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SECTION A: RISK MANAGEMENT PROGRAM ELEMENTS

Section 450-8.016(A) of County Ordinance 98-48 requires stationary sources that are subject to the requirements of Chapter 450-8 to apply the federal program 3 prevention program elements to all covered processes[1] within their facility. Federal program 3 prevention program elements include the following programs:

1. Process Safety Information
2. Operating Procedures
3. Employee Participation
4. Training
5. Mechanical Integrity
6. Management of Change
7. Pre Start-up Reviews
8. Compliance Audits
9. Incident Investigation
10. Hot Work
11. Contractors
12. Emergency Response Program
13. Safety Program Management

Programs 1-11 should be developed and implemented in conformance with Chapters 7 and 9 of the *Contra Costa County CalARP Program Guidance Document*. Program 12, Emergency Response Program, should be developed and implemented in conformance with Chapter 8 of the *Contra Costa County CalARP Program Guidance Document*.

Program 13, Safety Program Management, should be developed and implemented in conformance with Chapter 5 of the *Contra Costa County CalARP Program Guidance Document.* Additionally, stationary sources should include the following considerations in Safety Program Management.

A.1 MANAGEMENT SYSTEMS

Section 5.1 of the *Contra Costa County CalARP Program Guidance Document* states the management system developed by the stationary source must oversee the implementation of the CalARP program elements. Section 5.1.1 states that the management commitment to process safety is a critical element of the stationary source's CalARP program.

There are many documented approaches to management systems. In many cases management systems are typically categorized by the following elements:

- Defining or setting expectations (commitment and responsibilities)
- Communicating the expectations
- Enforcing the expectations
- Measuring and following up on the expectations

Whatever management system the stationary source chooses to use, the system must ensure ongoing implementation of the Safety Program prevention programs. This section lists factors to consider in developing or implementing management systems.

- Ensure continuous management commitment
- Ensure the management system for the Safety Program elements is consistent with the human factors guidance being developed by Contra Costa Health Services, Contra Costa Health Services CalARP Guidance Document Chapters 5, 7, and 8, the CalARP Program, Process Safety Management, and Industry Codes, Standards, and Guidelines as defined in 450-8.014(f) of the County Ordinance Code.

  - Ensure two-way communication between line personnel and senior management for the Safety Program elements, including what the elements consist of, implementing the Safety program elements, modifying the prevention elements, and the effectiveness of the Safety Program elements

  - Define the roles and responsibilities for the required Safety Program elements

  - Evaluate the effectiveness of the Safety Program elements

  - Develop a process to make changes when necessary to any of the Safety Program elements

  - Establish Goals and Objectives

  - Worker Feedback System

  - Ensure External Communication

These elements are described in detail below

A.1.1 MANAGEMENT COMMITMENT

"Management should lead its facility by taking a visible and active role in safety management, championing safety performance, set objectives and targets, and establish accountabilities at all levels."[2] *"Like the effort put in productivity, maintenance and quality, every participant in the organization should contribute to safety. By consequence, like productivity, maintenance and quality, safety should also be managed, and it should be managed from the top of the organization"*[3] *"No error management initiative will be successful unless commitment to change is engendered at all levels in the organization. This can only be achieved if the commitment of senior management is demonstrated explicitly in terms of the resources (time, money, and exposure) that they are prepared to devote to the initiative."*[4]

- The management systems should describe how senior stationary source staff have been assigned overall responsibility to oversee compliance for the Safety Program
- Safety Program elements should be discussed in management meetings on a periodic basis
- The management systems should state how senior stationary source staff has established detailed Safety Program goals for management with specific objective and goals, and tracks management involvement in workplace safety meetings, audits, and related activities
- The management systems should address how senior stationary source staff is held accountable for their Health and Safety Program record, and how do the rewards and penalties compare to those for production performance
- Senior stationary source staff should address how the stationary source promotes "safety first" approach
- Senior stationary source staff should periodically review the Safety Program management system for continuing appropriateness, adequacy, and effectiveness
- Senior stationary source staff should receive information on incident and incident investigations and inspection/audit reports
- Senior stationary source staff should participate in specific Safety Program initiatives/programs
- Senior stationary source staff should assist in the development of or issue specific types of Safety Program information and guidance
- Senior stationary source staff should ensure that there is expertise available in each of the different Safety Program elements, including Human Factors
- Senior stationary source staff should allocate time and resources for the different Safety Program elements
- Senior stationary source management should promote the understanding of the different Safety Program elements, including Human Factors. This will allow understanding of the Safety Program elements and incorporation of ideas into process design, operation, and maintenance

A.1.2 ENSURE THERE IS A MANAGEMENT SYSTEM FOR SAFETY PROGRAM ELEMENTS

The stationary source must have a management system in place to ensure that all of the Safety Program elements are developed, implemented, modified when needed, communicated, and roles and responsibilities are established. The management systems should be audited to determine the effectiveness of the program in place. The management system program should have written

policies and procedures that should be reviewed and revised annually. The management system should include the following subsections.

A.1.2.1 Communication

The management system should address the communication that exists between the line personnel, staff personnel, supervisors, and upper management. Effective two-way communication is essential to have a program that works effectively. Therefore, the program should address two-way communication, reporting lines, information exchange, and employee involvement.

The management system must ensure how communications are addressed in the Safety Program elements. The program must state how the findings, recommendations, and results of the process hazard analyses, incident investigations, and management of change are communicated to the employees. The program should address the communications between appropriate personnel in the organization (such as between shifts). The program must address how employee participation is incorporated in the prevention elements, including how this program will be communicated and how input will be solicited from the employees (see chapter 9 Employee Participation).

A.1.2.2 Roles And Responsibilities

The management system for the stationary source's Safety Program elements should include the stationary source's personnel's specific responsibilities for managing Safety Program elements development and implementation. The job descriptions and annual performance goals for safety of each employee should be clearly defined and documented and reviewed with the employee to be sure these are understood. Job descriptions should be collectively reviewed to be sure that there are no gaps in coverage.

A.1.2.3 Evaluation

The stationary source should have a management system in place to ensure the stationary source evaluates the effectiveness of the different Safety Program elements. To evaluate and measure the effectiveness of the Safety Program elements the stationary source should establish a baseline.

A.1.2.4 Modification To The Program

As part of the management system, the stationary source should have a way to make changes to the Safety Program elements policies and procedures. The changes should be based on the evaluation process, the auditing of the program, and input from the employees. The changes made to the Safety Program elements policies and procedures should be part of the overall

management of change program that the stationary source has implemented for their facilities.

A.1.2.5 Goals And Objectives

Site goals and objectives should be established for the Safety Program elements at all levels of the organization. The goals and objectives should define what is to be accomplished for each Safety Program element.

A.1.2.6 Worker Feedback System

Feedback from workers on job improvement will only happen in an environment of trust. Without this environment, employees are less likely to fully contribute to PHAs, incident investigation, including near miss reporting, and other Safety Program elements. The management systems should have procedures/policies in place to create an environment where workers can and will communicate problems with the processes, organization, and equipment. The management systems should describe how these procedures/policies are incorporated throughout the organization (e.g., just discipline).

A.1.2.7 External Communications

The stationary source should work with Contra Costa Health Services in preparing for public meetings associated with the Industrial Safety Ordinance and participate with Contra Costa Health Services in these meetings.

[1] "Covered Process" is defined as any process at the stationary source.
[2] Arthur D. Little, Inc. – Facility Level Safety Management Audit Protocol
[3] Moraal, J. (1992) Human Factors in Loss Prevention, International Conference on Hazard Identification and Risk Analysis, Human Factors and Human Reliability in Process Safety
[4] Embrey, D. E. (1992) Managing Human Error in the Chemical Process Industry, International Conference on Hazard Identification and Risk Analysis, Human Factors and Human Reliability in Process Safety

CHAPTER 1: INTRODUCTION

Section 450-8.016(B) of County Ordinance 98-48 requires stationary sources to develop a written human factors program within one year of the issuance of a guidance document developed or adopted by the Department. The written human factors program and therefore, the guidance document, must address the following:

- The inclusion of human factors in the Process Hazards Analysis process;
- The consideration of human systems as causal factors in the incident investigation process for Major Chemical Accidents or Releases or for an incident that could reasonably have resulted in a Major Chemical Accident or Release;
- The training of employees in the human factors program;
- Operating procedures;
- The requirement to conduct a Management of Change prior to staffing changes for changes in permanent staffing levels/reorganization in operations or emergency response. Employees and their Representatives shall be consulted in such Management of Changes;
- The participation of employees and their representatives in the development of the written human factors program;
- The development of a program that includes, but is not limited to, issues such as staffing, shiftwork and overtime; and
- The inclusion of a human factors program description in the Safety Plan.

Together these elements form the foundation of the human factors program. The initial scope of the human factors program guidance was limited to the preceding, explicit requirements for the following three reasons:

- Section 450-8.016(B)(1) requires that stationary sources develop a human factors program one year following the issuance of this guidance. Therefore, CCHS representatives felt that it was vital that the guidance document be issued as soon as possible
- Section 450-8.016(B)(1) requires that stationary sources develop a human factors program one year following the issuance of this guidance. Therefore, CCHS representatives wanted to identify the basic components of the program that could reasonably be implemented within one year.
- Section 450-8.030 allows for an annual performance review and evaluation. Therefore, CCHS representatives felt that there would be a natural avenue for reviewing and improving the human factors program requirements and guidance.

The Department established a Human Factors Program Committee including representatives with technical expertise in process safety and in human factors to develop the Human Factors Program Guidance Document. This document identifies the programs and activities that **must**, **should**, or **may** be developed or conducted by stationary sources to meet the expectations of the Department in regards to a human factors program. **Must** is used in accordance with very general programs that CCHS expects to be developed (e.g., a program to train employees on the human factors program) or that are otherwise required by existing regulation/legislation/ordinance. **Should** is used in accordance with general alternatives to meet requirements. **May** is used in accordance with specific

examples of acceptable methods for addressing human factors and errors. Examples denoted as **should** or **may** are provided to assist sources in developing their own programs; however, alternative methods may be acceptable and must be discussed with CCHS representatives.

Chapter 2 of this document provides a brief description of human factors and some of the existing classifications for and approaches to assessing human factor identification and resolution. Chapter 3 addresses evaluating and minimizing existing latent conditions. Chapter 4 provides methods for addressing active failures and latent conditions during Process Hazard Analyses. Chapter 5 describes methods for identifying human systems as causal factors during incident investigations. Chapter 6 and 7 include requirements for operating procedures and management of change respectively intended to minimize the existence or propagation of latent conditions. Chapter 8 describes employee participation in the development of the human factors program. Chapter 9 describes employee training in the human factors program.

CHAPTER 2: HUMAN FACTORS AND HUMAN ERROR

There are numerous references that provide definitions for, classifications of, and approaches for addressing human error and human factors. [1,2,3,4,5,6,9] The intent of this chapter is to familiarize the reader with the concepts that will be referenced throughout the remaining chapters of this guidance document, and the concepts that were used to formulate the general approach of this guidance document. It is not the intent of this chapter to present and compare the numerous definitions, classifications, and approaches that exist regarding human factors and human error. The reader is directed to the references provided in this section for additional information.

2.1 DEFINITIONS

For the purpose of this guidance document:

- Human Factors is defined as "A discipline concerned with designing machines, operations, and work environments so that they match human capabilities, limitations, and needs".[2]

- Human Factors can be further referred to as "…environmental, organizational, and job factors, and human and individual characteristics which influence behavior at work in a way which can affect health and safety."[9]

- Human Error is defined as "Departure from acceptable or desirable practice on the part of an individual that can result in unacceptable or undesirable results".[5]

2.2 CLASSIFICATIONS

Before a source can manage human factors and error, it may be useful to understand where and how human factors and error initiate. Literature commonly refers to active failures and latent conditions in describing where human factors and error originate and occur.[6&9] Active failures are errors and violations committed by people at the human–system interface such as operators and maintenance personnel. These failures are usually unique to a specific event and have immediate effects. Latent conditions arise due to decisions made throughout the organization (e.g., marketing personnel, designers, managers) and outside of the organization (e.g.,regulating agencies). Latent conditions exist in all systems and may lie unrecognized until combining with active failures to result in an incident. The same latent condition may contribute to a number of different accidents. An example of active failures and latent conditions is "the design of a scrubbing system may not be adequate to handle all credible releases. If an active human error initiates the production of an excessive volume of product the system may allow toxic materials to be released to the environment."[1]

Active failures or malfunctions can be classified as malfunctions of commission (actions taken by individuals that can lead an activity to realize a lower safety than intended) and malfunctions of omission (actions NOT taken by individuals that can lead an activity to realize a lower safety than intended)[5]. Malfunctions can be further described by the types of

error mechanisms: slips and lapses; mistakes; and violations. Slips are defined as errors in which the intention is correct but failure occurs when carrying out the activity required[1]. For example, a worker may know that Pump 1 must be isolated for maintenance, but instead closes the suction and discharge valves on Pump 2. Lapses are defined as an error in operator recall[5]. Lapses cause us to forget to carry out an action, to lose our place in a task or even to forget what we had intended to do. Lapses can be reduced by minimizing distractions and interruptions[9]. Mistakes are defined as an error in establishing a course of action. Mistakes develop when the action was intended but the intention was wrong. Mistakes can be caused by inappropriately applying rules, procedures, or reasoning based on first principles or analogies.

Violations are defined as errors when an intended action is made that deliberately ignores known operations rules, restrictions, or procedures (excluding sabotage). Violations are divided into three categories: routine, optimizing, and necessary. Routine violations involve "short-cuts" or "corner cutting" (i.e., breaking the rule has become the normal way of working). Optimizing violations involve violations for the thrill of it (e.g., increasing throughout-put to see if the system can handle it). Necessary violations involve situations were non-compliance is necessary to complete the job (e.g., an operator is not provided the right tools to perform a job). Stationary source may reduce violations by[9]:

- Taking steps to increase the chances of violations being detected (e.g., monitoring)
- Thinking about where there are unnecessary rules
- Making rules and procedures relevant and practical
- Explaining the reasons behind certain rules or procedures and their relevance
- Considering violations during risk assessments
- Reducing time pressure on staff to act quickly in novel situations

Individuals are more likely to conduct slips and lapses, and mistakes depending on the performance level of the task they are performing. Information processing or performance levels involved in industrial tasks have been classified in accordance with the Skill-, Rule-, and Knowledge-based (SRK) approach.[1] These types of information processing – skill, rule, and knowledge- are differentiated by the degree of conscious control exercised by the individual. Knowledge-based mode requires the highest degree of consciousness. There are no rules for handling the situation and individuals must improvise (e.g., troubleshooting during an upset condition). Rule-based mode requires the next highest degree of consciousness. This requires individuals to follow or apply previously developed rules or procedures (e.g., a pilot completing the checklist prior to take-off). The final mode, skill-based, requires little conscious attention (e.g., a driver switching gears in a manual-transmission automobile). Slips and lapses most often occur during the skill-based mode while mistakes can occur during the rule-based or knowledge-based modes.

2.3 APPROACH

There are various existing approaches for describing and evaluating the role of human error and human factors in incidents, and for addressing the source of human factors and error. The following brief narratives are not intended to provide a comprehensive discussion on each approach, rather they are intended to briefly describe the approach and to direct the reader to alternative resources for additional information.

2.3.1 "SWISS CHEESE" MODEL OF DEFENCES

The systems and defenses are lined up as barriers against a triggering event becoming an incident or accident. Each of these barriers has ever-changing "holes" resulting from latent conditions and active failures. If the "holes" created from latent conditions and active failures line up in successive defenses or systems, the result is an opportunity for an incident.[6]

2.3.2 MICROERGONOMIC APPROACH

Microergonomics addresses the relationship between human, equipment, and the physical environment[7]. It is focused on the human-machine system level and is, for example, concerned with the design of individual workstations, work methods, tools, control panels, and displays. Microergonomic considerations address:

- Materials handling
- Machinery design
- Workstation design
- Handtool design

2.3.3 MACROERGONOMIC APPROACH

Macroergonomics is focused on the overall people-technology system level and is concerned with the impact of technological systems on organizational, managerial, and personnel systems. [7] Human error within the macroergonomic approach is considered a result of the interface between workers and their environment or system.[8] The human system interface is comprised of three different dimensions:

- Situation based – those related to the immediate work environment in time and space (e.g., complicated workstation, wet work surface)
- Management based - (e.g., failures in communication, leadership, failure to train people, rewards system)
- Human based – (e.g.,emotional states, moral, motivation)

2.3.4 HUMAN AND ORGANIZATIONAL FACTORS (HOF)

Human and organizational factors can be related to the individuals that design, construct, operate, and maintain the system. [5] The actions or inactions of these individuals are influenced by four components:

- The organizations that they work for
- The procedures (formal, informal, software) they use to perform their activities
- The structure and equipment involved in these activities
- The environments in which the individual conducts activities.

Malfunctions can occur with the individual, with one of the preceding four components, or at the interfaces between the components and the individual.

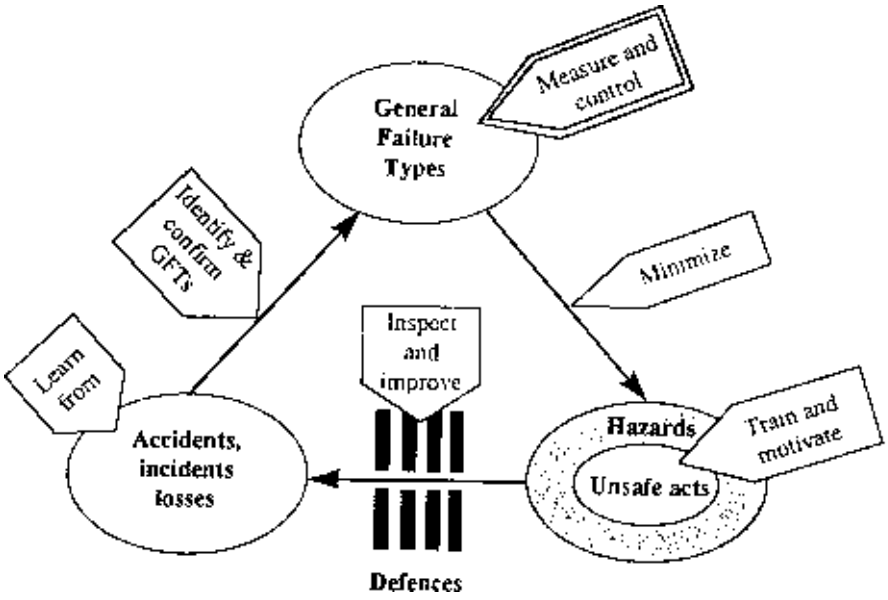
2.3.5 ERROR MANAGEMENT AND TRIPOD-DELTA APPROACH

Error management is made up of error reduction and containment[6]. It must be directed at the following levels:

- The individual and the team
- The task
- The workplace
- The organizational processes

One method for error management is the application of the Tripod–Delta method for revealing and correcting error-producing factors at both the workplace and the organizational levels. The method is depicted below in a figure taken from "Managing Risks of Organizational Error". [6] This method is comprised of three main elements and includes the safety management actions necessary at each stage. The first element is the performance of unsafe acts which facilities usually attempt to remedy through training and employee motivation. If these unsafe acts breech the existing defences of the facility, an accident, incident, or loss may occur. Facilities should routinely inspect and improve the defences to protect against an accident, incident, or loss. Once an incident occurs, the facility should investigate the event to identify the latent conditions that may have contributed to the event. The facility should also establish a method for identifying and managing latent conditions, or General Failure Types. This in turn can result in a minimization of the performance of unsafe acts.

The Tripod-Delta approach identified eleven General Failure Types: hardware, design, maintenance management, procedure, error-enforcing conditions, housekeeping, incompatible goals, communications, organization, training, and defences. The approach requires that the facility derive a checklist of specific indicators for each of the General Failure Types. The task specialists (e.g., operators, maintenance personnel) are then asked to complete the checklist.



2.3.6 SAFETY MANAGEMENT

Three approaches to safety management exist to address the different dimensions or components described in Sections 2.3.3, 2.3.4, and 2.3.5 above[6]. These approaches are referred to as the person model, the engineering model, and the organizational model. The person model is widely applied and uses tactics such as rewards and discipline, training, and writing procedures. The engineering model focuses on the influence of the physical workplace on the performance of individuals (e.g., operators at a refinery being influenced by the control panel and the information provided by the control system). The organizational model focus on the human error being a consequence of existing latent errors in the system.

2.4 GENERAL APPROACH OF THE GUIDANCE DOCUMENT

Comprehensive human factors programs must develop methods for evaluating and resolving active failures and latent conditions initiated within the following four dimensions or at the interfaces between the dimensions:

- Individuals (e.g., motivation, emotional states)
- The activity or task being conducted, including the procedures for the activity or task (e.g., routine, non-routine, written, practice, formal, informal)
- The physical environment (e.g., equipment) or workplace
- Management or organization (e.g., poor communication, reward and discipline system)

The goal of the guidance document is to develop the requirements from County Ordinance 98-48 (See Chapter 1) to ensure that sources will evaluate and resolve failures and conditions initiated within the previous four dimensions. Stationary sources must identify potential unsafe acts or active failures occurring in hazardous circumstances. They must also assess the adequacy of their existing safeguards and incorporate improvements if necessary. Both of these requirements can be fulfilled by conducting traditional and possibly procedural PHA's. When incidents and accidents do occur, sources must perform incident investigations to identify the active failures and existing latent conditions that contributed to the incident. The latent conditions identified during the incident investigation must be incorporated into a program developed to manage and control latent conditions. Other programs must also be developed and implemented to manage and control latent conditions including a management of change procedure to review staffing changes, a program for developing high quality procedures, and a program for developing a sound management system. Minimization of latent conditions should result in fewer unsafe acts or active failures or at least reduced risk from the unsafe acts and active failures that do occur.

[1] CCPS, Guidelines for Preventing Human Error in Process Safety (1994)
[2] CMA, A Manager's Guide to Reducing Human Errors
[3] J. Moraal, Human Factors in Loss Prevention, paper from International conference on Hazard Identification and Risk Analysis, Human Factors and Human Reliability in Process Safety (1992)
[4] Reason, J., Human Error (1998)
[5] Bea, Holdsworth, and Smith, "Human and Organization Factors in the Safety of Offshore Platforms", a paper presented at the 1996 International Workshop on Human Factors in Offshore Operations
[6] Reason, J., Managing the Risks of Organizational Accidents (1998)
NOTE: Tripod-Delta was developed for Shell Intl. Petroleum Corporation by a joint research team from Leiden U. (Wagenaar) and the U. of Manchester
[7] Meshkati, Najmedin, "Human Factors in Process Plants and Facility Design" chapter 6 of Cost-Effective Risk Assessment for Process Design (1995)
[8] Imada, Andy, A Macroergonomic Approach to Reducing Work Related Injuries (1998)
[9] Reducing Error and Influencing Behavior, HSG48, HSE (1999)

CHAPTER 3: EVALUATION AND MINIMIZATION OF LATENT CONDITIONS

The primary intent of this chapter is to provide a tool that stationary sources may use to identify existing latent conditions at their stationary source. Latent conditions can affect the rate at which employees execute active failures and the risk associated with active failures that are executed. Appropriate sections of this checklist are to be applied in conjunction with other programs described in the remainder of this guidance document such as process hazard analysis (Chapter 4), incident investigation (Chapter 5), and operating procedures (Chapter 6). Stationary sources are not required by CCHS to use the checklist verbatim but should ensure that their Human Factors program addresses the issues included in the checklist. The second intent of this chapter is to provide guidance to protect against the pitfalls often associated with completing checklists. The checklist is intended as a "brainstorming tool" to prompt personnel into further discussion not as an "end all solution". Stationary sources adopting an alternative method to the one presented in this chapter (e.g., walkthrough/talkthrough by human factors specialist) must consult with CCHS representatives.

3.1 DEVELOPING A LATENT CONDITIONS CHECKLIST

Stationary sources should develop a checklist or customize the checklist in Attachment A to reflect additional latent conditions that potentially exist at their stationary source. For example, stationary sources may revise Attachment A to include questions that indicate that the following latent conditions exist:

- Lack of clear responsibility for piping between units
- Lack of a system to track work orders scheduled for the next shutdown
- Lack of a system to manage dead legs
- Lack of a system to track critical equipment

The checklist should include all latent conditions identified during incident investigations (Chapter 5). The checklist should also include Performance Influencing Factors (PIF's) or Performance Shaping Factors (PSF's). The following classification structure for PIF's was adapted from Table 3.2 in AIChE's CCPS's *Guidelines for Preventing Human Error in Process Safety,* Copyright 1995, reproduced by permission from the Center for Chemical Process Safety of the American Institute of Chemical Engineers (AIChE).

