

# **Pipefitters Engulfed in Flames**

**Lessons Learned**

**Volume 03 Issue 22**

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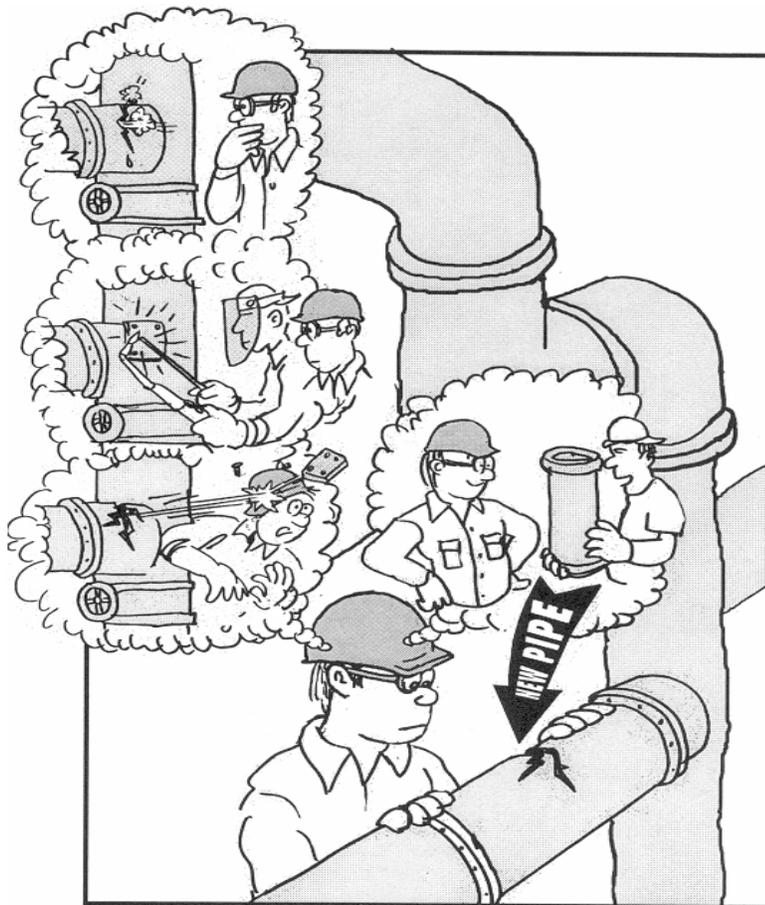
## Pipefitters Engulfed in Flames

### Purpose

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To conduct a small group “lessons learned” activity to share information gained from incident investigations.

To understand “lessons learned” through a systems of safety viewpoint.



This material was produced by The Labor Institute and USW under grant number 46DO-HT11 Susan Harwood Training Grant Program, from the Occupational Safety and Health Administration, U.S. Department of Labor. It does not necessarily reflect the views or policies of the U.S. Department of Labor, nor does mention of trade names, commercial products or organizations imply endorsement by the U.S. Government.

The incident and recommendations made are from an actual USW represented facility. These recommendations are a product of the site’s analysis of the incident and not meant to represent the USW official view on the topic(s). In fact, one of the goals of this exercise is evaluate the recommendations made and to suggest improvements.

## ***Introduction***

### **One Hour “Lessons Learned” Safety Training Activity**

This is a Small Group Activity Method (SGAM) exercise. It is designed for use in toolbox style meetings where a group of craft persons, operators, or other small group is assembled for a safety training session. The whole group should be further divided into smaller discussion groups of four to six people.

The tone of the meetings should be informal to create as much discussion as possible within the groups and among the groups. Active participation by group members is essential for this exercise to be successful.

If you plan to present a Lessons Learned Activity and have not been trained in the USW worker trainer program, you should contact the USW Health, Safety & Environment Department:

Phone (412) 562-2581

email: [safety@steelworkers-usw.org](mailto:safety@steelworkers-usw.org) for trainer information.

For this exercise, each person in the group should have their own copy of this activity printed in its entirety. The exercise consists of three tasks. Each task is designed to provoke thought and generate discussion about the incident at hand. Each discussion group should designate a scribe to keep notes and report back to the facilitator and class after each task. When the exercise is completed, review the Summary on page 13.

Definitions of terms used in this exercise are provided throughout the activity. A glossary of terms is also provided in the appendix.

The incident(s) depicted in this activity are based upon real occurrences. The names of persons and corporations are fictitious.

