THE CHEMICAL SAFETY AUDIT PROGRAM:

FY 1997 STATUS REPORT

September 1998

TABLE OF CONTENTS

APPENDICES

EXHIBITS

EXECUTIVE SUMMARY

This is a comprehensive report on the status of the U.S. Environmental Protection Agency's Chemical Emergency Preparedness and Prevention Office's (CEPPO) Chemical Safety Audit (CSA) program since its inception in fiscal year (FY) 89, a review of the successful and problematic trends of CSA program implementation in FY 97, and a discussion of the current and future role of the CSA program in the CEPPO Prevention Strategy.

In these nine years, the CSA program has encompassed the review of the chemical process safety management systems of over 350 facilities and the training of over 1000 federal, state, and local officials. In addition, the CSA program has developed a database of chemical safety audit information and supported numerous other related chemical accident prevention activities, including outreach and technical assistance for both the public and private sector.

Chemical accident prevention involves identifying the causes of accidental releases of hazardous substances and the means to prevent them from occurring, promoting industry initiatives in these areas, and sharing the results with the community, industry, and other interested groups. EPA established the CSA program to:

- Heighten awareness of and promote chemical safety among facilities handling hazardous substances, as well as in communities where chemicals are located;
- Build cooperation among facilities, EPA, and others by conducting joint audits;
- Gather information on safety practices and technologies from facilities handling hazardous substances; and
- To establish a database for the assembly and distribution of chemical process safety management information obtained from the facility audits.

The CSA program is not a compliance or regulatory program; however, EPA does have legal authority for entering a facility and conducting a chemical safety audit under sections 104(b) and 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The audit consists of interviews with facility personnel and an on-site review of various aspects of facility operations related to the prevention of accidental chemical releases. Observations and conclusions from the audit are detailed in a report, available to the public, that identifies both problematic and successful chemical process safety management practices, as well as technologies for preventing and mitigating chemical releases.

This status report is intended to provide EPA headquarters and regional management with a better understanding of how the program is being implemented both at headquarters and in the regions, the purpose and goals of the audit program, and the type of information being generated and its uses. The following four topics are the focus of this report ─ program activities, program results, regional program implementation, and analysis of audit results.

Regional Implementation Status

The CSA program has provided the opportunity for greater cooperation and communication with state and local officials as a result of their participation in the audit process and associated training and outreach activities. State and local audit participants stress the beneficial aspects of the program from increased government-industry coordination to enhanced understanding of chemical process safety issues in the community. In addition, as the CSA program has developed, the regional offices have initiated new programs and activities and introduced modifications to audit procedures that take advantage of the program's flexibility. Initiatives such as mini-audit programs and accident investigations, as well as greater pre-audit planning, coordination with other environmental and health and safety programs, and outreach to industry, have also been the products of the evolution of the CSA program. For example, in FY 97, Region 3 conducted 63 mini-audits of water treatment operations, ammonia refrigeration systems, and other facilities with toxic and flammable chemicals. In Region 4, a series of followup visits were conducted during FY 97 to interview facility staff and evaluate the status of recommendations implemented since the initial audit was conducted.

Program Activities/Results

The achievements of the audit program, outlined in Chapter 2, are based on the number of full-scale audits conducted and reports completed in each region, along with a summary of the audits by the facility's Standard Industrial Classification (SIC) code and by the hazardous substances examined during the audit. An overview of participation in training workshops offered by EPA headquarters is also included.

As of the close of FY 97, the regions had submitted a total of 349 final reports to EPA headquarters for the 358 full-scale chemical safety audits that were conducted between FY 89 and FY 97. Information from the 16 most recently submitted reports was examined for this status report, including a number of reports from audits conducted in FY 96 that were not submitted to EPA headquarters in time to be included in the FY 96 Status Report.

CEPPO has designed a four-day chemical safety audit workshop that gives potential audit team members the training to conduct an audit; beginning in FY 93, these courses have been presented by EPA's Environmental Response Team as part of their training curriculum. From 1989 through 1997, a total of 60 workshops, attended by nearly 1600 individuals throughout all ten regions, have been conducted; approximately 280 individuals attended the twelve workshops held in FY 97. The most noteworthy trend in these workshops has been the increased involvement of state and local officials, who account for approximately 50 percent of the overall attendance, but 60 percent of the attendees in the past year. This represents a concerted effort within the CSA program to increase awareness and participation by these individuals in combination with increasing state and local interest in chemical process safety issues. In addition, with the applicability of the new Risk Management Program regulations to operations at federal facilities, 20 percent of workshop attendees during FY 97 were federal officials and their contractors.

To realize the goals of the CSA program to collect and disseminate information on chemical process safety issues and to improve program coordination, CEPPO has assembled a computerized database to provide EPA regions and headquarters (as well as state and local government agencies) with information gathered from chemical safety audit reports in a format consistent with the CSA protocol. Through analysis of the database, the user can identify successful and problematic techniques or practices employed to manage process safety at facilities handling hazardous substances. The database is being used by CEPPO to develop guidance and technical assistance documents that will be distributed to individuals and organizations involved in chemical accident prevention. In addition, the database has been given to federal, state, and local officials attending the training workshops, who use the audit report information to increase their familiarity with chemical process safety issues and to support their own inspection and auditing activities.

FY 97 Audit Analysis

Chapter 3 presents an overview of conclusions and recommendations taken from recent EPA chemical safety audits, based on the latest 16 final CSA reports received by EPA headquarters as of September 30, 1997. Once again, the results have been organized according to the major elements of generally accepted chemical process safety management practices, which form the basis for the facility risk management programs specified under Clean Air Act (CAA) section 112(r). Seventeen major chemical process safety elements are examined in this chapter: corporate and facility management, process hazard analysis (hazard evaluation), offsite consequence analysis, process safety information, standard operating procedures, equipment and instrument maintenance, training, safety audits, accident investigation, management of change, pre-startup review, hot work permits, employee participation, contractors, release prevention and mitigation measures, facility emergency preparedness and response, and community emergency response coordination.

Each section of Chapter 3 reviews the key features in the implementation of one of these chemical process safety elements, as well as the role each element plays in maintaining a safe facility. The section also illustrates notable audit team observations and conclusions on related facility practices taken from the latest 16 audit reports. For example, most of the audited facilities have developed procedures for conducting investigations of certain accidental releases of hazardous substances. However, the audit teams visiting these facilities noted very significant differences in the range of releases that were investigated, the scope of the investigation, and the process of implementing recommendations emerging from the investigation.

Conclusion

EPA views the CSA program as an integral component of its overall chemical safety program and an ongoing means of stimulating chemical accident prevention initiatives. The voluntary nature of the audits encourages facilities to work with EPA and allows industry to feel comfortable in sharing their audit experiences and recommendations with other industry partners. Another important factor is the close coordination of resources and focus at the regional level with other CEPPO prevention efforts. Current benefits from the CSA program include the following:

- CSA training workshops and audit participation provide EPA, state emergency response commissions (SERCs), local emergency planning committees (LEPCs), and other federal agencies with a better understanding of chemical process safety management and facility practices to prevent and mitigate chemical releases;

- Audit activities foster a more cooperative attitude between government and industry on chemical process safety issues; and

- Jointly conducted audits and training support cooperation and coordination on chemical safety programs among federal, state, and local government agencies.

On May 24, 1996, EPA's Administrator signed the final rule for the risk management planning requirements mandated under Clean Air Act (CAA) section 112(r). The rule requires certain facilities ("sources") handling regulated substances in a process above specific quantities to develop and implement a risk management program consisting of a hazard assessment, a prevention program, and an emergency response program. Sources will summarize their risk management program in a risk management plan (RMP), which will be made available electronically to state and local government and the public. Sources with processes covered by the RMP rule must comply with these requirements by June 21, 1999. EPA and the other agencies responsible for implementing these regulations are required to conduct audits of RMPs and will also conduct site inspections to oversee and enforce compliance with the rule by evaluating actual practices.

Thus, chemical accident prevention practices, which the CSA program encourages, will soon be mandatory for certain processes at sources covered by the RMP rule. EPA is encouraging state governments to take responsibility for implementing the RMP program, and several states have indicated that they will apply for delegation of the program. The CSA program will continue to play a key role in assisting these states with guidance, training, and technical assistance on chemical process safety issues and the audit process. Although the number of chemical safety audits has declined in the last three years, training workshop attendance has remained strong and increased in many states. In addition, analysis of CSA program results across industry sectors will give RMP auditors and inspectors a basis on which to evaluate the efficacy of facility chemical safety policies and practices.

In addition, it is expected that CSA team members will be involved in implementation of these regulations at the regional level (for facilities in states that do not take delegation of the program) by providing compliance assistance, auditing facility RMPs, and inspecting facility risk management programs. RMP auditors and site inspectors will be able to draw on their CSA training and experience in selecting, planning, and conducting site visits. At the same time, there will still be many facilities handling extremely hazardous substances below threshold quantities that are not covered by the RMP requirements; for example, small-scale manufacturers, warehouses, and other chemical users. The CSA program will continue to have an important role in accident prevention through audits of these facilities.

The CSA program, the Risk Management Program, and the Clean Air Act General Duty Clause are components of EPA's integrated chemical safety program. Depending on the circumstances at a particular facility, EPA may choose to apply one or more of these elements to achieve greater protection of human health and the environment. As a result, the CSA program will continue to have an important role within EPA.

1.0 CHEMICAL SAFETY AUDIT PROGRAM: HISTORY AND FUTURE

In the nine years since EPA initiated the Chemical Safety Audit (CSA) program in 1988, over 350 full-scale chemical safety audits and approximately 100 mini-audits have been conducted by EPA regional offices. In addition, an extensive training program has been established and a CSA program database has been developed. The CSA program also has prompted a growing interest among state and local officials in the audit process and in the underlying concepts of chemical process safety management. With the publication of the final risk management planning regulations mandated under section 112(r) of the Clean Air Act (CAA), the CSA program has assumed a critical support role in the development of the national chemical accident prevention effort spearheaded by EPA's Chemical Emergency Preparedness and Prevention Office (CEPPO).

For the 358 full-scale chemical safety audits conducted over the seven years ending September 30, 1997, 349 final audit reports have been prepared (see Appendix B). To compile information for this report, the final audit reports have been summarized in a standard format consistent with the CSA protocol. These profiles present a summary of audit observations and include the audit team's conclusions and recommendations. The profiles also contain information on facility name, location, primary processes, and product(s); the hazardous substances examined for the audit; and the name, affiliation, role, and expertise of each audit team member.

The remainder of this chapter describes the future of the CSA program and the primary features of the existing CSA program, including its history and purpose, and key program activities — CSA training workshops and the CSA database. Chapter 2 presents a statistical overview of the results of CSA program activities and achievements. Lastly, Chapter 3 reviews facility chemical process safety practices identified in the final CSA reports submitted to CEPPO since the publication of the FY 96 CSA Status Report.

1.1 Program Background

<u>History</u>

The CSA program is part of a broad EPA initiative designed to accomplish four chemical accident prevention goals:

- Learn about and understand problematic and successful practices and technologies for preventing and mitigating releases from facilities handling hazardous substances;
- Heighten awareness of chemical safety among chemical producers, distributors, and users, as well as in communities where chemicals are located;
- Build cooperation among authorized parties by coordinating joint audits where appropriate; and
- Establish a database for the assembly and distribution of chemical safety information obtained from facility audits and from other sources.

Following the 1984 release of methyl isocyanate in Bhopal, India, and subsequent incidents in the United States, awareness of the threat to public safety posed by similar incidents led to an emphasis on preparedness and planning for response to chemical accidents. EPA established the Chemical

Emergency Preparedness Program to help states and communities plan for chemical emergencies. Many of the features of this voluntary program were incorporated into SARA Title III, which establishes a chemical emergency preparedness infrastructure within each state, territory, and Tribal land.

Recognizing accident prevention as the next step after instituting local emergency preparedness efforts, EPA sought to identify causes of accidental releases of hazardous substances and the means to prevent them from occurring, to promote accident prevention practices in industry, and to share information with the community, industry, and other groups (e.g., academia, professional organizations, trade associations, labor, and environmental groups). Many of these key concerns were identified in the Congressionally mandated SARA Title III section 305(b) study, *Review of Emergency Systems*. This study reviewed technologies, techniques, and practices for preventing, detecting, and monitoring releases of extremely hazardous substances, and for alerting the public to such releases. As part of the information-gathering needed to prepare this study, a number of facility audits were conducted to evaluate, first-hand, their chemical process safety management practices. As one method of acquiring additional information and encouraging awareness of accident prevention at facilities, the study recommended that EPA continue the program of facility audits, thus inaugurating the CSA program.

<u>Authority</u>

While the CSA program is not a compliance or regulatory program, EPA does have legal authorities for entering a facility and conducting a chemical safety audit. The primary authority for EPA and its designated representatives to enter a facility and review its records and operations is contained in CERCLA sections 104(b) and 104(e). The audits are intended to be non-confrontational and positive, so that information on safety practices, techniques, and technologies can be identified and shared between EPA and the facility. If serious problems are discovered during the audit, however, EPA may use a variety of legal authorities to address them.

<u>Audit Team</u>

An EPA audit team consists primarily of EPA employees and other designated representatives, including contractors and AARP members. Other federal, state, and local government personnel, particularly representatives of State Emergency Response Commissions (SERCs) and Local Emergency Planning Committee (LEPCs) established under EPCRA, are encouraged to participate in audits as team members or observers. The audit team can vary in size depending on the scope of the audit and the expertise of individual team members. Although states and local governments must use their own authorities for audit participation, the CSA program encourages the involvement of LEPC and SERC members throughout the audit process.

<u>Audit Selection</u>

In selecting a facility for a chemical safety audit, the EPA regional office may consider a number of factors, including but not limited to the hazardous substances used, the facility's history of releases, the facility's proximity to a sensitive population or area of high population density, its accident prevention technologies, or the industry's concentration in the area. The regional office may review federal, state, and local release notification reports and follow-up reports; On-Scene Coordinator (OSC) reports; Regional Response Centers; Accidental Release Information Program (ARIP) reports; and other sources. Currently, most facilities selected have been identified based on their history of accidental releases, using ARIP, the Emergency Response Notification System (ERNS), and other release information sources.

At present, EPA regional offices are not required to follow any formal procedures when selecting a facility for an audit, as long as the following two important requirements are met:

- Under CERCLA, EPA may enter a facility only if a release of a CERCLA hazardous substance, pollutant, or contaminant has occurred at the facility, or there is "reason to believe" that a threat of such a release exists; and

- The Office of the Regional Counsel and the SERC must be consulted to identify any legal actions currently being pursued or anticipated against the audited facility. Although not compliance-oriented, a chemical safety audit conducted at a facility where legal action is on-going or anticipated may interrupt or otherwise have an impact on the settlement process. It is also suggested that other regional program offices be consulted.

EPA can, of course, enter a facility and conduct an audit at the invitation or with the voluntary consent of the facility's management.

Audit Process

The audit consists of interviews with facility personnel and on-site review of various aspects of facility operations related to the prevention of accidental chemical releases. Observations and conclusions from the audits are detailed in a report prepared by the audit team. The report identifies and characterizes the strengths and weaknesses of specific chemical accident prevention program areas to allow the elements of particularly effective programs to be recognized and to share information on problematic practices. Copies of the report are given to the facility and its corporate management so that weak and strong program areas may be recognized.

The audit is conducted in accordance with the *Guidance Manual for EPA Chemical Safety Audit Team Members*, which contains mandatory procedures, as well as recommended actions, to follow to ensure the health and safety of program auditors and program integrity. Each member of the audit team should have a copy of the manual, and a copy of the manual should be sent to the facility prior to the audit. The guidance manual also contains an audit protocol (see Appendix A), a detailed outline that directs the scope and content of the audit and establishes a structure for preparing the audit report. The protocol is designed to provide CSA teams with an organized and detailed format for conducting an audit and preparing a comprehensive report. By following the protocol in preparing CSA reports, regional staff ensure continuity and consistency in report preparation.

1.2 Relationship to the CEPPO Prevention Strategy

The CSA program is one component of CEPPO's overall chemical accident prevention strategy. The key to the success of the CSA program in supporting accident prevention is the cooperation built between industry and EPA through the voluntary audit participation. The voluntary nature of the audits encourages facilities to work with EPA and allows industry to feel comfortable in sharing their audit experiences and recommendations with other industry partners. Another important factor is the ongoing coordination of the CSA program with other CEPPO prevention efforts including the Accidental Release

Information Program (ARIP), the Risk Management Plan (RMP) program, and the chemical accident investigation (CAI) program:

- In 1986, the ARIP program began to collect accident information through surveys issued to certain facilities experiencing accidental releases. The ARIP database, consisting of information taken from the ARIP survey, is used to identify candidate facilities for chemical safety audits and other prevention-related outreach programs.

- With the passage of the Clean Air Act Amendments of 1990, EPA began development of the RMP rule, in part using the information provided by ARIP and CSA. Since promulgating the RMP rule in 1996, CEPPO has been working to implement the RMP program. Regional chemical safety audit team members are involved in all the facets of the RMP program, including assisting CEPPO in developing guidance documents, providing assistance to personnel from state and local implementing agencies, and working directly to help facilities understand the requirements.

- EPA's statutory responsibility for the prevention and mitigation of accidental releases necessitates action by the Agency to investigate and understand the chemical accidents that occur. These investigations, conducted by EPA's Chemical Accident Investigation Team (CAIT), may lead to issuance of new guidance or regulations relating to accident prevention. Chemical safety audit team members provide critical support to the CAIT. Team members are involved in conducting accident investigations; developing safety alerts where an unrecognized hazard is identified; and developing reports on the facts, circumstances, and root causes of accidents.

The regional offices have substantial flexibility in implementing the CSA program. The regions have used this flexibility to model the CSA program into a vehicle for meeting regional priorities for accident prevention. Specific features of the CSA program (e.g., followup activities) have served as the basis for the development of new regional initiatives. In addition, several regions have begun separate chemical-specific initiatives to address commonly used hazardous chemicals that pose the greatest risk in an accident, such as mini-audits.

Four followups were performed by Region 4 during FY 1997 for facilities audited in previous years. They consisted of a return visit to interview facility staff and evaluate the status of recommendations implemented since the initial audit was conducted. For each visit, a post-audit report was prepared summarizing the original audit recommendations and the relevant activities taken by the facility in the intervening years. In general, these facilities viewed the chemical safety audits as a positive experience and had implemented many of the audit team's recommendations. The region will be continuing this effort in FY 1998.

In FY 1997, Region 3 conducted 63 "mini" chemical safety audits. By performing "mini" audits, the region was able to reach a larger number of facilities at a reduced cost to the government. In general, these audits focused on smaller facilities or a specific operation at larger facility, including two dozen visits to water treatment plants using chlorine and sulfur dioxide, two dozen visits to food processors and cold storage facilities with ammonia refrigeration systems, as well as a variety of other operations involving toxic and flammable chemicals, such as propane distributors, hospitals, and small chemical manufacturers. Following their site visit, the region sent a followup letter to the facility highlighting notable practices and recommendations for potential improvements. Region 8 intends to establish a mini-audit program in FY 1998.

