

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 below².

- 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