Review Questions

1. Explain the rationale for a comprehensive written safety and health plan.
2. The safety and health policy should convey certain messages. What are they?
3. Write examples of three safety and health goals that might be used in the plan for any construction company.
4. Explain management's responsibilities in the safety and health program.
5. Explain the supervisor's responsibilities in the safety and health program.
6. Explain the employee's responsibilities in the safety and health program.
7. Explain the safety professional's responsibilities in the safety and health program.
8. What is "progressive discipline" as it relates to the safety and health program?
9. What is the purpose of the job-site inspection?
10. Who typically conducts accident investigations at the job site? Why this person?
11. How do you think the safety and health training that an employee receives during in-processing orientation and job-site-specific training would differ?
12. Describe two different ways that medical assistance might be provided by a construction company.
13. The emergency response component of the safety and health plan has at least two critical elements. Explain both of them.
14. List six different strategies that might be used to communicate the safety and health plan to employees.
15. Explain how construction professionals can use the Deming cycle in planning, implementing, and evaluating the safety and health program.

Critical Thinking and Discussion Activities

1. John Rodgers is vice president for business operations at Northwest Construction Company (NCC); Mark Danson is chief engineer. They are debating the issue of safety and health plans. Rodgers says, "Written plans for safety are a waste of time. You don't have to write things down in order to do them. Our supervisors should show employees the safe way to do their jobs and make sure they comply. It takes too much time and costs too much money to write plans." Mark Danson disagrees. He says, "You're wrong, John. If we don't write it down, we won't do it. You have all of NCC's business plans and procedures in writing. Why is safety any different?" Join this debate. Who do you think is right and why? Defend your opinion.
2. Two supervisors for Casey Construction, Inc. (CCI) are discussing the medical assistance and first aid component of CCI's safety and health plan. "I don't like this approach we have to use," said the first supervisor. "I don't want any of our employees playing doctor. We need to leave medical problems up to the medical professionals. I think we should revise the plan so that outside help is called in when we need medical assistance, and drop the first aid part." The second supervisor disagreed. He said, "What if somebody needs CPR? By the time the EMTs get here, he'll be dead. I think we should have at least one person on every crew who is first aid certified." What do you think? Take the side of one of these supervisors, and make his case for him.

Application Activities

1. Identify a construction company that has a comprehensive written safety and health plan and is willing to work with you in completing this activity. Using the information learned in this chapter, develop a program evaluation checklist and evaluate the company's plan. Make note of any shortcomings in the plan. Tactfully share any shortcomings identified with your contact in the company.
2. Develop a comprehensive safety and health plan that could be used as a model by a construction company in developing its own plan. Add an appendix to the plan that describes how it should be communicated to employees.

Endnotes

1. Retrieved August 19, 2008, from http://deming.org/index.cfm?Content=66

CHAPTER EIGHT

JOB SAFETY AND HAZARD ANALYSIS

MAJOR TOPICS

- Overview of Hazard Analysis
- Preliminary Hazard Analysis
- Detailed Hazard Analysis
- Hazard Prevention and Reduction
- Risk Assessment

There is a saying, "An ounce of prevention is worth a pound of cure." This is certainly the case with workplace safety and health. Every accident that can be prevented should be. Every **hazard** that can be identified should be corrected or at least minimized through the introduction of appropriate safeguards. Careful analysis of potential hazards in the workplace has led to many of today's widely used safety measures and practices.

The key to preventing accidents is identifying and eliminating hazards. A hazard may be defined as follows:

> A hazard is a condition or combination of conditions that, if left uncorrected, may lead to an accident, illness, or property damage.

This chapter provides construction professionals with the information they need to analyze the workplace, identify hazards that exist there, and take the preventive measures necessary to neutralize the hazards.

OVERVIEW OF HAZARD ANALYSIS

If a hazard is a condition that could lead to an injury or illness, **hazard analysis** is a systematic process for identifying hazards and recommending corrective action. There are two approaches to hazard analysis: preliminary and detailed (Figure 8–1). A **preliminary hazard analysis (PHA)** is conducted to identify potential hazards and prioritize them according to (1) the likelihood of an accident or injury from the hazard and (2) the **severity** of injury, illness, or property damage that may result if the hazard caused an accident.

The Associated General Contractors of America state,

> *Job site hazards should be ranked in terms of the likelihood of their causing an accident and the potential magnitude of the accident. Hazards may be placed in the following categories: catastrophic, critical, marginal, and nuisance. The likelihood can be rated as very likely, likely, or not likely.*[1]

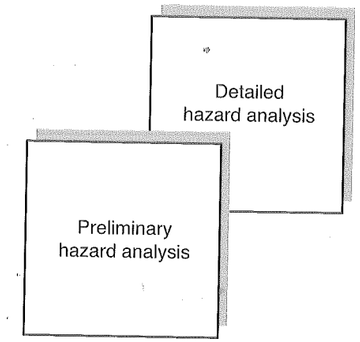


FIGURE 8–1 Two approaches to hazard analysis.

Key terms in this quote are those that describe the likelihood of an accident occurring (very likely, likely, not likely) and those that rate the probable level of injuries that could occur (catastrophic, critical, marginal, and nuisance). A key step in this process is rating the cost of correcting hazards. These concepts are covered later in this chapter.

Whereas a preliminary analysis may involve just observation or pilot testing of new equipment and systems, the **detailed hazard analysis** involves the application of analytical, inductive, and deductive methods. Figure 8–2 lists some of the more widely used methods for conducting a detailed hazard analysis. Each of these methods is covered at length later in this chapter.

PRELIMINARY HAZARD ANALYSIS

It is not always feasible to wait until all the data are compiled from a detailed analysis before taking steps to identify and eliminate hazards. For example, when a new system or piece of equipment is installed, management probably wants to

Failure mode and effects analysis (FMEA)
Fault tree analysis (FTA)
Hazard and operability review (HAZOP)
Human error analysis (HEA)
Risk analysis
Technic of operations review (TOR)

FIGURE 8–2 Detailed hazard analysis methods.

Operation: Date:

Number of Employees	Job Title	Exposure Substance	Form (Type of Hazard)						Route of Entry		Control Methods						
			Dust	Liquid	Vapor	Gas	Fume	Mist	Skin	Lungs	Local Ventilation	General Ventilation	Respirator	Gloves	Face Protection	Other Protection	

FIGURE 8–3 Sample job hazard analysis survey.

Adapted from survey instrument in *Safety Guide for Textile Machinery Manufactures*. NIOSH, Washington, D.C., U.S. Department of Health, Education, and Welfare (January 1978), 11.

bring it on line as soon as possible. In such cases, a PHA is in order. The PHA can serve two purposes:

- It can expedite bringing the new system on line, but at a substantially reduced risk of injuring workers.
- It can serve as a guide for a future detailed analysis.

PHA amounts to forming an ad hoc team of experienced personnel who are familiar with the equipment, material, substance, and process being analyzed. **Experience** and **related expertise** are important factors in conducting a preliminary review. For example, if a new piece of equipment is installed, the safety and health professional or supervisor may form a team that includes a variety of experienced personnel.

All members of the team are asked to examine the new equipment hazards. Then, they work as a group to play devil's advocate. Each team member asks the others a series of "what if" questions: What if a cutting bit breaks? What if the wrong command is entered? What if the material stock is too long? Depending on the nature of the process being analyzed, personnel from related processes should be added to the team.

Figure 8–3 is an example of a job hazard analysis survey adapted from one developed by the National Institute for Occupational Safety and Health (NIOSH). A preliminary analysis team would use this form to identify potential hazards associated with a painting process. Key elements include the substances to which workers will be exposed, the form that those substances will take, the probable route of entry, and recommended hazard-control strategies. A similar form can be developed for any process or operation that may be the focus of a PHA.

Cost and Benefit in Hazard Analysis

Typically, every hazard has several different remedies. Every remedy has a corresponding *cost* and corresponding *benefit*. Management is not likely to want to apply $10 solutions to $1 problems. Therefore, it is important to factor in cost when recommending corrective action regarding hazards. This amounts to listing all of the potential remedies along with their respective costs and then estimating the extent to which each will reduce the hazard (its benefit).

Going back to the earlier example of the new equipment, assume that the analysis team identified the following potential hazards:

- Lubricants spraying on the machine operator
- Flying wood chips hitting the operator or other workers
- Jammed wood stock kicking back into the operator

Figure 8–4 is a matrix that may be developed by the analysis team to illustrate the cost of each hazard versus the benefit of each remedy. After examining this matrix, the

Cost-Benefit Analysis Matrix

Possible Remedy	Estimated Cost	Hazard and Impact of Remedy: Spraying Lubricants	Metal Chips	Jammed Stock
Plexiglass door	$250	E	E	R
Flexible curtain	$75	R	R	N
Acme chip/ jam guard	$260	N	E	E
Acme spray guard	$260	N	E	E

Code For Impact of Remedy:
R = Reduces the hazard
E = Eliminates the hazard
N = No effect on the hazard
I = Increases the hazard
C = Create new hazard

FIGURE 8–4 Sample cost-benefit analysis matrix for possible remedies to hazards associated with a piece of manufacturing equipment.

remedy that makes the most sense from the perspectives of cost and **impact** on the hazards is the Plexiglas door. It eliminates two of the hazards and reduces the third. The flexible curtain costs less, but does not have a sufficient impact on the hazards. The third and fourth options cost more and have less impact on the hazards.

DETAILED HAZARD ANALYSIS

Typically, a PHA is sufficient. However, in cases where the potential exists for serious injury, multiple injuries, or catastrophic illness, a detailed hazard analysis is conducted. A number of different methods can be used for conducting detailed analyses. The most widely used of these are as follows:

- Failure mode and effects analysis
- Hazard and operability review
- Technic of operations review
- Human error analysis
- Fault tree analysis
- Risk analysis

Failure Mode and Effects Analysis

Failure mode and effects analysis (FMEA) is a formal step-by-step analytical method that is a spin-off of reliability analysis—a method used to analyze complex engineering systems. FMEA steps proceed as follows:

1. Critically examine the system in question.
2. Divide the system into its various components.
3. Examine each individual component and record all of the various ways in which the components may fail. Rate each potential failure according to the degree of hazard posed on a scale from 0 to 4: 0 = no hazard, 1 = slight, 2 = moderate, 3 = extreme, 4 = severe.
4. Examine all potential failures for each individual component of the system, and decide what effect the failures could have.