1.3 Future Role of the CSA Program

On May 24, 1996, EPA's Administrator signed the final rule for the risk management planning requirements mandated under Clean Air Act (CAA) section 112(r). The rule requires certain facilities ("sources") handling regulated substances in a process above specific quantities to develop and implement a risk management program consisting of a hazard assessment, a prevention program, and an emergency response program. Sources will summarize their risk management program in a risk management plan (RMP), which will be made available electronically to state and local government and the public. Sources with processes covered by the RMP rule must comply with these requirements by June 21, 1999. EPA and the other agencies responsible for implementing these regulations are required to conduct audits of RMPs and will also conduct site inspections to oversee and enforce compliance with the rule by evaluating actual practices.

Thus, chemical accident prevention practices, which the CSA program encourages, will soon be mandatory for certain processes at sources covered by the RMP rule. EPA is encouraging state governments to take responsibility for implementing the RMP program, and several states have indicated that they will apply for delegation of the program. The CSA program will continue to play a key role in assisting these states with guidance, training, and technical assistance on chemical process safety issues and the audit process. Although the number of chemical safety audits has declined in the last three years, training workshop attendance has remained strong and increased in many states. In addition, analysis of CSA program results across industry sectors will give RMP auditors and inspectors a basis on which to evaluate the efficacy of facility chemical safety policies and practices.

In addition, it is expected that CSA team members will be involved in implementation of these regulations at the regional level (for facilities in states that do not take delegation of the program) by providing compliance assistance, auditing facility RMPs, and inspecting facility risk management programs. Voluntary compliance assistance (with EPA and OSHA rules, in particular) has always been a component of chemical safety audits, and RMP auditors and site inspectors will be able to draw on their CSA training and experience in interacting with these facilities.

At the same time, there will still be many facilities handling extremely hazardous substances below threshold quantities that are not covered by the RMP requirements; for example, small-scale manufacturers, warehouses, and other chemical users. The CSA program will continue to have an important role in chemical accident prevention through audits of these facilities.

Headquarters and the regions have been examining their needs and making adjustments to the CSA program to reflect its evolving role in the chemical safety process. Chemical safety audits remain voluntary (although Regions have the discretion to enforce deficiencies noted during the audits), and the Regions retain flexibility on the scope of their CSA program. In the future, it is expected that some Regions will continue their successful audit programs, with special attention to facilities with accident histories and non-RMP-regulated facilities that may benefit from a voluntary audit. Other Regions may decide to focus less resources on chemical safety audits and concentrate on RMP audits instead. Further, as states become partners with EPA in implementing the risk management program, additional training and guidance drawing upon CSA program expertise may be needed. As implementation of the CAA regulations and the General Duty Clause continues, it will become clearer how the CSA program will evolve.

1.4 CSA Training Workshop

To provide guidance on the procedural and technical aspects of conducting an audit and to promote a better understanding of the objectives of the CSA program, EPA designed the Chemical Safety Audit program workshop. In FY 97, EPA's Environmental Response Training Program continued to offer the four-day CSA workshop as part of its regular curriculum. Workshops were held in Groton, CT; Pomona, NY; Harrisburg, PA; Little Rock, AR; Oklahoma City, OK; Lee’s Summit, MO; Great Falls, MT; Mesa, AZ; Pasadena, CA; Rancho Cordova, CA; Richmond, CA; and Honolulu, HI. A total of 279 EPA regional, AARP, contractor, state and local government, other federal agency personnel, and other individuals attended the 12 workshops.

For FY 98, the Environmental Response Training Program plans to present 10 additional four-day CSA courses. These workshops are designed for presentation to a combination of regional, AARP, contractor, and state and local government personnel who are or will be involved in conducting chemical safety audits. The topics addressed during the current four-day workshop include:

- Chemical process hazards
- Process safety management
- Computer modeling
- Process safety: equipment
- Process safety: operations
- Hazard and release mitigation
- Maintenance procedures and training requirements
- Conducting interviews
- Incident investigation
- Hazard evaluation
- Hazard evaluation techniques
- Emergency response
- Process inspection techniques
- Audit report writing

- *Guidance Manual for EPA Chemical Safety Audit Team Members*

- *Chemical Safety Audit Program Resource Guide*

In addition, a series of sequential group exercises is held during the workshop to provide participants with the opportunity to apply theoretical knowledge to scenarios that simulate all phases of conducting a chemical safety audit, including interviewing facility personnel.

1.5 CSA Database

To collect and disseminate information on chemical process safety issues and improve program coordination, CEPPO has assembled a computerized database to provide EPA regions and headquarters (as well as state and local government agencies) with information gathered from chemical safety audit reports in a format consistent with the CSA protocol. The profiles present a summary of audit observations and include the audit team's conclusions and recommendations. The profiles also contain information on facility name, location, primary processes, and product(s); the hazardous substances examined for the audit; and the name, affiliation, role, and expertise of each audit team member. The information in the database is useful to EPA regional offices for a variety of purposes, such as identifying field experts and comparing processes and safety practices at different facilities for the same chemicals. Although the database is not directly available to the public and industry, EPA will use it to develop guidance and technical assistance documents that will be distributed to individuals and organizations involved in chemical accident prevention.

The database has been given to interested federal, state, and local officials who have attended CSA training workshops. These individuals are using the database as a source of background information on chemical hazards, process hazards, and successful and problematic facility practices in preparation for their own inspection and auditing activities. For example, by reviewing the information on typical operating hazards and release prevention practices at the paper mills contained in the CSA database, these officials have been better prepared to conduct inspections of similar paper mills under their own jurisdiction.

The CSA database makes it possible to examine audit information about specific facilities quickly. For example, the database user can easily examine and compare audit observations and recommendations for facilities that use similar chemicals, that manufacture similar products, or that are located in the same EPA region. Users can search the database for different types of information, such as chemical names or Chemical Abstract Service (CAS) numbers, SIC codes, processes, and process safety practice or technique, or a combination of fields. For example, a user could search the database to identify the type of containment systems present at chemical manufacturing facilities (SIC code 28) that use chlorine. EPA regional and headquarters personnel (as well as other federal and state and local officials implementing similar programs) can also use the database to:

- Identify field experts for auditing advice or participation in an audit;

- Identify facilities with similar processes or practices to support an ongoing audit;

- Compare successful or problematic safety practices among similar facilities;

- Identify previous recommendations for a similar process safety practice or technique;
- Compare safety equipment among similar facilities; and
- Assemble information on a specific chemical safety process management practice.

The current version of the CSA database, distributed in July 1996, contains profiles of 312 chemical safety audits.

2.0 OVERVIEW OF CSA PROGRAM RESULTS

This chapter presents an overall summary of the achievements of the Chemical Safety Audit program focusing on the following subjects:

- Chemical safety audits and audit reports completed in each fiscal year;
- Breakdown of the audited facilities by Standard Industrial Classification (SIC) code;
- Hazardous substances examined by the audit teams; and
- Chemical safety audit training workshops conducted.

2.1 Chemical Safety Audits and Reports Completed

As of the close of FY 97, the regional offices have finalized a total of 349 audit reports for the 358 full-scale chemical safety audits, including several follow-up audits for which no audit report profile was prepared. Exhibit 1 displays totals for the number of chemical safety audits that the regional offices conducted during each fiscal year. The number of reports completed by each regional office is also included. The chart indicates that 32 full-scale chemical safety audits were completed in FY 89, 39 in FY 90, 53 in FY 91, 41 in FY 92, 57 in FY 93, 57 in FY 94, 44 in FY 95, 26 in FY 96, and 9 in FY 97. Exhibit 2 summarizes the chemical safety audits and final reports completed by region. In addition, note that these totals do not include the mini-audits conducted by the regional offices in the last three years; in FY 97, Region 3 conducted 63 mini-audits.

2.2 Chemical Safety Audits by SIC Code

Approximately half of the chemical safety audits conducted by the regional offices involved chemical manufacturing operations (SIC code 28). Exhibit 3 presents a breakdown by SIC code of the 349 audited facilities for which this information is available. (Some facilities' operations are categorized in more than one SIC code, a characteristic that is reflected in the exhibit.) Within SIC code 28, the vast majority of the processes examined were further classified under SIC codes 281, 282, 286, and 287. Other manufacturing operations at which a number of audits were conducted are paper and pulp mills — SIC code 26 (29), petroleum refineries — SIC code 29 (24), food processors — SIC code 20 (22), primary metal manufacturing — SIC code 33 (15), and electronic and electrical equipment manufacturing — SIC code 36 (14).

Non-manufacturing operations at audited facilities comprise one-seventh of the total number of audits and are classified in a variety of SIC codes. The major categories among these operations are nondurable goods wholesalers handling hazardous substances — SIC code 51 (22); electric, gas, and sanitary services — SIC code 49 (9); and public water treatment facilities — SIC code 95 (8).

Exhibit 1

Number of Chemical Safety Audits and Chemical Safety Audit Reports by Region

FY 89 through FY 97

Region	FY 89 Audits	FY 90 Audits	FY 91 Audits	FY 92 Audits	FY 93 Audits	FY 94 Audits	FY 95 Audits	FY 96 Audits	FY 97 Audits	Total Audits	Final Reports
1	4	4	3	3	3	3	0	0	0	20	20
2	2	4	3	3	4	3	2	4	0	25	22
3	4	4	4	5	6	6	4	2	0	35	35
4	5	5	15	6	10	8	8	6	5	68	67
5	3	5	3	3	4	4	4	3	0	29	24
6	4	5	5	4	4	4	4	0	0	30	30
7	0	0	4	6	14	18	14	4	4	64	64
8	3	4	6	4	5	4	3	0	0	29	29
9	4	4	4	4	3	3	1	2	0	25	25
10	3	4	6	3	4	4	4	5	0	33	33
Total	**32**	**39**	**53**	**41**	**57**	**57**	**44**	**26**	**9**	**358**	**349**

Note: These totals do not include regional chemical accident investigations and mini-audits.

Exhibit 2

Summary of Chemical Safety Audits and Final Reports Completed by Region

FY 89 through FY 97

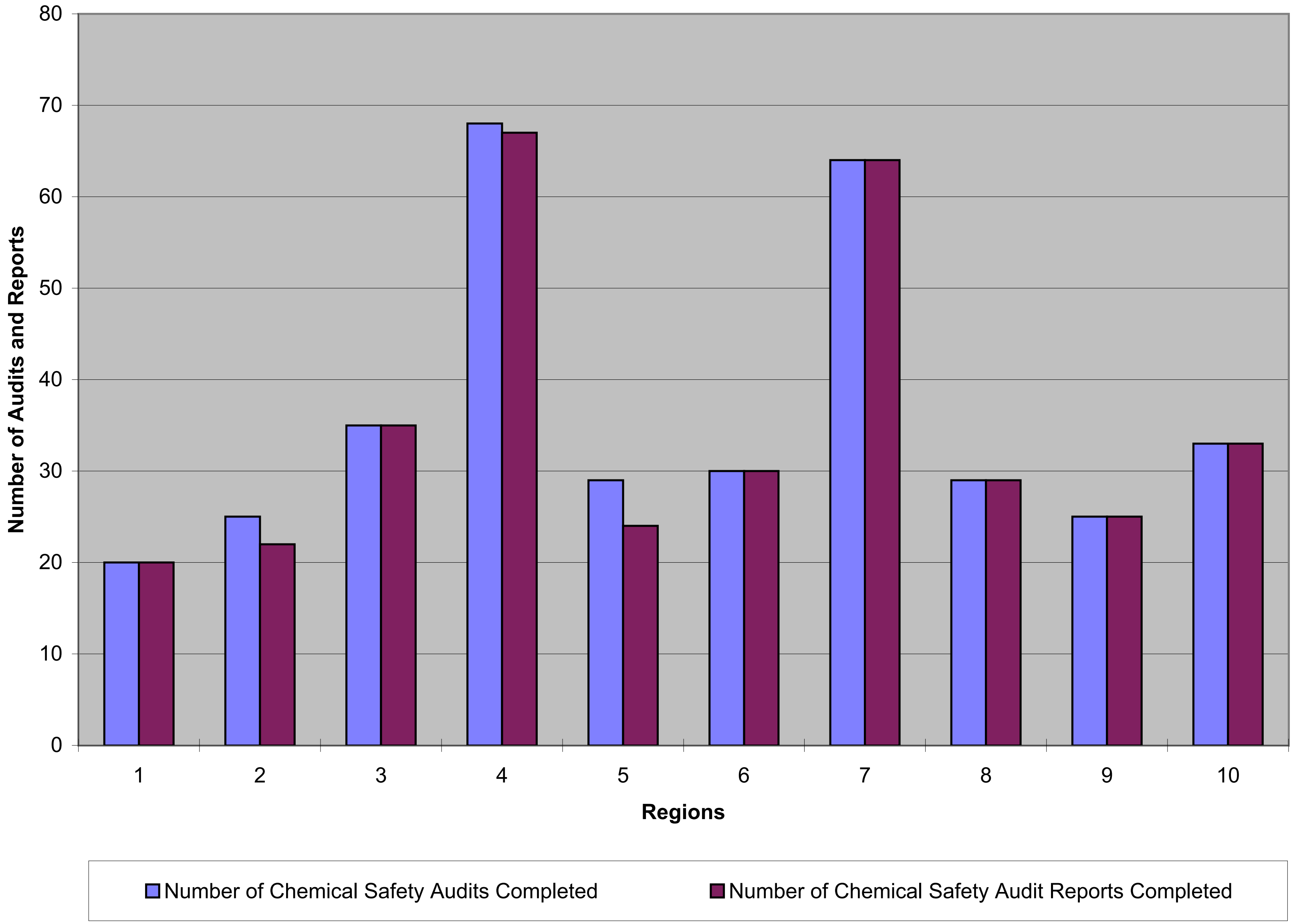
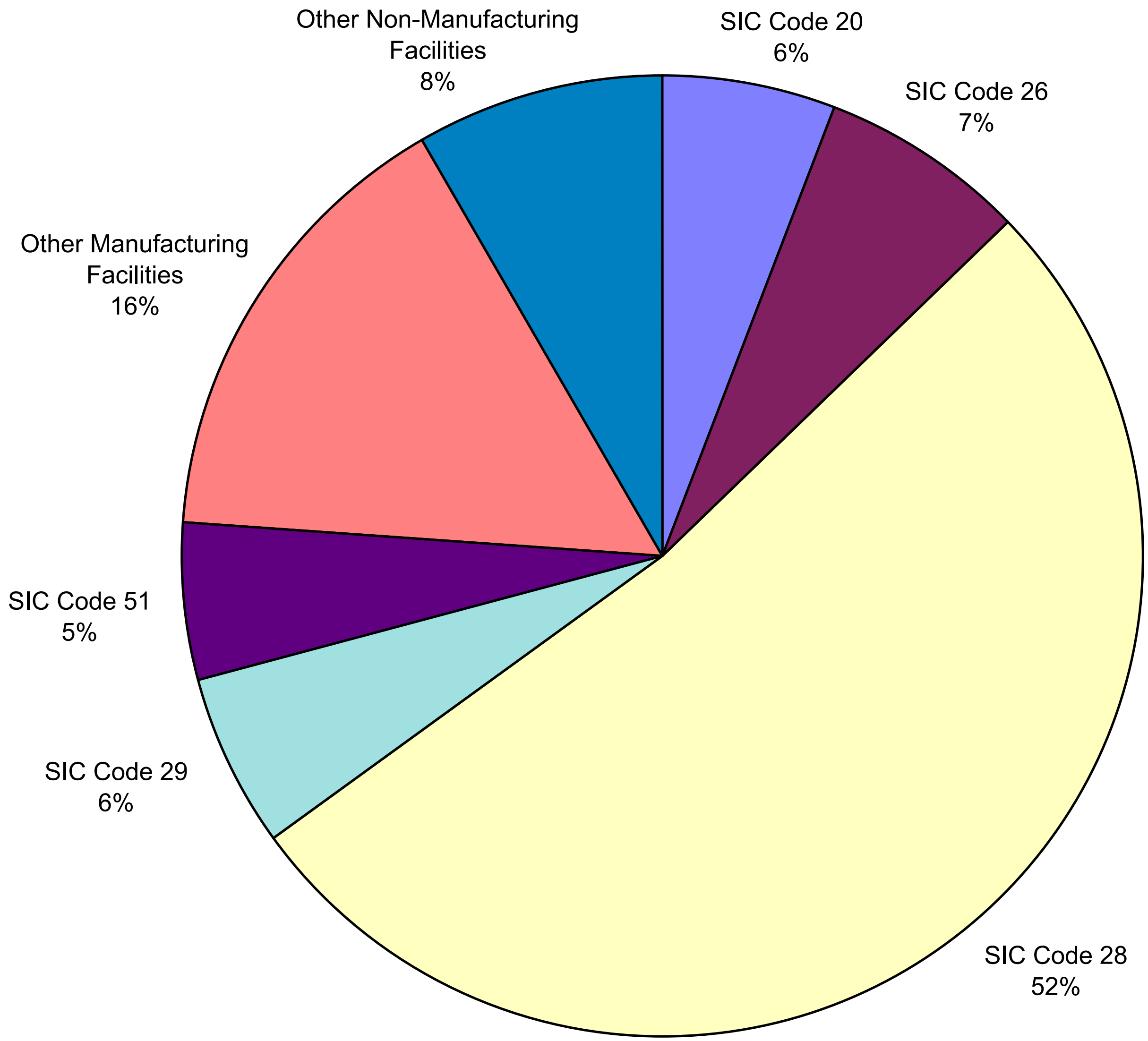


Exhibit 3

Breakdown of Audited Facilities by SIC Code

FY 89 through FY 97



2.3 Chemical Safety Audits by Hazardous Substance

A total of 192 different hazardous substances were examined by audit teams at the 325 audited facilities for which this information was available, including 170 classified as CERCLA hazardous substances and 77 listed as EPCRA extremely hazardous substances. Exhibit 4 presents a breakdown of the CERCLA hazardous substances and EPCRA extremely hazardous substances examined during the audits. On average, processes involving four hazardous and/or extremely hazardous substances were examined at each facility. The five most commonly examined substances were chlorine (125 audits), sulfuric acid (122), sodium hydroxide (101), ammonia (97), and hydrochloric acid (80).

2.4 CSA Training Workshops

As of the close of FY 97, 60 CSA workshops had been conducted in the EPA regions. Since FY 90, the host regions have been co-sponsors of the CSA workshops and provided valuable assistance in organizing and conducting the workshops. Hosting the workshop in cities near the locations of the regional office has allowed other EPA program offices and other federal agencies to attend. In addition, for the last six years the regional offices have been coordinating with the states to identify workshop locations to encourage attendance by state and local officials. This year, all of the workshops were held at sites away from the regional offices.

