THE CHEMICAL SAFETY AUDIT PROGRAM:

FY 1996 STATUS REPORT

July 10, 1997

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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 96, and a discussion of the current and future role of the CSA program in the CEPPO Prevention Strategy.

The CSA program has evolved from the chemical accident prevention (CAP) efforts of CEPPO into a program that has encompassed the review of the chemical process safety management systems of over 300 facilities and the training of over 1000 federal, state, and local officials. In addition, the CSA program continued the development of 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.

CEPPO's primary objectives are to identify the causes of accidental releases of hazardous substances and the means to prevent them from occurring, to promote industry initiatives in these areas, and to share 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.

Program Activities/Results

The achievements of the audit program, outlined in Chapter 2, are based on the number of 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 96, the regions had submitted a total of 333 final audit reports to EPA headquarters for the 344 audits that were conducted between FY 89 and FY 96. Information from the 22 most recently submitted reports was examined for this status report, including a number of reports from audits conducted in FY 95 that were not submitted to EPA headquarters in time to be included in the FY 95 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 FY 89 through FY 96, a total of 38 workshops, attended by nearly 1300 individuals throughout all ten regions, have been conducted; approximately 250 individuals attended the ten workshops held in FY 96. The most noteworthy trend in these workshops has been the increased involvement of state and local officials, who account for approximately 45 percent of the overall attendance, but three-fifths 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, one-sixth of workshop attendees during FY 96 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.

Regional Implementation Status

Chapter 3 discusses the status of CSA program follow-up, coordination, and implementation activities conducted by the regional offices during FY 96. In June 1993, CEPPO issued a revised edition of the *Guidance Manual for EPA Chemical Safety Audit Team Members*, which outlines the two important modifications to the CSA program that were implemented in the past several years — the institution of audit follow-up activities and the preparation of audit report profiles by the regional offices. To supplement the audit and audit report preparation, the regional offices were requested to establish an audit follow-up program. Regions have approached the follow-up process using various methods, including mailing questionnaires, returning to facilities for post-audit reviews, and conducting telephone interviews, all of which serve as an effective means to coordinate with the audited facilities on their progress. Overall, the regions have received a substantial degree of positive feedback from audited facilities in response to audit team recommendations.

Some of the regional offices have been preparing an audit report profile in conjunction with the submission of the chemical safety audit report. The profile is a summary document that organizes the key information in the audit report in a format compatible with the CSA program database. The profiles submitted by the regions over the last several years represent an important element in streamlining program analysis; headquarters continues to work with the regions to ensure that the information submitted in the profiles is consistent with the format of the CSA database.

The CSA program also 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.

FY 96 Audit Analysis

Chapter 4 presents an overview of conclusions and recommendations taken from recent EPA chemical safety audits, based on the latest 22 final CSA reports received by EPA headquarters as of September 30, 1996. 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 4 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 22 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 a cornerstone in chemical accident prevention and an ongoing means of stimulating chemical accident prevention initiatives. 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 and industry.

On May 24, 1996, EPA's Administrator signed the final rule for the risk management planning requirements mandated under 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 will have three years to comply with these requirements, with the initial RMP submissions due by June 21, 1999.

With the implementation of the requirements under CAA section 112(r), the focus and scope of the CSA program will change. First, CSA team members will be involved in implementing the RMP regulation at the regional level and working directly to help facilities understand the rule requirements. In addition, EPA is encouraging state governments to assume responsibility for implementing the RMP program; the CSA program will play a key role in assisting these states with guidance and training on chemical process safety issues. Following the submission date in 1999, regional CSA personnel also will be involved in reviewing facility risk management plans and conducting compliance audits.

There will still be many facilities handling extremely hazardous substances that are not covered by the RMP requirements. The CSA program will continue to have an important role in accident prevention by auditing these facilities. The audits serve to assist industry in understanding more about the holistic nature of chemical process safety management. Historically, the audits have also helped more than just the facility audited; many facilities have shared their audit experiences and recommendations with their corporate offices and with sister facilities within the corporation.

In addition, over the past two years, EPA and the Occupational Safety and Health Administration have begun conducting joint investigations of serious accidents involving hazardous chemicals. These investigations are designed to determine root causes of these incidents so that steps can be taken to prevent their recurrence. CSA audit team members, based on their training and knowledge of facilities and industrial processes gained from conducting audits, are key components of the EPA contingent of the Chemical Accident Investigation Team. They will be involved in conducting accident investigations; developing alerts where an unrecognized hazard is identified; and developing reports on the facts, circumstances, and root causes of accidents.

With these activities in mind, during the upcoming year headquarters and the regional offices will be examining their needs and making adjustments to the CSA program to reflect its evolving role in the accident prevention process.

1.0 CHEMICAL SAFETY AUDIT PROGRAM: HISTORY AND FUTURE

In the eight years since EPA initiated the Chemical Safety Audit (CSA) program in 1988, over 300 chemical safety audits have been conducted by EPA regional offices, and a CSA program database and an extensive training program have been established. 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).

Of the 344 chemical safety audits conducted over the seven years ending September 30, 1996, 333 final audit reports have been completed by regional personnel (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. Information from the latest profiles (completed after the publication of the FY 1995 Status Report) will be made available through the distribution of the CSA database later this year.

The remainder of this chapter describes the future of the CSA program, the key 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. Chapter 3 provides an overview of regional activities in implementing the CSA program. Finally, Chapter 4 reviews facility chemical process safety practices identified in the final CSA reports submitted to CEPPO since the publication of the FY 95 CSA Status Report.

1.1 Relationship to the CEPPO Prevention Strategy

The CSA program is one component of CEPPO's overall chemical accident prevention strategy. CEPPO prevention efforts also include 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 in developing guidance documents and working directly to help facilities understand the requirements. Following the initial submission of risk management plans in 1999, CSA team members will be involved in reviewing the RMPs submitted by facilities and conducting compliance audits.

- These amendments also required the President to create the Chemical Safety and Hazard Investigation Board (CSHIB). The CSHIB was to have been an independent agency to investigate and report to the public on the causes of serious chemical accidental releases. In its place, EPA and OSHA were asked by the administration to carry out the responsibility of the CSHIB using their existing legal authorities.

  Chemical safety audit team members, based on their training and extensive audit experience, are key components of the EPA contingent of the Chemical Accident Investigation Team (CAIT). They are involved in conducting accident investigations; developing alerts where an unrecognized hazard is identified; and developing reports on the facts, circumstances, and root causes of accidents. Information from the investigations could lead to EPA issuance of new guidance and/or regulations relating to accident prevention.

1.2 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 will have three years to comply with these requirements, with the initial RMP submissions due by June 21, 1999.

Thus, by mid-1999, chemical accident prevention practices, which the CSA program encourages, will be mandatory for certain processes at sources covered by the RMP rule. CSA team members will be involved in implementation of the RMP regulation at the regional level in providing compliance assistance. In addition, EPA is encouraging state governments to take responsibility for implementing the regulation; the CSA program will play a key role in assisting these states with guidance and training on chemical process safety issues. At the same time, it is important to recognize that 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.

Headquarters and the regions have been examining their needs and making adjustments to the CSA program to reflect its evolving role in the accident prevention process. In addition to participating in the implementing of the RMP program and the joint EPA-OSHA accident investigation, some regions have began conducting mini-audits at non-chemical manufacturers as well as at facilities that may not be required to comply with the RMP rule. Others have been conducting investigations of accidents in their region involving the release of reportable substances and determining preventive actions necessary to avoid recurrences. As implementation of the RMP program continues and the EPA-OSHA joint investigation protocol is developed, it will become clearer how the CSA program will evolve.

1.3 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 96, EPA's Environmental Response Training Program continued to offer the four-day CSA workshop as part of its regular curriculum. Workshops were held in Rochester, NY; Dover, DE; Greensboro, NC; Cincinnati, OH; Little Rock, AR; Kansas City, KS; Lakewood, CO; Novato, CA; Yuma, AZ; and Salem, OR. A total of 251 EPA regional, AARP, contractor, state and local government, other federal agency personnel, and other individuals attended the 10 workshops.

For FY 97, the Environmental Response Training Program plans to present 10 four-day CSA courses on the schedule below. The specific locations for all of these workshops are being determined by the appropriate regional office to encourage further state and local interest and participation in the CSA program:

- December 3-6, 1996 — Region 9: Richmond, California
- January 7-10, 1997 — Region 1: Groton, Connecticut
- February 4-7, 1997 — Region 7: Lee's Summit, Missouri
- March 11-14, 1997 — Region 4: Atlanta, Georgia
- April 8-11, 1997 — Region 9: Phoenix, Arizona
- May 13-16, 1997 — Region 10: Fort Richardson, Alaska
- June 3-6, 1997 — Region 2: Rockland County, New York
- June 17-20, 1997 — Region 3: State of Pennsylvania
- July 15-18, 1997 — Region 6: State of Oklahoma
- August 12-15, 1997 — Region 5: State of Michigan

These four-day 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.

1.4 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.

Through analysis of the data, CEPPO uses the CSA database to identify successful and problematic techniques or practices employed to manage process safety at facilities handling hazardous substances. In addition, CSA data are supporting the development of regulations and guidance for the risk management plans required under CAA section 112(r). CEPPO also refers to the database to assess the implementation of the CSA program in terms of the types of facilities visited (e.g., manufacturing versus non-manufacturing facilities or chemical manufacturers versus other manufacturers), the criteria for selecting facilities to audit, and the types of hazardous substances reviewed (e.g., SARA Title III extremely hazardous substances versus CERCLA hazardous substances).

In addition, 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. Later this year, each regional CEPP coordinator will receive an update to the CSA database containing information from the latest final audit reports.

1.5 CSA Program Background

History

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.

Authority

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.

Audit Team

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.

Audit Selection

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. Specific topics include:

- Awareness of chemical and process hazards;

- Process characteristics;

- Emergency planning and preparedness activities;

- Hazard evaluation and release detection techniques;

- Training of operators and emergency response personnel;

- Facility and corporate management structure;

- Preventive maintenance and inspection programs; and

- Community notification and response coordination mechanisms.

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.

Program Modifications

The latest edition of the *Guidance Manual for EPA Chemical Safety Audit Team Members* (June 1993) outlines two important modifications to the CSA program implemented in FY 93 — the preparation of report profiles by the regional offices and the institution of audit follow-up activities. As part of the audit process, the regional offices should prepare an audit report profile for headquarters in conjunction with the submission of the chemical safety audit report. The profile (see the annotated profile in the revised *Guidance Manual for EPA Chemical Safety Audit Team Members* for more information) organizes the key information in the audit report in a format suitable for direct entry into the CSA database. To facilitate this process, a hard copy and an electronic version of the profile should accompany the audit report when it is submitted to EPA headquarters. The profiles submitted by the regions over the last several years represent an important element in streamlining program analysis; headquarters continues to work with the regions to ensure that the information submitted in the profiles is consistent with the format of the CSA database.

