THE CHEMICAL SAFETY AUDIT PROGRAM:

FY 1995 STATUS REPORT

June 1996

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EXECUTIVE SUMMARY

This report is a comprehensive overview of 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 95, and a discussion of the future direction of the program.

The CSA program evolved from the efforts of CEPPO under the Chemical Accident Prevention (CAP) program into a program which this year alone encompassed the review of the chemical process safety management systems of over 40 facilities and the training of over 200 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 CAP activities, including outreach and technical assistance for both the public and private sector.

The primary objectives of the CAP program 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 as part of this broad initiative. The purposes of the CSA program are:

- To visit facilities handling hazardous substances to gather information on safety practices and technologies;
- To heighten awareness of the need for, and promote, chemical safety among facilities handling hazardous substances, as well as in communities where chemicals are located;
- To build cooperation among facilities, EPA, and other authorized parties by conducting joint audits; 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

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. In FY 95, the regional offices continued to implement follow-up programs, ranging from conference calls involving the audit team and facility representatives to site visits conducted by audit team members to follow-up questionnaires sent to audited facilities.

In addition, many 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 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 95, the regions had submitted a total of 310 final audit reports to EPA headquarters for the 325 audits that were conducted between FY 89 and FY 95, including several follow-up reports on previously audited facilities. Information from the 40 most recently submitted reports was examined for this status report, including a number of reports from audits conducted in FY 94 that were not submitted to EPA headquarters in time to be included in the FY 94 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 regular training curriculum. From FY 89 through FY 95, a total of 38 workshops, attended by over 1000 individuals throughout all ten regions, have been conducted; almost 250 individuals attended the ten workshops held in FY 95. 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 two-thirds 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.

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 95. A key trend in regional office activities under the CSA program during the past four years has been the institution of follow-up programs to track the implementation of audit team recommendations by audited facilities. Regions have approached the follow-up process from a variety of angles, 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.

At the same time, the CSA program has provided the opportunity for greater cooperation and communication with state and local officials as a result of their participation in the audit process and associated training and outreach activities. State and local audit participants stress the beneficial aspects of the program from increased government-industry coordination to enhanced understanding of chemical process safety issues in the community. In addition, as the CSA program has developed, the regional offices have initiated new programs and activities and introduced modifications to audit procedures that take advantage of the program's flexibility. Initiatives such as mini-audit programs and accident investigations, as well as greater pre-audit planning, coordination with other environmental and health and safety programs, and outreach to industry, have also been the products of the evolution of the CSA program.

FY 95 Audit Analysis

Chapter 4 presents an overview of conclusions and recommendations taken from recent EPA chemical safety audits, based on the latest 40 final CSA reports received by EPA headquarters as of September 30, 1995. 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 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, contractors, employee participation, hot work permits, release prevention and mitigation measures, 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 40 audit reports. For example, most of the audited facilities did not have formal programs in place to conduct process hazard analyses and offsite consequence analyses. While the audit teams noted that most of these facilities did evaluate process hazards on a less formal basis, few facilities had made an attempt to determine the potential offsite consequences of a release.

Conclusion

EPA views the CSA program as a cornerstone in the Chemical Accident Prevention program and as a continuing 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 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); the RMP information 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 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 the implementation of the RMP regulation at the regional level. 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, 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 through audits of these facilities. The audits serve as a means to assist industry in understanding more about the holistic nature of chemical process safety management. Historically, the audits have also helped more than 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 year, 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. Regional CSA team members will lead the accident investigations; their knowledge of facilities and industrial processes gained from conducting audits will be a valuable asset in this effort.

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 seven 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. At the same time, the CSA program 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 pending 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 325 chemical safety audits conducted over the seven years ending September 30, 1995, 310 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 1994 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 94 CSA Status Report.

1.1 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 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. The risk management program includes a hazard assessment, a prevention program, and an emergency response program. Sources will summarize their risk management program activity in a risk management plan (RMP); the RMP information 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.

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 the implementation of the RMP regulation at the regional level. 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 that are not covered by the RMP requirements. The CSA program will continue to have an important role in accident prevention through audits of these facilities.

In addition, over the past year, EPA and the Occupational Safety and Health Administration (OSHA) 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. Regional CSA team members will lead the accident investigations; their knowledge of facilities and industrial processes gained from conducting audits will be a valuable asset in this effort.

In view of the changes taking place as a result of the RMP rule and the accident investigations, Headquarters and the regions will examine their needs and make adjustments to the CSA program to reflect its evolving role in the accident prevention process.

1.2 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 95, EPA's Environmental Response Training Program continued to offer the four-day CSA workshop as part of its regular curriculum. Workshops were held in Boston, MA; Carolina, PR; Edison, NJ; Richmond, VA; Atlanta, GA; Springfield, IL; Austin, TX; Lincoln, NE; Riverside, CA; and Boise, ID. A total of 237 EPA regional, AARP, contractor, state and local government, other federal agency personnel, and other individuals attended the 10 workshops.

For FY 96, the Environmental Response Training Program plans to present 11 four-day CSA courses on the schedule below. The specific locations for 9 of these workshops will be determined by the appropriate regional office to encourage further state and local interest and participation in the CSA program:

- October 3-6, 1995 — Region 8
- October 24-27, 1995 — Region 9
- November 28-December 1, 1995 — ERT, Cincinnati, Ohio
- December 12-15, 1995 — Region 6
- January 23-26, 1996 — Region 1
- February 6-9, 1996 — Region 7
- March 5-8, 1996 — Region 4
- April 23-26, 1996 — Region 10
- May 7-10, 1996 — Region 2
- June 11-14, 1996 — ERT, Edison, New Jersey
- August 13-16, 1996 — Region 3

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 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. The following sections outline these changes.

Report Profile Preparation

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, including background information on the facility and the audit team, as well as audit team conclusions and recommendations, in a format suitable for direct entry into the CSA database.

In addition, the profile format can assist the audit team during the audit process. The profile can serve as a method to organize issues of interest and assign areas of responsibility to team members prior to the audit, monitor the progress of the team during the audit visit, and organize the collected information during report writing. To facilitate entry of the profile information into the CSA database, 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.

Audit Follow-Up Activities

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 in improving, as well as heightening awareness of the need for, chemical process safety among chemical producers, distributors, and users. In addition, the analysis of audit results 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 size of facility.

Within this framework, the regional offices are free to examine other audit issues (e.g., format, relationship with state and local officials) and to communicate with the facility in writing or in person. Some of the regions also may wish to develop a method to verify whether the information received from the facility is accurate, to the extent that regional resources permit. This may involve the continued participation of state and local officials in the audit process or another facility visit by EPA or Technical Assistance Team (TAT) members.

During FY 95, the regional offices continued the follow-up programs established in previous years. A variety of follow-up approaches has been implemented (e.g., telephone calls, questionnaires, and site visits), reflecting the role of the CSA program in the regions' overall chemical accident prevention efforts. Notable examples of regional activities include:

- Region 1 monitors records from the National Response Center to determine if releases continue to occur at facilities that have been subject to an audit. Their policy is to conduct follow-up activities at facilities where releases continue to occur. These activities may include a re-audit of the facility; if warranted, multimedia enforcement teams may be asked to participate with the safety auditors.

- In Region 10, four follow-up site visits were conducted in FY 95, including inspections to determine the level of implementation for audit team recommendations, bringing their overall total of follow-ups to 17 sites. Audit team members noted a high level of compliance with the recommendations (better than 85 percent). While in some instances recommendations were not acted upon immediately for budgetary reasons (but have been included in future capital expense

budgets), the region believes that the degree of positive response on the part of industry to their audit recommendations has been outstanding.

In addition, the regions have participated in site-specific follow-up activities, such as simulation exercises and response training. 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.

1.5 CSA Database

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

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.

As described above, 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 1995, contains profiles of 275 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.

1.6 CSA Program Background

History

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

- Visit facilities handling hazardous substances to learn about and understand problematic and successful practices and technologies for preventing and mitigating releases;
- Heighten awareness of the need for 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 Indian land.

Recognizing accident prevention as the next step after instituting local emergency preparedness efforts, EPA created the Chemical Accident Prevention (CAP) program in 1986. The CAP program

seeks 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, the CAP program conducted a number of audits of facilities 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 addressed 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.

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 95, the regional offices have finalized a total of 310 audit reports for the 325 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, and 44 in FY 95. Exhibit 2 summarizes the chemical safety audits and final reports completed by region. In addition, as part of a related initiative, Region 1 conducted nine accidental release investigations and Region 2 conducted one release investigation during FY 95.

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 310 audited facilities for which this information is available; please note that some facilities' operations are categorized in more than one SIC code. 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 (25), petroleum refineries — SIC code 29 (22), food processors — SIC code 20 (20), primary metal manufacturing — SIC code 33 (14), and electronic and electrical equipment manufacturing — SIC code 36 (13).

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 (21); electric, gas, and sanitary services — SIC code 49 (9); and public water treatment facilities — SIC code 95 (7).

Exhibit 1

Summary of Chemical Safety Audits and Final Reports by Year and Region
FY 89 through 94

Region	FY 89 Audits	FY 90 Audits	FY 91 Audits	FY 92 Audits	FY 93 Audits	FY 94 Audits	FY 95 Audits	Total Final Audits	Reports
1	4	4	3	3	3	3	0*	20	20
2	2	4	3	3	4	3	2*	21	18
3	4	4	4	5	6	6	4	33	32
4	5	5	15	6	10	8	8	57	56
5	3	5	3	3	4	4	4	26	21
6	4	5	5	4	4	4	4	30	29
7	0	0	4	6	14	18	14	56	55
8	3	4	6	4	5	4	3	29	26
9	4	4	4	4	3	3	1	23	23
10	3	4	6	3	4	4	4	30	30
Total	32	39	53	41	57	57	44	325	310

* These totals do not include the chemical accident investigations conducted by Regions 1 and 2 in FY 95.