Twelve workshops were held in eight regions during FY 97. Training workshops were held in Groton, CT (Region 1); Pomona, NY (Region 2); Harrisburg, PA (Region 3); Little Rock, AR (Region 6); Oklahoma City, OK (Region 6); Lee's Summit, MO (Region 7); Great Falls, MT (Region 8); Mesa, AZ (Region 9); Pasadena, CA (Region 9); Rancho Cordova, CA (Region 9); Richmond, CA (Region 9); and Honolulu, HI (Oceania). A total of 279 attendees participated in the 12 workshops. A variety of groups was represented at the workshops including 16 regional personnel, 73 state officials, 99 local officials, and 60 representatives from other federal agencies, including staff from the U.S. Department of Labor and officials from the U.S. Navy, Coast Guard, Marine Corps, Air Force, and Army. In addition, two foreign governments (Canada and Poland) sent officials to attend the training. Exhibit 5 presents a breakdown of CSA workshop attendees by affiliation. Since FY 93, there has been a concerted effort within the CSA program to increase awareness and participation by state and local government representatives in the program. As is demonstrated in Exhibit 6, which compares the percentage of attendees by affiliation from FY 89 to FY 96 to that in FY 97, 62 percent of the FY 96 attendees represented state, local, and tribal governments, as compared to 47 percent in the previous years.

Exhibit 7 is a breakdown by region of the number of audit team members who have received training. State and local officials, EPA headquarters personnel, EPA headquarters contractors, industry and academia, and other federal agency representatives are not included in these figures. The largest number of personnel attending a workshop were from Region 4 (86), Region 3 (69), and Region 2 (58). Note that this exhibit does not include data for TAT workshop attendance from FY 94 - FY 97 due to the involvement of the technical assistance team contractors whose responsibilities cover multiple regions.

Exhibit 4

Hazardous Substances Examined

FY 89 through FY 97

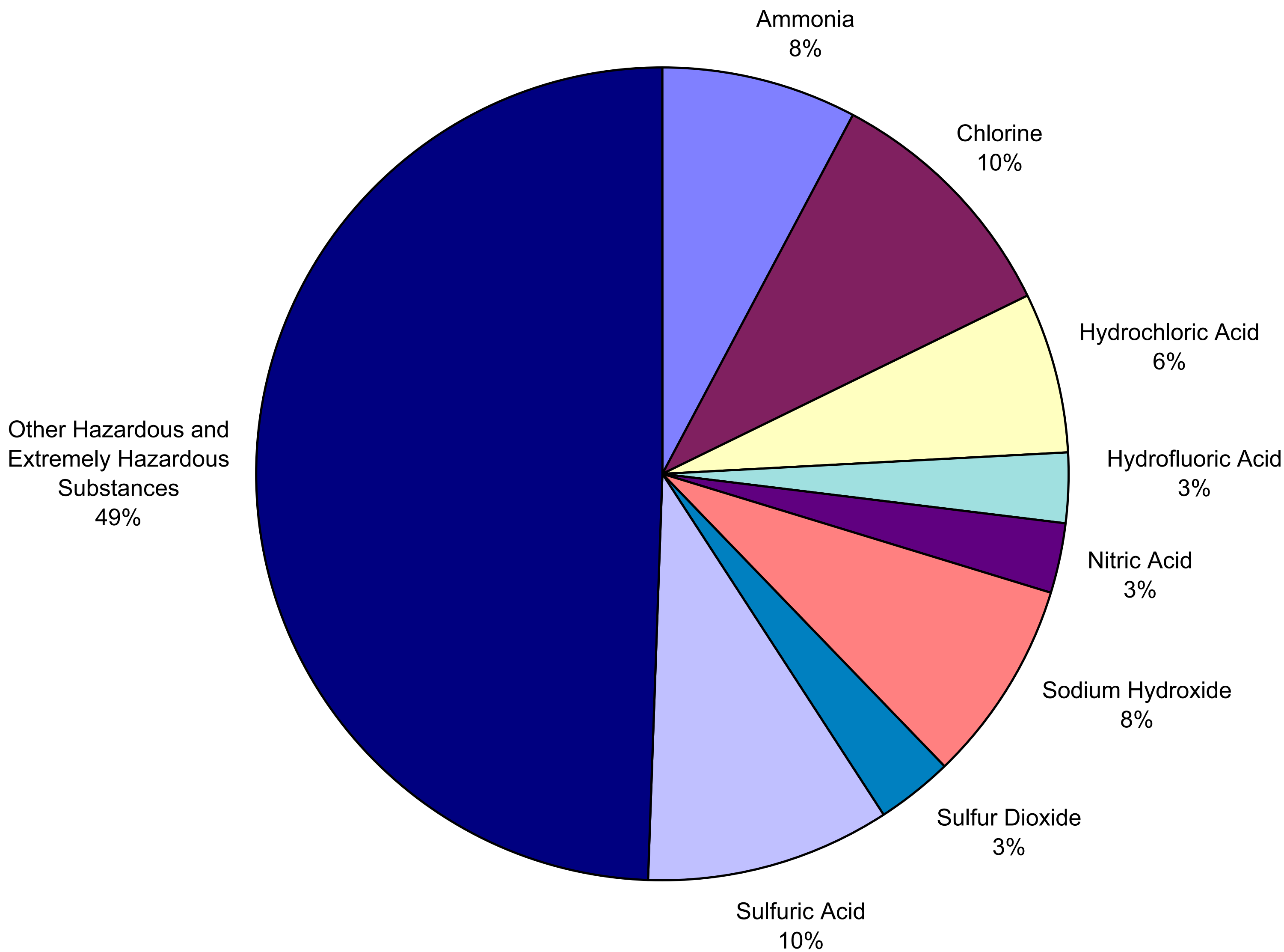


Exhibit 5

Chemical Safety Audit Workshop Attendees by Affiliation

FY 89 through FY 97

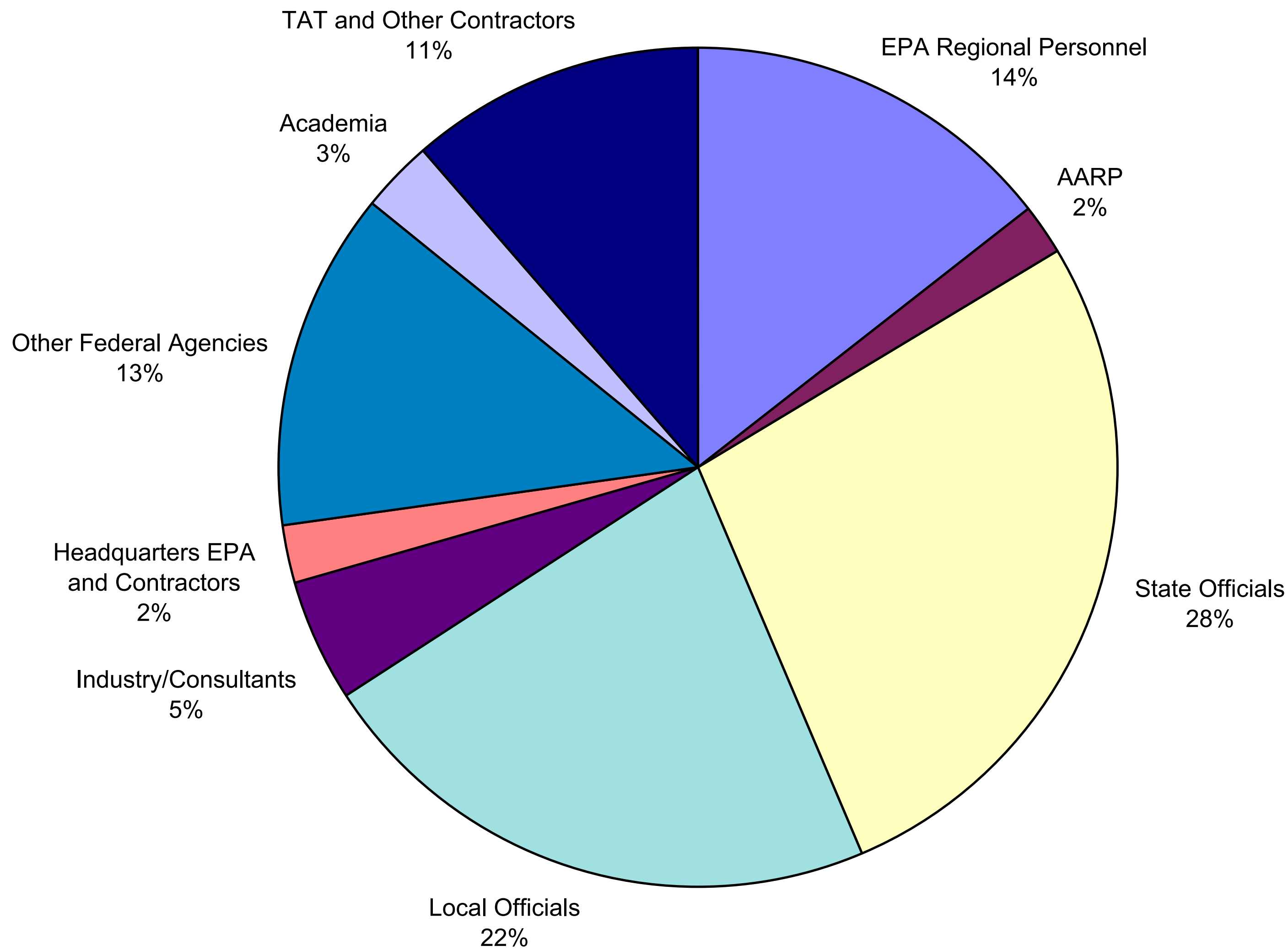
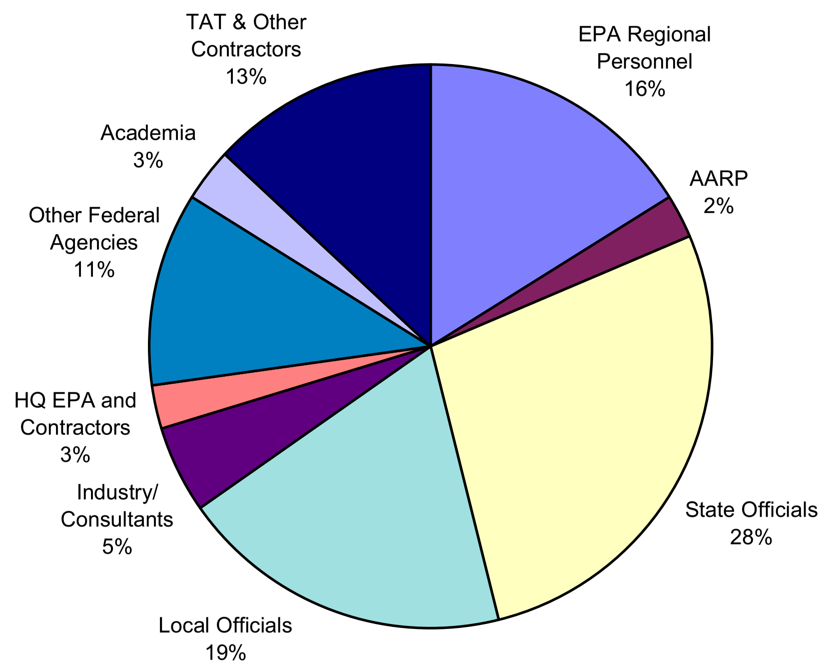


Exhibit 6

Chemical Safety Audit Workshop Attendees by Affiliation

FY 89 through FY 96



FY 97

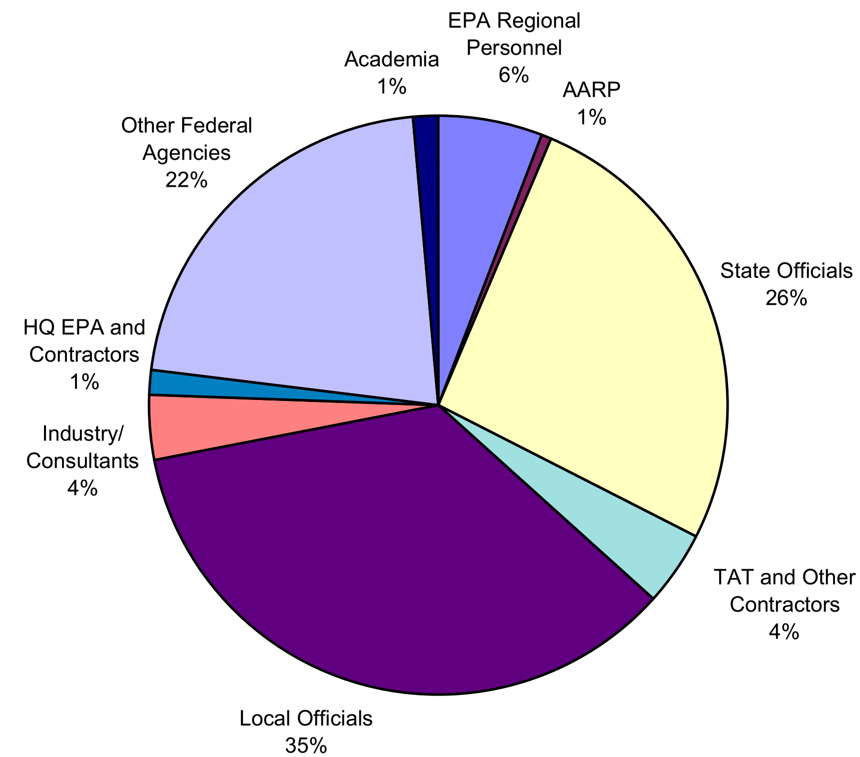
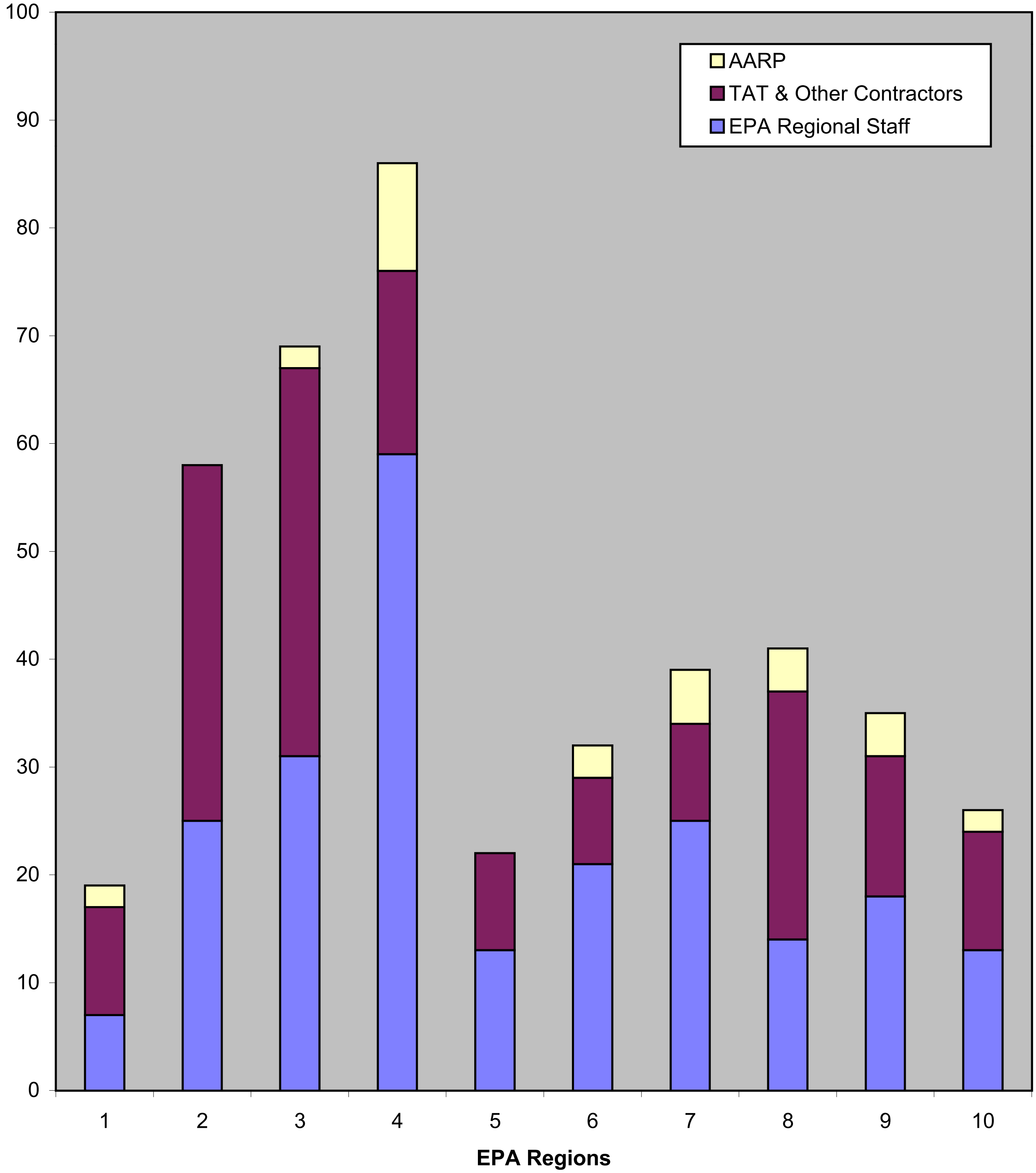


Exhibit 7

Chemical Safety Audit Workshops
Number of Persons Trained by EPA Region

FY 89 through FY 97



3.0 OVERVIEW OF CSA REPORT FINDINGS

This chapter presents a review of conclusions and recommendations taken from recent EPA chemical safety audits, based on the latest 16 final CSA reports received by EPA headquarters as of September 30, 1997. The results are organized according to the generally recognized elements of chemical process safety management practices, which form the basis for the risk management program regulations issued under CAA section 112(r) (see 40 CFR part 68), and OSHA's Process Safety Management (PSM) Standard (29 CFR 1910.119). These principles are specifically applicable to facilities with complex operations and chemical-based hazards, and, thus, in their detail may not be appropriate for simpler operations that do not involve chemical processing.

These chemical process safety elements are closely related to those of the CSA protocol, an outline of which can be found in Appendix A. The following 17 chemical process safety management elements are examined in this chapter of the report:

- Corporate and facility management
- Process hazard analysis (hazard evaluation)
- Offsite consequence analysis
- Process safety information
- Standard operating procedures
- Equipment and instrument maintenance
- Training
- Safety audits
- Accident investigation
- Management of change
- Pre-startup review
- Contractors
- Employee participation
- Hot work permits
- Release prevention and mitigation measures
- Facility emergency preparedness and response
- Community emergency response coordination

Each section of this chapter begins with an italicized overview of the key components of the corresponding chemical process safety management element, followed by a discussion of facility practices described in the latest chemical safety audit reports. CSA report conclusions highlight chemical process safety practices observed at the facility; they reflect the audit team's perception of the facility's understanding of and commitment to chemical process safety management, but are not judgments of adequacy or inadequacy of the practices observed by the team. CSA report recommendations address options that the facility may consider implementing to enhance facility knowledge of and practices in chemical process safety management. These recommendations are based solely on areas observed during the audit and are not required or mandatory actions to be taken by the facility, although audit teams do examine facility practices that are directly related to the components of existing federal regulatory programs (e.g., emergency response plans).

3.1 Corporate and Facility Management

Corporate and facility management play an integral role in ensuring a coherent and consistent approach to chemical safety and health issues at a facility. Corporate management has the unique role of fostering communication among and providing guidance to operations within the corporation, while facility management is better suited for addressing site-specific issues. The degree of support and resources dedicated by corporate and facility management has a direct impact on the effectiveness of all aspects of chemical process safety programs. Identification of responsible personnel is also a key step for ensuring effective process safety management.