Operating Environment

Chemical Process Environment
- Frequency of Personnel Involvement
- Complexity of Process Events
- Perceived Danger
- Time Dependency
- Suddenness of Onset of Events

Physical Work Environment
- Noise
- Lighting
- Thermal Conditions
- Atmospheric Conditions

Work Pattern
- Work Hours and Rest Pauses
- Shift Rotation and Night Work

Operator Characteristics

Experience
- Degree of Skill
- Experience with Stressful Process Events

Personality Factors
- Motivation
- Risk-Taking
- Emotional Control
- Type "A versus Type "B"

Physical Condition and Age

Organization and Social Factors

Teamwork and Communications
- Distribution of Workload
- Clarity of Responsibilities
- Communications
- Authority and Leadership
- Group Planning and Orientation

Management Policies
- Management Commitment
- Dangers of a "rule book" Culture
- Overreliance on Technical Safety methods
- Organizational Learning

Task Characteristics

Equipment Design
- Location/Access
- Labeling
- Personal Protective Equipment

Control Panel Design
- Content and Relevance of Information
- Identification of Displays and Controls
- Compatibility with user Expectations
- Grouping of Information
- Overview of Critical Information and Alarms

Job Aids and Procedures
- Clarity of Instruction
- Level of Description
- Specification of Entry/Exit Conditions
- Quality of Checks and Warnings
- Degree of Fault Diagnostic Support
- Compatibility with Operational Experience
- Frequency of Updating

Training
- Conflicts between Safety and Production Requirements
- Training in using New Equipment
- Practice with Unfamiliar Situations
- Training in Using Emergency Procedures
- Training in Working with Automatic Systems

There are a number of other references for identifying lists of PIF's or PSF's that should be considered by stationary sources such as CMA's *A Manager's Guide to Reducing Human Errors*[9]. This reference classifies PSF's as internal and external. Internal PSF's include such factors as training/skill, stress, intelligence, emotional state, gender, physical health, and culture. External PSF's include such factors as actions by supervisors, written or oral communications, complexity, calculational requirements, feedback, and physical requirements.

The checklist shown in Attachment A includes "indicators" or questions that are organized into the four sections and seventeen subsections shown below. Where appropriate, the term "employee" in Attachment A also applies to contract employees. This checklist was compiled from various sources. Additional sources may be used to revise or customize the checklist[1,2,3,4,5,6,7,8,9].

- **Individual:** Experience/knowledge, Stress/Fatigue/Substance Abuse, Shiftwork **NOTE**: The scope of the "Individual" questions or indicators is limited to those internal latent conditions that the facility can control
- **Activity/Task**: Procedures, Practices, Conflicts between
- **Physical Environment/Workplace**: Process Design and Labeling, Control Room/Panel Design Hardware, Safeguards, Work environment
- **Organization/Management:** Communications, Training, Staffing/overtime, Worker selection, Climate/culture, Management system

Representatives at each stationary source should review, revise, and apply the checklist appropriately. The revised checklist should include, at a minimum, the same general topics addressed in Attachment A; however, if the facility has an alternative program in place to identify and resolve specific latent conditions, they may elect to reference that program. For example, a facility may have developed and implemented a program to identify and address management system issues that incorporates all of the questions in the "Organization/Management" section of Attachment A. They may then elect NOT to complete those questions in Attachment A and reference their existing program. It is unacceptable for facilities to delete questions or sections from Attachment A, without ensuring that those indicators or questions are addressed elsewhere or that they are not applicable to that particular unit or facility. **NOTE:** Attachment A does not represent an all-inclusive list of latent conditions. It represents a template that can be revised and amended by stationary source representatives to reflect their operations.

3.2 APPLYING A LATENT CONDITIONS CHECKLIST

Checklists are easy to apply but can be ineffective in minimizing the latent conditions unless formal programs and procedures exist. Stationary sources using a checklist, such as Attachment A, to identify latent conditions must therefore ensure that the following are addressed:

- Each question is an indicator relating to a tangible item that can be observed. These indicators are symptoms of "bigger picture" problems that may exist and may need to be resolved. Sources should therefore, not only fix the indicator but also fix the program that allowed the indicator to exist.
- Personnel applying the checklist must be adequately trained to: understand the specific reason for each question, understand the relative importance of different questions, and understand the degree to which items fail to meet the criteria
- Personnel applying the checklist (particularly operators) should be trained to understand that the intent of the checklist isn't to identify their errors but rather to identify and rectify existing latent conditions that could cause them to make an error
- Personnel applying the checklist must have an understanding of the tasks being carried out (e.g., emergency shutdown procedures)
- Personnel applying the checklist should be trained to view the checklist indicators or questions as examples to lead the thought process. The checklist should be used as a tool to prompt further discussion. They should be encouraged to include additional, pertinent questions and findings. They should also be encouraged to include justification or examples to support their answers
- Facilities must implement a system to ensure that personnel applying the checklist are truly contemplating each questions and not simply "checking boxes". One method for this is to require that all answers - Yes, No, and N/A - be justified (e.g., the question is "Are procedures clear and concise?", personnel should document which procedures were reviewed and their observations). A second method for addressing this concern is to require personnel to enter "supporting examples". Regardless of method used, personnel should consider that these checklists will be reviewed sometimes years later by personnel not involved in the original completion. Documentation of supporting examples or justification will remove some of the subjectivity of applying the checklist.
- The employees who completed the checklist, and appropriate members of management, must review and sign off that the checklist has been appropriately applied and completed
- Any questions receiving a "No" answer must be thoroughly analyzed and a recommendation developed and implemented for resolution of the problem. This analysis should be conducted with appropriate members from operations and maintenance as well as supervisory positions and members of management
- A formal "feedback" loop must be developed to inform personnel of the recommendations from the checklist and to ensure that the recommendations developed will adequately address the concerns
- A formal tracking mechanism must be developed to ensure that recommendations are resolved in a timely fashion. **NOTE**: Section 450-8.016(D)(4) requires recommended actions from PHA's selected for implementation to be completed as follows: all actions not requiring a process shutdown shall be completed within one year after submittal of the Safety Plan; all actions requiring a process shutdown shall be completed during the first regularly scheduled turnaround of the applicable process subsequent to one year after submittal of the Safety Plan unless the Stationary Source demonstrates to the satisfaction of the Department that such a schedule is infeasible. The checklist must be routinely audited and revised to reflect the current situation at each process within the stationary source

[1] EQE International - Process Hazard Analysis Checklist: Human Factors
[2] Arthur D. Little, Inc. – Facility Level Safety Management Audit Protocol
[3] Ergonomic Checkpoints: Practical and Easy-To- Implement Solutions for Improving Safety, Health, and Working Conditions, International Labor Organization, 1996
[4] Ball, P. (1991), The guide to reducing human error in process operations. Report No. SRD R484. Warrington, England: Safety and Reliability Directorate, AEA Technology
[5] Blackman, H.S., Gertman D.I., and Gilmore, W.E. (1983) CRT Display Evaluation: The checklist evaluation of CRT-generated displays, NUREG/CR-3557, US Nuclear Regulatory Committsion, Washington DC 20555
[6] HSE (1989) Human Factors in Industrial Safety. HS (G) 48. London:HMSO
[7] United Kingdom Atomic Energy Authority (1987) Short Guide to Reducing Human Error in Process Operations, Warrington, UK: AEA Technology Ltd.
[8] Kinkade, R.G., and Anderson, J., (1984) Human Factors Guide for Nuclear Power Plant Control Room Development. Report EPRI-3659, Electric Power Research Institute, Palo Alto, California, August
[9] CMA, (1990), A Manager's Guide to Reducing Errors

CHAPTER 4: PROCESS HAZARD ANALYSIS

Section 450-8.016(B)(1)(i) of County Ordinance 98-48 requires stationary sources to include human factors in the Process Hazard Analysis (PHA) process. The intent of this chapter is to identify requirements of the PHA process that stationary sources must or should meet and to identify methods that sources may adopt to meet the requirements. This chapter applies to traditional (continuous and batch) PHA's and to all accepted methodologies (i.e., those methodologies listed in Section 450-8.016(D)(1) of County Ordinance 98-48). It also applies to procedural PHA's when the source determines that the activity would best be reviewed through this method (e.g., unloading/loading procedures, complex valve configurations) as opposed to traditional PHA's. This chapter applies to PHA's performed on existing systems, PHA revalidations, and PHA's performed during the design of a new process. Each stationary source must document the criteria applied when determining whether changes are simply modifications of the existing process or whether they constitute the design of new processes. Stationary sources electing to develop and implement programs other than those described in this chapter must consult with CCHS representatives.

4.1 REQUIREMENTS OF THE PROGRAM

PHA's conducted by the stationary source must meet the requirements listed in Section 450-8.016(D) of County Ordinance 98-48, and:

- Identify active failures or unsafe acts that employees may execute
- Identify latent conditions that may exist at the source, if not already done through another procedure
- Consider the effects of existing latent conditions on the frequency of and consequences associated with the active failure or unsafe act
- Assess the adequacy of safeguards (i.e., physical and administrative) toward reducing the risk associated with the active failure or unsafe act
- Manage the active failures and latent conditions by formulating and implementing action items in accordance with Section 450-8.016(D)(4)
- Evaluate action items or recommendations formulated during the explicit latent conditions review (Chapter 3) to ensure that they address the potential deficiency without creating additional deficiencies

4.2 TRADITIONAL PROCESS HAZARD ANALYSIS

Stationary sources should adopt an approach to ensure that human factors (i.e., active failures and latent conditions) are included in the PHA process. This guidance document conceptually describes two approaches. Regardless of approach, the PHA must meet the requirements outlined in Section 4.1.

4.2.1 FIRST APPROACH

The PHA is performed in accordance with accepted practice.[1] Additionally, stationary sources should complete the applicable sections of a latent conditions checklist, as described in Section 3.1 of this document. Not all of the answers to the questions or indicators included in the checklist are applicable to the PHA (e.g., some of the questions are overall management philosophy which may be more appropriately addressed elsewhere). The PHA team members should be provided copies of the completed latent conditions checklist (or documentation of an alternative approach) prior to the study. This documentation should include all the action items or recommendations formulated to resolve the latent conditions and the status of each. The PHA team leader or facilitator should use the results of the latent conditions checklist to focus the PHA revalidations in a manner similar to management of change (MOC) documentation and incident investigation reports (i.e., the results of the checklist should be used to focus the revalidation). The PHA team should evaluate the consequences of implementing action items or recommendations from the latent conditions review, where appropriate.

4.2.2 SECOND APPROACH

The PHA is performed in accordance with accepted practice.[1] Additionally, the PHA team should analyze and document "why" employees would execute each active failure or unsafe act resulting in a potentially hazardous scenario. The checklist described in Chapter 3 should be applied to guide PHA team members in identifying all possible latent conditions that could contribute to the active failure or exacerbate the consequences. The PHA team may elect to identify the latent conditions for each individual active failure or they may elect to group active failures with the potential for similar latent conditions (e.g., the latent conditions contributing to "Operator inadvertently opens wrong valve", may be similar regardless of the valve). PHA revalidations must include a review of each active failure or unsafe act resulting in a potentially hazardous scenario.

4.3 PROCEDURAL PROCESS HAZARD ANALYSIS

Stationary sources should consider conducting procedural PHA's for two distinct situations. First, there are certain processes or activities for which a procedural PHA can provide a more thorough and efficient review than a traditional PHA (e.g., unloading/loading, complex valve configurations). For these processes or activities, the source should conduct a procedural PHA rather than a traditional PHA. Second, there are certain activities or procedures within a process that the source can identify as having "high active failure likelihood and high hazard potential". For these activities, the stationary source should conduct a traditional PHA on the process as described in Section 4.2, but may also elect to conduct procedural

PHA's on specific procedures conducted within the process (e.g., sampling). These two approaches are discussed in more detail in subsections 4.3.1 and 4.3.2. Regardless of approach, the PHA's must meet the requirements described in Section 4.1.

4.3.1 PROCEDURAL PHA RATHER THAN TRADITIONAL PHA

There are certain activities or procedures for which a procedural PHA may be best suited. Stationary sources must first identify these activities or procedures (e.g., loading/unloading, manually moving hazardous materials). Stationary sources should then apply a systematic approach to conducting a procedural PHA. Two such approaches are briefly discussed below[2].

- Guidewords (i.e., missing, skip, out of sequence, as well as, more, less, and other than) are combined with the parameter "step" to establish deviations (e.g., skipped step, other than the step) for a Hazard and Operability Study (HAZOP) or questions (e.g., What if step number 3 is skipped) for a What-If Analysis. The remainder of the study is conducted according to accepted practice.[1]
- Guidewords (i.e., omit or incorrect) are combined with the parameter "step" to establish deviations (e.g., omitted step number 3 or performed XYZ instead of step number 3) for a HAZOP or questions (e.g., What if XYZ is performed instead of step number 3) for a What-If Analysis. The remainder of the study is conducted according to accepted practice.[1]

4.3.2 PROCEDURAL PHA IN ADDITION TO TRADITIONAL PHA

Stationary sources electing to conduct a procedural PHA in addition to a traditional PHA should first identify "high likelihood active failure and high hazard potential" tasks. The stationary source should screen all tasks performed in their processes using criteria, including, but not limited to the following:

- Frequency of the task: infrequent/non-routine or so frequent to result in complacency
- Emergency or temporary procedures such as emergency shutdown
- Hazards (e.g., flammability, toxicity, asphyxiation) in the process
- Human interactions with the process that could result in the hazard
- Familiarity of employees with the process

Stationary sources should then apply a systematic approach to conducting a procedural PHA (Section 4.3.1).

Procedural PHA's can provide a more detailed review of potential active failures or unsafe acts and the effects of latent conditions than traditional PHA's. However, procedural PHA's can be resource intensive and possibly not the most efficient or

effective means of ensuring that procedures are efficient (i.e., safe, accurate) and that the hazards of deviating from the procedure are understood. Consideration of human factors in operating procedures will be addressed in detail in Chapter 6.

In conclusion, stationary sources must evaluate the execution of unsafe acts and improve upon existing safeguards that reduce risk. The source must conduct a PHA which incorporates the results of the latent conditions review (Chapter 3) or that poses and analyzes the question "why" when an active failure or unsafe act resulting in a hazard is identified. Stationary sources should perform procedural PHA's on those activities for which it would be a more appropriate than performing a traditional PHA. Stationary sources may elect to conduct a procedural PHA, in addition to traditional PHA's, on those tasks that have a "high active failure likelihood and high hazard potential".

[1] CCPS *Guidelines for Hazard Evaluation Procedures*, 1992

[2] Bridges, Kirkman, and Lorenzo, "Include Human Errors in Process Hazard Analysis", *Plant Safety*, 1996

CHAPTER 5: INCIDENT INVESTIGATION

Section 450-8.016 (B) (ii) of County Ordinance 98-48 requires stationary sources to consider human systems as causal factors in the incident investigation process for Major Chemical Accidents or Releases, or for an incident that could reasonably have resulted in a Major Chemical Accident or Release[1].

The purpose of this chapter is to define "human systems" and "causal factors" and to give guidance on the consideration of human systems when conducting these incident investigations. This chapter does not cover incident investigation or root cause analysis requirements, methodologies or procedures. These requirements are set forth in Section 450-8.016 (A) (9) and Section 450-8.016 (C)of County Ordinance 98-48. Guidance for them is included in Chapter 7 of the *Contra Costa County CalARP Program Guidance Document* and Section C of this Document respectively.

5.1 DEFINITIONS

5.1.1 HUMAN SYSTEMS

Human Systems are defined as the systems (i.e., written and unwritten policies, procedures, and practices) in effect to minimize the existence/persistence of latent conditions at the stationary source. Latent conditions are discussed in Chapters 2 or 3 of this guidance document. Inadequate human systems allow latent conditions to persist and cause or exacerbate an incident. These human systems would include, but are not limited to, those implementing all the elements of the Stationary Source Safety Requirements of Section 450.8.016. Examples of human systems are:

- The overall policy or procedures at a stationary source governing the requirements for adequate communications to minimize or prevent latent conditions, such as those included in Attachment A, Communications.

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1 "Major Chemical Accident or Release" means an incident that meets the definition of a Level 3 or Level 2 Incident in the Community Warning System incident level classification system defined in the September 27, 1997 Contra Costa County guideline for the Community Warning System as determined by the Department; or results in the release including, but not limited to, air, water, or soil of a Regulated Substance and meets one or more of the following criteria:

(1) results in one or more fatalities;
(2) results in greater than 24 hours of hospital treatment of three or more persons;
(3) causes on and/or off-site property damage (including clean-up and restoration activities) initially estimated at $500,000 or more. On-site estimates shall be performed by the Stationary Source. Off-site estimates shall be performed by appropriate agencies and compiled by the Department.;
(4) results in a flammable vapor cloud of more than 5000 pounds.

- The overall policy or procedures at a stationary source affecting and ensuring the proper content and execution of procedures to minimize or prevent latent conditions, such as those included in Attachment A, Procedures.

Human systems would also include the broad area of the safety culture of a stationary source to the extent that it influences the actions of individuals or groups of individuals. A useful definition of Safety Culture is "the product of individual and group values, attitudes, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety programs. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by the confidence in the efficacy of preventive measures." (1)

5.1.2 CAUSAL FACTORS

Causal factors are defined as the events and conditions that are necessary to produce or contribute to an incident. Causal factors include:

- Direct cause – the active failure,
- Contributing causes – the events or conditions that collectively with other causes increase the likelihood of an incident but that individually did not cause the incident, and
- Root causes – the factors that if corrected, would prevent recurrence of the incident (e.g., system deficiencies, management failures, inadequate organizational communications).

Causal factors seek to answer the basic questions about an incident:

- What happened?
- How did it happen?
- Why did it happen?

5.2 METHODOLOGY

Section 450-8.016(B)(ii) actually requires stationary sources to conduct two separate activities. First, human systems (as defined in Section 5.1.1) are to be considered causal factors (as defined in Section 5.1.2) in incident investigations of Major Chemical Accident or Releases. Second, human systems are to be considered causal factors in investigations of incidents that could reasonably have resulted in a Major Chemical Accident or Release. Section 450-8.016 (C) requires that a root cause analysis be done for all Major Chemical Accidents or Releases. The combined effects of Sections 450-8.016(B) and (C) are that:

- Stationary sources must conduct a root cause analysis for Major Chemical Accidents or Releases that considers human systems as causal factors.
- Stationary sources must also consider human systems as causal factors for an incident that could reasonably have resulted in a Major Chemical Accident or Release.

These two activities are further described in Sections 5.2.1 and 5.2.2

Causal factors have been defined to include direct, contributing, and root causes of the incident. However, the direct cause of an incident is usually an active failure, therefore, human systems may not apply to the direct cause. Latent conditions and the inadequate human systems that allow them to exist/persist do apply when identifying contributing causes and root causes. For example, the direct cause of an incident may have been an operator adding an inappropriate amount of one reactant to a batch reactor. This in turn resulted in a "runaway" reaction and ultimately an explosion. One of the contributing causes was that the operator did not following the current procedure that identified the mitigation measures to be initiated during temperature excursions. Upon further investigation, the team discovered that the operator was using an outdated procedure that did not specifically address the temperature excursion. One existing latent condition was the existence and use of inaccurate and outdated procedures. One of the inadequate human systems was therefore the document control policy governing operating procedures.

In the batch reactor example above, if the "runaway reaction" was brought under control before an explosion happened, the incident was one that could reasonably have resulted in a Major Chemical Accident or Release and the same causal factor analysis should have been performed.

5.2.1 Investigation of Major Chemical Accidents or Releases

Stationary sources should follow the guidance described in Section C of this document when conducting a root cause analysis of a Major Chemical Accident or Release. Additionally, the source must explicitly consider human systems as causal factors for the incident. The purpose of a root cause analysis is to identify all causal factors. Therefore, stationary sources may already be considering human systems as causal factors during their root cause analysis.

Whether stationary sources are already considering human systems or not, they may find it beneficial to use Attachment A, Latent Conditions as a tool to augment their existing root cause analysis methodology. The checklist can also be useful to an investigator in forming a line of inquiry for an investigation. While most of the questions could be applicable and should be considered, areas to emphasize in Attachment A are:

- Section 2 on procedures, and
- Section 4 on organization and management issues

The way to use the checklist is to review it in the context of the incident and change the tense or syntax of the question. For example, to help determine if experience/knowledge was a factor in an incident, change question 1.1 from "Do employees remain in each unit for a sufficient amount of time to develop the experience and knowledge base necessary to safely operate the unit and respond to emergencies?" to "*were the employees involved in the incident in the unit for a sufficient amount of time to develop the experience and knowledge base necessary to safely operate the unit and respond to emergencies?"* If the answer is negative a latent condition exists, and the investigator should identify the human system that

failed, allowing the latent condition to exist. While going through the checklist in this manner, several of the questions will be recognized as being pertinent to the incident and should be followed up to develop more information. Other questions will be recognized as not being applicable at all to the incident. These can contribute to the basis for questions to ask during interviews and for selecting documents to review.

5.2.2 INVESTIGATIONS OF AN INCIDENT THAT COULD REASONABLY HAVE RESULTED IN A MAJOR CHEMICAL ACCIDENT OR RELEASE.

Stationary sources may elect to apply a root cause analysis methodology for an incident that could reasonably have resulted in a Major Chemical Accident or Release to ensure that the investigation considers human systems as causal factors, although this is not a requirement of the ordinance. Stationary sources electing to apply a root cause analysis methodology for an incident that could reasonably have resulted in a Major Chemical Accident or Release should follow the guidance provided in Section 5.2.1.

Stationary sources electing to not apply the root cause methodology for an incident that could reasonably have resulted in a Major Chemical Accident or Release must still consider human systems as causal factors in the incident investigation. The questions in Attachment A may be used as a tool to assist them in identifying the latent conditions which were contributing causes to, or root causes of, the incident. The human system that allowed those latent conditions to exist/persist should then be identified by the investigation team. Guidance on applying Attachment A is provided in Section 5.2.1. **NOTE:** Attachment A should be considered a brainstorming tool that should be revised to reflect the conditions at each stationary source. It should not be considered a complete list of all latent conditions that may exist at a particular stationary source.

[1] Reason, James (1998). *Managing the Risks of Organizational Accidents, Chapter 9, Page 194*

CHAPTER 6: OPERATING PROCEDURES

Section 450-8.016(B)(1)(iv) of County Ordinance 98-48 requires stationary sources to address operating procedures in their Human Factors Program. The intent of this chapter is to address the inclusion of human factors within the operating procedures and within the program developed and implemented to manage the operating procedures (i.e., development, review). It is not the intent of this chapter to address the general operating procedure requirements required by Section 450-8.016(A)(2). This chapter will identify those human factors elements that must or should be included and identify methods that sources may adopt to meet the requirements. Guidelines for Writing Effective Operating and Maintenance Procedures[1] states that, "Procedure writing is an exercise in the use of human factors". Personnel must be involved with the development and maintenance of procedures for them to "buy in" to their use. Procedures must also be written to avoid the latent conditions that could cause active failures (i.e., format, conciseness of statements, written for the user). This chapter applies to all operating procedures. Maintenance procedures and safework procedures (e.g. hot work permits) were not explicitly included in the human factors element of County Ordinance 98-48; however, stationary sources should consider applying the basic principles of this chapters to all procedures. Stationary sources electing to develop and implement programs for operating procedures other than those described in this chapter must consult with CCHS representatives.

6.1 PROCEDURE MANAGEMENT SYSTEM

The procedure management system at the stationary source must include mechanisms for evaluating the current situation, developing procedures (including identifying procedures to write and format), reviewing and approving procedures (including an evaluation of procedural errors), and maintaining procedures current and accurate on a daily basis. These mechanisms are discussed below.

6.1.1 EVALUATING CURRENT SITUATION

The checklist included in Attachment A and described in Chapter 3 includes a section entitled "Activity/Task". If the stationary source elects to apply the checklist, they must ensure that it is appropriately applied and that the causes of any indicators or questions receiving a "No" are completely identified. **NOTE**: The questions in the checklist are indicators of larger potential deficiencies (i.e., addressing the indicators may resolve the symptom but not the disease). Application of the checklist and requirements for resolving findings is discussed in detail in Chapter 3.

6.1.2 DEVELOPING PROCEDURES

Stationary sources must first determine which operating procedures to write or to verify that they have written procedures for every task of the operating procedure deemed necessary. Stationary sources should address routine

activities as well as infrequent tasks, shared tasks, or tasks requiring assistance from operators from other areas.[2] Training Needs Assessments, Process Hazard Analyses (Chapter 4), and Job Safety Analysis (if conducted) are all resources for identifying and selecting tasks that may require written procedures. Some factors that should be used to determine whether a written operating procedure is necessary are frequency, criticality, complexity, and regulatory requirements[1]. Stationary sources may find it beneficial to start by reviewing existing work instructions, training matrices, and the most hazardous or unreliable processes (e.g., emergency work orders).[2]

Stationary sources must identify a format that can be consistently applied to all written procedures within a unit or facility. Procedures should then be revised to reflect the accepted format, on a schedule to be determined by the stationary source. Different formats (e.g., lengthy training document, written procedures, checklists) may be appropriate if the source has a tiered operating structure (i.e., Operator 1, Operator 2, etc.) and clearly differentiates the level of training required to properly conduct the task (e.g., If Task A can only be performed by Level 1 Operators (the most experienced), a checklist may be appropriate).[2] The level of detail and format for each procedure must be commensurate with the lowest level of experience of personnel responsible for conducting the task. Stationary sources must develop a mechanism for organizing the procedures so that they are easy to locate (particularly emergency operating procedures). They must also ensure that interrelated procedures are reviewed and that gaps and overlaps are eliminated. Questions such as: Do the steps go beyond the purpose/scope? Is a procedure's last step the same as another's first step? Do any responsibilities overlap? should be asked.[2]

Stationary sources must develop a process for procedure development that includes identifying the hazards associated with the tasks and incorporating input from personnel with expertise in the process (both in the steps required to conduct the task and in the precautionary notes included as consequences of deviating from the procedure). One method for developing comprehensive task descriptions and procedures is to conduct task analyses. Task analysis techniques may be applied during the design mode, audit mode, or retrospective mode. Task analysis can help to ensure that the most efficient method (e.g., safest, least time consuming) is identified and that discrepancies between individuals and shifts is eliminated. Task analysis results may be used as input to the content of operating procedures, training, and operating manuals. Task analysis results may also be used during incident investigations (Chapter 5) to explicitly identify differences in the prescribed way of performing a task and the actual way it was performed. Several acceptable task analysis techniques exist such as Hierarchical Task Analysis, Tabular Task Analysis, and Timeline Analysis[4].