Exhibit 2

Summary of Chemical Safety Audits and Final Reports Completed by Region

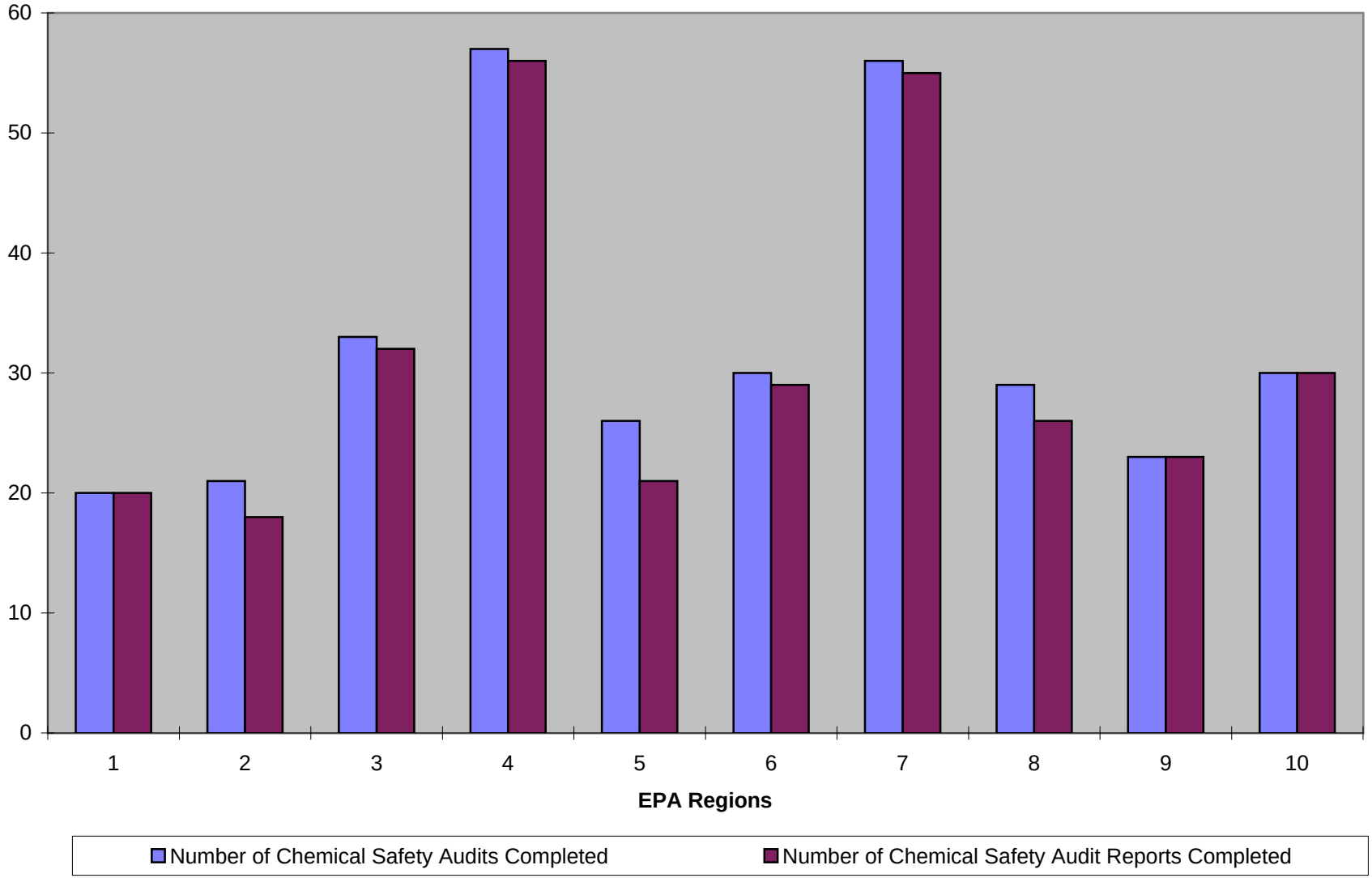
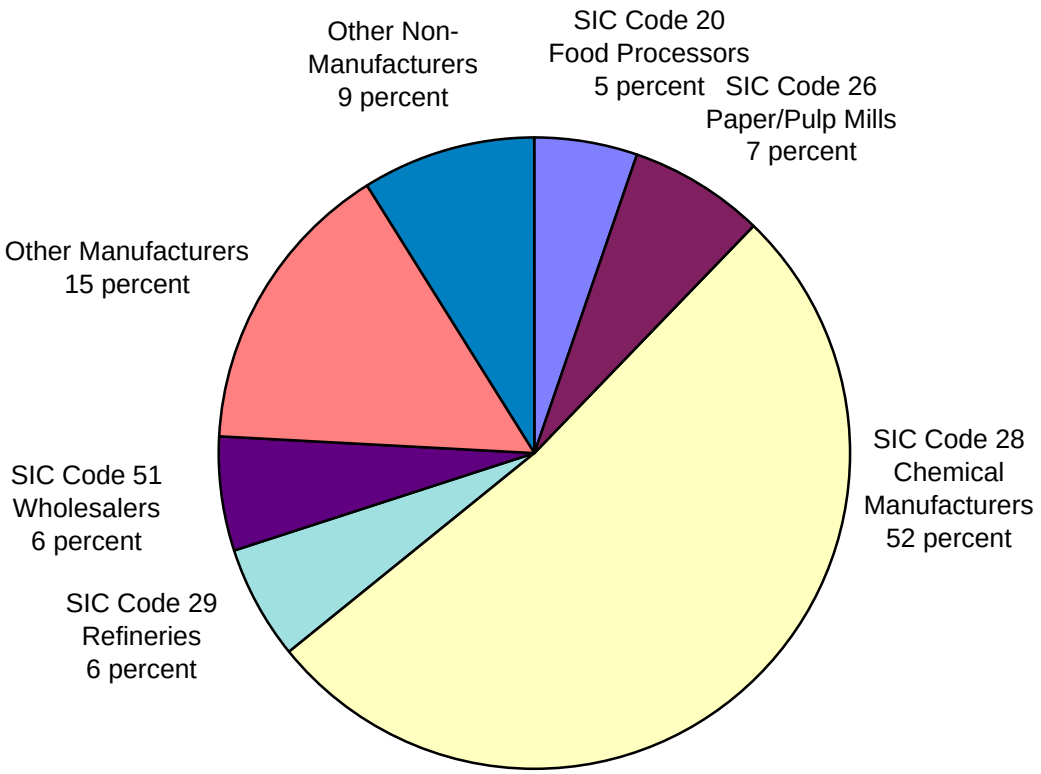


Exhibit 3

Breakdown of Audited Facilities by SIC Code*

FY 89 through FY 95



*This analysis is based on SIC codes gathered from 310 audited facilities. Several of these facilities had processes classified under more than one SIC code. This information is reflected in the exhibit.

2.3 Chemical Safety Audits by Hazardous Substance

A total of 183 different hazardous substances were examined by audit teams at the 310 audited facilities for which this information was available, including 164 classified as CERCLA hazardous substances and 74 listed as EPCRA extremely hazardous substances. Exhibit 4 presents a breakdown of the 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 sulfuric acid (111 audits), chlorine (110), sodium hydroxide (91), ammonia (87), and hydrochloric acid (70).

2.4 CSA Training Workshops

As of the close of FY 95, 38 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 four years the regional offices have been coordinating with the states to identify workshop locations to encourage attendance by state and local officials.

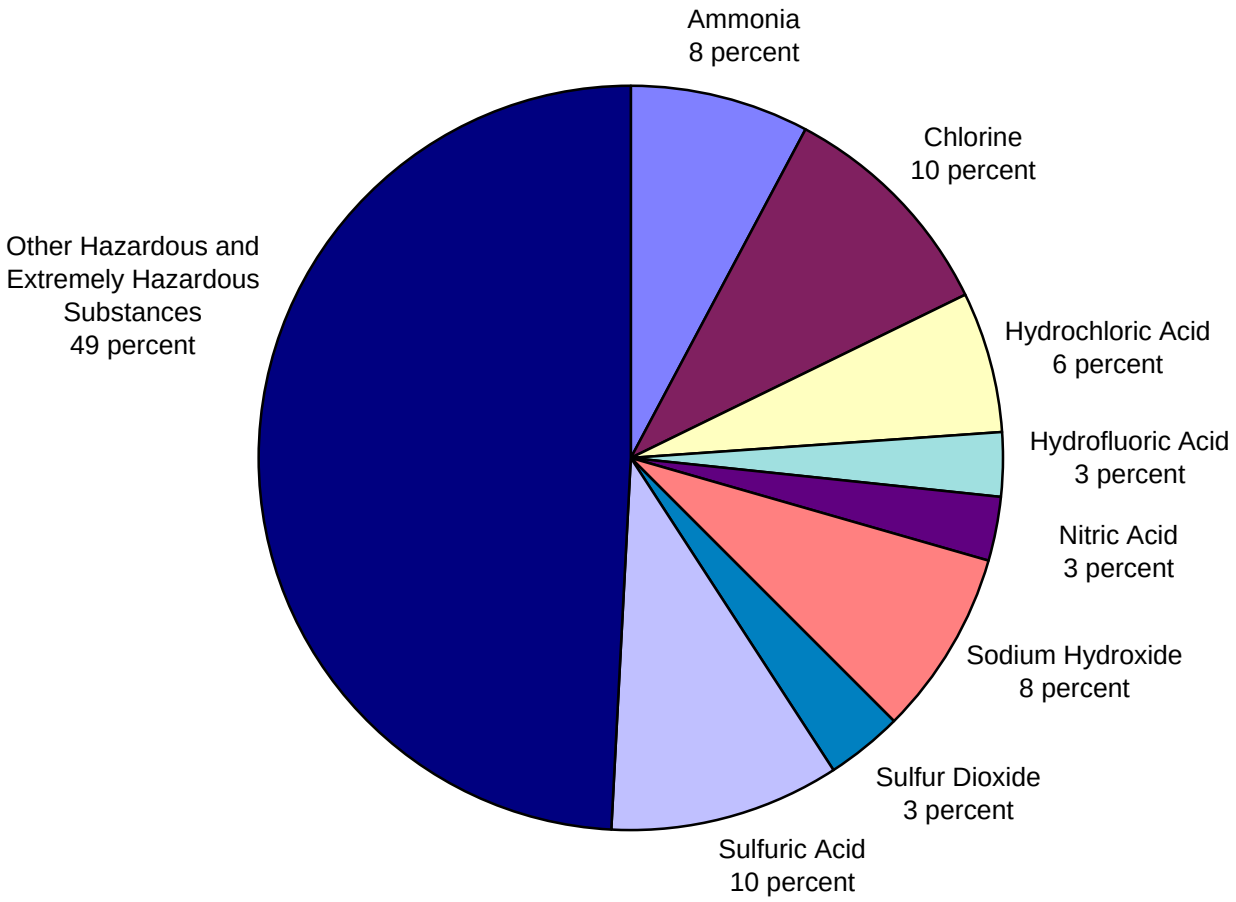
Ten workshops were held in nine regions during FY 94. Training workshops were held in Boston, MA (Region 1); Carolina, PR (Region 2); Edison, NJ (Region 2); Richmond, VA (Region 3); Atlanta, GA (Region 4); Springfield, IL (Region 5); Austin, TX (Region 6); Lincoln, NE (Region 7); Riverside, CA (Region 9); and Boise, ID (Region 10). A total of 237 attendees participated in the 10 workshops. A variety of groups was represented at the workshops including 18 regional personnel, six contractor personnel (primarily TAT members), 101 state officials, 57 local and tribal officials, and 36 representatives from other federal agencies, including officials from the U.S. Departments of Agriculture, Defense, Interior, Labor, and Transportation and the U.S. Air Force, Army, Coast Guard, Marine Corps, Navy, and the Panama Canal Commission. In addition, three industry representatives and 16 representatives from academic institution 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 94 to that in FY 95, 66 percent of the FY 95 attendees represented state, local, and tribal governments, as compared to 37 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 (81), Region 3 (67), and Region 2 (53). Note that this exhibit does not include data for TAT workshop attendance during FY 94 and 95 due to the involvement of the Zone I and Zone II technical assistance team contractors, whose responsibilities cover multiple regions.

