

## **SECTION B – 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 procedures (Chapter 6). Stationary Sources are not required by Contra Costa Hazardous Materials Programs (CCHMP) 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 CCHMP 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. CCHMP added additional questions for evaluation of latent conditions that may help improve the overall human factors program in 2010. Stationary Sources should review Attachment A to incorporate into their latent conditions checklists. 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
- Lack of a system to test and maintain orphaned equipment that are either far from the operating area or between units

The latent conditions checklist presented in Attachment A was first compiled during the development of the original human factors program guidance by CCHMP in 2000. Since that time, other similar checklists have been developed. One such checklist that contains similar information can be found in AIChE’s CCPS’s *Human Factors Methods for Improving Performance in the Process Industries*, Copyright 2007. Stationary Sources are encouraged to review this checklist, and similar checklists to ensure that the tools provided to employees to minimize latent conditions are the most current and useful.

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*.<sup>9</sup> 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.<sup>1,2,3,4,5,6,7,8</sup>

- **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. Attachment A does not represent an all-inclusive list of latent conditions. It represents a template that should 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 trained to include additional, pertinent questions, findings, and justification or examples to support their answers
- Stationary Sources must implement a system to ensure that personnel applying the checklist are truly contemplating each question and not simply “checking boxes”. One method for this is to require that all answers - Yes, No, and N/A - be justified (e.g., if 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 recognize 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. 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; all actions requiring a process shutdown shall be completed during the first regularly scheduled turnaround of the applicable process unless the Stationary Source demonstrates to the satisfaction of CCHMP that such a schedule is infeasible. LCC action items identified in a PHA are subject to the same PHA actions requirement.
- Stationary Sources must send CCHMP a request for extension before PHA actions related to LCC become overdue if they cannot be addressed within 1 year and a turnaround is not applicable.

- The checklist must be routinely audited and revised to reflect the current situation within the Stationary Source.

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<sup>1</sup> EQE International - Process Hazard Analysis Checklist: Human Factors, 1996

<sup>2</sup> Arthur D. Little, Inc. – Facility Level Safety Management Audit Protocol, 1996

<sup>3</sup> Ergonomic Checkpoints: Practical and Easy-To-Implement Solutions for Improving Safety, Health, and Working Conditions, International Labor Organization, 1996

<sup>4</sup> 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 Commission, Washington DC 20555

<sup>5</sup> HSE (1999) Reducing Error and Influencing Behavior. HS (G) 48. London: HMSO

<sup>6</sup> United Kingdom Atomic Energy Authority (1985) Guide to Reducing Human Error in Process Operations, SRD R 347, Warrington, UK: AEA Technology Ltd.

<sup>7</sup> 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

<sup>8</sup> CMA, (1990), A Manager's Guide to Reducing Human Errors, Improving Human Performance in the Chemical Industry, (CMA is now the American Chemistry Council ACC)

<sup>9</sup> The County ISO amendments are not mandatory for Stationary Sources subject to the City of Richmond Industrial Safety Ordinance, but encouraged.