
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 Release¹.

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.

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*