potential emergencies. The training program satisfies the requirements of Section 2760.4 of the CalARP regulation and is comprised of the following:

- Initial employee training(5);
- Existing employee certification;
- Training provided as a result of a management of change (MOC) or pre-startup review (PSR);
- Refresher training; and
- Training documentation.

All operators receive initial training in safe work practices and basic operating principles prior to assignment. The operators receive training specific to the operations of each process once they are assigned to a process. The training criteria are documented in job dimension documents that list the knowledge required (e.g., safe operating limits, safety system setpoints) and skills to demonstrate (e.g., emergency shutdown, lockout/tagout procedures). Various means are used to verify competency, including written and oral examinations, demonstrations, and on-the-job training. Documentation of the training is forwarded to the Training Department for filing and tracking. The Training Department included job dimension documents and certification letters in the training files of all employees involved in operating the process before June 1999.

Refresher training on specific operating procedures (e.g., normal operations, startup, shutdown), safe work practices (e.g., limiting contractor access, lockout/tagout), and company-wide practices is conducted during the monthly safety meetings, special training classes, and drills. The current schedule was developed with employee consultation and allows refresher training to be conducted at a minimum of every three years. Training documentation (e.g.,

(5) Initial operator training generally includes an overview of the process, including PSI, specific operating procedures, basic operator knowledge, safety and health hazards, and safe work practices.

meeting minutes, attendees, instructor, refresher content, and means used to verify competency) is provided to the Training Department for filing and tracking.

Training may also be required as a result of a MOC or PSR. The Area Supervisors are responsible for ensuring that the necessary training is conducted prior to implementation of the change to satisfy the MOC program requirements of Section 2760.6 of the CalARP regulation. These training records are attached to the completed MOC or PSR documentation and ultimately submitted to the Training Department for filing and tracking

The Training Department maintains a training matrix of all initial and refresher training, and training conducted as part of MOCs and PSRs. This matrix and the accompanying timetable help to ensure that each employee remains current on their training and qualified to perform the operations safely.

Mechanical Integrity: A well-established mechanical integrity program ensures that equipment critical to process safety is fabricated to meet process specifications, installed correctly, and maintained in a safe operating condition. It also allows maintenance employees to preemptively identify and correct equipment deficiencies to avoid associated incidents and down time. The AAA Ammonia Storage Facility has therefore developed a mechanical integrity program, satisfying the requirements of Section 2760.5 of the CalARP regulation, which is comprised of the programs and procedures shown below. The mechanical integrity program applies to pressure vessels and storage tanks, piping systems, relief and vent systems, emergency shutdown systems, controls and pumps and additional equipment deemed by operating and maintenance personnel to be important to safety (e.g., heat exchangers, rotating equipment, electrical equipment, and fire protection equipment).

- **Procedures are developed and implemented for ensuring quality assurance-** The design engineer specifies the required mechanical details on an equipment data sheet (EDS) once the equipment performance and physical characteristics are specified by the process engineer. The completed EDS is reviewed by the structural, equipment, materials, electrical, and instrumentation specialists as appropriate, and by operating and maintenance personnel. The EDS is used to ensure that the equipment

  - meets or exceeds all design specifications;
  - is properly constructed;
  - is suitable for its application;
  - is designed in accordance with good engineering practice; and
  - will meet the requirements for safety, reliability, and product quality.

  The Maintenance Supervisor and other members of the engineering and maintenance staff maintain EDSs for new, modified, and used parts. They review all new equipment and processes against the EDSs to ensure that the

equipment is fabricated in a manner suitable for the application. They also conduct appropriate checks and inspections to ensure that the equipment is installed properly and is consistent with the design specifications and the manufacturer's instructions. The preceding elements of the quality assurance program are often performed in conjunction with the management of change (MOC) program and the pre-startup review (PSR) program. The Maintenance Supervisor and the Storeroom Coordinator also developed and maintain purchasing documents for spare parts that include technical and engineering data. This ensures that all maintenance materials and spare parts are suitable for the process application.

- **Written maintenance procedures for process equipment-** Written procedures (including step-by-step instruction, applicable warnings or hazards, manufacturer's recommendations, and required personal protective equipment) were developed for maintaining process equipment. These procedures are reviewed annually by appropriate members of management for thoroughness and accuracy. Hard copies of these procedures are available in the Maintenance Supervisor's office. The regularly scheduled maintenance (preventive maintenance) requests are distributed to maintenance employees by the maintenance department. Non-preventive maintenance activities are performed through the work order system (i.e., operators and engineers submit work order requests to the Maintenance Supervisor who then distributes them to appropriate maintenance employees). The maintenance employee completes the preventive maintenance or work order documentation and submits it to the Maintenance Department for review and filing.

- **Maintenance employee training-** The AAA Ammonia Storage Facility carefully assesses each applicant for employment and only hires maintenance personnel with skills and knowledge pertinent to their required job tasks. Additional skills training is provided on an as-needed basis through a local community college or trade organizations. The Training Department maintains documentation of skills training (e.g., union training program, community college training, specialty equipment training) for maintenance employees.

  Maintenance employees are provided with an overview of the process, the hazards associated with the process, and safe work practices during initial employee training and annual refresher training. The Training Department maintains initial and annual training records including content of training, instructor, and means used to verify competency for maintenance employees.

- **Inspection and testing procedures for critical equipment-** Inspection and testing procedures and frequency for each piece of critical equipment were developed and documented by appropriate members of the maintenance, engineering, and operating departments. The procedures and frequency are based upon the manufacturer's recommendations, good engineering practice,

and operating history. The inspection and testing requests are distributed to maintenance employees at the established frequency. Completed inspection and test documentation including maintenance employee signature, date of the inspection or test, serial number of the equipment, inspection and test procedures, and the results of the inspection or test are returned to the maintenance department for review and filing. The Maintenance Supervisor, with the engineering and operating departments, review the results of each inspection or test to determine if the frequency of the inspections or tests should be increased/decreased, to ascertain whether the equipment is within the acceptable limits, and the predicted useful life of the equipment. Equipment outside of the acceptable limits is removed or replaced unless protective measures and continuous monitoring can be safely performed until the deficiencies are corrected. Inspection and test results are maintained for the life of the equipment.

