Department of the Army
Pamphlet 385–30

Safety

# Mishap Risk Management

Rapid Action Revision (RAR) Issue Date: 1 February 2010

Headquarters
Department of the Army
Washington, DC
10 October 2007

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# SUMMARY of CHANGE

DA PAM 385–30
Mishap Risk Management

This rapid action revision, dated 1 February 2010--

- o Clarifies the use of DA Form 7632 to document acceptance of installation/ operational risk decisions (para 1-5*d*).
- o Simplifies and corrects definitions in a table on Mishap Risk Management Process probability categories (table 3-3).
- o Clarifies the requirement for Certificate of Risk Acceptance use (para 4-11).
- o Clarifies options for documentation of risk acceptance (para 4-11).
- o Incorporates risk decision making standards from FM 5-19 Composite Risk Management, clarifies table, and factors for appropriate acceptance level (para 4-11*c* and table 4-2).
- o Updates table on risk acceptance authority (table 4-2).
- o Makes administrative changes (throughout).

**Headquarters**
**Department of the Army**
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**10 October 2007**

***Department of the Army**
**Pamphlet 385–30**

**Safety**

# Mishap Risk Management

By Order of the Secretary of the Army:

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**History.** This publication is a rapid action revision. The portions affected by this rapid action revision are listed in the summary of change.

**Summary.** This pamphlet provides information needed to carry out policies and procedures prescribed by AR 385–10. It is designed to assist users in implementing and integrating mishap risk management into all phases of the Army operations. It is written to complement and not duplicate the information provided in FM 5–19.

**Applicability.** This pamphlet applies to the Active Army, the Army National Guard/Army National Guard of the United States, and the U.S. Army Reserve, unless otherwise stated.

**Proponent and exception authority.** The proponent of this pamphlet is the Chief of Staff, Director of Army Safety. The proponent has the authority to approve exceptions or waivers to this pamphlet that are consistent with controlling law and regulations. The proponent may delegate this approval authority, in writing, to a division chief within the proponent agency or its direct reporting unit or field operating agency, in the grade of colonel or the civilian equivalent. Activities may request a waiver to this pamphlet by providing justification that includes a full analysis of the expected benefits and must include a formal review by the activity's senior legal officer. All waiver requests will be endorsed by the commander or senior leader of the requesting activity and forwarded through their higher headquarters to the policy proponent. Refer to AR 25–30 for specific guidance.

**Suggested improvements.** Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Army Safety Office (DACS–SF), Chief of Staff, 200 Army Pentagon, Washington, DC 20310–0200.

**Distribution.** This publication is available in electronic media only and is intended for command levels C, D, and E for the Active Army, the Army National Guard/Army National Guard of the United States, and the U.S. Army Reserve.

**Contents** (Listed by paragraph and page number)



*This edition publishes a rapid action revision of DA Pam 385–30.



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## Glossary

# Chapter 1
# The Mishap Risk Management Process of Composite Risk Management

## 1–1. Purpose
This pamphlet establishes a framework for making the Mishap Risk Management Process of composite risk management (CRM) a routine and required part of planning, preparing, and executing missions and everyday tasks in accordance with Department of Defense Instruction (DODI) 6055.1 and Army regulation (AR) 385–10. This framework allows Army leaders to operate with maximum initiative, flexibility, and adaptability. Army operations, whether they involve military situations including tough, realistic training, and combat operations, or the industrial base supporting research, development, testing, and production are demanding and complex. They are all inherently dangerous and each has the potential to jeopardize Soldiers and Army civilians alike, resulting in the needless loss of limited resources. Managing mishap risks related to such operations requires educated judgment, situational knowledge, demonstrated experience, and professional competence. The Mishap Risk Management Process of CRM permits Army leaders to make informed, conscious decisions to accept risk involving safety and occupational health factors; design and construction of equipment and other situational factors.

## 1–2. References
Required and related publications and prescribed and referenced forms are listed in appendix A.

## 1–3. Explanation of abbreviations and terms
Abbreviations and special terms used in this pamphlet are explained in the glossary.

## 1–4. Introduction
*a.* Unidentified and unmanaged threats and risks impede successful Army missions, undermine readiness, decrease morale, and deplete resources. The holistic approach of CRM provides commanders a tool to recognize, evaluate, eliminate, and control all the diverse threats and risks to mission execution. The underlying principle of CRM is that a loss is a loss. The loss can be either one of the following:

(1) Tactical (threat-based) loss.

(2) An accidental (hazard-based) loss.

(3) A loss due to terrorism, suicide, homicide, illness, or even substance abuse.

*b.* Any event that threatens combat readiness and the ability to project power can and should be considered a risk. Hence, Army leadership and management at every level will exercise CRM.

*c.* As shown in figure 1–1, below, due to the holistic nature of CRM, the process requires the multidisciplinary participation using a range of diverse tools to provide the commander with the knowledge to make informed risk decisions about all the identified losses and their risk. A major threat to combat readiness is losses caused by hazard-based accidents. Therefore, one of the major components of CRM is the Mishap Risk Management Process, as explained in this pamphlet. Practitioners use the Mishap Risk Management Process to identify, evaluate, and manage risks to missions, personnel, equipment, and the environment during peacetime, contingency operations and wartime due to safety and occupational health factors, design and construction of equipment, and other mishap factors.

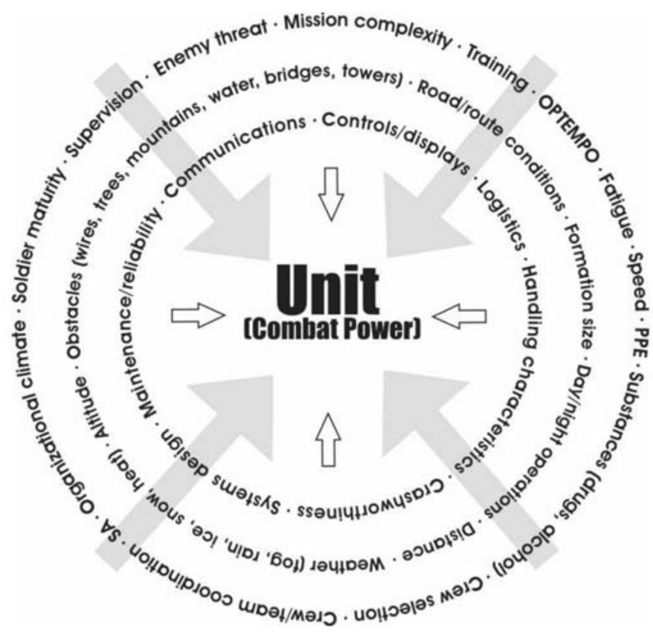


**Figure 1–1. Holistic approach of composite risk management**

## 1–5. Applicability

*a.* Army Leaders will integrate CRM and its component, mishap risk management, into all aspects of military and industrial planning, missions, development, systems, operations, equipment, procurement, testing, and processes to increase efficiency and effectiveness by eliminating or controlling adverse and risky conditions that will degrade their execution and value to the Army. Mishap risk management will be applied to Soldiers, on and off duty, and to the total life cycle of missions, systems, operations, equipment and facilities; from conception to completion or disposal.