Exhibit 4

Hazardous Substances Examined*

FY 89 through FY 95

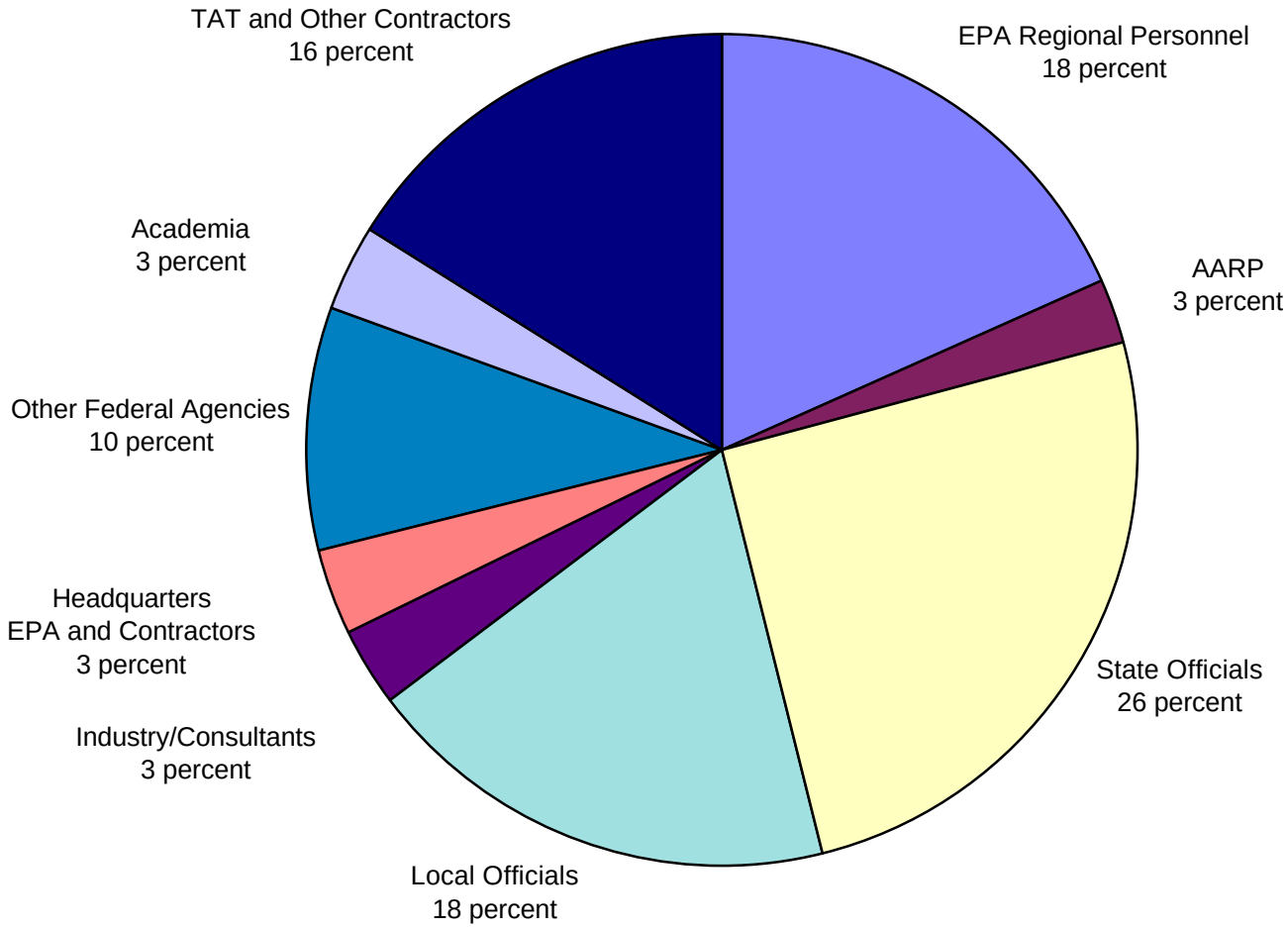


*In addition to CERCLA hazardous substances, this exhibit also includes extremely hazardous substances listed under EPCRA section 302, but not designated as CERCLA hazardous substances.

Exhibit 5

Chemical Safety Audit Workshop Attendees by Affiliation

FY 89 through FY 95



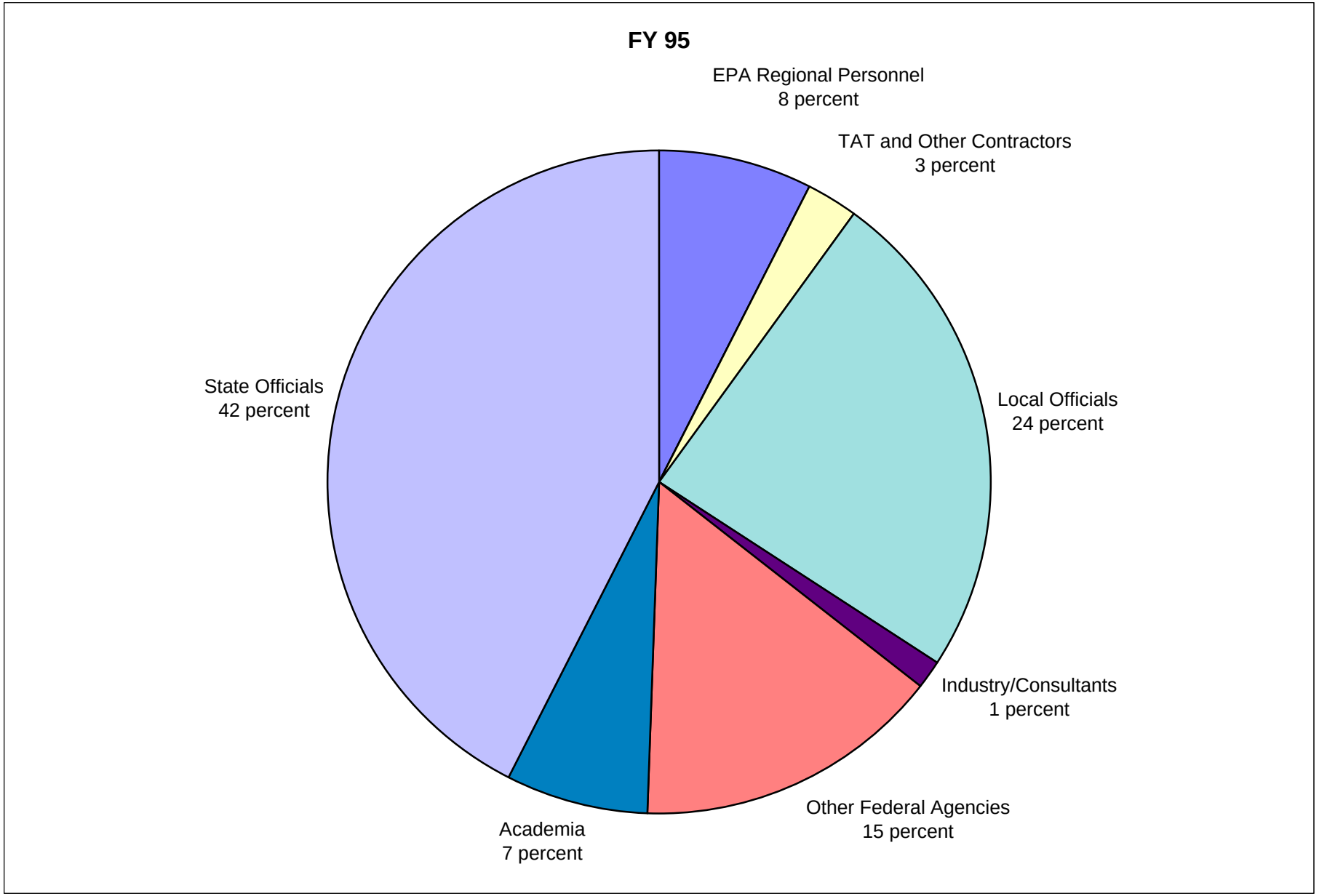
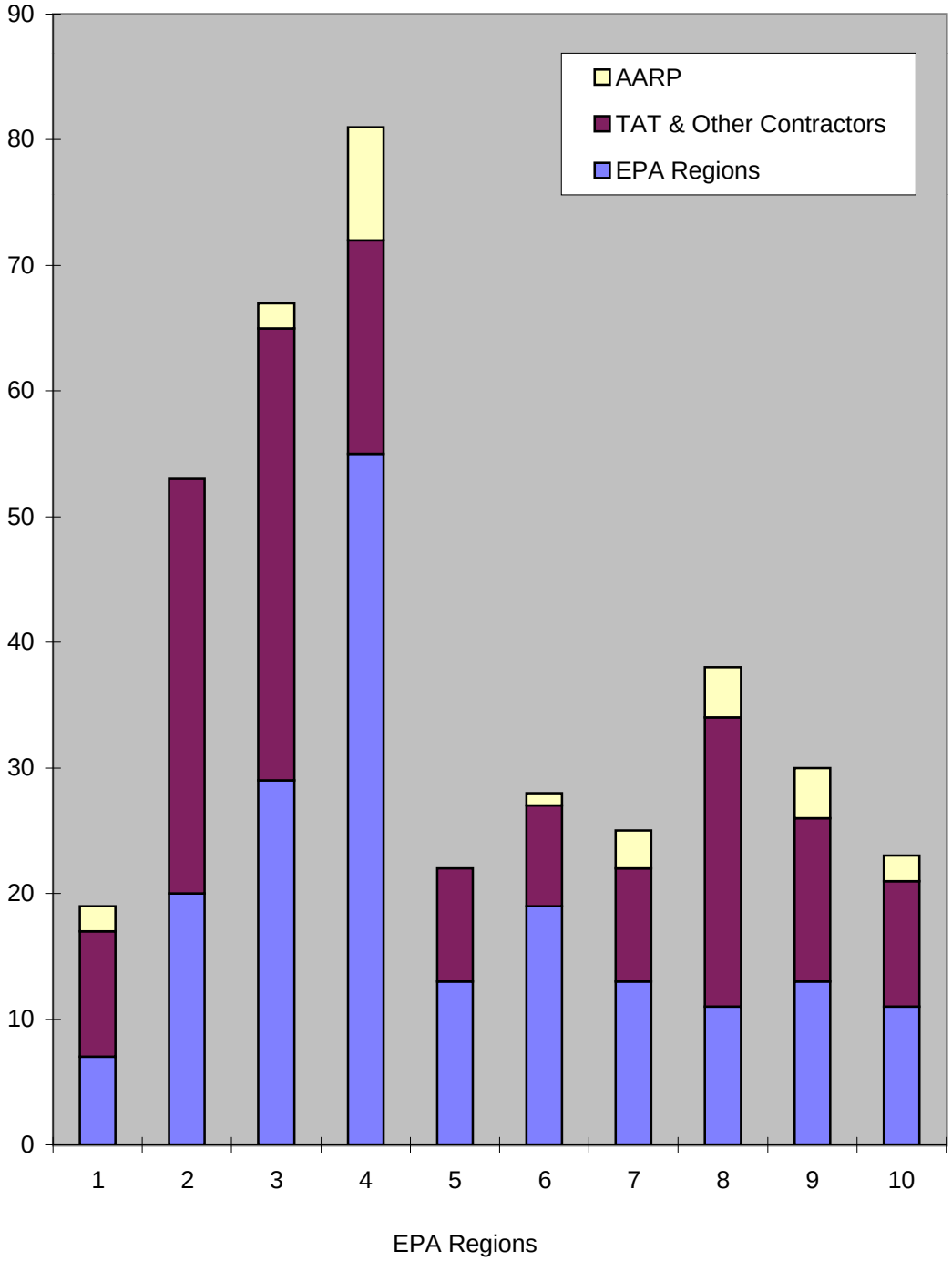

FY 95
EPA Regional Personnel
8 percent
TAT and Other Contractors
3 percent
Local Officials
24 percent
Industry/Consultants
1 percent
Other Federal Agencies
15 percent
Academia
7 percent
State Officials
42 percent

Exhibit 7

Chemical Safety Audit Workshops
Number of Persons Trained by EPA Regions
FY 89 through FY 95



3.0 STATUS OF CSA PROGRAM IMPLEMENTATION

This chapter focuses on the status of EPA regional implementation of the CSA program. With the issuance of the CAA section 112(r) regulations and growing interest among state and local officials in chemical accident prevention issues, regional implementation is best measured by a variety of factors. These factors include 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 95 was slightly lower than the level in FY 94, although this is, in part, attributable to the increase in accident investigation activities by regional audit teams. 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 1995. In addition, please note that Regions 1 and 2 conducted accidental release investigations during the past year.

CHART OF REGIONAL CSA ACHIEVEMENTS, FY 95

REGION	1	2	3	4	5	6	7	8	9	10
AUDITS	0	2	4	8	4	4	14	3	1	4
REPORTS	0	4	3	8	4	3	13	0	1	4

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 95. In the last year, the regions have encouraged state and local entities, facilities, and the community 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. Region 5 solicits comments on the feasibility of their recommendations and the status of their implementation when the draft report is sent to the facility; the facility's implementation strategies are then incorporated into the final audit report. In addition, many regions have called audited facilities to collect information on their progress.

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. There are numerous examples of how audit follow-up activities have not only improved chemical process safety in the audited facilities, but have also enhanced hazard awareness, overall safety, and planning coordination in the community.