Task analysis is a resource-intensive activity that may or may not be the most efficient or effective method for creating the task description. Stationary sources, not already performing task analysis, should therefore consult with employees and their representatives as to whether task analysis is appropriate for them. **NOTE:** Task analysis is provided as one example of a method to apply for developing comprehensive task descriptions and procedures. If a stationary source elects to use an alternate method, they should still consult with employees and their representatives if they are not already performing the alternate method.

Employees responsible for developing and maintaining the procedures must be trained in rules for writing effective instructions[3]. The requirements for operating procedures are discuss in more detail in Section 7.2.

6.1.3 REVIEWING AND APPROVING PROCEDURES

Stationary sources must develop programs to review and approve procedures to ensure that the procedures are accurate, current, and that the effects of procedural errors are fully understood. Section 450-8.016(A)(2) requires that the stationary source annually certify that the procedures are current and accurate. One method for evaluating whether the procedure is current and accurate is to require employees to review other employees performing the procedure. Deviations or discrepancies between the written procedure and the actual practice should be identified and resolved. Sources may also elect to combine procedure review and refresher training by requiring personnel to "walkthrough" the procedure with their supervisors.

One method for ensuring that the effects of procedural errors are fully understood and appropriately documented is to conduct an error analysis. Stationary sources routinely have personnel with expertise and experience in the process review procedures and insert precautionary notes. However, stationary sources may elect to conduct a more detailed, predictive analysis to identify consequences of deviating from the procedures. Formal error analysis can help to ensure that necessary precautions are identified at certain steps, that unnecessary steps are eliminated, and that employees actually understand the importance of each step as opposed to performing steps just because "that's the way its always been done".[2] Several acceptable error analysis techniques exist such as Barrier Analysis, Work Safety Analysis, and Human Error HAZOP (Section 4.3)[4,5].

6.1.4 MAINTAINING PROCEDURES

Stationary sources must develop a program for employees to revise procedures as necessary as opposed to just during the formal annual review. Section 450-8.016(A)(2) requires stationary source to review current operating practice, including changes that result from changes in process chemicals, technology, and equipment, and changes to stationary sources as often as necessary to assure that they reflect existing operating procedures . Section 450-8.016(B)(1)(v) requires stationary sources to conduct a Management of Change prior to staffing changes for changes in permanent staffing levels/reorganization in operations or emergency response. Chapter 8, Management of Change, will address the mechanism for conducting the staffing review. It is not the intent of this chapter to discuss general management of change issues; however, the following aspect should not be overlooked. The management of change process must ensure the review of procedures that require simultaneous tasks or that require tasks to be conducted by certain positions.

Stationary sources must also ensure that only current, approved versions of procedures are accessible to employees.

Employees must be trained in the importance of maintaining the procedures current and accurate. Employees should be trained that the procedures are essential work documents and represent an approved method for performing work.

6.2 WRITTEN OPERATING PROCEDURES

Each stationary source must develop an operating procedure format which is appropriate for them given the type of facility (i.e., continuous, batch), the type of procedure (i.e., normal, emergency), and the existing regulatory requirements (i.e., risk management program, ISO 9000). The intent of this section is not to dictate the content and format of operating procedures but rather to provide general elements of effective procedures which sources must or should incorporate[1,2, 5].

- Procedure title and number (if appropriate) should be easy to locate
- The last step of the procedure should be identified
- Temporary procedures should be clearly identified
- Each procedure should be written for the procedure user (i.e., engineer, operators, health and safety staff, level of experience)
- Each step should be written as a command
- Use common words
- Each step should include only one action. This will help to ensure that employees will not “overlook” an assumed but unwritten step
- Steps that should be performed in a particular sequence should be numbered and listed sequentially

- Critical step sequencing should be preceded by a caution or warning
- Whenever possible, the procedures should reference equipment or instrumentation by unique number or name
- Page layout (i.e., line spacing, length of lines, and font size) should not negatively affect readability
- Procedures should neither reference steps from nor excessively reference other procedures or documents
- Precautionary statements (e.g., warning, caution) should be clearly defined
- Precautionary statements should be clearly visible
- Procedure "branching" (e.g., return to step 3) should remain current and accurate
- Sign offs should be required for verifying critical steps of a procedure
- Steps within procedures to be performed by multiple employees should be clearly indicated and possibly require checklists or signoffs
- Complex procedures or procedures that require more than one shift to perform should require check-off or sign-off
- Steps that require contingencies or criteria to assist the employee should precede the action (i.e., if the temperature is XX, set the flowrate at YY)
- Formulas or tables should be included when procedures require calculations (i.e., minimize "in your head" calculations)
- Incorporate feedback loops as appropriate in the procedure so that employees can verify that their activities were correct.

6.3 EMERGENCY OPERATING PROCEDURES

The same requirements for procedures discussed in Section 7.2 apply to emergency procedures; however, emergency procedures must be particularly easy to access and clear to understand. During emergencies employees will also be required to make quick decisions based on different conditions or parameters. Accessibility may be enhanced by using a different color paper or a separate brightly colored binder for emergency procedures. Clarity in understanding may be enhanced by using larger type than usual, or by using lists in conjunction with simplified drawings. Decision aids (e.g., flow charts, decision trees, and quick yes/no answers) may be used to assist the operator in making correct decisions.

The following list of information was adapted from CCPS's Guidelines for Writing Effective Operating and Maintenance Procedures. This list includes types of information sources should include in emergency operating procedures:

- Acknowledging and silencing alarms
- Appropriate PPE
- Additional hazards not present during normal operations
- Location and use of emergency equipment
- Location of alternate/redundant panels
- Steps to shut down the process in the safest, most direct manner

- Conditions under which the user may have to stop and evacuate
- Required communication, announcements, and notifications, including initiating the Emergency Response plan.

[1] CCPS, *Guidelines for Effective Operating and Maintenance Procedures*, 1996
[2] ABS Group Inc., Process Safety Institute training manual Human Factors for Procedure Writers, 1999
[3] Williams and Gromacki, *Eliminating Error-Likely Situations During Procedure Updates*, Presented at AIChE 32nd Loss Prevention Symposium, 1998
[4] Kirwain, Barry, *Evolving Human Factors in Offshore Operations*
[5] CCPS, *Guidelines for Preventing Human Error in Process Safety*

CHAPTER 7: MANAGEMENT OF CHANGE FOR ORGANIZATIONAL CHANGES

Section 450-8.016(B)(v) of County Ordinance 98-48 requires stationary sources to conduct a Management of Change prior to staffing changes for changes in permanent staffing levels/reorganization in operations or emergency response. Employees and their representatives shall be consulted[1] in the Management of Change. The intent of this chapter is to identify those requirements that stationary sources must incorporate into their existing Management of Change procedure to satisfy these requirements. Stationary sources may elect to develop a separate MOC procedure for staffing changes. Primarily, this chapter details requirements for identifying the technical basis for the organizational change (Section 7.3) and for assessing the impact of the organizational change on safety and health (Section 7.4). It is not the intent of this chapter to address the general requirements of Management of Change specified in Section 450-8.016(A)(6). The requirements of this chapter apply to:

- Reduction in the number of positions, or number of personnel within those positions in operations, including engineers and supervisors with direct responsibilities in operations; positions with emergency response duties; and positions with safety responsibilities
- Substantive increase in the duties in operations, including engineers and supervisors with direct responsibilities in operations; positions with emergency response duties; and positions with safety responsibilities (e.g., addition of equipment or instrumentation which significantly adds to the complexity of the system)
- Changes in the responsibilities of positions in operations, including engineers and supervisors with direct responsibilities in operations; positions with emergency response duties; and positions with safety responsibilities

Each stationary source must develop criteria or guidance to assist appropriate personnel in determining "when" an MOC for an organizational change should be initiated.

The following process for managing organizational changes is based upon the method described in *Management of Safety and Health During Organizational Change*[1]. Sample worksheets provided in this publication are included in Attachment B of this document. Stationary sources may also consider applying appropriate questions or indicators from Attachment A. Stationary sources electing to develop and implement programs other than those described in this chapter must consult with CCHS representatives.

7.1 FORMING A "CHANGE TEAM" OR "MOC TEAM"

The *Management of Safety and Health During Organizational Change* publication advocates the use of a "change team" or "MOC team" to scrutinize staffing changes. Stationary sources should consider the use of a "change team" or "MOC team" to satisfy the requirement that employees and their representatives be consulted in the Management

1 The intent of consult is to exchange information, solicit input and participation from the employees and their representatives. It requires more than simply informing employees [Part 4, GISO Section 5189].

of Change. The "change team" or "MOC team" should include employees and their representatives, as appropriate, from engineering, maintenance, and operations as well as safety and health. Each stationary source must develop and disseminate criteria or guidance to assist personnel responsible for conducting the MOC in determining whether a team approach is appropriate and the composition of the team.

7.2 DEFINING THE EXISTING SITUATION AND IDENTIFYING AFFECTED AREAS

Stationary source representatives must clearly understand their existing situation (e.g., personnel, personnel responsibilities, program requirements) before they can thoroughly analyze the impact of the staffing change(s) on safety and health. Members of the "change team" or "MOC team" should consider developing checklists of general program requirements (safety and operational) that must be met. The following program requirements are examples that the stationary source may elect to consider:

- Safety Meetings
- Process Safety Management Programs
- Self Audits/Inspections
- Accident/Incident Reporting
- Safe Work Practices
- Health and Safety Training
- Contractor Safety
- Emergency Response
- Occupational Health Program
- Operations

Members of the "change team" or "MOC team" should also consider developing the specific tasks within each of the program requirements for which personnel are responsible (e.g., operations – correct staffing to handle the number of alarms associated with an upset or emergency; contractor safety – responsibility inspecting and auditing contractor work in progress). Additionally, stationary sources may elect to incorporate within the checklist "reminders" of the effects of the change(s) on procedures and training (e.g., could the organizational change require changes in personnel needing emergency response training).

Once the stationary source has clearly identified the existing situation, they should first identify all areas (e.g., programs, procedures, meetings, training) that could potentially be affected by the change, then focus the review on those areas with highest priority (i.e., not every identify change may warrant an extensive review). Members of the change team may elect to revise the checklists included in Attachment B of this document (Appendices A and B) to reflect conditions at their source.

7.3 DEVELOPING THE TECHNICAL BASIS FOR THE CHANGE

One or more members of the "change team" or "MOC team" must determine the purpose, scope, and schedule of the pending staffing change and the potentially affected positions. Members of the "change team" or MOC team" may elect to incorporate information from the worksheet in Attachment B (Appendix A). This information may be documented on the usual Management of Change form as the technical basis for the change.

7.4 ASSESSING THE IMPACT OF THE ORGANIZATIONAL CHANGE ON SAFETY AND HEALTH

Members of the "change team" or "MOC team" must assess the impact that the staffing change(s) will have on safety and health once they have clearly detailed their existing situation (e.g., program requirements, personnel tasks/responsibilities) and the reason for the organizational change. Members of the "change team" or "MOC team" should determine the potentially affected programs and tasks using the checklists/reminders developed in Section 7.2 (if available). Members of the "change team" or "MOC team" should also document the effects of the change and potential action items to mitigate the consequences of the change. Members of the "change team" or "MOC team" that are implementing the checklists developed in Section 7.2 should be encouraged to use the checklists to prompt discussion and brainstorming. It should not be used as an absolute.

Of primary importance during this phase of the MOC, is assessing the impact of the change on safety and health during "off hours" or during emergency situations (e.g., spills, fires, explosions, excursions). For example, the "change team" or "MOC team" may identify that the proposed organizational change will affect Operations. In particular, the personnel change will affect the number of operators available to bring the process to a safe state in an emergency situation. Another example is the addition of equipment that significantly adds to the complexity of the unit and requires additional resources to bring to a safe state during emergency situations. The "change team" or "MOC team" should then identify the consequences of the change and identify action items to mitigate the consequences if necessary.

Stationary sources that elected not to develop the checklists and stationary sources that want to perform a more detailed analysis than associated with the checklists may elect to conduct a modified PHA (e.g., What-If analysis) to analyze the potential impact of the change on safety and health. Members of the change team may elect to incorporate information from the worksheet shown in Attachment B (Appendix C). This information may be documented on the usual Management of Change form as the impact on safety and health.

7.5 COMPLETING THE MANAGEMENT OF CHANGE

The management of change procedure should be completed in accordance with Section 450-8.016(A)(6)following identification of the technical basis of the change (Section 7.3) and the potential impacts of the change (and suggested action items to mitigate the impacts) on safety and health (Section 7.4). Of particular importance, is to ensure that employees affected by a change are informed of, and trained in, the change prior to the change occurring. Also of particular importance, is to ensure that operating and emergency response procedures are updated accordingly. Stationary sources may elect to include these types of reminders in the checklists developed in Section 8.2 and implemented in Section 7.4 (e.g., is additional training required, does the change affect the procedures for notifying off-duty personnel during an emergency).

"Change team" or "MOC team" members should document the MOC process thoroughly, particularly when the management decision is inconsistent with the team findings (e.g., the MOC team concludes that removing a particular position could negatively impact safety and cannot be appropriately mitigated. Members of management feel that the negative impacts can be mitigated through certain corrective actions).

[1] CMA, Management of Safety and Health During Organizational Change (1998)

CHAPTER 8: EMPLOYEE PARTICIPATION

Section 450-8.016(B)(2) of County Ordinance 98-48 requires stationary sources to ensure that employees and their representatives participate in the development of the written human factors program. The intent of this chapter is to first identify steps that sources must take to ensure that employees are provided an opportunity to participate in the development of the written human factors program. The chapter will then summarize opportunities (explicitly identified in Chapters 3 through 7 of the Human Factors Guidance) for employees and their representatives to participate in implementation of the written human factors program. A majority of the participation outlined below is already specified in existing regulation/legislation. Therefore, it is not the intent of this chapter to reiterate those existing requirements (e.g., to address Section 450-8.016(A)(3)), but rather to discuss inclusion of the human factors program into the existing employee participation structure. Stationary sources electing to adopt an alternative method to the one presented in this chapter must consult with CCHS representatives.

8.1 DEVELOPMENT OF THE WRITTEN HUMAN FACTORS PROGRAM

Employees and their representatives must participate in the development of the written human factors program. This does not necessarily mean that employees and their representatives be responsible for actually writing the programs, but that, in general, the following occurs:

- Employees and their representatives must be provided the opportunity to submit input into the initial development of the program (e.g., brainstorming sessions on how operating procedures should be reviewed to ensure that latent conditions are addressed)
- Employees and their representatives must be provided the opportunity to review the program and submit comments within a reasonable time frame
- Stationary source representatives must address all written comments submitted either accepting the comment and offering a revision, or denying the comment and providing justification for the denial within a reasonable time frame.

Chapters 3 through 8 strongly advocate the use of checklists (Attachments A and B) to assist stationary source representatives in identifying and resolving existing latent conditions as part of a PHA or in response to an incident. These checklists should be customized for each stationary source and even then should only be considered as guidance. Employees and their representatives should be provided the opportunity to participate in the customization of the checklists.

8.2 IMPLEMENTATION OF THE WRITTEN HUMAN FACTORS PROGRAM

Once the written human factors program is developed, employees and their representatives should be involved in implementing the program. Sections 8.2.1 through 8.2.5 (taken from Chapters 3 through 7) summarize specific opportunities for employee participation in the implementation of the human factors program. This list should not be considered an exhaustive list (i.e., stationary sources should expand upon this list and identify site-specific programs). In addition to the specific opportunities for employee involvement described in Sections 8.2.1 through 8.2.5, stationary sources must ensure that, in general, the following occurs):

- Employees and their representatives review the written human factors program on an established frequency and ensure that any necessary revisions are incorporated
- Employees and their representatives understand, and participate as appropriate, in finalizing the written human factors program following the review
- Employees and their representatives participate in maintaining the written human factors program current and accurate (i.e., the stationary source may identify certain types of changes that would require that the program be updated as soon as possible as opposed to waiting until the usual (e.g., annual) review

8.2.1 CHAPTER 3: EVALUATION AND MINIMIZATION OF LATENT CONDITIONS

Chapter 3 advocates the use of a "Latent Conditions Checklist" to assist employees in identifying existing latent conditions at their source that could contribute to or exacerbate an active failure. Employees should participate in customizing/developing the checklist to reflect the stationary source. Chapters 4 through 8 then advocate application of the checklist as appropriate.

8.2.2 CHAPTER 4: PROCESS HAZARD ANALYSIS

Chapter 4 discusses various approaches for including human factors in process hazard analyses (PHA's). Regardless of approach used, employees must participate in the PHA and participate in evaluating the existence of latent conditions and consequences of active failures.

8.2.3 CHAPTER 5: INCIDENT INVESTIGATION

Chapter 5 discussed the consideration of human factors in incident investigations. Employees and their representatives should be included in the incident investigation team as described in Chapter 5.

8.2.4 CHAPTER 6: OPERATING PROCEDURES

Chapter 6 advocates objectively reviewing existing procedures to identify existing latent conditions that may cause an active failure. This chapter also discusses developing, reviewing, finalizing, and maintaining procedures. Appropriate employees must participate in all of these phases, including identification of latent conditions existing within the operating procedures that could cause or exacerbate an active failure.

8.2.5 CHAPTER 7: MANAGEMENT OF CHANGE FOR ORGANIZATIONAL CHANGES

Employees and their representatives shall be consulted in the management of change for organizational changes. Chapter 7 specifically discusses the formulation of a "change team" or "MOC team" made up of employees, as appropriate, from engineering, maintenance, operations, and safety and health. This chapter also advocates the use of checklists to augment brainstorming sessions of the "change team" or "MOC team" during the review.

Stationary sources may find it beneficial to create a human factors committee to assist in the initial development and in the continuous implementation of the human factors program. Considerations in creating a human factors committee include, but are not limited to: team composition; preparation/participation time for employees and their representatives; meeting schedules to accommodate each committee member's needs (particularly important for shift workers); and training for committee members (See Chapter 9).

In conclusion, stationary sources must ensure that employees and their representatives participate in the development of the written human factors program. Stationary sources should ensure that employees and their representatives participate in the implementation of the written human factors program including reviewing, finalizing, and maintaining the program. Stationary sources may elect to revise the established structure for employee participation to ensure that it includes the human factors program.

CHAPTER 9: TRAINING

Section 450-8.016(B)(1)(iii) of County Ordinance 98-48 requires stationary sources to train employees in the human factors program. The success of the human factors program at each stationary source relies heavily on employee (e.g., operator) input. Therefore, employees must have a basic understanding of human factors and should have specialized training to ensure that they can fulfill their specific responsibilities within the program. The intent of this chapter is to outline the general requirements of a human factors training program that each stationary source should customize to meet their particular needs. The chapter addresses identifying training participants (Section 9.1), initial training (Section 9.2), and refresher training (Section 9.3). Stationary sources adopting an alternative method to the one presented in this chapter must consult with CCHS representatives.

9.1 IDENTIFYING TRAINING PARTICIPANTS

The training curriculum and participants at each stationary source will vary to some degree depending upon the programs that comprise the overall human factors program. Stationary sources should therefore recognize all employee responsibilities within the human factors program (e.g., human factors program development, incident investigation team member, responsibilities to complete a latent conditions checklist). Stationary sources should then identify the employees that are best suited to fulfill those responsibilities. The stationary source should document the criteria they used to identify training participants. **NOTE:** All employees must receive human factors program training.

9.2 INITIAL TRAINING

The stationary source should develop an initial training curriculum for each group of employees identified in Section 9.1. Initial training should be provided to all employees currently working at the stationary source and upon hiring for new employees. Three general areas of initial training should address: basic awareness of human factors, training on the overall human factors program (once developed), and specialized training to ensure that employees can fulfill their specific responsibilities for implementing the program (e.g., completion of Latent Conditions Checklist, incident investigation team members). Stationary sources should maintain documentation on each course (e.g., course curriculum, instructor qualifications, course participants). Also, stationary source representatives should devise some method to verify that course participants understood the training.

9.2.1 Basic Awareness Training

All employees should be provided with basic awareness training on human factors. Each stationary source should develop and document their curriculum for human factors, however, the stationary source may find it beneficial to include:

- Philosophy and reasoning behind human factors
- Active failures versus latent conditions
- Types of active failures (e.g., slips, lapses, violations)
- Performance shaping factors – overview of categories
- Human failure analysis techniques
- Automation and impact on worker
- Management systems and human factors
- Possible effects of staffing, shiftwork, and overtime

Each stationary source should determine the most appropriate time for conducting training within the development of the human factors program. For example, stationary sources must ensure that employees participate in the development of the written human factors program (Chapter 8). For employees involved in the development of the program to have meaningful input, they should be provided with basic awareness training prior to development of the written program. This initial training must therefore occur very early in the development of the human factors program. Other employees, not directly involved in the development of the written human factors program, may not require basic awareness training until much later.

9.2.2 Overall Human Factors Program Training

All employees must be provided with training on the human factors program.. The training should describe how the program elements are interconnected and who has overall responsibility for the human factors program and for each of the elements.

9.2.3 Specialized Training

Prior to implementation of the human factors program elements (except employee participation), employees should have received a basic awareness training and training on the overall human factors program. Employees participating in completing the latent conditions checklist, conducting PHA's, developing operating procedures, conducting management of change, and conducting incident investigations should receive training or orientation on each program. For example, employees responsible for completing the latent conditions checklist should be trained in properly completing the checklist. They should also be trained

to understand that the focus of completing the checklist is to identify existing conditions that could cause someone to make a mistake not to assign blame. This orientation should be expanded to explicitly describe how the programs, including incorporation of human factors, are to be implemented.

Many of the programs described in the previous chapters of this section rely heavily on employees completing the latent conditions checklist included in Attachment A. Chapter 3 of this section describes how to customize/develop a checklist and how to apply the checklist. Employees should be trained to understand management's expectations for completing the checklist and the issues listed in Section 3.2 (e.g., Personnel applying the checklist should be trained to view the checklist indicators as examples to lead the thought process).

9.3 REFRESHER TRAINING

Employees should be provided with refresher training on each of the three topics discussed in Sections 9.2.1, 9.2.2, and 9.2.3 in accordance with the following schedule. The stationary source should consult with employees to determine the appropriate frequency and content of refresher training.

- Basic Awareness Training – Every three years, and more often if necessary, the stationary source should provide general human factors training. This training may be an extension of the material provided in the initial basic awareness training curriculum. Stationary sources may elect to focus the training on latent conditions that are prevalent at their facility
- Overall Human Factors Program Training – Every three years, and more often if necessary, the stationary source should provide refresher training to all employees regarding the human factors program
- Specialized Training – On an as-needed basis, the stationary source should provide refresher training to employees who have specific responsibilities for implementing the human factors program (e.g., completion of the Latent Conditions checklist, incident investigation team members).

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SECTION C: ROOT CAUSE ANALYSIS AND INCIDENT INVESTIGATION

Section 450-8.016(C)(1) requires that Stationary Sources conduct a Root Cause analysis for each Major Chemical Accident or Release. Section 450-8.016(C)(2) allows CCHS to conduct either a root cause analysis for a Major Chemical Accident or Release that requires certain cooperation from the Stationary Source. This chapter gives guidance on the Stationary Sources responsibilities for both conducting a root cause analysis and cooperating with CCHS when CCHS conducts a root cause analysis or incident investigation.

C.1 DEFINITION OF MAJOR CHEMICAL ACCIDENT OR RELEASE

Section 450-8.014(h) defines a Major Chemical Accident or Release as:

- an incident that meets the definition of a Level 3 or Level 2 Incident in the Community Warning System incident level classification system defined in the September 27, 1997 Contra Costa Guideline for the Community Warning System as determined by the Department; or
- an incident that results in the release including, but not limited to, air, water ,or soil of a Regulated Substance and meets one or more of the following criteria:
  (1) results in one or more fatalities;
  (2) results in greater than 24 hours of hospital treatment of three or more persons;
  (3) causes on and/or off-site damage (including clean-up and restoration activities) initially estimated at $500,000, or more. On site estimates shall be performed by the Stationary Source. Off-site estimates shall be performed by appropriate agencies and compiled by the Department;
  (4) results in a flammable vapor cloud of more than 5000 pounds.

C.1.1 INTERPRETATIONS OF DEFINITION

Level 3 or 2 Incidents: Table C.1 describes the September 27, 1997 incident level classification system. Note that if there is any off-site impact, an incident is at least a level 2 incident requiring that the Stationary Source conduct a root cause analysis.

Note that the criteria for conducting a root cause analysis for the effects of a release of a regulated substance are not limited of off-site effects, but include either on-site or off-site effects.

C.2 STATIONARY SOURCE ROOT CAUSE ANALYSIS

C.2.1 CAUSAL FACTOR ANALYSIS

The primary purpose of an incident investigation is to prevent reoccurrence through the identification and correction of the causal factors of the incident. The process of determining of the causal factors seeks to answer the basic questions about an incident:

- What happened?
- How did it happen
- Why did it happen?

A root cause analysis is a systematic process that determines the causal factors, i.e., the events and conditions that are necessary to produce or contribute to an incident. The analysis develops what happened and how it happened, and then focuses on finding the underlying causes for why an incident happened by determining the causal factors of an incident. There are three types of causal factors:

- Direct cause
- Contributing causes
- Root causes

The direct cause of an incident is the immediate events or conditions that caused the incident. The direct cause addresses what happened.