Secondly, to supplement the audit and audit report preparation, the regional offices have been asked to establish some form of audit follow-up program. The follow-up program will support EPA's efforts to evaluate the effectiveness of the CSA program and may provide a basis for amending the focus and direction of the CSA program to achieve its goals more effectively. The specific nature of the follow-up activities has been left to the discretion of the regional offices, but at a minimum the program should be designed to track audited facilities' implementation of CSA report recommendations. This will allow Headquarters to analyze trends in the implementation of CSA recommendations as a function of issue (e.g., employee training or instrument maintenance), level of effort (e.g., fixing a relief valve or replacing a storage tank), and type and of facility. The regional offices should refer to the latest edition of the *Guidance Manual for EPA Chemical Safety Audit Team Members* for more information and guidance on the development of audit follow-up programs.

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 96, the regional offices have finalized a total of 333 audit reports for the 344 chemical safety audits conducted, including three 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 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, and 19 in FY 96. Exhibit 2 summarizes the chemical safety audits and final reports completed by region.

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 333 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 comprised one-seventh of the total number of audits and were classified in a variety of SIC codes. The major categories among these operations were 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

Summary of Chemical Safety Audits and Final Reports by Year and Region
FY 89 through 96

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	Total Audits	Final Reports
1	4	4	3	3	3	3	0	0	20	20
2	2	4	3	3	4	3	2	1	22	19
3	4	4	4	5	6	6	4	2	35	35
4	5	5	15	6	10	8	8	6	63	62
5	3	5	3	3	4	4	4	1	27	22
6	4	5	5	4	4	4	4	0	30	29
7	0	0	4	6	14	18	14	4	60	60
8	3	4	6	4	5	4	3	0	29	28
9	4	4	4	4	3	3	1	2	25	25
10	3	4	6	3	4	4	4	3	33	33
Total	32	39	53	41	57	57	44	19	344	333

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

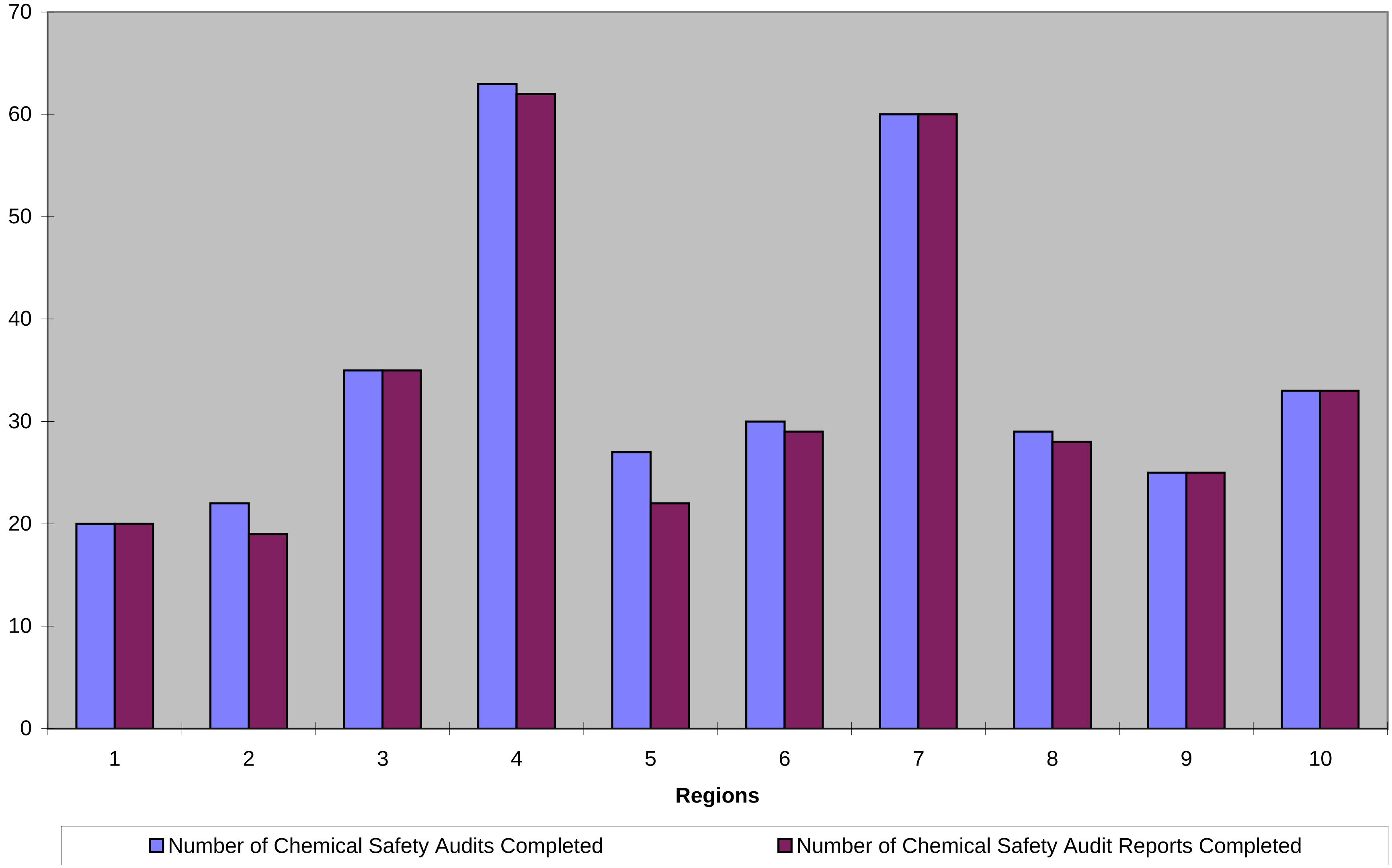
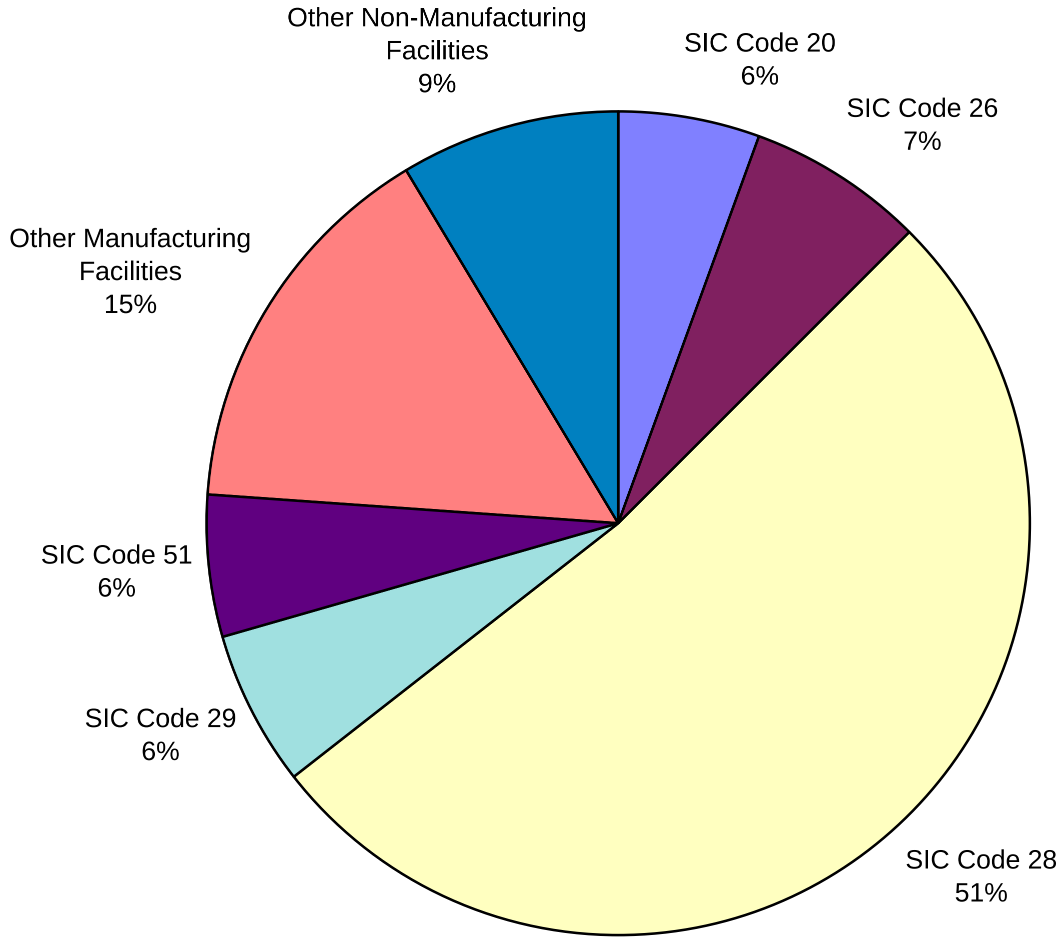


Exhibit 3

Breakdown of Audited Facilities by SIC Code

FY 89 through FY 96



2.3 Chemical Safety Audits by Hazardous Substance

A total of 187 different hazardous substances were examined by audit teams at the 310 audited facilities for which this information was available, including 166 classified as CERCLA hazardous substances and 76 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 (120 audits), sulfuric acid (117), sodium hydroxide (98), ammonia (92), and hydrochloric acid (74).

2.4 CSA Training Workshops

As of the close of FY 96, 48 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 five years the regional offices have been coordinating with the states to identify workshop locations to encourage attendance by state and local officials.

Ten workshops were held in nine regions during FY 96. Training workshops were held in Rochester, NY (Region 2); Dover, DE (Region 3); Greensboro, NC (Region 4); Cincinnati, OH (Region 5); Little Rock, AR (Region 6); Kansas City, KS (Region 7); Lakewood, CO (Region 8); Novato, CA (Region 9); Yuma, AZ (Region 9); and Salem, OR (Region 10). A total of 251 attendees participated in the 10 workshops. A variety of groups was represented at the workshops including 19 regional personnel, 91 state officials, 58 local and tribal officials, and 44 representatives from other federal agencies, including staff and contractors from the U.S. Department of Energy, and officials from the Occupational Safety and Health Administration, U.S. Coast Guard, Air Force, Navy, Marine Corps, and Federal Highway Administration. In addition, 28 industry representatives also attended the workshops. 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 95 to that in FY 96, 59 percent of the FY 96 attendees represented state, local, and tribal governments, as compared to 44 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 (82), Region 3 (68), and Region 2 (53). Note that this exhibit does not include data for TAT workshop attendance from FY 94 and FY 95 due to the involvement of the technical assistance team contractors whose responsibilities cover multiple regions.