The AAA Ammonia Storage Facility is currently compiling all the mechanical integrity information (e.g., preventive maintenance documentation, quality assurance, the work order system, inspection and tests) on a computer program. This program will allow the preventive maintenance procedures and inspection and test procedures to be automatically distributed. The computer will maintain a record of all equipment inspection results and identify any equipment that does not meet the safe operating limits. The computer program will be used to develop and disseminate maintenance reports for delinquent preventive maintenance, work orders, and test and inspections. The computer program will also be linked with the storeroom to allow any replacement parts needed for preventive maintenance activities to be automatically deducted from the inventory. Finally, the computer program will contain all of the purchasing documents for new, modified, used, or spare part for easy access by all appropriate personnel.

Management of Change: Changes within a stationary source are sometimes necessary to address safety, environmental, and operational concerns. A change made in one part of the process or other processes may have unintended effects on other parts of the process because the stationary source is an integrated system. These changes are therefore appropriately scrutinized before they are made to ensure the changes do not compromise the safety and integrity of the process and to avoid adverse effects to worker and public safety, and the environment.

The AAA Ammonia Storage Facility developed a written management of change (MOC) procedure, satisfying the requirements of Section 2760.6 of the CalARP regulations, to ensure that all changes to the following are properly managed:

- Process chemicals (e.g., raw materials, intermediate products, solvents);
- Technology (e.g., operating parameters, catalyst, rates);
- Equipment (e.g., materials of construction, equipment specifications);

- Procedures (e.g., emergency response, preventive maintenance, operating); and
- Stationary sources that affect a covered process.

This procedure does not apply to "replacement in kind" which is defined as replacements that satisfy the design specifications.

Form ABC was developed to document the MOC procedure when changes in covered processes are identified or planned by facility personnel (e.g., maintenance supervisors when completing work orders). Changes are designated as routine, temporary, or emergency. Emergency changes require appropriate signatures, are only allowed during off-hours and holidays, and require that a formal MOC procedure be initiated within 24 hours. Temporary changes can only be re-authorized once and require that a maximum allowable time frame be identified.

Personnel (e.g., engineering, operations, safety) assess the potential impact of the change on safety and health through a safety checklist for minor changes or a process hazard analysis (PHA) for major changes. The following steps are taken to ensure proper implementation of the change:

- Process safety information (PSI) is updated as necessary but always prior to startup. Copies of revised PSI are attached to Form ABC;

- Operating procedures are updated as necessary in accordance with the written operating procedure program. Copies of updated procedures are attached to Form ABC; and

- Employees (e.g., operations, maintenance, contract) whose job tasks are affected by the change, are trained in accordance with the written training program prior to the startup of the process. Copies of the training records are forwarded to the Training Department for inclusion in the training matrix. The original training records are attached to Form ABC.

Form ABC and the attachments are forwarded to the appropriate personnel for authorization. The MOC records and recommendations are tracked according to the assigned tracking number. The MOC records and documentation of completion of the recommendations are maintained for five years.

Pre-Startup Review: The AAA Ammonia Storage Facility is comprised of a variety of complex processes. Modifications to these processes are sometimes required to improve safety and operability. When these modifications require that the process safety information (PSI) be updated or if it is a new process, employees formally verify that all controls (engineering and administrative) are installed and implemented prior to startup. This review applies to modifications

requiring that the process safety information (PSI) be updated. The AAA Ammonia Storage Facility developed a written pre-startup review (PSR) procedure and checklist satisfying the requirements of Section 2760.7 of the CalARP regulation to confirm the following prior to the introduction of regulated substances:

- Construction and equipment is in accordance with design specifications;
- Safety, operating, maintenance and emergency procedures are in place and are adequate;
- For new stationary sources, a process hazard analysis (PHA) has been performed and recommendations have resolved or implemented before startup;
- For modified stationary sources, the requirements contained in the written management of change (MOC) program have been meet; and
- Training of each employee involved in operating a process has been completed.

When changes in covered processes are identified or planned by facility personnel, they must assess whether a PSR should be performed. This assessment is conducted as part of the written MOC procedure. A PSR is performed in addition to MOC's when the proposed change requires that the process safety information (PSI) be modified. Also, appropriate personnel (e.g., Plant Manager) review all capital projects to ensure that PSR's are initiated when new covered processes are installed.

The PSR checklist was developed to facilitate the PSR and to document that all of the requirements were addressed prior to the introduction of regulated substances. The Operations Department ensures that the following steps are taken prior to startup:

- A review of the design specifications is conducted for the new or modified equipment and construction. These design specifications are verified against the equipment specifications documented in the written mechanical integrity (MI) program, and the design codes and standards and generally accepted good engineering practices all included in the PSI element;

- The safety, operating, maintenance, and emergency procedures are revised or developed as necessary. This is conducted in accordance with the written operating procedure, MI, and emergency response elements;

- For newly constructed stationary sources, the piping and instrumentation diagrams (P&ID's) are complete and a process hazard analysis (PHA) is performed. The recommendations from the PHA must also be addressed;

- For modified stationary sources, the P&IDs are updated. The recommendations previously formulated during incident investigations,

compliance audits, and PHAs are reviewed to determine the effects of the modification; and

- If employee (e.g., operators and individuals performing routine and non-routine tasks) job tasks will be affected, training is conducted in accordance with the training and mechanical integrity elements.

The appropriate personnel (e.g., Engineering Supervisor, Operations Supervisor, Maintenance Supervisor, Plant Manager) review the completed PSR documentation and perform a physical walk-through inspection before authorizing startup. The PSR records and documentation are tracked according to the assigned tracking number that corresponds to the MOC tracking number. PSR records and documentation of completion of the recommendations are maintained for a minimum of five years.