## **Task 1**

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### **Please read the following scenario:**

A fuel gas control valve for a process heater was to be removed and repaired by instrument repairmen because the valve was sticking. The heater was to remain in operation and the fuel gas to the heater was to be controlled manually by adjusting the control valve bypass valve.

Operators took the control valve out of service by opening the bypass valve and closing the block valves on both sides of the automatic control valve. Only one bleeder valve was present on the control valve configuration and it was located between the upstream block valve and the control valve. There was no downstream bleeder valve. After the control valve was isolated, the control room operator opened and closed the valve several times from the control board and then left the valve in the open position. The local indicator on the valve stem showed the valve was open but the indicator had slipped, giving an erroneous indication. It had actually stuck in the closed position due to residue in the valve body.

The operators depressured the control valve through the single bleeder valve and rodded the bleeder to ensure the bleeder valve was completely open. They then LOTO'd the equipment so that maintenance personnel could remove the control valve.

After obtaining a work permit, pipefitters first removed all the bolts from the upstream flange on the control valve. (The side with the bleeder valve.) They then began unbolting the downstream flange and as the valve broke loose, a hissing sound emitted from the downstream flange. Realizing the downstream block valve was leaking fuel gas, the pipefitters attempted to retighten the flange but the gasket fell out before they could accomplish this. The pipefitters then decided to remove the valve completely and install a flat cap on the leaking side of the control loop.

Before they could complete this task, a sufficient amount of fuel gas had leaked to the atmosphere to be ignited by the nearby heater. The two pipefitters became engulfed in flames. They were taken to a safety shower as soon as possible and then transported to a hospital. The fire was extinguished with a fire monitor.

It was later determined that the downstream block valve leaked badly and although the control board indicated that the control valve was open, it was actually stuck shut, not allowing the downstream side of the control valve to depressure to the single bleeder.

## **Task 1** *(continued)*

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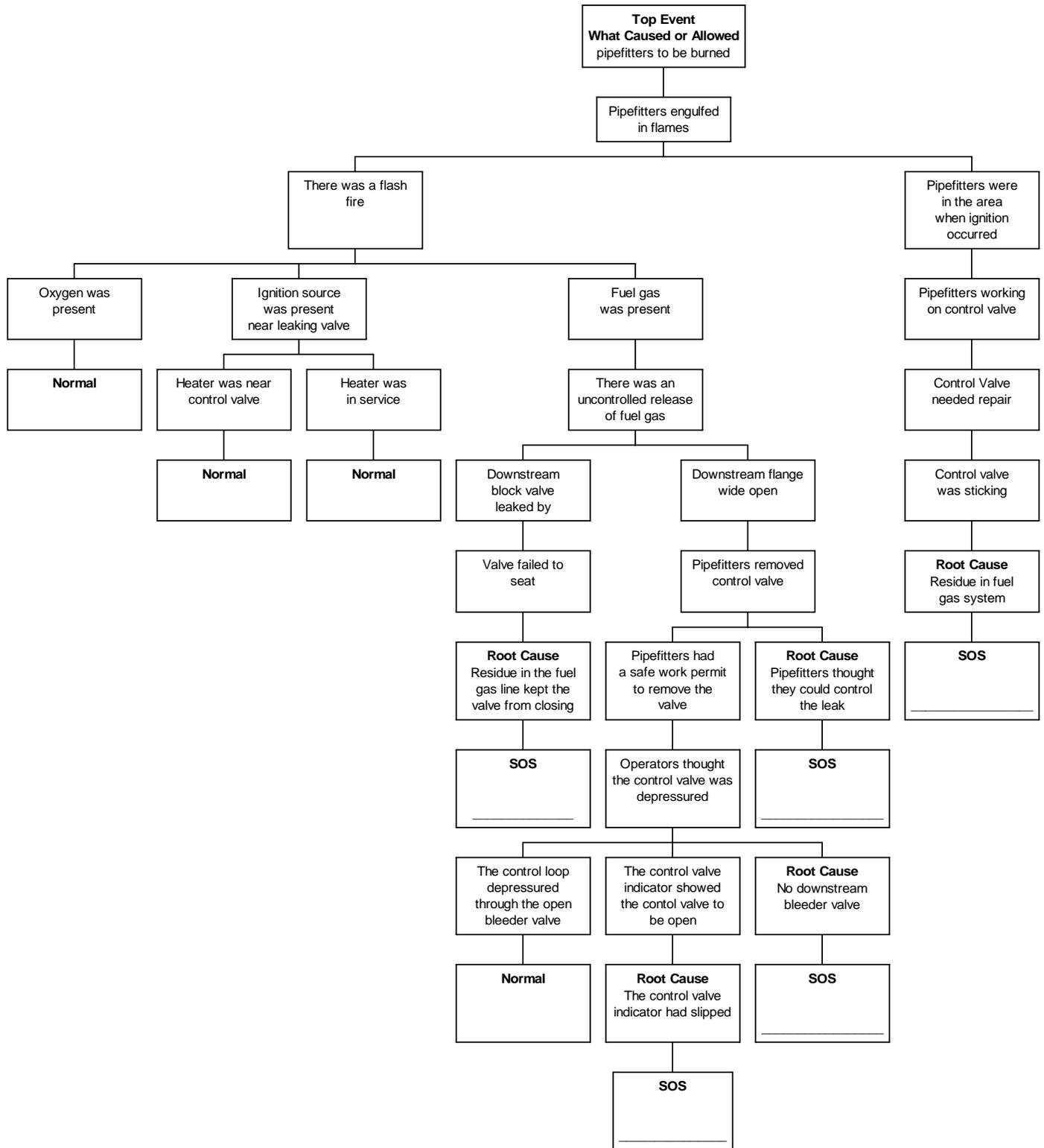
**On the next page you will find a logic tree that shows how the investigators at this site linked the incident that occurred (the top event) to the facts described in the scenario and the incident’s root causes. Below each root cause in the logic tree you will find a block with the title “SOS” (System of Safety).**