Exhibit 4

Hazardous Substances Examined

FY 89 through FY 96

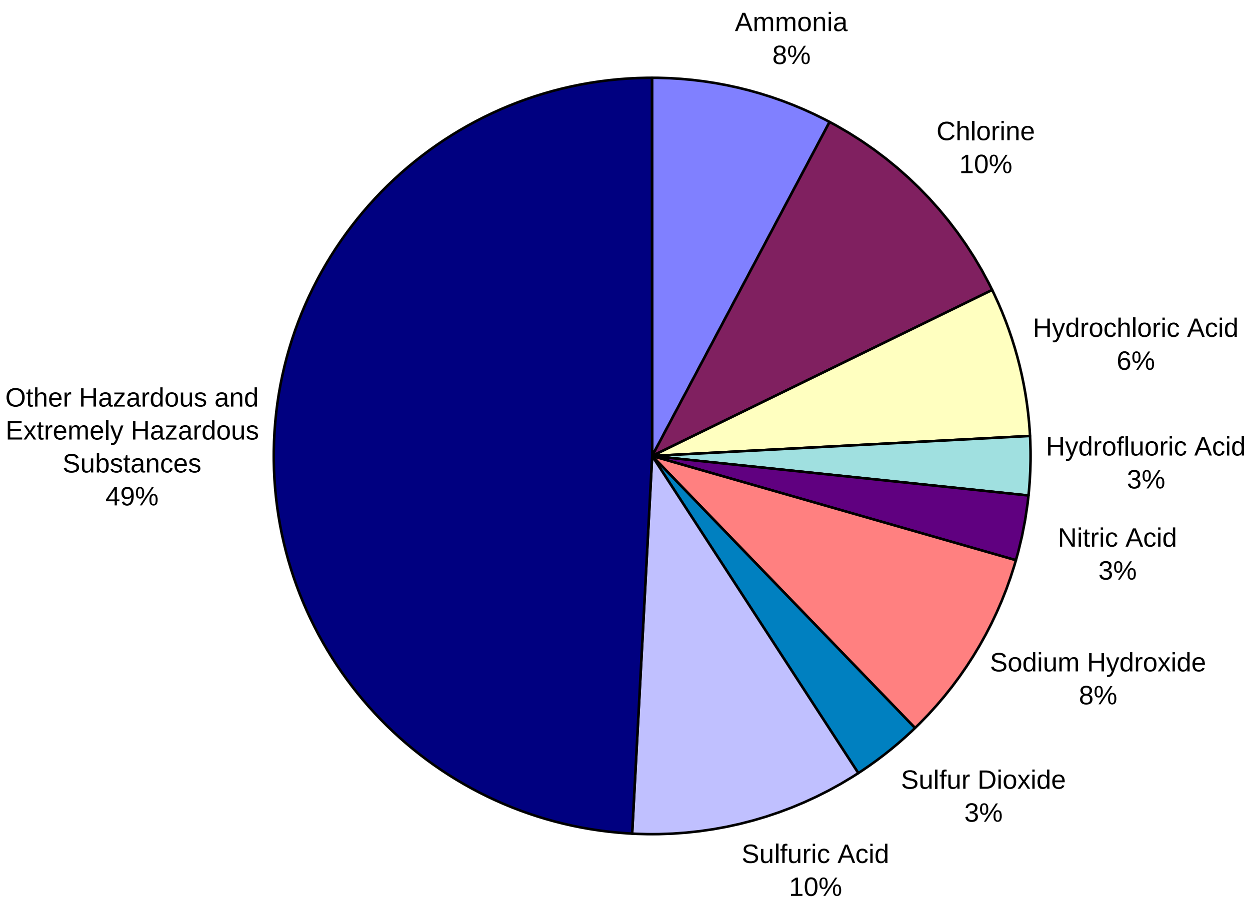


Exhibit 5

Chemical Safety Audit Workshop Attendees by Affiliation

FY 89 through FY 96

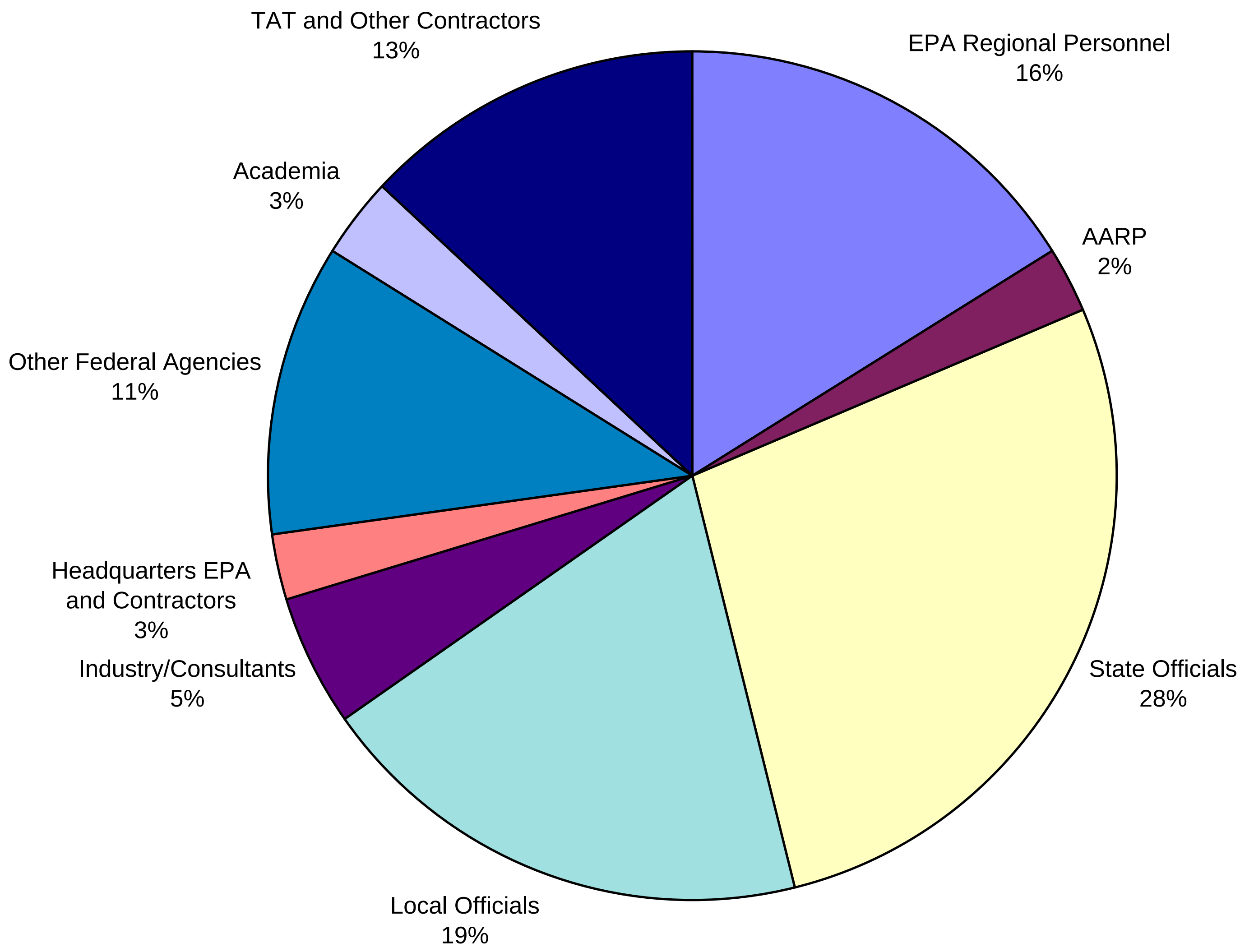
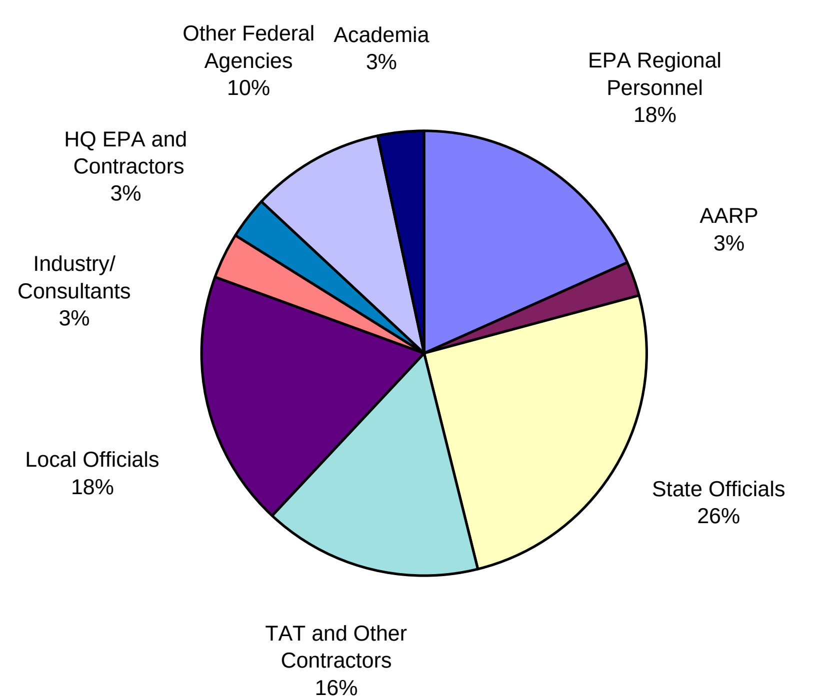