Compliance Audits: The AAA Ammonia Storage Facility believes that ensuring that the prevention program elements are functioning properly (i.e., that they are complete, current, and applied in compliance with company policy, regulations, and good process safety practices) is vital to the continuous improvement of the prevention program. Personnel perform internal compliance audits at least every three years to review and evaluate the written documentation/records and implementation of the prevention program. Potential areas that can be improved within the prevention program elements are identified and recommendations are formulated and implemented to ensure an effective and improved overall prevention program. The developed compliance audits program satisfies the regulatory requirements of Section 2760.8 of the California Accidental Release Prevention (CalARP) regulation.

Two trained representatives from the Health, Safety, and Environment Department (HS&E) will rotate the responsibility of audit team leader. The remaining audit team is comprised of qualified facility personnel (hourly and salary) knowledgeable in the process and personnel from the Corporate office.

The audit team will utilize an audit protocol (approximately 250 questions) to perform:

- An assessment of the written prevention program elements;
- A review of records (e.g., completed hot work permits, incident investigations) to assess implementation of the written prevention program elements;
- Employee interviews to assess fundamental level of understanding for applicable programs (e.g., maintenance personnel have a basic understanding of the mechanical integrity program); and
- Interviews with key personnel (those with primary responsibility for each prevention program element).

The audit team members will formulate findings and recommendations for improvement. The results of the compliance audit will be communicated to all interested personnel (e.g., plant manager, members of management, employees) during a closing meeting. Appropriate supervisors will then be responsible for reviewing the recommendations, determining appropriate resolution of each recommendation, and assigning responsibility for each recommendation. The Area Supervisor will also be responsible for compiling status reports for the recommendations. These are forwarded to the HS&E Department quarterly and will be maintained with the compliance audits. The facility will retain the two most recent compliance audit reports. The facility will track to final disposition the recommendations formulated during all compliance audits.

Incident Investigation: The AAA Ammonia Storage Facility believes incident investigation to be vital to the overall prevention program. Therefore, the AAA Ammonia Storage Facility developed an incident investigation procedure, satisfying the requirements of Section 2760.9 of the CalARP regulation, to investigate each incident which resulted in, or could reasonably have resulted in a release of ammonia causing personnel injury or major property damage. Personnel identify underlying cause(s) and develop and implement corrective actions to prevent reoccurrence of the incident, or similar incidents. A root cause analysis is performed for significant incidents (e.g., onsite fatality, offsite health effects).

The Area Supervisors provide training, during monthly safety meetings, to employees regarding the importance of reporting all near miss situations. A near miss is an incident that could reasonably have resulted in a catastrophic release. Employees are reminded that the root cause(s) of minor incidents and "near misses" could result in major incidents if uncorrected. Employees are encouraged to report minor incidents and "near misses" to Area Supervisors either verbally or anonymously.

Trained management personnel assume the position of incident investigation team leader, when an incident occurs. The number of and experience of the other team members is dependent upon the severity and complexity of the incident. Typically, the incident investigation teams are comprised of a team leader, an expert in the process, and other employees (including contract employees) knowledgeable in the operation, design, and maintenance of the process. The incident investigation team leader is responsible for initiating the investigation as soon as possible but definitely within 48 hours of the time of the incident or near miss.

The incident investigation involves four stages:

- Gathering evidence (involves interviewing witnesses, taking photographs, collecting evidence and records, and obtaining samples as applicable);

- Analyzing the evidence (also involves identification of root cause if a root cause analysis was performed);
- Developing conclusions; and
- Formulating recommendations.

The incident investigation team prepares a written report at the conclusion of the investigation that includes:

- Date and time of the incident or "near miss";
- Date and time the investigation was initiated;
- Team members and expertise;
- Description of the incident or "near miss";
- Factors that contributed to the incident or "near miss" (root cause if a root cause analysis was performed); and
- Recommendations formulated as a result of the investigation.

The written report is forwarded to the appropriate members of management for review. The appropriate members of management address each recommendation (i.e., identify the most appropriate solution and schedule completion of each recommendation). The team leader or designee tracks the recommendation resolution status using a computer database. Recommendations not implemented by the proposed date are forwarded to the Plant Manager.

The investigation results, including the disposition of all formulated recommendations, are reviewed with employees (including contract employees) whose job tasks are relevant to the findings. The Health, Safety, and Environment (HS&E) Department retains copies of the investigation reports for a minimum of five years to be used during process hazard analysis (PHA) revalidations. The results are also shared with other companies using the same or similar process, when appropriate, to the extent that proprietary information is not divulged.

Employee Participation: The AAA Ammonia Storage Facility relies on the expertise of employees (including hourly and contract employees when appropriate) at all levels and disciplines to optimize operations and safety. This is achieved by consulting with (i.e., exchanging information with, and soliciting input and participation from) employees to ensure consideration of their knowledge and experience in all applicable areas of the prevention program. The AAA Ammonia Storage Facility has therefore developed a written plan of action regarding employee participation in the prevention program elements, the hazard assessment, and emergency response program, satisfying the requirements of Section 2760.1 of the CalARP regulation. The written employee participation plan (available in hard copy or through the local area network computer) and facility policies ensure that:

- Employees and their representatives are consulted on the conduct and development of process hazard analyses (PHAs) conducted to comply with Section 2760.2 of the CalARP regulation. The AAA Ammonia Storage Facility requires participation by plant operators and maintenance personnel as members of the analysis team. Other employees with responsibilities relating to specific processes are consulted prior to and during the PHA;

- Employees and their representatives are consulted on the development of all elements of the prevention program, the hazard assessment performed in accordance with Sections 2750.1 through 2750.9 of the CalARP regulation, and the emergency response program developed in accordance with Section 2765.2 of the CalARP regulation. Examples of participation include:

  - operations and maintenance employees being actively involved in the development of procedures;
  - operations and maintenance employees being integral members of the established incident investigation teams; and
  - operations and maintenance employees being consulted with regarding the appropriate type and frequency of training.

- Employees and their representatives are provided access to PHAs and to all other information required to be developed under the CalARP rule (e.g., hazard assessment, emergency response program) through the Engineering Department and the CalARP Coordinator.