**Find the boxes marked SOS. Directly above those boxes will be a root cause of the incident. Your task is to complete the logic tree by identifying the *major* system of safety affected where the root cause failure occurred and list it in the box. These “systems” are listed in a chart on page 9. *Note: some of the SOS boxes may already be completed for you.***

**Please select someone in your group to act as scribe to report back your answers.**

## A USW “Lessons Learned” Activity

A **Logic Tree** is a pictorial representation of a logical process that maps an incident from its occurrence to the root causes of the incident.



## Task 2

**A. Below you will find two lists. On the left are the root causes from the logic tree on the previous page. On the right are recommendations made by the team that investigated this incident. On the chart below identify which of the “recommendations” would eliminate or reduce each “root cause” by placing the number of the recommendation(s) on the line provided. More than one recommendation can apply to a root cause.**

	Root Causes	Recommendations
	A. Residue in fuel gas caused control valve to stick	1. Examine residue in fuel line to determine its source and methods to remove it from the system.
	B. Control valve position indicator slipped.	2. Train maintenance personnel to sound the alarm immediately to summon help in emergency situations.
	C. No downstream bleeder valve on system.	3. Install bleeder valves on both sides of control valves to ensure proper draining and isolation.
	D. Residue in fuel gas kept the downstream block valve from closing.	4. Train operations personnel to visually verify valve movement by watching the stem. Position indicators can be unreliable.
	E. Pipefitters thought they could control the leak.	

*A USW “Lessons Learned” Activity*

**B. Use the concepts found on the factsheets on pages 9 through 12 and evaluate the recommendations from Question A. How would you strengthen or add to the list?**

### **Task 3**

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**Discuss ways in which the “Lessons Learned”(listed below) from this incident can be applied at your workplace. Please explain.**

#### **Lessons Learned**

- Dealing with emergencies requires specialized training. It is important that all workers understand their role during an emergency.
- Running a system with a control system bypassed should never be accepted as normal. A careful hazard assessment should be performed before attempting this type of operation.
- Proper control loop preparation cannot be done with only one bleeder. Purging cannot be accomplished.
- Simply depressuring equipment does not rid the equipment of its contents. Gas testing a control loop with one bleeder rarely yields acceptable readings. Purging is almost always required.
- When valve leakage occurs, extreme care must be taken before removing all means to control that leakage. Backup plans for alternate means of isolation must be made well in advance, should the leak becomes unmanageable.

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## All Systems of Safety Are Not Created Equal!