Corporate management can play an important role in ensuring that all facilities in a corporation have access to process safety lessons learned. This is especially critical when a single corporation maintains numerous facilities conducting similar processes. For instance, the corporate management of one facility requires that all spill reports be submitted to the corporate office, which then produces a quarterly spill summary documenting incidents and actions to be taken. The corporate headquarters for a network of 32 refrigeration facilities promotes information-sharing and lessons learned between similar facilities by disseminating similar information.

Corporate management can also play a role in monitoring regulatory changes and providing other skills and services that could not be maintained or developed cost-effectively at each facility. Corporate management of a brewery conducts process safety management audits at its facilities and evaluates environmental compliance every two years. An integral part of these audits are the followup reports on the resolution of the audit findings. Management has also issued company-wide procedures for mechanical integrity assurance of ammonia systems. The corporate office overseeing numerous poultry processing facilities coordinated process safety management training for outside contractors and also supplies its facilities with manuals that include adjustments made to cover site-specific needs. Corporate management of another audited facility promotes safety by monitoring and communicating regulatory requirements, arranging hazard analysis training for divisions, and conducting periodic audits.

Audit teams encouraged corporate management for several facilities to take a more active role in developing standards and in sharing lessons learned between similar facilities. For instance, corporate management of a brewery, although active in other areas of process safety management, was prompted to make computer modeling results of hypothetical ammonia releases at one of its facilities available to other facilities where ammonia is used. Corporate management of another audited facility was encouraged to establish a specific vehicle to routinely (e.g., monthly) share results of incident investigations between two of its plants that are identical in design.

Audited facilities use a variety of management techniques to disseminate process safety information within the facility. A typical facility established a safety committee consisting of both staff and management and uses monthly safety meetings with all personnel to share company memoranda and review any safety literature. The format includes a presentation, open discussion, and then a quiz. This same facility ensures that a single individual is responsible for ensuring effective process safety management, with the plant manager's annual appraisal dependent, in part, on achieving specific environmental and safety objectives. Another facility manages quality assurance, as well as safety and health, by using a system of quality teams throughout the plant. Facility management keeps plant personnel informed of all safety and environmental requirements through meetings, training, written notices, and other mechanisms.

3.2 Process Hazard Analysis (Hazard Evaluation)

Process hazard analysis (PHA), also known as hazard evaluation, is a key factor in the prevention of chemical accidents and, generally, in the management of safety at a facility. A process hazard analysis identifies the hazards at the facility, helps assess the risk posed by the hazards, evaluates the consequences of the hazards, and identifies ways in which the hazards can be controlled or mitigated, thus directing facility attention to areas in most need of improvement. In conjunction with the management of change, this analysis serves as a foundation for the ongoing revision of a facility's accident prevention efforts. Although there are several methods for performing this analysis, each approach will provide the facility with information on identifying potential accidental release scenarios and, thus, support the preparation of an offsite consequence analysis.

For more complex chemical processing operations, facilities conducting a process hazard analysis should use one of the generally recognized formal techniques (e.g., What If, Checklist, What If/Checklist, Hazard and Operability study (HAZOP), Fault Tree Analysis, or Failure Mode and Effect Analysis); less formal approaches may be sufficient for simpler operations. Depending upon the complexity of the process(es) being examined, facilities may find that a review of the hazards posed by a process, rather than a detailed PHA, may be sufficient to carry out the aim of effective process safety management. Facilities should implement the results of the analysis; this process should be tracked to determine whether recommendations are implemented in a timely manner. Finally, the evaluation should be updated periodically or whenever a process modification is introduced.

Most audited facilities have at least an informal program to evaluate hazards, and a number of facilities have formal process hazard analysis programs to enhance process safety management and identify and address areas for improvement. A chemical manufacturing company uses HAZOP analysis to evaluate its bleach manufacturing process and bleach bulk storage operation. Criticality, frequency, and risk values are assigned to each deviation. Results and recommendations are recorded and tracked on the same form, and when an action is taken, the new values are updated. Another facility also uses the HAZOP hazard evaluation method; the facility's corporate offices evaluated the different process hazard analysis methods and selected the HAZOP method as the most detailed and precise method to evaluate plant processes. To further aid in the process hazards analysis, this facility uses a HAZOP software program.

Most facilities perform at least some process hazard analysis, although this analysis is frequently limited to the extent required by regulation. Audit teams often recommended that facilities consider broadening their process hazard analysis to include either additional processes or information not required by regulations, or to include the requirements of EPA's Risk Management Program (RMP) rule.

For instance, one fiberglass insulation manufacturer currently has a HAZOP team that reviews reports submitted by its accident investigation team and suggests corrective actions, which facility management then reviews for implementation. However, the audit team recommended that the facility broaden their HAZOPs to include other, potentially less critical processes. At another facility, the audit team found that formal process hazard analyses had been conducted in accordance with OSHA's PSM standard, including HAZOPs and "What If" analyses. The PHA on the ammonia refrigeration system at this facility resulted in 136 prioritized recommendations. Although past incidents, piping and instrumentation diagrams, SOPs, and materials of construction requirements were used in conducting the hazard evaluations, the audit team recommended that the PHA could be enhanced by developing a more detailed list of documents for use in conducting facility HAZOPs. Relevant documents might include corporate policy documents, as well as ANSI, ASME, ASHRAE, and International Institute of Ammonia Refrigeration guidance.

An audited chemical manufacturer performs process hazard analysis on eleven OSHA PSM processes. However, auditors recommended that the facility consider incorporating air modeling with offsite consequences into its process hazard analyses when they are updated (as is required under the RMP rule). At another facility, the audit team noted that the facility used the hazards and operability technique, focusing on OSHA PSM requirements with little emphasis on offsite consequences. Noting that some of the PHAs will need to be updated and revalidated shortly, the audit team recommended that the facility incorporate the RMP requirements as appropriate. Several other audit teams recommended that facilities begin addressing the requirements of the RMP rule as soon as possible. For example, a paper products manufacturer was encouraged to perform process hazard analyses for its aqueous ammonia process.

In a few cases, audit teams found no evidence of substantial activities to support process safety management, especially with regard to process hazards analysis. Two chemical manufacturers had no formal system for hazard evaluation and investigation. The audit team encouraged the facilities to develop and implement a formal system.

3.3 Offsite Consequence Analysis

An offsite consequence analysis is designed to assess the potential impacts of a release of a hazardous chemical on the populations and environments surrounding a facility. Based on the potential hazards identified in the process hazard analysis, facilities should examine a range of potential accidental release scenarios to identify the potential offsite consequences and evaluate the likelihood of the release occurring. As a result, the offsite consequence analysis will help facilities establish emergency response needs and priorities in the case of a release (and the implementation of measures to prevent or mitigate such events) based on both their potential impact and their likelihood of occurrence.

Only a few audit teams found that facilities were using offsite consequence analysis to evaluate potential hazards. One such facility, a polymerization unit, performed release modeling for vinyl chloride, hydrogen chloride, ethylene dichloride, and chlorine using the Complex Hazardous Air Release Model. Although the facility has modeled potential explosions, this did not address fires or Boiling Liquid Expanding Vapor Explosions (BLEVEs). The audit team recommended that the facility consider more extensive modeling, because the facility is located close to sensitive areas that may be adversely affected by a fire or BLEVE and has many flammable chemicals, numerous pressurized storage tanks, and potentially explosive organic peroxides.

Audit teams found that numerous other facilities are not implementing offsite consequences analysis efforts at all; other facilities do not use their air modeling results in emergency preparedness or response efforts, or are doing so incompletely. One facility, located near two elementary schools, a hospital, and two public parks, does not perform any modeling to track releases into air, surface water, or groundwater. Vulnerability zones for a chlorine and an ammonia release from rail cars were calculated in this facility's plan, but the assumptions used for this analysis were not the same as those required by the *Technical Guidance for Hazardous Analysis*. The audit team recommended that the facility conduct in-house modeling to determine the effects of releases to the environment. Two other facilities had not conducted any air modeling for emergency response purposes. Another facility, a machining plant that maintains stores of corrosive materials, has not identified potential vulnerable zones for their worst-case scenario, or for other, more likely scenarios.

Audit teams provided or recommended modeling software to some facilities. For example, a team conducting an audit of a refrigeration service suggested that the facility perform contingency modeling and provided the facility with a copy of the ARCHIE modeling program. The audit team also noted that the local fire department has ALOHA modeling software that the facility could use.

Several facilities located in close proximity to sensitive populations had not performed offsite consequence modeling or identified their vulnerability zones. In general, audit teams recommended to these facilities that release modeling would be a useful tool to predict the direction or concentration of potential releases and could be of great value in emergency preparedness and planning. Teams suggested that modeling should include both a worst-case scenario and a release of lesser magnitude but higher likelihood. The audit team visiting a brewery noted that the facility had not performed modeling to estimate the potential extent of a worst-case release or more likely release events. In another region, two chemical companies in populated areas had not used modeling to predict the direction or concentration of potential releases.

Several audit teams recommended that audited facilities should begin to implement the off-site consequence analysis provisions of the RMP rule as soon as possible, without waiting for the regulatory compliance deadline. For instance, the audit team at a paper processing facility recommended that the facility conduct air modeling of aqueous ammonia to determine the potential consequences of a release.

3.4 Process Safety Information

Documentation of process safety information (including chemical hazards and process technologies and equipment) is important because a facility's accident prevention program must be based on up-to-date information on chemical hazards, processes, and equipment. Data on chemical hazards ensure that a facility's employees understand the inherent toxicity of a substance, as well as the potential for fire, explosion, corrosivity, or reactions with other chemicals. Current data on processes are imperative to conduct a hazard evaluation and to implement effective standard operating procedures, training, and maintenance. Equipment information — piping and instrument diagrams, materials of construction, electrical classification, relief system design and design basis, ventilation system design, design codes and standards employed, material and energy balances, and safety systems — should be documented and kept current.

Several facilities established procedures to guarantee that MSDSs are obtained for each hazardous chemical onsite and are up-to-date. However, MSDSs were not always equally accessible in all areas of a facility. For example, at a chemical manufacturer, MSDSs are on file in the production office, but are only available on microfiche in the operations area. Audit teams also noted situations where different personnel types (e.g., visitors or contractors) could be better oriented to plant hazards, such as at a chemical manufacturer.

Audit teams commended facilities who made MSDS information easily accessible and understandable to employees. A chemical manufacturer maintains a written hazard communication program whereby MSDSs for chemicals used or produced in the facility are available for review in the laboratory. Prior to handling new chemicals, the supervisor briefs workers on safe handling practices of these materials. At a brewery, facility storage vessels and containers are well-labeled, color-coded, and placarded with NFPA diamonds. Furthermore, instructions for interpreting specific placards are posted at the facility's unloading station.

Audits also revealed facilities whose chemical hazard information was poorly documented or not up-to-date. For example, a manufacturer of paperboard did not keep MSDSs for chemical byproducts at the facility. In the absence of other forms of chemical hazard data, the audit team recommended to an insulation manufacturer that the facility develop its own MSDS or hazard information sheet format using the Chemical Manufacturers Association guidelines. In addition, an audit team noted that a cold storage facility did not have an approval system for new, revised, or updated MSDSs.

At some facilities, additional work was recommended to familiarize employees with process safety information. For example, at a chemical manufacturer, audit team members observed that while some plant personnel seemed knowledgeable about the hazards associated with the chemicals they work with, some employees were uncomfortable with the contents and use of MSDSs.

At a number of facilities, audit teams noted areas for improved process and equipment safety measures. Commonly cited issues were the lack of labeling on pipes (i.e., contents and direction of flow markings) and tanks, incompatible materials (such as flammables and oxidizers) stored in close proximity, and process safety information that was not kept current. For example, at a chemical manufacturer, some tanks, reactors, drums, valves, and chemical storage areas were not marked and labeled in accordance with standards. Similarly, some containers in the facility were labeled with the color-coded hazard warning labels (i.e., flammable, corrosive, oxidizer), chemical numbers, and chemical names, while others were not. Also, at a refinery, equipment labeling was hard to read and there was a lack of labeling for flow direction and contents on most tanks and pipes.

3.5 Standard Operating Procedures

Standard operating procedures (SOPs) provide the basis for coherent, safe facility operations by supporting safety in day-to-day activities and in operator training programs. SOPs describe site access, process startups and shutdowns during routine and emergency operations, lockout and tagout, confined space entry, opening process equipment or piping, storage, handling, loading, and unloading. SOPs addressing operating parameters should include operating instructions about pressure limits, temperature ranges, flow rates, and steps on how to handle process deviations. Furthermore, SOPs should be reviewed as necessary to ensure that they reflect current operating practices (including changes that result from alterations in process chemicals, technology, equipment, and modifications of the facility) and that current information is transmitted as part of employee training.

Most large facilities audited had extensive SOPs for their processes. Audit teams cited many examples of thorough SOPs that were formally documented and implemented by employees. One such facility, a chemical manufacturer, had SOP manuals available for many areas. For example, a manual exists for the sodium hypochlorite manufacturing process, and the facility prepares production worksheets for each production run, as well as for loading and unloading of bulk chemicals. The review date for each SOP is listed at the top of the first page of the SOP. To ensure document control, whenever an SOP is updated or changed, the master copy is written in blue ink and the copy sent to the corporate office for final revision. The new SOP is reissued to the branch office within 60 days of the initial change. In addition, the facility has developed a mandatory training SOP describing training in worker health and safety and facility operations for all operations.

Audit teams frequently made suggestions regarding potential improvements to the SOPs even at facilities that maintain detailed SOPs. A brewery with an ammonia refrigeration system was found to have SOPs that were, in general, clearly written and highly detailed. SOPs are reviewed annually by operating personnel, under the responsibility of the maintenance department. If a process or operation is changed, the operators review and make any necessary revisions to the SOPs. All SOP changes are reviewed by the operator's supervisor and field-tested. This brewery was also found to have a detailed written procedure for unloading ammonia delivery trucks, including inspection and equipment details that are overlooked by many facilities. However, the audit team noted that the truck unloading procedure does not instruct facility personnel to verify that the vehicle's brake is set and wheels are chocked before the unloading connections are made.

Typical problems with SOPs observed by the audit teams ranged from a lack of formal written procedures to insufficient documentation and failure to cover all operations. For example, a manufacturer that receives and stores corrosive acids maintained SOPs for loading and unloading procedures. However, the audit team found that the SOP was not sufficiently detailed and recommended that the facility prepare a more detailed SOP for the loading and unloading of hazardous chemicals, including emergency response considerations. Other facilities were encouraged to make changes in their SOPs to make them easier to read and reference. A team auditing a refrigeration service suggested that the SOPs should be better organized to make them easier to use. For example, the team noted that some SOPs referenced other SOPs. In addition, the SOPs did not include a generation date, review dates, or reasons for activating the procedures. Similarly, the SOPs developed by another chemical plant were not adequately detailed and did not include written maintenance procedures. The audit team suggested that this facility review its SOPs for accuracy and completeness.

Several audit teams found that facilities' SOPs were not reviewed with sufficient frequency or that revisions were not clearly documented. For example, at the chemical manufacturer described above, the SOP for the prevention and control of discharges was last updated in late 1993. The audit team recommended that management consider implementation of a schedule for internal review and updating of this SOP to incorporate process and equipment changes. A refinery maintains SOPs, but several of the procedures in the safety manual appeared to need updating. Several audited facilities recognized the need to update their SOPs more regularly, but had not yet begun this process. One poultry processor was organizing their SOPs at the time of the audit. The facility reported that, when this process is complete, SOPs will be reviewed annually. The audit team recommended that the date of the review and the reviewing person(s) should be recorded on the document whenever an SOP is revised or updated.

Several facilities are voluntarily participating in programs to verify or improve environmental and safety processes. However, even these facilities frequently were found to limit their SOP development or review to the levels required for such programs. For instance, a chemical corporation has completed an ISO 9002 registration audit and received certification; all SOPs and other documents are prepared and controlled in accordance with ISO 9000 requirements. However, the audit team recommended that the facility generate and implement a schedule to update its SOPs. Another facility, a paper processing plant, has developed SOPs in accordance with ISO 9002 standards, as well, and has expanded its SOPs to include OSHA PSM requirements for covered processes only. The audit team recommended that the facility consider standardizing its SOPs in the OSHA PSM format.

3.6 Equipment and Instrument Maintenance

Equipment and instrument maintenance falls into two categories: predictive/preventive maintenance, which is performed to avoid equipment failure or breakdown, and emergency maintenance, which is performed in response to equipment failure. While emergency maintenance is an essential element of any facility safety program, systems of predictive or preventive maintenance are essential to the prevention of equipment failure and subsequent releases. The purpose of a maintenance program is to ensure that equipment is regularly monitored and serviced so that emergency situations do not occur; this can help not only to prevent releases, but also to decrease facility downtime and increase overall efficiency. To be effective, maintenance programs should cover chemical process and handling equipment, instruments, and emergency response equipment.

For larger, chemical processing operations, generally accepted practices for a comprehensive maintenance program include developing a list of critical equipment and controls; designing a maintenance program that includes procedures and schedules; training employees in maintenance procedures; and ensuring that maintenance supplies are suitable for the facility's purposes. Most successful programs for large or complex facilities include the use of computer databases or other systems to track maintenance activities. Smaller or less complex facilities may, however, find that a less formal process can also result in an effective preventive maintenance program.

A few audited facilities were commended for outstanding preventive maintenance practices. For example, a scroll compressor manufacturer has instituted a rotating equipment program whereby a contractor provides infrared electrical checks at the facility on a two-year cycle. Similarly, many audited facilities used computerized tracking systems to run their preventative maintenance programs. For example, a brewery tracks its preventive maintenance on a computerized system used throughout the corporation. PM intervals are based on the original equipment manufacturer's recommendations, except where experience with a particular piece of equipment indicates otherwise. Scheduled PM is supplemented by routine walk-through inspections performed by operators six times daily. The system can also track actual operating hours for expensive equipment that do not operate continuously. The audit team reported that this facility is also beginning to incorporate vibration analysis and oil analysis as predictive maintenance tools. Furthermore, this brewery maintains approximately 4,500 instruments on the facility's instrument maintenance and calibration tracking system. PSM-critical instruments are identified in this system, as well as tag numbers for each instrument and other relevant information.

Other facilities did not have such elaborate systems to track and predict maintenance needs, but performed systematic preventive maintenance nonetheless. At a chemical manufacturer, requests for routine "replacement in kind" work are entered into a maintenance workbook in the production area. Preventive maintenance is conducted where possible as part of the PSM mechanical integrity program, and the most critical equipment at the facility has in-line spares installed. At a chemical manufacturer, the facility has written documentation of all maintenance on its equipment, and work order forms are used for all maintenance operations.