The plan also requires that the Health and Safety Committee and the CalARP Coordinator meet monthly to discuss employee participation in each of the applicable elements and to identify the best method for disseminating the following information to all affected employees. The CalARP Coordinator retains copies of the meeting minutes for a minimum of five years. Copies of the most recent meeting minutes are available on the lunchroom bulletin board.

- The results of process hazard analyses (PHAs) including the hazards of the process and the formulated recommendations;
- The results of any pending incident investigations performed; and
- The results of any compliance audits conducted.

Hot Work Permit: Controlling ignition sources is vital to the AAA Ammonia Storage Facility's release prevention program. Therefore, it is critical that pertinent personnel are notified when hot work (i.e., any spark producing operation including use of power tools, grinding, burning, welding, brazing) is to be performed in a unit and that appropriate safety precautions are taken prior to initiation of the work. The stationary source has developed a hot work permit program, satisfying the requirements of Section 2760.11 of the CalARP regulation, which requires that employees complete permits certifying that the applicable portions of the fire prevention and protection requirements are

implemented prior to beginning hot work operations. These requirements are contained in the fire prevention and suppression procedure and hot work permit, Title 8 California Code of Regulations (T8 CCR) §4848 and §6777 respectively.

The operations department issues hot work permits for all grinding, burning, welding, and brazing performed on or near covered processes in areas not approved for cutting and welding through the fire prevention and suppression procedure. The hot work permit is terminated when continued use of the ignition source is hazardous, when conditions of its issuance change, or when the permitted hot work has been inactive for more than 2 hours (unless tests show that conditions are still non-hazardous).

Two copies of the hot work permit are maintained. The first is posted at the physical location of the hot work for the duration of the work. The second is provided to the operations department where it is kept on file for at least six months after the date of issue. The hot work permit contains the following information:

- The effective date and time;
- The place of use;
- The hours during which the source of ignition may be used, not to exceed 24 hours;
- The specific location or piece of equipment where the source of ignition will be used;
- The nature of the use of the source of ignition; and
- Any special precautions or limitations to be observed before, during, or after the use of the source of ignition, including the need for a fire watch and fire hoses or extinguishers. The criteria for needing a fire watch and the responsibilities of the fire watch are identified in the fire prevention and suppression procedure.

Trained personnel (e.g., Operations Supervisor or Maintenance Supervisor) perform an inspection of the area to ensure the following prior to authorization of the hot work permit:

- The source of ignition may be safely used. The fire prevention and suppression procedure requires that only approved apparatus be used and that personnel performing the hot work (including contractors) be informed of the hazards and properly trained. Also, the flammable gas or vapor content in the air must be less than 20% of the lowest content that is flammable or explosive;
- Combustible materials in areas that will be exposed during hot work are protected or relocated;
- Oil accumulations moved; or
- Proper fire extinguishing equipment is available to employees performing the hot work.

Personnel in the control room are notified prior to initiation of the hot work to make them aware of the ignition source. This awareness allows personnel in the control room to quickly contact the fire watch and personnel performing hot work when continued use of the source of ignition becomes hazardous.

Contractors: The AAA Ammonia Storage Facility relies on contractors to supplement the existing workforce primarily during maintenance turnarounds and construction. The AAA Ammonia Storage Facility and all contract owners are jointly responsible for safety and must ensure that contractors are trained in and understand the following:

- Work practices necessary to perform his or her job;
- Hazards associated with a process;
- Applicable sections of the emergency response procedure; and
- Applicable safe work practices.

It is also critical for contractors to inform the stationary source of any unique hazards that they introduce while performing their work.

The stationary source developed a contractor program, satisfying the requirements of Section 2760.12 of the CalARP regulation, to ensure that safety issues are addressed during contractor selection and that owner and contractor owner share responsibility for the safety of all employees (including contractors).

The AAA Ammonia Storage Facility requires that potential contract owners complete and return a questionnaire regarding their safety programs to the Health, Safety, and Environment (HS&E) Department for review against established criteria. This questionnaire includes a section for contract owners to describe any unique hazards that will be introduced by their work. The HS&E Department may also request that the contract owner submit additional documentation (e.g., the written safety program) or safety training records/logs. The contractor selection process also includes verification of appropriate skills and certification required to perform the job. Contract owners found to be acceptable against the established criteria are then logged into the "Acceptable Contractor Owners" list. The HS&E Department maintains the completed questionnaires and any additional information requested in the "Contractors" file cabinet. Contractor owners are asked to re-submit questionnaires to the AAA Ammonia Storage Facility every three years.

Contractor employees from the "Acceptable Contractor Owners" list are required to receive training before being allowed on-site. The training consists of a safety video describing emergency procedures and stationary source wide practices (e.g., contractor and employee access). Training also consists of safe work practices and process specific hazard descriptions. The content and duration of the training is dependent upon the contractor's responsibilities. A written examination is given at the conclusion of the training. Written examinations are forwarded to the

HS&E Department for filing. Contractor employees who receive an acceptable score on the written examination are provided with green stickers for their hard hats.

The HS&E Department audits each contractor owner at least annually. The frequency of the audits is adjusted according to safety performance/history, and the type of service being provided. The HS&E Department ensures that proper training is provided and documentation maintained for each contractor. The HS&E Department also monitors contractor performance (e.g., compliance with stationary source safe work practices, knowledge of types of work and the hazards involved). Documentation of the audits and on site evaluations is maintained for a minimum of five years.

THE FIVE-YEAR ACCIDENT HISTORY

AAA Ammonia Storage Facility compiled a five-year accident history for all accidental releases from covered processes that resulted in deaths, injuries, or significant property damage on site, or known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage. The compilation of this information satisfies the requirements of Section 2750.9 of the CalARP regulation. The five-year accident history allows the AAA Ammonia Storage Facility to explain to the community the factors causing or contributing to accidental releases, the onsite and offsite impacts of accidental releases, and the procedural and technological changes made to minimize the likelihood that these accidental release will not occur again. The intent of this information exchange is to create an informed community while also documenting that accidental releases are investigated and concrete changes are made to protect against reoccurrence.