Overall, the regions have received a substantial degree of positive feedback from audited facilities in response to audit team recommendations. As an example, a pulp mill audited by Region 9 described the audit process as "the most positive and mutually cooperative experience they have had with any government organization." At the same time, informal feedback from two audited facilities in Region 2 indicated that numerous recommendations had been implemented completely or in some modified fashion. The following is an overview, with illustrative results, of successful or innovative follow-up activities initiated by the regional offices:

- Region 1 continues to monitor records from the National Response Center to determine if releases continue to occur at facilities that have been subject to an audit. Their policy is to conduct follow-up activities at facilities where releases continue to occur. These activities may include a re-audit of the facility; if warranted, multimedia enforcement teams may be asked to participate with the safety auditors.

- Region 7's follow-up program consists of technical assistance to facilities for activities such as developing comprehensive standard operating procedures. Although these efforts do not fall within the confines of a "traditional" follow-up program, they have led to concrete improvements in facility chemical process safety.

- In Region 10, four follow-up visits were conducted in FY 95, including inspections to determine the level of implementation for audit team recommendations, bringing their overall total of follow-ups to seventeen sites. Audit team members noted a high level of compliance with the recommendations (better than 85 percent). While in some instances recommendations were not acted upon immediately for budgetary reasons (but have been included in future capital expense budgets), the region believes that the degree of positive response on the part of industry to their audit recommendations has been outstanding.

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 be coordinated among a multitude of federal and state agencies and would include enforcement components under numerous EPA statutes. A major focus of the audit would include the items listed in EPA's proposed regulations under section 112(r) of the Clean Air Act. The audit would 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 overall chemical process safety practices at a particular facility coupled with a focused accidental release investigation. This audit thoroughly explores the circumstances surrounding a significant 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. In one case, the recommendations from an audit conducted last year were incorporated in the settlement phase of an EPCRA enforcement action. In two other audits, the facilities were required by the LEPC and the local fire marshall to address the audit team recommendations.

In FY 95, Region 9 completed the third in a series of audits on the major railroads located in the region to learn about their chemical management practices. In reviewing these facilities, the region has concentrated on accident prevention, emergency preparedness and response, and community outreach issues. The region has attempted to draw analogies between the chemical industry's process safety management practices and those of the rail industry. The region intends to issue a comparison paper, following the completion of an audit of the third major rail line, describing common issues among the railroads, innovative ideas, and weaknesses in the context of the areas that the audits addressed.

Facility Selection Criteria

Each region uses standard risk factors (e.g., accident history, amount and type of chemicals onsite, presence of sensitive and vulnerable populations, natural hazards) to determine which facilities to audit. In FY 95, Region 5 conducted audits at facilities that are located in the Great Lakes drainage basin and the Mississippi or Ohio River basins. The selection process focused on facilities that experienced releases with offsite impact, issues raised by local communities, and environmental justice concerns.

The region also requested that SERCs recommend facilities for an audit based on their previous history of releases.

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 Region 1, audits and accident reviews are closely coordinated with the SERC and LEPC. In one case, the recommendations from an audit conducted last year were incorporated in the settlement phase of an EPCRA enforcement action. Drawing upon the region's experience with the CSA program, the Region 1 Safety Officer has developed a modular, chemical process safety training course. This course contains comprehensive chemical process safety principles and is consistent with the requirements under the proposed CAA risk management regulations. Deliveries of this modular training course are planned once the final regulations are promulgated. Region 5 is coordinating its activities with the state of Illinois, which has a Chemical Safety Act that requires facilities in certain SIC codes to submit reports on accident prevention to the state. When one of these facilities as a significant chemical release, the state will initiate an investigation into the chemical release.

3.2.3 State And Local Coordination

For EPA, one significant benefit of the CSA program is greater cooperation and communication with state and local officials as a result of their participation in the audit process and associated activities. State and local audit participants have stressed the beneficial aspects of the program from increased government-industry understanding to enhanced coordination on chemical process safety issues in the community. The following sections illustrate the nature of regional interaction with state and local government entities that has produced a more coordinated approach to chemical process safety.

Audit Participation

Although state and local officials have participated in chemical safety audits since the start of the program, they have recently become more actively interested and involved in all phases of the audit process. Audit participation by state and local officials increases their awareness of facility hazards and supports the establishment of communication links between state and local entities and industry. This increased awareness and communication in turn tend to encourage a more proactive approach to chemical process safety.

The Region 9 audit team received invaluable assistance from a senior hazardous materials inspector from the California public utilities commission who accompanied the region on three audits of railroad facilities. In Region 5, state officials participate as observers and provide comments on the state's perspective on the issues raised during the audit. Region 7 continues to encourage state personnel to participate in the audit process; Missouri officials have expressed interest, but their participation has been limited because of travel restrictions.

Training

The CSA training workshops have served as a primary force in the development of a variety of other training initiatives designed to heighten awareness of the concepts of chemical process safety management at the state and local level. Eight of the ten workshops in FY 95 were held in locations apart from the regional offices to encourage greater attendance and to promote chemical process safety expertise among state and local officials. In addition to encouraging the attendance of 158 state and local officials at CSA training workshops conducted by EPA in the past year, the regions have also implemented complementary training programs on chemical safety issues. For example, Region 7 has had considerable success in working with larger industries to co-sponsor basic hazardous materials training for volunteer emergency responders in rural areas. The region has delivered several 40-hour hazmat health and safety programs with industry support on a succession of weekends.

4.0 OVERVIEW OF CSA REPORT RESULTS

This chapter presents a review of conclusions and recommendations taken from recent EPA chemical safety audits, based on the latest 40 final CSA reports received by EPA headquarters as of September 30, 1995. The results are organized according to the generally recognized elements of chemical process safety management practices, which form the basis for the risk management programs proposed as part of the regulations under CAA section 112(r) (see 40 CFR part 68), and the Occupational Safety and Health Administration'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 of the 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 distribute newsletters or issue guidance for process safety management. Corporate management at several audited facilities has established particularly effective systems for managing health and safety. One paper mill sponsors an exchange program that allows hourly employees from one site to visit another site to exchange information and ideas. Management at another mill coordinates safety-related matters through a committee with representatives from labor unions and management personnel; the committee meets once every two weeks to discuss safety issues and develop plans to improve safety. The programs developed by the committee are shared with all personnel at monthly safety meetings.

However, corporate management for some of the audited facilities has not made a strong commitment to chemical accident prevention. The parent company of a petroleum refinery did not provide any safety policy or guidance to any of its facilities. Nevertheless, facility management at this refinery has initiated several programs to encourage employees to voice their safety and environmental concerns, including a weekly publication addressing health and safety concerns, safety improvement work sheets, and a labor-management safety committee. Crew chiefs conduct a weekly safety meeting to discuss safety and health concerns; questions raised by employees are documented and receive a response from the plant manager.

At other facilities, lack of a strong corporate management commitment appeared to hinder facilities' attempts to increase preparedness. At a waste management facility, the audit team found that the health and safety manager recognized the need for establishing management of change procedures, revising SOPs, and strengthening the preventive maintenance program, but had been unable to implement these initiatives due to a lack of resources. Audit teams also encouraged corporate offices to set standards and develop procedures to promote proactive programs to address chemical safety at each facility under the corporate umbrella. For example, an audit of a paper mill found that the facility was not practicing a formal root cause approach to investigations following major incidents; the audit team recommended that corporate management assists facilities in establishing formal methodologies for the investigation of root causes.

Several facilities were encouraged by audit teams to adopt a proactive process safety management program by focusing on relevant health and safety standards and codes, rather than simple regulatory compliance. At a chemical handling facility, it appeared that neither corporate nor facility management had a comprehensive program to evaluate the use of codes or standards in their safety programs or to evaluate new codes or standards when issued. The audit team recommended that the corporate environmental management team should develop a "standard of care" perspective on relevant standards and codes, as well as regulations relating to their operation, and a system to review new versions of these codes as they are issued to determine the potential impact on plant status.

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.

Some facilities have a long history of successful use of hazard evaluations to understand and minimize the risks onsite. One paper mill had contracted with two chemical manufacturers to evaluate its chlorine and chlorine dioxide systems; they recommended protection for the liquid side of the chlorine handling system. As a result, a chlorine unloading facility was built. Since then, the facility has also successfully implemented an ozone bleaching line and a C-FREE (elemental chlorine-free) process.

However, their use of hazard evaluation has not been systematically applied to other areas of the plant. The audit team recommended that the hazard evaluation should be extended beyond the chorine system to all of the facility. This was a common recommendation; many audited facilities have implemented a hazard evaluation program for only a subset of chemicals or processes.

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. For instance, a pharmaceutical company is completing HAZOPs for all existing processes to comply with OSHA's PSM regulations. Before a HAZOP is conducted, process flow diagrams are developed and reviewed, and a piping and instrumentation diagram (P&ID) review session is held. During this session, the entire process is reviewed by process, project, instrument, safety, environmental, industrial hygiene, and production personnel. Additions or deletions are made to the drawings, after which newly revised P&IDs are produced. These drawings are then used for the HAZOPs. For a chemical storage area, the preferred method is a "What If" checklist.

Chemical safety 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 assembled. However, the recommendations that result from the evaluations are not always pursued by management. One refinery, for instance, did not prioritize recommendations from the PHAs.

Some facilities have performed no hazard evaluations. For instance, the management at one specialty gas producer told the audit team that the chemicals used at the facility do not present a significant risk to the facility or to the surrounding community and that the facility, therefore, does not need to perform process hazard analysis. The audit team suggested that the facility investigate the development of a process hazard analysis program and evaluate the potential impact on the public and the environment from a worst-case release.

In most cases where PHAs have not been conducted, facilities are either developing a process safety management program or have simply maintained poor records of evaluation programs. At one facility, the regulatory compliance officer is also responsible for payroll accounting. Because the compliance officer's predecessor had not kept very good records of the programs that were in effect, the audit team could not determine whether PHAs had been conducted. The audit team recommended that the facility shift the workload to enable the regulatory compliance officer to bring the facility's programs up to date.

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.

A number of the audited facilities use offsite consequence analysis to identify potential hazards. A pharmaceutical company uses HAZOP studies to identify facility process hazards and contracts with private consultants to develop a worst-case scenario for a volatile toxic substances release that may impact neighboring populations. Another pharmaceutical manufacturer uses an innovative technique whereby offsite consequence analysis is used for both planning and preparedness. "Footprints" of the vulnerable zone produced using ALOHA (Areal Locations of Hazardous Atmospheres) are printed on clear acetate for 14 scenarios of potential chemical releases. In the event of a chemical emergency, the acetate for the most appropriate scenario would be overlaid on a map, which is kept with the acetates on file, to enable emergency responders to quickly ascertain the vulnerable zone.

Modeling of offsite consequences has had significant consequences for the processes used at a rubber plant. When the plant manager was shown a scenario developed in CAMEO (Computer-Aided Management of Emergency Operations) depicting the potential for offsite effects of a chlorine release, he directed that chlorine be eliminated from the plant. Chlorine was replaced with sodium hypochlorite in the facility's water treatment plant.

Audit teams found that other facilities are not implementing offsite consequences analysis as effectively as possible. In several cases, audit teams recommended that facilities should perform offsite consequences analyses for a wider spectrum of the chemicals onsite or that modeling could be used more effectively. For example, a pharmaceutical manufacturer did not thoroughly model releases of chemicals not covered under the state risk management program; the audit team recommended that the facility conduct some limited hazard analysis and assess offsite consequences for hazardous chemicals beyond those currently regulated. Another audit team recommended that a food-processing facility should base release scenarios on the historical record of releases at the plant and on the PHA for their anhydrous ammonia storage system. The audit team also recommended, in this case and others, that release scenarios should be shared with local public emergency officials.

Other facilities have conducted offsite consequence analyses but have not adequately considered all hazards or situations. For instance, a commercial waste management facility for which vulnerable zone identification studies had been performed by several contractors, has apparently restricted their analyses to air dispersion modeling; no secondary effects, such as fire, explosion, or damage to the facility, have been considered. The audit team recommended that the facility conduct a more thorough analysis.