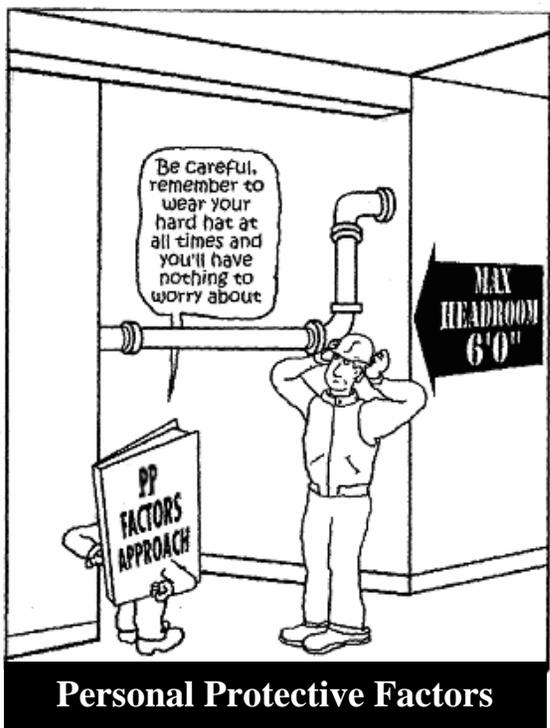


Surprisingly, the same hazard can often be addressed in more than one system. Take the low pipe in the doorway above, on the next two pages you'll see how this same problem could be handled by each of the major Systems of Safety.

Which is the best approach? Well, if you look at the Systems of Safety Chart on the previous page, you will find the SOS's arranged in order of strength: the most powerful – Design – on down to the least powerful – Personal Protective Factors.

A good investigation team will consider the full range of recommendations for each root cause.

A USW “Lessons Learned” Activity



**Personal Protective Factors**

Sub-systems that include a broad range of working conditions and situations that affect workers.

- Weakest system
- Controls the hazard directly at the individual’s level



**Procedures and Training**

The instructions and knowledge necessary to maintain and operate equipment or processes

- Easier to affect groups of workers.
- Dependent on individuals’ memories and lack of distraction

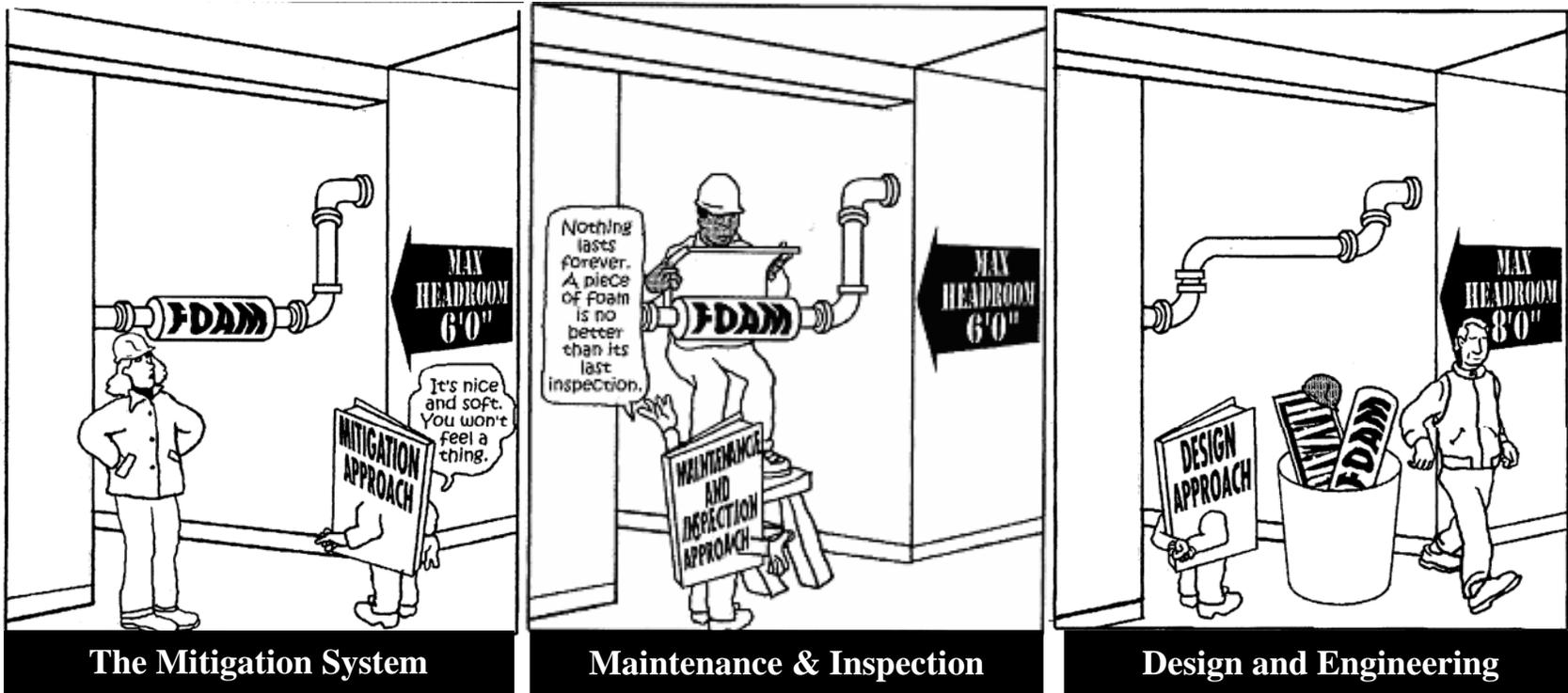


**The Warning System**

Devices that warn of a dangerous or potentially dangerous situation.