Contributing causes address how and why an incident happened. Contributing causes are causal factors that are events or conditions that collectively with other causes increase the likelihood of an incident but that individually did not cause the incident.

The identification of root causes answers the question of why an incident happened. Root causes are the causal factors that if corrected, would prevent recurrence of the incident. Root causes can include system deficiencies, management failures, inadequate competencies, performance errors, omissions, non-adherence to procedures and inadequate organizational communication. Root causes are generally, not always, attributable to an action or lack of action by a particular group or individual in the line organization. Root causes can be found at more than one level of an organization from management down through the first line supervisors and to the worker.

As stated above, root causes may be found at the worker level. However, CCHS agrees with the guideline set forth in the Department of Energy Accident Investigation Workbook [(1)] that a root cause of an accident can be

found at the worker level if, and only if, the following conditions are found to exist:

- Management systems were in place and functioning, and provided management with feedback on system implementation and performance.
- Management took appropriate actions based on the feedback.
- Management, including supervision, could not reasonably have been expected to take additional actions based on their responsibilities and authorities. .

C.2.2.1 Methodology

There are a number of root cause methodologies available to the Stationary Source, both in the public domain and proprietary. In order to establish criteria for acceptable methods, the Industrial Safety Ordinance states that a Stationary Source shall use a root cause analysis methodology recommended by the Center for Chemical Process Safety or one reviewed by CCHS for substantial equivalency. CCPS, in their book "Guidelines for Investigating Chemical Process Incidents" lists seven primary methodologies that CCHS considers acceptable and which CCHS will judge other methods against for substantial equivalency. These are:

- Accident Anatomy Method
- Causal Tree Method
- Fault Tree Analysis
- Multiple-Cause, Systems-Oriented Incident Investigation
- Multilinear Events Sequencing
- Sequentially Timed Events Plot
- TapRoot™ Incident Investigation System

CCHS does not recommend any particular methodology. When the CCPS book cited above was published in 1992, additional methodologies were available and since then, other methodologies have been developed. Most of these will be acceptable to CCHS. The main criteria that CCHS consider in judging equivalency is that a methodology is documented, and is a systematic method for determining causal factors, i.e., the contributing causes and root causes.

C.2.2.2 Team

A team should conduct a root cause analysis. At least one member of the team should have had training in facilitating a root cause analysis team in the

methodology to be used. An employee and employees' representative should be on the team. The remainder of the team should include at least one person knowledgeable in the Covered Process involved, and the rest of the team should be people with appropriate knowledge and experience to thoroughly investigate and analyze the incident. To the extent possible, the team should be individuals from outside the covered process to avoid potential conflict of interest.

C.2.2.3 Report Content

The Industrial Safety Ordinance states that the final report shall contain the root cause analysis, including recommendations to be implemented to mitigate against the release or incident reoccurring, if any, and a schedule for completion of the resulting recommendations. The ordinance does not specify the exact content of the report, nor is it the intention in this guidance document to specify one. CCHS recognizes that report content may vary due to the severity and complexity of an incident, and possibly due to methodology used for the root cause analysis. CCHS suggests that a Stationary Source consider including the following items in a report to the extent consistent with the severity and complexity of an incident.

- Table of Contents
- Executive Summary
- Introduction
- Scope of Investigation
- Description of the incident, including on-site and off-site effects
- Brief description of the process involved
- Facts, including a time line of events
- Casual Factor Analysis, concluding with citing of the direct cause, contributing causes and root causes.
- Recommendations
- Schedule for implementing recommendations
- Glossary: recognizing that the document will be in the public domain with non-technical people reading it.

C.3 CCHS ROOT CAUSE ANALYSIS

C.3.1 SINGLE POINT OF CONTACT

Section 450-8.016(C)(2) sets forth the cooperation requirements of the Stationary Source when CCHS conducts a root cause analysis. In order to facilitate this cooperation, the stationary source should appoint a person to be the single point of contact with CCHS (and any other agencies involved) to coordinate the interface between CCHS and the Stationary Source. This person would be responsible for coordinating such things as:

- Receiving and processing requests from CCHS
- Interview schedules
- Providing documentation
- Document control
- Security and testing of physical evidence
- Office space: depending on the scope of the investigation, CCHS may require secure on-site office space
- Photography permits
- Access to incident site
- Passes to access stationary source

TABLE C.1

DEFINITIONS OF PLANT INCIDENT CLASSIFICATION LEVELS

LEVEL 0 (easily contained and controlled by plant personnel) is defined by any of the following:

1. On-site only.
2. Plant safety is put on alert.
3. Liquid spill contamination.
4. At least 5 unsubstantiated odor complaints within an hour.
5. No federal/state spill or release notification requirements.

LEVEL 1 is defined by any of the following:

1. On-site; possible off-site.
2. Confirmed (greater than or equal to 5 odor complaints within one hour and substantiated by plant personnel as an on-site problem) off-site odor from facility.
3. Fire/smoke which requires a response from workers outside the immediate area, but not visible off-site.
4. Excess flaring.
5. Spill or release incident that meets an RQ (Reportable Quantity) requirement and also meets one or more of the other Level 1 criteria.

LEVEL 2 is defined by any of the following:

1. Off-site impact where eye, skin, nose and/or respiratory irritation may be possible.
2. Explosion with noise/pressure wave impact off-site.
3. Fire/smoke/plume (other than steam) visible off-site (does not include fire training exercises).

LEVEL 3 is defined by any of the following:

1. Off-site impact that is expected to cause eye, skin, nose and/or respiratory irritation in the community (ERPG Level 2 concentration reading or greater).
2. Explosion with off-site damage.
3. Fire, heat or smoke off-site impact.
4. Major fire and/or explosion.
   Examples: (a) On a process unit (excluding precipitators and boilers) where mutual aid is requested to mitigate the event and the fire will last longer than 15 minutes; (b) Where the local fire department strikes multiple alarms to mitigate the event.

SECTION D: PROCESS HAZARD ANALYSIS/ACTION ITEMS

County Ordinance Code Chapter 450-8, Section 450-8.016(D) requires facilities to conduct a process hazard analysis (PHA's) on each covered process at their facility. The PHA's and PHA revalidations should be conducted in conformance with Section 2760.2 of the CalARP program regulations and Section 7.3 of the *Contra Costa County CalARP Program Guidance Document* except in assessing whether seismic events must be considered.

Seismic events must be considered (i.e., a seismic assessment must be conducted) if the covered process (as defined in Section 450-8.014(a) of County Ordinance Code Chapter 450-8) contains a regulated substance (as defined in Section 2735.3(n) of the CalARP program regulations) and the distance to the nearest public receptor for a worst case release scenario[1] is within the distance to the toxic or flammable endpoint.[2] The seismic assessment should be conducted in accordance with Section 7.3.4 and Appendix B of the *Contra Costa County CalARP Program Guidance Document.*

Additionally, County Ordinance Code Chapter 450-8, Section 450-8.016(D) requires the following for conducting PHA's.

D.1 INHERENTLY SAFER SYSTEMS

The intent of the Inherently Safer Systems requirements is that each stationary source, using good engineering practices and sound engineering judgment will incorporate the highest level of reliable hazard reduction to the greatest extent feasible, to prevent Major Chemical Accidents and Releases.

"Inherently Safer Systems (ISS) means Inherently Safer Design Strategies as discussed in the 1996 Center for Chemical Process Safety Publication "Inherently Safer Chemical Processes" and means feasible alternative equipment, processes, materials, lay-outs, and procedures meant to eliminate, minimize, or reduce the risk of a Major Chemical Accident or Release by modifying a process rather than adding external layers of protection. Examples include, but are not limited to, substitution of materials with lower vapor pressure, lower flammability, or lower toxicity; isolation of hazardous processes; and use of processes which operate at lower temperatures and/or pressures." County Ordinance Code Chapter 450-8, §450-8.014(g) *"For all covered processes, the stationary source shall consider the use of inherently safer systems in the development and analysis of mitigation items resulting from a process hazard analysis and in the design and review of new processes and facilities."* County Ordinance Code Chapter 450-8 as amended by County Ordinance 2000-20, Section 450-8.016(D)(3). The term inherently safer implies that the process is safer because of its very nature and not because equipment has been added to make it safer.[3]

1996 Center for Chemical Process Safety Publication Inherently Safer Chemical Processes has defined four categories for risk reduction:

[1] As specified in California Code of Regulations, Title 19, Chapter 4.5, Section 2750.3
[2] As specified in California Code of Regulations, Title 19, Chapter 4.5, Section 2750.2(a)
[3] Process Plants: A Handbook for Safer Design, 1998, Trevor Kletz

- Inherent - Eliminating the hazard by using materials and process conditions which are nonhazardous; e.g., substituting water for a flammable solvent.
- Passive - Minimizing the hazard by process and equipment design features which reduce either the frequency or consequence of the hazard without the active functioning of any device; e.g., the use of equipment rated for higher pressure.
- Active – Using controls, safety interlocks, and emergency shutdown systems to detect and correct process deviations; e.g., a pump that is shut off by a high level switch in the downstream tank when the tank is 90% full. These systems are commonly referred to as engineering controls.
- Procedural – Using operating procedures, administrative checks, emergency response, and other management approaches to prevent incidents, or to minimize the effects of an incident; e.g., hot-work procedures and permits. These approaches are commonly referred to as administrative controls.

"*Risk control strategies in the first two categories, inherent and passive, are more reliable because they depend on the physical and chemical properties of the system rather than the successful operation of instruments, devices, procedures, and people."*[4] The inherent and passive categories should be implemented when feasible for new processes and facilities and used during the review of Inherently Safer Systems for existing processes if these processes could cause incidents that that could result in a Major Chemical Accident or Release. The final two categories do require the successful operation of instruments, devices, procedures, and people. The concepts that are discussed in the CCPS book, Inherently Safer Chemical Processes, A Life Cycle Approach, for looking at active and procedural applications of risk reduction, should be used in developing recommendations and mitigations from process hazard analyses along with the inherent and passive categories. This is good risk reduction. These concepts should also be used in the review and application of human factors in the process hazard analysis of new and existing processes.

Approaches to consider Inherently Safer Systems include the following[4]:

- Minimization – Use smaller quantities of hazardous substances (also called *Intensification*)
- Substitute – Replace a material with a less hazardous substance
- Moderate – Use less hazardous conditions, a less hazardous form of a material, or facilities that minimize the impact of release of hazardous material or energy (also called *Attenuation* or *Limitation of Effects*)
- Simplify– Design facilities that eliminate unnecessary complexity and make operating errors less likely, and that are forgiving of errors that are made (also called *Error Tolerance*)

The following guidance on the review of Inherently Safer Systems is broken down into seven separate sections. The first section addresses new covered processes; the second section addresses existing processes; the third section addresses mitigations resulting from Process Hazard Analysis (PHA); the fourth section defines feasibility; the fifth section

[4] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996

addresses recommendations from process hazard analyses; the sixth section addresses Inherently Safer System Reports; and the seventh section contains definitions. As discussed in the following sections, the ISS analyses must be performed for situations where a major chemical accident or release could reasonably occur[5].

References on the approaches to Inherently Safer Systems to consider are listed at the end of this section.

D.1.1 Inherently Safer Systems Analysis for New Covered Processes

The Industrial Safety Ordinance requires a stationary source to consider Inherently Safer Systems " . . . in the design and review of new processes and facilities." (§450-8.016(D)(3)). This section describes the different phases in the development of a project that an Inherently Safer Systems analysis should be used. Inherently Safer Systems should be reviewed early in the development phase of a new covered process and then reviewed throughout the different project design phases. The objectives for an inherent safety review are to employ synergistic teams[6] to:

- *Understand the hazards*
- *Find ways to reduce or eliminate the hazards*

"The first major objective for the inherent safety review is the development of a good understanding of the hazards involved in the process. Reducing and eliminating hazards and their associated risks is the second major objective. Applying inherent safety principles early in the product/process development effort provides the greatest opportunity to achieve the objectives of the inherent safety review process for the project at hand."[7]

The stationary source should use a review process for new processes that includes an Inherently Safer Systems review at different phases of the design process such as the following phases when applicable:

- During the chemistry forming (synthesis) phase for product/process research and development to focus on the chemistry and process

[5] Process Hazard Analysis methods determine the risk of a deviation or potential incident. The risk determination is based on a combination of the hazard (severity) of the potential incident and likelihood (probability) of an incident occurring. If the potential hazard (severity) of consequence of a deviation meets the definition of a Major Chemical Accident or Release an ISS Analysis should be done for those that could reasonably occur.

[6] Composition of the review teams will vary at different phases of the development cycle of the project and with the nature of the process. In product development and design scope, the team may comprise of chemist, process design engineers, industrial hygienist, safety engineer, environmental, and control engineer etc. In the hazard and operations review phase, the team may include operations and maintenance personnel as well. A stationary source may choose not to use an ISS review team at a particular phase. If this does occur, the stationary source should document the reasons for not using a team for performing an ISS review during this particular phase. A multi-disciplined group should be used throughout the various phases of development, implementation, and operation.

[7] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996

- During the facilities design scoping and development prior to completion of the design basis to focus on equipment and configuration
- During the basic design phase of the project

CCHS understands that for different stationary sources and different projects that the above phases, timing and sequencing, may not always be applicable. For some projects, the chemistry may be complete and the chemistry-forming phase is not applicable. For some stationary sources it may be more appropriate to do inherently safer system analyses at phases that are not quite the same as described above, but is at the same approximate timing in a project development and design phases. The intent is that a stationary source conducts inherently safer system analysis early in the project development and throughout the various phases of the design. Stationary Sources should recognize that the earlier in a project development and design the easier and less costly it is to make a change to implement Inherently Safer Systems.

D.1.1.1 Applying Inherently Safer Systems Review – Chemistry-Forming Phase

Inherently Safer Systems should be evaluated early in the assessment of the project. When applicable, this assessment should be done in the chemistry-forming phase during the product and process research and development. A team with a diverse background would best perform the assessment. The team assessment should address topics such as:

- An understanding of the hazards
- The best route to produce a given chemical or product
- Process improvement
    - Reactor types and conditions
    - Intermediate storage optimization
    - Waste minimization
- Identify requirements for additional information

Some of the information that may need to be available prior to this review includes the following[8]:

- Simplified process flow diagrams
    - Include alternative processes
- Defined chemical reactions
    - Desired and undesired
    - Develop potential for runaway reactions/decompositions
- A list of all chemicals and materials employed
    - Develop compatibility matrix
    - Include air, water, rust, etc.
- Defined physical, chemical, and toxic properties

[8] Early review often will not have all of the information listed, as it may not be developed yet. Do not wait for the undeveloped information to complete the reviews. Later reviews should cover the information that was not available in the earlier reviews.

- Defined process conditions (pressure, temperature, etc.)
- Estimated quantities used in each process system (tanks, reactors, etc.)
  - Estimate quantities of wastes/emissions

The review team should examine the following questions:

- Can safer chemicals be used?
- Can quantities be reduced?
- Is the overall risk increased by implementing an ISS?
- Can waste be reduced? (Regenerable catalyst or recyclable.)
- What additional information is required? (Toxicology information, heats of reaction, or reactive chemicals data.)

Documentation that should be kept for this phase of the project, when applicable, includes, but is not limited to:

- How the decision was made to perform an Inherently Safer Systems Review at this phase
- How the assessment was performed
- The assessment team leader, including the relevant experience of the team leader
- The makeup of the assessment team by discipline, experience, and name of the participants
- The information that was prepared and available during the assessment
- How the hazards were understood, including flammability, toxicity, and reactivity
- The different routes to produce a given chemical or product and how the best route was determined, including the criteria and method used for this determination
- How process improvements were reviewed and the determination of the process that was determined to be the inherently safest process
- The answers to such questions as those listed above
- The identification of requirements for additional information

D.1.1.2 Applying Inherently Safer Systems Review – Facilities Design Scoping and Development

Inherently safer systems should then be evaluated during the design-scoping phase of the project when applicable. The evaluation should concentrate on the following:

- Minimizing equipment
- Reducing inventories
- Simplifying the process
- Reducing wastes
- Moderating process conditions

The preliminary information that should be available prior to the development phase of the project ISS review may include the following:

- Process flow diagram or simplified process flow diagram
- Material and Energy Balance
- Defined chemical reactions
- Defined physical, chemical, and toxic properties

During the review the team should examine questions such as:

- Previously unanswered questions
- Can potential releases be reduced via lower temperatures or pressures, or elimination of equipment?
- Can quantities be reduced?
- Can waste be reduced? (Regenerable or recyclable catalyst.)
- Can different equipment be used resulting in safer conditions?

Documentation that should be kept for this phase of the project includes, but is not limited to:

- How the decision was made to do an Inherently Safer Systems Review at this phase
- How the assessment was performed
- The assessment team leader, including the relevant experience of the team leader
- The makeup of the assessment team by discipline, experience, and name of participants
- The information that was prepared and available during the assessment
- The process used to determine that the equipment sizes are minimized and the results of this determination
- The process used to determine the minimum inventories needed and the results of this determination
- The process used to simplify the covered process, if applicable, and the results of this process

- The process used to reduce the waste made from the project and the results of the determination
- How the moderation of the process was done – the checklist in Attachment A could be used in this determination
- The answers to such questions as those listed above
- The identification of requirements for additional information

D.1.1.3 Applying Inherently Safer Systems Review – During the Basic Design of the Project

During this assessment phase, use of inherently safer systems should be reviewed and documented. This may be achieved using a checklist that incorporates ISS considerations such as those listed in Attachment A. Another method that may be used is the incorporation of additional parameters and guidewords such as those used in a Hazard and Operability Study. An example of guidewords or parameters that could be used is shown in Attachment B. These analyses would review the covered processes for ways to eliminate or reduce hazards that are present in the covered process. Preliminary safety critical devices and procedures should be examined to determine if there is a way to eliminate the need for the device or procedure by applying principles of inherently safer systems. The information prepared prior to the design phase of the project should include the process safety information that is required under the Industrial Safety Ordinance and CalARP Program. Some of the information to be included with the process safety information is the following:

- Process Flow Diagrams (PFD's)
- Piping and Instrument Diagrams (P&ID's)
- Material and Energy Balance
- Equipment specifications
- Designing equipment for isolation when applicable – (P&ID's may be sufficient to address this requirement)
- Preliminary safety critical procedures or guidelines
- Instrumentation logic information – (P&ID's may be sufficient to address this requirement)

During the ISS Study the team should consider such questions as:

- Can potential releases be reduced via lower temperatures or pressures, lower concentrations, elimination of equipment?
- Can quantities be reduced?
- Can waste be reduced?

The documentation that should be included for the checklist analysis includes the items that are applicable from the checklist in Attachment A, what items were considered, how they were considered, and the results of the consideration. For items that were applicable and not considered, document why each item was not considered.

The documentation for incorporating the guidewords for inherently safer systems into a Hazard and Operability Study should be consistent with the documentation used during any Hazard and Operability Study.

Other methods for performing an Inherently Safer Systems Analysis may be appropriate. If another method is used, the stationary source must work with Contra Costa Health Services in determining that this method is appropriate for analyzing for inherently safer systems prior to implementation.

The documentation must include the makeup of the review team by discipline, relevant experience, and the names of the review leader and participants.

D.1.2 Inherently Safer Systems Analysis for Existing Process Units

The Industrial Safety Ordinance requires that stationary sources consider hazards as part of the process hazard analyses.

> *"The process hazard analysis shall be appropriate to the complexity of the Covered Process and shall identify, evaluate, and control the hazards involved in the Covered Process. The process hazard analysis shall address: the hazards of the process; the identification of any previous incident which had a likely potential for catastrophic consequences; engineering and administrative controls applicable to the hazards and their interrelationships such as appropriate application of detection methodologies to provide early warning of releases."* Chapter 450-8 §450-8.016(D)(1)

NOTE: Inherently Safer Systems need only be considered for scenarios where a Major Chemical Accident or Release could reasonably occur. This could include a process or parts of a process. The stationary source needs to establish a method to make the determination of a potential occurrence of a Major Chemical Accident or Release. This could include examining each consequence of a deviation, including the severity of each consequence.

Stationary sources should perform one of the following methods to ensure that inherently safer systems (inherent and passive categories) are considered and documented for the covered processes:

- An independent inherently safer system analyses that is done in addition to a PHA[9]. These analyses should review the covered processes for ways to eliminate or reduce hazards that are present in the covered process. This may be achieved by using a checklist (Attachment A) or guideword analysis (Attachment B) that incorporates ISS. If the stationary source decides to use some other ISS checklist or other methods to evaluate ISS, these must be approved by CCHS prior to their use.

[9] If the stationary source decides to do an independent inherently safer systems analysis, CCHS suggests that this be done in conjunction with the process hazard analysis, but it may be appropriate for a stationary source to perform an inherently safer systems analysis that is done at a different time than the process hazard analysis. Either approach meets the guidance from this document, as long as the inherently safer systems analysis is revalidated at least once every five years.

- An inherently safer system analyses that is incorporated into the existing PHA review process. This would require that each covered process in its entirety have an initial ISS analyses conducted. (Incorporating inherently safer systems into a revalidated process hazard analysis may not be sufficient to satisfy the initial inherently safer system review if the whole process is not evaluated.) This may be achieved using a checklist (Attachment A) or guideword (Attachment B) that incorporates ISS considerations into a Hazard and Operability Study where a Major Chemical Accident or Release could reasonably occur. These analyses would review the covered processes for ways to eliminate or reduce hazards as well as risks that are present in the covered process.

Whichever type of ISS analysis is implemented by the stationary source the following will need to be done:

- The stationary source will develop and document their approach to evaluating ISS for existing processes. Contra Costa Health Services will review the ISS analysis method selected to verify that the method meets the requirements of the Industrial Safety Ordinance and this guidance document.

- The stationary source will document the qualifications of the team facilitator/leader and team makeup, including positions, names, and any relevant experience or training.

- The stationary source will document the ISS's considered as well as those implemented. Implementing only one option to address identified hazards may not be adequate to address the greatest hazard reduction or elimination. However, it is not necessary to implement more than one ISS if the implementation of a second ISS does not add any significant hazard reduction or has been documented as infeasible.

- If the stationary source chooses to do an independent inherently safer systems analysis, the stationary source should document the method used for the analysis, what inherently safer systems were considered, and the results of each consideration. If the checklist for Inherently Safer Systems was used, for items that were not considered, document why those items were not considered, i.e., not applicable or were already considered in previous consideration.

- The stationary source will document for the ISS considered and not implemented, the grounds that were used to make the feasibility determination (See D.1.4 Feasibility).

- The documentation for incorporating the guidewords for inherently safer systems into a Hazard and Operability Study should be consistent with the documentation used during any Hazard and Operability Study.

- For any other inherently safer system analysis, the stationary source should document the inherently safer system considered, the inherently safer system implemented, and the inherently safer systems not implemented.

- The ISS analyses should be revalidated at least once every five years. The revalidation should include and document the following:

  - Incorporate improvements made in method since the last review was conducted or select a new method to perform the ISS analyses.

  - ISS review for all changes that have been made since the last ISS analysis.

  - Review of all major chemical accidents or releases or potential major chemical accidents or releases that occurred at the process under review.

  - Review for any new and existing technologies not previously reviewed that can be incorporated that will make the process under review inherently safer.

D.1.3 Process Hazard Analysis Recommendations and Mitigations

The concepts as addressed in the CCPS book Inherently Safer Chemical Processes A Life Cycle Approach for looking at all four categories of risk reduction (Inherent, Passive, Active, and Procedural) should be used in the development and mitigation of recommendations from process hazard analysis as well as for considering Human Factors.[10] Chapter 4 of the CCPS book Inherently Safer Chemical Processes A Life Cycle Approach discusses many inherently safer system strategies that can be incorporated in the development of mitigations to address the recommendations from process hazard analysis.

The stationary sources should provide guidance to personnel responsible for developing and analyzing recommendations and mitigation items resulting from the unit PHA. The guidance should include the concepts of inherently safer systems including:

- The different categories of risk reductions
- Moving up the different levels from procedural to active to passive to inherent levels
- Approaches to apply inherently safer systems including minimization, substitution, moderation, and simplification

The stationary source should document how they used the inherently safer system strategies for risk reduction in developing and analyzing mitigations to address the recommendations from a process hazard analysis. There should be sufficient detailed documentation satisfactory to CCHS and should at least include the following for the stationary sources ISS program description:

[10] County Ordinance Code Chapter 450-8, §450-8.016(D)(3) *"For all Covered Processes, the Stationary Source shall consider the use of Inherently safer Systems in the development and analysis of mitigation items resulting from a process hazard analysis . . ."* and County Ordinance Code Chapter 450-8, §450-8.016(D)(4) *"For all Covered Processes, the Stationary Source shall document the decision made to implement or not implement all process hazard analysis recommended action items and the results of recommendations for additional study. . ."*

- The facility has a program in place to ensure that risk reduction actions taken to address PHA recommendations incorporate inherently safer systems.
- The program incorporates at a minimum; the four levels of risk reductions described beginning on page D-2 of this document.
- How the stationary source encourages moving up the levels from procedural to inherent in the implementation of the inherently safer system strategies.

The stationary source should also document the implementation of ISS strategies and should include the following:

- At least one risk reduction action was taken using inherently safer system strategy for each PHA mitigation item for scenarios that have the potential for a Major Chemical Accident or Release.
- A description of the risk reduction method selected and the inherently safer system strategy used.
- Details of risk reduction mitigation considered using the inherently safer system strategy that was not implemented.
- Reasons the rejected risk reduction mitigation was determined to be infeasible using the inherently safer system strategies.