Exhibit 6

Chemical Safety Audit Workshop Attendees by Affiliation

FY 89 through FY 95



FY 96

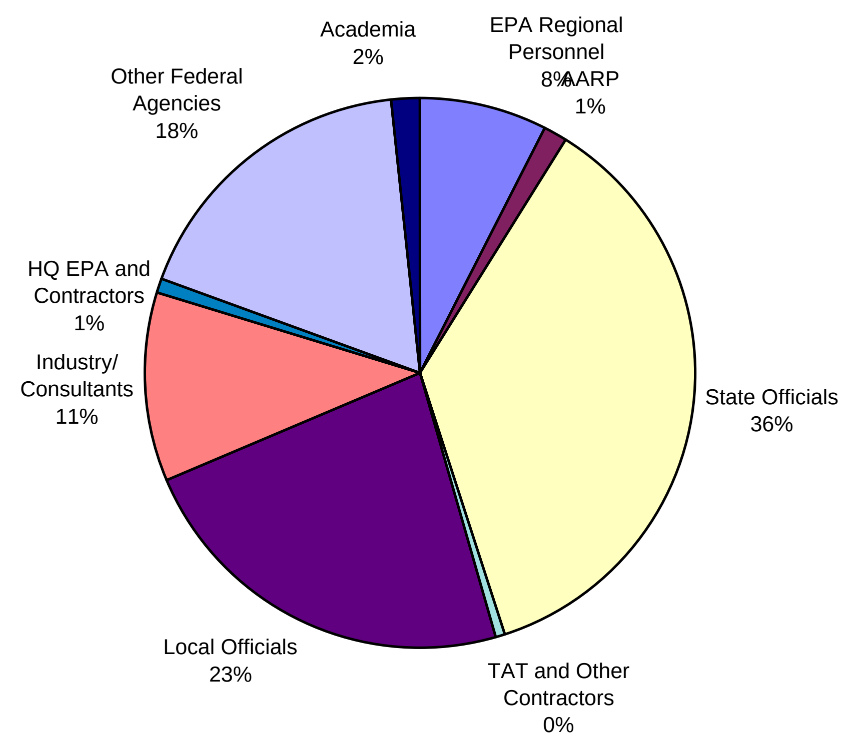
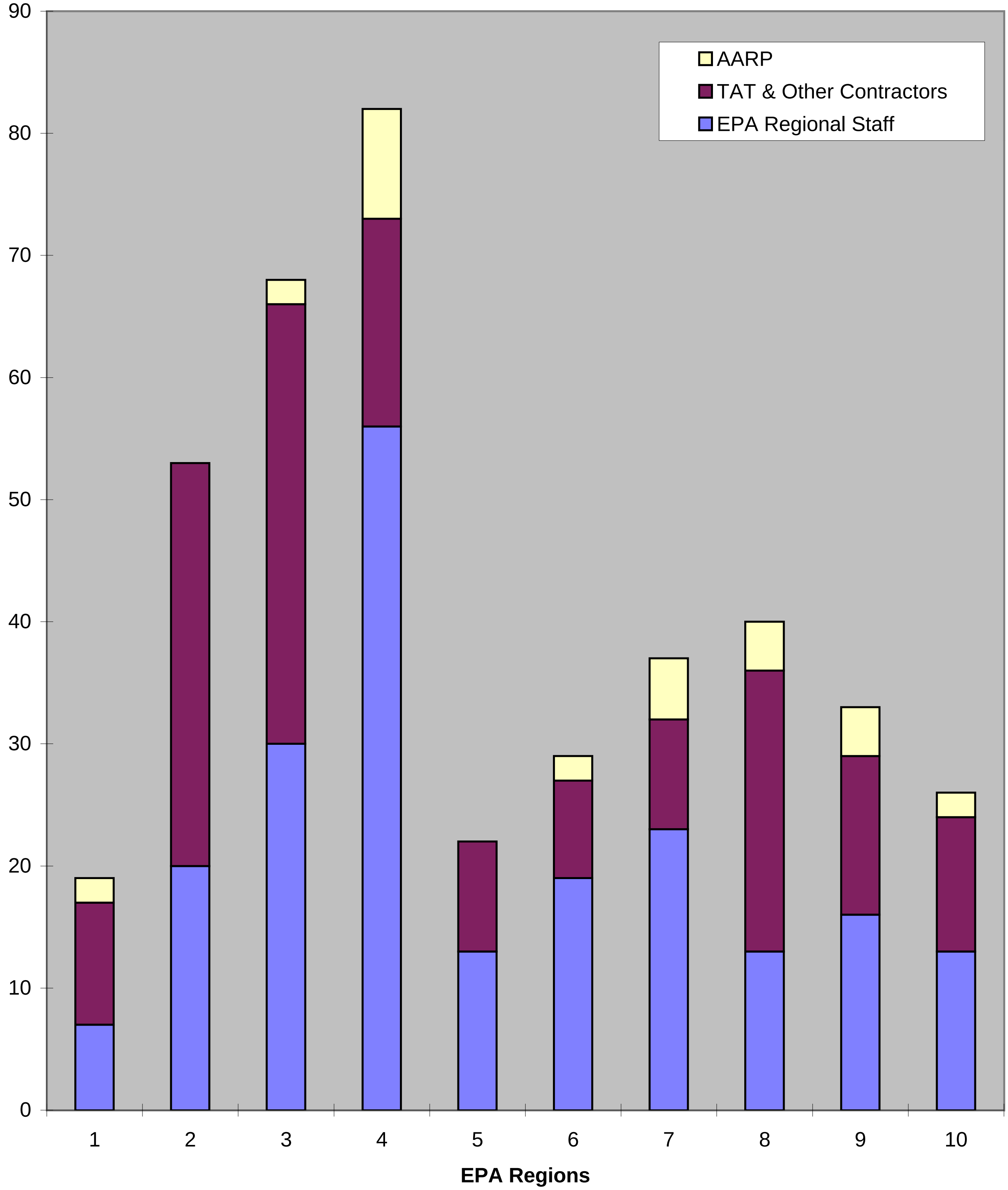


Exhibit 7

Chemical Safety Audit Workshops
Number of Persons Trained by EPA Region

FY 89 through FY 96



3.0 STATUS OF CSA PROGRAM IMPLEMENTATION

This chapter focuses on the status of EPA regional implementation of the CSA program. With the added responsibility associated with the issuance of the CAA section 112(r) regulations and the development of the Chemical Accident Investigation program, the success of the regional offices in achieving the goals of the CSA program can be measured by considering several factors, including the number of audits conducted and audit reports completed, participation in CSA training courses, audit follow-up activities, state and local coordination, and regional program initiatives and modifications.

3.1 Regional CSA Status

The progress of the program at the regional level is measured by the number of audits performed and audit reports completed, as well as training and workshop participation. Overall, the number of audits conducted and the number of final audit reports completed for FY 96 was lower than the level in FY 95, although this is in part attributable to the shift in resources to other prevention activities, such as accident investigations and mini-audits. The following chart highlights the number of audits conducted by each region and the number of final audit reports received by CEPPO from each region for fiscal year 1996. In addition, please note that Region 3 has conducted numerous mini-audits and Regions 1 and 2 have conducted accident investigations during the past year.

CHART OF REGIONAL CSA ACHIEVEMENTS, FY 96

REGION	1	2	3	4	5	6	7	8	9	10
AUDITS	0	1	2	6	1	0	4	0	2	3
REPORTS	0	1	2	6	1 4	0		0	2	3

3.2 Regional CSA Implementation Activities

This section reviews the principal accomplishments of the CSA program at the regional level and identifies notable successes and implementation strategies during FY 96. In the last year, the regions have encouraged state and local entities, facilities, and communities to increase their level of involvement in accident prevention activities and achieve a better understanding of the holistic concept of chemical process safety management. In addition, regional offices have continued to conduct follow-up activities to support the overall success of the program. The remainder of this section is organized according to types of activities performed by the regional offices: audit follow-up activities by the regions, specific regional initiatives related to the implementation of the CSA program, and regional interaction with state and local government entities.

3.2.1 Follow-Up Activities

During the last year, the regions have continued existing follow-up programs to supplement the chemical safety audits that they have conducted. Regions have approached the follow-up process from a variety of angles, including mailing questionnaires and returning to facilities for post-audit reviews. State and local participation in follow-up activities produces long-term benefits from the enhanced planning, coordination, and information exchange that often result from the cooperative CSA follow-up process. Multiple agency participation opens communication channels among many organizations and government offices. Increased communication allows for a cooperative approach to addressing the problems noted during an audit — from emergency notification difficulties to building an effective unified command system.

During FY 96, Region 9 implemented a follow-up program to cover all facilities at which a chemical safety audit had been conducted since 1989. The program was designed to provide the region with an assessment of the outcome and application of audit findings and recommendations documented in the final audit reports. A follow-up package, consisting of a cover letter, instructions, and a worksheet listing the findings and recommendations included in the audit report, was sent to each facility. Region 9 requested that each facility categorize the stage of the response to each of the audit team recommendations (e.g., no action, developing action plan, in place) and then describe the implementation activities more fully. Responses to the follow-up package have been received from almost all of the audited facilities.

Region 1 continues to monitor release reports from the National Response Center to determine if releases continue to occur at facilities that have been subject to a chemical safety audit. Their policy is to conduct follow-up activities at facilities where releases continue to occur. These activities can result in informal compliance activities or in some cases they could lead to formal enforcement actions.

Depending on the speed of the facility's response to the audit team's recommendations, several regions have been able to incorporate follow-up information into their chemical safety audit reports and profiles. Specific recommendations are often implemented at the time of the audit, or directly following the visit, while others are prioritized for implementation along with other facility capital improvement projects.

3.2.2 Regional CSA Program Initiatives

As the CSA program has developed, the regional offices have taken advantage of the program's flexibility and begun new initiatives and activities to support awareness of chemical process safety issues. These efforts, such as mini-audit programs, facility selection criteria based on special regional priorities, and coordination with other programs, have been the products of the evolution of the CSA program.

CSA Program Initiatives

To maximize the effectiveness of the overall Chemical Accident Prevention program, CEPPO encourages program modifications and new initiatives that support the CSA program and regional goals by allowing regional offices substantial flexibility in the implementation of the CSA program. The regions have used this flexibility to model the CSA program into a vehicle for meeting regional priorities. In many cases, specific features of the CSA program (e.g., follow-up activities) have served as the basis for the development of additional regional initiatives. In addition to modifying audit procedures (e.g., facility selection criteria) to focus audits in coordination with existing regional initiatives, several regions have begun separate chemical-specific initiatives to address commonly used hazardous chemicals that pose the greatest risk in an accident.

As discussed last year, the Region 1 CSA Program is implemented at two levels. A full-scale CSA would be conducted for facilities experiencing a large scale accidental release involving death, personal injury, and/or significant environmental impact. The audit would, if warranted, be coordinated with OSHA and various state and local agencies and would include enforcement components under the

Clean Air Act and other EPA statutes. A major focus of the audit would be the practices listed in EPA's RMP regulations. The audit would identify the root cause of the release and determine if the facility is operating in a manner consistent with the CAA General Duty clause. However, no major chemical events occurred in New England in the past year and no full-scale audits were conducted.

The second level of activity is a limited scale audit of selected facility operations and safety practices coupled with a focused accidental release investigation. This audit thoroughly explores the circumstances (e.g., equipment and practices) surrounding an accidental release, discusses the probable root cause of the incident, and offers recommendations for corrective actions. The audit also serves to exchange safety information among similar industry types. Audited facilities are encouraged to address the recommendations of the audit team voluntarily. All audits and accident reviews are closely coordinated with the appropriate SERC and LEPC. A total of six limited scale audits and accident investigations were conducted in 1996. Four of the audits focused on anhydrous ammonia refrigeration systems and two involved chlorination systems at waste water treatment plants.

Region 3 conducted approximately 80 "mini" chemical safety audits during FY 96. Most were performed at ammonia refrigeration and water/wastewater treatment facilities to review their approach to ammonia and chlorine hazards, although several other chemical users were also visited. By performing "mini" audits, the region was able to reach a larger number of facilities at a reduced cost to the government. Following a site visit, the region sent a followup letter to the facility highlighting notable practices and recommendations for potential improvements. Outreach on the Risk Management Program regulations was also conducted during these audits.

Based on the results of the audits conducted at these facilities, Region 3 has drafted fact sheets outlining their principal conclusions and recommendations for ammonia and chlorine use. They plan to distributed these fact sheets to LEPCs by the end of FY 97. In addition, the regional chemical accident prevention group gave a presentation on the success of the program at the National Conference of the Refrigerating Engineers and Technicians Association. In addition to the ammonia refrigeration and water/wastewater treatment facilities, the chemical accident prevention group plans to conduct audits at propane distributors and at the chemical storage/transfer areas of chemical manufacturers during FY 97.

In late FY 96, Region 9 began a new project to apply the CSA methodology to stationary sources and an associated transportation system in the San Francisco Bay Area. This project was designed to enable the region to better understand the hazards associated with the handling of hydrofluoric acid (HF), from manufacture to end use. Region 9 conducted a chemical safety audit at an HF manufacturing facility in 1992 and a follow-up visit in 1994. Chemical safety audits are now scheduled at a chemical wholesaler/distributor and two semiconductor manufacturers in the area. In addition, Region 9 will be meeting with U.S. Department of Transportation and state and local emergency management and response officials to discuss safety and risk management issues related to the presence of HF and other hazardous substances in this densely populated area of California.