Figure 8–5 is an example of an FMEA conducted on a concrete extrusion process. The process or system is broken down into seven components: die backer, die, billet, dummy block, pressing stem, container liner, and container fillet. The types of failures that may occur are identified as corrosion, cracking, shattering, bending, and surface wear. Of the various components, only the dummy block poses an extreme hazard and a corresponding hazard to workers.

An FMEA produces an extensive analysis of a specific process or system, as illustrated in Figure 8–5. However, FMEAs have their limitations. First, the element of **human error** is missing. This is a major weakness because human error is more frequently at the heart of a workplace accident

Jones Prestressed Concrete, Inc.
1605 Highway 39
Fort Walton Beach, Florida 32548

Department Production **Process/System** Concrete Extrusion of Cored Floor Members **Date** January 15, 2002

Component	Type of Potential Failure	Component	Related Components	Process/ System	Workers	Potential Effect On: 0	1	2	3	4	H	M	L	U	Examination Method	Recommendation
Diebacker	Corrosion	Shutdown to replace	None	Shutdown to replace	None	✓							✓			
Die	Cracking	Shutdown to replace	Damage to die backer	Shutdown to replace				✓				✓				
Billet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dummy block	Shattering	Shutdown to replace	Could damage others	Shutdown all	Injuries from flying metal				✓			✓				
Pressing stem	Bending	Shutdown to replace	None	Shutdown to replace	None	✓							✓			
Container liner	Surface wear	Shutdown to replace	None	None	None	✓								✓		
Container fillet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Analysis conducted by: _____

FIGURE 8–5 Sample failure mode and effects analysis (FMEA).

than is system or process failure. This weakness can be overcome by coupling human error analysis with an FMEA. Second, FMEAs focus on the components of a given system as if the components operate in a vacuum. They do not take into account the interface mechanisms between components or between systems. It is at these interface points that problems often occur.

Hazard and Operability Review

Hazard and operability review (HAZOP) is an analysis method that allows problems to be identified even before a body of experience has been developed for a given process or system. It is especially useful for operations involving chemicals or toxic materials. Although originally intended for use with new processes, it need not be limited to new operations. HAZOP works equally well with old processes and systems.

HAZOP involves forming a team of experienced, knowledgeable people from a variety of backgrounds related to the process or system and having team members brainstorm about potential hazards. The person responsible for safety and health should chair the team and serve as a facilitator. The chair's role is to elicit and record the ideas of team members, make sure that one member does not dominate or intimidate other members, encourage maximum participation from all members, and assist members in combining ideas, when appropriate, to form better ones.

A variety of approaches can be used with HAZOP. The most widely used approach is based on the following guide words: *no, less, more, part of, as well as, reverse,* and *other than.*[2]

These guide words relate to the operation of a specific component in the system or a specific part of an overall operation. They describe ways in which the component may deviate from its design or its intended mode of operation. For example, if a component that should rotate 38 degrees in a cycle fails to rotate at all, the *no* guide word applies. If it rotates fewer than 38 degrees, the *less* guide word applies. *More* would apply if the component's rotation exceeded 38 degrees. *Reverse* would be used if the component rotated 38 degrees in a direction opposite of the one intended. *As well as* is similar to *more* in that it indicates an increase in an intended amount. *Other than* is used when what actually occurs is something completely different from what was intended. For example, if the component fell off rather than rotating 38 degrees, *other than* would be used.

HAZOP proceeds in a step-by-step manner, which is summarized as follows:

1. Select the process or system to be analyzed.
2. Form the team of experts.
3. Explain the HAZOP process to all team members.
4. Establish goals and time frames.
5. Conduct brainstorming sessions.
6. Summarize all input.

Figure 8–6 is an example of a form that can be used to help organize and focus brainstorming sessions. It can also be used for summarizing the results of the brainstorming sessions. This particular example involves a plastic mixing process. Only one component in the process (flow-gate number 1) has been analyzed. If the flow-gate does not work as intended, there will be no flow, too little flow, or too much flow. Each condition results in a specific problem. Action necessary to correct each situation has been recommended. Every critical point, sometimes referred to as a *node*, in the process is analyzed in a similar manner.

HAZOPs have the same weaknesses as FMEAs: they do not factor human error into the equation. HAZOPs predict problems associated with system or process failures; however, these are technological failures. Since human error is so often a factor in accidents, this weakness must be addressed. The next section provides guidelines for analyzing human error.

Human Error Analysis

Human error analysis (HEA) is used to predict human error, not to review what has occurred. Although the records

Martin Contracting
1512 Airport Road
Crestview, Florida 32536
HAZOP SUMMARY FORM

Department Department B **System/Process** Termite Protection **Date** January 7, 2002

System/Process Component	Factor Analyzed	Guide-word	Resulting Difference	Potential Problem	Recommended Remedy
Flow-gate number one	Amount of flow	No	No flow	No mix	Make sure flow-gate is open
		Less	Insufficient flow	Weak mix	Troubleshoot and repair the flow-gate
		More	Excess flow	Too strong mix	Troubleshoot and repair the flow-gate

FIGURE 8–6 Sample hazard and operability review (HAZOP).

of past accidents can be studied to identify trends that can, in turn, be used to predict accidents, this should be done as part of an accident investigation. HEA should be used to identify hazards before they cause accidents.

Two approaches to HEA can be effective: (1) observing employees at work and noting hazards (the task analysis approach) and (2) actually performing job tasks to get a first-hand feel for hazards. Regardless of how HEA is conducted, it is a good idea to perform it in conjunction with FMEA and HAZOP. This will enhance the effectiveness of all three processes.

Technic of Operations Review

Technic of operations review (TOR) is an analysis method that allows supervisors and employees to work together to analyze workplace accidents, failures, and incidents. It answers the question, "Why did the system allow this incident to occur?" Like FMEA and HAZOP, this approach seeks to identify systemic causes. It does not seek to assign blame.

TOR is not new. It was originally developed in the early 1970s by D. A. Weaver of the American Society of Safety Engineers. However, for 20 years, user documentation on TOR was not readily available. Consequently, wide-scale use did not occur until the early 1990s, when documentation began to be circulated. Richard G. Hallock describes TOR as follows:

> TOR is a hands-on analytical methodology designed to determine the root system causes of an operation failure. Because it uses a work sheet written in simple-to-understand terms and follows an uncomplicated yes/no decision-making sequence, it can be used even at the lowest levels of the firm. TOR is triggered by an incident occurring at a specific time and place and involving specific people. It is not a hypothetical process. It demands careful and systematic evaluation of the real circumstances surrounding the incident and results in isolating the specific ways in which the organization failed to prevent the occurrence.[3]

A weakness of TOR is that it is designed as an after-the-fact process. It is triggered by an accident or incident. A strength of TOR is its involvement of line personnel in the analysis. The process proceeds as follows:

1. *Establish the TOR team.* The team should consist of workers who were present when the accident or incident occurred, the supervisor, and the safety and health director. The safety and health professional should chair the team and serve as a facilitator.
2. *Conduct a roundtable discussion to establish a common knowledge base among team members.* At the beginning of the discussion, five team members may have five different versions of the accident or incident. At the end, there should be a consensus.
3. *Identify one major systematic factor that led to or played a significant role in causing the accident or incident.* This one TOR statement, about which there must be a consensus, serves as the starting point for further analysis.
4. *Use the group consensus to respond to a sequence of yes/no options.* Through this process, the team identifies a number of factors that contributed to the accident or incident.
5. *Evaluate identified factors carefully to make sure that there is a team consensus about each.* Then prioritize the contributing factors beginning with the most serious.
6. *Develop corrective or preventive strategies for each factor.* Include the **corrective or preventive strategies** in a final report that is forwarded through normal channels for appropriate action.

Fault Tree Analysis

Fault tree analysis (FTA) can be used to predict and prevent accidents or as an investigative tool after the fact. FTA is an analytical method that uses a graphic model to display the analysis process visually. A fault tree is built using special symbols, some derived from Boolean algebra. Consequently, the resultant model resembles a logic diagram or a flow chart. Figure 8–7 shows and describes the symbols used in constructing fault trees. Figure 8–8 shows how these symbols may be used to construct a fault tree. The top box in a fault tree represents the accident or incident that could either occur or has occurred.

All symbols below the top box represent events that contribute in some way to the ultimate accident or incident. The sample fault tree shown in Figure 8–8 is qualitative in nature. Fault trees can be made quantitative by assigning **probability** figures to the various events below the top box. However, this is rarely done because reliable probability figures are seldom available. A fault tree is developed using the following steps:

1. Decide on the accident or incident to be placed at the top of the tree.
2. Identify the broadest level of failure or fault event that could contribute to the top event. Assign the appropriate symbols.
3. Move downward through successively more specific levels until basic events are identified.

Experience, deliberate care, and systematic analysis are important in constructing fault trees. Once a fault tree has been constructed, it is examined to determine the various

SAFETY FACTS & FINES

Asbestos removal is a delicate, difficult process, and it can be tempting to do it the easy way. But the easy way can be more trouble than it is worth. A company in Milan, Illinois, was fined $1 million by the Environmental Protection Agency for improperly removing asbestos. It knowingly stripped material containing the dangerous substance without wetting it down first. Three individual employees were fined and were sentenced to either prison or home confinement.