A few audited facilities had not conducted any offsite consequence analysis. The ice cream plant at a dairy, for instance, has contracted for modeling potential releases from its ammonia refrigeration process, primarily in response to neighbor complaints of ammonia odors. The plant has not, however, conducted any modeling for any of its other extremely hazardous substances, and facility management does not anticipate doing so in the future. The audit team recommended that the dairy should model such releases and incorporate the results into its emergency response planning efforts. In another case, a producer and repackager of specialty gases has not conducted an offsite consequence modeling to date and has not identified a vulnerable zone for the site. The audit team recommended that the facility define the vulnerable zone; knowledge of the area likely to be affected by a release would be helpful in conducting emergency response drills with the local community.

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.

Several facilities established procedures to guarantee that MSDSs are obtained for each hazardous chemical onsite and are up-to-date. Any chemicals received at a poultry distributor without an MSDS form are placed in storage until an MSDS can be obtained from the manufacturer. A water treatment facility maintains MSDSs from suppliers for each chemical they receive, including janitorial and maintenance chemicals, by requesting an MSDS with each purchase order. A paper mill has all of its MSDSs in a database and searches this database frequently to uncover information that is more than two years old. The plant's purchasing department determines whether the chemical is still used at the plant and, if so, contacts the supplier to determine if more current MSDSs are available. A semiconductor processing facility requires all new chemicals to be reviewed by the chemical department manager and the safety administrator for their hazards, use, and potential waste streams.

Audit teams commended facilities who made MSDS information easily accessible and understandable to employees. For example, at a paper manufacturer, MSDSs are accessible to facility personnel through a mainframe computer, and hard copies are maintained in the medical center, control rooms, the day lab, and the shift lab. To reinforce the safety information found in MSDSs for its employees, one chemical manufacturer develops 550 "workplace precautions" per year. These precautions summarize health and safety information from the MSDSs and provide them in a more condensed, easier to use format.

Audits also revealed facilities whose chemical hazards were not formally identified or were poorly documented. For example, a chemical storage and distribution terminal maintained health and safety information on its products, but had no hazard information or MSDSs on maintenance or janitorial chemicals used at the facility. MSDSs in an employee handbook at a water treatment plant were very poor copies (causing them to be illegible) and were formatted in a variety of ways, making it difficult for new employees to determine the location and relevance of specific types of information. At a battery manufacturing facility, some employees were replacing their personal protective equipment too often in comparison to industry standards, while others were not replacing theirs often enough. This indicated to the audit team that employees were not receiving (and/or applying) consistent hazard information.

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, one audit team noted that many of the facilities visited had problems keeping their NFPA hazard placards accurate, complete,

and up-to-date. Problems included worn and damaged signs, illegible signs, signs blocked by other equipment, and inconsistent labeling and markings. At a chemical manufacturer in another region, storage tanks were clearly identified, but no placards were posted at the entrances to the building that houses the shipping dock and the production area, where hazardous chemicals are present. At a specialty chemical manufacturer, flammable materials were scattered throughout the tank farm; the audit team recommended that these materials be grouped together. An audit team at a paper mill suggested that the mill improve the poor lighting provided in the vicinity of loading/unloading areas. Finally, an audit team at a latex manufacturer noted that housekeeping in many areas of the plant could be improved, including better definition of paths for forklift movement.

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 of the audited facilities had SOPs in some form. Audit teams cited many examples of thorough SOPs that were formally documented and implemented by employees. A pharmaceutical manufacturer had particularly comprehensive SOPs, including written procedures for emergency response, natural disasters, hazardous waste handling, spill response, and facility evacuations. Furthermore, a written SOP exists for each process batch, and batch check sheets are available to personnel involved in a particular process to monitor the amount of materials used; the audit team commended this facility for its effort to add specific process safety information and safe shutdown procedures to these individual process batch sheets.

Another example of comprehensive SOPs was noted at a chemical manufacturer. SOPs at this facility were detailed, step-by-step procedures that document processes from the beginning to the end; they were clearly written and prominently marked when a process included a state-listed extremely hazardous substance. These SOPs are signed by all shift operators, production supervisors, and five department heads. At a gas production and repackaging facility, the audit team found that the facility's SOPs were highly detailed and recommended that perhaps a shorter version (in the form of a checklist) might be useful in addition to the formal SOPs for more experienced employees.

Typical problems with SOPs observed by the audit teams included a lack of formal written procedures to insufficient documentation and the absence of review procedures. For example, instructions at a chemical distribution terminal indicated that the SOPs were to be updated annually, but there were no dates or authorized signatures on the SOPs to determine when and if such actions occurred. An electric utility uses a checklist for unloading sulfuric acid instead of detailed step-by-step SOPs; the audit team recommended that this facility develop formal SOPs and include in these SOPs the type of PPE to be worn during the procedure. During an audit of an organic chemical manufacturer, the audit team noticed that SOPs for processes not covered under the Delaware EHS or the OSHA PSM

regulations may not be annually reviewed and that the operating instructions for calibrating the chlorine sensors needed more detail; the audit team recommended that the facility consider several specific improvements to its SOPs.

Audit teams noted that the SOPs at several facilities lacked information on how to handle process deviations. To avoid upsets, SOPs on operating parameters should include process deviation information so that operators are familiar with the indicators of a process deviation and know when a process needs to be shut down. At a poultry distribution facility, the audit team recommended that the facility include operating limits and significance of deviation information in all of its SOPs.

Audit teams addressed the consequences of not following procedures and safety measures with several facilities. At a rail transportation terminal, the audit team observed that some drivers of hostler trailers did not always drive on specified driveways but cut across empty stalls marked for parking of chassis and containers. The audit team recommended that the facility review the vehicles in operation, vehicle speeds, and traffic patterns and consider revising operating practices to conform to procedures in the facility design and engineering plan. At a chemical distributor, the audit observed that some stacks of five-gallon containers were standing outside of the marked aisles, putting them at risk of accidental contact with forklifts running through the plant. The audit recommended that the facility follow its written procedures and not overcrowd traffic ways with hazardous containers.

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 instance, one facility that produces specialty gases uses a maintenance management system that can list basic equipment specifications and the history of equipment maintenance, and can automatically generate preventive maintenance work orders at a given frequency. Separate paper files are kept in the maintenance building. In addition, the facility has also developed a stand-alone database that incorporates more specific data than the management system, such as calibration and specification data. Workers enter the results of every test and calibration directly into a portable computer, from which the

data are downloaded into the main stand-alone system that tracks and reports results. Every major piece of equipment is assigned an identification number; smaller components are tagged with a number based on the piping and instrumentation diagrams. The system alerts the maintenance department two weeks before the scheduled preventive maintenance.

Other facilities did not have such elaborate systems to track and predict maintenance needs, but performed systematic preventive maintenance nonetheless. At a chemical manufacturer, the work order system mandates communication between maintenance workers and operators; thus, maintenance workers are informed if the equipment is critical to the safety of the operation and if any process changes or modifications have occurred. However, not all audited facilities were careful to communicate with process workers or to identify any modifications to processes or equipment; at one facility, for example, the audit team noted that maintenance workers did not verify that replacement parts were, in fact, true "like for like" replacements; the audit team noted that such practices are important because different vendors may recommend different maintenance, testing, and calibration schedules and procedures.

Other facilities did not conduct proactive and/or thorough preventive maintenance programs. Audit teams commented at several facilities that, even when preventive maintenance was conducted for other equipment onsite, emergency equipment was often not similarly maintained. For instance, the audit team recommended that an aluminum and magnesium extruder should have instituted a thorough inspection and maintenance program for emergency equipment. The audit team specifically recommended that a formal testing and inspection plan should be instituted to ensure proper operability of the in-plant communications devices (including a plant-wide whistle, personal pagers, and two-way radios).

Several facilities failed to conduct any preventive maintenance activities. At a chemical processor, for instance, the audit team noted that many of the vendor-supplied compressed gas cylinders were substantially out of date (i.e., ten years) for hydrostatic test compliance. The audit team recommended that the facility develop and implement a preventive maintenance program to check the testing dates on compressed gas cylinders both in the plant and as delivered by vendors. At a semiconductor processing plant, facility personnel indicated that no integrity tests had been conducted on an ammonia storage tank or the associated piping since the tank was purchased, in used condition, over ten years ago. The audit team recommended that the facility refer to the technical literature for information on ammonia piping inspection programs and apply statistical analysis of equipment performance to justify changes in inspection frequency. At a storage and distribution facility, the audit team could find no evidence that valves, piping, or pumps had been maintained. The team recommended that the facility develop a preventive maintenance program that would identify each component's replacement or repair cycle.

Some audited facilities have incorporated emergency equipment into their regular maintenance programs, while others conduct these activities in conjunction with drills and exercises. However, at one chemical manufacturer, the audit found that upkeep on the emergency equipment was poor; fire protection water lines were difficult to identify, and the SCBAs had no dates or tags indicating periodic inspections. The audit recommended that the facility add visible inspection tags to emergency equipment and periodically inspect, test, and repair fire suppression systems as necessary for emergency preparedness.

The depth and quality of the training afforded to maintenance workers can also affect the quality of a facility's maintenance program. The maintenance department of a chemical manufacturer requires all mechanics to have basic math and blueprint training. All of the instrument shop technicians have taken college-level courses, and the upper level mechanics have college degrees. The facility is also developing programs with a technical school in the area for specific training and is planning to use a third party, a technical college, to evaluate mechanics' ability for certain tasks (e.g., welding). In addition, the facility sponsors other equipment- or instrument-specific training periodically; for instance, technicians performing non-destructive testing were sent to an outside training course.

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 their health and safety needs.

Many of the facilities audited have implemented the basic components of a training program, including detailed training policies, refresher courses, and incorporation of management of change procedures. A petroleum refinery had a particularly thorough training documentation program. A computerized spread sheet of all employees is updated after each training session and includes the employee name, job title, response role, social security number, certification(s) held, training and refresher courses completed, and applicable OSHA standards addressed by each training segment. In addition, the facility has recently hired a contractor to write safety training lesson plans and materials to standardize the training received by all employees and contractors.

Audit teams did suggest specific improvements to round out existing training programs at numerous facilities: a common recommendation was to track training records electronically. At a specialty chemical manufacturer, once an operator has been trained, there are no established procedures to evaluate operator knowledge or performance; the audit team recommended that the facility establish a method of evaluating operator performance on a periodic basis to ensure they have not forgotten SOPs. At a paper mill, the audit team suggested that, to maintain a consistent level of safety training in all departments, all facility departments should mandate attendance at monthly safety meetings/training and document minutes and attendance.

Audit teams found that some facilities with basic training programs needed to enhance or strengthen their programs. For example, a poultry distribution facility has an annual written refresher training exam, but the same test is given every year. The audit team suggested that this test be modified each year to receive the benefit from this exam. The audit team noted that the "Hazard Communication Rule" manual at a chemical manufacturer does not provide any specifics about the content of training,

the qualifications of instructors, or the duration of the training. Finally, although a petroleum refinery had a well-equipped training facility with a computer-based training program, the audit team recommended that the facility needed to provide a formal retraining program for personnel conducting a "train the trainer" program.

In a few cases, audit teams found that facility personnel were performing tasks for which they had not been trained. At a manufacturing facility, nearly all personnel are allowed to operate forklifts, although no one is trained in safe forklift operation. At another facility, employees participate in responses to hazardous materials incidents although no employees are trained to the OSHA Hazwoper First Responder level.

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 of the audited facilities conducted safety audits, both internal (i.e., conducted by facility employees) and external (i.e., conducted by other individuals). One chemical manufacturing facility undergoes audits frequently. External audits are performed by corporate personnel, the facility's insurance company, regulatory agencies, customers, and, in special cases, by contracted personnel (i.e., ISO-9002 audits). The facility also conducts numerous internal audits, both scheduled and unscheduled. For example, the facility's training department conducts training audits to insure that training meets company objectives. Company policy requires operating divisions to conduct safe work permit audits "routinely"; the plant's Acid Division interprets this as a weekly requirement.