*b.* Application of this pamphlet is not directive for troops and troop operations. The basic concepts of mishap risk management apply to all Army operations and functional areas. However, the methodology for thinking about and performing Troop CRM tasks has been established and embraced under FM 5–19. Therefore all troop tasks and operations will utilize FM 5–19 to maintain continuity of process. Tools and techniques found in this pamphlet are available to support FM 5–19 analyses and decisionmaking.

*c.* This pamphlet complements the information provided in FM 5–19. The focus of the information contained in this pamphlet is directed towards the safety professional and supervisory personnel for use in the sustaining the base and applies to industrial, installation, office, explosives, chemical agent, and biological safety functions. However, any discipline can benefit from the understanding and application of the material presented.

*d.* This pamphlet introduces DA Form 7632 (Certificate of Risk Acceptance), which replaces DA Form 7319–R, Waiver/Exemption Request form. The new form is only required for violations of explosives and chemical safety standards but may be used to document acceptance of installation/operational risk decisons.

## 1–6. The Mishap Risk Management Process

*a.* The Mishap Risk Management Process is the process of providing recommendations on whether to accept or resolve potential consequences of hazards associated with a given activity. The activity can be executing a mission; designing and operating systems or equipment; performing a process or operation; or designing and building a facility.

*b.* The Mishap Risk Management Process is neither a "science" in the sense that it provides Army leadership with a precise prediction of the future events nor just "common sense" or "something good commanders have always done." The Mishap Risk Management Process is a technique for identifying undesirable outcomes in all phases of the Army's execution of its mission. It uses systematic procedures and specific techniques to analyze safety and occupational health factors, design and construction of equipment, and other situational hazards.

*c.* The Mishap Risk Management Process is the process of identifying and assessing hazards; determining their risk; developing, evaluating and selecting controls; making risk decisions; and implementing and managing those decisions to improve operational effectiveness and conserve Army resources.

*d.* The process consists of the following five steps shown below and in figure 1–2:

(1) Identify hazards.

(2) Assess hazards to determine risk.

(3) Develop possible countermeasures and make risk decisions.

(4) Implement controls.

(5) Supervise and evaluate.

*e.* The risk assessment consists of the first two steps of the risk management process. In Step 1, individuals identify the hazards that may be encountered in executing an activity. In Step 2, they determine the impact of each hazard on the activity. The risk assessment provides for enhanced situational awareness. This awareness builds confidence and allows Soldiers, units, civilians, and organizations to implement timely, efficient, and effective protective control measures.

*f.* Steps 3 through 5 are the essential follow-through actions to manage risk effectively. In these steps, leaders balance risk against costs and take appropriate actions to eliminate unnecessary risk. During execution, leaders continuously assess the risk to the overall mission and to those involved in the task. Finally, leaders and individuals evaluate the effectiveness of controls and provide lessons learned so that others may benefit from the experience.

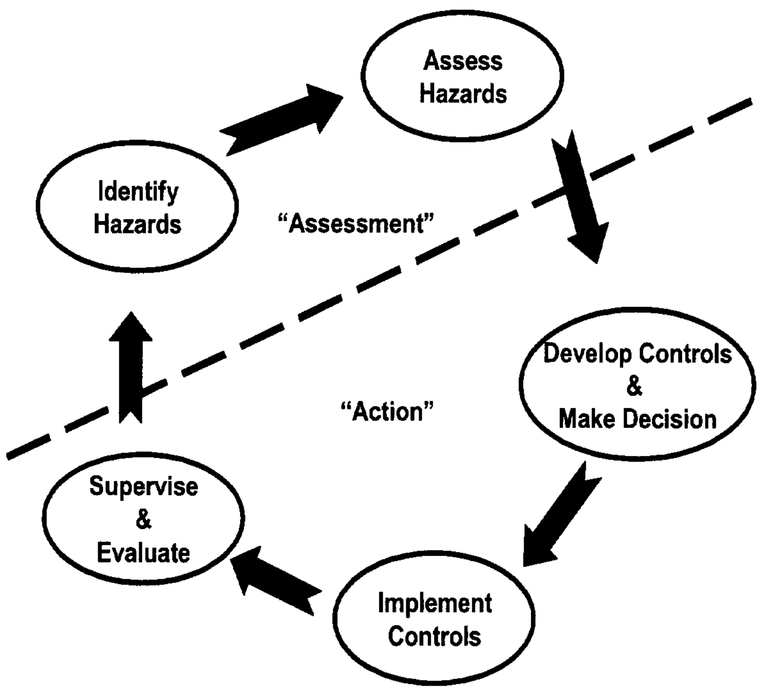


**Figure 1–2. Five-step cycle of the Mishap Risk Management Process**

### 1–7. Compliance versus Mishap Risk Management Process

*a.* Rather than the historical approach of simply evaluating safety compliance and identifying what cannot be accomplished, the Mishap Risk Management Process allows commanders the ability to balance the degree of risk against desired outcomes in terms of impact to mission, cost, performance, and schedules. This process does not convey authority to violate or deliberately disobey local, state, national, or host nation laws. Commanders cannot use the process to justify ignoring regulatory restrictions and applicable standards. Neither can commanders use the process to justify bypassing risk controls required by law, such as life safety and fire protection codes, physical security, transport and disposal of hazardous material and waste, or storage of classified material. Commanders may not use the Mishap Risk Management Process to alter or bypass legislative intent. However, when restrictions imposed by other agencies adversely affect the mission, planners may negotiate a satisfactory course of action (COA) if the result conforms to the legislative intent.

*b.* The process assists the commander in complying with regulatory and legal requirements by—

(1) Identifying applicable legal standards that affect the mission.

(2) Identifying alternate COAs or alternate standards that meet the intent of the law.

(3) Ensuring better use of limited resources through establishing priorities to correct known hazardous conditions that will result in projects with the highest return on investment funded first.

(4) Documenting their deviations from regulatory requirements through certificates of risk acceptance.

### 1–9. Mishap Risk Management Process and the Federal Tort Claims Act

*a.* The Federal Tort Claims Act (FTCA) (28 United States Code, Section 2671 (28 USC 2671)) waives sovereign immunity and constitutes the consent of the United States Government to be sued for the negligent acts of its employees who were acting within the scope of their employment. It is not an absolute waiver, as the objective was not to make the Government "absolutely liable" to everybody for everything, or the Government would simply be unable to function. The FTCA is a limited waiver; both in terms of who can sue and for what they can sue. Under the FTCA, injured persons can recover monetary damages in a tort suit against the United States Government. To do that, they have to establish the following elements:

(1) An employee of the Government acted within the scope of his/her employment.