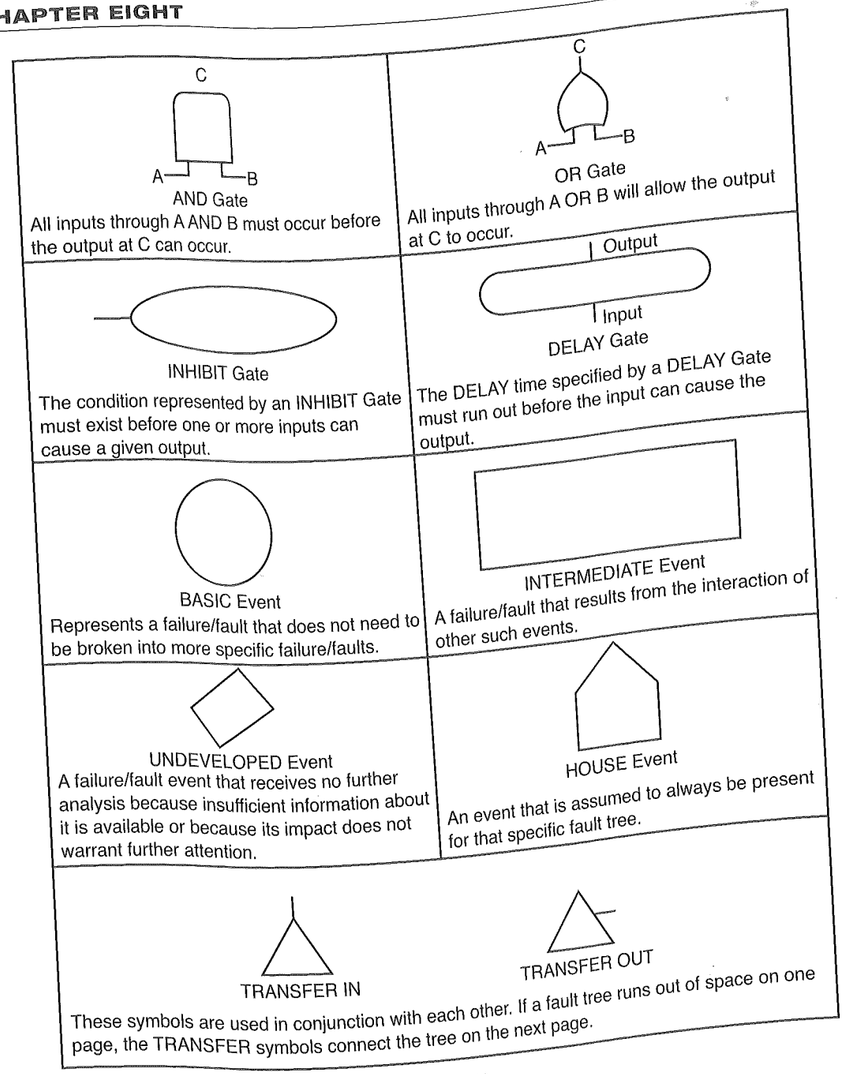


FIGURE 8–7 Symbols used in fault tree analysis (FTA).

combinations of failure or fault events that could lead to the top event. With simple fault trees, this can be accomplished manually (without computer assistance); with more complex trees, this step is more difficult. However, computer programs are available to assist in accomplishing this step. The final step involves making recommendations for preventive measures.

Risk Analysis

Where are we at risk? Where are we at greatest risk? These are important questions for safety and health professionals involved in analyzing the workplace for the purpose of identifying and overcoming hazards. **Risk analysis** is an analytical method that is normally associated with insurance and investments. However, risk analysis can be used to analyze the workplace, identify hazards, and develop strategies for overcoming these hazards. The risk analysis process focuses on two key questions:

1. How frequently does a given event occur?
2. How severe are the consequences of a given event?

The fundamental rule of thumb of risk analysis is that risk is lessened by decreasing the **frequency** and severity of hazard-related events. Construction professionals should understand the relationship that exists between the *frequency* and *severity* factors related to accidents. Historical data on

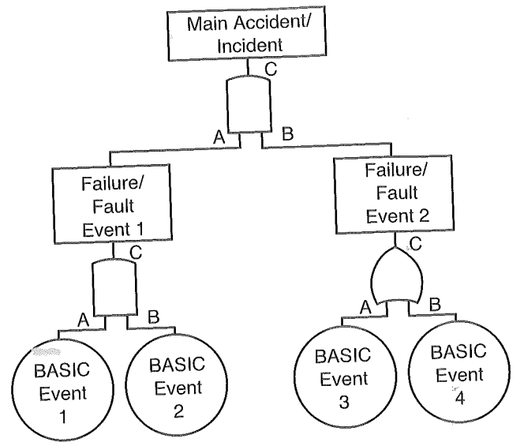


FIGURE 8–8 Sample fault tree.

accidents, injuries, and illness show that the less severe an injury or illness is, the more frequently it is likely to occur. Correspondingly, the more severe an injury or illness is, the less frequently it is likely to occur. For example, there are many more minor scrapes, bumps, and abrasions experienced in the workplace than major debilitating injuries, such as amputations or broken bones.

A number of different approaches can be used in conducting a risk analysis. One of the most effective is that developed by Chapanis.[4] Chapanis's approach to risk analysis considers both *probability* and *impact*.

Probability levels and corresponding frequency of occurrence ratings are as follows:

1 = Impossible (frequency of occurrence: 10^{-8}/day)

2 = Extremely unlikely (frequency of occurrence: 10^{-6}/day)

3 = Remote (frequency of occurrence: 10^{-5}/day)

4 = Occasional (frequency of occurrence: 10^{-4}/day)

5 = Reasonably probable (frequency of occurrence: 10^{-3}/day)

6 = Frequent (frequency of occurrence: 10^{-2}/day)[5]

The lowest rating (1) means it is impossible that a given error will be committed or a given failure will occur. The highest rating (6) means it is very likely that a given error will be committed frequently or a given failure will occur frequently. Note the quantification of frequency levels for each level of probability. For example, the expected frequency of occurrence for a probability level of 3 is 10^{-5}/day.

Severity levels can also be linked with the corresponding likely consequence of an accident or failure event. The least severe incidents (1) are not likely to cause an injury or damage to property. The most severe incidents (4) are almost certain to cause death or serious property damage. Critical accidents (3) may cause severe injury or major loss. Marginal accidents (2) may cause minor injury, minor occupational illness, or minor damage.[6]

HAZARD PREVENTION AND REDUCTION

All of the methods and procedures discussed in this chapter have been concerned with identifying potential hazards. This section deals with using the information learned during analysis to prevent accidents and illnesses. The following hazard-control methods are recommended:

- Eliminate the source of the hazards.
- Substitute a less hazardous equivalent.
- Reduce the hazards at the source.
- Remove the employee from the hazard (e.g., substitute a robot or other automated system).
- Isolate the hazards (e.g., enclose them in barriers).
- Dilute the hazard (e.g., ventilate the hazardous substance).
- Apply appropriate management strategies.
- Use appropriate personal protective equipment (PPE).
- Provide employee training.
- Practice good housekeeping.[7]

For every hazard identified during the analysis process, one or more of these hazard-control methods will apply. Figure 8–9 shows the steps involved in implementing hazard-control methods. The first step involves selecting the method or methods that are most likely to produce the desired results. Once selected, the method is applied and monitored to determine if the expected results are being achieved.

Monitoring and observing are informal procedures. They should be followed by a more formal, more structured assessment of the effectiveness of the method. If the method selected is not producing the desired results, adjustments should be made. This may mean changing the way in which the method is applied or dropping it and trying another.

The example of Mathew Construction Company's (MCC) problems with toxic paint illustrates how the process works. MCC constructs aluminum buildings on military bases. The buildings are painted as the last step in the process. Although the specified paint was supposed to be only slightly toxic—a problem that should have been resolved by using PPE—painters complained frequently of various negative side effects.

MCC's safety and health director, working with management, solved the problem by applying the following steps:

1. *Select a method.* Of the various methods available, the one selected involved eliminating the source of the hazard (the toxic paint). MCC personnel were asked to test various nontoxic paints until one was found that could match the problem paint in all categories (e.g., ease of application, drying time, quality of surface finish). After 40 different paints were tested, a nontoxic substitute was found.
2. *Apply the method.* The new paint was ordered and used on a portion of a building.
3. *Monitor and observe.* The safety and health director, along with MCC's painting supervisors, monitored both

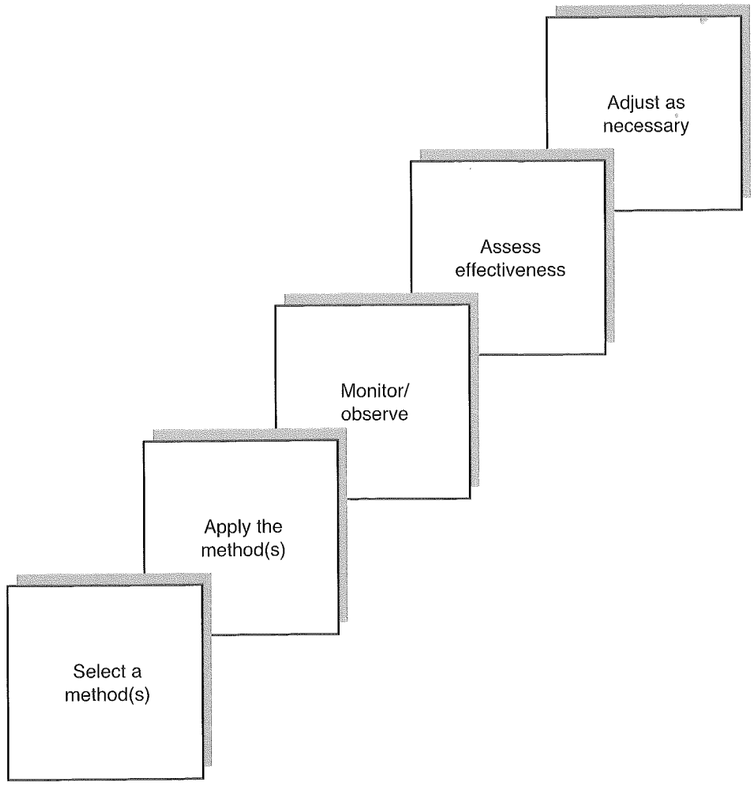


FIGURE 8–9 Steps for implementing hazard-control measures.

employee performance and employee complaints concerning the paint.