- Draws attention
- May be missed or ignored

A USW “Lessons Learned” Activity



Sub-systems that automatically act to control or reduce the effect of hazards.

- Workers protected automatically

The system responsible for maintaining, repairing and inspecting equipment and processes.

- Vital to make sure even the best designed system continues to function safely

The primary (highest level) system that designs the hazard out of the process.

- Strongest system
- Hazard eliminated

## **Summary: Lessons Learned**

1. The objective of “lessons learned” is to prevent accidents through identifying and correcting underlying defects in systems of safety. To achieve maximum prevention, all recommended changes should be made.
2. Corrective action resulting from lessons learned is one of the best methods for achieving proactive health and safety. Maximum prevention is achieved by correcting the conditions that led to the incident at other sites in the plant and at other sites.
3. Systems of safety-based analysis help identify the underlying causes of incidents and are valuable for determining what corrective measures should be taken as a result of the lessons learned.
4. Many times the result of an incident investigation is that worker error is identified as the main contributing factor. When a systems of safety-based analysis is used, multiple root causes are usually uncovered.
5. The most effective controls of health and safety hazards are those which are integrated or designed into the process, such as engineering controls. The least effective controls involve personal protective equipment and procedures that merely acknowledge the hazard and do nothing to eliminate it.
6. All work-related hazards must be evaluated before work begins to eliminate or reduce worker exposure to hazards and to prevent injuries.

## Glossary of Terms (Appendix)

Several unique terms are used while doing the “Lessons Learned” exercises. Their definitions are listed below.

**Contributing Factor**—something that actively contributes to the production of a result, an ingredient.

**Fact**—a piece of information presented as having objective reality, an actual occurrence or event.

**Hierarchy of Systems of Safety**—the ranking of systems of safety as to their relative effectiveness in providing accident prevention. This hierarchy is represented by the “Fulcrum” with the most effective system of safety residing on the left side of the lever. Less effective systems reside further to the right on the lever.

**Lessons Learned**—A summation of an investigation that describes safety hazards or conditions with general educational recommendations to identify and correct similar conditions. These differ from investigation recommendations as illustrated below:

*Investigation recommendation:* Replace the carbon steel gate valve on the vacuum tower bottoms line with a chrome valve. The valve failed due to corrosion.

*Lessons Learned:* Verify that carbon steel valves and piping are not used in vacuum tower bottoms service because corrosion can cause them to fail.

**Logic Tree**—a pictorial representation of a logical process that maps an incident from its occurrence to the root causes of the incident.

**Recommendations**—calls for specific changes that address each root cause of an incident or accident to prevent its reoccurrence.

**Root Cause**—basic cause of an accident found in management safety systems.

**Glossary of Terms** (*continued*)

**Supports and Barriers**—“supports” are conditions that promote or render assistance to implementing recommendations while “barriers” are conditions that obstruct the implementation of recommendations.

**Systems of Safety**—management systems that actively seek to identify and control hazards before they result in an incident or injury.

- Design and Engineering
- Maintenance & Inspection
- Mitigation Devices
- Warning Systems
- Procedures and Training
- Personal Protective Factors

### Conducting a “Lessons Learned” Activity

Circle the number that best shows your response to each of the following questions.

1. How easy was it for you to understand the “systems of safety” approach presented in this activity?

<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>Very easy</b>	<b>Somewhat easy</b>	<b>Somewhat hard</b>	<b>Very hard</b>

2. How useful do you think this “systems of safety” way of thinking could be for tackling safety and health problems at your workplace?

<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>Very useful</b>	<b>Somewhat useful</b>	<b>Not very useful</b>	<b>Of no use</b>

3. How much do you agree or disagree with the following statement:

The logic tree diagram approach can be helpful for analyzing the root causes of safety and health incidents.

<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>Strongly agree</b>	<b>Agree</b>	<b>Disagree</b>	<b>Strongly disagree</b>

4. Overall, how useful was this “lessons learned activity” for considering safety and health problems at your workplace?

<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>Very useful</b>	<b>Somewhat useful</b>	<b>Not very useful</b>	<b>Of no use</b>