(2) The employee was negligent.

(3) The negligent act or omission caused either injury or loss, real or personal property, or personal injury or death.

(4) The circumstances are such that if the United States were a private person, liability would be imposed under the law of the place where the act or omission occurred.

*b.* The act affords Government employees and Soldiers protection through a process called "military discretionary decisions." This process involves Government officials weighing the benefits, costs, safety, and other factors and their integration into the mission accomplishment.

*c.* The key to meeting the "military discretionary decision" is a well-defined, documented, and articulated process such as the Mishap Risk Management Process, which defines and articulates risks, and the certificate of risk acceptance or similar record that helps document the decision as part of a conscious and well-informed decisionmaking process.

*d.* Since courts have been reluctant to second-guess military decisionmaking, these records serve as evidence that help firmly establish for a fact finder that the Army properly assessed the risks and that Army leaders exercised their discretionary Governmental decisionmaking (that is, that leaders did not view mission accomplishment irrespective of safety considerations). Instead, they carefully balanced the risk against the benefits of the mission, elevated the decisionmaking authority to the appropriate level, and proceeded in a conscientious manner to accept no unnecessary risks.

## Chapter 2
## Step 1 — Identification of Hazards

### 2–1. Introduction

The first step in the Mishap Risk Management Process is to identify the hazards associated with a facility, operation, process, or equipment. The process of identifying risk is called hazard assessment. Hazard assessment scrutinizes the given activity to recognize mishap hazards.

## 2–2. Defining limits

*a.* One of the first tasks that must be accomplished when conducting a risk assessment and identifying hazards is defining the limits of the assessment.

*b.* If the analysis were being conducted, for example of a vehicle repair operation, then the limits of the analysis would be stated as the garage area or even as just bay 1 in the garage area. The assessor would only consider those hazards that might be present in bay 1 and would not look at identifying possible hazards on the driveway coming into the bay or on the street outside. For a training event, the evaluator might define the limits as from when the Soldiers muster in front of the barracks to the time they return and all events in between.

*c.* The purpose of defining limits is not to ignore hazards, but rather to clearly define what is being analyzed. This allows the assessor to focus on those hazards associated with the event and not on other hazards that have no relationship to it. Those unassociated hazards should be addressed by another risk assessment.

## 2–3. Hazard versus risk

*a.* Hazard is any condition that can cause illness, injury or death to personnel or damage to or loss of ability to perform the mission, equipment, property, or even reputation. Therefore, a hazard can have several possible negative outcomes or losses (for example, injury, death, damage, mission failure, mission degradation, increased resource(s) expenditures, adverse public relations, and decrease in Soldier confidence in leadership).

*b.* Risk is a combined expression of loss probability and severity.

## 2–4. Hazard scenario

An approach to identifying a hazard is to consider it a sequence of specific events or an accident-loss scenario. The accident-loss scenario consists of three elements (source, mechanism, and outcome) that describe the hazard.

*a.* The source or cause (for example, energy) is a condition that is a prerequisite to a mishap (for example, a rain-slick roadway (kinetic energy), an open-sided platform (gravity), an unprotected sharp edge (mechanical), fog (thermal), rocky terrain (gravity)). Appendix B provides two possible checklists of hazard areas to consider and help identify sources, one of which the Occupational Safety Health Administration (OSHA) developed for doing a job hazard analysis (JHA) and therefore is more operator-orientated.

*b.* The mechanism, or effect, is how the source, or cause, manifests itself. See table 2–1, below, for examples of mechanisms and sources.

**Table 2–1**
**Examples of mechanisms and sources**

| Mechanism or effect | Sources or causes |
|---|---|
| Hydroplaning | Rain-slick roadway |
| Leaking pipe joint | Inert gas |
| Inattentive walking | Open-sided platform |
| Unprotected hand contact | Exposed electrical wire |
| Exposure to heat | Stored blasting materials |
| Hand contact | Unprotected sharp edges |
| Inattentive walking | Rocky terrain |

*c.* The outcome, or undesired event, is the result of the mechanism occurring due to the source being present. Table 2–2, below, shows examples of various outcomes, mechanisms, and sources.

**Table 2–2**
**Examples of outcomes, mechanisms, and sources**

| Outcome or undesired effect | Mechanism or effect | Sources or causes |
|---|---|---|
| Auto crash | Hydroplaning | Rain-slick roadway |
| Asphyxia | Leaking pipe joint | Inert gas |
| Fall from elevation | Inattentive walking | Open-sided platform |
| Electrocution | Unprotected hand contact | Exposed electrical wire |
| Detonation or explosion | Exposure to heat | Stored blasting materials |
| Cut | Hand contact | Unprotected sharp edges |
| Sprained ankle | Inattentive walking | Rocky terrain |

## 2–5. Hazard assessment tools

Over the years, evaluators have developed many investigative tools to aid in identifying hazards. One set of these tools, called hazard analyses, provides a systematic method of identifying hazards. All hazard analyses evaluate a given activity to identify hazards; however, each type of analysis does so in a different manner, and therefore, each has its strengths and weaknesses. With experience, the evaluator learns which analysis tool is best for investigating which type of activity.

*a.* The qualities of a good hazard analysis are—

(1) Clear, concise, and a well-defined method that a reviewer or reader can readily understand.

(2) Orderly and consistent in systematically reviewing the activity or system for risk.

(3) A closed loop where the assessor reviews each hazard control for its impact on the other hazards and their controls.

(4) Objective in that reviewers and users can understand and verify each step of analysis.

*b.* Hazard analyses can be subdivided into three general categories.

(1) The first category is qualitative analyses (for example, checklists, hazard list, hazard matrix, preliminary hazard analysis (PHA) and job hazard analysis). These represent the easiest and fastest of the techniques to use.

(2) The second category is tree-based analyses (for example, fault tree analysis, event tree analysis, cause-consequence analysis, management-oversight risk tree). These complicated techniques depend on being able to graphically represent the system or hazard being investigated.

(3) The third category is the dynamic system analysis (for example, go method, sneak-circuit, digraph/fault graph, Markov modeling). These are the most complex of the techniques often requiring large computer resources and considerable amount of assessor's effort in gathering data and constructing models.

(4) This pamphlet will describe the most common qualitative techniques, those that have been most feasible for use in installation, garrison, and industrial activities. However, there are many occasions where more powerful and sophisticated tools are needed. Other analytical techniques may be found in a variety of system safety textbooks, manuals, and on the Internet.

## 2–6. Hazard reference lists

Table B–1 and table B–2 are reference lists of possible hazards that evaluators have developed over the years. These are not all-inclusive lists but rather a beginning list of possible hazards. As hazard analyses are completed, lessons learned, and accidents investigated, new hazards, or sources should be added to the reference list.

