SECTION B - CHAPTER 4: PROCESS HAZARD ANALYSIS

The Contra Costa County Industrial Safety Ordinance and the City of Richmond Industrial Safety Ordinance (ISO/RISO) require 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 Stationary Sources may adopt to meet the requirements. This chapter applies to traditional PHAs and to all accepted methodologies listed in ISO Section 450-8.016(b)(1) or RISO Chapter 6.43.090(b)(1). It also applies to procedural PHAs conducted on procedures in addition to, or separate from, the traditional unit process PHA to further identify operational hazards. Methodology and use of Procedural PHA is discussed in detail in Chapter 6, section 6.2 in this guidance. Note: This chapter is intended to work with Section D and Section H in this guidance.

Although this chapter uses the term "PHA" throughout, it applies to PHAs performed on existing systems, PHA revalidations, and PHAs performed during the design of a new process. This chapter also applies to project PHAs, where the project may involve significant modifications to a covered process or processes. 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 Contra Costa Health Hazardous Materials Programs (CCHHMP) representatives.

4.1 REQUIREMENTS OF THE PROGRAM

PHAs conducted by the Stationary Source must meet the requirements listed in ISO Section 450-8.016(d) or RISO Chapter 6.43.090(d) and:

- Identify active failures or unsafe acts that employees may execute
- Identify latent conditions that may exist at the Stationary Source, if not already done through an alternative program
- 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 ISO Section 450-8.016(d)(3) or RISO Chapter 6.43.090(d)(3)
- Evaluate recommendations (action items) formulated during the Human Factors Assessment (i.e. Chapter 3 latent conditions review) to ensure that PHA recommendations address the potential deficiency without creating other additional deficiencies.

4.2 HUMAN FACTORS IN PROCESS HAZARD ANALYSIS

Stationary Sources should adopt an approach to ensure that human factors (i.e., active failures and latent conditions) are evaluated in the PHA process. This guidance document conceptually describes how this can be accomplished.

4.2.1 APPLYING THE LATENT CONDITIONS CHECKLIST

The PHA is performed in accordance with accepted practices.[1] As part of the PHA, Stationary Sources should complete the applicable sections of a latent conditions checklist, as described in Section B.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) if the checklist list is not customized. The PHA team members should be provided with 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 and direct the PHA discussions in a manner similar to the management of change (MOC) documentation and incident investigation reports (i.e., the results of the checklist should be used to focus and identify scenarios and failure modes for the analysis) to consider the effects of existing latent conditions on the frequency of and consequences associated with any active failure or unsafe act. The PHA team should evaluate the consequences and effects of identified issues from latent conditions checklists and develop recommendations. The PHA team shall document the justification for not developing recommendations associated with issues identified while completing the latent conditions checklists.

4.2.1.1 COMPLETION OF THE LATENT CONDITIONS CHECKLIST

As described in Section 4.2.1, if the latent conditions checklist (LCC) is used, it should be completed prior to the PHA study. This will allow the team to review the human factor issues identified and properly assess the implications in the risk determination and develop appropriate action items. However, if the LCC is completed during or after the PHA sessions, all the applicable scenarios should be revisited against the identified human factors issues to assure proper risk determination and recommendation priority. To accomplish this, each node of the PHA would need to be evaluated by the complete LCC. The Stationary Source should determine how the latent conditions checklist will be completed.

CCHHMP encourages facilities to take the following into consideration when selecting members for the PHA team:

Team Makeup: A latent conditions checklist cannot be filled out by just one person. To provide enough feedback during the review, a team approach should be used. The size of the team can be determined by the facility; however, the team must be diverse enough to include a variety of skill sets, experience, personality factors, and physical limitations. The team must include at least one operator who is actively working the unit. In addition, a minimum of two personnel from different crews should be invited to participate in completing checklist(s). The facility may elect to have a team from each crew complete one checklist or several crews complete multiple checklists. Team makeup must account for the stationary source's employee participation program.

The latent conditions checklist should be completed as part of a control room/field walkthrough of the unit. Each PHA team should document all issues as well as justifications for any "No" answer or develop recommendations to address the issue. Each team should also compile and document issues found during the completion of the checklist.

4.2.2 NON LCC CHECKLISTAPPROACH

Using any other method besides Latent Conditions Checklist to uncover human systems issues must be pre-approved by CCHHMP in writing.

4.2.3 CONSIDERATION OF RESPONSE TIME AND SEQUENCING

During a PHA, when a human based safeguard is claimed, consideration should be given to the availability of personnel to perform functions such as completion of rounds, general area surveillance, completing assigned tasks, and especially response to upset conditions leading up to and including response to an emergency. If the required reaction time is not evaluated properly, the analysis of critical time constraints may not be effective. Without a complete understanding of the time constraints, the PHA has potential to fall short on verifying the effectiveness of the response action. For example, the "*PHA team*" may identify that a particular operating condition necessitates a heavier personnel demand during an emergency situation. In particular, manual operation or field verifications may be required to bring the process to a safe state in an emergency. To assist in assessing the impacts of these demands on existing personnel, "*PHA teams*" are encouraged to perform time sequencing analyses to outline all of the tasks and their sequence that must be performed during critical and emergency situations.[3] The intent of such an analysis should be to identify if there are situations where, for example, an operator is required to perform multiple tasks in unreasonable timeframes based on the situation (e.g., an operator must run up to the fifth deck to turn a switch, run down to the first deck for another switch, and back to the fifth deck all within a short timeframe). Such an analysis is more than just adding up the number of instrument loop counts on the process.[2] Another example is when evaluating unique or complex equipment that requires additional

resources to bring to a safe state during process upsets. The "*PHA team*" should then identify the consequences of failure to perform all the tasks in the given time and identify action items to mitigate the situation as appropriate (e.g. installation of motor operated valves (MOVs) to reduce time to operate the valve, or the configuration of alarms that allows for earlier detection and more response time, etc.)

The Stationary Source must conduct a PHA which incorporates the results of the latent conditions review (Chapter 3). The PHA team must identify and evaluate human factors/latent conditions during the PHA and improve upon existing safeguards that reduce risk by posing and analyzing the question "what if?". The PHA team may elect to perform procedural PHAs to evaluate their procedures to make sure that sufficient instructions are in place to execute the required tasks and minimize negative consequences. See section 6.2 for a more detailed discussion of performing procedural PHAs.

[1] CCPS, Third Edition, *Guidelines for Hazard Evaluation Procedures*, 2008
[5] I. Nimmo, Determining Operator Workload and Console Loading is more than a simple loop count, Chemical Engineering Progress, November 2002