4. *Assess effectiveness.* To assess effectiveness, employee complaints were tabulated. The number of complaints was down to a negligible amount, and the complaints were not serious in nature. Productivity was also assessed. It was found that the new paint had no noticeable negative or positive effect on productivity.
5. *Adjust as necessary.* MCC found that no further adjustments were necessary.

RISK ASSESSMENT

Risk assessment in this context involves quantifying the level of risk associated with a given process.[8] It should be a structured and systematic process that answers the following four specific questions:

1. How *severe* are potential injuries?
2. How *frequently* are employees exposed to the potential hazards?
3. What is the *possibility* of avoiding the hazard if it does occur?
4. What is the *likelihood* of an injury if a safety-control system fails?

The most widely used risk assessment technique is the decision tree, coupled with codes representing these four questions and defined levels of risk. Figure 8–10 is an example of a risk assessment decision tree. In this example, the codes and their associated levels of risk are as follows:

S = Severity

Question 1: Severity of potential injuries

S1 Slight injury (bruise, abrasion)

S2 Severe injury (amputation or death)

F = Frequency

Question 2: Frequency of exposure to potential hazards

F1 Infrequent exposure

F2 Frequent to continuous exposure

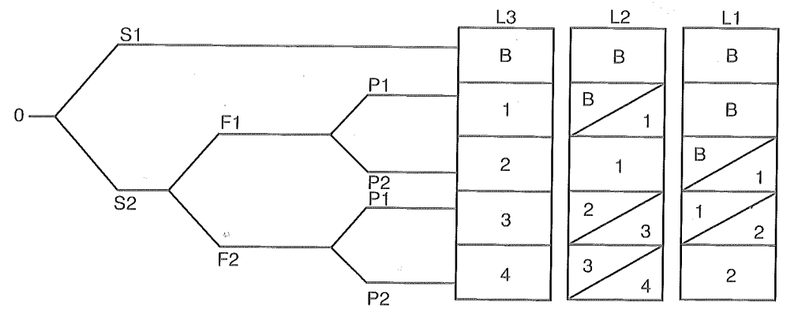


FIGURE 8–10 Risk assessment decision tree (see explanation in text).

P = Possibility

Question 3: Possibility of avoiding the hazard if it does occur

P1 Possible

P2 Less possible to not possible

L = Likelihood

Question 4: Likelihood that the hazard will occur

L1 Highly unlikely

L2 Unlikely

L3 Highly likely

Risk Levels = B, 1, 2, 3, or 4

Associated risk factors ranging from lowest (B) to highest (4)

By applying the decision tree in Figure 8–10 or a similar device, the risk associated with the operation of a given process can be quantified. This assists safety personnel in assigning logical priorities for hazard prevention.

Summary

A hazard is a condition or combination of conditions that, if left uncorrected, may lead to an accident, illness, or property damage. Hazards can be ranked as potentially catastrophic, critical, marginal, or nuisance.

Hazard analysis is a systematic process for identifying hazards and recommending corrective action. There are two approaches to hazard analysis: preliminary and detailed. A preliminary hazard analysis (PHA) involves forming an ad hoc team of experienced personnel who are familiar with the equipment, material substance, and process being analyzed. Experience and related expertise are critical in conducting a PHA.

Failure mode and effects analysis (FMEA) is a detailed hazard analysis method that involves dividing a system into its various components, examining each component to determine how it may fail, rating the probability of failure, and deciding what effect these failures would have.

Hazard and operability review (HAZOP) is a detailed hazard analysis method that was developed for use in the chemical industry. It involves forming a team of experts and brainstorming.

Human error analysis (HEA) is used to predict human error and its potential effects. It can be used in conjunction with FMEA and HAZOP to strengthen those approaches.

Technic of operations review (TOR) is a hazard analysis method that allows workers and supervisors to conduct the analysis. It uses a simple worksheet that allows team members to respond to a sequence of yes-or-no options.

Fault tree analysis (FTA) is a hazard analysis method that uses a graphic model to display the analytical process visually. The model resembles a logic diagram.

Risk analysis, although more commonly associated with the insurance industry, can be used for hazard or safety analysis. The process revolves around answering two questions: (1) How frequently does a given event occur? (2) How severe are the consequences of a given event? The fundamental rule of thumb of risk analysis is that risk is lessened by decreasing the frequency and severity of hazard-related events.

The fundamentals of hazard prevention and deterrence include the following strategies: eliminate the source of the hazard, substitute a less hazardous substance, reduce the hazard at the source, remove the employee from the hazard, isolate the hazard, dilute the hazard, apply appropriate management strategies, use personal protective equipment (PPE), provide employee training, and practice good housekeeping.

Risk assessment should answer four questions: (1) How severe are potential injuries? (2) How frequently are employees exposed to the potential hazards? (3) What is the possibility of avoiding the hazard if it does occur? (4)What is the likelihood of an injury if a safety-control system fails?

Key Terms and Concepts

Corrective or preventive strategies
Detailed hazard analysis
Experience
Failure mode and effects analysis (FMEA)
Fault tree analysis (FTA)
Frequency
Hazard
Hazard analysis
Hazard and operability review (HAZOP)
Hazard prevention or reduction
Human error
Human error analysis (HEA)
Impact
Preliminary hazard analysis (PHA)
Probability
Related expertise
Risk analysis
Risk assessment
Severity
Technic of operations review (TOR)

Review Questions

1. Define the term *hazard.*
2. What is the purpose of preliminary hazard analysis?
3. Explain why experience and related expertise are so important when conducting a preliminary hazard analysis.
4. Why is cost-benefit analysis such a critical part of hazard analysis and prevention?
5. Briefly describe the following detailed hazard analysis methods: FMEA, HAZOP, HEA, FTA, and TOR.
6. What is the most fundamental weakness of both FMEA and HAZOP? How can it be overcome?
7. Name and briefly explain two approaches to HEA.
8. Why did it take so long for TOR to be adopted?
9. What is the most important strength of TOR?
10. Name five widely applicable hazard-prevention strategies.
11. What is risk assessment? How is it used?

Critical Thinking and Discussion Activities

1. "This stuff is way too complicated. I don't see anybody using hazard analysis in construction," said one college student. "I disagree. I like this stuff. If I get a job with a large enough company, I'm going to use it," answered his classmate. Join this debate. Is it realistic to expect construction professionals to apply the various hazard analysis techniques described in this chapter? Why or why not? Do you think that the size of the construction company is a factor?
2. "The only hazard analysis technique I'm going to use is *human error analysis*," said one student. "Why do you say that?" asked her classmate. "Because human error is what's really behind every construction accident," replied the first student. Do you agree with the first student that human error is ultimately the cause in every construction accident? What might some other causes be? Could these causes be attributed at any level to human error?

Application Activities

1. Locate a construction company in your community that will allow you to visit a job site and observe the work there. Select a given operation and observe it in detail. Develop a *fault tree analysis* for the project.
2. Locate a construction company that will work with you and your classmates on this project. With the permission of the company, organize a team of students to develop a partial *hazards inventory* containing at least four different processes.

Endnotes

1. The Associated General Contractors of America, retrieved January 7, 2009, from http://www.agc.org/cs/safety_management_training_course
2. American Institute of Chemical Engineers, *Guidelines for Hazard Evaluation Procedures* (Chicago: American Institute of Chemical Engineers, 1985), 13.
3. R. G. Hallocak, "Technic of Operations Review Analysis Determines Cause of Accident/Incident," *Safety & Health* 60, no. 8 (August 1991): 38–39, 46.
4. A. Chapanis, "To Err Is Human, to Forgive, Design," proceedings of the American Society of Safety Engineers Annual Professional Development Conference, New Orleans, 1986, 6.
5. Ibid., 37.
6. bid., 38.
7. The Associated General Contractors of America, retrieved January 7, 2009, from http://www.agc.org/cs/safety_management_training_course
8. EN 954, Part I, "Safety of Machinery—Principles of Safety Related to Control Systems," *European Union* 2, no. 12 (1997): 16–19.

CHAPTER NINE

ACCIDENT INVESTIGATION, RECORD KEEPING, AND REPORTING

MAJOR TOPICS

- When to Investigate
- What to Investigate
- Who Should Investigate
- Conducting the Investigation
- Interviewing Witnesses
- Reporting Accidents
- Record Keeping

When an accident occurs, it must be investigated thoroughly. A comprehensive **accident report** can help construction professionals pinpoint the cause of the accident. This information can then be used to prevent future accidents, which is the primary purpose of **accident investigation**.

According to the Associated General Contractors of America, the importance of thoroughly investigating accidents is attested to by the following:

> *The purpose of accident investigation is to determine the cause for the purpose of preventing future accidents, not for assessing blame.*[1]

This chapter gives construction students and professionals the information they need to conduct thorough, effective accident investigations and prepare comprehensive accident reports.

WHEN TO INVESTIGATE

Of course, the first thing to do when an accident takes place is to implement **emergency procedures**. This involves bringing the situation under control and caring for the injured worker. As soon as all emergency procedures have been accomplished, the accident investigation should begin. Waiting too long to complete an investigation can harm the results. This is one important rule of thumb to remember. Another is that *all* accidents, no matter how small, should be investigated. **Evidence** suggests that the same factors that cause minor accidents also cause major accidents.[2] Furthermore, a near miss should be treated like an accident and investigated thoroughly.