D. 1.4. Feasibility

The Industrial Safety Ordinance requires the stationary source to select and implement ISS to the greatest extent feasible (Section 450-8.016 (D)(3)). The Industrial Safety Ordinance also defines feasible " . . . capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." To assist in the determination of feasible, Contra Costa Health Services is using a modification of the following guidance from OSHA (Federal OSHA provided guidance for justifiably declining recommendations from incident investigations in the September 1994, OSHA Instruction CPL 2-2.45A CH-1. These criteria have since been applied to recommendations formulated during PHA's.) and the U.S. EPA:

- The analysis upon which the recommendations are based contains factual errors.
- The recommendation is not necessary, i.e., the safeguards may be inadequate, but the consequences are operational or the consequence or severity of the scenario would not result in a Major Chemical Accident or Release.
- An alternative ISS would provide a sufficient level of hazard reduction (NOTE: Implementing only one option to address identified hazards may not be adequate to address the greatest hazard reduction or elimination. However, it is not necessary to implement more than one ISS if the implementation of a second ISS does not add any significant hazard reduction or has been documented as infeasible.)

- The recommendation is in conflict with existing federal, state, or local laws.
- The recommendation is in conflict with Recognized and Generally Accepted Good Engineering Practices (RAGAGEP).

- The recommendation is economically impractical, such that the process unit can no longer be financially operated. This can include the following factors:
    - Capital investment
    - Product quality
    - Total direct manufacturing costs
    - Operability of the plant
    - Demolition and future clean-up and disposal cost
- The recommendation would have a negative social impact such that the project should not be implemented. Some examples of social impact include the recommendation would have a visual or noise impact on the community that is not acceptable and the recommendation would cause or increase the traffic congestion.
- The recommendation may violate a license agreement and the license agreement cannot be modified and must remain in effect.
- The recommendation may decrease the hazard, but would increase the overall risk.
- An alternative measure would provide more risk reduction than the ISS.
- If the ISS recommended is determined not to be implemented because it will create more risk, or if other modifications that are not ISS are made such that the overall risk is less than if the ISS were implemented, the stationary source will need to document how this determination was made. A qualitative risk assessment/analysis could be used as a basis for the risk analysis. The facility needs to document how they determined the qualitative severity and likelihood for the existing or modified conditions and for the conditions if the ISS is implemented. If the qualitative risk analysis shows the same level of risk, then a quantitative risk assessment/analysis should be performed to compare the risk of the existing or modified conditions to the risk if the ISS is implemented. The documentation should include the background information that was used to do the comparison of the existing or modified conditions to the conditions if the ISS is implemented. Another method may be used by the stationary source, such as a weighted scoring decision matrix as shown on page 23 of CCPS book Inherently Safer Chemical Process A Life Cycle Approach, if that method is approved by Contra Costa Health Services prior to the use of the method.

County Ordinance Code Chapter 450-8, §450-8.016(D)(3) requires the following: "This documentation shall include (1) sufficient evidence to demonstrate to the County's satisfaction that implementing this inherently safer system is impractical, and (2) the reason for this conclusion." The documentation should include the applicable background information, calculations, and the reasons that an inherently safer system was not implemented. If there is any concern that the reasons for not implementing an inherently safer system would not satisfy Contra Costa Health Services, the stationary source should consult with Contra Costa Health Services to determine if the justification is satisfactory. The stationary source should then receive in writing from Contra Costa Health Services their decision and how they came to their decision including background information, calculations, and alternatives considered.

D.1.5 Completion of Recommended Action Items

Stationary sources must document the decision made to implement or not implement all process hazard analysis recommended action items and the results of recommendations for additional study. This documentation must include the justification for not implementing any recommended actions. Federal OSHA provided guidance for justifiably declining recommendations from incident investigations in the September 1994, OSHA Instruction CPL 2-2.45A CH-1. These criteria have since been applied to recommendations formulated during PHA's. **NOTE:** Additionally, CCHS encourages stationary sources to consider the impact on surrounding communities when declining recommendations.

- The analysis upon which the recommendation is based contains material factual errors
- The recommendation is not necessary to protect the health and safety of the employer's own employees, or the employees of contractors
- An alternative measure would provide a sufficient level of protection
- The recommendation is infeasible

Cal/OSHA issued the following clarification in Part 4 of the June 1994 Process Safety Management Guidelines. "…Cal/OSHA's intent is that an employer is required to implement the teams' findings and recommendations except to the extent that an employer can document that an alternative will be at least as effective or efficient in addressing the safety concerns that are the subject of those findings and recommendations".

The stationary source must complete the recommended actions selected for implementation, including those formulated during PHA, as follows:

- All actions not requiring a process shutdown must be completed within one year after submittal of the original Safety Plan or after completion of the PHA revalidation unless the stationary source demonstrates to the satisfaction of Contra Costa Health Services that within one year is infeasible
- All actions requiring a process shutdown shall be completed during the first regularly scheduled turnaround of the applicable process subsequent to one year after submittal of the Safety Plan or after completion of the PHA unless the stationary source demonstrates to the satisfaction of Contra Costa Health Services that such a schedule is infeasible

ISS Study and ISS Revalidation recommendations should be resolved in a timely manner. CCHS Staff may request that the stationary source make the plans for completing these recommendations available during facility audits.

Examples of situations where the schedule may be infeasible include procuring customized equipment requiring a long lead time for fabrication and delivery, complex projects requiring significant front-end engineering, facilities that require substantial time to construct, or implementing a recommended action that requires the application of a local air district permit to construct or county land use permit and its requirements (a CEQA analysis may be

conducted.) **NOTE:** the stationary source must demonstrate that they initiated the land use permit process in a timely manner.

The stationary source must retain documentation of closure and any associated justification of actions identified by the process hazard analysis. CCHS interprets "actions" to include, but not be limited to, all recommendations made for changes to physical equipment and procedures, and for additional studies and information. The stationary source must also retain documentation of communication to operating, maintenance, and other employees whose work assignments are in the process and who may be affected by the recommendations or actions.

D.1.6 Inherently Safer System Reports

An Annual report on the Industrial Safety Ordinance is made to the Board of Supervisors in October each year. Each June, Contra Costa Health Services will request information from the stationary sources for this report. Part of this information includes information on the inherently safer systems already implemented. The information on inherently safer systems should include a brief description of each inherently safer system that was implemented from June 1 – May 31 each year that meet the definitions of the inherent or passive levels for processes where a Major Chemical Accident or Release could reasonably occur. The description should include the level of risk reduction (inherent or passive), and the basis for the inherently safer system implemented (e.g., PHA, Inherently Safer System Analysis, Review of Inherently Safer Systems for new processes or facilities).

D.1.7 Definitions

1. *"Active – Using controls, safety interlocks, and emergency shutdown systems to detect and correct process deviations; e.g., a pump that is shut off by a high level switch in the downstream tank when the tank is 90% full. These systems are commonly referred to as engineering controls."*[11]

2. Could Reasonably Occur[12] – is a relative term that depends on the severity of the incident that qualifies a scenario as a Major Chemical Accident or Release. A scenario resulting in a Major Chemical Accident or Release could reasonably occur if:

    a. For a scenario resulting a Level 2 incident, or on-site property damage (including clean-up and restoration activities) initially estimated at $500,000 or more, the likelihood can be described by "has happen in unit, or at least at location"

    b. For a scenario resulting a Level 3 incident, the likelihood can be described by "has happened at location, but very rare"

[11] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996
[12] Shell Canadian Study

c. For a scenario resulting in one or more fatalities, or greater than 24 hours of hospital treatment of three or more persons, or off-site property damage (including clean-up and restoration activities) initially estimated at $500,000 or more, or a flammable vapor cloud of more than 5,000 pounds, the likelihood is greater than "has not happened at location, and very remote"

The shaded cells in the table below indicate what should be considered reasonable for the different severities

	Severity (a)	Severity (b)	Severity (c)
Has occurred at process unit			
Has occurred at Stationary Source			
Has not occurred at Stationary Source, but could occur during process unit's lifetime or has occurred within industry			
Has not occurred at Stationary Source or within the industry and occurrence is remote over process unit's lifetime			

3. Inherently Safer Systems – " *Inherently Safer Design Strategies as discussed in the 1996 Center for Chemical Process Safety Publication "Inherently Safer Chemical Processes", and Feasible alternative equipment, processes, materials, lay-outs, and procedures meant to eliminate, minimize, or reduce the risk of a Major Chemical Accident or Release by modifying a process rather than adding external layers of protection. Examples include, but are not limited to, substitution of materials with lower vapor pressure, lower flammability, or lower toxicity; isolation of hazardous processes; and use of processes, which operate at lower temperatures and/or pressures."* (County Ordinance Code Chapter 450, §450-8.014(g)

4. *"Inherent - Eliminating the hazard by using materials and process conditions which are nonhazardous; e.g., substituting water for a flammable solvent."*[13]

5. Inherently Safer Systems Analysis – Performing a study to incorporate concepts of inherently safer systems. The analysis will include recommendations on incorporating inherently safer systems into a process. The analysis will include the documentation on how the study was performed, the recommendations from the study, and how the recommendations were formulated.

[13] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996

6. Less Hazardous Form – Materials being handled under conditions that is considered less hazardous. Less hazardous conditions can be accomplished by strategies that are either physical (lower temperatures, and/or pressures, dilution) or chemical (development of reaction chemistry that operates less severe conditions). Examples include: dilution, refrigerated liquids that are gases at standard temperatures and pressures, and operating at lower temperatures and pressures.

7. Major Chemical Accident or Release - is defined by the ordinance (§450-8.014(h)) as *" . . . means an incident that meets the definition of a Level 3 or Level 2 Incident in the Community Warning System incident level classification system defined in the September 27, 1997 Contra Costa County guideline for the Community Warning System as determined by the Department; or results in the release including, but not limited to, air, water, or soil of a Regulated Substance and meets one or more of the following criteria:*

   (1) results in one or more fatalities;

   (2) results in greater than 24 hours of hospital treatment of three or more persons;

   (3) causes on and/or off-site property damage (including clean-up and restoration activities) initially estimated at $500,000 or more. On-site estimates shall be performed by the Stationary Source. Off-site estimates shall be performed by appropriate agencies and compiled by the Department.;

   (4) results in a flammable vapor cloud of more than 5000 pounds."

8. *"Minimization – Use smaller quantities of hazardous substances (also called Intensification)"*[14]

9. *"Moderate – Use less hazardous conditions, a less hazardous form of a material, or facilities that minimize the impact of release of hazardous material or energy (also called Attenuation or Limitation of Effects)"*[15]

10. New Process - *The addition of a process that did not previously exist or a major revamp of an existing process resulting in a substantial change in the process configuration or process chemistry.*

11. *"Passive - Minimizing the hazard by process and equipment design features which reduce either the frequency or consequence of the hazard without the active functioning of any device; e.g., the use of equipment rated for higher pressure."*[16]

12. *"Procedural – Using operating procedures, administrative checks, emergency response, and other management approaches to prevent incidents, or to minimize the*

[14] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996
[15] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996
[16] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996

effects of an incident; e.g., hot-work procedures and permits. These approaches are commonly referred to as administrative controls."[17]

13. Process - Any activity involving a regulated substance including any use, storage, manufacturing, handling, or on-site movement of such substances, or combination of these activities. For the purposes of this definition, any group of vessels that are interconnected, or separate vessels that are located such that a regulated substance could be involved in a potential release, shall be considered a single process. (CCR Title 19, Section 2735.3(tt)

14. *"Process Flow Diagram – A diagram that shows the material flow from one piece of equipment to the other in a process. It usually provides information about the pressure, temperature, composition, and flow rate of the various streams, heat duties of exchangers, and other such information pertaining to understanding and conceptualizing the process."*[18]

15. *"Quantitative Risk Analysis – The systematic development of numerical estimates of the expected frequency and/or consequence of potential accidents associated with a facility or operation based on engineering evaluation and mathematical techniques*."[19]

16. Safer Chemicals – Chemicals where the acute and chronic toxicity, flammability, reactivity, and instability are lower. A chemical may be safer in some of these hazard categories and higher in others. The facility needs to determine the impact from a release of a chemical based on the above hazards. The chemical with the least impact should be safer.

17. *"Simplify– Design facilities that eliminate unnecessary complexity and make operating errors less likely, and that are forgiving of errors that are made (also called Error Tolerance)"*[20]

18. *"Substitute – Replace a material with a less hazardous substance"*[21]

19. Sufficient Level of Hazard Reduction - The level where the accidental release scenario being considered is not likely to occur.

References

References include but are not limited to:

CCPS, Guidelines for Engineering Design for Process Safety, 1993

[17] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996
[18] CCPS, Guidelines for Process Safety in Batch Reaction Systems, 1999
[19] CCPS Guidelines for Hazard Evaluation Procedures, Second Edition,1992
[20] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996
[21] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996

CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996

Process Plants: A Handbook for Inherently Safer Design, Kletz, 1998

SECTION E: SAFETY PLAN

Stationary sources are required to submit a Safety Plan to CCHS by January 15, 2000 for existing stationary sources (i.e., those facilities meeting the definition of stationary source as of January 15, 2000) or within three years of the date a facility becomes a stationary source. Existing stationary sources adding a new covered process(es) must consult with CCHS to determine when the Safety Plan must be revised. Existing stationary sources significantly changing covered process(es) or regulated substances should consult with CCHS to determine when the Safety Plan should be revised. The initial Safety Plan submittal for existing stationary sources will not include a description of human factors program. An initial description of the human factors program (Section E.3) must be submitted to CCHS by January 15, 2001 for inclusion in the Safety Plan.

Stationary sources must review and update Sections E.1 through E.5, and Section E.8 of the Safety Plan every three years per Section 450-8.018(E) of County Ordinance 98-48. Any revisions to these sections of the Safety Plan must be submitted to CCHS by January 15 of that year (i.e., 2003, 2006, 2009, etc.). Sections E.6, Accident History, and E.7, Annual Performance Review and Evaluation, of the Safety Plan must be updated annually in accordance with the following schedule:

- Section E.6, Accident History - Stationary sources must annually submit an accident history report (i.e., an update) to CCHS per Section 450-8.016(E)(2) of County Ordinance 98-48. The first report shall be due January 15, 2001. Subsequent reports shall be due January 15 of every year thereafter. **NOTE:** The original Accident History (June1, 1992 through January 15, 1999) must be submitted in the Safety Plan by January 15, 1999.

- Section E.7, Annual Performance Review and Evaluation – CCHS must prepare an annual report for the Board of Supervisors by October for each fiscal year (i.e., July through June) beginning in the year 2000. Stationary sources will therefore be asked to provide an initial submission of this information in the January 15, 2000 Safety Plan submittal and annual updates beginning June 30, 2000 and occurring each year thereafter. **NOTE:** There are only five months between the initial submittal date of the Safety Plan and the first update of the performance review and evaluation data. If the submitted information has not changed within that time period, stationary sources may simply submit a written statement that the existing information is accurate and current.

The following table summarizes the initial submittal dates and subsequent updates for each of the eight sections included in this chapter.

Section	Initial Submittal	Updates
E.1	January 15, 2000	January 15, 2003; 2006; 2009…
E.2	January 15, 2000	January 15, 2003; 2006; 2009…
E.3	January 15, 2001	January 15, 2003; 2006; 2009…
E.4	January 15, 2000	January 15, 2003; 2006; 2009…
E.5	January 15, 2000	January 15, 2003; 2006; 2009…
E.6	January 15, 2000	January 15, 2001; 2002; 2003…

E.7	January 15, 2000	June 30, 2000; 2001; 2002…
E.8	January 15, 2000	January 15, 2003; 2006; 2009…

The remainder of this section describes CCHS's expectations for the content of the Safety Plan. Stationary sources electing to include information other than that which is requested below must consult with CCHS. Stationary sources may elect to develop the Safety Plan as a stand-alone document or as an addendum to the Risk Management Plan (RMP). Stationary sources should consult with CCHS regarding an appropriate format for their Safety Plan.

E.1 DESCRIPTION OF YOUR STATIONARY SOURCE AND THE REGULATED SUBSTANCES HANDLED

Conveying fundamental information regarding your non-exempt covered process(es)[1] will stimulate dialogue and increase the community's understanding of your operation. This information will also serve as an accompaniment to or reference for the remaining sections of the Safety Plan.

CCHS recommends that you include the following information:

- A simplified process flow diagram of each non-exempt covered process that indicates risk management program boundaries;
- A brief description of the stationary source and the individual non-exempt covered processes, including the purpose(s);
- A table listing all non-exempt covered processes indicating program applicability for state and federal risk management regulations and Chapter 450-8 of Co. Ord. 98-48, federal and state risk management program level, regulated substance(s)[2,] and quantities of each regulated substance; and,
- A brief description of the hazards associated with each regulated substance identified in the preceding bullet. **NOTE:** The stationary source may generally describe the hazards associated with flammable mixtures, as appropriate.

E.2 RISK MANAGEMENT PROGRAM ELEMENTS

1 **Non-Exempt Covered Process** means any process or activity at a Stationary Source (Section 450-8.014(a)) that is not otherwise exempt, per Section 450-8.010(B)

2 **Regulated substance** means (1) any chemical substance which satisfies the provisions of California Health and Safety Code section 25532(g), as amended from time to time, or (2) a substance which satisfies the provisions of Hazard Categories A or B in section 84-63.1016. Mixtures containing less than 1% of a regulated substance shall not be considered in the determination of the presence of a regulated material (Section 450-8.014(i)).

Stationary sources should adhere to the guidance provided in Section 9.3.1 Executive Summary, General Accidental Release Prevention Program and Chemical-Specific Prevention Steps, Program 3 Prevention Program; and Section 9.3.1 Executive Summary, Emergency Response Program of the *Contra Costa County CalARP Program Guidance Document* when describing the following programs in the Safety Plan:

- Process Safety Information
- Operating Procedures
- Employee Participation
- Training
- Mechanical Integrity
- Management of Change
- Pre Start-up Reviews
- Compliance Audits
- Incident Investigation
- Hot Work
- Contractors
- Emergency Response Program
- Safety Program Management

Additionally, CCHS recommends that the following information regarding Safety Program Management be included in the Safety Plan. **NOTE:** The initial Safety Plan submittal will not include information regarding the human factors program because stationary sources have until January 15, 2001 to develop their programs. The following management system information will need to be updated appropriately for human factors January 15, 2001.

- A description of the Goals and Objectives for the Safety Program

- A description of how the stationary source ensures continuous management commitment, including:
  - A description of how senior stationary source staff has established detailed Safety Program goals for management with specific objectives and goals, and tracks management involvement in workplace safety meetings, audits, and related activities
  - A description of how the senior stationary source staff encourages and promotes "safety first" approach
    - A description of how the Safety Program elements are discussed in management meetings on a periodic basis
    - A description of how senior stationary source staff participates in specific Safety Program initiatives/programs (e.g., safety newsletters, safety slogans, bonuses for safety performance, near miss reporting, etc.)
  - A description of how senior stationary source staff is held accountable for their Health and Safety Program record, and how do the rewards and penalties compare to those for production performance
  - A description of how senior stationary source staff receives information on

incident and incident investigations and inspection/compliance audit reports
  - A description of how senior stationary source staff assist in the development of or issue specific types of Safety Program information and guidance
  - A description of how senior stationary source staff ensures that there is expertise available in each of the different Safety Program elements
  - A description of how the senior stationary source management ensures two-way communication between management and non-management personnel for the Safety Program elements, including what the elements consist of, implementing the Safety program elements, modifying the prevention elements, and the effectiveness of the Safety Program elements. Note: This you may have already been addressed in the employee participation section. If so, it does not have to be included in this section.

- A description of how the stationary source ensures the management system for the Safety Program elements are consistent with the Safety Program guidance developed by CCHS, CCHS CalARP Guidance Document Chapters 5, 7, and 8, the CalARP Program, Process Safety Management, and Industry Codes, Standards, and Guidelines as defined in 450-8.014(f) of the County Ordinance Code.

- A description of the roles and responsibilities for the required Safety Program elements
  - A description of how senior stationary source staff have been assigned overall responsibility to oversee compliance for the Safety Program

- A description of how the stationary source ensures that the Safety Program elements remain current and effective
  - A description of how senior stationary source staff periodically reviews the Safety Program elements for continuing appropriateness, adequacy, and effectiveness
  - A description of the stationary source's process to make changes when necessary to any of the Safety Program elements

E.3 HUMAN FACTORS

E.3.1 PROCESS HAZARD ANALYSIS

CCHS recommends that stationary sources develop a brief, site-specific overview of the method used to ensure inclusion of human factors in the Process Hazard Analysis process, including but not limited to:

- A description of the approach used to identify active failures or unsafe acts
- A description of the approach used to identify latent conditions that exist at the source,
  - selection process for questions from the Latent Conditions Checklist in Attachment A of Section B

  - description of approach if a method other that the Latent Conditions Checklist in Attachment A of Section B is used
- A description of the approach used to consider the effects of latent conditions on the frequency of and consequences associated with the active failure or unsafe act
- A description of the approach used to assess the adequacy of safeguards towards reducing the risk associated with the active failure or unsafe act.
- A description of the approach used to evaluate recommendations made during the explicit latent conditions review, if applicable, during the PHA
- A description of the approach used to include human factors and latent conditions in PHA revalidations
- A description of the approach used to determine whether a procedural PHA should be conducted and the method for conducting the procedural PHA

E.3.2 INCIDENT INVESTIGATION

CCHS recommends that stationary sources develop a brief, site-specific overview of the methods used to ensure compliance with the requirement to consider human systems as casual factors in incident investigations for two types of incidents: (1) actual Major Chemical Accidents or Releases or (2) incidents that could reasonably have resulted in a Major Chemical Accident or Release. Since the incident investigation for a Major Chemical Accident or Release must be a root cause analysis which is covered in Section E.4, and a Major Chemical Accident or Release must be described under Accident History in Section E.6, the discussion in this section regarding actual incidents should be consistent with these sections. For both types of incidents, the overview should include but is not limited to:

- A brief description of what a human system is (See Chapter V)
- A brief description of causal factors (See Chapter V)
- A description of the methodology used for considering human systems as causal factors for:
  - Major Chemical Accidents or Releases (this may be a reference to the root cause analysis Section E.4)
  - Incidents that could reasonably have resulted in a Major Chemical Accident or Release.
- Describe human systems considered as casual factors for both Major Chemical Accidents or Releases and incidents that could reasonably have resulted in a Major Chemical Accident or Release. (NOTE: The following information need not be discussed for incidents that occurred before the required date for implementation of the Human Factors Program.)
  - Describe or cite the incident
    - ♦ For Major Accidents or Releases (the stationary source may reference Accident History Section E.6.)
    - ♦ For incidents that could reasonably have resulted in a Major Chemical Accident or Release, the stationary source should describe the incident and potential impacts following the incident description outlined in Section E-6 as appropriate to put the human systems determined to be causal factors in context.

- Discuss the human systems determined to be causal factors. For Major Accidents or Releases, identify whether the human system was a contributing cause or root cause.

- Describe recommendations for improvements made as a result of the human systems considerations and the implementation of the recommendations.

E.3.3 OPERATING PROCEDURES

CCHS recommends that stationary sources develop a brief, site-specific overview of the method used to ensure inclusion of human factors in operating procedures, including but not limited to:

- A description of the approach used to evaluate the current situation (i.e., evaluate existing operating procedures)
- A description of the approach used to determine the activities that require written procedures
- A description of the approach used to develop operating procedures
  - Format selection
  - Participant selection
  - Method used (e.g., task analysis)
- A description of the approach used to maintain the procedures accurate and current
- A description of the approach used to ensure that the effects of procedural errors (i.e., consequences of deviation) are identified and fully understood
- A description of any special considerations taken when writing Emergency Operating Procedures

E.3.4 MANAGEMENT OF CHANGE

CCHS recommends that stationary sources develop a brief, site-specific overview of the method used to review staffing changes in permanent staffing levels/reorganization in operations or emergency response, including but not limited to:

- A description of the criteria used by personnel to determine when an MOC for an organizational change should be initiated
  - a description of how a physical change to the process or a change in procedures could trigger an organizational MOC
- A description of how the stationary source ensures that employees and their representatives, as appropriate, are consulted in the MOC
  - composition of “change team”, if applicable
  - criteria used to determine that a team approach is necessary
- A description of the method used by the stationary source to conduct the MOC including
  - defining the existing situation
  - developing the technical basis for the change
  - assessing the impact of the change on safety and health, including during emergency situations

- A description of how employees affected by the change are informed of, and trained in, the change prior to the change occurring
- A description of how the stationary source ensures that operating and emergency response procedures are updated accordingly

E.3.5 EMPLOYEE PARTICIPATION

CCHS recommends that stationary sources develop a brief, site-specific overview of the method used to ensure that employees and their representatives participate in the development of the written human factors program including but not limited to:

- A description of how employees and their representatives were selected to participate in the development of the human factors program
  - any training provided prior to beginning development
  - human factors committee members and meeting schedule, if appropriate
- A description of how employees and their representatives participated in the development of the human factors program
  - how input was solicited on the initial written program development
  - method for submitting comments
  - method for responding to all written comments
- A description of how employees and their representatives participated in the customization of the latent conditions checklist, if appropriate
- A description of how employees and their representatives participated in the implementation of human factors program
  - any special training provided to employees prior to their involvement in the implementation
  - evaluation and minimization of latent conditions
  - PHA
  - incident investigation
  - operating procedures
  - MOC for organizational changes

E.3.6 TRAINING

CCHS recommends that stationary sources develop a brief, site-specific overview of the method used to ensure that all employees are trained on the human factors program including but not limited to:

- A description of the method used to identify employees for training
  - basic awareness training
  - training on the human factors program
  - training necessary for employees to implement the human factors program

- A description of any basic awareness, human factors program, or specialized training provided

- curriculum of the course
- duration of the course
- instructor qualifications
- means used to ensure participants understood training

E.4 ROOT CAUSE ANALYSIS

Section C of this document describes the requirements and gives guidance for implementing a program for conducting Root Cause Analysis (RCA) following a Major Chemical Accident or Release. CCHS recommends that each stationary source develop a brief, site-specific overview of their implementation of the applicable requirements of the RCA procedure, including:

- Describe the purpose, depth of investigation, and objectives of a root cause analysis. If applicable, make reference to the root cause analyses cited in Section E6, Accident History, and the implementation of the resulting recommendations.