Coordination with Other Programs

Just as the CSA program serves as an important guide for the implementation of the CAA section 112(r) requirements within EPA's Chemical Accident Prevention program, the CSA program also provides a link to a variety of related programs and activities both inside and outside of EPA. Over the past few years, the regions have taken advantage of the audit process to coordinate their activities with other EPA program and media offices, as well as with other health and safety-related agencies, such as OSHA.

In addition, with the applicability of the new Risk Management Program regulations to operations at federal facilities, there has been a dramatic increase in interest in accident prevention issues among other federal agencies. During FY 96, a total of 44 federal officials and their contractors attended CSA training, including representatives from the U.S. Department of Energy, Occupational Safety and Health Administration, Coast Guard, Air Force, Navy, Marine Corps, and Federal Highway Administration.

4.0 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 22 final CSA reports received by EPA headquarters as of September 30, 1996. 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).

4.1 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. To demonstrate management commitment to chemical process safety, a facility should ensure that all elements of the accident prevention and emergency preparedness and response programs are integrated and that responsibility for the overall program is clear. For example, facilities should develop a management system to oversee the chemical process safety program, and identify a person or position that has overall responsibility for the development, implementation, and integration of the chemical safety process.

Corporate and facility management of most audited facilities has established general chemical process safety policies, goals, and guidelines and a designated health and safety department or a safety manager. Some corporations have chosen to follow industry standards voluntarily to enhance facility process safety management. For example, a dairy products manufacturer plans to gradually update its process safety program to comply with OSHA's Process Safety Management standard voluntarily (although the facility is not subject to the regulation currently), to ensure safe operation and provide the flexibility to respond to future regulatory changes. Management at both a chemical manufacturer and a semiconductor manufacturer decided to certify their facilities under the International Standards Organization (ISO)-9000 program. ISO certification requires that an accredited third party audit the facility to certify that its quality control management and assurance system meets the basic requirements of the ISO-9000 standard. This certification indicates that good management practices have been established, implemented, and documented at the facility.

Audited facilities use a variety of management techniques to disseminate process safety information both within the facility and to the surrounding community. One typical facility established an employee safety steering team consisting of four managers and four hourly employees, and uses a point system to award points to employees for attending safety meetings and subtract points for lost-time accidents. At another facility, management conducted a survey to gain a better understanding of the concerns of the community surrounding a refinery complex. Key issues in shaping facility policy that emerged from this survey included: (1) the need for improved communication; (2) neighborhood concern about air pollution; (3) a specific need for the development of an early warning system; and (4) the community's view that previous refinery efforts to provide financial support to the local community were inadequate.

Some corporations are more involved in supporting process safety management at their facilities than others. One chemical manufacturer has a corporate-level safety steering committee comprised of facility departmental and safety managers. This corporation also has established a detailed process safety policy (based on the OSHA standards), and corporate safety experts travel extensively to individual facilities to provide guidance and audits. However, management for some of the audited facilities has only made "paper" commitments to accident prevention. For example, an audit team noted that although a chemical manufacturer is subject to the OSHA PSM standard and has developed written documentation for a facility PSM program, several components of the program are incomplete in practice, including the operator training, maintenance, and contractor elements.

4.2 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.

Although most facilities have at least an informal program to evaluate hazards, a number of audited facilities have formal process hazard analysis programs that are designed to enhance process safety management and identify areas for improvement in facility practices. A chemical manufacturer performs a preliminary analysis and then a detailed engineering analysis (using the HAZOP methodology) in accordance with corporate and facility standards. At a brewery, piping and instrument diagrams, operating procedures, and maintenance records are all reviewed prior to conducting process hazard analyses. Particularly noteworthy was management's commitment to following up on identified improvement areas: after the basic portion of the refrigeration system was evaluated in a HAZOP, the facility developed checklists for evaluating all other areas of the system. The checklists contained 38 high-priority and 53 secondary-priority modifications; at the time of the audit, the facility had completed all but three of the modifications from both lists. Another facility incorporates PHA results into their emergency response plan. This facility conducted a vulnerability analysis that examined the potential effects of natural disasters, labor strikes, civil disorder, equipment failures, and accidents and then developed recommendations for preventative and mitigative actions.

At the same time, audit teams found room for improvement in the hazard evaluation practices at some facilities. In general, audit teams found that, where hazard evaluations are being conducted, a broad team of technical experts is usually assembled. However, the recommendations that result from the evaluations are not always pursued by management and "the big picture" is sometimes not fully considered. For example, although a PHA team at a chemical manufacturer evaluated the placement of some pressure relief valves to determine if a release could be directed in a hazardous direction or form a vapor cloud, they did not conduct a systematic evaluation of valve placement. The audit team recommended that this facility evaluate all PHAs to determine if additional effort should be made in evaluating release detection and control mechanisms, and directed the facility to pay particular attention to assessing the potential for a flammable vapor cloud to form and reach an ignition source.

In addition, some audited facilities have performed no hazard evaluations. In some cases, these facilities were not required by federal regulation to perform PHAs. Other facilities are in the process of building in-house expertise to conduct hazard evaluations. For instance, a chemical distributor recently has done internal training for several employees in process hazard analysis, and two employees attended a four-day PHA course given by the Process Safety Institute. A metal extrusion manufacturer had not performed a hazard evaluations on facility processes in the past, but at the time of the audit was conducting a fault tree analysis of a transport system within the facility.

4.3 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.

Many audited facilities use offsite consequence analysis to identify potential hazards. One audit team commended a chemical manufacturer for the dispersion modeling kits in use at the facility. These kits include maps and aerial photography of the local area and templates of modeled chemical plumes. The facility developed six templates for each substance of concern, incorporating scenarios ranging from a minor incident to a worst-case release occurring during the day and night. The kits are strategically located at four different locations. In the event of a release, the template most closely approximately the actual leak or spill is place on the photograph at the point of release, and the affected area is determined by rotating the template to account for wind direction. The templates are color-coded with green sections denoting evacuation areas and white sections denoting warning areas.

However, audit teams found that other facilities are not implementing offsite consequences analysis efforts as effectively as possible. In several cases, audit teams recommended that facilities should perform offsite consequences analyses for a wider spectrum of the chemicals on-site or possible hazardous situations. In several cases, audit team members recommended specific additional analyses or techniques to facilities. For instance, employees at a paper mill told audit team members that the facility had conducted a "What If" analysis after neighbors complained of objectionable odors in the area, but no other hazard analyses have been conducted. As a result, during the audit, the team demonstrated CAMEO software and recommended that the facility perform air modeling exercises to determine the potential impact of releases to the surrounding community. At a chemical manufacturer, air modeling for emergency response purposes had been conducted both by the facility and the county emergency management agency using ALOHA. However, the audit team noted that the only conditions modeled had been those considered "most likely" by the facility, which used IDLH concentrations for levels of concern. The audit team recommended that ALOHA scenarios for this facility be developed using less than the IDLH values for chemicals to account for exposures to more vulnerable populations, and that more active weather conditions be incorporated based on weather patterns typical to the area.

Furthermore, a few audited facilities had not conducted any offsite consequence analysis. For example, a dairy products facility has not performed any modeling of hypothetical releases, although it has experienced several reportable releases of anhydrous ammonia. Similarly, off-site consequences of releases were not addressed in a chemical manufacturer's process hazard analyses. Likewise, a metal products manufacturer located on Tribal lands has not performed any modeling of chlorine or any other chemicals that have off-site release potential. In these situations, the audit teams recommended that facilities conduct off-site consequence analyses and share the results with the local community and incorporate them into facility emergency planning. In one instance, the audit team recommended that the facility conduct offsite consequence modeling as a planning tool. In addition, the audit team recommended that a facility consider developing real-time monitoring capabilities in addition to consequence modeling for use during a release incident to inform employees and the general public about potential exposures.

4.4 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.

Audit teams commended several facilities who made MSDS information readily available and understandable to employees. For example, a semiconductor manufacturer maintains MSDSs for all chemicals on site electronically in a data bank and full sets of hard copies are kept in the safety office, first aid office, and control room. Unit-specific MSDSs are located wherever chemicals are used or stored, and training in understanding MSDSs is part of the new hire program.

Audits also revealed facilities whose chemical hazards were not formally identified or were poorly documented. For example, at a dairy products manufacturer, a bulletin describing some of the hazards of ammonia is distributed to contract security guards, but this bulletin is not very detailed and included numerous errors that could lead to, rather than prevent, an injury. An audit team at an explosives device manufacturer found an overall atmosphere of complacency regarding the hazards of cyanide among facility employees. The team made a number of suggestions to improve hazard awareness at the facility, including requiring all employees working on cyanide systems to be "cyanide-qualified" and wear a pin or patch so that unqualified employees can easily be recognized if they are conducting work in the area.

Other audits revealed the need to take further steps to make chemical hazard information more readily accessible to employees. For instance, at a chemical manufacturer, MSDSs for chemicals used or produced in the facility are available for review in the warehouse and the office area. However, it is difficult to open the file drawers where the MSDSs are stored and the lighting is inadequate in the area where the files are to be read. The audit team recommended that this facility keep its MSDS information area organized, updated and fully accessible, and that it provide more illumination around the reading area. At the semiconductor manufacturer mentioned earlier, the audit team recommended that the facility translate critical sections of the safety plan and contingency plan into those languages used by foreign-speaking employees. At a pulp mill, the audit team found that MSDSs were stored in several administrative locations, but recommended that they be maintained in other areas where the hazardous chemicals are found.

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, specific problems observed included piping and valves that were not sufficiently labeled or protected from truck traffic; insufficient labeling of some bulk storage tanks; and uncovered conveyor belts carrying raw materials, which allowed particulates to escape and contributed to the generally poor housekeeping at the facility. At an explosives device manufacturer, the audit recommended that lighting and ventilation be improved to meet current standards.

4.5 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 audited facilities had extensive SOPs for their processes. Audit teams cited many examples of thorough SOPs that were formally documented and implemented by employees. At one refinery, for example, SOP manuals exist for each operation performed, describing the process and equipment associated with each area and containing safety information on the chemicals used in that unit. SOPs are updated annually by having an operator walk through the unit for verification purposes. In addition, the refinery devised a system to augment SOP guidance and aid communication between shifts through the development of additional "orders" that are written by the area supervisor and kept in a loose-leaf binder in the control room.

Another large facility maintains extensive SOPs for the operation of equipment (in a standard checklist format), maintenance tasks, incident investigation, and management of change. For each step in the equipment operation procedures, an Action/Condition is listed to correspond to each expected Response/Warning description. If personnel other than the operator must perform a step in the procedure, the Action/Condition section indicates who will perform the task. The development of formal SOPs was not limited to large facilities, however. One audit team noted that a small ink manufacturer with only 20 employees had developed documentation that was more detailed and comprehensive than is sometimes found at facilities with an order of magnitude larger number of employees.