Personnel at the AAA Ammonia Storage Facility reviewed all incident investigation reports from January 1994 to present to identify accidental releases of ammonia and other extremely hazardous substances that resulted in deaths, injuries, or significant property damage onsite, or known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage. Four accidental releases of ammonia were identified. The Community Warning System (CWS) was activated twice for precautionary shelter in place. There were three onsite injuries identified that required minor medical attention and first aid. No offsite deaths, injuries, property damage, or environmental damage occurred. Data regarding these incidents and the resulting procedural and technological changes are described in the Five-Year Accident History data elements of the RMP. None of the accidental releases of other extremely hazardous substances satisfied the criteria.

THE EMERGENCY RESPONSE PROGRAM

Overall safety at the AAA Ammonia Storage Facility is governed not only by the ability to prevent accidental releases of regulated substances from occurring, but also by the ability to mitigate any accidental releases of anhydrous ammonia. The AAA Ammonia Storage Facility therefore developed an emergency response program to minimize the effects of accidental releases of anhydrous ammonia on employees, the public, and the environment. The AAA Ammonia Storage Facility has formed an emergency response team (ERT) to respond to onsite releases of ammonia. A modular emergency response program was developed which consists of an emergency action plan (EAP), satisfying the requirements of Title 8 California Code of Regulations (T8 CCR§3220); an emergency response plan (ERP), satisfying the requirements of the Hazardous Waste Operations and Emergency Response (HAZWOPER) regulation T8 CCR §5192l; and coordination with local emergency response personnel and officials, satisfying the requirements of Section 2765.1(b) of the CalARP regulation.

The AAA Ammonia Storage Facility developed and implemented an EAP for all employees that are not responsible for responding to the release of anhydrous ammonia. This plan includes employee evacuation routes, headcounting procedures, and EAP training for employees. This EAP also includes a "Notification Matrix" which provides the telephone numbers of agencies and individuals to contact in the event of one of several pre-identified emergencies (e.g., fire, employee injury, employee fatality). The agencies and individuals represent local emergency responders (e.g., Fire Department), public notification and regulatory reporting requirements (e.g., CCCHSD), and internal notification (e.g., Plant Manager, Corporate Headquarters). The "Notification Matrix" requires that designated personnel make the notifications and document when the telephone calls were placed and the name and position of the person contacted. Completed "Notification Matrices" are maintained for five years.

The AAA Ammonia Storage Facility does not have a fire brigade, and is therefore dependent upon the Fire Department for response to fires in the area. All personnel will therefore instigate the EAP and evacuate the area in the event of a fire. Properly trained employees can respond to incipient fires requiring one fire extinguisher after notifying the fire department. The AAA Ammonia Storage Facility works closely with the Fire Department to prevent fires from occurring and to quickly mitigate fires. Annually, the Fire Department provides fire extinguisher training for incipient fires and performs walk-throughs of the processes. This pre-planning ensures that employees of AAA Ammonia Storage Facility are aware of the preferred method of notifying the fire department (e.g., activation of any of the manual pull switches or sprinkler system automatically sounds an audible alarm and alerts the fire department). This pre-planning also ensures that members of the fire department are familiar with stationary source, the hazards of the anhydrous ammonia, the resources available at the stationary source, and the locations of the resources.

The AAA Ammonia Storage Facility developed and implemented an ERP to respond to releases of anhydrous ammonia. The ERP identifies the emergency response team (ERT) training requirements, qualifications, and responsibilities within the incident command system. The ERT is comprised of individuals from operations, maintenance, and engineering with the Operations Supervisor acting as stationary source incident commander. The team members have all been trained to the First Responder Operations Level and Hazardous Materials Technician Level except the Operations Supervisor who has been trained to the Incident Commander/On-Scene Manager Level. In addition to the ERT, the stationary source has identified, properly trained, and properly equipped employees to administer first aid and emergency medical treatment until the YYY Ambulance arrives. All emergency response team members attend an annual eight-hour refresher.

The ERP includes the chemical-specific emergency response procedures for releases of ammonia and other extremely hazardous substances. The procedures identify the individuals by training level who perform the actions, administrative and engineering controls (e.g. ventilation), the required personal protective equipment (PPE), first aid requirements, and required equipment.

The AAA Ammonia Storage Facility maintains emergency response equipment and personal protective equipment (PPE) for use by the emergency response team and the Fire Department. The emergency response equipment is included in the mechanical integrity program, requiring that testing and inspection frequencies be developed and preventive maintenance activities be conducted. Examples of PPE maintained at the AAA Ammonia Storage Facility include air-purifying respirators and self-contained breathing apparatus. Additional chemical-specific engineering controls that mitigate releases are discussed in the executive summary. Annually the AAA Ammonia Storage Facility conducts an emergency drill where the offsite responding agencies (e.g., fire department, police department, CCCHSD), the emergency response team members, and non-responding personnel from the stationary source work together to resolve the given scenario (e.g., release of a ammonia). This pre-planning activity ensures that the members of the responding agencies are familiar with the AAA Ammonia Storage Facility, the hazards of ammonia, the resources available at the stationary source and the locations of the resources. It also clearly identifies the capabilities and limitations of each responding agency. Copies of the drill records, including recommendations and critiques, are maintained in the ERP for review.

The AAA Ammonia Storage Facility also works closely with Contra Costa County Health Services (CCCHSD) for any necessary response to hazardous material releases, to assist in determining any downwind air monitoring, and to alert the public of the accidental release of ammonia. AAA Ammonia Storage Facility worked with CCCHSD to establish Community Alert Network (CAN) zones that will be notified of the incident through the Community Warning

System for any level 3 incidents. The CAN zones and the sensitive receptors within them are depicted on the offsite consequence map.

The emergency response program, including the EAP and the ERP, is reviewed annually to ensure that it remains accurate and current. Employees are trained on the emergency response program when initially hired, when the emergency response plan is revised, and when employees' responsibilities are changed. All employees receive annual refresher training on the emergency response program.