- Describe your Implementation and administrative requirements for the RCA procedure including:
  - Requirements or criteria for initiating a RCA.
  - Requirements for method or procedures for conducting RCA (e.g., Tap Root^{tm})
  - Requirements for make-up of a root cause analysis team
  - RCA team leader and members' qualifications and experience requirements
  - RCA team leader training and team member training requirements
  - RCA team leader responsibilities and team member responsibilities
  - RCA record retention requirements
  - Content requirements of RCA report
  - Requirements for formulation, addressing, resolving, and tracking recommendations
  - Requirements for communicating RCA report findings to employees (including contract, where appropriate), CCHS, the public, and other stationary sources as applicable. NOTE: Stationary sources have various outlets available for communicating with the public through CCHS (e.g., 72-hour reports, 30-day reports, 5-year accident histories) or for communicating with the public directly (e.g., statements to Board of Supervisors, press conferences, presentations to Community Advisory Panels (CAP's)). Depending upon the incident none, some, or all of these outlets may be applicable.

E.5 PROCESS HAZARD ANALYSIS/ACTION ITEMS

By identifying hazards associated with the design and operation of a covered process, you can manage these hazards to secure the safety of your employees, the community, and the environment. The purpose of performing a process hazard analysis (PHA) is to identify these hazards, determine if existing hazard safeguards are adequate, and where existing safeguards are inadequate, identify recommendations/action items that can be taken to mitigate the hazard. CCHS recommends that you develop a brief, site-specific overview of your PHA

process, including:

- A description of the approach used for conducting the PHA, including;
  - applicable external events[3], including seismic events;
  - human errors
  - equipment malfunctions
- The rationale used in selecting the PHA methodology;
- The rationale used to select the team conducting the PHA, including their qualifications;
- A description of the revalidation and updating procedures;
- A description of the method used to document and resolve recommendations/action items identified during the PHA; and
  - criteria applied to justifiably decline a recommendation
  - method used to ensure recommendation are incorporated within the prescribed time limits
- A description of the method used to ensure that inherently safer systems were considered in the development and analysis of mitigation items from the PHA's and in the design and review of new processes and facilities
- A description of those recommended action items selected for implementation, but not yet complete, that are expected to reduce the risk (severity or likelihood) of an incident which could have reasonably resulted in an offsite consequence as defined in the CalARP program regulations:
  (a) Toxic substances – Exceeding values provided in Appendix A to Title 19, Division 2, Chapter 4.5, Subchapter 1 "Table of Toxic Endpoints" NOTE: Stationary sources should consult with CCHS on an acceptable endpoint for regulated substances not listed in the "Table of Toxic Endpoints"
  (b) Flammable substances – Exceeding an overpressure of 1 psi or a radiant heat of 5 kw/m^2 for 40 seconds.

  NOTE: Stationary sources are continually conducting PHA's and PHA revalidations. Therefore, the list of selected action items that meet the appropriate criteria for inclusion in the Safety Plan could be continually changing. Stationary sources do not have to submit updates (other than the 3 year Safety Plan update) of the action items; however, they should be prepared to provide the current list to CCHS during on-site audits

  - The scheduled completion date for the action item and the reason it was not completed within a year (i.e., a shutdown is required to complete the action item), if appropriate.
  - The inherently safer systems considered during the development and analysis of the action item.

Additionally, we recommend the stationary source include the following information regarding the seismic assessment:

3 Included as part of the PHA is an analysis of external events associated with the process. External events are those occurrences whose causes are outside of the scope of the process, but which may impact the process and, in some cases, may initiate a release of a regulated substance.

- A list of all covered processes for which a seismic assessment was conducted;
- A description of the method the source uses to identify general/specific seismic hazards that may affect the stationary source (refer to the reference list in Appendix B, Seismic Assessment Guidelines, p. B-5.of the *Contra Costa County CalARP Program Guidance Document*);
- A description of the performance objective(s) used for the review (e.g., primary containment, maintain position, etc.);
- A discussion of the site relative to known active faults as defined by the State Geologist, as well as a discussion of any site-specific seismic hazards considered (e.g., liquefaction, fault rupture, etc.);
- A description of any design practices or standards used by the source to minimize the risk resulting from the identified seismic hazards; and
- A description of inspection and maintenance practices to maintain integrity of structural components.

E.6 ACCIDENT HISTORY

Section 450-8.016(E) of County Ordinance 98-48 requires facilities to include an accident history in the Safety Plan for all Major Chemical Accidents or Releases from June 1, 1992 through the date of Safety Plan submittal. A Major Chemical Accident or Release is defined as an incident that meets the definition of Level 2[4] or Level 3[5] Incident in the Community Warning System incident level classification system defined in the September 27, 1997 Contra Costa County guideline for the Community Warning System as determined by the Department; or results in the release including, but not limited to air, water, or soil of a regulated substance[6] and meets one or more of the following criteria:

- Results in one or more fatalities

[4] **Level 2**
- Off-site impact where eye, skin, nose and/or respiratory irritation may be possible
- Explosion with noise/pressure wave impact off-site
- Fire/smoke/plum (other than steam) visible off-site (does not include fire training exercises)

[5] **Level 3**
- Off-site impact that is expected to cause eye, skin, nose and/or respiratory irritation in the community (ERPG Level 2 concentration reading or greater).
- Explosion with off-site damage
- Fire, heat or smoke off-site impact
- Major fire and/or explosion
  Examples:(a) On a process unit (excluding precipitators and boilers) where mutual aid is requested to mitigate the event and the fire will last longer than 15 minutes; (b) Where the local fire department strikes multiple alarms to mitigate the event.

[6] **Regulated substance** means (1) any chemical substance which satisfies the provisions of California Health and Safety Code section 25532(g), as amended from time to time, or (2) a substance which satisfies the provisions of Hazard Categories A or B in section 84-63.1016. Mixtures containing less than 1% of a regulated substance shall not be considered in the determination of the presence of a regulated material.

- Results in greater than 24 hours of hospital treatment of three or more persons
- Causes on and/or off-site property damage (including clean-up and restoration activities) initially estimated at $500,000 or more. On-site estimates shall be performed by the stationary source. Off-site estimates shall be performed by appropriate agencies and compiled by the Department
- Results in a flammable vapor cloud of more than 5000 pounds

NOTE: the triggering criteria for this accident history is different than the five-year accident history required under the CalARP program regulations and described in Chapter 3 of the *Contra Costa County CalARP Program Guidance Document.*

Stationary sources must report the following information, where applicable and to the extent known. Subsequent reports (updates) must be provided to the Department annually (i.e., January 15, 2001, 2002, etc.):

- Date, time and approximate duration of the release
- Chemicals released
- Estimated quantity released in pounds
- Type of release event and its source
- Weather conditions at the time of the release
- On-site impacts
- Known off-site impacts
- Initiating event and contributing factors
- Root cause(s)
- Whether off-site responders were notified
- Operations or process changes that resulted from the investigation of the release

CCHS also recommends that stationary sources develop a brief, narrative description of the following elements, taken from Section 9.3.3 of the *Contra Costa County CalARP Program Guidance Document:*

- Include the name of the unit or operation where the accidental release occurred;

- Include information regarding the types of injuries (e.g., very minor requiring simple first aid, very serious requiring hospitalization) and the equipment or units involved in the property damage;

- Include information regarding the types of offsite injuries and medical treatment provided and whether evacuations and shelter in place were initiated (perhaps through the Community Warning System). The discussion should also include the property that was damaged and a description of any environmental damage that occurred;

- Include a description of the initiating event, rather than simply noting equipment failure, human error, or weather condition. The initiating event may be a combination of these (e.g., piping failure due to installation of pipe with incorrect metallurgy is an equipment

failure as a result of a human error).

- Include a description of the root cause and contributing factors;

- Include information regarding how the accidental release was discovered and how (and by whom) the offsite responders and various agencies were first contacted; and,

- Include specific information regarding the changes, including the status of implementation.

E.7 ANNUAL PERFORMANCE REVIEW AND EVALUATION

Section 450-8.030 of County Ordinance 98-48 requires the Department to annually (1) Review its activities to implement Chapter 450-8, Risk Management (2) Evaluate the effectiveness of the Risk Management Chapter in achieving it purpose and goals pursuant to the following:

- requiring the conduct of process hazard analyses for Covered Processes handling hazardous materials not covered by the Federal or State Risk Management Programs
- requiring the review of action items resulting from process hazard analyses and requiring completion of those action items selected by the Stationary Source for implementation within a reasonable time frame
- requiring the review of accidental release prevention efforts of Stationary Sources and providing for the conduct of investigations and analyses for the determination of the Root Cause for certain incidents
- providing review, inspection, auditing and safety requirements that are more stringent than those required in existing law and regulations
- providing for public input into the Safety Plan and Safety Program and public review of any inspection and audit results
- facilitating cooperation between industry, the County, and the public in the prevention and reduction of incidents at Stationary Sources
- expanding the application of certain provisions of the Federal and State Risk Management Programs to processes not covered by the Federal or State Risk Management Programs
- requiring the development and implementation of a written human factors program
- preventing and reducing the number, frequency, and severity of accidental releases in the County

The Department will conduct the annual performance review and evaluation in accordance with the following CCHS Policy and Procedures: *ISO Annual Performance Review and Evaluation Policy; Conducting the ISO Annual Performance Review and Evaluation; ISO Annual Performance Review and Evaluation Submission.* CCHS will prepare and submit an annual performance review and evaluation report containing this information for the Board of Supervisors on or before October 31, 2000 and each year thereafter. Stationary sources shall

coordinate with CCHS on the preparation of the following information:

- Summarize the status of the Stationary Source's Safety Plan and Program (450-8.030(B)(2)(i))
- Summarize safety Plan update information (i.e., brief explanation for update and corresponding date) (450-8.030(B)(2)(ii))
- List of locations where Safety Plans are available for review, including contact telephone numbers if the source will provide individuals with copies of the document (450-8.030(B)(2)(ii))
- Summarize annual accident history reports pursuant to Section 450-8.016(E)(2) of County Ordinance 98-48 (450-8.030(B)(2)(iii))
- Summary of each Root Cause Analysis (Section 450-8.016(C)) including the status of the analysis and the status of implementation of recommendations formulated during the analysis (450-8.030(B)(2)(iv))
- Summary of the status of implementation of recommendations formulated during audits, inspections, Root Cause Analyses, or Incident Investigations conducted by the Department (450-8.030(B)(2)(v))
- Summary of inherently safer systems implemented by the source including but not limited to inventory reduction (i.e., intensification) and substitution (450-8.030(2)(vi))
- Summarize the enforcement actions (including Notice of Deficiencies, Audit Reports, and any actions turned over to the *Contra Costa County District Attorney's Office*) taken with the Stationary Source pursuant to Section 450-8.028 of County Ordinance 98-48 (450-8.030(B)(2)(vii))
- Summarize total penalties assessed as a result of enforcement of this Chapter (450-8.030(B)(3))
- Summarize the total fees, service charges, and other assessments collected specifically for the support of the *ISO* (450-8.030(B)(4))
- Summarize total personnel and personnel years utilized by the jurisdiction to directly implement or administer this Chapter (450-8.030(B)(5))
- Copies of any comments received by the source (that may not have been received by the Department) regarding the effectiveness of the local program that raise public safety issues(450-8.030(B)(6))
- Summarize the impact of the Chapter in improving industrial safety (450-8.030(B)(7))
- Summarize the emergency response activities conducted at the source (e.g., CWS or CAN activation) in response to major chemical accidents or releases.

This information must be submitted in the initial Safety Plan (January 15, 2000). Annual updates must also be submitted beginning June 30, 2000 and occurring each year thereafter (i.e., June 30, 2001, 2002, etc.). **NOTE:** There are only five months between the initial Safety Plan submittal date and the first update of the performance review and evaluation data. If the submitted information has not changed within that time period, stationary sources may simply submit a written statement that the existing information is accurate and current.

E.8 CERTIFICATION

The owner or operator or senior official with management responsibility for your stationary source must sign and date the certification statement in your Safety Plan that reads "The undersigned certifies that, to the best of my knowledge, information, and belief formed after reasonable inquiry, the information submitted is true, accurate, and complete."

ATTACHMENT A: LATENT CONDITIONS

FILENAME:	AttachmentA.doc	**Review Date:**	
Checklist/Rev. Date:	December 2, 1999	**Location:**	
Prepared by:		**Unit/Project:**	

Checklist Questions	Y/N/ NA	Justification/Examples
1. INDIVIDUAL:		
Experience/Knowledge:		
1.1 Do employees remain in each unit for a sufficient amount of time to develop the experience and knowledge base necessary to safely operate the unit and respond to emergencies?[1]		
1.2 Is there experience available for each of the different Safety Programs, including Human Factors?[1]		
1.3 Are workers knowledgeable of the type and magnitude of the hazards associated with their work?[1]		
1.4 Are the worker's knowledge, skills, and abilities adequate to perform the job safely? [7]		
1.5 Do operators have sufficient knowledge to safely operate or shutdown the unit in emergency situations where they must assume manual control?[1]		
Stress/Fatigue/Substance Abuse:		
1.6 Are emergency procedures presented in a clear, step-by-step format to reduce the "panic" factor during upset situations? [2]		
1.7 Does the facility attempt to minimize exposing operators to physical obstacles or discomforts for prolonged periods (e,g,. poor accessibility of equipment, narrow and/or low crawl space, etc.) during normal operation?[3]		
1.8 Are there jobs that are beyond employees' physical limits or safe physical limits (e.g., carrying equipment, that requires both hands, up stairs that are poorly lighted at night?[1&8]		
1.9 Are periods of sustained concentration shorter than one hour (including emergencies) (i.e., is there adequate staffing and backup to accommodate mental and physical breaks? [8&1]		
1.10 Does the facility enforce a drug and alcohol testing program?[1]		
Shiftwork:		
1.11 Is the length of a normal shift appropriate given the degree of alertness required and potential for operator fatigue [*consider number of manual adjustments required in a single shift, effect of rotating shifts*]?[2]		
1.12 Is the length of a shift during startup and turnaround appropriate given the degree of alertness required and potential for operator fatigue? [2]		

Y = Concern raised by the question has already been addressed. No further documentation is required.
N = Concern raised by the question has <u>not</u> already been addressed. Further analysis and documentation are required. The PHA team should fully develop the concern using an approved PHA methodology.
NA = Concern raised by the question is not applicable for the area under consideration.

FILENAME:	AttachmentA.doc	**Review Date:**	
Checklist/Rev. Date:	December 2, 1999	**Location:**	
Prepared by:		**Unit/Project:**	

Checklist Questions	**Y/N/ NA**	**Justification/Examples**
1.13 Are shift turnover periods sufficient to adequately communicate plant operating conditions from off-shift to on-shift personnel? [2]		
1.14 Are shift turnover communications maintained in an accessible log?[9]		
1.15 Are job turnover communications within shifts adequate? [1]		
1.16 Are job turnover communications between shift adequate? [1]		
1.17 Are job turnover communications between shift operations and first line supervisors and managers adequate? [1]		
1.18 Are job turnover communications oral, allowing discussions and questions? [1]		
2. ACTIVITY/TASK:		
Procedures:		
2.1 Are procedures readily available?[3]		
2.2 Does the facility ensure that only current, approved versions of procedures are available?[1]		
2.3 Do written procedures exist for normal operation?[4]		
2.4 Do written procedures exist for startup? [6]		
2.5 Do written procedures exist for shutdown? [6]		
2.6 Do written procedures exist for emergency operations? [6]		
2.7 Do written procedures exist for unique or critical operating or maintenance tasks such as catalyst regeneration, catalyst sulfiding, etc.? [6 & 8]		
2.8 Are procedures updated on a scheduled basis? [3]		
2.9 Are procedures certified as being current and accurate?[1]		
2.10 Are steps written in clear, concise sentences? [5]		
2.11 Is the procedure difficult to use? [1]		
2.12 Were the procedures originally prepared and are they periodically reviewed with line-management and the other employees responsible for performing the designated tasks? [2]		
2.13 Does each procedure have a unique and permanent identifier? [5]		
2.14 Is there a simple indexing method for choosing the required procedure? [5]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
2.15 Do the titles accurately describe the nature of the procedure?[6]		
2.16 Is there a mechanism for keeping place in a sequence of instructions, so that it can be returned to after an interruption or distraction? [4]		
2.17 Does a different person subsequently make an independent check that mandatory procedures have been carried out? [4]		
2.18 Is the last page of the procedure clearly identified?[5]		
2.19 Are temporary procedures clearly identified? [5]		
2.20 Is all information necessary for performing the procedure included or referenced in the procedure? [5]		
2.21 Do Cautions, Warning, and Notes stand out from procedure steps? [5]		
2.22 If more than one person is required to perform the procedure, is the person responsible for performing each step identified? [5]		
2.23 If the procedure must be performed by someone with a special qualification, are the required technical skill levels identified? [5]		
2.24 Do the procedures require "sign-offs" for critical steps or when completion of the procedure may require coordination with others (e.g., numerous shifts or operators)? [5]		
2.25 If the step contains more than two items, are they listed rather than buried in the text? [5]		
2.26 Are steps that must be performed in a fixed sequence identified as such? [5]		
2.27 Are operating limits or specifications written in quantitative terms (i.e., "normal operating range for temperature is 200 degrees F to 250 degrees F" as opposed to "normal operating range for temperature is +/- 25 degrees F from setpoint)? [5]		
2.28 Are calculations clear and easy to understand? [5]		
2.29 For complicated or critical calculations, is a formula or table included or referenced? [5]		
2.30 Do emergency operating procedures contain provisions for verifying: *conditions associated with an emergency (initiating conditions)? *automatic actions associated with an emergency? *performance of critical actions? [5]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
2.31 When two or more procedures share a common sequence of operations, or working environment, do they contain checks that the operator is continuing to use the correct procedure?[4]		
2.32 Are the actual procedures used in the operator training programs?[4] (If no, go to question 2.31)		
2.33 If separate procedural training documents are used, are they consistent with the actual procedures? [4]		
2.34 Do the procedures contain enough detail to adequately enable a trained operator to perform all modes of operation? [6]		
2.35 Is equipment and instrumentation clearly labeled and are the equipment and instrument tag numbers used in the procedures? [6]		
2.36 Do procedures prevent changing alarm set points without proper review and authorization? [2]		
2.37 Are alarm changes (set point or priority) communicated to all affected employees? [2]		
2.38 Do procedures prevent changing process control system or safety shutdown system control or logic (software) without proper review and authorization? [2]		
2.39 Are process control system or safety shutdown system changes communicated to all affected employees? [2]		
2.40 Do operating procedures document the alarm set points? [2]		
2.41 Do the procedures specify the potential consequences if the alarm set points are exceeded (i.e., consequences of deviation)? [2]		
2.42 Do procedures require routine testing of critical alarms and safety shutdown systems, including primary elements or sensors, shutdown system control and logic, and final elements such as emergency isolation valves or equipment shutdown interlocks [*determine the need for on-line testing of safety shutdown systems*]? [2]		
2.43 Do operating crews communicate unusual equipment, control, or instrument status (bypassed or out of service) in writing? [2 &8]		
2.44 Are operating crews provided with written temporary operating procedures when equipment, controls, or instruments are bypassed or out of service? [2&8]		
2.45 Do procedures require verification that equipment, controls, or instruments that are deliberately disabled during operation (e.g., shutdown interlocks bypassed to allow testing) are placed back in service? [2&8]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
2.46 Do procedures require control valve bypasses to remain closed during normal operation [*possible concern for loss of level during upset conditions if the bypass around an LCV is open*]? [2]		
2.47 Do procedures specify proper response to alarm indicators (e.g., lights, horns, or whistles) during emergency situations? [2]		
2.48 Can emergency procedures be implemented whether or not the operator knows what is wrong (i.e., are they "symptom" based rather than "event" based)? [4]		
2.49 Do procedures require that individuals perform multiple tasks simultaneously that practically cannot be performed? [1]		
2.50 Do operators have time to respond in an emergency and report, in accordance with the procedures, appropriately? [1]		
2.51 Is there a feedback communication loop in place to determine the effectiveness and understanding of the procedures? [1]		
2.52 Does management provide the necessary expertise to write procedures and to implement the procedures? [1]		
2.55 Do procedures or controls prevent a vacuum from occurring in vessels during steamouts, prior to the introduction of hydrocarbons during startup? [8]		
2.56 Do procedures or controls ensure air is adequately displaced before startup? [8]		
2.57 Do procedures or controls ensure water is not present during warm-up that could vaporize and cause an upset?		
2.58 Do procedures or controls address the opening of vessels to the atmosphere? [8]		
2.59 Do procedures address any materials, which will auto-ignite if exposed to the atmosphere? [8]		
Practices:		
2.60 Does the facility attempt to minimize hazardous or high risk work during night shifts (i.e., does facility management recognize that individuals have a tendency to be less alert during night/early morning hours and take special precautions)? [1]		
Conflicts Between Practice and Procedure:		
2.61 Are the procedures consistent with actual operating practices, particularly operating practices responding to emergency or upset conditions? [1]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
3. PHYSICAL ENVIRONMENT/WORKPLACE		
Process Design and Labeling:		
3.1 Are remote startup/shutdown switches clearly labeled and protected from inadvertent operation? [2]		
3.2 Are remote switches for different systems separated by sufficient distance to prevent operation of the wrong system during stressful situations? [2]		
3.3 Are shutdown switches and other controls required for emergency operation readily accessible to the operator from a safe location? [3]		
3.4 Are drain valves located to allow personnel to monitor levels while draining? [2]		
3.5 Are there adequate vents and drains available? [8]		
3.6 Are the engineering units of similar instruments consistent [*e.g., do the pump seal flush rotameters all display flow in either gpm or gph*]? [2]		
3.7 Are field instrument indicators routinely checked for accuracy? [2]		
3.8 Are field instrument ranges appropriate for the service [*e.g., avoid using a 0-2500 psig pressure gage on a 100 psig system*]? [2]		
3.9 Are control valves and associated instrumentation accessible for maintenance? [2]		
3.10 Is equipment (e.g., emergency control valves, ladders) accessible in an emergency? [8]		
3.11 Are operating ranges for process variables specified in the same engineering units as the instrument read-out or indicator (i.e., mental conversion of units is avoided)? [2]		
3.12 Are there enough indications and controls available to adequately place the plant in a safe and stable state, or safely shutdown the plant, in the case of an emergency? [6]		
3.13 Are all equipment labels (e.g., vessels, piping, valves, instrumentation, etc.) easy to read (clear and in good condition)? [2]		
3.14 Are all equipment labels correct and unambiguous? [2]		
3.15 Are all equipment labels located close to the items that they identify? [2]		
3.16 Do all equipment labels use standard terminology (e.g., acronyms, abbreviations, equipment tags, etc.)? [2]		
3.17 Are the equipment labels consistent with nomenclature used in procedures? [2]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
3.18 Are all components that are mentioned in procedures (e.g., valves) labeled or otherwise identified? [2]		
3.19 Do switch labels identify discrete positions (e.g., ON or OFF, OPEN or CLOSE)? [2]		
3.20 Are signs (e.g., emergency exit, restricted entry, etc.) clearly visible [*consider location and condition*]? [2]		
3.21 Are the signs easy to read [*consider letter size and color*]? [2]		
3.22 Are pipelines and electrical conduit clearly labeled at points where they become invisible (e.g., routed underground)? [2]		
Control Room/Panel Design:		
3.23 Are displays of process control instrumentation clearly identified? [3]		
3.24 If displays are shared with another unit, does it cause any problems at times? [3]		
3.25 Does the process control system console layout allow for rapid response to upset situations? [2]		
3.26 If required, does the process control system console layout allow for response by multiple personnel? [2]		
3.27 Do the process control system displays adequately present the process information [*consider the logical layout of process or equipment configuration information, consistent presentation of information, visibility of information from various work positions, and the logical linking of information between displays*]? [2]		
3.28 Do the process control system displays for similar equipment (e.g., parallel trains or similar equipment in series) present the information in a unique manner to avoid confusion? [2]		
3.29 Are alarms or signals clear and distinguishable? [8]		
3.30 Do the process control system displays provide feedback to operations personnel to confirm operator actions? [2]		
3.31 Does the feedback provide operators with logical information (e.g., is 100% valve output equivalent to valve wide open)? [2]		
3.32 When a control action has been made, is there a display to indicate that the required plant change has been made(i.e., it is misleading only to indicate that the control signal has been sent)? [4]		
3.33 Is it easy to work at or move past the control panel without accidentally altering any of the controls? [4]		