A paper product facility tracks recommendations from both safety audits and investigation reports on a computer network. Each recommendation is assigned a date of completion by the employee responsible for its implementation. Active recommendations are examined on a weekly basis; if a due date has passed and a completion form has not been submitted, the accountable employee is issued a status form, which is completed and submitted in place of the completion form. These two forms are color-coded to distinguish them from one another. A report, organized by accountable employees and listing the status and projected completion dates of active recommendations, is printed on a monthly basis and distributed to management personnel.

Many other facilities, however, did not actively pursue or track the recommendations of safety audits. As an example, an ammonia storage facility conducted an internal audit that recognized housekeeping and labeling as the primary deficiencies. The audit team found that there was no formal program for assigning responsibility for correcting deficiencies and recording the corrective actions taken. The audit team encouraged the facility to establish a formal program for identifying health and

safety concerns, assigning responsibility for corrections, and documenting how problems were corrected or why corrective action was not performed.

At other facilities, safety audits were not conducted, or were not conducted regularly. At a water purification plant, the audit team found that the facility was not actively developing a process safety management or risk management program. The facility management did not have a regular schedule of audits; according to records, a complete safety audit of the facility had not been conducted for more than five years. However, the audit team found a number of problems (e.g., illegible and poorly organized MSDSs, lack of detail in the SOPs, lack of specific details in response plans) that could have been identified by a safety audit. The audit team recommended that the facility consider some of the PSM/RMP training programs and documents provided by AIChE at their training courses.

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 chemical manufacturer, for instance, has documented procedures for identifying the causes of spills and release incidents. Incidents are investigated by a team consisting of the operator(s) involved, the area supervisor, and a manager. A questionnaire allows the employee to alert management to potential root causes (e.g., failure due to poor engineering design, failure of supervisor to address a problem in the process). The investigation starts immediately (within 24 hours) and must be completed within a two-week period. A manager reviews the incident reports and is responsible for ensuring that actions to correct identified problems or prevent recurrence are completed.

At a paper mill, the audit team cited a four-hour workshop (mandatory for all employees who participate in the investigation process) as the key to that facility's accident/incident investigation program. Several dozen employees have attended the investigation workshop. A core group of six or seven employees participate in most of the investigations, with assistance from other trained members of

the larger group. The audit team had some concerns, however, regarding the facility's accident investigation program:

- The facility had limited, formal documentation on how major incidents would be investigated. In addition, formal root cause investigation methodology did not appear to be used in the investigation proceedings; instead, the facility used an "accident weed" similar to fault tree analysis.

- The facility has not established a formal system for tracking recommendations generated in incident investigations; the audit team advocated that the facility develop specific written guidelines regarding recommendations generated in all future facility incident investigations, designed to eliminate vague wording from the recommendations. The audit team urged that recommendations be clearly stated with measurable goals; target dates be established for each recommendation; and specific individuals be assigned to implement each recommendation.

Other facilities did not have explicit accident investigation procedures or could have had more complete accident investigation programs. At facilities with incomplete programs, two elements were commonly observed: no investigation of near-miss incidents and no clearly specified responsibilities for following-up on recommendations from accident investigations. For instance, an audit team found that one facility that stores bulk quantities of sulfuric acid failed to address near-misses, investigate actual root cause of an incident, or identify corrective actions to prevent a recurrence.

An audit team similarly found that a petroleum refinery did not have a process to ensure that all incidents or near-misses that do not directly affect employee safety were investigated. The audit team recommended that the facility should consider implementing an investigation procedure for releases unrelated to worker safety issues, such as sulfur dioxide emissions or small fires. Audit teams also addressed circumstances in which facilities were not taking advantage of the valuable information collected during the accident investigations. Following an audit of a battery manufacturer, the audit team recommended that corporate management consider establishing a system for sharing results of accident investigations of its facilities.

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.

Many of the audited facilities had well-developed management of change programs. At a specialty chemical manufacturer, management of change procedures are well documented, and the

affected operator(s) and foremen participate on the process review committee along with representatives from other relevant departments. Another chemical manufacturing facility has established a plant-wide management of change team. The procedures developed by this facility had already been used to handle thousands of changes by the time of the audit. Each area containing an affected process must establish an internal management of change coordinator and process to review new installations, removals, or modifications to existing processes. At a petroleum refinery, management of change activities are tracked on the facility's computer mainframe and are easily accessible by all facility employees.

One chemical manufacturer has a program that tiers its management of change procedures based on the magnitude of the change. Specifically, the facility may pursue one of three management of change options: (1) for the smallest changes, a memorandum is prepared advising the affected personnel that a change will occur; (2) for the next higher level of change, the change is announced by a memorandum requiring affected employees to acknowledge receipt of the notification and participate in a limited training program; and (3) for a major change, a scheduled training period and walk-through by operators and other departmental staff who may be affected are required. The engineering and construction division is required to provide approval of all equipment and facility changes.

Audit teams found that a number of facilities' management of change procedures were incomplete or too informal. For example, an audit team recommended that a chemical distributor develop and implement a consistent policy for the application of local fire and building codes to plant modifications, including a formal evaluation of new applicable code editions to evaluate their impact on existing plant features. In addition, this team recommended that the facility adopt a proactive policy of using the most current National Fire Protection Association standards and continuously review applicable new code editions to evaluate the implications of code changes on existing and planned activities. At an agricultural chemical facility, the audit team found that the facility's management of change procedures were a generic plan developed by a corporate policy board, primarily for changes in company standards and policy. The audit team recommended that this facility modify its procedures to make them more specifically applicable to the facility itself.

Audit teams also recommended at several facilities that they update their emergency response plans on a regular basis (e.g., annually, after exercises, etc.), thereby institutionalizing "management of change" into their emergency response programs. For example, at an electric utility, there is no established schedule for performing a comprehensive review of the facility's emergency guidelines at regular intervals. The audit team recommended that the facility conduct an annual review of the site emergency guidelines to ensure that all revisions made to the guidelines since the latest comprehensive review are fully compatible and that all physical and procedural changes made at the plant since the latest review have been incorporated.

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.

Specifics of the pre-startup review process were not addressed in many audits. A few facilities were developing pre-startup review procedures, generally in response to the requirements of OSHA's PSM Standard. In addition, a few facilities that had formal management of change programs had complementary pre-startup review procedures. For example, a water treatment facility has outlined a pre-startup safety review as part of its established management of change procedures.

One audit team noted the absence of a written pre-startup review procedure. At a petroleum refinery facility, the audit team observed that the facility's operators take care of small, but important details in startup procedures that are not documented in the plant's operating manual or steps of operation. The team recommended that, regardless of the thorough training that operators have received, operating manuals should be reviewed for completeness to ensure that all relevant steps for unit operation are documented and easily referenced in the manual.

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" protect 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.

Specific procedures related to hot work permits were not covered in many audits. However, audit teams noted that several facilities with hot work permit programs were not fully implementing these procedures. For example, the facility compliance officer at a non-ferrous metal processor told the audit team that the facility has a hot work policy, but a facility manager informed the audit team that this policy is out-dated and has not been rigorously implemented. The audit team strongly recommended that this facility update and fully implement its hot work control program in accordance with OSHA regulations and National Fire Protection Association Standard 51B, which describes fire protection in use of cutting and welding processes. At an agricultural chemical facility, the audit team suggested that the facility needed to require that hot work permits, lockout-tagout permits, and/or management of change permits be completed and obtained prior to granting confined space work permits.

A few facilities were specifically identified by audit teams as not having hot work permit programs. For example, at a shipbuilding facility that sponsors a welding program for members of the local high school, an acetylene/oxygen welding station is located directly outside a break room commonly used for smoking. Compounding the safety problem of having a smoking break room neighboring a welding station, there are no signs in the welding area to discourage smoking around the welding station or to warn of flammable materials.

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).

Many audited facilities were commended by audit teams for encouraging employee participation. At a petroleum refinery, employees participated in the preparation of a document that describes how to be involved in process safety management. At a chemical warehouse, safety policies, guidance, and directives are employee-driven. Each employee is assigned the responsibility to write safe work practices within his/her respective work area and subsequently presents this information to the rest of the facility during safety meetings.

An emphasis on employee participation can have direct payoffs for managing plant safety initiatives. For example, at a pharmaceutical manufacturer, the audit team believes that the strong commitment made by management to plant safety and hazardous materials response training is reflected in the enthusiastic response by employees in voluntarily joining the facility's emergency response team. In addition, audit teams noted that the personnel across a facility can benefit when the results from training, drills and exercises, and accident investigations are shared.

At a few facilities, audit teams recommended that additional employee participation in process safety management procedures would be beneficial. For example, a paper mill established a committee to develop behavioral job analyses for each job at the mill. Each behavioral job analysis will contain a job description, a checklist, a listing of hazards associated with the job, protective equipment needed, and a test to ensure worker understanding. The audit team recommended that including employees in the behavioral job analyses would prove very beneficial in terms of internal accountability. Audit teams also recommended having employees participate on accident investigation teams. For example, at a specialty chemical manufacturer, the audit team commended the facility for its "root cause questionnaire" that provides employees with a mechanism for presenting their evaluation of the reason for a particular incident.

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 water treatment facility serves as an example of a thorough contractor evaluation program. Contractors conducting large projects and those working on processes covered under the facility process safety management program are formally evaluated by facility personnel. In addition, contractors are informally evaluated using weekly personal observation reports, contractor employee interviews, and/or reviews of contractor work records. The facility maintains the health and safety records for its contractors and has a sheet in its safety manual addressing contractor safety review and evaluation procedures. Facility policy requires that the contractor's hazard communication program be reviewed by facility personnel, and in turn that the facility's hazard communication program be reviewed by the contractor personnel. The facility's safety director is also developing a contractor evaluation checklist to be used by engineers as a standard evaluation tool.

Several facilities had effective contractor training and orientation programs. For example, a chemical manufacturing facility was commended by the audit team for its excellent contractor safety program and information booklet explaining plant operations, security, parking policies, personal safety, and alarms and evacuation routes. A gas production and repackaging facility instituted a formal contractor orientation program consisting of a three-hour video and lecture workshop given by facility management. A chemical manufacturer using particularly large numbers of contractor employees established a "contractor safety partnership" with eight of its major contractor companies. In addition, this facility has developed a series of intensive training programs for all contractor personnel who will be onsite for more than a brief period.

In many cases, audit teams recommended improvements or additions to a facility's contractor safety procedures. The audit team visiting a chemical manufacturer facility recommended that the facility's stated policy of requiring contractors to check in at the entrance be followed more rigorously to facilitate emergency procedures and evacuations in the event of an emergency. At a battery manufacturing facility, the audit team advised the facility to review OSHA-200 accident reports, training, inspections, and emergency response procedures (where applicable) when selecting contractors, instead of solely relying on price considerations. A petroleum refinery received a suggestion to develop and distribute a written evacuation plan for its contractors and designate additional evacuation assembly points for contractors.

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, either across the site or at a single unit that could be involved in a release event. For example, a chemical distributor has consciously chosen not to handle certain materials that are incompatible with the flammable products that comprise the major storage products onsite. To save the expense of constructing a containment system to accommodate a 90-ton rail tank car, a water treatment plant is considering switching to storing one-ton chlorine cylinders; the audit team noted that this decision would result in a major reduction in onsite hazard far beyond just the amount of materials in the container.

In keeping with the diverse operations examined by the audit teams, the audited facilities exhibited a variety of release prevention measures. Secondary containment and high-level alarms on process and storage vessels were common. At a chemical manufacturer, a computer system controls material transfer to and from tanks in the bulk chemical tank farm, and highly visible bar graphs on the tanks indicate the percentage full. In addition, high-level and high-high level alarms (which automatically shut down the whole reactor if the operator is unsuccessful in gaining control after the high-level alarm sounds) are present on tanks throughout the facility to prevent overflows, and redundant systems and backups are employed extensively. Another petroleum refinery uses separate power sources, redundant equipment, and steam-driven equipment to backup electrical equipment and ensure safe operations even under unusual or unexpected circumstances.