## 2–7. Task analysis

When analyzing a task or operation, one of the first steps in hazard identification is understanding the task or operation. Conducting a task analysis can help the evaluator gain the necessary knowledge.

*a.* Jobs can best be understood as a series of tasks. A task is an action designed to contribute a specified result to the accomplishment of an objective. It has an identifiable beginning and end that is a measurable component of the duties and responsibilities of a specific job.

*b.* Although each job has a title, the actual work that is expected of that job can vary widely. Tasks are the means of describing a job in detail. For example, a surgeon is a job title. However, the tasks performed by each surgeon vary from doing orthopedic surgery to brain surgery to heart surgery; each has its own set of skills.

*c.* Task analysis is the breakdown of exactly how a task is accomplished, such as what sub-tasks are required. This information can be used for many purposes, improving the design of tools and procedures that aid in performing the task. It should be considered as part of the hazard assessment step and executed as early as possible.

*d.* The task analysis consists of the following steps:

(1) Identify the task to be analyzed.

(2) Break this down into between 4 and 8 sub-tasks.

(3) These sub-tasks should be specified in terms of objectives and, between them, should cover the whole area of interest.

(4) Draw the sub-tasks as a layered diagram ensuring that it is complete.

(5) Decide upon the level of detail h to stop breaking the task down into smaller tasks. Making a conscious decision at this stage will ensure that all the sub-tasks are treated consistently. It may be decided that the breakdown should continue until flows are more easily represented as a task flow diagram.

*e.* An example of a task analysis is provided in appendix C.

**2–8. Checklists**

Checklists represent the simplest analysis techniques. They are developed to analyze a specific activity or system for hazards. However, their usefulness and accuracy depend upon the knowledgeable personnel developing the checklist.

*a.* The advantages of using well-designed checklists are that they can—

(1) Provide an aid to memory to ensure that important hazards of equipment or machinery, or aspects of work processes, are not overlooked.

(2) Ensure organized and consistent review.

(3) Underpin a system of accountability by providing records of risk assessment.

(4) Increase the efficiency of recording, and standardize record-keeping (so that real comparisons and checks on progress are possible).

(5) Facilitate sharing of risk knowledge.

(6) Be easily used by inexperienced personnel.

*b.* The disadvantage of checklists are that they—

(1) Limit the review to only items on the list.

(2) Are not often updated as new lessons are learned, near misses are reported, and accidents occur.

(3) Are not tailored to a specific operating environment or conditions (for example, checklist designed for daytime activity used at nighttime, a checklist for the rural environment used for urban environment).

*c.* Figure 2–1, below, illustrates a simple checklist requiring only a “yes or no” to be entered. An answer of “no” indicates a hazard control is missing.

**Example 1 of Hazard Checklist**

| **Building:** | | | **Date:** | |
|---|---|---|---|---|
| **Floor:** | | | | |
| **Inspected by:** | | | | |
| | **Yes** | **No** | **Reported to:** | |
| **AREA EXITS** | | | | |
| Clearly Placarded? | | | OH&S | |
| Kept closed or close automatically? | | | Public Works | |
| Free from obstruction? | | | OH&S | |
| **FIRE APPLIANCES** | | | | |
| Easily accessible? | | | OH&S | |
| Mounted and clearly sign-posted? | | | Public Works | |
| Operational (Not fully or partially used)? | | | Public Works | |
| **SIGNS** | | | | |
| Standard Fire Orders clearly displayed? | | | OH&S | |
| All emergency signs visible? | | | OH&S | |
| **DANGEROUS GOODS** | | | | |
| Gas cylinders and fittings safe? | | | Public Works | |
| Empty gas cylinders removed to storage? | | | OH&S | |
| Flammable substances properly stored? | | | OH&S | |
| **HOUSE KEEPING AND STAFF AWARENESS** | | | | |
| New staff introduced to procedures? | | | OH&S | |
| All areas free of non-essentials & rubbish? | | | OH&S | |
| **OTHER EQUIPMENT** | | | | |
| All emergency equipment operational? | | | Public Works | |
| Electrical appliances safe? (e.g. frayed cords or other obvious faults) | | | Public Works | |

**Figure 2–1. First sample of a hazard checklist**

*d.* Figure 2–2, below, illustrates a more complicated checklist that lends itself to computerization. It uses numeric values to arrive at a point-value used in determining the risk associated with the activity undergoing analysis.

**Example 2 of Hazard Checklist**

| **PART I** | | | |
|---|---|---|---|
| **HAZARD CLASSIFICATION OF AMMUNITION BEING STORED IN ARMS ROOM** | | | |
| **FACILITY LOCATION** | **Only HD 1.4** | **Only HD 1.3 and/or HD 1.4** | **HD (04) 1.2 and/or HD 1.3 and/or HD 1.4** |
| Barracks | 3 | 15 | 25 |
| Office | 2 | 10 | 20 |
| Stand-alone arms room | 1 | 5 | 10 |
| | | Total Points: | _______________ |

| **PART II** | | |
|---|---|---|
| **SAFETY MEASURES** | | |
| **PREVENTION** | **YES** | **NO** |
| If there are HD (04) 1.2 items stored in the arms room, are they stored with fragmentation barriers according to DA PAM 385-64? | 0 | 20 |
| If flammables are stored in the arms room, are they kept to a minimum and kept away from ammunition items? | 0 | 10 |
| Ammunition is kept in metal containers. | 0 | 3 |
| Ammunition is kept in original packing containers. | 0 | 5 |
| Ammunition has been inspected by the QASAS within the past 12 months. | 0 | 3 |
| The armorer has been briefed on proper fire and safety procedures within the past 12 months. | 0 | 10 |
| An up-to-date standing operating procedure is in-place and on-hand for the operation of the arms room. | 0 | 5 |
| Total Points: | _______________ | |
| | | |
| **CONTINGENCY** | **YES** | **NO** |
| Fire symbols are secured properly and placed according to requirements of servicing fire departments. | 0 | 5 |
| Fire extinguishers are properly placed. | 0 | 10 |
| Fire extinguishers are properly charged and up-to-date. | 0 | 10 |
| Total Points: | _______________ | |
| | | |
| **PHYSICAL SECURITY** | **YES** | **NO** |
| Physical Security concerns have been addressed. | 0 | 5 |
| Physical Security concerns have been documented. | 0 | 3 |
| Total Points: | _______________ | |
| **PART II, Total Points:** | _______________ | |
| **PART I, Total Points:** | _______________ | |
| **GRAND TOTAL POINTS: (PART I + PART II)** | _______________ | |

| **RISK-LEVEL DETERMINATION** | |
|---|---|
| Points | Risk Level |
| 0 to 10 Points | Low |
| 11 to 20 Points | Medium |
| 21 to 30 Points | High |

| | |
|---|---|
| **OVERALL RISK LEVEL:** | _______________ |

**Figure 2–2. Second sample of a hazard checklist**

### 2–9. Hazard list

The hazard list is simply a listing of hazards that may exist in the activity under evaluation. Appendix C contains an example.