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, one manufacturing plant lacked a formal process for the development and maintenance of SOPs for process operations and maintenance. A dairy products facility has few written SOPs for operating their ammonia refrigeration system (other than the manufacturer's instructions), and where this facility does have SOPs, they are sometimes incomplete. For instance, although there are SOPs for confined space entry, these SOPs do not include the evaporators, which can be entered from unbolted manways.

Audit teams encouraged several facilities to recognize the benefits that can result from the development of SOPs. Audit teams encouraged facilities without process documentation (such as the manufacturer described above) to develop SOPs with operator assistance, so that the SOPs could be used in training new employees, in addition to providing more complete documentation of facility operations. Several audit teams recommended that facilities model the development of SOPs on the guidance attached to the OSHA PSM regulation; a chemical producer subject to the OSHA PSM standard received such a recommendation after the audit team found that written programs with supporting documentation were not complete for operator training, maintenance, contractor qualification and oversight, new hire and visitor orientation, and pre-startup safety review.

In response to the mandate of the OSHA and EPA regulatory initiatives, audit teams noted several facilities with less formal SOPs were already revising their programs to more fully document operations. One chemical manufacturer was revising its Safety Program Manual because a number of mandatory elements were incomplete. In addition, the management of another chemical manufacturer had already undertaken the development of written SOPs for the safe handling and storage of chemicals prior to the audit, recognizing the deficiency in their process safety management efforts.

4.6 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 paperboard box manufacturer has a preventive maintenance program (controlled by a computer-driven work order system) that automatically generates reports identifying maintenance tasks that are due. This system also tracks and generates reports for instrument calibration, testing, and maintenance. Maintenance procedures and intervals for new equipment are based on the original equipment manufacturer's recommendations. However, particularly noteworthy is that the company has, in many cases, modified these procedures and intervals to reflect actual historical repair needs at the facility.

Audited facilities used a variety of techniques to engage and involve employees in preventative maintenance, with mixed results. For example, a semiconductor manufacturer motivates its maintenance employees by assigning one maintenance person "ownership" to each major piece of equipment; this individual is then solely responsible for maintaining and operating that machine, and his or her name is posted on that equipment. A chemical manufacturer has developed self-directed work teams to improve process operation and maintenance. The facility emphasizes empowerment of operators and maintenance personnel on these teams; for example, operations personnel are encouraged to submit maintenance work requests directly to the maintenance department, and to develop the safety work permits required for the maintenance work. In this situation, however, the audit team did raise a concern that this effort to decentralize control of the maintenance of production units may lead to some negative safety and environmental effects.

Many audited facilities used computerized tracking systems to run their preventative maintenance programs. For example, one chemical manufacturer uses a computerized work order system that permits a large number of employees to request work orders. However, centralized control is maintained by mandating that all orders must be approved by the area engineer and a designated member of production supervision before being entered into the schedule for repair. A similar centralized computerized maintenance management system at a wastewater treatment facility does not include certain activities (e.g., visual inspection of chlorine and sulfur dioxide piping). To its credit, however, this facility has provided every component on site with an individual identification number that is tracked in the computerized system.

Other facilities did not conduct pro-active or thorough preventive maintenance programs. For example, at a metal products manufacturer, maintenance personnel do not perform instrument maintenance, although they do calibrate the instruments. Several audited facilities failed to conduct any preventive maintenance activities. At a paper mill, the audit team recommended that a written work order system and preventive maintenance system be implemented for the entire facility.

Although some audited facilities have incorporated emergency equipment into their regular maintenance programs, and others conduct these activities in conjunction with drills and exercises, some facilities did not have procedures to maintain their emergency equipment. A semiconductor manufacturer ensures that all of its equipment for Level B Emergency Response Team response is staged and cleaned so that it can immediately be used to respond in clean areas of the facility. In contrast, a brewery does not have a master inventory list of the emergency response equipment on site, or inspection check lists to ensure that response equipment is replaced when its recommended useful service life has expired.

The depth and quality of the training afforded to maintenance workers can also affect the quality of a facility's maintenance program. For example, a chemical manufacturer has a comprehensive training program consisting of individualized training plans for all employees, including maintenance staff. Another commendable effort is the incorporation of digitized piping and instrumentation diagrams into the training system. At the same time, the training program for instrument mechanics at a refinery includes a formal, three-year state certified apprenticeship program as well as vendor-supplied training. However, there is no formal refresher training for instrument technicians, and although operators are trained on the distributed control system operation, the mechanics are not. Likewise, the operators do not receive any specific training on the instrumentation. The audit team encouraged this facility to consider formal refresher training for all operations and maintenance personnel, and use cross-training to sponsor maintenance and operations employees familiarity.

4.7 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. One polymer manufacturer has a particularly detailed training program, with individual training plans for each employee. The facility Training Department issues a monthly calendar of training being held and a monthly master qualification list that shows who is qualified to perform each job, including training and also keeps complete records of training sessions and certifications issued. The audit team specifically noted the facility's use of interactive computer training software to test employees as they learn.

A number of facilities have established extensive training programs that must be completed before employees can be consider qualified. At a refinery, for example, new hires must attend a one-week orientation program, in which candidates are evaluated daily. Candidates then enter a two-week program stressing the fundamentals of facility operations, during which they are again tested and evaluated daily. Successful candidates then enter a month-long unit evaluation program. Successful completion allows the candidate to enter the refinery's three-year formal operator training program. A chemical manufacturer maintains an extensive library of printed and video training materials and requires all workers to pass a qualifying test before advancing to the next step in the progression scale.

The facility training room contains a large assortment of plant equipment used for both new hire orientation and refresher and advanced training.

Audit teams did suggest specific improvements to round out existing training programs at several facilities; strongest criticism was directed at those facilities where no formal training program existed. Some facilities with no formal training program seemed to rely on the circulation of hazard bulletins to alert employees to safety risks. At one facility that manufactures explosive devices, no formal program or schedule is in place. Although chemical hazard training was provided to all new hires and contractors, the audit team was concerned with the limited training provided on the health impacts of specific chemicals to which employees might be exposed, such as chlorine, cyanide, and acetone. Periodic refresher training was provided, but too infrequently to train all operators, especially given the frequency with which employees are transferred between process areas.

4.8 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 audited facilities conducted safety audits, both internal (i.e., conducted by facility employees) and external (i.e., conducted by other individuals) on a regular schedule. At a dairy products manufacturer, the safety manager conducts internal safety and environmental compliance audits with the help of the various departments and the facility's insurance company. Internal audits are conducted each quarter, and insurance accident prevention inspections are conducted semi-annually.

Larger facilities in some cases were able to dedicate substantial resources to audit programs. As an example, an automobile manufacturer requires annual and monthly environmental and safety reports. Periodic corporate environmental audits are performed under the direction of legal staff, and also at the corporate level the company and its labor union have jointly established a plant health and plant safety audit process. In addition, various internal audits are conducted by facility managers, including a HAZCOM audit. At a metal products manufacturer, corporate staff developed safety, industrial hygiene, and environmental audit protocols, and three corporate personnel are dedicated full-time to conducting internal audits throughout the company. Audit findings and outcomes are tied to performance reviews of managers. The audit team recommended that this facility expand its auditing practices further by providing audit training to all employees, focusing on what to look for on a day-to-day basis throughout the plant.

At other facilities, safety audits were not conducted, or were not conducted regularly. For example, one chemical manufacturer reported that it does not conduct audits of its facility, nor does it subcontract to an outside vendor to conduct audits. Audit teams also found a few facilities that only expended minimal efforts at safety audits or who needed to improve procedures for tracking audit recommendations. For example, at another chemical manufacturer, the audit team found that only the required annual OSHA PSM audit had been conducted at the facility; the audit team recommended that this facility consider conducting interim or semi-annual audits on individual process elements. At a chemical distributor, facility and corporate personnel conduct both "hard" internal audits (following a formal written protocol, and result in a set of findings and recommendations), and "soft" internal audits for information-sharing. The audit team recommended that this facility consider developing a more formal written checklist for its soft audits, in order to improve accountability for following up on suggested changes.

4.9 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 that many audited facilities have explicit accident investigation procedures requiring follow-up reports and/or actions. A brewery has accident investigation procedure describing the actions to be taken during several phases of the investigation, including initial response, organizing the investigation team, determining the facts, determining the cause, recommending corrective and preventive actions, communicating results and follow-up. After gathering information, the investigation team brainstorms to determine the "root cause" and secondary causes of the incident. Once the root cause and secondary causes have been determined, the team develops recommended corrective actions and generates a formal report, which is distributed to various departments, including the department where the incident occurred. Time frames are established for implementation of the recommendations. Outstanding recommendations are addressed on monthly status reports generated by the investigation team leader.

Another facility, a dairy foods processor, implemented a formal release investigation and tracking procedure for incidents involving injuries, resulting in a significant reduction in recordable accidents. To achieve this reduction, the facility conducts Job Hazard Analyses for all positions, supervisors produce reports on injuries in their sections, and these reports are then used to perform root cause analyses. The facility Safety Committee determines the cause of each incident by consensus.

A common failing noted by audit teams was that facilities could have had more complete accident investigation programs. Two elements were commonly observed among incomplete accident investigation program: no investigation of near-miss incidents and no clearly specified responsibilities for following-up on recommendations from accident investigations. Even at the two facilities noted above, the audit teams were concerned that some non-reportable releases would not be formally investigated. In a more extreme case, an audit team visiting a waste water treatment plant found that only spills meeting the CERCLA RQ are formally investigated. A brake fluid manufacturer was found to lack procedures for conducting a root cause accident investigation or to assign a responsible employee. The audit team encouraged the manufacturer to not only establish a procedure and assign responsibility, but also develop procedures for all agencies to debrief and follow-up on accidents.

The audit team at a printing company noted that the facility did not have a formal procedure or document specifying which incidents were to be investigated and reported, resulting in sporadic review of incidents. Some incidents were investigated and thorough reports were written, while other incidents were reviewed less formally, and written reports were not always prepared. The audit team made a number of recommendations for improving the facility's accident release investigation procedures, including:

- Documenting which incidents are to be investigated (to include all incidents or near misses) and who is responsible for the investigation;

- Ensuring that incident investigation reports include recommendations for corrective actions, where needed, and are approved by high-level management;

- Monitoring implementation of corrective actions; and

- Circulating approved incident reports to all parties involved and to other company locations where similar chemicals, processes, or equipment are used.

4.10 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 fully well-developed management of change programs. A refinery has established forms to request changes, and procedures exist to review and approve requested changes. When implementation of a change begins, the plan is posted in the affected control room. Furthermore, when a piping and instrumentation change is required, the management of change document cannot be closed out until the new piping and instrumentation drawings are developed and approved. The original management of change document is printed on mylar to identify it as the original, and operating copies are printed on light green paper. Another example of a well-developed management of change program was observed at a brewery. At this facility, a comprehensive procedure is used to ensure that maintenance issues are discussed during the design phase for new equipment and modifications. The procedure applies to all changes in procedures or equipment, regardless of whether the change is considered major or minor, or is temporary or permanent.