Several facilities have taken strides to make it easier for operators to spot and correct potentially hazardous situations. At a pulp mill, video cameras provide operators in the control room with views of selected points within the bleach plant, and the bleach plant has an emergency shutdown device that is activated by pushing one button. A petroleum refinery specifically trains its employees to troubleshoot abnormal conditions to detect and overcome indicator or transmitter problems. Many facilities have installed monitors and/or alarms to alert employees of chemical releases in process areas. For example, at a specialty chemical manufacturer, the ethylene oxide storage/handling area is equipped with 14 combustible gas detectors and automatic shutoff buttons.

In a few cases, audit teams suggested technological or procedural solutions to facilities to increase their ability to detect and prevent releases. For example, an audit team advised a chemical warehouse to consult NIOSH criteria documents for specific engineering controls that might help ensure the safe handling of chemicals and recommended that the facility install remote "kill switches" for all pumps used to transfer hazardous materials. At an inorganic chemical processing facility, the audit team recommended that the facility install equipment that would enable personnel to detect releases that might occur in unmanned areas. Furthermore, at a pharmaceutical manufacturer, no containment system was in place in the raw materials warehouse, and standing water with algae was detected in the containment area, posing a slip hazard in addition to the fact that a spill could go undetected due to the water. At a chemical distributor, the audit team suggested that the facility employ backups and redundancy systems for an automatic shutdown in their storage areas.

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.

Nevertheless, emergency preparedness and response activities 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.

Because of the site-specific nature of emergency response plans, each facility must make a determination about how to organize its plan and how comprehensive it needs to be. Many of the audited facilities had response plans that were insufficiently detailed or were missing information that would be critical in an emergency and, thus, the audit teams identified additional areas that should be included. For instance, a team conducting an audit at one facility noted that the facility lacked a Spill Prevention, Control, and Countermeasures (SPCC) plan for its fuel oil storage; the team provided management with a copy of the SPCC regulation and a guidance manual to assist the facility in preparing an SPCC plan, if necessary. A water treatment facility maintained an emergency response plan, but many of the emergency procedures in the response plan were general and did not highlight the specific personal protective equipment to be worn, the training necessary to perform actions, or specific dangers that might be encountered during a response. An ice cream dairy had prepared an emergency response plan, but the plan omitted the required telephone numbers for regulatory release notifications.

As a result of various federal and state regulatory programs, as well as facility and corporate initiatives, many facilities prepare several documents addressing emergency preparedness and response issues. A few audit teams noted that facilities were already integrating the elements required to comply with such mandates. For example, a facility that produced specialty gases was combining its SPCC plan, facility emergency response plan, and the state-required preparedness and contingency plan into one preparedness and response plan.

On the other hand, due to the existence of multiple plans at some facilities, audit teams noted instances in which it was not obvious whether certain key information had not been developed by the facility or whether it was simply located in another document, and other cases in which a combined plan did not completely address certain elements of a particular planning requirement. For instance, a chemical manufacturer maintained a single manual, located at the guard shack, to contain emergency response plans. However, although the audit team believed that all of the material for a good plan was in place at the facility, the information was not all contained within the one manual. For instance, the manual did not provide information regarding evacuation corridors or a listing of the types of hazmat equipment available at the plant. In 1996, EPA, in conjunction with the National Response Team, issued *Integrated Contingency Plan Guidance* to provide a mechanism for facilities to consolidate multiple plans into a single, functional emergency plan.

Although specific elements contained in the plan may vary by facility, there are certain standard components, including the generic emergency categories, procedures for facility personnel, and a list of reference materials. Evacuation procedures are one component of a plan and should include escape routes, gathering areas, and accounting methods. The majority of the audited facilities have evacuation procedures and have marked escape routes on maps posted around the facility. At a petroleum refinery, an audit team found that management had recently improved its system of accounting for employees present in the facility at any given time by issuing bar-coded identification cards. The employees use these cards to check in and check out from their shifts. In the event of an emergency, a computer can quickly identify which employees, if any, are unaccounted for after an evacuation.

Evacuation procedures contained in the response plans of a number of audited facilities, however, were found to be insufficient to ensure employee safety. At a shipyard, for instance, the audit team found that the facility's four-step emergency response procedure directed all personnel to report to the toolroom. There were no provisions for alternative assembly areas or facility evacuation in the procedure. At another audited facility, the audit team noted that evacuation routes were made difficult by the fact that one side of the facility property is bounded by the Missouri River. The audit team recommended that the facility should investigate the possibility of an evacuation route away from the plant, along the river, in case the primary evacuation route was blocked by a catastrophic fire or event.

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 of the audited facilities, the plan is reviewed at least once a year by facility management personnel; the reviewers approve revisions to the plan and implement any necessary changes. Other facilities, however, did not provide a schedule for updating the emergency response plans or procedures; as a result, some plans contained information that may have been out of date. An ice cream dairy, for instance, had not updated the MSDS information in the plan since 1979.

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 more than a minimal number of employees in emergency response procedures and training management personnel to ensure that a qualified manager is on site at all times should an incident occur. Despite this progress, commitment to emergency response training remains a problem at some facilities.

Even facilities that do not have their employees respond to incidents may need to provide some response training. After an audit of an aluminum product producer, the audit team stated that, as far as could be determined, no one who might be called upon to coordinate emergency response activities with the local fire department or other outside response teams had had any training beyond the first responder awareness level.

One of the most critical emergency response issues raised by the audit teams has been insufficient training of response personnel in keeping with their stated job responsibilities and federal requirements, notably the OSHA HAZWOPER Standard. For example, a chemical manufacturer provided team members with initial training to the Hazardous Material Technicians level in accordance with OSHA requirements. However, refresher training courses were not routinely provided. At a chemical distribution facility, the emergency response plan and employee training did not adequately address the requirements of the HAZWOPER regulation as it applies to the role of plant staff and managers when releases occur. The facility initially maintained that additional training was not required under 29 CFR 1910.120 because response contractors are used for major incidents.

Once a trained response force is developed, the facility must ensure that untrained individuals do not participate in response actions. One audit team recommended that new hires and contract employees wear a brightly colored hard hat or arm band for identification, so that trained employees would be able to assist them with evacuation should a spill or release take place; the audit team recommended that new staff should remain so labeled until their supervisor is comfortable that they are familiar with the entire site and the location of critical areas. Not all facilities were careful to require training for response personnel, however. One water treatment facility asked supervisors to perform duties in which they were not explicitly trained (e.g., first aid, search and rescue). The audit team recommended that the facility review both 29 CFR 1910.120 and 29 CFR 1910.134 to identify training requirements for their employees, and then train their employees accordingly.

Some facilities have not established any internal response capability and rely on public responders to address major fires and hazardous materials incidents. For example, a lumber company relied on the local fire department for containment and suppression of fires. However, the audit team noted that facility personnel would have to assist as a resource for potential onsite hazards. A large group of minimally trained employees currently serves to respond to onsite fires. The audit team recommended that a small, trained fire response team, equipped to respond to incidents in their incipient stages, be established; the audit team suggested that such a team could accomplish what now requires a large group of minimally trained staff.

Several audit teams expressed concern regarding whether security personnel were adequately prepared to carry out their assigned roles under facilities' emergency response plans. At a paper mill, for example, the security guard at the main gate served as the contact point for persons dialling in or signalling an emergency and was also the principal contact for outside response agencies on arrival at the

site. At this mill, the position of security guard was filled by a contractor, and the turnover rate for the position was high. The audit team recommended that the security guard should be trained and that the facility should set a minimum standard for gate guard training and conduct monthly drills. A better model for the use of security personnel was provided by another audited facility, a paper mill. The mill required the security personnel (because they are often the first to arrive on-scene of an incident) to secure the incident area. This facility provided guards with training in medical emergency response, perimeter security, incident response center security, news media, and coordination with offsite emergency response agencies.

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 eyewash stations; absorbents, neutralizing agents, and booms; portable pumps and hoses and fire monitors; response vehicles; and monitoring instruments, as well as backup equipment. This 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 facilities, however, were not careful to maintain adequate distance between the emergency equipment and process areas. For example, at a chemical manufacturer, eye wash stations were found in the vicinity of water-reactive chemicals. In addition, evacuation corridors were not kept clear of vehicles, and fire equipment would in some cases be difficult to deploy because of poor housekeeping practices (e.g., painting of stand-pipe discharges and hydrants stems) and poor placement of equipment. The audit team recommended that the facility examine re-positioning eyewashes and showers where water-reactive materials are present; increase their visibility; and differentiate between fire protection and process water lines using color coding.

Some facilities did not have fire protection and other safety equipment. One facility that stored quantities of ammonia did not have confined space rescue capabilities onsite, and depended on the local fire department to conduct such activities; however, the local fire department, whose members had been trained in confined space rescue, did not have the necessary equipment.

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. A paper mill, for instance, had a telephone network system comprised of phones strategically located throughout the plant. The telephone network operating procedures were posted on each phone and on public bulletin boards on each floor. Upon notification of an emergency, the system would be activated, causing all phones to ring; in areas of the mill where ear plugs are used, a red light flashes when the phone rings. When the phone is answered, it notifies the person of the emergency and the appropriate procedures. The system was tested every month, and there were three power generator backups in case of a power failure.

Even if a comprehensive communication system has been installed, problems may still exist. For instance, an audit of a railroad intermodal transport facility found that, despite a public alert and notification plan, detailed initial notification procedures, and good coordination between the corporation's facilities, local responders were unable to directly communicate with railroad personnel located in the control towers because the radio frequencies are on different channels. Only the railroad's police could communicate with local responders. As a result, the control tower personnel would have to go through the facility's police operations to communicate with an arriving responder. The facility was encouraged to coordinate more actively with local, state, and federal agencies; the audit team advocated inclusion of local agency participation in the facility's emergency response plan.

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 the audited facilities conduct drills and exercises, although some facilities did not have a regular schedule for conducting such activities. However, depending on the facility, these efforts involve local response organizations and neighboring facilities in varying degrees. For example, an audit team found that a facility possessed monitoring equipment that could be useful onsite during an emergency. However, during the audit, it became obvious that the facility does not have any clear plans for use of the devices to assess airborne contaminant concentrations following a release. The audit team recommended that the facility develop emergency air sampling procedures and encouraged the facility to use drills to assist responders in becoming familiar with the techniques and skills needed in a response. The audit team also recommended that local responders be involved in the drills and exercises at the plant.

In addition, some facilities do not currently perform exercises at all. One refinery does not conduct emergency response drills; at the time of the audit, local management had not conducted a scheduled evacuation drill within the past two years or developed a schedule for drill activities. The audit team recommended that the facility initiate a schedule for holding emergency drills and critiques of these drills as part of the plant's on-going process safety program. The team noted that a comprehensive drill program should include integration of drills into personnel and contractor safety training materials, development of a drill schedule, and critique of drill results and performances.

For the most part, audited facilities evaluated the results of drills and exercises, and, in keeping with the precepts of process safety management, often incorporated procedural changes and lessons learned into future training and the emergency response plan. Many of these facilities recognized that all employees can benefit when the results from training and exercises are shared. One refining facility accomplishes this by following all field exercises with a critique including all involved personnel and publishing the results of the exercise critique session (and subsequent policy and procedure changes) in a monthly newsletter.

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 degree with regard to emergency preparedness and planning. For many facilities, this consists primarily of fire prevention and pre-planning with local officials during fire inspections or the submission of hazardous chemicals inventory lists under EPCRA section 311-312. However, some audited facilities have become LEPC members, participate regularly in the local planning process, and distribute copies of their emergency response plan within the community.