Other facilities did not conduct thorough preventive maintenance programs. For example, until recently, a circuit board manufacturer only conducted equipment repairs and instrument maintenance on an as-needed basis; this facility has recently instituted a scheduled repair program to reduce production interruptions. An audit team noted that a chemical manufacturer did not regularly calibrate process control instruments, and that the work order system of a manufacturer of paperboard did not ensure that only approved replacement in-kind mechanical stores are used for repairs. Furthermore, at another chemical manufacturer, a manual maintenance work order system is used, and additional work is needed to complete the facility’s mechanical integrity program. The audit team recommended that this facility evaluate the benefits of using computerized systems for the work order system, complete a mechanical integrity program, and consider implementing a preventive maintenance program.

Although some audited facilities have incorporated emergency equipment into their regular maintenance programs, and others conduct these activities in conjunction with drills and exercises, other facilities did not have procedures to maintain their emergency equipment. A chemical manufacturer inspects its emergency equipment weekly. Documentation of these inspections is maintained in a binder located in the environmental health and safety department, but is not included in the facility’s contingency plan. At a refinery, the audit team recommended that the facility begin regular maintenance of its emergency equipment stations. However, other facilities had thorough emergency equipment maintenance and inspection procedures. For example, a brewery inspects and inventories its emergency equipment cage monthly, and restricts access to this equipment to authorized personnel by a keypad security code. The encapsulating suits and other equipment with specified shelf lives at this facility are checked during each inventory to ensure that they are still within their manufacturer's recommendations.

The depth and quality of the training afforded to maintenance workers can also affect the quality of a facility's maintenance program. For example, an audit team observed that a chemical manufacturer did not have a formal training program for maintenance personnel. However, the new maintenance manager at this facility has received permission to allow personnel to attend trade shows as well as classes at equipment vendor schools and on programmable logic controllers. There are no equipment history records for the time prior to the hiring of the new maintenance manager. However, this new manager is now instituting a system to support both preventive and predictive maintenance programs.

3.7 Training

Training of supervisory and operations personnel provides the most immediate opportunity to increase awareness of chemical health and safety issues and ensures the competence of employees in performing their responsibilities. Training programs are the key to ensuring the effectiveness of SOPs, maintenance programs, pre-startup reviews, and emergency response. Refresher training ensures that established employees are reminded of appropriate procedures periodically and of alterations that have occurred. To minimize the risk of accidents occurring because employees are unfamiliar with their assigned tasks, a successful training program for a facility with complex, chemical processing operations should include the following: initial and refresher training for all employees; procedures to confirm that all employees are competent to do their jobs safely; additional training after any change is made to the process or to the facility overall; and formal documentation. Smaller operations, and those with more limited chemical handling activities, may find a less formal program sufficient to fill their health and safety needs.

Many of the facilities audited had implemented the basic components of a training program, including training policies and schedules, refresher courses, and incorporation of management of change procedures. For instance, a circuit board manufacturer trains its new employees in the operation of equipment prior to allowing them to assume responsibility for that equipment and its operation. Training documents consist of quality improvement checklists, the quality control manual, acceptability criteria, safety rules, shop rules, company policies, and the employee training document. Facility policy is to provide refresher training to employees every twelve months.

One audit team noted a chemical facility with an unusually well-documented training program. Health and safety training is conducted on a monthly basis, as specified in the Mandatory Training SOP. Records for job-specific training are maintained in the mandatory training binder. Employee training records are kept in the individual's employee file. All training sessions have the training date and training description recorded on a form. An accompanying sign-in sheet for employee signatures attending the training is kept in the binder along with the SOPs. The facility verifies qualifications by requiring employees to demonstrate proficiency in their work and passing grades on training quizzes.

At a brewery, an audit team found an established training program and training group, with a designated plant training coordinator. Most training activities are tracked using a computerized skills tracking program. In addition, each department typically has two designated trainers. Employees who work on or near the ammonia system receive at least 40 hours of initial ammonia training and refresher training every three years. The training includes a videotape that illustrates ammonia hazards, including vaporization and flammability hazards. Employees are tested to verify comprehension after the initial training, but currently are not tested after the refresher training. However, facility personnel indicated that such tests are being developed.

Audit teams did suggest specific improvements to round out training programs at several facilities. One chemical manufacturer has developed training courses for its employees on hazard communication, emergency response, and chemical hazards, which is given using video presentations and question and answer sessions. The audit team encouraged the facility to continue to improve the hazard communication, emergency response, and chemical hazards training programs and increase chemical safety awareness in the facility by updating all programs in light of any new regulatory requirements. Another audit team encouraged a chemical facility to expedite the planned training of all of its employees to the HAZWOPER Awareness level.

One or two audited facilities had no formal training programs. For example, one chemical production facility had no formal training for maintenance personnel. The team noted that the new maintenance manager had received permission to allow personnel to attend trade shows as well as classes at equipment vendor schools and on programmable logic controllers. Production supervisors at the facility were responsible for training production personnel on operations and procedures. Other facilities had training requirements, but no formal training procedures. For instance, a halocarbon manufacturer maintains documentation of training. However, although new and temporary employees were placed with experienced operators and required to pass a certification test to advance, no written, formalized training procedures exist. The audit team encouraged the facility to consider preparing written procedures for training.

3.8 Safety Audits

A schedule of regular audits not only improves specific process unit conditions, but also supports a consistent approach to health and safety issues throughout the facility. The safety audit has two purposes. First, it serves as a tool for management to ensure that covered processes are in compliance *with the chemical accident prevention regulations, as well as other environmental regulations. In addition, the audit allows management to perform a "real-time" check on the safety of its operations. A safety audit should include at least one person knowledgeable in the process, a written report with recommendations, and a management response. The size of the safety audit team, and the formality of the follow-up process, can be scaled to suit the complexity of the process being audited. To be effective, management should document actions taken to address and correct deficiencies identified in the report.*

Many of the audited facilities conducted safety audits, both internal (i.e., conducted by facility employees) and external (i.e., conducted by other individuals). For example, at an insulation manufacturer, corporate management conducts periodic audits and monitors and communicates changes in regulations and requirements. Corporate management at this facility also has recently developed "plant report cards" to summarize environmental health and safety shortcomings and strengths identified during audits. Audit team members also observed that a chemical manufacturer performs 12 CMA-format self audits and one corporate safety audit every year. These audits are overseen by the environmental, health, and safety manager with input from the corporate office and outside consultants, when necessary. One pesticide handler had recently completed an ISO 9002 registration audit.

Internal audits were not always conducted at some of the larger audited facilities, who might be expected to be able to dedicate more substantial resources to such practices auditing. For example, at a brewery, internal audits have not been conducted onsite. However, the corporation conducts process safety management audits at its facilities, and the state and county public health and environment agencies do inspect the site regularly for compliance with environmental requirements.

Audit teams also found facilities that had exemplary procedures for tracking and prioritizing audit recommendations. For example, when audits identify problem areas at one chemical manufacturer, an action item list is generated and given to the person responsible for implementing the audit findings. Action items are considered confidential. Action item lists are prioritized from one to three ((1) low potential, (2) medium potential, and (3) potential for high personnel or environmental damage), and the responsible person is given 30 to 60 days to implement the action items.

3.9 Accident Investigation

Facilities should investigate releases to identify the root causes of accidents to prevent repeated or similar accidents and to assess the need for improvements in equipment, maintenance, training, and operating procedures. The concept of root cause involves identifying management system inadequacies or failures, such as poor design or lack of training, that allow leaks to occur, when, for example, an operator turns the wrong valve in a process line. To address the root cause would be to design a fail-safe process, or make operators more aware of proper procedures, rather than focusing on the initiating cause and assigning blame.

There are four generally recognized components of a comprehensive accident investigation program. First, the facility should establish procedures to investigate accidental releases or near misses and develop a system to promptly address and resolve accident report findings and recommendations. When a release occurs, the facility should promptly initiate an investigation by a formal accident investigation team to find the facts and root causes of the incident. Next, the team should prepare a summary investigation report that includes key data about the incident and any recommendations for remedying the root cause(s). Finally, the facility should document any resolutions and corrective actions *taken and review the accident report with personnel whose job tasks are relevant to the investigation's findings.*

Audit teams found many audited facilities have explicit accident investigation procedures requiring follow-up reports or actions. For instance, at a chemical plant, an audit team found that all spill events are reviewed to determine causes and corrective action based on an SOP covering chemical releases that details internal report and review steps. Responsibility for initiating the release report is assigned to the branch (local) emergency communications coordinator with input for corrective action from the operations manager. These forms are submitted to the corporate office, which produces a review form. Instructions for all of these procedures are well documented and clearly assign responsibility for each task. Another chemical facility has an incident investigation procedure to identify the underlying causes of all incidents involving recordable injury or illness, property loss or damage, and any near misses with a high potential for such events to occur.

Similarly, a plastics manufacturer was found to have an extensive incident investigation and reporting policy that requires an investigation to prevent reoccurrence for any recordable injury, non-compliance release, over-exposure and near-miss. The facility's managers, directors, and supervisors receive training on incident investigations, and they are responsible for training their staff members. The facility has adopted the National Safety Council's Investigation, Causal Factors, and Corrective Action Checklist to ensure all appropriate areas are investigated. The investigation process includes determining the causal factor (behavioral, policy or procedure, equipment, maintenance, training, personnel protective equipment and environment). The investigation team recommends corrective actions. The safety department reviews investigation reports to ensure the team covered all appropriate areas in determining root cause(s). The facility tracks investigation recommendations with computerized tracking programs. The facility disseminates investigation results during regularly scheduled departmental and safety council meetings.

Several facilities were encouraged to more thoroughly investigate the root causes of incidents. For example, the audit team noted that the polymer manufacturer referred to above does not have a formal procedure for ensuring that the investigation team determines the root cause of an incident. The audit team recommended that the facility consider using a more formal incident investigation procedure for releases from the vinyl chloride process to aid the investigation team in determining root cause. At the time of an audit conducted at a brewery, no one was designated to ensure that incident investigations identify the root cause of releases or near-misses. The audit team recommended that thorough root-cause analysis training should be provided for at least one, and possibly two, facility employees.

Two additional elements were commonly observed among incomplete accident investigation programs: (1) lack of documentation of the investigation procedure and (2) no clearly specified responsibilities or documentation for following-up on recommendations from accident investigations. For instance, a chemical handling facility records and investigates all reported accidents; however, the audit team suggested that the facility implement a formal written incident investigation procedure, including designating the composition of the investigation team and actions taken as a result of the conclusion of the investigation. A fluorochemical production facility has a form that requires the investigation of all accidents, but does not have a written procedure to investigate all accidents of significance. The audit team recommended that the facility develop written procedures for incident investigations and include investigation of all accidents of significance and the actions to prevent similar accidents from happening again. A facility that manufactures paper products records and investigates all reported accidents, from lost time to near misses. However, the facility does not similarly track and investigate chemical releases and near misses. The audit team recommended that the facility document all chemical releases, and track the causes of all accidental releases, even releases that are below the reporting threshold quantity.

Other audit teams made other recommendations for improving accident investigation procedures. For example, an audit team recommended that a chemical facility modify its SOPs to designate an alternate to conduct incident investigations when the designated investigator (i.e., the production supervisor), is absent from the facility. A brewery has OSHA PSM incident investigation guidelines that do not provide a mandatory format for use in all situations; instead, they represent an example of an effective investigation procedure for a major incident. The guidelines can be adjusted to fit any type of incident being investigated; however, the audit team found that the parameters for adjustment of these guidelines are not addressed, and personnel with the authority to adjust the guidelines are not specified. In addition, the audit team was told that several facility personnel had completed introductory incident investigation training, and they in turn have trained facility supervisors. The audit team recommended that thorough incident investigation training should be provided for at least one, and possibly two, facility employees.

Other facilities were encouraged to implement their accident investigation programs more rigorously. For example, an audit team found that a refinery did not always investigate all accidents that were reported to the National Response Center (NRC). The audit team encouraged the facility to consider conducting an accident investigation within a 24-hour period on every release in which a reportable quantity is involved, or when a report is made to the NRC.

3.10 Management of Change

Chemical processes are integrated systems; changes in one part of the process can have unintended effects in other parts of the system. For example, installation of better seals may increase the pressure in vessels and, thus, the opportunity for excess pressure situations to develop. It is, therefore, important that all changes in processes, chemicals, and procedures be reviewed prior to their implementation to identify any potential hazards that may be created by the modification. Chemical processing facilities should develop written procedures to review and manage changes in processes, chemicals, and procedures prior to their implementation. A facility should identify potential hazards that may be created by such changes and ensure that facility procedures, process safety information, training, and process hazards analysis reflect changes and are kept up-to-date. At smaller facilities with less complex chemicals operations, however, such a thorough, formal approach may not be necessary.

Several audited facilities had exceptionally well-developed management of change (MOC) programs. The management of change system at a chemical manufacturer employs four change forms, each of which lists a training query for identified personnel (including maintenance technicians) and an identified trainer. One chemical manufacturer ensures that even temporary process changes incorporate the facility's management of change form and procedure. A brewery's comprehensive management of change procedure applies to all OSHA PSM-regulated processes and instrumentation. This facility's procedure specifies that only OEM replacement parts are to be used for PSM equipment and controls, unless approved by plant engineering. Purchase and use of materials such as valves and piping must meet the specifications in the most recent corporate engineering technical provisions addressing that type of equipment. The MOC procedure at this facility applies to all changes of process technology, equipment, and controls except replacement-in-kind, whether the changes are permanent, temporary, or experimental. Furthermore, changes that are expressly subject to MOC review include those to safety alarm settings, interlocks, or process trip settings; safety relief valve settings or capacity; any repair or replacement except in kind; physical changes to process equipment, piping, instrumentation, or electrical components; revision of control systems, control scheme, or critical alarm limit; changes in operations that will cause process variables to deviate outside of the limits specified in the SOP; and changes to safety/protective equipment regarding its location or type.

Some facilities had management of change programs, but the audit team noted room for improvement. For example, at a chemical manufacturer, the audit team noted that the facility's definition of equipment "change" is less stringent than at other facilities, calling into question the safety processes in place for management of equipment change at this facility. Work at this facility that may involve change, as defined by PSM, is requested on an MOC form that serves as a manual work order. In general, audit teams noted an increase in management of change procedures at audited facilities over previous years; however, audit teams still found that a few facilities' management of change procedures were incomplete. For example, an audit team determined that changes in operating procedures and material changes are often not documented using the MOC procedure at a refinery.

3.11 Pre-Startup Review

The pre-startup review serves as a final check on management of change. It ensures that all issues have been addressed and all systems have been checked prior to startup of a new or substantially modified process or after emergency shutdowns for routine processes. Startup of a new or modified system can be a particularly hazardous time, especially for complex processes and those that require high temperatures, high pressures, or exothermic reactions. However, even simple facilities need to conduct such reviews. The basic elements of the pre-startup review involve ensuring that construction and equipment is in accordance with design specifications; safety, operation, maintenance, and emergency procedures are in place; appropriate hazard evaluation activities have been completed; management of change has been followed; and updated training for each employee involved in operation or maintaining a process has been completed.

Once again, a growing number of audited facilities exhibited pre-startup review procedures, generally in response to the requirements of OSHA's PSM Standard. Generally, facilities with the most thorough SOPs also had pre-startup review procedures. For example, the SOP for the prevention and control of discharges at a chemical manufacturer defines the procedures and conditions for normal operations as well as pre-startup, start-up, and shutdown procedures. The SOPs at a brewery are written clearly and in great detail, and they contain specification of normal operating ranges, correction of deviations, normal operations and shutdown, emergency shutdown, and post-emergency shutdown startups. At a plastics manufacturer, the facility has standard operating procedure requirements for tube thickness checks and weld repairs when the facility is shutdown. To remove moisture from the process before startup, operators follow a detailed checklist. Even facilities not subject to the OSHA PSM requirements have, in some cases, adopted PSM-like procedures, including pre-startup review. For example, a scroll compressor is revising its plant operating manual to incorporate PSM philosophies.

Some facilities were still noted to lack pre-startup review procedures. For example, a chemical manufacturer does not have an SOP covering processes that are on hold or idle. In a number of cases, such as a pesticide handler, a coated paperboard manufacturer, and a chemical manufacturer, auditors noted that these facilities appeared to be in broad compliance with the OSHA PSM standard for covered processes, but did not specifically note whether these facilities had pre-startup review procedures.

3.12 Hot Work

Non-routine work that is conducted in process areas needs to be controlled by the facility in a consistent manner. The relevant hazards should be communicated to those doing the work as well as those operating personnel whose work could be affected. A system of "hot work permits" protects employees and others from potentially hazardous situations resulting from non-routine, "hot work" operations (e.g., welding) that may take place in process areas. Hot work permits should document that the required fire prevention and protection measures have been implemented and should indicate the date(s) authorized for hot work and the object on which the hot work is to be performed.

Hot work procedures were often not reviewed in detail at audited facilities. However, audit team members specifically stated that one chemical manufacturing facility did have lockout/tagout and confined space entry SOPs. Audit team members also observed that another chemical manufacturer monitors the concentration of hydrocarbon vapors in the areas where hot work is being performed.

At a printed circuit board manufacturer, audit team members noted that maintenance personnel did not use a lockout/tagout system for machinery and electrical items. Maintenance personnel merely inform operators not to use machinery while work is being performed. This situation holds the potential for serious threat of a release or injury should a piece of machinery be used by an uninformed operator, or if intervention occurs by a third party not informed of the ongoing maintenance. The audit team recommended that this facility implement a mandatory lockout/tagout system for any machinery or electrical systems in the facility that are either not working properly or are undergoing maintenance.

3.13 Employee Participation

An important component of a successful process safety management program is active and informed participation by employees. Employees have uniquely informed perspectives on facility processes and situations. Accordingly, employers need to consult with their employees as they develop and implement a process safety management program and hazard assessments. Ideally, safety information should flow both from the employer (e.g., training and education for employees, informing affected employees of the findings from incident investigations, and publicizing company-wide initiatives) and from the employee (e.g., through participation in safety committees, use of anonymous comment boxes, and through membership on safety investigation teams).

Facilities emphasized employee participation in safety using different methods. Some facilities used formal policy statements. For example, adherence to environmental health and safety standards is considered every employee’s responsibility at a scroll compressor. While no formalized safety incentive program exists at a specialized chemical manufacturer, safety awards are given on an ad hoc basis for reaching safety milestones. Employees also routinely practice emergency rescue in cooperation with the local public safety department, and facility staff are informally tested during safety meetings to determine their ability to interpret warning alarms. At a chemical manufacturer, facility personnel submit projects ideas to the corporate office for funding. These projects can be for process modifications, plant improvement, or projects to improve safety or environmental protection.

Many facilities hold safety meetings to promote employee participation. For example, an insulation manufacturer conducts weekly meetings of its overall safety committee. Each department has its own safety committee, and sends a single delegate to the facility-wide committee. At a cold storage facility, safety committees meet monthly and perform periodic facility inspections. These committees consist of eight employees, including management, representatives from each department and each shift, and the process employees. Other facilities promote employee participation by having employees staff emergency response teams, such as at a polymer manufacturer.

However, audit teams noted that other facilities featured limited employee participation in safety. For example, the audit team recommended that all employees be educated about evacuation and alarm systems at a chemical manufacturer. At a refinery, safety meetings are conducted on a biweekly basis for maintenance personnel, but are not held for operating or salaried personnel. Finally, audit team members observed that it was not clear whether accident and incident reports were shared with operating-level personnel or other facility locations at a chemical manufacturer.