A chemical manufacturer uses a two-tiered management of change system. All process changes are first screened using a standard form that needs to be approved by the technical superintendent, engineering superintendent, and production superintendent for the department in which the change occurs. This form contains a list of hazards, and if the process change indicates an increase in the hazard potential of any of these, the change is classified as major. If equipment changes are involved, an equipment change safety assessment is required.

At the same time, an increasing number of audited facilities are developing management of change programs as they continue to implement their OSHA PSM programs. At a water treatment chemical manufacturer, a management of change procedure is used, but the audit team observed that a clear working definition of what actually constitutes a change is still needed.

However, audit teams still found that a few facilities had incomplete or non-existent management of change procedures. For instance, a dairy products manufacturer had no written procedures; the audit team observed that the water spray chamber being built at the time of the audit was a good example of a modification that should be thoroughly reviewed prior to approval to ensure that all applicable code requirements are met for new construction and substantial modifications.

4.11 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.

A growing number of audited facilities exhibited pre-startup review procedures, generally in response to the requirements of OSHA's PSM Standard. For example, at a wastewater treatment facility, the procedure for startup of a new process includes three SOP interim review cycles before submission of the documents for formal review. In the case of the chlorination/dechlorination process at this facility, more than 20 interviews with plant personnel were conducted in developing the SOPs before start-up. The process safety management compliance plan at a refinery is comprised of 14 specific elements, including detailed procedures for pre-startup safety reviews. The audit team observed that part of a semiconductor manufacturer's aggressive SOP program are startup and shutdown procedures that allow operators to take advantage of the downtime for refresher training or to cross-train and work in similar process areas elsewhere in the facility.

Audit teams did note the absence of a written pre-startup review procedures at a few facilities. For example, one chemical manufacturer did not have a pre-startup safety review program, although pre-startup safety reviews are referenced in the facility's PSM program. Another chemical manufacturer did not have a pre-startup review procedure or any other formal written safety and procedure manuals for the facility. This facility has voluntarily entered into an agreement with EPA to improve conditions at the plant; the audit team recommended that this facility continue its improvement efforts, and develop and maintain SOPs for all operations within the facility.

4.12 Hot Work Permits

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.

In past years, audit teams have noted certain common problems in the development and implementation of hot work permits, as a few facilities were specifically identified by audit teams as not having hot work permit programs, and other facilities that did have hot work permit programs were not fully implementing these procedures. This year, specific procedures related to hot work permits were not covered in many audits; however, in those cases where audit teams did remark upon the existence of hot work permit programs, programs were generally found to be adequately considered and implemented. For instance, one brewing company requires that hot work permits be renewed after each eight-hour shift. This facility requires a hot work permit when hot work is performed on or near (five feet or less) its ammonia refrigeration system. In other cases, facilities require a permit before any hot work is performed within the facility. For instance, an automotive assembly plant considers the entire plant a "hot work" area, requiring a permit before any cutting, burning, or grinding of metal where sparks might be produced.

4.13 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).

Several audited facilities were commended by audit teams for encouraging employee participation. A printer has an employee safety steering team, consisting of four managers and four hourly employees, that meets monthly and reviews safety incident reports and shares any noteworthy report with the other employees. In another case, a chemical manufacturer involves hourly employees on its PSM steering team, which coordinates facility OSHA PSM activities. Finally, at a wastewater treatment plant, an audit team noted that the extensive nature of employee participation could to some extent mitigate the lack of a more formal safety program. The audit team found that the plant's personnel attend regularly scheduled safety meetings, and that their safety and employee suggestion program works hand-in-hand to bring potential issues to management's attention quickly and to improve facility performance.

Several facilities have programs to provide incentives to employees for participating in safety management. For example, a dairy processor has a safety incentive program that rewards employees with prizes twice each year; to be eligible, employees must attend all safety and training meetings applicable to their jobs, complete and return Job Safety Analyses each quarter, and report accidents and near-misses within 24 hours. In the audit of a paper processing plant where such an incentive program did not exist, the audit team suggested that the facility should consider providing incentives for good safety performance.

4.14 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.

Most audited facilities appeared to have some contractor safety procedures in place, and many also had thorough contractor awareness components in their training programs. A brewery, which rarely uses maintenance contractors, nonetheless had a thorough program in place for the training of all contractors. Any contractors hired to work at the facility receive site-specific training in the area of the facility where the contract work is to be performed, in addition to receiving at least hazardous materials training corresponding to the awareness-level under OSHA's HAZWOPER standard. They also reviews the safety and accident experience of potential contractors in its bid review process. At a refinery, contractors are required to pass written tests prior to entering specific areas. In a somewhat unconventional approach, one audited facility has implemented a plan to avoid safety problems posed by contractors by using plant personnel for new construction, which the audit team found might minimize incidents caused by contractor personnel unfamiliar with the facility and the processes.

In many cases, however, audit teams recommended improvements or additions to a facility's contractor safety procedures. Several of the audited facilities depend on contractors to provide training to their own employees; an audit team visiting a wastewater treatment plant, however, suggested that any claims involving training by contractors should be verified prior to work. A number of audit teams suggested increasing the information made available to contractors or other visitors (e.g., delivery drivers) as they enter the facilities. For example, a polymer manufacturer was encouraged to expand its existing orientation program for truck drivers to verbally notify them of the general hazards in the plant and to provide orientation on the alarms and evacuation plan. Another audit team reminded the forementioned treatment plant that a briefing on the hazards found at the plant should be provided to all incoming personnel, regardless of the amount of time an individual spends on the property. Finally, even when contractors and other visitors have been adequately briefed on the hazards in the plant, one audit team recommended that all new hire and contractor employees should be provided with brightly colored armbands. This arm band would identify the wearer as a person who might need assistance when the fire or evacuation signal sounded. The audit team added that supervisors should be responsible for evaluating when a contractor or new hire was sufficiently knowledgeable as to no longer need the arm band.

In rare cases, audit teams did find significant failings in the area of contractor awareness programs. For instance, one facility had no active contractor qualification and oversight program. In another case, an audit team noted that equipment labeling was not sufficient to ensure that contractors and other workers from off-site (e.g., truck drivers) could clearly recognize differences in plant operations. The audit team was concerned that deliveries of sulfuric acid or of ferric sulfate could be misdirected, because the connection points for the two storage tanks are side-by-side and very similar.

4.15 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. One chemical manufacturer has reduced the quantities of chemicals it receives, and places a strong emphasis on reducing hazardous chemical storage and minimizing waste production. A plastics manufacturer has devised and implemented programs to reduce the toxicity of some of its process wastes, and to convert these wastes into a recyclable product, enabling the facility to be reclassified as a Resource Conservation and Recovery Act Small Quantity Generator. At a semiconductor manufacturer, the facility is continuously reducing the amount of water that it processes in its wastewater treatment plant; in the near future the plant is expected to consume 50 percent less water than currently, and it will shutdown if a 20 percent recycle rate is not maintained.

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. One chemical manufacturer has taken a particularly proactive stance on pollution prevention technologies. It installed state-of-the-art odor reduction technology, a thermal oxidizer to reduce emissions, and a unique wastewater treatment system containing a passive biological treatment process. A dairy products manufacturer has recently invested in dual pressure relief valves to replace its existing single valves, is taking the initiative to upgrade older storage vessels, and at the time of the audit was constructing a spray chamber to mitigate ammonia releases.

In a few cases, audit teams suggested technological or procedural solutions to facilities to increase their ability to detect and prevent releases. For instance, at a chemical distributor, the audit team recommended that the facility consider producing and running a mathematical model of the emission rate of its scrubber exhaust to estimate arsine concentrations in the vicinity of the facility to determine if the emissions are safe from a public health perspective. The audit team also suggested that this facility should not rely on an unsecured ball-joint valve as a relief system because such a device cannot be adequately tested, set, or re-set, and recommended that the facility use a pressure relief valve or a rupture disk instead.

Audit teams paid particular attention to the presence or absence of appropriate alarms and sensors to alert employees to potential release situations. At an explosives device manufacturer, the audit team observed that the facility lacked audible alarms for its chlorine sensors, and that operators were confused about how to interpret alarm levels. The audit team recommended that this facility install an audible alarm with a flashing/revolving strobe light on the top of the chlorine building, activated by chlorine sensors at that location, and that the facility modify the chlorine warning system and level-of-protection protocols so that they are more easily understood. At a automotive brake fluid manufacturer, the audit team was informed that the facility does not have a system installed of monitors and/or alarms that would identify storage releases during non-work periods. In contrast, at a semiconductor manufacturer, the audit team found that numerous sensors were located throughout the facility to detect leaks, and that sensor concentrations are displayed in the control room and an alarm is triggered when high levels are reached. Employees are alerted to dangerous conditions by alarms and a unique reader board that displays text.

Audit teams also focused attention on facility containment systems, in many cases making practical suggestions for improvements to these systems to better mitigate spills in the future. At a chemical manufacturer, a containment system was set up for the wet mixing room in case of a spill, but it was not known whether the room could contain the maximum capacity of liquid that could be released from the tank. In addition, the dry mixing room at this facility did not have a containment system to mitigate a release from the tanks. The audit team recommended that the facility install containment systems around the tanks in both the wet and dry mixing rooms, and that it ensure that the containment systems used can mitigate a worse case scenario spill. At a paper mill, the audit team found that the only tank with a containment wall was a methanol tank, and that tanks ranging from 10,000 to 300,000 gallons were not diked. The audit team recommended specifically that the hydrogen peroxide and sulfuric acid tanks be diked.

4.16 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 a facility emergency response plan; training employees in relevant emergency response procedures; acquiring appropriate emergency 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 surrounding 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 facilities may have emergency response plans that are less detailed than those maintained by a larger or more complex facility with its own response squad. Such a facility might choose to maintain evacuation procedures and procedures to contact outside parties (e.g., local response agencies, contractors), rather than 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 have been written to fulfill regulatory requirements, rather than for use in an actual response, although response and evacuation procedures were often included within the plan. For instance, one large brewing company has three different emergency response plans, each targeted toward different circumstances and regulatory requirements. It should be noted that 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.

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. A number of these facilities based their response management structures on the Incident Command System (ICS). For instance, a refinery operates under a system that employs principles of the ICS to provide a mechanism for emergency response. All emergency response operations are led by the incident scene commander, who controls the escalation of levels and any requests for additional support. The operations chief heads the facility's Emergency Response Team, while the refinery shift coordinator coordinates the operational response to the emergency.

Several audit teams encouraged facilities without Incident Command Systems to adopt this model in improving their own emergency response capabilities. For instance, one audit team encouraged a chemical manufacturer to adopt an incident command structure to clarify the lines of authority and responsibility during a response and to investigate the use of a Unified Command, a component of an Incident Command System, to manage joint response operations. One audit team noted, however, that before a facility could successfully implement an ICS, its employees would need to receive proper training under OSHA's HAZWOPER standard.