*a.* The evaluator develops a list by using one of the hazard reference lists, table B–1 or table B–2, from reviewing past similar activities, accident reports, near-misses, technical manuals, other hazard lists, or by brainstorming the activity. The evaluator lists the possible hazards by possible source without regard to outcome or consideration of likelihood.

*b.* The list should include any hazard suspected of being present in the activity however remote.

*c.* The list serves as point to launch further evaluation. As the hazards are further evaluated, they can be eliminated from consideration if found not to be applicable.

*d.* Even if the evaluator does not develop the hazard evaluation beyond the list, its original inclusion provides the reviewers with information on what the evaluator considered and eliminated.

### 2–10. Hazard matrix

The hazard matrix uses the hazard list to begin developing the hazard scenario.

*a.* The evaluator uses the hazard matrix to associate potential failures with the generic hazards from the hazard list (see fig C-2 for an example of a hazard matrix).

*b.* The potential failure area represents those areas where if the hazard occurred, it would most likely have an effect on the activity, such as structural failures, power systems failures, pressure failures, leakage, spills, mechanical failures, personnel failures, or procedural failures. These investigated areas may be tailored to fit the operation or mission-area being evaluated.

### 2–11. Preliminary hazard analysis

Another tool is the preliminary hazard analysis (PHA), which was originally developed for the evaluation of hazards during the beginning stages of system development. It can be used as well for the development of a process, operation, or facility. A PHA helps the evaluator to anticipate hazards, thereby reducing the number of surprises that occur during the development process. In many cases, taking the time to perform a PHA may actually speed up the development process.

*a.* The following is a summary of PHA characteristics—

(1) It relies on brainstorming and expert judgment to assess the significance of hazards and assign a ranking to each situation. The PHA helps in prioritizing recommendations for reducing risks.

(2) It is normally performed by one or more people who are knowledgeable about the type of activity through participation in review meetings of documentation and field inspections, when possible.

(3) It is applicable to any activity or system.

(4) It is used as a high-level analysis early in the life of a process.

(5) It generates qualitative descriptions of the hazards related to a process.

(6) It provides a qualitative ranking of the hazardous situations; this ranking can be used to prioritize recommendations for reducing or eliminating hazards.

(7) It is a quality evaluation depending on the quality and availability of documentation, the training of the review team leader with respect to the various analysis techniques employed, and the experience of the review teams.

*b.* A PHA is most commonly used as a precursor to further hazard analyses.

*c.* Because the PHA technique is typically conducted early in the process, before other analysis techniques are practical, this methodology has two primary limitations—

(1) Generally requires additional follow-up analyses. Because the PHA is conducted early in the process and uses preliminary information, additional analyses are generally required to more fully understand and evaluate hazards, and potential accidents identified by the PHA team.

(2) Quality of the results is highly dependent on the knowledge of the team. At the time of a PHA, there are few or no fully developed details and little or no information. Therefore, the risk assessment relies heavily on the knowledge of subject matter experts. If these experts do not participate in the risk assessment or if the system is a new technology having little or no early operational history, the results of the PHA will reflect the uncertainty of the team in many of its assessments and assumptions.

*d.* Unlike the preliminary hazard list and preliminary hazard matrix, the PHA includes the likelihood of the hazard scenario being present and occurring, the measure of the seriousness of the outcome as well as the risk associated with that hazard. A discussion on the likelihood of the hazard scenario, the seriousness of outcome and associated risk is provided later in this pamphlet.

*e.* Whenever an analysis technique requires identification of the resulting outcome or mishap, standard practice is to identify the maximum credible damage or injury that could result. This means that the outcome or mishap be both credible and represents the greatest damage possible. It would not be credible to state that a Soldier tripping on a rock in the field would be killed. However, it is highly possible that the Soldier will suffer a head injury and be off work for several days or will break an arm and require light duty while it heals.

*f.* Another difference is that a control measure is suggested for consideration in eliminating, reducing or controlling the hazard. Additionally, the PHA contains the anticipated effect of the control measure on the likelihood, severity, and final risk called residual risk. Controls will be discussed further in chapter 4.

*g.* Figure 2–3 and figure 2–4, below, show samples of various PHAs. While the format and mechanics for each varies slightly, the outcomes are the same.

*h.* Figure 2–3 shows a PHA which consists of columns and rows. The hazards are listed in rows across the sheet and each column is completed to provide information necessary to evaluate and manage the hazard.

(1) Advantages of this PHA are that it allows—

*(a)* Listing of more than one hazard on a page.

*(b)* The ability to see several hazards at one time, giving a bigger picture of all the hazards.

(2) Its disadvantages are—

*(a)* It can lead to problems when trying to discuss a particular hazard on the page, since reviewers may want to discuss other hazards on the page.

*(b)* It cannot separate closed and verified hazards from unresolved hazards.

*i.* Figure 2–4 shows another PHA format. This format is different in that only one hazard scenario is shown per page.

(1) The form provides the following additional information:

*(a)* A statement of the hazard sequence scenario used by the evaluator to determine the probability of the outcome of occurring.

*(b)* A statement as to whether the control measure has been verified as having been done.

*(c)* A statement on the status of the hazard.

*(d)* An area is provided for additional remarks.

(2) The advantages of the form beyond the additional information are that—

*(a)* It fully documents the hazard evaluation process.

*(b)* It addresses hazards can be separated when verified and closed from other hazards unaddressed.

*(c)* It aids reviewers in understanding the rationale behind the probability selected.

*(d)* It can more easily control measures that are developed to eliminate a step or add a step which will reduce the likelihood of the occurrence, by listing the sequence.

*(e)* When necessary, limits discussion to the hazard presented.

(3) Disadvantages are—

*(a)* More paper is used.

*(b)* The process requires more time to document the hazard.

*j.* Steps for developing a PHA are given in appendix C.

| Activity: | Vehicle Convoy | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Assessor: | CPT Smith | | | | | Date: | 1 January 2007 | | |
| Hazard | Cause | Outcome | Initial | | | Control Measure | Residual | | |
| | | | Prob | Sev | Risk | | Prob | Sev | Risk |
| Failure to Decelerate | Breakdown | Vehicle crash | C | I | H | Train drivers to look ahead. Use PPE. | D | II | M |
| Heat and Temperature | Hot work environments | Heat stroke/ exhaustion | B | III | M | PMCS of AC systems. Hydrate. | C | III | M |
| Weather and Environment | Hydroplaning | Vehicle crash | C | II | H | Reduce speed. | E | III | L |
| Physiological Stress | Fatigue | Vehicle crash | C | I | H | Utilize assistant drivers and work/rest cycles. | E | I | M |
| Chemical Reactions | Leaking exhaust | CO poisoning | D | II | M | Shut off vehicles when not in motion. | E | II | L |
| Walking and working surfaces | Inattentive walking | Injury from fall | C | III | M | Use 3 points of contact. | E | III | L |