3.14 Contractors

Facilities that use contractors to perform work in and around processes that involve hazardous chemicals need to include their contractors in the facility process safety management chain. Special efforts must be made to screen contractors appropriately and to assure that contractor employees receive up-to-date training and emergency procedures information. The following activities should be conducted, as appropriate: informing contractors of potential fire, explosion, or toxic release hazards; explaining to contractors the applicable provisions of the facility emergency plan; developing work practices to control the entrance, presence, and exit of contractors in process areas; providing and documenting contract employee training; and evaluating the performance of contractors in fulfilling their obligations.

Some audited facilities took special precautions to ensure that contractors were well-informed and trained on facility process safety. For example, a scroll compressor manufacturer was commended for providing all contractors who enter the facility with a formal orientation training on all chemicals used onsite. Furthermore, the facility employs a procedure to review contractor activities regarding proper management and control of chemicals brought into the facility. At a chemical manufacturer, outside contractors are fully trained in company health and safety procedures. For example, all contracted drivers must pass the minimum training requirements for health and safety, transportation of hazardous materials, and emergency preparedness.

Some facilities rely on contractors to train their employees. For example, a brewery relies on its contractor to conduct training and requires that a certification statement be submitted that training has been conducted. However, facility-wide safety standards are maintained by requiring contractors who work on OSHA PSM-regulated systems to pass the same certification training as facility personnel. All contractors receive a manual containing the facility safety and environmental policies.

Auditors noted that one facility verifies the safety records of its contractors. They check the safety record (e.g., OSHA 200 reports) of potential contractors as part of its contractor selection process.

Other facilities were asked to consider improving their procedures involving contractors. For example, the audit team recommended that a pesticide handler review its contractor safety program to ensure that it provides safety comparable to that provided under the facility plan. Similarly, a chemical manufacturer was asked by the audit team to consider establishing a contractor qualification and oversight program. Auditors at another chemical manufacturer suggested that the facility develop a program or schedule for refresher training of its contractors.

3.15 Release Prevention and Mitigation Measures

Release prevention and mitigation measures are the practices and equipment implemented by a facility to address the potential for accidental releases of hazardous chemicals. Because each operation is unique, they are by nature site-specific. Prevention systems seek to reduce the likelihood, or severity, of accidental releases of hazardous chemicals. Examples include monitors, detectors, sensors, and alarms for early detection of accidental releases, and backup equipment and redundancy features to protect against sudden accidents or failures. Containment structures, flares, scrubbers, quench systems, and surge or dump tanks, can also act to prevent an abnormal occurrence (e.g., overpressurization) from producing a release. Substitution of hazardous chemicals with less hazardous substances, inventory reduction, and other process design changes can lessen the potential for accidental releases of hazardous chemicals. Finally, practices that may reduce the severity of the impact of a hazardous chemical release (e.g., by containing its spread and neutralizing volatility) can be grouped together as release mitigation systems.

Many audited facilities have implemented accident prevention through major efforts to reduce the hazardous and toxic chemicals they use, either across the site or at a single unit that could be involved in a release event. In keeping with the diverse operations examined by the audit teams, the audited facilities exhibited a variety of release prevention measures. Secondary containment and high-level alarms on process and storage vessels were common. At one chemical manufacturer, release prevention activities included converting processes to programmable logic control; replacing ejectors with dry vacuum pumps to reduce the load on the waste treatment plant and the venting of condensible gases to the environment; and installing double mechanical seals on all pumps and batch reactor agitator shafts. The audit team commended another chemical manufacturer for being very active in its efforts to eliminate spills and releases, as typified in its spill elimination policy. The facility has implemented many equipment modifications as well as new procedures and training to reduce spills onsite.

Larger facilities in some cases appeared to have more resources to devote to release prevention and mitigation. For example, audit team members noted that a large brewery has invested a lot of time and money into efforts to prevent ammonia releases at the facility, including: (1) good engineering practices and designs that are applied to all new ammonia installations and significant modifications; (2) replacement of the original ammonia refrigeration control system with an upgraded system two years ago; (3) a flash-distillation unit to remove ammonia from compressor oil and condensed water that accumulate in liquid traps; and (4) pressure relief valves sized to relieve excess pressure that could damage equipment.

Several facilities have taken strides to make it easier for operators to spot and correct potentially hazardous situations. For example, a chemical manufacturer is phasing out the use of rubber-lined phosphoric acid tanks and replacing them with fiberglass tanks. These tanks may be repaired more easily, deterioration is more easily detectable in them. Many facilities have installed monitors and/or alarms to alert employees of chemical releases in process areas. Several facilities, including two chemical manufacturers, were installing overflow or other alarm systems.

In a few cases, the audit teams cautioned that solutions that increase a facility's ability to detect a release do not necessarily solve the problems causing the actual release. For example, an audit team noted that a plastics manufacturer's early relief system would most likely mitigate the majority of vinyl chloride releases that were historically a problem at the facility. However, this early relief system does not remedy the actual root cause of the releases at this facility.

Facilities were also warned that release prevention and mitigation measures need to be accessible and need to anticipate changing facility conditions in order to be effective. For example, pressure relief valves installed at a polymer manufacturer were observed to be undersized by the audit team, possibly because the facility expanded operations by 150 percent since the original design calculations were performed. Furthermore, at a chemical manufacturer, a standby trailer with spill mitigation equipment was not readily identifiable for quick access in the event of a spill at the facility.

3.16 Facility Emergency Preparedness and Response

Comprehensive facility emergency planning is a crucial element in effective and rapid response to accidents. An emergency response program prepares a facility to respond to and mitigate accidental releases, thereby limiting the severity of such releases and their impact on public health and the environment. Generally accepted practices with regard to emergency response programs can be grouped into five activities: developing an emergency response plan; training employees in relevant emergency procedures; acquiring equipment to support response efforts; conducting drills and exercises to test the plan and evaluate its effectiveness; and coordinating with the surrounding community. The first four of these activities are dealt with in this section; coordination with the community, a focus of the Emergency Planning and Community Right-to-Know Act (EPCRA), is discussed in the following section. Although there is a common understanding of these key components of an emergency response program, emergency preparedness and response activities nonetheless can vary significantly for facilities of varying size and complexity. Facilities that are small, or where the likelihood of a release is minimal, may choose not to (or be unable to) respond to an incident with their own employees. Such a facility might choose to maintain evacuation procedures and procedures to contact outside parties (e.g., local response agencies, contractors), rather than developing extensive emergency response plans.

Emergency Response Plan

A facility's emergency response plan is a critical element in the auditing process because, in many respects, the plan reflects a cross-cutting set of facility activities and procedures. The plan also demonstrates the facility's commitment to minimizing harm to its own employees and the surrounding community if an emergency situation occurs. During an audit, the team reviews the organization of a facility's emergency response plan, its utility in the potential emergencies that a facility may experience, and its comprehensiveness. An emergency response plan should be comprehensive in two senses: plan elements are addressed in a site-specific, rather than generic fashion, and the plan contains all the critical elements necessary to a successful response effort.

In many cases, audit teams noted that facility emergency response plans appeared to be written to fulfill regulatory requirements, rather than for use in an actual response. In 1996, EPA, in conjunction with the National Response Team, issued the *Integrated Contingency Plan Guidance* to provide a mechanism for facilities to consolidate multiple plans into a single, functional emergency plan. It is expected that this document may serve to increase the functionality of emergency response plans examined in future audits. However, some facilities audited this year with multiple plans were found to have inconsistencies between plans. For example, one chemical manufacturer maintains a detailed Emergency Action Plan (EAP), a Discharge Prevention, Containment, and Countermeasure (DPCC) Plan (developed to meet state requirements); and a Discharge Cleanup and Removal (DCR) Plan (developed by a consultant). The audit team noted that these plans identified three separate individuals as the primary emergency response coordinator. The audit team recommended that the facility should consider generating a new DPCC/DCR plan to eliminate the inconsistencies that exist within the plan and with other applicable documents.

Because of the site-specific nature of emergency response plans, each facility must make a determination about how to conduct responses. Some audited facilities, typically larger facilities, have developed comprehensive emergency response plans and trained and equipped hazmat teams to carry out responses. One such facility, a chemical manufacturer, has an emergency response plan that documents procedures in the event of a spill. The facility's spill contingency plan documents spill cleanup procedures and a flow chart, and includes a spill response guide with detailed safety information on all of the materials handled by the company. The ERP also includes emergency numbers for facility emergency response team members, and a call-out list for facility and corporate personnel. The 24-hour numbers are listed on all company product labels and MSDSs.

Although specific elements contained in a plan may vary by facility (or even within a facility), there are certain standard components. The majority of the audited facilities have evacuation procedures and escape routes on maps posted around the facility. Audit teams noted some evacuation procedures that were insufficient to ensure employee safety or inadequately communicated to employees. For example, at a chemical company, an audit team suggested that (1) evacuation routes should be posted throughout the plant; (2) meeting points should be designated and clearly marked for each production area; (3) assembly points should be posted in all plants and building locations so that everyone, including visitors, will know where to assemble in an emergency; (4) sheltering-in-place procedures should be posted in plant buildings; and (5) fire and rescue corridors should be marked with road signs to direct traffic. One fluorochemical producer had designated multiple and alternate evacuation routes, but only one rally point; the audit team suggested that the facility consider developing alternate rally points in the event of an accident or unfavorable wind conditions at the current meeting point.

Other facilities were encouraged to adopt techniques to better account for personnel during an evacuation. For example, an audit team recommended to a refinery that it keep a logbook at the reception desk that all visitors, including contractors, must use to sign in and out of the facility. Another audit team found that, although a chemical production plant maintains a number of sign-in logs, no one was identified as responsible for removing the logs in the event of an emergency. In addition, primary rally points and evacuation routes are identified by wind direction, but there is no indication of how wind direction will be determined or communicated to employees. The audit team noted that, during a recent evacuation drill, there was some confusion as to the appropriate route. The audit team suggested that evacuation routes through the buildings should be identified in the plans and posted within the buildings.

Many audited facilities had plans that were insufficiently detailed or were missing information that might be critical in an emergency. One facility has established an internal emergency response team capable of handling chemical emergencies, but did not have a complete response plan. The audit team encouraged the facility to revise, update, and complete its plan and include information on local and facility contacts. The emergency response plan at a food handling facility contained very little information on how a manager, hazmat team member, or employee should respond to an emergency chemical release. The audit team recommended that the facility place an emphasis on developing a consistent and useful emergency response plan as a training tool for all employees. A plastics manufacturer's emergency response plan includes an explanation of response command and authority (based on a customized version of the National Incident Management System for emergency management), but does not include a chart showing the chain of command and lines of communication. The audit team recommended that the facility include a diagram of its Incident Command System in the plan. The audit team also recommended that the facility consider developing decontamination protocols for specific materials and include them in an appendix to the emergency response plan.

In rare cases, audit teams found facilities that had no written emergency response plans or procedures. For example, a circuit board manufacturer was found to have no written plan for fires, explosions, or other environmental hazards. Instead, this facility relies on a system that automatically calls the fire department to respond whenever the sprinkler system is activated.

Finally, for an emergency response plan to be effective, the plan must be reviewed periodically to ensure that it reflects the changing needs of the facility. Many facilities were found to maintain and implement schedules for periodically updating their plans. For example, the fluorochemical producer referred to above updates its emergency response plan periodically and as changes are made to personnel or conditions. However, the audit team encouraged this facility to identify the responsibility for updating the plan by name or position. In the absence of these regular updates, information can become outdated. For example, a chemical facility was urged to update the emergency phone numbers list attached to its plan, and to address the errors found on the list. Similarly, a chemical production plant was found to have a RCRA contingency plan and SPCC spill response plan that were both overdue for the update and review noted within the plans themselves. In addition, the spill response plan indicated management approval by an individual who was no longer employed by the company. The audit team suggested that, although the plan may have been informally reviewed in-house already, a written memorandum should be attached to the plan to indicate completion of the annual review process.

Training

Emergency response training must meet the needs of a facility in addition to complying with all federal requirements; specific training needs may include procedures for spill or vapor containment and fire fighting, or decision-making on the need for response, evacuation, or in-place sheltering. Comprehensive emergency response training programs can cover a wide range of site-specific activities, including evacuation and sheltering procedures, incident command systems, release notification, and fire fighting.

A significant number of facilities are taking advantage of offsite training opportunities to allow for a mix of site-specific training and more general response and rescue training presented by experts in various fields. Furthermore, a few facilities are taking the initiative to train a more substantial number of employees in emergency response procedures. For example, one chemical manufacturer ensures that two emergency communications coordinators are trained at each facility and response team members receive function-specific response training; for example, chlorine responders are trained in the use of chlorine kits and chlorine overpack operations. Another chemical plant ensures that personnel assigned to the response team receive 28 hours of industrial fire training prior to actually performing emergency response and attend a major fire training course annually. In addition to 40 hours of initial training, firefighters also receive 72 hours of emergency medical training from an outside organization. Emergency response team members receive three hours of refresher training monthly, which includes exercises and the use of emergency equipment. Facility employees who are not on the emergency response team, but may be required to attempt to control or stop a leak or spill, receive training on chemical identification, PPE, and response equipment.

Another large facility provides emergency response training for employees ranging from Level 1 (awareness level) to Level 5 (incident command level). Nearly all employees, with the exception of some clerical employees, receive Level 1 training; an additional 40-hour ammonia class is given to utility operators and maintenance technicians, and utility operators also receive Level 5 HAZWOPER training. Other audit teams found that facilities were attempting to increase the amount of emergency awareness and response training provided to their employees. For example, a chemical handling facility, which currently has two employees with 40 hours of HAZWOPER training, told the audit team that its goal is for all employees to be awareness-level trained.

Despite this progress, commitment to emergency response training remains uneven among audited facilities. One area commonly lacking was medical personnel training. One paper processor was encouraged to ensure that the outside nurse who provides assistance during shut downs and emergencies is adequately trained on the characteristics of the hazardous or extremely hazardous chemicals associated with the facility. In another case, a refinery had no medical personnel or personnel trained in advanced first aid available except on the day shift. The audit team recommended that the facility ensure that trained medical personnel are available for all shifts.

Emergency Equipment

Emergency equipment, ranging from safety gear to response vehicles to communications apparatus, must be available to implement the emergency activities designated in the plan. However, with the exception of OSHA fire prevention regulations, there are no detailed federal requirements on what equipment must be available to respond to a hazardous materials emergency. As a result, each facility must decide which equipment is necessary to address likely accident scenarios and develop a system for maintaining it. In addition, to be effective, response equipment should be staged in areas not likely to be affected by an incident, but close enough to be quickly accessed by response personnel.

Some audited facilities keep significant amounts of response equipment and maintain it on a regular basis. The emergency equipment maintained by one chemical production facility includes foam fire-fighting pumps, a ladder truck, a pumper truck, an air trailer, a hazmat/confined space rescue trailer, a medic van, and air monitoring equipment. The facility has numerous fire fighting systems because many of their chemicals are flammable. Most storage spheres have water spray halos or some other type of a fixed water spray system. Throughout the process areas, the facility has fixed water spray and elevated water spray monitors. Each piece of fire fighting apparatus is configured such that pump and foam controls, as well as most incoming and outgoing hose connections, are the same. The similar configurations allow for uniform operation of each apparatus to avoid operator confusion.

At a brewery, SCBAs, canister-type masks, and hand-held monitors are located inside the powerhouse control room. Each operator has his or her own mask to ensure a proper fit. In addition, six fully encapsulated suits, 60-minute SCBA cylinders, hand-held air monitoring equipment, tyvek suits, cartridge-type air purifying respirators, acid suits, and other emergency supplies are kept in the emergency response cage. The equipment in the cage is inspected and inventoried monthly. Access is restricted to authorized personnel by a keypad security code. Spill kits are sealed after being inventoried to discourage pilferage. The encapsulating suits and other equipment with specified shelf lives are checked during each inventory to ensure that they are still within their manufacturer's recommendations.

At another chemical production facility, locations of emergency equipment are shown on the facility layout map. Testing of the equipment is conducted on a regular basis; most items are tested quarterly, while others (such as telephones and forklifts) are tested daily. Some equipment, such as eyewash/showers and first aid kits, are inspected monthly. An equipment checklist is filled out each time equipment is tested or restocked, and these checklists are kept at the facility for a minimum of one year. An internal facility compliance form is listed in the inspection SOP detailing all inspection lists, their frequency, and who performs the inspections. Another chemical production facility provides information on the locations of response equipment and a map indicating the locations of some equipment in its contingency plan. The facility has also equipped its emergency eyewash stations and showers with alarms that sound in the control room when they are turned on to facilitate the speedy provision of assistance to injured workers.

Some facilities, however, did not have certain emergency response equipment that might be needed in a response. For example, the brewery noted above was encouraged to put up a windsock to help evacuees identify safe assembly areas quickly. At a refinery, the audit team recommended that, because the facility uses chlorine, chlorine kits should be made readily available, and personnel at the facility should be trained in their use. At a plant that manufactures circuit boards, an audit team found that there were no eyewash stations or spill kits in some portions of the plant. In addition, a chemical handling facility was encouraged to consider some form of backup to the use of hand-held extinguishers and reliance on the fire department.

Other facilities were encouraged to ensure that their emergency response and safety equipment were adequately audited to be sure that they worked when an emergency occurred. One paper processor was encouraged to follow up on its auditing procedures for emergency showers and eyewash stations to ensure that they were maintained in operable condition at all times. Another facility, which maintains both respiratory and chemical protective ensembles for emergency use, was encouraged to establish a shelf-life with the respective PPE vendor, and make each individual responsible for reviewing this information to take action when necessary.

In other cases, response equipment was present, but was either difficult to see or not clearly labeled. For example, at a chemical facility, a standby trailer with spill mitigation equipment was not readily identified for quick access in the event of a spill. In addition, at least one eyewash station was not readily visible. The audit team recommended that the background areas around emergency equipment such as showers, eyewash stations, and fire extinguishers should be painted in a contrasting color to be readily identifiable in an emergency. In addition, the audit team encouraged the facility to ensure that eyewash stations and fire extinguishers were clearly marked. Similarly, an audit team found that, at a printed circuit board manufacturer, the location of safety equipment, spill prevention, and fire suppression systems were not easily observable in some areas of the facility due to the lack of contrasting background colors at their locations.

In some cases, audit teams found obstructed access to emergency equipment. For example, at a chemical manufacturer, an audit team found that emergency equipment accessibility, identification, and maintenance could be improved. The eyewash stations and emergency shower areas were not easily accessible due to materials being stored under or near these areas. For example, pallets of soda ash were staged in front of the eyewash station; a metal pallet was noted leaning on the fire door and an additional pallet was located next to the fire door; and a portable scale was located underneath the emergency shower. The audit team recommended that the facility inspect all emergency equipment and keep it readily accessible, and fire doors should be kept free of any debris or equipment that might prevent the door from closing properly.