There are several reasons for conducting investigations immediately. First, immediate investigations are more likely to produce accurate information. The longer the time span between an accident and an investigation, the greater the likelihood of important facts becoming blurred as memories fade. Second, it is important to collect information before the **accident scene** is changed and before witnesses begin comparing notes. Human nature encourages people to change their stories to agree with those of other witnesses.[3] Finally, an immediate investigation is evidence of management's commitment to preventing future accidents. An immediate response shows that management cares.[4]

WHAT TO INVESTIGATE

The purpose of an *accident investigation* is to collect facts, not to find fault. It is important that construction professionals make this distinction known to all involved. **Faultfinding** can cause reticence among witnesses who have valuable information to share. **Causes** of the accident should be the primary focus. The investigation should be guided by the following words: **who**, **what**, **when**, **where**, **why**, and **how**.

This does not mean that mistakes and breaches of precautionary procedures by workers are not noted. Rather, when these things are noted, they are recorded as facts instead of faults. If fault must be assigned, that should come later—after all the facts are in. The distinction is a matter of emphasis. The National Safety Council (NSC) summarizes this approach as follows:

> As you investigate, don't put the emphasis on identifying who could be blamed for the accident. This approach can damage your credibility and generally reduce the amount of accuracy of information you receive from workers. This does not mean you ignore oversights or mistakes on the part of employees nor does it mean that personal responsibility should not be determined when appropriate. It means that the investigation should be concerned with only the facts. In order to do a quality job of investigating accidents, you must be objective and analytical.[5]

In attempting to find the facts and identify causes, certain questions should always be asked, regardless of the nature of the accident. The following questions should be asked when conducting accident investigations:[6]

- What were the date, time of day, weather condition, location on the job site, and traffic conditions (if applicable)?
- What type of work was the injured person doing?
- Exactly what was the injured person doing or trying to do at the time of the accident?

- Was the injured person proficient in the task being performed at the time of the accident? Had the injured person received proper training?
- Was the injured person authorized to use the equipment or perform the process involved in the accident?
- Were other workers present at the time of the accident? If so, who are they, and what were they doing?
- Was the task in question being performed according to properly approved procedures?
- Was the proper equipment being used, including personal protective equipment?
- Was the injured employee new to the job?
- Was the process, equipment, or system that was involved new?
- Was the injured person being supervised at the time of the accident?
- Are there any established safety rules or procedures that were clearly not being followed?
- Where did the accident take place?
- What was the condition of the accident site at the time of the accident?
- Has a similar accident occurred before? If so, were corrective measures recommended? Were they implemented?
- Are there obvious solutions that would have prevented the accident?

The answers to these questions should be carefully and copiously recorded. You may find it helpful to dictate your findings into a microcassette recorder. This approach allows you to focus more time and energy on investigating and less on taking written notes. Regardless of how the findings are recorded, it is important to be thorough. What may seem like a minor, unrelated fact at the moment could turn out to be a valuable fact later—when all of the evidence has been collected and is being analyzed.

WHO SHOULD INVESTIGATE

Who should conduct the accident investigation? Should it be the supervisor responsible? A higher-level manager? An outside specialist? There is no simple answer to this question, and there is disagreement among professional people of goodwill.

In some companies, the supervisor of the injured worker conducts the investigation. In others, a safety and health professional performs the job. Some companies form an investigative team; others bring in outside specialists. There are several reasons for the various approaches used. Factors considered in deciding how to approach accident investigations include the following:

- Size of the company
- Structure of the company's safety and health program
- Type of accident
- Seriousness of the accident
- Technical complexity
- Number of times similar accidents have occurred
- Company's management philosophy
- Company's commitment to safety and health

After considering all of the variables just listed, it is difficult to envision a scenario in which a safety and health professional would not be involved in conducting an accident investigation. If the accident in question is very minor, the injured employee's supervisor may conduct the investigation, but a safety and health professional should at least study the accident report and be consulted regarding recommendations for corrective action.

If the accident is so serious that it has widespread negative implications in the community and beyond, responsibility for the investigation may be given to a high-level manager or corporate executive. In such cases, a safety and health professional should assist in conducting the investigation. If a company prefers the team approach, a safety and health professional should be a member of the team and, in most cases, chair it. Regardless of the approach preferred by a given company, a safety and health professional should play a leadership role in collecting and analyzing the facts and developing recommendations.

CONDUCTING THE INVESTIGATION

The questions in the previous section summarize what to look for when conducting accident investigations. Figure 9–1 lists five steps to follow when conducting an accident investigation.[7] These steps are explained in the following paragraphs.

Isolate the Accident Scene

You may have seen a crime scene that was sealed off by the police. The entire area surrounding such a scene is typically blocked off by barriers or heavy yellow tape. This is done to keep curious onlookers from removing, disturbing, or unknowingly destroying vital evidence. This same approach should be used when conducting an accident investigation. As soon as emergency procedures have been completed and the injured worker has been removed, qualified personnel should **isolate the accident scene** until all pertinent evidence has been collected or observed and recorded. Furthermore, nothing but the injured worker should be removed from the scene. If necessary, a security guard should be posted to maintain the integrity of the accident scene. The purpose of isolating the scene is to maintain as closely as possible the conditions that existed at the time of the accident.

Record All Evidence

Make a permanent record of all *pertinent evidence* as quickly as possible. There are three reasons for this:

1. Certain types of evidence may be perishable.
2. The longer an accident scene must be isolated, the more likely it is that evidence will be disturbed, whether knowingly or unknowingly.

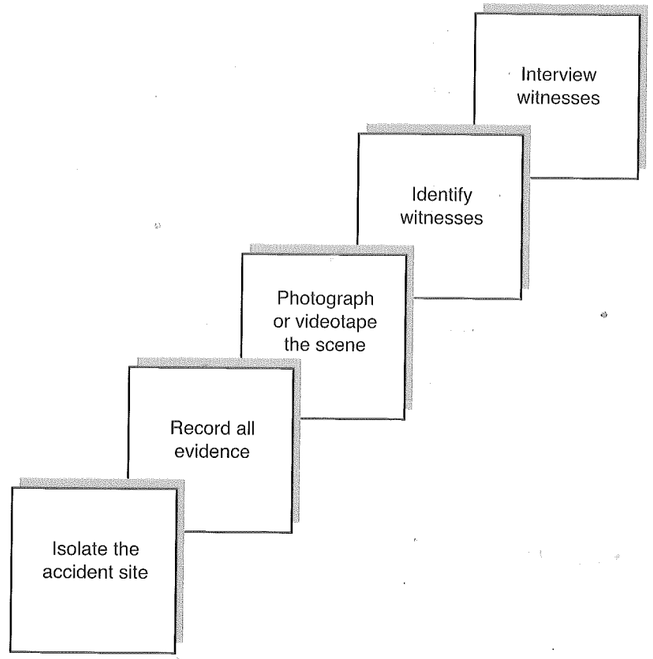


FIGURE 9–1 Steps in conducting an accident investigation.

3. If the isolated scene contains a critical piece of equipment or a critical component in a larger process, pressure will quickly mount to get it back into operation.

Evidence can be recorded in a variety of ways, including written notes, sketches, photography, videotape, dictated observations, and diagrams. In deciding what to record, a good rule of thumb is "If in doubt, record it." It is better to record too much than to skip evidence that may be needed later—after the accident scene has been disturbed.

Photograph or Videotape the Scene

This step is actually an extension of the previous step. Photographic and videotaping technology has simplified the task of observing and recording evidence. Construction professionals who are responsible for safety should be proficient in the operation of a still camera, even if it is just an instant camera, and a videotaping camera.

The advent of the digital camera has introduced a new meaning to the term *instant photographs.* Using a digital camera in conjunction with a computer, photographs of accident scenes can be viewed immediately and transmitted instantly to numerous locations. Digital camera equipment is especially useful when photographs of accident scenes in remote locations are needed.

Both still and video cameras should be on hand, loaded, and ready to use immediately should an accident occur. As with the previous step, a good rule of thumb in photographing and videotaping is "If in doubt, shoot it." When recording evidence, it is better to have more shots than necessary than to risk missing a vital piece of evidence.

A problem with photographs is that, by themselves, they don't always reveal objects in their proper perspective. To overcome this shortcoming, the NSC recommends the following technique:

> When photographing objects involved in the accident, be sure to identify and measure them to show the proper perspective. Place a ruler or coin next to the object when making a close-up photograph. This technique will help to demonstrate the object's size or perspective.[8]

Identify Witnesses

During the process to **identify witnesses,** it is important to compile a witness list. Names on the list should be recorded in three categories: (1) **primary witnesses,** (2) **secondary witnesses,** and (3) **tertiary witnesses** (Figure 9–2). When compiling the witness list, ask employees to provide names of all three types of witnesses.

Interview Witnesses

Every witness on the list should be interviewed, preferably in the following order: primary witnesses first, secondary next, and tertiary last. After all witnesses have been interviewed, it may be necessary to re-interview witnesses for clarification

- Primary witnesses are eyewitnesses to the accident.
- Secondary witnesses are witnesses who did not actually see the accident happen, but were in the vicinity and arrived on the scene immediately or very shortly after the accident.
- Tertiary witnesses are witnesses who were not present at the time of the accident nor afterward, but may still have relevant evidence to present (e.g., an employee who had complained earlier about a problem with equipment involved in the accident).

FIGURE 9–2 Categories of accident witnesses.

or corroboration. Interviewing witnesses is such a specialized process that the next major section is devoted to it.

INTERVIEWING WITNESSES

The techniques for interviewing accident witnesses are designed to ensure that the information is objective and accurate and can be corroborated in a manner as untainted by the personal opinions and feelings of witnesses as possible. For this reason, it is important to understand the *when, where,* and *how* of interviewing the accident witnesses.

When to Interview

Immediacy is important. Interviews should begin as soon as the witness list has been compiled and, once begun, should proceed expeditiously. There are two main reasons for this. First, a witness's recollections will be best right after the accident. The more time that elapses between the accident and the interview, the more blurred the witness's memory will become. Second, immediacy avoids the possibility of witnesses comparing notes and, as a result, changing their stories. This is just human nature, but it is a tendency that can undermine the value of testimony given and, in turn, the facts collected. Recommendations based on questionable facts are not likely to be valid. Also, witnesses should be interviewed individually and separately, preferably before they have talked to each other.