**Figure 2–3. First sample of a preliminary hazard analysis**

| Activity: | Moving Pallets with Forklift Truck | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Assessor: | SFC John Doe | | | Date: | | 1 Jan 2007 | | | |
| Hazard | Cause | Outcome | Initial | | | Control Measure | Residual | | |
| | | | Prob | Sev | Risk | | Prob | Sev | Risk |
| Failure to Decelerate | Brake Failure | Truck runs off loading dock. Driver injured. | D | I | H | Put railing on open sides of loading dock. Install gate for necessary access. | E | I | T |

| Hazard Sequence Scenario | Prob. | Tracking | Date: 3 Jan 2007 |
|---|---|---|---|
| Forklift moving towards end of the loading dock. | 0.500 | Control measure verified as being done. | Waiting verification of guard rails. |
| Brakes fail. | 0.010 | | |
| Forklift goes over edge of dock. | 0.001 | | |
| Driver is not wearing seatbelt. | 0.250 | Hazard status | Open |
| Driver falls out of forklift. | 1.000 | | |
| Forklift lands on driver. | 0.500 | | |
| Driver injured. | 1.000 | Remarks: work order submitted and approved. | |
| | | | |
| Estimated Probability: | $6.25 \times 10^{-7}$ | | |

SAMPLE

**Figure 2–4. Second sample of a preliminary hazard analysis**

## 2–12. Job hazard analysis

Another technique developed and highly recommended by OSHA is the job hazard analysis (JHA).

*a.* The JHA analyzes individual tasks to increase the knowledge of hazards in the workplace and focuses on integration of accepted safety and health principles and practices into a particular operation. It focuses on hazards before they occur and the relationship between the worker, the task, the tools, and the work environment.

*b.* The analysis results in a detailed written procedure that can be used for safely completing a particular job. The JHA is the process. The completed JHA form is a product of that process.

*c.* The analysis examines each basic step of a job to identify potential hazards and to determine the safest way to do the job.

*d.* The terms "job" and "task" are commonly used interchangeably to mean a specific work assignment, such as "operating a grinder," "using a pressurized water extinguisher," or "changing a flat tire." JHAs are not suitable for jobs defined too broadly (for example, "overhauling an engine") or too narrowly (for example, "positioning car jack").

*e.* Four basic stages in conducting a JHA are—

(1) Selecting the job to be analyzed.

(2) Breaking the job down into a sequence of steps, this is very similar to a task analysis.

(3) Identifying potential hazards.

(4) Determining preventive measures to overcome these hazards.

*f.* Unlike the PHA, the JHA does not consider the risk associated with the hazards identified.

*g.* A JHA should be done for all jobs. However, resources, time, and other practical constraints limit analyzing all jobs. For these reasons, it is usually necessary to identify which jobs have the greater need to be analyzed. Even if planned to analyze all jobs, prioritizing their order ensures that the most critical jobs are examined first. In assigning a priority for analysis of jobs, consider the following factors:

(1) Jobs where accidents occur frequently.

(2) Jobs where accidents occur infrequently but result in disabling injuries.

(3) The consequences of an accident, hazardous condition, or exposure to harmful substance are potentially severe.

(4) Newly established jobs where hazards may not be evident or anticipated.

(5) Modified jobs where changes in job procedures may have introduced new hazards.

(6) Infrequently performed jobs and non-routine jobs.

*h.* After selecting a job, the next step is to break the job into steps. A job step is defined as a segment of the operation necessary to advance the work.

*i.* The evaluator must take care not to make the steps too general, thereby missing specific steps and their associated hazards. On the other hand, if they are too detailed, there will be too many steps. A rule of thumb is that most jobs can be described in less than ten steps. If more steps are required, you might want to divide the job into two segments, each with its separate JHA, or combine steps where appropriate. Figure 2–5 shows an example of breaking a job down into steps. An important point to remember is to keep the steps in their correct sequence. Any step out of order may cause the evaluator to miss potential hazards or to address hazards that do not actually exist.

*j.* Record each step in sequence. Note what is done rather than how it is done. Start each item with an action verb.

*k.* A key to a successful JHA is to involve the employees who are doing the job. Conduct a preliminary job review. Discuss with your employees the hazards they know exist in their current work and surroundings. Brainstorm with them for ideas to eliminate or control those hazards for use later in developing controls. They have a unique understanding of the job, and this knowledge is invaluable for finding hazards. Additionally, involving employees will help minimize oversights, ensure a quality analysis, and get workers to "buy in" to the solutions because they will share ownership in their safety and health program.

*l.* Perform a second observation of the job being evaluated. Since the basic steps have been documented, this observation should focus on potential hazards. At this stage, do not attempt to solve any problems that are detected.

*m.* To help identify potential hazards, the job assessor may use questions such as the following (this is not a complete list):

(1) Can any body part get caught in or between objects?

(2) Do tools, machines, or equipment present any hazards?

(3) Can the worker make harmful contact with objects?

(4) Can the worker slip, trip, or fall?

(5) Can the worker suffer strain from lifting, pushing, or pulling?

(6) Is the worker exposed to extreme heat or cold?

(7) Is excessive noise or vibration a problem?

(8) Is there a danger from falling objects?

(9) Is lighting a problem?

(10) Can weather conditions affect safety?

(11) Is harmful radiation a possibility?

(12) Can contact be made with hot, toxic, or caustic substances?

(13) Are there dusts, fumes, mists, or vapors in the air?

*n.* The JHA will be completed later in this pamphlet in the appropriate chapters.

| Job Task Breakdown | | | |
|---|---|---|---|
| **Job:** | Forklift Operation | **Date of analysis:** | 1 January 2007 |
| **Job location:** | Quartermaster Company Staging Area | | |
| **Assessor:** | WO1 John Doe | | |

| **Step** | **Description of Step** |
|---|---|
| Perform PMCS | Check:<br>-Engine Oil<br>-Hydraulic oil<br>-Radiator coolant<br>-Fuel level<br>-Fire extinguisher<br>-Tires<br>-Seatbelt<br>-Hydraulic Controls<br>-Brakes |
| Prepare Load | Stacks material onto pallets.<br>Secure pallet load.<br>Verify forklift capacity is not exceeded. |
| Lift Load | Clear area.<br>Lift load/tilt load back. |
| Carry Load | Carry forks low to the ground (4-8 inches above ground).<br>Ensure clear visibility.<br>Monitor other vehicle and foot traffic. |
| Place Load | Check for proper clearance.<br>Position load at destination. |

**Figure 2–5. Example of a job task breakdown**

## 2–13. Barrier analysis

The barrier analysis (sometimes called barrier and control analysis or energy trace and barrier analysis) is based on the premise that an energy flow is associated with all accidents.