Facilities employ a wide range of communication schemes, including fire alarms, steam whistles, air horns, pagers, radios, and telephones; many facilities have backup systems available in the event of a power failure. At one of the chemical production facilities described above, intercoms, walkie talkies, and audible and visual alarms are used to notify on-site personnel of emergencies. Alarms for the sprinkler system, ammonia, and chlorine are activated when a fire occurs and/or if ammonia or chlorine levels exceed the set levels. The alarm sensors are reset and calibrated once a year. All personnel are trained twice a year to recognize the different facility alarms and take appropriate action. An answering service is used to inform facility response personnel about the appropriate action.

For emergency communications, another chemical production facility has an interactive alarm system, a siren system with voice over communications, an internal radio system, and telephones. The interactive alarm system has touch-screen monitors that personnel use to activate audible alarms. The audible alarms sound from each monitor and siren location. Monitors are located in each process control room, the warehouse, dispatch, laboratories, a gate, and the emergency operations center (EOC). The type of emergency can be indicated (e.g., fire, medical emergency, liquid spill or vapor release) as well as its severity. Typewritten messages can also be sent to all panels from the EOC alarm panel. The system has a self test to insure monitors are functioning. The alarms are tested weekly to activate the facility siren system, which consists of three electronic siren towers and speaker systems in the control rooms and other commonly-populated facility areas.

Even if a comprehensive communication system has been installed, however, problems may still exist. Several facilities were encouraged to make their emergency evacuation alert systems simpler and easier to understand. A refinery was found to have alarm signals for various areas that were relatively complex, with five different sounds to be remembered in an emergency. The audit team encouraged the facility to consider supplementing its alarms with a public address system, clarifying the nature, location, and extent of the emergency and also reaching areas that may not be able to hear the present alarms. Another audit team suggested that a facility educate employees both at its facility and a neighboring plant about evacuation procedures and alarm systems.

Drills & Exercises

Drills and exercises supplement training and allow each employee to understand more clearly what steps to take in the event of an emergency. Testing emergency procedures, such as evacuation routes, internal/external alert systems, and community coordination, enhances response time and demonstrates whether the procedures are viable in an emergency. Drills and exercises generally cover evacuations, fire fighting, and medical and rescue operations; field response to a hazardous materials event may also be addressed, although generally with somewhat lesser frequency.

Nearly all of the audited facilities conduct drills and exercises, although some facilities did not have a regular schedule for conducting such activities. Most facilities conduct drills and exercises on an annual basis. A brewery holds at least two unannounced emergency response drills annually, some of which involve hazardous chemical release scenarios. Several facilities were encouraged to change the scope of emergencies addressed in their exercises. For example, a scroll compressor manufacturer that stores quantities of acid was encouraged to expand its drills for fire and tornadoes to include a periodic hazardous materials drill. Another chemical corporation conducts a simulated emergency response drill annually, unless an accident occurs. If an accident occurs, such as a release or injury, the facility will use that situation as its drill. The audit team recommended that the facility conduct focused drills in addition to the emergency response drill that incorporates all of these elements.

In rare cases, contingency plans did not call for drills or exercises to be conducted. At one such facility, a chemical production plant, the audit team found that the plan outlined procedures for emergencies, but did not address exercises and scenarios for training and preparedness. However, facility personnel annually practice Level A emergency rescue in cooperation with the local public safety department. Another chemical production plant conducted its first emergency evacuation drill during the audit. However, no formal schedule for future drills is in place, although management has expressed the desire to conduct two drills per year. Although the LEPC sponsors annual spill simulations and drills, at the time of the audit, the facility had never conducted a full-scale drill or exercise or participated in one at another facility.

Depending on the facility, drills and exercises involve local response organizations and neighboring facilities in varying degrees. In some cases, extensive interaction is conducted with outside planning and response organizations. A chemical manufacturer conducted a simulation of a chlorine rail car incident in cooperation with the LEPC and, at the time of the audit, had scheduled another joint LEPC-facility simulation at a local chemical company. Another chemical manufacturer conducts annual evacuation drills as well as fire drills in conjunction with the local fire department. However, the audit team noted that a building at one end of the company's property is leased to and operated by another company, and suggested that, because of their proximity, the company should conduct its preparedness activities (including drills and exercises) jointly with the other facility.

Other facilities conduct joint exercises less frequently, or not at all. A number of audit teams encouraged facilities to begin conducting drills and exercises with their LEPC, fire department, or other response organizations, and to take advantage of regularly scheduled drills and exercises being conducted in their areas. For instance, one food handler was found to have last held a joint emergency exercise with the LEPC and local responders four years prior to the audit. A chemical manufacturer, despite its coordination with local responders through off-site simulation exercises, does not provide clear information on the roles of community groups and local emergency responders in its emergency response plan and there has been no on-site drill involving local responders. The audit team recommended that the facility plan and conduct an on-site response drill that involves the local fire department, medical providers, LEPC, and other responders to familiarize them with the facility layout and the chemicals present.

Although follow-up for drills and exercises was not extensively discussed in the audit reports, several audit teams recommended that facilities increase their critique programs and incorporate procedural changes and lessons learned into future training and the emergency response plan. For example, the audit team visiting a brewery recommended that the facility consider implementing a formal critique procedure to identify and correct any significant problems discovered during drills. At another facility, the audit team found that the contingency plan did not address the evaluation of exercises and scenarios, nor state how exercise findings would be used. However, interviews with facility personnel indicated that tabletop exercises were reviewed during safety meetings.

3.17 Community Emergency Response Coordination

Working with local response organizations and the LEPC on emergency planning initiatives, drills and exercises, mutual aid arrangements, and other response issues completes the circle of preparedness begun with facility emergency preparedness activities. Although many facilities initially respond to and contain an emergency themselves, local first responders are normally involved in responding to those release events that threaten public health and safety. Coordination with public *officials is of special importance to those facilities that depend on local responders for response to any onsite incident; appropriate responses to their hazards should be addressed in the community emergency response plan developed under EPCRA.*

Almost all of the audited facilities work with the community to some extent with regard to emergency preparedness. For many facilities, this consists primarily of fire prevention and pre-planning with local officials during fire inspections. However, some audited facilities are LEPC members, participate regularly in the local planning process, and distribute copies of their emergency response plan to affected parties within the community. As discussed in the preceding section, a number of facilities also are taking advantage of opportunities to increase emergency preparedness by conducting drills and exercises with LEPCs and local response organizations.

Most of the audited facilities have taken steps to ensure that emergency responders in the surrounding communities are aware of the hazards associated with their facilities, such as providing a copy of their contingency plan to the LEPC and fire department. One facility, a chemical manufacturer, conducts facility walk-throughs for police and fire department personnel, although the audit team also suggested that emergency medical services staff be included in future walk-throughs. Another facility has provided MSDSs to the local hospital and responders and informed the LEPC and the fire and police departments about the rail and truck transport routes used by the facility. In addition, the company trains non-employee chlorine responders both locally and state-wide, and provides chlorine training to its customers. A polymer manufacturer purchased the air release modeling software CHARM for the county emergency manager and has made monetary and equipment contributions to local response agencies. They sponsored fire academy training for 15 local fire fighters and provided excess fire hydrants to the community to replace hydrants in poor condition.

Other facilities have worked to develop ties with the local communities beyond those with emergency responders. One chemical manufacturer was found to have a very cooperative relationship with the LEPC and the local family practice center. The facility participates in outreach programs, including adopting a school, organizing an open house for the industrial park in which it is located, and actively participating in the industrial park committee. A plastics manufacturer paid for a shelter-in-place study for local schools. The study reviewed the potential chemical releases from the facility, the air tightness of the school buildings, and the use of evacuation alarms and air treatment systems on the school buildings. The recommendations of the study were implemented immediately after the conclusion of the study. In conjunction with the county's emergency manager, the facility also helped produce a shelter-in-place video for the community.

Some facilities were encouraged to assist in establishing an LEPC where there was no active local committee. For instance, a paper processor was encouraged to work with local medical facilities, the Chamber of Commerce, and other industries in the area to establish an LEPC. One audit team noted a brewery that had supported the recreation of the LEPC after several years of inactivity; facility personnel have attended all recent LEPC meetings and serve on the LEPC committee that had been formed to rewrite the county emergency plan.

A number of facilities were encouraged to develop stronger ties with the local media. For instance, a chemical manufacturer, had very little interaction with the local media. The audit team recommended that the facility develop a media interaction strategy. Another chemical manufacturer had no ongoing interaction with the local media, and was encouraged to establish a direct, ongoing communication link with the media and to designate a media emissary.

Several of the audited facilities have undertaken extensive efforts to develop notification and communication systems for interacting with the local community in the event of an incident, while a number of others depend on local police and fire departments. A refrigeration service has cable override and radio public broadcast ability in case of an emergency. A plastics manufacturer has an extensive equipment for notifying the local community and response organizations of an incident. If a chemical release, fire, or potential explosion threatens to impact offsite areas, the facility contacts the county office of emergency management. The community alarm system utilizes four alarm receivers and two siren towers. Receiving units located at the local elementary school, day care center, church preschool, and city hall emit an audible signal and can display messages on an LED screen. Two offsite towers are also part of the system. In addition, twelve receiving units have been provided to homeowners near the facility, away from the town. Homeowners with the alarm units are also provided the EOC phone number to allow them direct access to facility personnel knowledgeable of the incident. Three hotline phones in the EOC are connected to the neighboring school district principal's office, the principal's home, and the bus barn office.

Most other audited facilities depend on local police and fire departments for notification and communication with the local community in the event of an incident. One such facility, a chemical handling facility, has no public alert notification systems, and relies solely on the local sheriff's department to communicate with local residents in the event of an emergency. The audit team suggested that the facility should consider developing a public notifications system beyond the sheriff's department. A fluorochemical producer has no off-site alarm system in place, although community notification via an automated system was under consideration by the facility at the time of the audit. The audit team encouraged the facility to continue to work with public safety and emergency preparedness officials to develop an automated telephone public notification system.

Facilities also can work together to provide a variety of resources; several audited facilities belong to regional mutual aid groups. For instance, a fiberglass insulation manufacturer had recently coordinated with neighboring facilities on a mutual aid agreement. The facility had also established an environmental/safety committee within the local industrial association. The polymer manufacturer referred to above has a mutual aid agreement with the city, county, and emergency response organizations. The facility is also part of the local Community Awareness Emergency Response group, the state Chemical Council, the state Emergency Management Association, and has two representatives on the county Disaster Assessment Team.

In rare cases, there are facilities that have little formal cooperation with state and local response and planning entities. One such facility, a chemical handler, has, as a result, a negative image within the community and the LEPC, despite an excellent working relationship with the local fire department. The audit team recommended that the facility consider greater LEPC participation and community outreach (such as open houses) to address this negative image. The audit team also suggested that the facility consider the development of mutual aid agreements with other facilities in the vicinity and assist the LEPC in developing a county-wide response plan. Another facility, a chemical manufacturer, was found to have undertaken no facility planning or outreach activities with the community or any local emergency response planning.

APPENDIX A

OUTLINE OF THE CHEMICAL SAFETY AUDIT PROTOCOL

APPENDIX A

OUTLINE OF THE CHEMICAL SAFETY AUDIT PROTOCOL

1.0 INTRODUCTION

2.0 SUMMARY OF FINDINGS/CONCLUSIONS

3.0 BACKGROUND

- 3.1 General Facility and Audit Information
- 3.2 Purpose of the Audit and Facility Selection Process
- 3.3 Audit Methodology

4.0 FACILITY BACKGROUND INFORMATION

- 4.1 Site and Surrounding Area Description
  - 4.1.1 Facility Profile
  - 4.1.2 Site Topography and Meteorological Conditions
  - 4.1.3 Site Access
  - 4.1.4 Special/Sensitive Populations and Environments
  - 4.1.5 Regional Demographics
  - 4.1.6 Identification of Vulnerable Zones

5.0 CHEMICAL HAZARDS

- 5.1 Overview of Hazards for Chemical(s) Being Audited
- 5.2 Facility Management of Chemical Hazard Data

6.0 PROCESS INFORMATION FOR HAZARDOUS CHEMICALS

- 6.1 Storage and Handling
  - 6.1.1 Storage Systems
  - 6.1.2 Shipping/Receiving
  - 6.1.3 Material Transfer
- 6.2 Process Description
  - 6.2.1 Overview of Processing Steps and Operating Procedures
  - 6.2.2 General Description of Process Equipment Capacity
  - 6.2.3 Back-ups and Redundancy
  - 6.2.4 Process Parameter Monitoring
  - 6.2.5 Environmental Monitoring
- 6.3 Process Hazards

7.0 CHEMICAL ACCIDENT PREVENTION

- 7.1 Management Activities
  - 7.1.1 Corporate Role in Facility Process Safety Management

APPENDIX B

LIST OF CHEMICAL SAFETY AUDITS

APPENDIX B

LIST OF CHEMICAL SAFETY AUDITS
as of September 30, 1997

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
1	03/22/89	X	Polysar, Inc., Indian Orchard, MA
	04/10-14/89	X	W.R. Grace, Nashua, NH
	08/03/89	X	Fall River Treatment Plant, Fall River, MA
	08/07-11/89	X	Upjohn Co., North Haven, CT
	11/29/89	X	Bradford Soap Works, W. Warwick, RI
	03/20/90	X	Jones Chemicals, Merrimac, NH
	06/20-21/90	X	Monet Crystal Brands, Pawtucket, RI
	09/12-13/90	X	LCP Chemicals, Orrington, ME
	12/17-18/90	X	Hercules, Inc., Chicopee, MA
	05/13-14/91	X	Pacific Anchor, Cumberland, RI
	07/24-25/91	X	Rising Paper Company, Housatonic, MA
	12/18/91	X	Johnson Controls, Benington, VT
	01/27-30/92	X	Hoechst Celanese, Coventry, RI
	06/25-26/92	X	Pratt & Whitney, Southington, CT
	10/28-30/92	X	James River, Old Town, ME
	05/11-14/93	X	Monsanto, Springfield, MA
	08/24-25/93	X	Davol, Cranston, RI
	03/23-25/94	X	H.C. Starck, Newton, MA
	06/14-15/94	X	Cambridge Plating Company, Belmont, MA
	07/19-22/94	X	Georgia-Pacific, Woodland, ME
2	08/21-24/89	X	BASF, Rensselaer, NY
	09/11/89		**Xerox Corporation, Webster, NY**
	01/09-10/90	X	Du Pont Agrichemicals, Manati, PR
	01/11-12/90	X	Bacardi Rum, San Juan, PR
	07/31 - 08/01/90	X	Goodyear, Niagara Falls, NY
	09/10-11/90	X	BASF, Washington, NJ
	03/11-13/91	X	C.P. Chemicals, Sewaren, NJ
	06/03-05/91	X	3M/O-Cell-O, Tonawanda, NY
	08/05-07/91	X	Schenectady Chemicals, Schenectady, NY
	03/25-26/92	X	CPS Chemical Company, Old Bridge, NJ
	06/22/92	X	Caguas WWTP, Caguas, PR
	06/23/92	X	Puerto Nuevo WWTP, San Juan, PR
	06/24/92	X	Bayamon WWTP, Catano, PR
	11/11-12/92	X	Witco Corporation, Brooklyn, NY
	6/21-23/93	X	ArsynCo, Carlstadt, NJ
	Unknown		**PRASA**
	07/19-21/93	X	International Paper, Ticonderoga, NY
	10/12-13/93	X	Pfizer, Barceloneta, PR
	06/28-30/94	X	Occidental Chemicals, Niagara Falls, NY
	02/01-02/95	X	Hoffman-LaRoche, Nutley, NJ
	07/07/95		**Middlesex County WWTP, Sayreville, NJ**
	09/26/96	X-D	Patclin Chemicals, Yonkers, NY
	05/06/96	X-D	PNC, Nutley, NJ
	05/07/96	X-D	Elan Chemicals, Newark, NJ
	09/12/96	X-D	Dexter Chemical Company, Bronx, NY
3	07/30-08/03/89	X	Rhone-Poulenc, Charleston, WV

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	08/14-16/89	X	LCP Chemicals, Inc., Moundsville, WV
	09/11-12/89	X	Purolite Company, Philadelphia, PA
	09/25-26/89	X	Carl Falkenstein, Philadelphia, PA
	01/31 & 02/02/90	X	Automata, Sterling, VA
	02/12-16/90	X	Mobay Chemical, New Martinsville, WV
	03/26-28/90	X	Olin Chemical, Charleston, WV
	08/20-22/90	X	Occidental Chemicals, Delaware City, DE
	01/07-10/91	X	Rohm & Haas, Bristol, PA
	04/15-16/91	X	Anzon Lead, Philadelphia, PA
	04/23-25/91	X	DuPont Textile Fibers, Waynesboro, VA
	05/21-23/91	X	SCM Chemicals, Baltimore, MD
	11/19-22/91	X	Vista Chemicals, Baltimore, MD
	02/03-07/92	X	Allied-Signal, Hopewell, VA
	04/27-29/92	X	BP Oil Refinery, Marcus Hook, PA
	07/07-10/92	X	Huntsman Chemical Corp., Chesapeake, VA
	07/28-29/92	X	Beatrice Cheese, Whitehall, PA
	11/09-11/92	X	Allied-Signal, Philadelphia, PA
	01/12-14/93	X	Weirton Steel, Weirton, WV
	03/09-11/93	X	Koppers Industries, Follansbee, WV
	05/18-20/93	X	Merck and Company, Riverside, PA
	06/22-23 & 07/14 1993	X	Konsyl/Trinity, Easton/Salisbury, MD
	09/27-29/93	X	Allied-Signal BF_3 Plant, Marcus Hook, PA
	11/03-05/93	X	Hoechst Celanese, Narrows, VA
	02/23-24/94	X	Jones Chemicals, Milford, VA
	04/06-08/94	X	GE Specialty Chemicals, Morgantown, WV
	04/20-22/94	X	PPG Industries, New Martinsville, WV
	05/11-13/94	X	Armstrong World Industries, Lancaster, PA
	06/01-03/94	X	Carpenter Technology, Reading, PA
	09/19-21/94	X	Union Camp, Franklin, VA
	11/11-13/94	X	Air Products and Chemicals, Hometown, PA
	01/10-11/95	X	Standard Chlorine, Delaware City, DE
	02/06-08/95	X-D	Sunoco Girard Point, Philadelphia, PA
	02/14-16/95	X	Blue Plains WWTP, Washington, DC
	07/11-13/95	X-D	Cytec Industries, Willow Island, WV
4	03/20-24/89	X	Royster Phosphate, Piney Point, FL
	05/01-05/89	X	Olin Corporation, Charleston, TN
	07/11/89 & 08/03-04/89	X	Armco Steel, Ashland, KY
	07/18-20/89	X	Kerr McGee, Hamilton, MS
	08/17/89 & 09/11-15/89	X	Texas Gulf, Aurora, NC
	02/12-13/90	X	Photocircuits Atlanta, Peachtree City, GA
	02/26-03/02/90	X	Kemira, Savannah, GA
	04/04-05/90	X	Astrotech, Titusville, FL
	05/08-11/90		**Cardinal Chemical Co., Columbia, SC**
	09/11-13 & 24-27/90	X	Tennessee Chemical Co., Copper Hill, TN
	10/26/90	X	Kason Industries, Newnan, GA
	11/29/90	X	C & S Chemical Company, Austell, GA
	12/4-5/90	X	Carolina Solite, Norwood, NC
	12/4-5/90	X	Oldover Corporation, Albemarle, NC
	12/12/90	X	Tull Chemical Company, Oxford, AL
	01/07-10/91	X	Peridot Chemical Company, Augusta, GA
	01/22-25/91	X	Aqua Tech/Groce Labs, Duncan, SC