PLANNED CHANGES TO IMPROVE SAFETY

Studies associated with prevention program elements such as PHAs (including external events analysis and seismic analysis), incident investigation, management of change, and compliance audits are regularly conducted at AAA Ammonia Storage Facility to verify designs and to identify potential hazards. Recommendations may be developed as a result of these studies and as a result of equipment inspections, safety meetings, review of industry experience, technology improvements, and employee suggestions. Once formulated, recommendations are reviewed and corresponding action items are developed to implement each recommendation. Communication of these action items or planned activities informs the public of measurable improvements for safety that are being incorporated at the AAA Ammonia Storage Facility.

Personnel reviewed the following technical studies (i.e., PHAs, seismic analyses) to identify all action items not yet implemented which were formulated to reduce the risk (severity or likelihood) of an incident which could have reasonably resulted in an offsite consequence (i.e., exceeding the ERPG-2 for ammonia):

- 1992 Unit A Hazard and Operability study (HAZOP);
- 1997 Unit A HAZOP revalidation;
- 1992 Unit B HAZOP;
- 1997 Unit B HAZOP revalidation;
- 1993 Unit C What-If analysis;
- 1998 Unit C What-If analysis revalidation; and
- 1998 Stationary-source wide seismic analysis.

Seventy action items meeting the selection criteria were identified. Fifty-five of those action items are complete and the major items are included in the "chemical-specific prevention steps" section of the RMP. Eleven of the fifteen outstanding action items are scheduled for completion prior to their assigned due date. The Maintenance Supervisor, Engineering Supervisor, and Plant Manager rejected two of the fifteen outstanding action items based on factual errors in the PHAs. Two of the fifteen outstanding action items and due dates were revised as a result of a detailed engineering study.

Personnel also reviewed numerous other action items generated during various activities including the following to identify action items not yet implemented that have a reasonable likelihood of resulting in offsite consequences:

- 1995 PSM Compliance Audit;
- 1998 PSM Compliance Audit;
- Incident investigation reports from 1994;
- Safety meeting minutes since 1994; and
- Recommendations stemming from industry-wide experience since 1994.

Summaries of the action items (from technical studies and other activities) meeting the selection criteria are depicted in Table A-11. Table A-11 includes the source of the action item, the action item summary, the purpose of the action item, and the projected completion date of the specific action item or the generalized group. It also includes a comments column for any additional information. This column will be used to document the progress of each action item during the five-year RMP update.

Table A-11 Planned Changes to Improve Safety

Source	Planned Change	Purpose	Projected Completion Date	Comments
1998 PSM Compliance Audit	Revise the existing emergency response program to ensure that personnel are adequately trained on notification procedures, including initiation of the Community Warning System (CWS)	Early notification of responding agencies and the public helps to ensure quick mitigation of the accidental release and minimization of impact to public receptors	12/99	
1998 PSM Compliance Audit	Continue with the current task of "computerizing" the mechanical integrity program. Specifically, personnel are entering equipment information including specifications, inspection & testing procedures and frequencies, and preventive maintenance procedures and frequencies. This allows work orders to be automatically distributed and for delinquent work orders to be easily identified. This system will also be linked to the storeroom.	This computerized system will help to ensure that inspections, tests, and preventive maintenance are performed correctly and on schedule. This will minimize accidental releases due to mechanical failure	11/99	
PHA	Install nitrogen purge to C101 compressor distance piece to vessel, V-300	Prevent piston rod packing from leaking ammonia to atmosphere	2/99	
PHA	Include "ensure that pump min. flow valves are only open to the correct storage vessel" in the daily rounds list	Reduce potential to overfill the storage vessel	6/99	
PHA	Minimize vertical deadleg between	Minimize piping subject to overpressure	1/2000	

Source	Planned Change	Purpose	Projected Completion Date	Comments
	the high pressure control valve (CVH-100) and chiksan arm on liquid loading line	from solar heating. Overpressure prevented by thermal relief valves		
Safety Meeting	Prepare documentation for the testing and maintenance of the emergency shutdown systems for the loading compressors, pumps, and tank car loading racks	Ensure that the emergency shutdown systems are tested and that the tests are documented	11/99	
Safety Meeting	Establish a procedure (including documentation requirements) for properly maintaining the chiksan joints on the unloading arm at a 3-6 month frequency	Minimize potential releases of ammonia during the loading procedure due to improperly maintained chiksan joints	12/99	

OFF-SITE CONSEQUENCE ANALYSIS

CHARACTERISTICS AND HAZARDS OF ANHYDROUS AMMONIA

Anhydrous ammonia is the third highest-volume chemical produced in the United States. Ammonia is used for fertilizer production and is a common industrial refrigerant.). At atmospheric temperatures and pressure, ammonia is a colorless gas with a sharp, intensely irritating odor. Ammonia is very soluble in water, which makes water useful in reducing ammonia releases. Properties and hazards of ammonia are shown in Table A-12.

Table A-12
Properties and Hazards of Ammonia

PROPERTY	VALUE	COMMENTS
Odor threshold	5.2 ppm	
ERPG-1	25 ppm	Definition: The concentration that nearly all individuals could be exposed to for one hour without experiencing other than mild transient health effects or perceiving a clearly defined objectionable odor.
ERPG-2	200 ppm	Definition: The concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
ERPG-3	1000 ppm	Definition: The concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening effects
Vapor specific gravity	0.6 (Non-aerosol Form)	Ammonia vapor is lighter than air. When pressurized liquid ammonia is released, it initially forms an aerosol, a heavy cold cloud of ammonia mist. From the release point, a pool of liquid ammonia can form beneath the container. This pool can add to the amount of ammonia evaporating to the atmosphere.
Boiling point	-28.4^{o}F	
Ignition temperature	1,204^{o}F	Ammonia is difficult to ignite and is not flammable under normally encountered conditions.

Depending on the concentration and duration of exposure, the health effects of ammonia gas can range from mild to severe irritation to the lining of the nose, eyes, throat and lungs. Inhalation of high concentrations (above those in the table above) may injure the lungs with potentially fatal results. Due to its low odor threshold, ammonia has very good "warning properties" because it can be smelled at a level about 200 times lower than the ERPG-3 level.