Many of the audited facilities have taken a more proactive approach to working with the community. This cooperation embraces information exchange, training opportunities, joint drills and exercises, development of public alert systems, and other forms of outreach, such as facility presentations. One paper mill has contacted each of the communities that could be affected by a potential chemical release and has joined a panel of community representatives. The mill's industrial engineer has identified and mapped 100 households in the immediate vicinity, in cooperation with the panel. Mill management then disseminated information packages for community emergency response. In addition, mill representatives meet with panel members on a bimonthly basis to discuss mill activities (e.g., upcoming events that may create noise or an unusual amount of activity). The mill has also established a close relationship with the LEPC and the state emergency management agency.

Other audited facilities have also provided outreach to their communities. One chemical manufacturer purchased personal computers, with air dispersion and emergency operation modeling software installations, for the nearby towns. An environmental manager at the facility is a member of one of the area LEPCs and provides information to both of the neighboring communities' LEPCs. In addition, offsite community notification procedures have been developed by the facility, in conjunction with the local communities, to alert residents to emergency situations or disasters. A warning is distinguished from an emergency alert for possible evacuation by the type of alarm, duration, and number of repetitions.

Coordination activities may also be specific to emergency response concerns. For instance, one audited facility has entered into a mutual aid agreement with local fire departments. Because the facility is the major industry in the area and the only one with trained personnel, they are often called upon to provide assistance to local first responders. In addition, management schedules drills with local responders, including two "call-down" drills that are performed each year between the two local fire departments and the facility.

Facilities can also work together to provide a variety of resources. One audited facility belongs to a regional critical incident stress management team. The team (led by a licensed mental health

professional) responds within 24 to 72 hours of an industrial incident that results in a death or a serious injury. A debriefing or defusing is conducted by team members. Management of this facility also provides a chemical incident response team that responds to incidents in areas outside the facility.

Some facilities have not yet begun formal cooperation with state and local response and planning entities. For example, facilities may have information that could help local contingency planners prepare for potential incidents. At a gas production and repackaging facility, the audit team advised the facility to establish specific transportation routes to the facility, since all of its shipments are received by truck. By establishing specified transportation routes, and ensuring the local emergency planners and responders are aware of these routes, the facility could facilitate community emergency response planning.

This same facility has never participated in an emergency response exercise involving community responders; the audit team indicated that facility management did not know which of the three fire stations had their MSDSs and Tier II forms. Although management is aware of the LEPC and the Chemical Manufacturers Association's Community Awareness and Emergency Response program, it does not currently participate in either program. The audit team encouraged the facility to schedule drills and exercises that involve the community, LEPC, local hospitals, and police and fire departments.

At one audited refinery, the audit team found that, although the LEPC has a county-wide plan, no coordination had occurred between the facility plan and that of the county. Facility environmental personnel, however, expressed eagerness to participate in activities and believe there is a need for LEPC leadership to provide an avenue for inter-industry activities such as information exchange and mutual aid organization. (As a result of the audit, the SERC, which participated in the audit team, committed to providing assistance in developing the LEPC into an active, functioning organization.)

Problems such as this are rare, however; more typical difficulties surround actual coordination for response efforts. For instance, during the audit of a rubber manufacturer, the audit team found that, although the facility is a member of the LEPC, as well as other local community emergency preparedness and response programs, and sponsors a community advisory council, the facility had not adequately coordinated its emergency response needs with the local medical community; the primary medical facility that would be used by the plant in an emergency did not have the plant's MSDSs on file, which could be detrimental to the quality of the care provided following an emergency. The audit team recommended that the facility provide the local hospital with all relevant MSDSs.

Other facilities failed to take adequate steps to ensure that chemicals used onsite would not pose hazards to the surrounding community. One commercial waste management facility did not perform general public exposure monitoring at locations on the site perimeter, although there were frequent occasions when odors from chemicals at the plant could be detected outside the plant. The audit team recommended that the facility perform periodic general exposure monitoring at the facility perimeter; the audit team also encouraged the facility to perform release modeling to consider potential effects on the community.

APPENDIX A

OUTLINE OF THE CHEMICAL SAFETY AUDIT PROTOCOL

APPENDIX A

OUTLINE OF THE CHEMICAL SAFETY AUDIT PROTOCOL

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  - 4.1.4 Special/Sensitive Populations and Environments
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APPENDIX B

LIST OF CHEMICAL SAFETY AUDITS

LIST OF CHEMICAL SAFETY AUDITS

as of October 1, 1995

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-D	International Paper, Ticonderoga, NY
	10/12-13/93	X-D	Pfizer, Barceloneta, PR
	06/28-30/94	X-D	Occidental Chemicals, Niagara Falls, NY
	02/01-02/95	X-D	Hoffman-LaRoche, Nutley, NJ
	07/07/95		**Middlesex County WWTP, Sayreville, NJ**
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
	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

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	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-D	Union Camp, Franklin, VA
	11/11-13/94	X-D	Air Products and Chemicals, Hometown, PA
	01/10-11/95	X-D	Standard Chlorine, Delaware City, DE
	02/14-16/95		**Blue Plains WWTP**
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
	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

REGION	DATE OF AUDIT	REPORT STATUS	NAME OF FACILITY
	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-R	Holox Limited, Union City, GA
	11/14-18/94	X-R	Tennessee Eastman, Kingsport, TN
	12/12-15/95	X-R	Union Carbide Corporation, Tucker, GA
	01/24-27/95	X-R	PCR, Gainesville, FL
	01/30-02/03/95	X-R	Scott Paper Company, Mobile, AL
	04/17-21/95	X-R	Henkel Corporation, Charlotte, NC
	06/19-23/95	X-R	American Synethetic Rubber, Louisville, KY
5	07/25-28/89	X	Koppers, Cicero, IL
	08/08-11/89	X	Best Foods, Chicago, IL
	09/15/89		**Shell Oil, Wood River, IL**
	03/05/90		**Eli Lilly, Clinton, IN**
	03/26-30/90		**Anderson Development, Adrian, MI**
	04/14-18/90	X	General Electric Plastics, Mt. Vernon, IN
	06/11-15/90		**Tremco, Inc., Cleveland, OH**
	07/16-19/90		**Flexel, Inc., Covington, IN**
	03/18-20/91	X	Detroit Edison, River Rouge, MI
	05/20-22/91	X	Nalco Chemical Company, IL
	08/12-14/91	X	SCM Chemicals, Ashtabula, OH
	03/10-12/92	X	Elf Atochem, Riverview, MI
	04/21-23/92	X	BASF Corporation, Wyandotte, MI
	06/02-04/92	X	G.E. Superabrasives, Worthington, OH
	11/03-05/92	X	Yenkin-Majestic Paints, Columbus, OH
	12/15-17/92	X	Allison Gas Turbine, Indianapolis, IN
	04/13-15/93	X	Lomac Corporation, Muskegon, MI
	06/15-17/93	X	Specialty Chem, Marinette, WI
	07/20-21/93	X	Witco, Chicago, IL
	08/17-18/93	X	Interplastic, Minneapolis, MN
	03/29-31/94	X	Upjohn Company, Portage, MI
	08/31-09/01/94	X	Stepan Company, Elwood, IL
	10/11-12/94	X	Farley Company, Brimfield, OH
	02/21-23/95	X-D	Capital Resin Corporation, Columbus, OH
	05/02-04/95	X-D	Clark Refining and Marketing, Blue Island, IL
	06/06-08/95	X-D	Spectrulite Consortium, Madison, IL
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

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	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
	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-R	Chemcentral, Maryland Heights, MO
	12/31/94	X-R	Hudson Foods, Noel, MO
	01/17/95	X-R	Nat. Coop. Refinery Assoc., McPherson, KS
	01/31/95	X-R	St. Louis Water Company, Florissant, MO
	02/09/95	X-R	Howard Bend WWTP, Chesterfield, MO
	03/28/95	X-R	Chemtech, Kansas City, MO
	05/08/95	X-R	Douglas Battery, N. Kansas City, MO
	05/12/95	X-R	Slay Bulk Terminals, St. Louis, MO

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	06/13/95	X-R	Extrusions, Fort Scott, KS
	06/16/95	X-R	Philip Environmental, Kansas City, MO
	09/14/95		**Foamax, Cape Girardieu, MO**
8	05/02-04/89	X	Phillips Refinery, West Bountiful, UT
	06/13-15/89	X	Chevron Chemical, Rock Springs, WY
	08/15-17/89	X	Western Forge, Colorado Springs, CO
	03/27/90	X	Koppers Industries, Denver, CO
	05/15-17/90	X	Amoco Production Company, Powell, WY
	06/26-29/90	X	Amoco Casper Refinery, Casper, WY
	08/27-31/90	X	Western Zirconium, Ogden, UT
	11/01/90	X	Jemm Plating, Co., Denver, CO
	02/06-07/91	X	SAS Circuits, Littleton, CO
	02/19-21-91	X	Kodak-Colorado Division, Windsor, CO
	04/30-05/03/91	X	Col. Falls Aluminum, Columbia Falls, MT
	05/29-31/91	X	Syncom Techologies, Mitchell, SD
	09/29-30/91	X	LaRoche Industries, Orem, UT
	11/12-13/91	X	T.G. Soda Ash, Granger, WY
	02/18-20/92	X	Coastal Chemical, Cheyenne, WY
	02/25-27/92	X	Chevron Refinery, Salt Lake City, UT
	05/27-29/92	X	Rhone-Poulenc, Butte, MT
	08/18-19/92	X	ALCHEM, Ltd., Grafton, ND
	02/09-12/93	X	Stone Container Corp., Missoula, MT
	05/18-21/93	X	Magnesium Corp., Salt Lake City, UT
	06/15-18/93	X	Frontier Refining, Cheyenne, WY
	09/08-10/93	X	Koch Sulfur Products, Riverton, WY
	03/01-04/94	X	Dakota Gasification, Mercer County, ND
	05/03-06/94	X	John Morrell, Sioux Falls, SD
	06/07-10/94	X	Huish Detergents, Salt Lake City, UT
	09/13-15/94	X	Montana Refining, Great Falls, MT
	07/10-14/95		**Coors Brewing Company, Golden, CO**
	08/29-31/95		**Anheuser Busch Brewer, Fort Collins, CO**
	09/18-21/95		**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-D	Southern Pacific Lines, Long Beach, CA
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

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	04/23-27/90	X	FMC Corporation, Pocatello, ID
	05/14-18/90	X	Neste Resins, Springield, OR
	09/24-28/90	X	Unocal Chemicals, Kenai, AK
	01/08/91	X	Occidental Chemicals, Tacoma, WA
	01/15-18/91	X	Chevron USA, Seattle, WA
	03/18-22/91	X	James River Corporation, Clatskanie, OR
	04/22-26/91	X	Potlatch Corporation, Lewiston, ID
	07/23-26/91	X	Great Western Chemical Co., Nampa, ID
	08/05-09/91	X	Boise Cascade Mill, Wallula, WA
	02/24-28/92	X	Georgia-Pacific Paper Division, Toledo, WA
	03/23-27/92	X	SEH America, Vancouver, WA
	04/28-05/01/92	X	Amalgamated Sugar Company, Twin Falls, ID
	07/27-31/92	X	ALCOA, Wenatchee, WA
	11/16-20/92	X	Weyerhauser Company, Springfield, OR
	01/25-29/93	X	Wacker Siltronics, Portland, OR
	04/12-16/93	X	Ponderay Newsprint, Usk, WA
	07/26-27/93	X	Darigold, Caldwell, ID
	07/28-29/93	X	Simplot, Caldwell, ID
	10/25-29/93	X	Unocal, Kennewick, WA
	02/14-17/94	X	Boise Cascade, Medford, OR
	03/22-25/94	X	Ocean Spray, Markham, WA
	06/20-24/94	X	Elf Atochem, Portland, OR
	11/14-15/94	X-D	Southern Oregon Marine, Coos Bay, OR
	11/16/94	X-D	South Coast Lumber, Brookings, OR
	02/27-03/03/95	X-D	Georgia-Pacific, Bellingham, WA
	06-05-09/95	X-D	American Microsystems, Pocatello, ID

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.