Where to Interview

The best place to interview is at the accident scene. If this is not possible, interviews should take place in a private setting elsewhere. Ensure that all distractions are removed, interruptions are guarded against, and the witness is not accompanied by other witnesses. All persons interviewed should be allowed to relate their recollections without fear of contradiction or influence by other witnesses or employees. Select a neutral location in which witnesses will feel comfortable. Avoid the **principal's office syndrome** by selecting a location that is not likely to be intimidating to witnesses.

How to Interview

The key to getting at the facts is to put the witness at ease and to listen. Listen to what is said, how it is said, and what is not said. Ask questions that will get at the information listed earlier in this chapter, but phrase them in an **open-ended question** format. For example, instead of asking "Did you see the victim pull the red lever?", phrase your question as follows: "Tell me what you saw." Don't lead witnesses with your questions or influence them with gestures, facial expressions, tone of voice, or any other form of nonverbal communication. Interrupt only if absolutely necessary to seek clarification on a critical point. Remain nonjudgmental and objective.

The information being sought in an accident investigation can be summarized as *who, what, when, where, why,* and *how* (Figure 9–3). As information is given, it may be necessary to take notes. If you can keep your note taking to a minimum during the interview, your chances of getting uninhibited information are increased. Note taking can distract and even frighten a witness.

An effective technique is to listen during the interview and make mental notes of critical information. At the end of the interview, summarize what you have heard and have the witness verify your summary. After the witness leaves, develop your notes immediately.

A question that sometimes arises is "Why not tape the interview?" Safety and health professionals disagree on the effectiveness and advisability of taping. Those who favor taping claim that it allows the interviewer to concentrate on listening without having to worry about forgetting a key point or having to interrupt the witnesses to jot down critical information. It also preserves everything that is said for the record and the tone of voice in which it is said. A complete transcript of the interview also ensures that information is not taken out of context.

Those opposed to taping say that taping devices tend to inhibit witnesses so that they are not as forthcoming as they would be without taping. Taping also slows down the investigation while the taped interview is transcribed, and the interviewer must wade through voluminous testimony trying to separate critical information from irrelevant information.

In any case, if the interview is to be taped, the following rules should be applied:

- Use the smallest, most unobtrusive taping device available, such as a microcassette recorder.
- Inform the witness that the interview will be taped.
- Make sure the taping device is working properly and that the tape it contains can run long enough so that you do not have to interrupt the witness to change it.
- Take time at the beginning of the interview to discuss unrelated matters long enough to put the witness at ease and overcome the presence of the taping device.
- Make sure that the personnel are available to transcribe the tapes immediately.
- Read the transcripts as soon as they are available, and highlight critical information.

An effective technique to use with **eyewitnesses** is to ask them to reenact the accident for you. Of course, the effectiveness of this technique is enhanced if the **reenactment** can take place at the accident site. However, even when this is not possible, an eyewitness reenactment can yield valuable information.

SAFETY FACTS & FINES

Where to Conduct Accident Interviews

To ensure that employees are willing to give accurate information, safety and health professionals should conduct accident interviews in the privacy of their office, right? Not necessarily. Experience has shown that the best way to promote accuracy is to interview witnesses at the site of the accident. This puts the accident interview in context in a setting that will help stimulate the memory. To ensure privacy and confidentiality, interview witnesses one at a time.

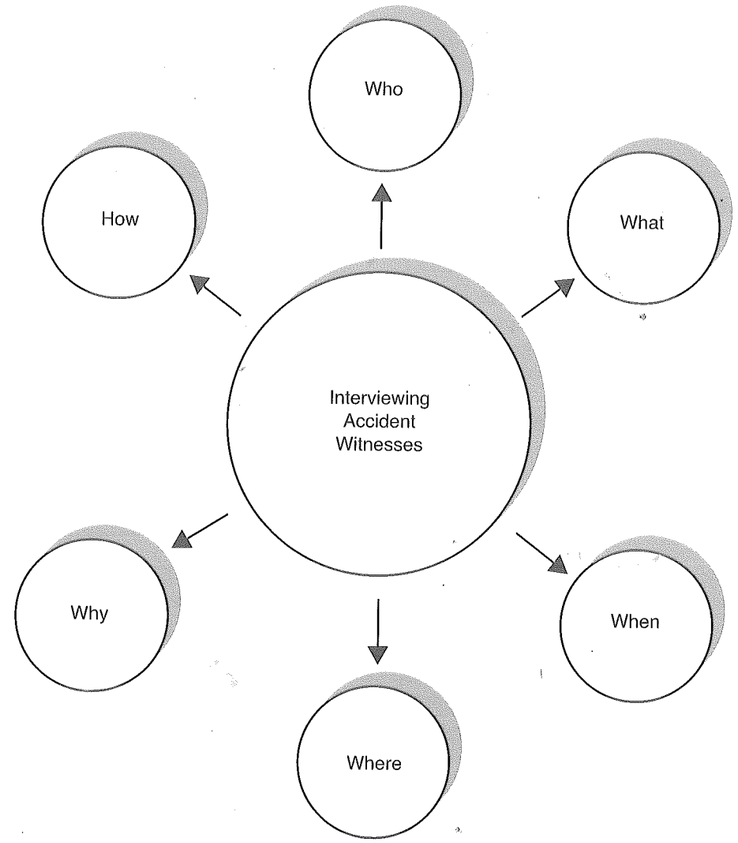


FIGURE 9–3 Questions to ask when interviewing witnesses.

SAFETY FACTS & FINES

Insufficient guarding devices on power tools and machines can introduce amputation hazards. A company in Trenton, Georgia, was fined $68,900 for failing to use machine guards in a way that would protect workers from amputation hazards. The company was cited for the following violations: (1) use of unguarded machines with exposed chains, (2) no lockout or tagout procedures, (3) improper use of compressed gas for cleaning, and (4) failure to provide guardrails for stairs.

In using the *reenactment technique,* a word of caution is in order. If an eyewitness does exactly what the victim did, there may be another accident. Have the eyewitnesses explain what they are going to do, before letting them do it. Then, have them *simulate,* rather than actually perform, the steps that led up to the accident.

REPORTING ACCIDENTS

Before presenting the details of accident reporting, it is important to present a pertinent Occupational Safety and Health Administration (OSHA) requirement: any case of a fatality or of three or more employees being hospitalized requires notification of the appropriate regional office of OSHA within eight hours of the incident (reference 29CFR 1903 and 1904).

An accident investigation should culminate in a comprehensive accident report. The purpose of the report is to record the findings of the accident investigation, the cause or causes of the accident, and the recommendations for corrective action.

All injuries and illnesses should be recorded, regardless of severity, if they result in any of the outcomes shown in Figure 9–4. If an accident results in the death of an employee or hospitalization of three or more employees, a report must be submitted to the nearest OSHA office within eight hours. This rule applies regardless of the size of the company.[9]

Accident report forms vary from company to company. However, the information contained in them is fairly standard. Regardless of the type of form used, an accident report should contain at least the following, according to the NSC[10]:

- Case number of the accident
- Victim's department or unit
- Location and date of the accident or date that an illness was first diagnosed
- Victim's name, social security number, sex, age, home address, and telephone number
- Victim's normal job assignment and length of employment with the company
- Victim's employment status at the time of the accident (i.e., temporary, permanent, full time, part time)
- Case numbers and names of others injured in the accident
- Type of injury and body part(s) injured (e.g., burn to right hand, broken bone in lower right leg) and severity of injury (i.e., fatal, only first aid required, hospitalization required)
- Name, address, and telephone number of the physician called
- Name, address, and telephone number of the hospital to which the victim was taken
- Phase of the victim's workday when the accident occurred (e.g., beginning of shift, during break, end of shift)
- Description of the accident and how it took place, including the sequence of events leading up to the accident
- Specific tasks and activities with which the victim was involved at the time of the accident (e.g., task: mixing cleaning solvent; activity: adding detergent to the mixture)
- Employee's posture or proximity to his or her surroundings at the time of the accident (e.g., standing on a ladder, bent over at the waist inside the robot's work envelope)
- Supervision status at the time of the accident (i.e., unsupervised, directly supervised, indirectly supervised)
- Causes of the accident
- Corrective actions that have been taken so far
- Recommendations for additional corrective action

In addition to these items, you may want to record such additional information as the list of witnesses; dates, times, and places of interviews; historical data related to similar accidents; information about related corrective actions that had been taken in the past, but had not yet been followed up; and any other information that might be relevant. Figure 9–5 is OSHA Form 301, "Injury and Illness Incident Report." It satisfies the requirements for information, but is not a mandatory form. Companies may develop their own forms, as long as they contain all of the necessary information.

Injuries and illnesses should be recorded if they result in any of the following:

- Death
- One or more lost workdays
- Restriction of motion or work
- Loss of consciousness
- Transfer to another job
- Medical treatment (more than first aid)

FIGURE 9–4 Record-keeping requirements.

