
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

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- 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