WORST-CASE SCENARIO

SELECTION CRITERIA & SCENARIO DESCRIPTION

The Worst-Case Scenario (WCS) for the AAA Ammonia Storage Facility is the release of total contents of 50 tons (100,000 pounds) of ammonia (NH_3) vessel in 10 minutes. This scenario is the WCS as defined in the CalARP regulation sections 2750.3(a)(2)(A) and (c)(1).

Although there are numerous installed control measures that, in an actual event, would have mitigated the release, no credit for active mitigation measures was taken into account for this scenario. The results for the WCS were generated from the EPA's *RMP Offsite Consequence Analysis Guidelines*.

The release results were determined assuming the following conditions for a WCS:

- Neutrally buoyant gas;
- Ten-minute release;
- Rural conditions;
- F stability class; and
- Wind speed of 1.5 meters per second.

RESULTS SUMMARY

The following table contains the results for the WCS:

Table A-13
Ammonia WCS Results

RELEASE SCENARIO	MATERIAL	AMOUNT	ENDPOINT	DISTANCE	
Toxic	NH_3	50 tons	200 ppm (ERPG-2)	9.9mi.	52,200 ft.

Figure A-8 shows the area affected by this worst-case release scenario on a map of the area. Using census data from LandView III, the estimated population within the worst case scenario circle is 310,000.

ALTERNATIVE RELEASE SCENARIO

To assist in emergency response planning, AAA Ammonia Storage Facility developed an Alternative Release Scenario (ARS) to represent a reasonable "outer bound" for our emergency response planning and for explaining potential hazards to the community.

SELECTION CRITERIA & SCENARIO DESCRIPTION

Distances to endpoints for ammonia were generated using TRACE 8.0, a computer program developed by Safer Systems, Inc., designed to model chemical accidental releases for emergency planning and training. Trace predicts the rates at which chemical vapors may escape into the atmosphere, and predicts how a gas cloud might disperse in the atmosphere. Trace takes into account the release conditions, the physical characteristics of the release site, and the meteorological conditions at the time of the release.

The tank car loading system at AAA Ammonia Storage Facility consists of a loading pump P-1 that has a maximum discharge flow rate of 150 gpm (gallons per minute) at a pressure of 235 psig.

To determine the most appropriate scenario for the ARS, the following steps were taken:

- Using the HAZOP of the system, as well as reviewing the five-year accident history, a set of upset conditions was identified that could lead to an ammonia release;
- A conservative set of release conditions, physical characteristics of the release site, and meteorological conditions at the time of the release were identified for each upset condition; and
- An analysis of the distance to each endpoint was performed to determine which release scenario had the highest likelihood of resulting in the greatest offsite impact.

Based on scenarios generated during the Unit PHA, and using the EPA lookup tables as a screening tool, it was determined that the potential exists for a 2" line to be severed on the pump discharge line, resulting in a five-minute release of ammonia. Because the area is continually monitored by ammonia detectors, and the system is equipped with automatic shutdowns, five minutes was the time determined for the release to be discovered and the system isolated.

Refer to Table A-14 for OCA modeling input.

Mitigation systems included the following:

- NH_3 detection systems with alarms in the control room;
- Remote isolation of transfer pump suction valve upon indication of release; and
- Remote shutdown of transfer pump upon indication of release.

RESULTS SUMMARY

The following table contains the results for the ARS:

Table A-15
Ammonia ARS Results

RELEASE SCENARIO	MATERIAL	AMOUNT	ENDPOINT	DISTANCE	
Toxic	NH_3	772 lbs.	200 ppm (ERPG-2)	1.4 mi.	7630 ft.
			1000 ppm (ERPG-3)	0.5 mi.	2953 ft.

Figure A-9 shows the areas affected by this ARS on a map of the area. Using census data from LandView III, the estimated population within the ARS ERPG-2 circle is 4,000.

Following is a list of public receptors within the vulnerability zone for this release scenario:

Table A-4
Public Receptor List

	RECEPTOR NAME	ADDRESS	CITY	PHONE #	DISTANCE FROM FENCELINE
1	Monte Vista High School	3131 Stone Valley Rd.	Danville	(925) 820-2900	4,800 ft.
2	Los Cerros Middle School	968 Blemer Rd.	Danville	(925) 838-2900	5,100 ft.
3	Green Valley Elementary School	1001 Diablo Rd.	Danville	(925) 837-1805	6,000 ft.
4	Athenian Middle/High School	2100 Mount Diablo Scenic Blvd.	Danville	(925) 837-5375	5,400 ft.
5	Valley Parent's Nursery School	1550 Diablo Rd.	Danville	(925) 837-5401	3,300 ft.
6	SRVSACCA-Kids Country-Green Valley Center	1001 Diablo Rd.	Danville	(925) 743-9108	6,900 ft.

MITIGATED RELEASE SCENARIO

One way to effectively mitigate the risks associated with the operation of the ammonia transfer system would be to install automatic water curtains, initiated immediately upon detection of an ammonia release. This mitigation item was identified during the hazard review, and is scheduled for implementation by mid-1999. The amount of ammonia released to the atmosphere would be reduced by a minimum of 75% (the calculated efficiency of the water curtain). Assuming the water curtain is of good design and is maintained and tested regularly, the distance to the toxic endpoint would not reach a public receptor.

RESULTS SUMMARY

The modeling results for a release, using the same ARS parameters, but including the mitigating factor of the scrubber, is shown in Table A-16 below:

Table A-16
Mitigated Ammonia Release Results

RELEASE SCENARIO	MATERIAL	AMOUNT	ENDPOINT	DISTANCE	
Toxic	NH_3	193 lbs.	200 ppm (ERPG-2)	0.8 mi.	4100 ft.
			1000 ppm (ERPG-3)	0.3 mi.	1720 ft.

Figure A-10 shows the area affected by this mitigated release scenario on a map of the area. Using census data from LandView III, the estimated population within the mitigated release scenario circle is 1,900.

Following is a list of public receptors within the vulnerability zone for this release scenario:

Table A-6
Public Receptor List

RECEPTOR NAME	ADDRESS	CITY	PHONE #	DISTANCE FROM FENCELINE
(1)-Valley Parent's Nursery School	1550 Diablo Rd.	Danville	(925) 837-5401	3,300 ft.