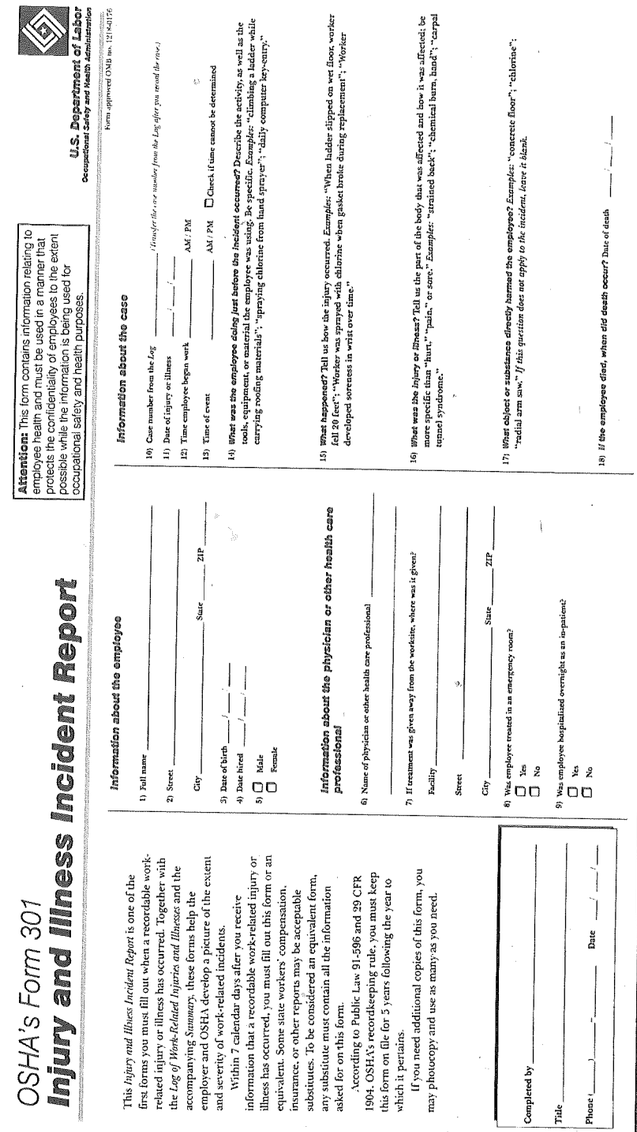
Why Some Accidents Are Not Reported

Many accidents go unreported. According to Cunningham and Kane,[11]

> The majority of accidents are not being reported! Articles in the Wall Street Journal testify to this fact. Many firms failed to report OSHA-recordable incidents, presumably either to avoid OSHA inspections that result from poor incident rates or to achieve statistical goals. The saddest part of non-reporting of accidents is that they are not investigated to determine and eliminate the causes.

There are several reasons why accidents go unreported. Be familiar with these reasons so that you can do your part to overcome them. Cunningham and Kane list the main reasons as follows[12]:

1. *Red tape.* Some people see the paperwork involved in accident reporting as red tape and, therefore, do not report accidents just to avoid paperwork.



Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

U.S. Department of Labor
Occupational Safety and Health Administration
Form approved OMB no. 1218-0176

OSHA's Form 301
Injury and Illness Incident Report

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary*, these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Information about the employee

1) Full name
2) Street
City State ZIP
3) Date of birth
4) Date hired
5) ☐ Male ☐ Female

Information about the physician or other health care professional

6) Name of physician or other health care professional
7) If treatment was given away from the worksite, where was it given?
Facility
Street
City State ZIP
8) Was employee treated in an emergency room? ☐ Yes ☐ No
9) Was employee hospitalized overnight as an in-patient? ☐ Yes ☐ No

Completed by
Title
Phone ( ) Date

Information about the case

10) Case number from the Log
11) Date of injury or illness
12) Time employee began work AM / PM
13) Time of event AM / PM ☐ Check if time cannot be determined
14) **What was the employee doing just before the incident occurred?** Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. *Examples:* "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."
15) **What happened?** Tell us how the injury occurred. *Examples:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was spraying with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."
16) **What was the injury or illness?** Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or "sore." *Examples:* "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."
17) **What object or substance directly harmed the employee?** *Examples:* "concrete floor"; "chlorine"; "radial arm saw." *If this question does not apply to the incident, leave it blank.*
18) **If the employee died, when did death occur?** Date of death

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about this estimate or any other aspects of this data collection, including suggestions for reducing this burden, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

FIGURE 9–5 OSHA Form 301: Injury and Illness Incident Report.

2. *Ignorance.* Not all managers and supervisors are as knowledgeable as they should be about the reasons for accident reporting. Many are not familiar with OSHA's reporting specifications.
3. *Embarrassment.* Occasionally, people do not report an accident because they are embarrassed by their part in it. A supervisor who did not properly supervise or a manager who has not provided the proper training for employees may be embarrassed to file a report.
4. *Record spoiling.* Some accidents go unreported just to preserve a safety record, such as the record for days worked without an accident.
5. *Repercussions and fear.* Some accidents go unreported because the people involved are afraid of being found at fault, being labeled accident prone, and being subjected to other negative repercussions.
6. *No feedback.* Some accidents go unreported because those involved feel that filing a report is a waste of time. This typically happens when management does not respond to recommendations made in earlier accident reports.

Clearly, these reasons for not reporting accidents present construction professionals with a challenge. To overcome these inhibitors, it is necessary to develop a simple reporting system that will not be viewed as too much bureaucratic paperwork. Construction professionals must educate personnel at all levels concerning the purpose of accident reporting and why it is important. An important step is to communicate the fact that faultfinding is not the purpose. Another important step is to follow up to ensure that recommendations are enacted or that employees are told why they are not being enacted. This helps to ensure the integrity of the process.

Discipline and Accident Reporting

Faultfinding is not the purpose of an accident investigation. However, an investigation sometimes reveals that an employee has violated or simply overlooked safety regulations. Should such violations be condoned? According to Kane and Cunningham,[13]

> Many companies condone nonconformance to safety rules as long as no injury results. However, if the nonconformance results in an accident involving an injury, the disciplinary boom is promptly lowered. This inconsistency inevitably leads to resentment and failure to report accidents and abiding of accident problems.

There is a built-in dilemma here that construction professionals must be prepared to handle. On the one hand, it is important that faultfinding not be seen as the purpose of an accident investigation. Such a perception limits the amount of information that can be collected. On the other hand, if those workers whose behavior leads to accidents are not disciplined, the credibility of the safety program is undetermined. Kane and Cunningham recommend the following procedures for handling this dilemma: *Never* discipline an employee because he or she had an accident. *Always* discipline employees for noncompliance with safety regulations.[14]

Such an approach applied with consistency will help maintain the integrity of both the accident investigation process and the overall safety program.

RECORD KEEPING

OSHA has specific requirements for record keeping related to injuries and illnesses. OSHA Form 300, "Log of Work-Related Injuries and Illnesses," is used to classify work-related injuries and illnesses and to describe the extent or severity of each case (Figure 9–6).[15] OSHA Form 300A, "Summary of Work-Related Injuries and Illnesses," is used to show the total number of injuries and illnesses in each category in a given year (Figure 9–7). Employers are required to maintain a separate "log" for each location or site. They must also maintain a separate "summary" for each location that is expected to be in operation for one year or more. Entering a case on the "log" does not imply any guilt or negligence on the part of the employer, nor does it mean that an employee has qualified for workers' compensation.

"Work-Related" Injury or Illness Defined

OSHA requires employers to keep records of work-related injuries and illnesses, but how does an employer know if a case is work related? An injury or illness is work related if an event or exposure in the work environment caused or contributed to the injury or illness or significantly aggravated a preexisting condition. Injuries or illnesses that result from events or exposures in the workplace can be assumed to be work related, unless a specific exception applies. The work environment includes establishments, job sites, or other locations where one or more employees are working or are present as a condition of employment.

Injuries and Illnesses That Must Be Recorded

Companies are required to record work-related injuries and illnesses that result in any of the following:

- Death
- Loss of consciousness
- Days away from work
- Restricted work activity or transfer
- Medical treatment beyond first aid
- Diagnosis by a physician or other licensed health-care professional
- Cancer
- Fractured or cracked bone
- Chronic irreversible disease
- Punctured eardrum

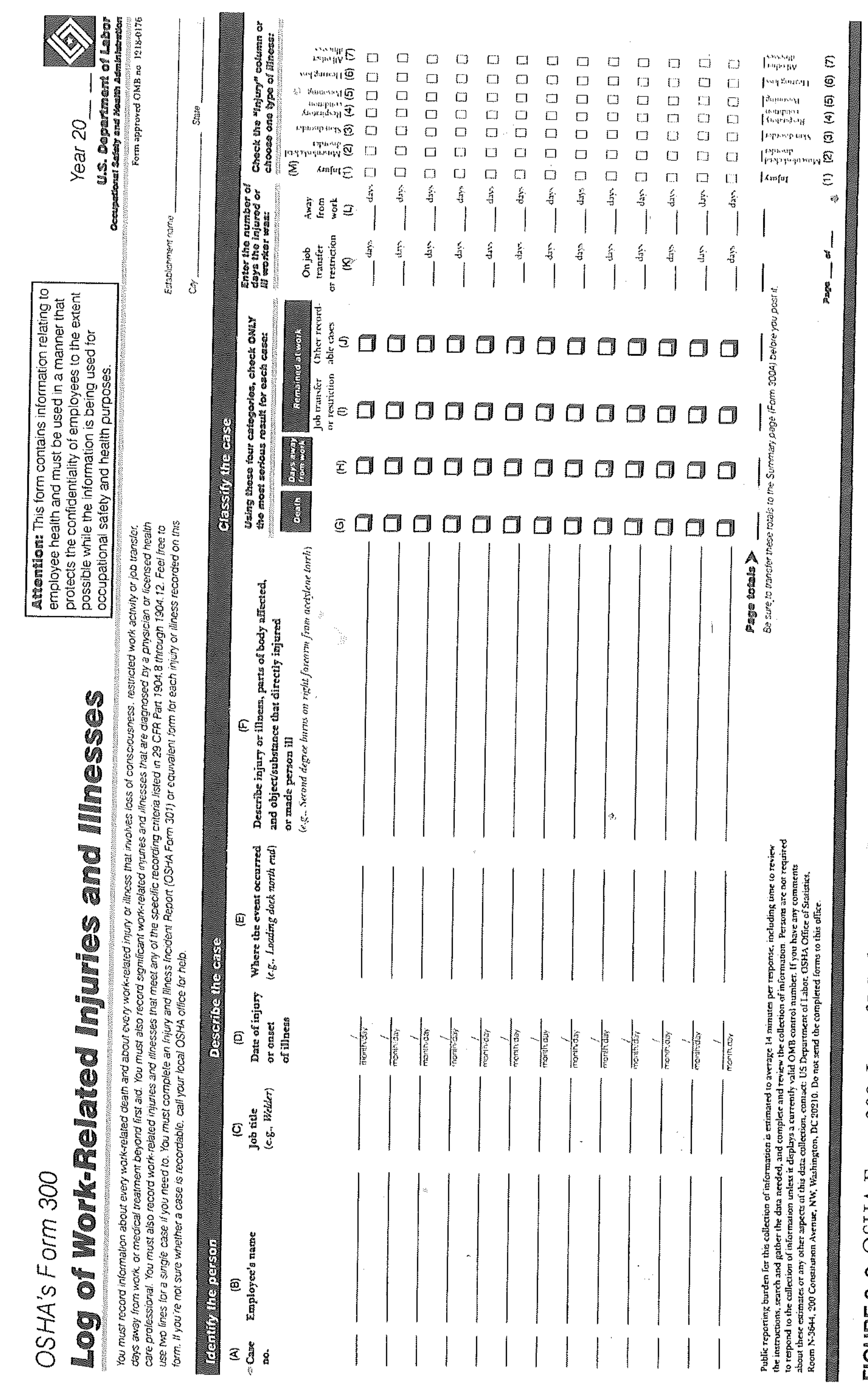


FIGURE 9–6 OSHA Form 300: Log of Work-Related Injuries and Illnesses.