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Checklist Questions	Y/N/ NA	Justification/Examples
3.34 Are emergency shutdown switches guarded against inadvertent operation [*consider location, switch operation, and guards or covers*]? [2]		
3.35 Are board-mounted shutdown switches or buttons sufficiently distinguishable/separated from alarm acknowledgment buttons to minimize inadvertent operation? [2]		
3.36 Are emergency isolation valves operable from the control room? [6]		
3.37 Can the operators or other personnel override automatically activated safeguards? [6]		
3.37.1Do(es) the control system(s) have test switch positions which allow bypass of safety features while performing test and calibration tasks? [6]		
3.37.2 If yes in 3.36.1, is there an indication available to the operators which shows that the control system is in a test mode and that the safety features are bypassed? [6]		
3.37.3 Is the test switch position administratively controlled? [6]		
3.38 Are the alarm indicators routinely tested? [2]		
3.39 Are control system display targets (touch screens) spaced adequately to prevent accidental operation? [2]		
3.40 Are the control system display symbols consistent and meaningful? [2]		
3.41 Are the control system display symbols standardized (i.e., consistent representation and common use of acronyms, abbreviations, and equipment tags)? [2]		
3.42 Do controls agree with strong population sterotypes for color (e.g., red means stop, green means run) and direction of movement (counterclockwise to open), etc.?[8]		
3.43 Can color blind, left-handed, etc. operators operate in the control room sufficiently?[8]		
3.44 Are critical alarms prioritized to alert operations personnel to upset situations that require immediate response? [2]		
3.45 Are alarms arranged, or otherwise coded, according to their level of urgency (i.e., is there an alarm priority system)?[4]		
3.46 Is the cause of "nuisance" alarms (repetitive alarms that operations personnel ignore or acknowledge without investigating) determined and repaired in a timely manner? [2]		
3.47 Are equipment "run" indicators (running lights or other process indicators) and valve position indicators provided at a continuously staffed location for critical equipment, valves, and instruments? [2]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
3.48 Will the keys for locked control functions be readily available during an emergency? (The items in question are the control functions that are generally locked during normal operation but may be required during a plant upset) [3]		
3.49 Are calculations performed by operations personnel documented in a consistent manner and periodically checked for correctness? [2]		
3.50 Does the level of automation allow sufficient operator involvement so operators do not feel detached from the process, particularly during emergency situations where they must assume manual control?[1]		
3.51 Are instruments, displays, and controls promptly repaired after malfunction?[8]		
3.52 Is sufficient lighting provided in the control room during a loss of power to allow operators to perform emergency actions?[9]		
3.53 Is it easy to communicate with related groups of workers (i.e., upstream and downstream processes, below or above in hierarchy of decision making)?[4]		
Hardware:		
3.54 Are all the tools and equipment necessary to perform the routine and necessary tasks available? [2]		
3.55 Are the tools and equipment provided suited for the tasks being conducted? [2]		
3.56 Are all tools required for special tasks and emergency operations available? [2&8]		
3.57 If an instrument is unreliable, is there other information which is conveniently located and which can be used for cross-checking?[4]		
Safeguards:		
3.58 Does the location of emergency personal protective equipment (e.g., fire gear, SCBA, acid suits, etc.) allow for rapid access and use? [2]		
3.59 Does the location of first aid supplies allow for rapid access and use? [2]		
3.60 Are escape routes clearly labeled, lighted, and maintained clear of obstacles? [2]		
3.61 Is the personal protective equipment acceptable to the workers? [2]		
3.62 Does the facility provide support for cleaning, maintaining, and storing personal protective equipment? [2]		
3.63 Does the protective gear allow freedom of movement necessary to perform necessary tasks (routine and emergency)?[8]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
Work Environment:		
3.64 Is the lighting adequate in the unit [*consider local instrument panels, battery or plot limit valve manifold locations, equipment and valves requiring operation during emergency conditions, etc.*]? [2]		
3.65 Is the emergency lighting (light fixtures on the emergency power circuit) adequate in the unit? [2]		
3.66 Is the control room lighting adequate [*review direct and indirect lighting*]? [2]		
3.67 Is the control room emergency lighting (light fixtures on the emergency power circuit) adequate? [2]		
3.68 Are the control building air conditioning and pressurization adequate to protect the electronic instrumentation? [2]		
3.69 Are the control building air conditioning and pressurization adequate to prevent intrusion of toxics, flammables, or corrosive contaminants (if applicable)? [2]		
3.70 Are environmental conditions, such as humidity, satisfactory? [3]		
3.71 Can the HVAC system in the control room be isolated quickly from outside air? [6]		
3.72 Are employees protected from excessive heat and cold? [1] **NOTE:** "Excessive" to the point that it affects mental workload and cognitive ability as opposed to physical harm (e.g., "I am so hot I cannot concentrate")		
3.73 Are employees protected from excessive noise? [1] **NOTE:** "Excessive" to the point that it affects mental workload and cognitive ability as opposed to physical harm (e.g., "It is so loud I cannot concentrate")		
4. ORGANIZATION/MANAGEMENT		
Communications:		
4.1 Are the communications facilities between process units adequate for clear and uninterrupted communications during both normal and emergency situations [*e.g., telephone land lines, radio, computer network, and E-mail, and are systems redundant and/or secure*]? [2]		
4.2 Is communications equipment adequate for the number of persons or stations who must communicate with each other? [6]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
4.3 Is the communication capability between operators, and between operators and the control room or other necessary locations adequate during normal operations and emergencies? [6]		
4.4 Are communications adequate to inform the worker of any hazards? [7]		
4.5 Are there good communication methods from upper management to line personal?[1]		
4.6 Are communications systems susceptible to electromagnetic interference during any operating mode of the plant? [6]		
4.7 Is there an environment of trust between on line workers and supervision, such that, feedback communications are used?[1]		
4.8 Are communications required at periodic intervals so that injured or incapacitated operators can be identified[6]		
Training:		
4.9 Are training requirements for the unit identified? [3]		
4.10 Are training methods developed? [3]		
4.11 Are process control operators and field operators cross-trained? [3]		
4.12 Are the effects of changes to process control operations clearly defined to the process control operator? [3]		
4.13 Does the operator training program cover all of the operating procedures and required operations, including emergency operations? [6]		
4.14 Is all training consistent with written procedures?[1]		
4.15 Is training given in the use of all job aids including procedures, and other ancillary and emergency equipment?[4]		
4.16 Are operating teams trained together in the transfer of information? [4]		
4.17 Are risks, penalties, and performance goals for both process and operator behavior emphasized during training? [4]		
4.18 Are operator training records up-to-date?" [3]		
4.19 Is there continuous and/or refresher training? [3]		
4.20 Is refresher training frequency adequate? [3]		
4.21 Does the facility assess the effectiveness of the training provided? [1]		
4.22 Are simulators used for teaching manual skills and fault handling? [4]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
4.23 Are the operators trained in diagnostic skills which will help them to cope in unfamiliar situations? [4]		
4.24 Is training provided in basic supporting skills such as chemistry, physics, and math?[1]		
4.25 Are hypothetical drills of emergency situations periodically performed, in accordance with established schedule?[7]		
4.26 Do hypothetical drills cover a variety of emergency situations (i.e., line failures, vapor releases, fires, spills, etc.?[1]		
Staffing/Overtime:		
4.27 Are staff levels (both size and experience) sufficient to handle routine and nonroutine duties that can be reasonably expected to occur during a shift? [2]		
4.28 Is an operator also an emergency responder (e.g., fire brigade member)? [3]		
4.29 Is there backup assistance when an operator emergency responder must respond to an emergency? [3]		
4.30 Can tasks requiring the operator to perform nearly simultaneous actions be accomplished without traveling large distances (e.g., switching unit rundown into an alternate rundown line, lighting furnace burners, etc.)? [2]		
4.31 Are sufficient tasks assigned during low activity operation to minimize the effects of boredom (e.g., possible loss of alertness)? [2]		
4.32 Are restrictions applied to employee overtime (e.g., employees are not allowed to work consecutive 12-hr. shifts)?[1]		
Worker Selection:		
4.33 Does the facility consider worker's skills and preferences in assigning people to jobs? [2]		
4.34 Are criteria for the choice of operator behavior clear?[4]		
4.35 Does the facility use results from job or tasks analysis as criteria for worker selection based on physical abilities, aptitudes, experience?		
Climate/Culture:		
4.36 Is a management philosophy that safety takes precedence over production adequately covered? [1]		

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4.37 Has the facility developed and implemented a "just" system for disciplining employees?(i.e., a blame-free atmosphere is unrealistic; however do employees feel that the discipline is fair)?[1]		
4.38 Are employees disciplined for taking risks to increase/maintain production without regard for safety?[1]		
4.39 Can operators resolve conflicts between productivity and safety?[4]		
4.40 Is there an attitude of non-penalization when an operator says there is a failure and there is not? [4]		
4.41 Is upper management's commitment to employee health and safety clear (do *sincere* policy statements exist that communicate this commitment?)[8]		
4.42 Have supervisors and workers been specifically told to err on the safe side whenever they perceive a conflict between safety and production?[2]		
4.43 Do workers understand they have the authority to shutdown unsafe operations or maintenance activities? [1&7]		
4.44 Do workers feel that unsafe operations or maintenance activities can be shutdown without fear of retaliation?[1 &7]		
4.45 Is the immediate supervision and instructions provided by first line supervisors adequate? [1]		
4.46 Is job planning by supervisors adequate? [1]		
4.47 Do the rewards and penalties for safety compare to those for production performance (i.e., equal rewards for safety performance and production)For example, do employees receive a company hat for safety rewards and substantial monetary rewards for production?[1&2]		
4.48 Have there been site goals and objectives established for the Safety Program elements at all levels of the organization?[1]		
4.49 Does the stationary source communicate their Incidents and Safety Program with their neighboring community? This includes working with Contra Costa Health Services in preparing for public meetings on the Safety Programs.[1]		
4.50 Does senior management promote the understanding of the different Safety Program elements, including Human Factors?[1]		
4.51 Are managers held accountable for their health and safety record? [2]		
4.52 Are members of management or facility units/department rewarded or penalized for good/bad performance (e.g., bonuses, delayed promotions) [2]		

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Checklist Questions	**Y/N/ NA**	**Justification/Examples**
Management System:		
4.53 Are operators' individual responsibilities clearly defined? [3]		
4.54 Is there a team responsibility for operating a unit? [3]		
4.55 Does the facility consult with workers when there are changes in production and when improvements are needed for safer, easier, and more efficient work? [2]		
4.56 Has the facility established clear lines of accountability for the administration and enforcement of contract requirements? [2]		
4.57 Is there a clear line of authority and responsibility from the workers up through management? [1]		
4.58 Does senior management establish safety-related policies to promote a safe work environment? [9]		
4.59 Is senior management involved in the site wide prioritization of work? [7]		
4.60 Does senior management institutionalize the stop-work authority philosophy? [7]		
4.61 Is senior management aware of previous safety-related incidents? [7]		
4.62 Is senior management visibly involved in assessing safety-related policy implementation? [7]		
4.63 Does senior management use lessons learned/feedback from previous incidents to prevent future similar incidents? [7]		
4.64 Does senior management prohibit contract terms and conditions that are not consistent with safe working conditions (e.g., accelerated schedules, reduced quality requirements)? [7]		
4.65 Does middle management implement policy through plans and programs development? [7]		
4.66 Is middle management aware of the status of plans and program implementation? [7]		
4.67 When problems occur, does middle management request feedback on the nature of problems? [7]		
4.68 Does middle management have a system for monitoring and measuring organizational performance? [7]		
4.69 Is stop-work authority communicated to the organization from middle management? [7]		

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Checklist Questions	Y/N/ NA	Justification/Examples
4.70 Is middle management involved in the development and implementation of corrective actions? [7]		
4.71 Does lower management ensure that required procedures are developed and kept current to assure a safe work environment? [7]		
4.72 Does lower management implement required programs for worker safety? [7]		
4.73 Is lower management aware of problems regarding procedure implementation and compliance? [7]		
4.74 Is lower management involved in the work planning, control, and execution process? [7]		
4.75 Does lower management have a system for eliciting feedback on work-related hazards? [7]		
4.76 Does lower management have a system for identifying and disseminating work process lessons learned? [7]		
4.77 Does lower management define stop-work authority for first line supervisors and their staff? [7]		
4.78 Does lower management take timely corrective actions when problems occur or are identified? [7]		
4.79 Are the first line supervisors' work instructions adequate to allow the work to be performed safely? [7]		
4.80 Are required procedures provided or communicated to the worker by supervision? [7]		
4.81 Do first line supervisors provide the required training to the worker? [7]		
4.82 Do first line supervisors discuss job hazards with workers prior to starting work? [7]		
4.83 Do first line supervisors define stop-work authority for workers? [7]		
4.84 Do first line supervisors confirm the readiness to perform work prior to the execution of work? [7]		
4.85 Do first line supervisors provide the worker with the proper tools and equipment to perform the work safely? [7]		
4.86 Do first line supervisors provide feedback to management on prior incidents and/or safety concerns? [7]		
4.87 Do first line supervisors implement timely corrective actions based on previous incidents? [7]		

Y = Concern raised by the question has already been addressed. No further documentation is required.
N = Concern raised by the question has not already been addressed. Further analysis and documentation are required. The PHA team should fully develop the concern using an approved PHA methodology.
NA = Concern raised by the question is not applicable for the area under consideration.

FILENAME:	AttachmentA.doc	**Review Date:**	
Checklist/Rev. Date:	December 2, 1999	**Location:**	
Prepared by:		**Unit/Project:**	

Checklist Questions	Y/N/ NA	Justification/Examples
4.88 Are Safety Program elements discussed in management meetings on a periodic basis?[1]		
4.89 Does senior staff establish detailed Safety Program goals for management with specific objective and goals, and tracks management involvement in workplace safety meetings, audits, and related activities?[1]		
4.90 Does management periodically review the Safety Program management system for continuing appropriateness, adequacy and effectiveness?[1]		
4.91 Does senior staff participate in specific Safety Program initiatives/programs?[1]		
4.92 Is the senior staff is held accountable for their health and Safety Program record?[1]		
4.93 Does senior staff ensure that there is expertise available in each of the different Safety Program elements, including Human Factors?[1]		
4.94 Does senior staff allocate time and resources for the different Safety Program elements?[1]		
4.95 Has management been assigned overall responsibility to oversee compliance for the Safety Program?[1]		

[1] CCHS
[2] EQE PHA Checklist: Human Factors, developed for and used by Chevron and Tosco (1996)
[3] MRC Human Factors Review Checklist (1994)
[4] Primatech Human Factors Checklist (1994)
[5] Guide to Reducing Human Error In Process Operation, Short Version (1985)
[6] CCPS, Guidelines for Writing Effective Operating and Maintenance Procedures (1996)
[7] U.S. Department of Energy workbook for Conducting Accident Investigations, Revision 1, November 21, 1999
[8] RRS Engineering Human Factors Checklist (1999)
[9] AcuTech (1999)
[10] CMA's A Manager's Guide to Reducing Human Errors (1990)

Y = Concern raised by the question has already been addressed. No further documentation is required.
N = Concern raised by the question has not already been addressed. Further analysis and documentation are required. The PHA team should fully develop the concern using an approved PHA methodology.
NA = Concern raised by the question is not applicable for the area under consideration.

ATTACHMENT B: SAMPLE WORKSHEETS FROM CMA'S MANAGEMENT OF SAFETY AND HEALTH DURING ORGANIZATIONAL CHANGE

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CHEMICAL MANUFACTURERS ASSOCIATION (1998)

Management of Safety and Health During Organizational Change

A Resource and Tool Kit for Organizations Facing Change

FOREWORD AND DISCLAIMER

The guide is intended for the safety manager or professional familiar with safety and health management. It suggests a process that may be used to manage safety and health during organizational change, and provides sample worksheets and checklists as appendices. Although directed specifically to safety and health at the plant level, the concepts may also be adaptable to related areas such as environmental protection, quality assurance, occupational health, and more.

This guide is necessarily general in nature and leaves resolution of site-specific circumstances to the user. The samples and figures presented in this guide are intended to illustrate the principles discussed and represent only one option for managing safety and health during organizational change. **The guide is not intended to represent uniform or mandatory industry practice, and its use is purely voluntary.** Users of this guide have an independent obligation to ascertain that their actions comply with existing federal, state and local laws and regulations, and should consult with legal counsel concerning such matters. Users of this guide also have an independent obligation to ascertain that their actions represent sound practices, and should evaluate organizational change in light of the specific facts and circumstances of their particular case.

The information contained in this document is current as of the date of publication. The reader should be alert to changes in any applicable standards and regulations after the publication date of this document.

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APPENDICES

FIGURES

INTRODUCTION

1.0 General

Change is an important and necessary part of a vital and growing organization, and many chemical plants are undergoing or contemplating significant organizational change. Such changes may be the result of redesign (re-engineering) of the workplace, new technology, downsizing, changing workforce, acquisitions, mergers, or regulations. Regardless of the cause, organizational change can cause permanent or transitory changes in work load, roles and responsibilities, and the manner in which work is done. Such changes can affect formal and informal work processes and the employees, with attendant stress on the organization. In addition, the organizational change may result in disruption of safety and health management, changes in available human and financial resources, reduction in experience levels, and revisions to safety-critical work processes. These factors could lead to inadvertent deterioration of safety and health performance.

"Process safety management of change" for operating facilities is now generally well-understood and work processes and procedures for evaluating such changes are widely used. However, the application of similar work processes for organizational change is not as well developed or widely used.

1.1 Objective

The resource and tool kit is intended for use by the safety and health professional or manager in a facility facing organizational change. It describes a process that may be used to plan for and manage safety and health during organizational change, and provides useful worksheets and checklists as appendices. The process in this guide is only one option for managing safety and health during organizational change. The process should be adapted as appropriate for the facility and can be integrated into any overall plant effort to plan and implement the change.

1.2 Potential Benefits

Without planning, significant organizational change may result in inadvertent lack of emphasis on safety and health management, the loss of established formal and informal safety processes, and deterioration of performance. With proper planning, safety and health performance can be mai ntained, and the organizational change can even become an opportunity for improvement.

IN ADDITION TO ITS INTENDED PURPOSE OF ASSISTING MANAGEMENT OF SAFETY AND HEALTH DURING SPECIFIC ORGANIZATIONAL CHANGES, THE CONCEPTS AND TOOLS CONTAINED HEREIN - ONCE PRACTICED - MAY BECOME PART OF THE PLANT'S CULTURE, JUST AS MANAGEMENT OF OTHER TYPES OF CHANGE IS NOW WELL ESTABLISHED.

SCOPE AND APPLICATION

2.0 General

This publication is intended for manufacturing facilities (plants) where significant organizational change may be pending or underway. It is primarily a planning tool, but may also be used to evaluate change already in progress. Although directed specifically to safety and health at the plant level, the concepts may also be adaptable to related areas such as environmental protection and quality assurance. With suitable adaptation, it may also have use in other parts of an organization.

2.1 Potentially Affected Positions and Work Processes

Depending on nature and scope of the organizational changes, a number of safety-critical positions may be affected. For example:

- Operator positions may be consolidated
- Self-directed work teams may be established
- Supervisory positions may be eliminated
- The span of control for supervisors or other managers may be increased
- Maintenance (craft) assignments may be revised, or multi-craft teams established
- Manager positions may be reduced and areas of responsibility changed
- Technical and quality assurance assignments may be revised
- Safety and health positions may be eliminated

As a result, many traditional roles and responsibilities may change, affecting the manner in which work is done, by whom, and the system of checks and balances that have evolved within a plant's culture. These changes in roles and responsibilities may affect formal and informal work processes and procedures, such as:

- Safety and health management systems
- Operating procedures
- Safe work authorization and permitting
- Special work authorizations (hot work, confined space, lockout/tagout, hot tapping, flare entry)
- Safety and health training needed or delivered
- Emergency response capability
- Undocumented or informal safety cultures, practices, and norms

The above lists illustrate some potential areas of concern and are not meant to be inclusive.

2.2 Relationship to Overall Plant Effort

In many cases, a special plantwide effort may be underway to plan and implement the organizational changes being contemplated. Managing safety and health should be considered as an integral part of that effort. This resource and tool kit is intended for the safety and health manager or professional (hereinafter "safety liaison") who should be an integral part of the overall "change team." Depending on the scope and nature of the change, the application or use of the materials in this publication may also involve other plant personnel.

2.3 Adapting to Specific Needs or Limited Scope

The scope and nature of organizational change being contemplated can vary significantly. For example, in some cases the organizational change may be limited to specific departments, or otherwise limited in scope and potential safety and health impacts. While the process and tools provided were designed with significant or plantwide changes in mind, they may also be useful for changes of limited scope. The process and tools suggested in this publication may be adapted as appropriate to the need.

A PROCESS FOR MANAGING SAFETY AND HEALTH DURING ORGANIZATIONAL CHANGE

3.0 General

The overall process for managing safety and health during organizational change consists of three broad areas of activity. These are:

- Understanding the change
- Planning for the change
- Implementation and monitoring

A more detailed eight-step process is outlined. The steps are described below, and shown in Figure 1. In addition, sample worksheets and checklists are provided in the appendices. The process described in this guide is only one option for managing potential impacts to safety and health during organizational change. The steps, figure, sample worksheets and sample checklists are not intended to represent uniform industry practices. Rather, they are intended to illustrate the principles discussed in the example framework provided in this guide.

3.1 Understanding the Organizational Change

The first step in managing safety and health during organizational change is to understand the nature and scope of the pending change. One starting point may be to obtain management direction and input on the purpose, scope and potential timing of the change. A next step is to confer with the plant "change team" to obtain its input. In some cases, a single meeting between management, the "change team" and the safety liaison may be preferred.

Using this input and working as part of the overall plant "change team," the plant safety liaison should consider characterizing the planned changes by establishing a written description of the purpose and scope of the change, the potentially affected positions and work processes, and the timing. Understanding the organizational change is fundamental to anticipating possible problems and safety improvement opportunities. The written description can also be used to promote communication and common understanding between the overall "change team" and the safety liaison.

It is also likely that the plant's vision of the organizational changes may continue to evolve while the process of evaluating safety-related aspects of the change is underway (i.e., the change may be a moving target). Any written description can be updated as appropriate as the planned changes evolve.

The first page of the sample worksheet *Understanding the Organizational Change* (Appendix A) is intended to help the safety liaison and the plant "change team" understand and communicate the nature and scope of the pending change.

3.2 Identifying Potential Safety and Health Impacts (Screening)

Next, the facility can determine the personnel (positions) affected by the change and consider performing a preliminary screening to identify the affected work processes, prioritizing the importance of each. This suggests a systematic approach to consider the effects of the change on all aspects of safety and health, aided by an inventory checklist. This step produces a "going-in" assessment of the potential safety and health impacts of the organizational change. This assessment can help to identify the most important concerns and the areas where more detailed evaluation using the other worksheets and checklists may be appropriate. Pages 2-3 of the sample worksheet *Understanding the Organizational Change* (Appendix A) can assist this process. A simple "high-medium-low" prioritizing system can be used to set priorities.

Good documentation skills should be used in creating documents of this nature and appropriate personnel should be involved to approve the document as final. The emerging Appendix A worksheet should be reviewed with the "change team" and management as appropriate. In addition, involvement of other appropriate functions or disciplines, including legal, is critical prior to completion. When completed, the Appendix A worksheet may be used to summarize a common front-end vision of the safety and health aspects of the organizational change.

Depending upon the nature and scope of the change, the Appendix A worksheet may be prepared by the safety liaison (for small changes), or completed by a group in a brainstorming session as appropriate. The group could be the plant's "change team" or a special group assembled for the purpose, with representatives of various levels from affected departments (safety, operations, maintenance, etc.).

3.3 Integrating Safety and Health Management into the Organizational Change Design

As discussed, significant organizational change may be under the direction of a plantwide team established by and reporting to local management. Communications with employees regarding the planned changes and the process being used to manage the changes will likely be coordinated through this plantwide effort. Since concern for maintaining or improving safety and health during the change may be of interest to many, consideration should be given to communicating the planned approach to safety and health as part of the overall dialogue or communication with the workforce.

3.4 Assessing Potential Safety and Health Impacts and Opportunities

The next step may be to assess the potential safety and health impacts and opportunities for improvement resulting from the change. Building upon step 3.2, the facility should consider performing a more detailed assessment. Again, any written assessment should be drafted in accordance with good documentation skills and should involve the appropriate functions including legal, prior to completion.

Depending upon nature and scope of the change, areas to be addressed may include, but are not limited to, the following:

- Safety and Health Management
- Safety and Health Training
- Safe Work Practices
- Process Safety Management (PSM) Elements
- Contractor Safety
- Emergency Response
- Safety and Health Regulatory Compliance
- Occupational Health
- Operations Safety Effectiveness
- Craft Safety Effectiveness

To assist assessment of safety and health impacts and opportunities, sample checklists for each of the above are provided in the *Safety and Health Checklists* (Appendix B). The appropriate portions of the Appendix B checklists could be completed by the safety liaison or by a special group assembled for this purpose, with representatives of various levels from affected departments. The safety liaison should consider adding to the checklists as appropriate for the facility.