TABLE A-14
AAA AMMONIA STORAGE MODEL INPUT

	WCS		ARS		ADDITIONAL SCENARIOS	
	TOXIC	**FLAMMABLE**	**TOXIC**	**FLAMMABLE**	**TOXIC**	**FLAMMABLE**
CHEMICAL NAME	Ammonia	N/A	Ammonia	N/A	Ammonia	N/A
PHYSICAL STATE	Buoyant Gas		Liquid/Aerosol		Liquid/Aerosol	
MODEL/REFERENCE USED	EPA Guidelines		Trace		Trace	
SCENARIO	Toxic Gas Release		Liquid Release		Mitigated Liquid Release	
QUANTITY RELEASED	100,000 lbs.		772.5 lbs.		193 lbs.	
RELEASE RATE	10,00 lbs./minute		154.5 lbs./minute		38.6 lbs./minute	
RELEASE DURATION	10 minutes		5 minutes		5 minutes	
AMBIENT TEMPERATURE	N/A		"See attached Trace Report"		"See attached Trace Report"	
PROCESS/STORAGE TEMPERATURE	N/A		"		"	
PROCESS/STORAGE PRESSURE	N/A		"		"	
POOL DEPTH/AREA	N/A		"		"	
RELEASE HEIGHT	N/A		"		"	
SURFACE TYPE	N/A		"		"	
WIND SPEED	1.5 meters/sec.		"		"	
RELATIVE HUMIDITY	N/A		"		"	
CLOUD COVER	N/A		"		"	
STABILITY CLASS	'F'		"		"	
TOPOGRAPHY	Rural		"		"	
ROUGHNESS FACTOR	N/A		"		"	
ENDPOINTS USED	ERPG-2, ERPG-3		ERPG-2, ERPG-3		ERPG-2, ERPG-3	
PASSIVE MITIGATION	N/A		N/A			
ACTIVE MITIGATION	N/A		-NH3 detection systems with alarms in the control room; -Remote isolation of transfer pump suction valve upon indication of release; and -Remote shutdown of transfer pump upon indication of release.		-Same as ARS -Proposed water curtain spray system	

INSERT WCS MAP – PROGRAM 3

INSERT ARS MAP – PROGRAM 3

INSERT MITIGATED RELEASE MAP – PROGRAM 3

COVERED PROCESSES DATA SHEET

This guidance document does not provide examples of completed data sheets except for the following example of five-year accident history information. This is included as an example because CCCHSD is requesting that additional information be provided to clarify the data element entries. Only one of the four reported incidents is included.

6 .0 FIVE –YEAR ACCIDENT HISTORY

Unit: Ammonia Storage
6.1 1994
6.2 Time 11:00 a.m.
6.3 Release duration 12 minutes
6.4 Chemical(s) ammonia
6.5 Quantity released (lbs.) 64lbs.

6.6 Release event
- a. Gas release
- b. ✔ Liquid spill/evaporation
- c. Fire
- d. Explosion

6.7 Release Source
- a. Storage vessel
- b. ✔ Piping
- c. Process vessel
- d. Transfer hose
- e. Valve
- f. Pump

6.8 Weather conditions as time of event (if known)
- a. Wind speed/direction_____
- b. Temperature_____
- c. Stability class_____
- d. Precipitation present
- e. Unknown

6.9 Onsite impacts
- a. _Deaths (number)
- b. Injuries 1 (number)
- d. Property damage ($)25,000

6.10 Known offsite impacts
- a. Deaths (number)
- b. Hospitalizations (number)
- c. Other medical treatment (number)
- d. Evacuated (number)
- e. Sheltered 45 (number)
- f. Property damage ($)
- g. Environmental damage (specify type)

6.11 Initiating event

a. ✔ Equipment failure
b. ✔ Human error
c. Weather condition

6.12 Contributing factors (check all that apply

a. Equipment failure
b. Human error
c. Improper procedure
d. Overpressurization
e. Upset condition
f. By-pass Condition
g. ✔ Maintenance activity/Inactivity
h. Process design
i. Unsuitable equipment
j. Unusual weather condition
k. Management error

6.13 Offsite responders notified a. ✔ Yes b. No

6.14 Changes introduced as a result of the accident

a. ✔ Improved/upgrade equipment
b. ✔ Revised maintenance
c. ___ Revised training
d. ___ Revised operating procedures
e. ___ New process controls
f. ___ New mitigation systems
g. ___ Revised emergency response plan
h. ___ Changed process
i. ___ Reduced inventory
j. ___ Other
k. ___ None

6.0 FIVE-YEAR ACCIDENT HISTORY ADDENDUM

6.9 Onsite personnel were evacuated from the area. One operator sustained minor burns when exposed to the subcooled liquid ammonia releasing from the damaged chiksan joint

6.10 The community warning system (CWS) was activated to provide information to the community and to issue a precautionary shelter in place for CAN zone 15 (approximately 45 homes bracketed by 1st street to the north, 22nd street to the south, Bob Drive to the west, and Laura Avenue to the east). There were no injuries, property damage, or environmental damage identified.

6.11 A large leak ammonia release occurred in the ammonia loading area because the chiksan joint developed a large leak and the emergency shutdown system did not respond appropriately.

6.12 The large ammonia leak occurred because the chiksan joint had not been inspected on a regular basis (i.e., maintenance inactivity). Also the emergency shutdown system had not been inspected and tested as required. The root cause was identified as the failure of management to include the chiksan joint in the mechanical integrity program.

6.13 The large leak was identified by a unit operator during daily rounds. The proper practical and regulatory notifications were made as outlined in the "Notification Matrix" including Bay Area Air Quality Management District and CCCHSD.

6.14 A procedure was developed for properly maintaining the chiksan joint on a 3 month frequency. Documentation of this inspection and testing is maintained by the maintenance department. Also, a procedure was developed for inspecting and testing (and documenting) the emergency shutdown system on a regular frequency.