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	01/30-31/91	X	Virtex Chemicals, Bristol, TN
	02/20-21/91	X	Water Treatment Plant, Cape Coral, FL
	02/25-26/91	X	Canal Pumping Station, Cape Coral, FL
	03/04-08/91	X	Kentucky American Water, Lexington, KY
	03/19/91	X	Drexel Chemical Co., Tunica County, MS
	03/27/91	X	Columbia Organics, Camden, SC
	04/02/91	X	Armstrong Glass, Atlanta, GA
	08/26-29/91	X	B. F. Goodrich, Calvert City, KY
	11/12-14/91	X	West Lake Monomers, Calvert City, KY
	01/21-24/92	X-ND	Piney Point Phosphates, Piney Point, FL
	03/24-26/92	X	Reichold Chemicals, Kensington, GA
	04/28-05/01/92	X	G.E. Lighting Systems, Hendersonville, NC
	07/20-21/92	X	Jones Chemicals, Charlotte, NC
	08/25-26/92	X-ND	Peridot Chemical Company, Augusta, GA
	08/03-07/92	X	Velsicol Chemicals, Chattanooga, TN
	11/16-20/92	X	Mississippi Chemicals, Yazoo City, MS
	01/04-08/93	X	DuPont, Louisville, KY
	02/01-02/93	X	IMC Fertilizer, Tampa, FL
	02/02-03/93	X	Seminole Fertilizer, Tampa, FL
	02/04-05/93	X	CF Industries, Tampa, FL
	03/29-04/02/93	X	Jones Chemicals, Mobile, AL
	03/29-04/02/93	X	Occidental Chemicals, Mobile, AL
	07/12-13/93	X	Trojan Battery, Lithonia, GA
	08/02-06/93	X	Ciba-Geigy, McInstosh, AL
	11/29-12/02/93	X	High Point Chemicals, High Point, NC
	12/07-08/93	X	Grady Hospital, Atlanta, GA
	01/11-13/94	X	Albright and Wilson, Charleston, SC
	02/07-11/94	X	Sherwin-Williams, Richmond, KY
	04/05-06/94	X	Allied Universal, Leesburg, FL
	04/15-29/94	X	First Chemical Corporation, Pascagoula, MS
	04/26-28/94	X	Witco Corporation, Memphis, TN
	07/11-15/94	X	General Electric, Burkville, AL
	10/17/94	X	Ashland Petroleum, Ashland, KY
	11/01-03/94	X	Holox Limited, Union City, GA
	11/14-18/94	X	Tennessee Eastman, Kingsport, TN
	12/12-15/95	X	Union Carbide Corporation, Tucker, GA
	01/24-27/95	X	PCR, Gainesville, FL
	01/30-02/03/95	X	Scott Paper Company, Mobile, AL
	04/17-21/95	X	Henkel Corporation, Charlotte, NC
	06/04-09/95	X	Arcadian Fertilizer, Augusta, GA
	06/19-23/95	X	American Synethetic Rubber, Louisville, KY
	11/27-12/01/95	X	Degussa Corporation, Theodore, AL
	02/12-16/96	X-R	Vicksburg Chemical Company, Vicksburg, MS
	02/13-15/96	X-R	Gilman Paper Company, St. Marys, GA
	04/15-19/96	X-R	CONDEA Vista, Aberdeen, MS
	07/15-19/96	X-R	Vinings Industries, Marietta, GA
	11/18-22/96	X-R	Great Lakes Chemical, Newport, TN
	02/10-14/97	X-R	Riverwood International, Macon, GA
	03/17-21/97	X-R	Platte Chemical Corporation, Greenville, MS
	05/05-09/97	X-R	MAPCO, Memphis, TN
	09/22-26/97	X-R	Halocarbon Products, North Augusta, SC

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
5	07/25-28/89	X	Koppers, Cicero, IL
	08/08-11/89	X	Best Foods, Chicago, IL
	09/15/89		**Shell Oil, Wood River, IL**
	03/05/90		**Eli Lilly, Clinton, IN**
	03/26-30/90		**Anderson Development, Adrian, MI**
	04/14-18/90	X	General Electric Plastics, Mt. Vernon, IN
	06/11-15/90		**Tremco, Inc., Cleveland, OH**
	07/16-19/90		**Flexel, Inc., Covington, IN**
	03/18-20/91	X	Detroit Edison, River Rouge, MI
	05/20-22/91	X	Nalco Chemical Company, IL
	08/12-14/91	X	SCM Chemicals, Ashtabula, OH
	03/10-12/92	X	Elf Atochem, Riverview, MI
	04/21-23/92	X	BASF Corporation, Wyandotte, MI
	06/02-04/92	X	G.E. Superabrasives, Worthington, OH
	11/03-05/92	X	Yenkin-Majestic Paints, Columbus, OH
	12/15-17/92	X	Allison Gas Turbine, Indianapolis, IN
	04/13-15/93	X	Lomac Corporation, Muskegon, MI
	06/15-17/93	X	Specialty Chem, Marinette, WI
	07/20-21/93	X	Witco, Chicago, IL
	08/17-18/93	X	Interplastic, Minneapolis, MN
	03/29-31/94	X	Upjohn Company, Portage, MI
	08/31-09/01/94	X	Stepan Company, Elwood, IL
	10/11-12/94	X	Farley Company, Brimfield, OH
	02/21-23/95	X	Capital Resin Corporation, Columbus, OH
	05/02-04/95	X	Clark Refining and Marketing, Blue Island, IL
	06/06-08/95	X	Spectrulite Consortium, Madison, IL
	08/15-17/95	X	Waldorf Corporation, St. Paul, MN
	07/09-11/96	X-D	Hydrite Chemical, Oshkosh, WI
	09/22-24/96	X-D	ISP Fine Chemicals, Columbus, OH
6	06/13/89	X	Western Extrusion, Carrollton, TX
	08/30-31/89	X	Great Lakes Chemical Co., El Dorado, AR
	08/15-16/89	X	Farmland Industries, Enid, OK
	09/12-13/89	X	Fermenta ASC Corporation, Houston, TX
	10/16-17/89	X	Chief Supply, Haskell, OK
	11/06-07/89	X	Phillips Petroleum, Pasadena, TX
	11/14/89	X	Texas Instruments, Dallas, TX
	01/17-18/90	X	Exxon Refinery, Baton Rouge, LA
	04/17-19/90	X	Olin Chemicals, Lake Charles, LA
	03/05-06/91	X	Sid Richardson Carbon Co., Borger, TX
	03/20-22/91	X	ARCO Chemical, Channelview, TX
	05/01-03/91	X	Citgo Refinery, Lake Charles, LA
	07/09-11/91	X	International Paper, Pine Bluff, AR
	08/27-29/91	X	Agricultural Minerals, Catoosa, OK
	02/25-26/92	X	Safety-Kleen Corporation, Denton, TX
	06/09-10/92	X	Halliburton Services, Caldwell, TX
	08/17-18/92	X	Houston Woodtech, Houston, TX
	08/24/92	X	Allied-Signal, Geismar, LA
	11/17-18/92	X	CPS Chemicals, West Memphis, AR
	03/16-17/93	X	Labbco, Inc., Slidell, LA
	08/31-09/03/93	X	Chevron USA, El Paso, TX
	09/08-09/93	X	Harcros Chemicals, Dallas, TX

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	10/05-07/93	X	Ethyl Corporation, Magnolia, AR
	12/14-15/93	X	Champion Technologies, Odessa, TX
	06/07-09/94	X	Phillips 66, Borger, TX
	08/23-25/94	X	Sterling Chemicals, Texas City, TX
	11/01/94	X	Creamland Dairies, Albuquerque, NM
	11/02/94	X	DPC Industries, Albuquerque, NM
	11/15-17/94	X	Navajo Refining Company, Artesia, NM
	08/22-25/95	X-D	Formosa Plastic, Point Comfort, TX
7	10/25/90	X	ICI Americas, Omaha, NE
	11/20/90	X	Jacobson Warehouse, Des Moines, IA
	05/01/91	X	ABB Power Transformers, St. Louis, MO
	07/31/91	X	Hydrozo, Inc., Lincoln, NE
	12/04/91	X	Rhone-Poulenc, Sedalia, MO
	05/06-07/92	X	American Cyanamid, Hannibal, MO
	06/15-16/92	X	Proctor and Gamble, Kansas City, KS
	06/22-23/92	X	Hercules Aqualon Company, Louisiana, MO
	07/15/92	X	Cotter and Company, Kansas City, MO
	08/17-18/92	X	Cornbelt Chemical Company, McCook, NE
	08/31/92	X	Eagle Lithographing, Kansas City, MO
	09/03/92	X	Independence WWTP, Sugar Creek, MO
	09/30/92	X	Flexel, Inc., Tecumseh, KS
	12/16/92	X	Arcadian Fertilizer, Clinton, IA
	12/18/92	X	Rock Creek WWTP, Independence, MO
	04/26/93	X	Rhone-Poulenc AG, St. Louis, MO
	05/13/93	X	LaRoche Industries, Crystal City, MO
	05/11/93	X	Golden Valley Cheese, Clinton, MO
	06/03/93	X	Total Petroleum, Arkansas City, KS
	06/29/93	X	Farmland Petroleum, Coffeyville, KS
	07/08/93	X	AG Processing, Eagle Grove, IA
	07/21/93	X	Farmland Industries, Lawrence, KS
	07/29/93	X	Beech Aircraft, Wichita, KS
	08/05/93	X	Ralph Green Plant, Pleasant Hill, MO
	10/11/93	X	Whitmire Research Lab, Valley Park, MO
	10/12/93	X	Doe Run Company, Herculaneum, MO
	11/09/93	X	Ecolab Pest Elimination, Kansas City, MO
	11/30/93	X	Carmar Group, Carthage, MO
	01/13/94	X	Cook Composites, N. Kansas City, MO
	02-05/94	X	Van Waters and Rogers, St. Louis, MO
	02/11/94	X	Wells' Dairy, Le Mars, IA
	02/15-07/18/94	X	3M, Springfield, MO
	02/17/94	X	Armour Swift-Eckrich Plant, Kansas City, MO
	02/28/94	X	Terra International, Sergeant Bluff, IA
	04/19/94	X	Seitz Foods, St. Joseph, MO
	04/28/94	X	Fleming Foods, Sikeston, MO
	05/04-06/94	X	Mallinckrodt Chemicals, St. Louis, MO
	06/22/94	X	Meadow Gold Dairies, Des Moines, IA
	06/23/94	X	3M Commercial Graphics, Nevada, MO
	07/08/94	X	ICI Explosives, Joplin, MO
	09/15/94	X	BioKyowa, Cape Girardeau, MO
	09/29-30/94	X	Elf Atochem, Wichita, KS
	11/08/94	X	IES Industries, Marshalltown, IA

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	11/10/94	X	Dyno-Nobel, Louisiana, MO
	11/28/94	X	Vulcan Chemicals, Wichita, KS
	12/30/94	X	Chemcentral, Maryland Heights, MO
	12/31/94	X	Hudson Foods, Noel, MO
	01/17/95	X	Nat. Coop. Refinery Assoc., McPherson, KS
	01/31/95	X	St. Louis Water Company, Florissant, MO
	02/09/95	X	Howard Bend WWTP, Chesterfield, MO
	03/28/95	X	Chemtech, Kansas City, MO
	05/08/95	X	Douglas Battery, N. Kansas City, MO
	05/12/95	X	Slay Bulk Terminals, St. Louis, MO
	06/13/95	X	Extrusions, Fort Scott, KS
	06/16/95	X	Philip Environmental, Kansas City, MO
	07/14/95	X-R	Wagner Brake, Berkeley, MO
	09/14/95	X	Foamex, Cape Girardieu, MO
	02/12/96	X-R	Siegwerk, Inc., Greenfield, IA
	04/09/96	X-R	Koch Sulfur Products, DeSoto, KS
	08/08/96	X-R	General Motors, Kansas City, KS
	11/04/96	X-R	Owens-Corning, Kansas City, KS
	11/08/96	X-R	Tyson Foods, Monett, MO
	12/13/96	X-R	Copeland Corporation, Lebanon, MO
	01/29/97	X-R	United Refrigeration Services, Wichita, KS
8	05/02-04/89	X	Phillips Refinery, West Bountiful, UT
	06/13-15/89	X	Chevron Chemical, Rock Springs, WY
	08/15-17/89	X	Western Forge, Colorado Springs, CO
	03/27/90	X	Koppers Industries, Denver, CO
	05/15-17/90	X	Amoco Production Company, Powell, WY
	06/26-29/90	X	Amoco Casper Refinery, Casper, WY
	08/27-31/90	X	Western Zirconium, Ogden, UT
	11/01/90	X	Jemm Plating, Co., Denver, CO
	02/06-07/91	X	SAS Circuits, Littleton, CO
	02/19-21-91	X	Kodak-Colorado Division, Windsor, CO
	04/30-05/03/91	X	Col. Falls Aluminum, Columbia Falls, MT
	05/29-31/91	X	Syncom Techologies, Mitchell, SD
	09/29-30/91	X	LaRoche Industries, Orem, UT
	11/12-13/91	X	T.G. Soda Ash, Granger, WY
	02/18-20/92	X	Coastal Chemical, Cheyenne, WY
	02/25-27/92	X	Chevron Refinery, Salt Lake City, UT
	05/27-29/92	X	Rhone-Poulenc, Butte, MT
	08/18-19/92	X	ALCHEM, Ltd., Grafton, ND
	02/09-12/93	X	Stone Container Corp., Missoula, MT
	05/18-21/93	X	Magnesium Corp., Salt Lake City, UT
	06/15-18/93	X	Frontier Refining, Cheyenne, WY
	09/08-10/93	X	Koch Sulfur Products, Riverton, WY
	03/01-04/94	X	Dakota Gasification, Mercer County, ND
	05/03-06/94	X	John Morrell, Sioux Falls, SD
	06/07-10/94	X	Huish Detergents, Salt Lake City, UT
	09/13-15/94	X	Montana Refining, Great Falls, MT
	07/10-14/95	X-D	Coors Brewing Company, Golden, CO
	08/29-31/95	X-D	Anheuser Busch Brewer, Fort Collins, CO
	09/18-21/95	X-D	Sinton Dairy Foods, Colorado Springs, CO

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9	05/12-13/89	X	Nunes Cooling, Salinas, CA
	07/25-27/89	X	Unocal Chemical, Brea, CA
	08/16-17/89	X	Eticam of Nevada, Fernley, NV
	09/07-08/89	X	Coronado Generator, St. Johns, AZ
	04/17-20/90	X	Ultramar Refinery, Wilmington, CA
	06/19-22/90	X	Magma Copper, San Manuel, AZ
	07/17-20/90	X	Pioneer Chlor-Alkalai, Henderson, NV
	09/10-16/90	X	Dole Packaged Foods, Honolulu, HI
	04/09-12/91	X	Motorola, Phoenix, AZ
	07/16-19/91	X	Dow Chemicals, Pittsburg, CA
	08/20/91	X-ND	Pioneer Chlor-Alkalai, Henderson, NV
	08/21-23/91	X	Timet Corporation, Henderson, NV
	02/11-14/92	X	Brewer Environmental Services, Honolulu, HI
	06/08/92	X	General Chemical Corporation, Pittsburg, CA
	07/14-17/92	X	Chevron Refinery, Richmond, CA
	08/24-27/92	X	Shell Oil Refinery, Martinez, CA
	02/23-24/93	X	Brewer Environmental Services, Honolulu, HI
	05/04-05/93	X	Union Pacific Railroad, Stockton, CA
	07/27-30/93	X	Louisiana Pacific Pulp Mill, Samoa, CA
	04/12-15/94	X	ATSF Rail Yard, Barstow, CA
	07/19-21/94	X	General Chemical Corporation, Pittsburg, CA
	10/06-08/94	X	Kerley Ag, Antioch, CA
	12/05-08/94	X	Southern Pacific Lines, Long Beach, CA
	08/14-15/95	X-D	Pimalco, Chandler, AZ
	08/16/95	X-D	Solkatronic Chemical, Chandler, AZ
10	07/27/89	X	All Pure Chemical Company, Kalama, WA
	08-10/89	X	ITT Rayonier, Port Angeles, WA
	09/12-15/89	X	McWhorter Northwest, Portland, OR
	03/19-23/90	X	BP Oil Company, Ferndale, WA
	04/23-27/90	X	FMC Corporation, Pocatello, ID
	05/14-18/90	X	Neste Resins, Springield, OR
	09/24-28/90	X	Unocal Chemicals, Kenai, AK
	01/08/91	X	Occidental Chemicals, Tacoma, WA
	01/15-18/91	X	Chevron USA, Seattle, WA
	03/18-22/91	X	James River Corporation, Clatskanie, OR
	04/22-26/91	X	Potlatch Corporation, Lewiston, ID
	07/23-26/91	X	Great Western Chemical Co., Nampa, ID
	08/05-09/91	X	Boise Cascade Mill, Wallula, WA
	02/24-28/92	X	Georgia-Pacific Paper Division, Toledo, WA
	03/23-27/92	X	SEH America, Vancouver, WA
	04/28-05/01/92	X	Amalgamated Sugar Company, Twin Falls, ID
	07/27-31/92	X	ALCOA, Wenatchee, WA
	11/16-20/92	X	Weyerhauser Company, Springfield, OR
	01/25-29/93	X	Wacker Siltronics, Portland, OR
	04/12-16/93	X	Ponderay Newsprint, Usk, WA
	07/26-27/93	X	Darigold, Caldwell, ID
	07/28-29/93	X	Simplot, Caldwell, ID
	10/25-29/93	X	Unocal, Kennewick, WA
	02/14-17/94	X	Boise Cascade, Medford, OR
	03/22-25/94	X	Ocean Spray, Markham, WA
	06/20-24/94	X	Elf Atochem, Portland, OR

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	11/14-15/94	X	Southern Oregon Marine, Coos Bay, OR
	11/16/94	X	South Coast Lumber, Brookings, OR
	02/27-03/03/95	X	Georgia-Pacific, Bellingham, WA
	06-05-09/95	X	American Microsystems, Pocatello, ID
	11/13-17 and 12/11-13/95	X-D	Kalama Chemical, Kalama, WA
	04/08-11/96	X-D	Blount International, Lewiston, ID
	07/08-11/96	X-D	Fujitsu Microelectronics, Gresham, OR

Notes:

1. "X" indicates that the final report has been received, and the profile has been entered into the database.

2. "X-R" indicates that the final report and the profile has been received, and the profile will be finalized.

3. "X-D" indicates that only the final report has been received, and the profile will be developed and completed.

4. "X-ND" indicates that the final report has been received, but no profile will be prepared because the audit was a follow-up visit, rather than a new audit.

5. **Bold** text indicates that the final report has not yet been received.

6. The audit conducted by Region 10 at ITT Rayonier in Port Angeles, WA, occurred over a period of several months.