OSHA's Form 300A

Summary of Work-Related Injuries and Illnesses

Year 20__

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35, in OSHA's recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases			
Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
(G)	(H)	(I)	(J)

Number of Days	
Total number of days of job transfer or restriction	Total number of days away from work
(K)	(L)

Injury and Illness Types			
Total number of . . .	(M)		
(1) Injuries		(4) Respiratory conditions	
		(5) Poisonings	
(2) Musculoskeletal disorders		(6) Hearing loss cases	
(3) Skin disorders		(7) All other illnesses	

Establishment information

Your establishment name _____

Street _____

City _____ State _____ ZIP _____

Industry description (e.g., Manufacture of motor truck trailers)

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

Employment information *(If you don't have these figures, see the Employment info section on page 4 of this form.)*

Annual average number of employees _____

Total hours worked by all employees last year _____

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive _____ Title _____

Phone _____ Date _____

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Public reporting burden for this collection of information is estimated to average 20 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: U.S. Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

FIGURE 9–7 OSHA Form 300A: Summary of Work-Related Injuries and Illnesses.

In addition to these conditions, the following must be recorded: (1) any puncture or cut from a sharp object that is contaminated with another person's blood or any other infectious substance, (2) any condition requiring an employee to be removed under the requirements of an OSHA health standard, (3) any standard threshold shift in hearing, and (4) tuberculosis infection as diagnosed by a physician or a licensed health-care professional or an approved skin test.

Medical Treatment versus First Aid

In deciding whether or not an injury or illness should be recorded or in deciding how it should be recorded, it is important to understand the difference between medical treatment and first aid. Medical treatment involves managing and caring for a patient for the purpose of combating a disease or disorder. The following are *not* considered medical treatment: (1) visits to a physician or health-care professional for the purpose of observation or counseling, (2) diagnostic procedures, including the administration of prescription medicines used solely for diagnostic purposes, and (3) any procedures that qualify as first aid.

First aid procedures do not qualify as medical treatment. Consequently, injuries and illnesses that require only first aid do not have to be recorded. First aid includes the following:

- Administering nonprescription medications at nonprescription strengths
- Administering tetanus immunizations
- Cleaning, flushing, or soaking wounds on the skin's surface
- Using wound coverings, such as bandages, gauze pads, adhesive strips, or butterfly bandages
- Administering hot or cold therapy
- Using any totally nonrigid means of support, such as elastic bandages, wraps
- Using temporary immobilization devices while transporting an accident victim (splints, slings, neck collars, or back boards)
- Drilling a fingernail or toenail to relieve pressure or draining fluid from blisters
- Using eye patches
- Using simple irrigation or a cotton swab to remove foreign bodies from the eye that are not embedded in or adhered to the eye
- Using irrigation, tweezers, cotton swabs, or other simple means to remove splinters or foreign material from areas other than the eye
- Using finger guards
- Using massages
- Drinking fluids to relieve heat stress

Privacy Cases

In some cases involving injuries and illnesses, privacy becomes an issue. The following types of cases should be recorded as "privacy cases," rather than using the employee's name:

- An injury or illness involving the reproductive system or an intimate part of the body
- An injury or illness resulting from sexual assault
- A mental illness
- A case involving HIV, hepatitis, or tuberculosis infection or transmission
- A needlestick injury from a cut or a sharp object that is contaminated with blood or some other potentially infectious substance
- An injury or illness in which the employee in question specifically requests that his or her name not be entered into the log

Posting of the Summary

It is not necessary to post the log (OSHA Form 300), but the summary (OSHA Form 300A) must be posted according to specific criteria. The summary must be posted—in a conspicuous location accessible to employees—no later than February 1, covering the previous year that ended in December. The summary is prepared and posted according to calendar years rather than fiscal years. Once posted, the summary must remain posted until April 30. Both the log and the summary are to be retained on file for five years after the year they cover.

Summary

Accidents are investigated for the purpose of identifying causal factors that could lead to other accidents if not corrected. The purpose is *not* to assign blame.

It is important to begin an accident investigation as soon as possible after an accident occurs so that evidence and the memories of witnesses are still fresh.

Facts to be uncovered in an accident investigation can be summarized as *who, what, when, where, why,* and *how.*

Who conducts the accident investigation can vary according to circumstances. However, regardless of how it is done, a safety and health professional should play an active role in the process.

Steps for conducting an accident investigation are as follows: (1) isolate the accident scene, (2) record all evidence, (3) photograph or videotape the accident scene, (4) identify witnesses, and (5) interview witnesses.

Witnesses to accidents fall into one of three categories: primary (eyewitnesses); secondary (were present at the

scene, but did not see the accident); and tertiary (were not present, but have information that may be relevant).

Interviews should take place at the accident site whenever possible. When this is not practical, interviews should take place at a neutral location that is private and where the witness is comfortable.

The keys to getting at the facts in an interview are as follows: (1) put the witness at ease, (2) ask open-ended questions, and (3) listen. Interrupt only if absolutely necessary.

When possible, let eyewitnesses reenact the accident through simulation at the job site. Do not let them actually perform the tasks that led up to the accident.

The purpose of an accident report is to record the findings of the accident investigation, the cause or causes of the accident, and the recommendations for corrective action. Report forms should meet the record-keeping specifications of OSHA.

Key Terms and Concepts

Accident investigation
Accident report
Accident scene
Causes
Emergency procedures
Evidence
Eyewitnesses
Faultfinding
How
Identify witnesses
Immediacy
Isolate the accident scene
Open-ended question
Primary witnesses
Principal's office syndrome
Reenactment
Secondary witnesses
Tertiary witnesses
What
When
Where
Who
Why

Review Questions

1. Explain the rationale for investigating accidents.
2. When should an investigation be reported? Why?
3. What are the terms that should guide the conduct of an accident investigation?
4. What role should the safety and health professional play in conducting an accident investigation?
5. List and explain the steps for conducting an accident investigation.
6. Why is it important to record all pertinent evidence relating to an accident immediately after the accident has occurred?
7. What can you do when taking close-up photographs to put them in the proper perspective?
8. List and differentiate among the three categories of witnesses to an accident.
9. Briefly explain the *when* and *where* of interviewing witnesses.
10. Briefly explain the *how* of interviewing witnesses.
11. What is the purpose of an accident report?

Critical Thinking and Discussion Activities

1. "I'm no investigator," said Mack Jones, project superintendent for Indies Construction Company (ICC). He had just put a seriously injured employee, Wanda Burke, in an ambulance and sent it speeding away to the hospital. "I'll get someone to help me investigate what happened tomorrow or the next day," said Jones. "Right now, we need to get everyone back to work. Then I'm going to the hospital to check on Wanda." Critique the approach Jones is taking to accident investigation. How effective do you think it will be? What, if anything, would you do differently?
2. "We've got to get to the bottom of this accident. I want to know who is responsible and I want him fired today!" You are the safety director for Bell Contracting Company, and these are the orders your boss gave you just 10 minutes ago. Should you do what he ordered, or should you give him time to cool down and then try to convince him to take a different approach? If you think a different approach is called for, what do you recommend?

Application Activities

1. Use the material in this chapter to develop a detailed list of questions that a medium-sized construction company can use to interview witnesses after an accident.
2. Use the material in this chapter to develop a comprehensive "Standing Operating Procedures Manual" for accident investigation that could be used by any construction company. Include the list of questions from Activity 1 in the manual.

Endnotes

1. The Associated General Contractors of America, retrieved January 7, 2009, from http://www.agc.org/cs/safety_managment_training_course
2. Ibid.
3. Ibid.
4. Ibid.
5. National Safety Council, *Supervisor's Safety Manual 9th edition* (Chicago: NSC, 1997), 69–70.
6. The Associated General Contractors of America, retrieved January 7, 2009, from http://www.agc.org/cs/safety_managment_training_course
7. National Safety Council, *Supervisor's Safety Manual,* 71.
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9. OSHA 2056, 1991 (Revised), U.S. Department of Labor, 11.
10. National Safety Council, *Supervisor's Safety Manual,* 76–77.
11. Cunningham, J., and A. Kane, "Accident Reporting—Part I: Key to Prevention," *Safety & Health* 139, no. 4: 70.
12. Ibid., 70–71.
13. Kane, A., and J. Cunningham, "Accident Reporting—Part II: Consistent Discipline Is Vital," *Safety & Health* 139, no. 5: 78.
14. Ibid.
15. Occupational Safety and Health Administration, "OSHA Forms for Recording Work-Related Injuries and Illnesses," U.S. Department of Labor, August 2001. Available at http://www.osha.gov