Many audited facilities had response plans that were insufficiently detailed or were missing information that would be critical in an emergency. For instance, one manufacturing facility has a formal emergency response plan, but the audit team noted that several areas of the plan were incomplete as compared to the criteria listed in OSHA's HAZWOPER guidance. In a few cases, facilities simply had no emergency response plan at all. One dairy processing plant had no written emergency response plan; the facility believes that, because they rely on the local fire department hazmat team for responses to non-incidental releases, there was no need for a facility plan. However, in at least one release incident at the site, there appeared to have been a lack of understanding by employees regarding who was in charge. The audit team recommended that the facility develop an emergency response plan to comply with OSHA's HAZWOPER standard to clarify the roles of employees and contract security guards during a response.

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 have marked escape routes on maps posted around the facility. Some facilities have also implemented systems to increase accountability and incorporated these systems into their plans. One polymer plant uses a locator guide in the guardhouse at the entrance to the facility to account for personnel. Employees manually move a marker that personally identifies them to a place on a board indicating the area of the plant in which they will be stationed. Upon notification of an incident, employees proceed to the nearest of 17 designated shelter areas.

Evacuation procedures contained in the response plans of a number of audited facilities, however, were found to be insufficient to ensure employee safety. For example, one audit team found that the evacuation route at an ammunition plant passed right next to a hazardous process area where cyanide is used and where incidents might take place. The audit team was also concerned that the placement and quality of evacuation maps was insufficient; the audit team suggested that the facility should upgrade the existing evacuation route maps through the use of enhanced graphics and color, place a copy of the evacuation instructions next to the maps, and locate this information at more strategic sites. The facility was also encouraged to redesign its notification and evacuation procedures so that employees would be rapidly notified and would not evacuate past impacted areas.

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. At many audited facilities, the plan is reviewed at least once a year by facility management; reviewers approve revisions to the plan and implement any necessary changes. One facility has a more aggressive schedule for updating its plan; the plan is revised when changes are made to the emergency response organization, or refinery processes or equipment, and to reflect information gained from incident investigations, drills, and exercises.

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 and to train management personnel to ensure that a qualified manager is on site whenever an incident occurs. For instance, one brewing company ensures that all personnel at the facility, including administrative staff, receive at least awareness-level training as defined by OSHA's HAZWOPER. In addition, security officers, who will usually assume incident command, have all been certified to act as One-Scene Incident Commanders in accordance with 29 CFR 1910.120.

However, despite this progress, commitment to emergency response training remains uneven among audited facilities. For instance, at one facility, the audit team found that, although personnel training was mentioned in the facility's emergency response plan, the plan did not define the type or level of response training that employees would receive. The audit team suggested that response training should be tailored to be job-description-specific, specified by job title/OSHA response level. In addition, the team encouraged the facility to maintain records documenting what training each employee had received, when, and whether the employee had satisfactorily completed the training.

At the same time, a lack of sufficient training was frequently found at facilities where employees were expected to conduct cleanups in non-emergency situations. A printing plant, for example, permits employees to conduct some emergency response activities, such as diking large spills, when the incident is not deemed to pose a significant emergency. To legally conduct such activities, however, employees would be required to be trained to the HAZWOPER operations level. Another facility maintains a very limited supply of emergency response assets, but does not provide employees with training in the use of the equipment that is provided.

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.

Facilities often need a range of equipment that can include personal protective equipment, SCBA, safety showers, and eye-wash stations; absorbents, neutralizing agents, and booms; portable pumps and hoses and fire monitors; response vehicles; and monitoring instruments, as well as backup equipment. Such 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 of the audited facilities maintained significant amounts of response equipment. For instance, one chemical company has established onsite emergency medical care at the facility dispensary. Another facility provides all employees in its chemical shipping/receiving area with personal protective equipment.

Some facilities, however, either did not have certain emergency response equipment that would be needed in a response or did not ensure that it was accessible when needed. For instance, one paper plant does not maintain PPE appropriate to the chemical hazards at the facility. Several audit teams noted lack of safety showers or eye-wash stations in areas where chemicals were stored or used. At a brewery, the audit team found that there were few showers or eye-wash stations in areas where ammonia is present. For instance, there is no safety shower or eye-wash in the immediate area where the unloading of ammonia takes place.

In other cases, response equipment was present, but was either difficult to reach or not clearly labeled. For instance, one polymer plant posts emergency response equipment identification labels under the operators' work tables in the processing area, which would make them difficult to find in case of an emergency. At another facility, fire suppression equipment and sorbent materials are stored at various locations. However, the audit team noted that the pins to charge some of the carbon dioxide extinguishers were located inside the wall of an overhang, which could put an employee in danger when attempting to activate the system during a fire. In one case, an audit team recommended that a facility paint the background areas near emergency equipment (such as showers, eye-wash stations, and fire extinguishers) a contrasting color so that they are readily identifiable in an emergency.

Some facilities did not have fire protection and other safety equipment, which audit teams felt hindered their ability to respond swiftly to releases. In the audit of a chemical manufacturer, the audit team stated that they believed that the facility's ability to safely and effectively respond to chemical spills was weakened by the lack of easy access to monitoring instruments, suitable protective clothing, or any rapidly transportable spill kits. The facility relies on a distant contractor for spill response, which limits its ability to rapidly control releases that could cause a fire or downwind chemical exposure. The audit team recommended that the facility stage spill response kits onsite, placed on pallets for rapid transport throughout the facility.

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. One facility provides security and maintenance personnel, and some operations employees, with six-channel radios. Each group uses designated channels; however, employees from different groups are able to communicate during an emergency. A brewery requires employees to dial Security when a hazardous materials emergency occurs; the security dispatcher then dispatches security officers to the area and places a global page, advising all necessary personnel, including the hazmat team and environmental control staff, of the location and situation.

Even if a comprehensive communication system has been installed, however, problems may still exist. For instance, several audit teams cited concerns that the emergency notifications systems would not be heard in noisy portions of various facilities. For instance, at one facility, the audit team noted that pages and the facility's plant-wide public address system, which is used to alert employees to emergencies, might not be audible in all areas of the plant due to machinery and equipment noise. In other cases, audit teams were concerned that communications procedures were ill-conceived. One chemical manufacturing facility requires responders to telephone the facility in response to a pager call, potentially tying up phone lines; the audit team suggested that the facility eliminate the requirement and consider using pagers that allow the transmission of a recorded message with instructions.

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. However, others were less structured in their performance of such activities. In other cases, although facility plans called for drills and exercises to be conducted, there was no record that they had actually been performed. For instance, in the audit of one manufacturing facility, an audit team found that, although exercises and simulations were discussed in the emergency response plan, exercises were not held annually. In other cases, such as that seen by an audit team at a dairy processing facility, a facility had experienced actual evacuations and emergencies, but no drills or exercises had been conducted.

Depending on the facility, these efforts involve local response organizations and neighboring facilities in varying degrees. In some cases, extensive interaction is conducted with outside planning and response organizations. For instance, a brewery has an agreement with the LEPC to conduct six exercises every year, with at least one of those being a hazardous chemical exercise. After each exercise, an evaluation is completed and a debriefing occurs. In addition, the facility participates in joint hazardous materials exercises with the local fire department at least once every year. Another facility has exercised with the city fire department, but has never conducted drills or exercises with any of the local hospitals, although it keeps the hospital to which it would send chemically contaminated patients informed of the chemicals in use at the facility.

Other facilities conduct joint exercises significantly 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 audit team noted that a chemical distribution facility had never participated in the biannual exercises held by the regional hospital, fire department, and nearby industry.

Although follow-up on drills and exercises was not extensively discussed by the audit teams, a number of facilities incorporate procedural changes and lessons learned into future training and the emergency response plan. A polymer plant follows its drills with a meeting of the participants to review the performance of the responders and to identify strengths and weaknesses. Drills are critiqued by the safety manager, who distributes a report detailing recommendations for change and designating the individual responsible for implementation.

4.17 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 within the community. And, as discussed in the preceding section, a number of facilities are taking advantage of opportunities to increase emergency preparedness by conducting drills and exercises with LEPCs and local response organizations.

Many of the audited facilities have taken a more proactive approach to working with the community to improve emergency response coordination. For instance, one chemical producer maintains an excellent working relationship with the LEPC and has participated in emergency response exercise and emergency planning seminars, along with other members of the emergency response community. Another audited facility, a printing plant depends on the local fire department for response to hazardous materials incidents and entertains frequent visits from its representatives. The fire department also assists in the critique of the plant drills, sprinkler systems, and hazard assessments. Another company, a brewery with extensive onsite response resources, has provided offsite assistance to public response teams at incidents not related to its operations. The facility would also provide offsite emergency response, if requested, in the event of a transportation-related accident involving an ammonia shipment.

Finally, even in the absence of an active LEPC, some facilities have worked to develop good relationships with the local community. For instance, one facility has made an extensive effort to provide copies of the plan to cooperating public and private entities and to ensure that these entities are aware of the plan and available to carry out their assigned roles in the event of a release.

A number 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. For instance, one polymer manufacturer has designed a community warning system to rapidly provide early warning to facility neighbors and emergency responders through an automated telephone message system. The system is used in conjunction with community warning sirens and the Emergency Broadcasting System (EBS); neighbors have also been instructed to tune in the radio and listen for the EBS broadcast when the siren is sounded. The outdoor sirens can warn neighbors up to one mile from the facility to shelter in place (with a steady signal) or to evacuate (with an alternating wail). Another audited facility had recently purchased two sirens for the city to notify the community in the event of a release. When installed, the sirens will notify the public to seek in-place shelter and to monitor a particular AM radio station for information and the all-clear signal.

Facilities can also work together to provide a variety of resources; several audited facilities belong to regional mutual aid groups. For instance, the refinery noted above is a member of a regional fire and safety group, whose purpose is mutual aid in fire, disaster, or other extreme emergency. The refinery is also a charter member of a cooperative that provides mutual assistance in the control of releases to navigable waters.

In rare cases, there are facilities that have little formal cooperation with state and local response and planning entities. For instance, one chemical manufacturer was found to have little contact with the public, the media, hospital emergency personnel, the local fire departments, or emergency management agencies. The facility also did not have an alarm system to notify the public of an emergency release. Another manufacturing facility has not participated in any planning activities with the tribal emergency response commission and does not have an established procedure for notifying the public of emergencies, other than calling the fire department.

APPENDIX A

OUTLINE OF THE CHEMICAL SAFETY AUDIT PROTOCOL

APPENDIX A

OUTLINE OF THE CHEMICAL SAFETY AUDIT PROTOCOL

1.0 INTRODUCTION

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  - 4.1.3 Site Access
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APPENDIX B

LIST OF CHEMICAL SAFETY AUDITS

LIST OF CHEMICAL SAFETY AUDITS
as of September 30, 1996

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
3	07/30-08/03/89	X	Rhone-Poulenc, Charleston, WV
	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

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	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
	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

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	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
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

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	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
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
	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		**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

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	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
	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
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

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	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		**Anheuser Busch Brewer, Fort Collins, CO**
	09/18-21/95	X-D	Sinton Dairy Foods, Colorado Springs, CO
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

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	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
	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.