In the course of completing the Appendix B checklists, it may become apparent that a more detailed analysis (exceeding the depth of the checklist) is needed, or additional safety-sensitive concerns may be identified for which no checklist is provided. In such cases, one approach is to assemble a team with the appropriate expertise to conduct a more in-depth review of the issue, functioning in a manner much like a process hazards analysis (PHA) team. For example, some aspects of work authorization and permitting may require input from a multidisciplinary team, exploring issues not reached by the questions on the sample checklist. As another example, craft safety effectiveness may require more detailed analysis, benefiting from the synergism of an appropriate team. A sample generic worksheet for a more in-depth review is in the *General Purpose Worksheet* (Appendix C).

The completed worksheets can then be used to prepare a list of proposed actions to address any potential impacts as appropriate.

3.5 Developing an Action Plan and Monitoring

The Appendix worksheets and checklists described above are constructed in a manner to assist facilities in identifying potential concerns and listing possible actions. Using the completed worksheets, the safety liaison or team can prepare a proposed action plan. The safety liaison should consider reviewing the proposed actions with the plant "change team" and management, as appropriate. Agreed-upon actions can be assigned and target completion dates established.

Another planning step for consideration is monitoring the change process through the identification of leading safety and health indicators or key work processes and preparation of a plan for monitoring these during implementation of the change. For example, the change team may decide that work authorization and permitting and craft safety effectiveness should be monitored as important leading indicators of success or potential problems. The plan should incorporate monitoring such leading indicators. While this monitoring will be performed in Step 3.8, the monitoring protocol can be designed before implementing the change. The sample worksheet *Monitoring Implementation* (Appendix D) is a tool for planning the monitoring process.

The final action plan, consisting of agreed-upon actions and an approved plan for monitoring, is then ready for implementation.

3.6 Communicating the Plan

As a logical continuation of the workforce communication begun in step 3.3, the approved safety and health management action plan can be summarized and communicated to the workforce as appropriate. This communication can occur within the framework and tenor of other communications regarding the overall change or as a separate safety initiative to deal with the change. The potential benefits of an informed workforce include easier and faster implementation of the actions, familiarity with (and feedback on) the planned monitoring process, and even improved understanding and support for the change itself.

3.7 Assessing Readiness

Prior to implementing the change, the facility should consider conducting the equivalent of a "pre-startup safety review" to assess the state of readiness for the planned change. This review could address the status of the agreed-upon action items and the plan for monitoring the success of the change. Appropriate personnel, e.g., plant management, should review the state of readiness and give final approval to implement.

3.8 Monitoring Implementation

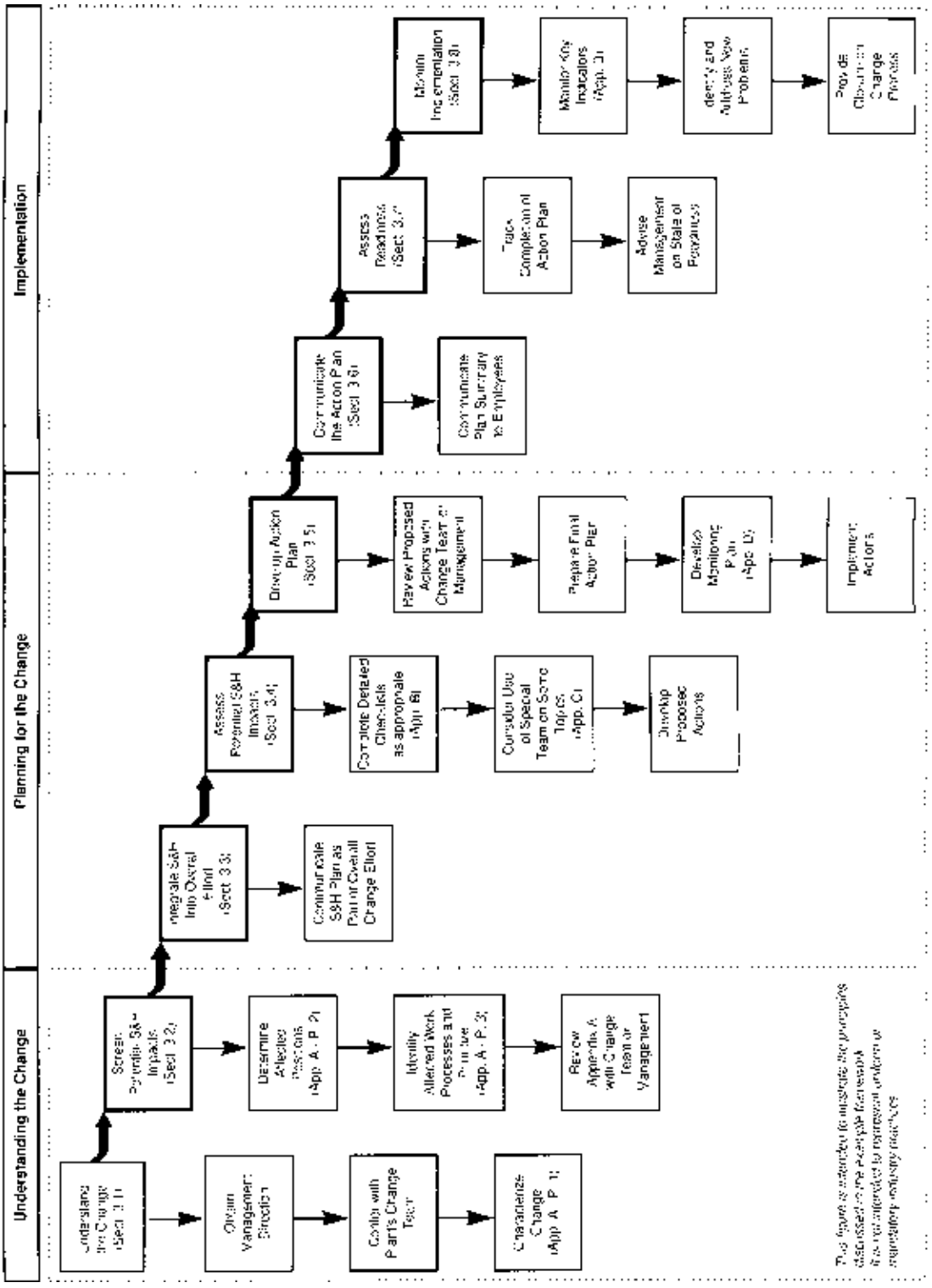
When the change has been initiated, the plan for monitoring implementation should be

followed, as discussed in section 3.5.

New issues or concerns may become apparent during implementation, requiring additional action items or adjustments to the action plan. These should be addressed as they emerge to identify suitable actions.

It is important to reach an appropriate closure on the special effort to manage safety and health during organizational change and to consider communicating that closure to the workforce. This might entail a summary communication to employees regarding the lessons learned, new procedures or responsibilities which will become part of the culture, and actions still pending (if any).

FIGURE 1: Process for Managing Safety and Health During Organizational Change



Appendix A

Sample Worksheet
Understanding the Organizational Change

Appendix A contains sample worksheets. These samples are intended to serve as a tool for understanding the organizational change and identifying potential safety and health impacts. Users should adapt these worksheets to meet their particular needs. These samples are not intended to be all-inclusive.

The samples in this appendix are intended to illustrate the principles discussed and represent only one option for managing safety and health during organizational change. These samples are not intended to represent uniform or mandatory practices.

In addition, these worksheets should be drafted in accordance with good documentation skills. All appropriate functions or disciplines, including legal, should be involved prior to completion.

APPENDIX A

SAMPLE WORKSHEET -- UNDERSTANDING THE ORGANIZATIONAL CHANGE

Purpose:	A tool for understanding the organizational change and identifying potential safety and health impacts (screening)
When used:	In steps 3.1, Understanding the Organizational Change; and 3.2, Identifying Potential Safety and Health Impacts
Prepared by:	Safety liaison, or special multi-functional group created for the purpose
Used by:	Safety liaison or change team

DESCRIPTION OF ORGANIZATIONAL CHANGE
General Description of Organizational Change:
Purpose of Change:
Scope of Change:
Timing:

IDENTIFYING POTENTIAL SAFETY AND HEALTH IMPACTS - POSITION SCREENING			
Positions Affected	**Description**	**Potential Safety Impact**	**Priority1**
Operations (list)			
Maintenance (list)			
Supervisors			
Managers			
Safety			
Industrial Hygiene			
Staff (oprns, mtce, HR, etc)			
Security			
Other			

1 Suggested three-tiered priority system H = high; M = medium; L = low

IDENTIFYING POTENTIAL SAFETY AND HEALTH IMPACTS - WORK PROCESS SCREENING		
Work or Process Affected	**Potential Safety Impact**	**Priority2**
Safety & Health Management		
Line mgmt. involvement		
Injury/illness recordkeeping		
Injury/illness investigation		
Departmental safety meetings		
Routine self safety audits/inspections		
Accident/incident reporting		
Safety suggestion systems		
Safety/Health committees		
Safety/Health performance appraisals		
Observation programs		
Enforcement & corrective action		
Safe Work Practices		
Work authorization (permitting)		
Confined space entry procedure		
Lockout/tagout procedure		
Hot work procedure		
Firewatch procedure		
Flare entry procedure		
Other		
Safety & health training		
Process safety management		
Contractor safety		
Emergency response		
S & H regulatory compliance		

2 Suggested three-tiered priority system H = high; M = medium; L = low

IDENTIFYING POTENTIAL SAFETY AND HEALTH IMPACTS - WORK PROCESS SCREENING		
Work or Process Affected	**Potential Safety Impact**	**Priority2**
Occupational health program		
Operations safety effectiveness		
Craft safety effectiveness		

Appendix B

Sample Safety and Health Checklists

Appendix B contains sample checklists. These samples are intended to serve as a tool for assessing safety and health impacts of organizational change and identifying potential corrective actions. Users should adapt these checklists to meet their particular needs. These samples are not intended to be all-inclusive.

The samples in this appendix are intended to illustrate the principles discussed and represent only one option for managing safety and health during organizational change. These samples are not intended to represent uniform or mandatory practices.

In addition, these worksheets should be drafted in accordance with good documentation skills. All appropriate functions or disciplines, including legal, should be involved prior to completion. Facilities should also consider documenting resolution for each potential issue identified during the process. The resolution may be an action plan or the conclusion that no additional action is necessary.

CONTENTS

APPENDIX B SAMPLE CHECKLISTS

SAMPLE #1 HEALTH & SAFETY MANAGEMENT CHECKLIST					
Could The Change…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Affect the **reality** of line management commitment to safety?					
Affect the **perception** of line management commitment to safety?					
Affect the visibility of line management in the plant (i.e., walking the talk?)					
Affect accountability for safety?					
Require revision or consideration of the S&H Policy statement?					
Require revision of the safety manual(s) or booklet(s) for the facility?					
Require revision to safety awareness programs?					
Require changes in the manner in which departmental safety meetings are done?					
Require changes in the manner in which safety bulletins or periodical newsletters are prepared or issued?					
Require changes in the way that safety and health information is communicated?					
Affect the injury and illness reporting and investigation procedure?					
Affect the involvement of direct supervision in the management of workplace injury and illness cases?					

SAMPLE #1 HEALTH & SAFETY MANAGEMENT CHECKLIST					
Could The Change…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Affect the manner in which safety performance data are collected, analyzed and reported?					
Affect the manner in which safety performance goals or targets are established?					
Require revisions to written role descriptions for managers, supervisors, technical staff, operators, maintenance crafts or other safety-critical personnel?					
Potentially affect the community?					
Necessitate discussions with the community about the change?					
Require changes in the way that drug and alcohol control policies are administered?					

SAMPLE #2 HEALTH & SAFETY TRAINING CHECKLIST					
Could The Change…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Require changes to the safety training **programs** for the **plant** as a whole?					
Require changes to the safety training					

SAMPLE #2 HEALTH & SAFETY TRAINING CHECKLIST					
Could The Change…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
materials (i.e., workbooks, videos, etc.) for the **plant** as a whole?					
Require changes to the safety training programs within **departments**?					
Require changes to the safety training **materials** (i.e., workbooks, videos, etc.) within **departments**?					
Require new or different instructors who must be trained?					
Result in changes in safety procedures which will require new or additional training?					
Require training of existing employees in procedures or practices that will be new to them?					
Require changes in "on-the-job" training?					
Affect "hands-on" application support?					
Result in changes in how the safety training recordkeeping system functions?					
Require special "one-time" training to implement the change?					

SAMPLE #3 SAFE WORK PRACTICES CHECKLIST					
Could The Change Require Changes In…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Procedures or personnel involved in removing equipment from service or					

SAMPLE #3 SAFE WORK PRACTICES CHECKLIST					
Could The Change Require Changes In…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
preparing it for maintenance?					
Blinding or isolation procedures?					
Work authorization procedures?					
Vehicular entry procedures?					
Confined space entry procedure (see also S & H Regulations Checklist)					
Lockout/Tagout procedures ? (see also S & H Regulations Checklist)					
Hot work authorization procedures?					
Hot tap procedure?					
Fire watch procedures?					
Flare entry (opening) procedures?					
Temporary connection procedures?					
Periodic audits of equipment? (e.g., operator audits or verifications)					

SAMPLE #4 PROCESS SAFETY MANAGEMENT (PSM) CHECKLIST					
Could The Change Require Changes In…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Employee participation?					
Process safety information?					
Process hazard analyses?					
Operating procedures?					
Training?					
Contractors? (see also separate section)					
Pre-startup safety review?					
Mechanical integrity?					
Hot work permit?					
Management of change procedures?					
Incident investigation procedures?					
Emergency planning and response? (see also separate section)					
Compliance audits?					

SAMPLE #5 CONTRACTOR SAFETY CHECKLIST

Could The Change Require Changes In …	Yes/ No	Possible Effect	Action To Maintain Or Improve Safety	Action For	By (Date)
Persons responsible for implementing a contractor S&H program?					
New contractors in the plant?					
Types of work performed by contractors?					
Contractor pre-qualification procedures?					
Owner's S&H requirements for contractors?					
Owner's pre-bid package for contractors?					
Contractor selection process?					
Pre-job activities?					
Contractor S&H statistical reporting?					
Inspections and audits of contractor work in progress?					
Investigation of contractor incidents?					
Contractor emergency drills and exercises?					
Periodic evaluation of contractor's safety & health performance?					

SAMPLE #6 EMERGENCY RESPONSE CHECKLIST					
Could The Change Require Changes In …	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**

SAMPLE #6 EMERGENCY RESPONSE CHECKLIST					
Could The Change Require Changes In …	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
The plant's written emergency response plans?					
The personnel who respond to emergencies as part of an organized response team?					
The personnel who respond to emergencies within a department?					
The plant's emergency alarm or notification system?					
The procedures for notifying off-duty personnel to respond to an emergency?					
The incident command system?					
Emergency response training?					
Personnel needing emergency response training?					
Compliance program or strategy for emergency response regulations? (see also S&H Regulatory Checklist)					

SAMPLE #7 SAFETY AND HEALTH REGULATORY COMPLIANCE CHECKLIST FOR SELECTED REGULATIONS					
Could The Change Require Changes In Compliance Programs For…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**

SAMPLE #7 SAFETY AND HEALTH REGULATORY COMPLIANCE CHECKLIST FOR SELECTED REGULATIONS					
Could The Change Require Changes In Compliance Programs For…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
OSHA (General)					
Injury/illness recordkeeping (29 CFR Part 1904)?					
Handling OSHA inspections?					
OSHA General Industry Work Practices					
Lockout/tagout (29 CFR 1910.147)?					
Confined space entry (29 CFR 1910.146)?					
Electrical safety - General Industry (29 CFR Subpart S)?					
Electrical safety - Special Industries (29 CFR 1910.269)?					
OSHA Emergency Response					
Emergency and fire prevention plans (29 CFR 1910.38)?					
Fire brigades (29 CFR 1910.156)?					
Hazardous waste operations and emergency response (Hazwoper) (29 CFR 1910.120)?					
Medical services and first aid (1910.151)?					
OSHA PSM (see separate checklist)					

SAMPLE #7 SAFETY AND HEALTH REGULATORY COMPLIANCE CHECKLIST FOR SELECTED REGULATIONS					
Could The Change Require Changes In Compliance Programs For…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
OSHA Other Selected Standards					
Scaffolds (29 CFR 1910.28 or 1926.450-454)?					
Powered industrial trucks (29 CFR 1910.178)?					
Excavation (29 CFR 1926 Subpart P)?					
OSHA Health Standards (selected)					
Hazard communication (29 CFR 1910.1200)?					
Personal protective equipment (29 CFR 1910 Subpart I)?					
Respiratory protection (29 CFR 1910.134)?					
Occupational noise exposure (29 CFR 1910.95)?					
Radiation (29 CFR 1910.96-97)?					
Asbestos (29 CFR 1910.1001 or 1926.1101)?					
Benzene (29 CFR 1910.1028)?					
Lead (29 CFR 1910.1025 or 1926.62)?					
Access to employee exposure and medical records (29 CFR 1910.1020)?					
Bloodborne pathogens (29 CFR 1910.1030)?					

SAMPLE #7 SAFETY AND HEALTH REGULATORY COMPLIANCE CHECKLIST FOR SELECTED REGULATIONS					
Could The Change Require Changes In Compliance Programs For…	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Other Regulatory					
TSCA 8(c)and 8(e) reporting?					
FIFRA 6(a)(2)?					

SAMPLE #8 OCCUPATIONAL HEALTH CHECKLIST					
Could The Change Require Changes In …	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
General					
Management of potential workplace illnesses?					
Administration of general medical examinations?					
Administration of OSHA-required medical examinations?					
Administration of OSHA health regulations?					
Exposure monitoring strategy?					
Handling employee complaints?					
Respiratory Protection (see also S&H Regulatory Checklist)					
Program administration?					
Persons subject to use of respirator?					
Fit testing program?					
Training?					
Selection and use?					
Cleaning, maintenance and repair?					
Hearing Conservation and Noise (see also S&H Regulatory Checklist)					

SAMPLE #8 OCCUPATIONAL HEALTH CHECKLIST					
Could The Change Require Changes In …	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Program administration?					
Persons subject to use of hearing protection?					
Audiometric testing & recording shifts?					
Training?					
Selection and use?					
Signage?					
Personal protective equipment (see also S&H Regulatory Checklist)					
Program administration?					
Persons subject to use of PPE?					
Selection criteria?					
Training?					
Hazard Communication (see S&H Regulatory Checklist)					
Chemical-Specific Standards (see S&H					

SAMPLE #8 OCCUPATIONAL HEALTH CHECKLIST					
Could The Change Require Changes In …	**Yes/ No**	**Possible Effect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Regulatory Checklist)					
Heat stress					
Administration of program?					
Engineering controls					
Maintenance of ventilation systems?					
Ergonomics					
Administration of program?					

SAMPLE #9 OPERATIONS EFFECTIVENESS HEALTH & SAFETY CHECKLIST				
Factor or Issue of Concern	**Yes/ No/ NA**	**Action item**	**By**	**Date**
Planning and Participation				
Has a process been established to involve affected personnel in the safety and health considerations pertaining to the change?				

SAMPLE #9 OPERATIONS EFFECTIVENESS HEALTH & SAFETY CHECKLIST				
Factor or Issue of Concern	**Yes/ No/ NA**	**Action item**	**By**	**Date**
Should a special team be considered as one means to obtain employee participation and input?				
Should on-shift meetings be considered as one means of obtaining employee input, and assuring communication?				
Administrative Factors				
Are new lines of authority established and understood by all, particularly with regard to around-the-clock communications?				
Are procedures in place for decision making, particularly in off-hours?				
Have the procedures for calling out additional personnel been addressed?				
Human Factors				
Will the responsible operator be able to monitor critical controls and alarms?				
Will the responsible operator be able to deal with the number of alarms associated with an upset or emergency?				
Will the responsible operator be able to				

SAMPLE #9 OPERATIONS EFFECTIVENESS HEALTH & SAFETY CHECKLIST				
Factor or Issue of Concern	**Yes/ No/ NA**	**Action item**	**By**	**Date**
monitor appropriately the number of control loops assigned?				
Are the roles, responsibilities and authorities of the board and field operators clear and concise?				
Are there procedures and equipment in place to promote clear communication between board and field operators?				
PHA Reviews				
Have the PHA reports been reviewed to identify events where safeguards include operator intervention and procedural activities involving operators?				
Are these safeguards still appropriate?				
Operating Procedures				
Have the operating procedures been revised to reflect the new assignments and duties, as appropriate?				
Do the procedures provide for safely conducting activities for each phase of operation? • Initial startup • Normal operations • Temporary operations				

SAMPLE #9 OPERATIONS EFFECTIVENESS HEALTH & SAFETY CHECKLIST				
Factor or Issue of Concern	**Yes/ No/ NA**	**Action item**	**By**	**Date**
• Emergency shutdown (more…) • Emergency operations • Normal shutdowns • Startup following turnaround or emergency shutdown				
Are the procedures written such that staffing is appropriate for special tasks such as lighting furnaces, special line-ups and transfers, operator entry into confined spaces such as pits, or similar tasks where short-term assistance may be necessary?				
Are procedures in place for managing changes to operating procedures, particularly during off hours?				
Emergency Procedures				
Can the operator(s) reasonably complete all tasks necessary to safely shutdown the process?				
Does the answer change if all instrumentation fails simultaneously?				
Are emergency valves, switches and shutdown devices accessible?				
Is staffing appropriate to make proper emergency communications (local and facility communications; affected units)?				
Does the operator have time to activate emergency systems such as manual				

SAMPLE #9 OPERATIONS EFFECTIVENESS HEALTH & SAFETY CHECKLIST				
Factor or Issue of Concern	**Yes/ No/ NA**	**Action item**	**By**	**Date**
sprinkler systems and fire water monitors?				
Are the number and location of emergency breathing apparatus appropriate for both board and field personnel?				
Does the change affect the make-up of the plant's emergency response teams or fire brigade?				
Are there procedures to address response to medical emergencies?				
Are there procedures for dealing with non-emergency injuries and illnesses?				
Training				
Are the employees affected by the change identified and informed of the changes?				
Are affected employees trained in the operating procedures as appropriate?				
Are affected employees trained on significant hazards (chemical and physical) and use of appropriate personal protective equipment (PPE) for their area/work responsibility?				
Are process managers and supervisors trained in the hazards of processes for which they are now responsible? Have they demonstrated proficiency and knowledge as appropriate?				
Is all training documented?				

SAMPLE #9 OPERATIONS EFFECTIVENESS HEALTH & SAFETY CHECKLIST				
Factor or Issue of Concern	**Yes/ No/ NA**	**Action item**	**By**	**Date**
Are plans in place for appropriate emergency drills, involving all affected operating personnel?				
Process Safety Information (PSI)				
Did the change result in any modifications to PSI? • Chemical hazards • Process technology • Process equipment				
Equipment changes				
Did the change result in modification to equipment?				
If Yes, is management of change process completed?				
Are the changes mechanically complete?				
Is a pre-startup safety review (PSSR) planned or complete?				

SAMPLE #9 OPERATIONS EFFECTIVENESS HEALTH & SAFETY CHECKLIST				
Factor or Issue of Concern	**Yes/ No/ NA**	**Action item**	**By**	**Date**

SAMPLE #10 CRAFT SAFETY EFFECTIVENESS CHECKLIST					
Could The Change Require Changes In …	**Yes/ No**	**Possible Affect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
The way in which work is assigned to crafts?					
Work authorization procedures (craft's perspective)					
The nature or type of work assigned to particular crafts?					
The amount of supervision provided?					
Technical or functional direction for crafts?					
The way in which persons within a craft work together?					
The way in which various crafts work together?					
Supervision of multi-craft tasks?					
Quality assurance of craft work?					

SAMPLE #10 CRAFT SAFETY EFFECTIVENESS CHECKLIST					
Could The Change Require Changes In …	**Yes/ No**	**Possible Affect**	**Action To Maintain Or Improve Safety**	**Action For**	**By (Date)**
Skills required within a craft?					
Skill level within a craft?					
Training required within a craft?					
Informal or on-the-job training in safe work practices?					
Craft safety meetings?					

Appendix C

Sample General Purpose Worksheet

Appendix C contains a sample worksheet. This sample is intended to serve as a tool for a more detailed analysis of selected topics (exceeding the depth of the Appendix B checklists), or for assessing safety-sensitive concerns for which no checklist is provided. Users should adapt this worksheet to meet their particular needs. This sample is not intended to be all-inclusive.

The samples in this appendix are intended to illustrate the principles discussed and represent only one option for managing safety and health during organizational change. These samples are not intended to represent uniform or mandatory practices.

In addition, these worksheets should be drafted in accordance with good documentation skills. All appropriate functions or disciplines, including legal, should be involved prior to completion.

APPENDIX C

SAMPLE GENERAL PURPOSE WORKSHEET

Purpose:	A tool for reviewing additional potential safety and health impacts of organizational change
How used:	As a supplement to the specific checklists used to assess safety & health impacts and opportunities (Section 3.4)
Prepared by:	A special multi-disciplinary group created for the purpose
Used by:	Safety liaison or change team
Discussion	In the course of completing the specific checklists, it may become apparent that a more detailed analysis (exceeding the depth of the checklist) is needed, or additional safety-sensitive concerns may be identified for which no checklist is provided. In such cases, one approach is to assemble an appropriate team to conduct a hazard review of the issue, functioning in a manner much like a PHA team. This is a general purpose work sheet for that purpose, similar to a "what if" PHA worksheet. For example, it could be useful in assessing work authorization and permitting procedures.

GENERAL PURPOSE WORKSHEET			
What if…?	**Potential Consequences**	**Existing Systems and Safeguards**	**Additional Considerations**

GENERAL PURPOSE WORKSHEET			
What if…?	**Potential Consequences**	**Existing Systems and Safeguards**	**Additional Considerations**