*a.* The analysis is a structured way to consider the events related to a system failure. Developed for the Department of Energy (DOE) under the Management Oversight and Risk Tree (MORT) Program, barrier analysis suggests that an incident can be likened to the uncontrolled transfer of energy, and therefore for an incident to occur there needs to be—

(1) A person present.

(2) A source of energy.

(3) A failed barrier between the two.

*b.* Barriers are developed and integrated into a system or work process to protect personnel and equipment from unwanted energy flows (see fig 2–6, below). For an accident to occur, there must be—

(1) A hazard or energy (for example, kinetic, biological, acoustic, chemical, electrical, mechanical, potential, electromagnetic, thermal, radiation, or any other energy source which comes into contact with).

(2) A target, which is a person or object that an unwanted energy flow may damage, injure, or cause a fatality.

(3) Barriers or controls (for example, anything used to control, prevent, or impede energy flows, which fails). Barriers are intended to protect personnel and property against hazards (see fig 2–6). Three common types of barriers are shown in figure 2–7.

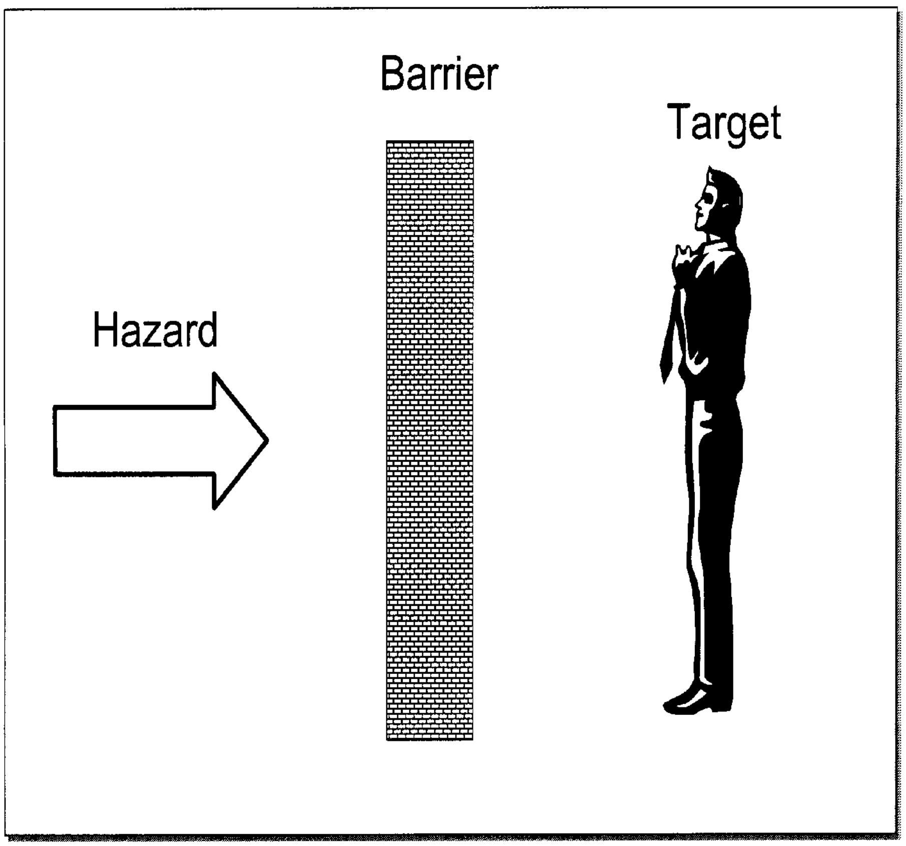


**Figure 2–6. Concept of barrier analysis**

(4) While the analysis is relatively simple to implement, it does have several disadvantages—
*(a)* Some hazards may go undiscovered.
*(b)* Some countermeasures defy easy classification.
*(c)* Potential interactions between risk components may be difficult to foresee.

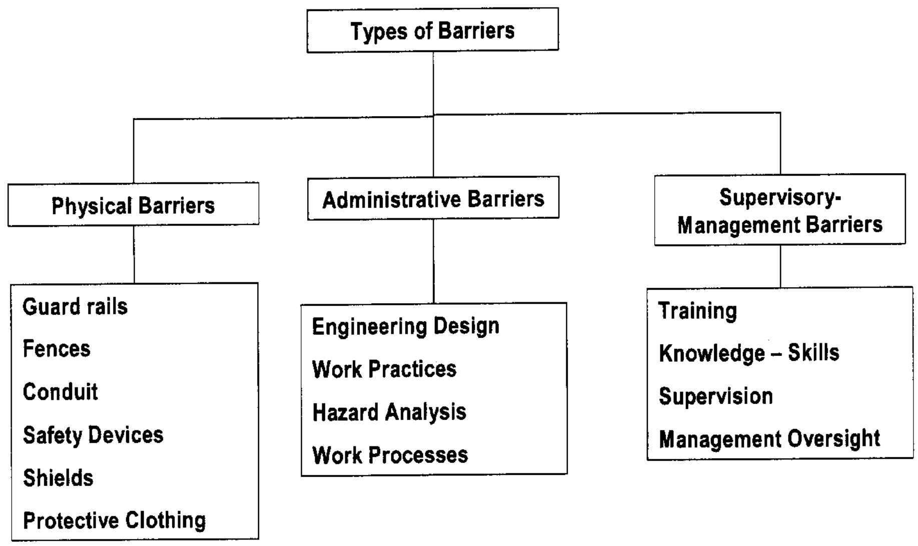


**Figure 2–7. Types of barriers**

*c.* A barrier's exact function and location must be considered after determining how energy sources and targets can come together and what is required to keep them separated. Obvious barriers are those placed directly on the hazard (for example, a guard on a grinding wheel); those placed between a hazard and a target (for example, a railing on a second-story platform); or those located on the target (for example, a welding helmet). Barriers such as those defining the exposure limits required to minimize harm to personnel are less obvious. Therefore, analysts must cross-validate results with other core analytic techniques to ensure that all failed, unused, or uninstalled barriers are identified.

*d.* Barrier analysis is often used as an accident investigation method. It identifies barriers/controls that were in place to prevent accidents (physical, management controls, and/or administrative) that either were absent, inadequate, or bypassed to allow the accident. This analysis allows safety personnel or investigators to examine the sequence of events/causes that may have led up to the accident. The DOE expanded on the barriers concept by implementing a six-step process—
(1) Identify the barriers.
(2) Find the ones that failed.
(3) Identify how they failed.
(4) Then determine why.
(5) Identify where barriers may have prevented the accident.

(6) Validate the findings from the information learned.

*e.* An analysis of an accident sequence can be initiated by investigating—

(1) The energy source(s).

(2) Their paths.

(3) The people or objects that are vulnerable to the unwanted energy flow.

(4) The barriers and controls that were designed to protect vulnerable people and objects.

(5) The precursor events of energy transfers and barrier failures that lead to the accident.

*f.* Identifying failed barriers aids in developing improved or additional defenses.

*g.* Barrier analysis requires the investigators to have a good working knowledge of the task process in order to properly identify and evaluate the barriers or controls and possible means of failure. Since barriers may be administrative, managerial, and supervisory, as well as physical, a competent overall knowledge of the work process is essential.

*h.* An example of the format of the construction of the barrier analysis is shown in figure 2–8, below.

| **Operation/Process:** Forklift Operation | | | **Date:** 1 Jan 2007 | |
|---|---|---|---|---|
| **Analyst:** WO1 John Doe | | | | |
| **Hazard - Energy Flow** | **Barrier or Control** | **Possible Factors Contributing to Barrier - Control Failure** | **Possible Root Cause of Failure** | **Evaluation** |
| Truck runs off loading dock. [Kinetic] | Railing on open sides of loading dock. | Missing. | Not part of original construction plan. | Work order for railing submitted and approved. |
| Inability to decelerate. [Mechanical] | Forklift Brakes. | Insufficient PMCS and maintenance. | Faulty break system design. | Contacted manufacturer and performed maintenance. |
| Personnel hit by forklift. [Kinetic] | Work practices / restricted areas. | Not observed by operator or foot traffic. | Unclear aisle markings / warning procedures. | Update procedures to clearly define vehicle routes. |
| Load dropped and damaged. [Potential] | Load tie-downs. | Not used by operator. | Insufficient preparation and training. | Added to pre-operational checklist. |
| CO poisoning (asphyxiation). [Chemical] | Ventilation. | Closed doors / poor awareness of CO hazard. | High CO emissions from vehicle. | Using low-emission electric forklifts indoors. |
| Electrocution [Electrical] | Hazard analysis. | Lack of overhead line identification. | Insufficient hazard analysis before operation due to time constraint. | Emphasized during forklift operator training. |



**Figure 2–8. Example of barrier analysis**

(1) *Define final loss event.* The events that result in loss or damage (for example, injury sustained, equipment damaged).

(2) *Identify barriers.* Both barriers that were in place and those that should have been in place; note that more than one barrier may be associated with each unwanted event.

(3) *Evaluate purpose of barrier.* Describe the purpose of the barrier and its intended function in eliminating hazardous conditions.

(4) *Evaluate barrier's performance.* Describe how and why the barrier failed and the consequences of the failure.

(5) *Validate analysis.* Ensure that results provide the protection required.

*i.* Sources of needed data for a barrier analysis include—

(1) Preliminary drawings of equipment.

(2) Systems or facilities.

(3) Hazard analysis results.

(4) Maintenance procedures.

(5) Operational procedures.

(6) Site maps.

*j.* The minimum data needed to perform a barrier and control analysis includes—

(1) Facts and evidence in chronological order.

(2) Identification of all relevant hazards.

(3) Identification of all relevant barriers and controls.

(4) Facts regarding the function of each barrier and control.

### 2–14. Special analyses

In addition to above analyses, there are specialized hazard analyses for explosives, confined spaces, electrical environments, and other unique situations. These are beyond the scope of this pamphlet but can be found in specialized manuals and textbooks for those who need to evaluate such types of hazards.

*a.* Regardless of the type of analysis used, the detection of hazards should go beyond one individual's knowledge and experience. The goal is to get a total picture of the risk; those risks mitigated already and new ones that have not been mitigated. The following are some general sources that can be used to learn of possible hazards associated with a given event:

(1) Historical information.

(2) Lessons learned.

(3) Examine experience; use experts, such as master gunners, CSMs, 1SGs, safety officers, operators, maintenance personnel.

(4) Consult standards, codes, checklists, FMs, standing operating procedures (SOPs), ARs, TMs, safety of use messages.

(5) Consider all sources, all assets, mission phases risk for a given hazard varies from mission to mission, asset to asset, mission phase to mission phase, season to season, with duration of exposure, with time of day and with number of assets.

*b.* Do not blindly accept someone else's hazard analysis. Adapt for local conditions; review for missing hazards (that is, a hazard analysis for a light armor group may not be sufficient for a heavy armor group), examples are—

(1) A hazard analysis for a bivouac area in the woods in July will not address the possible hazards of a bivouac area in a city or the hazards of a bivouac area in the mountains in January.

(2) Different areas of the country and different units have different cultural, educational, and professional experiences which make each unique.

## Chapter 3
## Step 2 — Assessing Hazards

### 3–1. Assess the hazards

Step 2 involves evaluating each hazard and assigning a level of risk based on the estimated probability and severity for the likelihood and impact of the hazard on mission, Soldiers, civilian personnel, public, equipment, systems, and the environment. Risk always deals with uncertainty or events that cannot be predicted with certainty. If the events could be predicted with surety, there would be no risk. Risk involves estimating future losses, where neither the likelihood nor magnitude is known with certainty.

### 3–2. Definitions

*a. Risk.* Risk is defined as the measure of the expected loss from a given hazard or group of hazards, usually estimated as the combination of the likelihood (probability) and consequences (severity) of the loss.

*b. Probability.* An approximation of the likelihood of a hazard scenario occurring. Probability has no dimension but must be attached to an interval of exposure (for example, one operating year, a million vehicle miles, 1,000 landings, and so on).

*c. Severity.* An approximation of the amount of potential harm, damage, or injury associated with a given hazard scenario or mishap.

*d. Residual risk.* The risk associated with a hazard that remains after implementing all planned countermeasures or controls to eliminate, reduce or control the impact of the hazard. The residual risk can also be the initial risk. This situation happens when the initial risk was so low that the hazard did not warrant expenditure of funds to mitigate.

### 3–3. Probability

Probability helps us figure out the likelihood of something happening. The likelihood of an event can range between 0 and 1.0. Zero represents an event that cannot possibly occur. A probability of 1.0 indicates an event that always occurs.

*a.* For a probability to be meaningful, an exposure interval must be associated with it. The exposure interval can be a unit of time; an activity, such as, miles driven, aircraft landings, operations, machine cycles, units produced; or the life cycle of the facility, equipment, or process.

(1) Normally, the life cycle for a building is 25 years, special purpose facilities may have a greater or shorter life cycle.

(2) For equipment, the life cycle is considered 10 years except for electronic equipment which can have a very short life cycle.

(3) A process can have a short life cycle from of a couple weeks to a couple of years or more.

*b.* The following examples demonstrate associating an exposure interval with a probability.

(1) During the year 2003, 220 workers across the nation died on the job. This results in a probability of 0.0000007 per year of a worker dying on the job. Note, that the probability is associated with an exposure interval of “per year.” However, the probability of being injured at work during that same year, resulted in a probability of 0.005 injured employees per year, based on 150,559 reported injuries. Again, the exposure interval is “per year.”

(2) If we change the exposure interval to a working life time (from 18 years to 68 years), the probability of being killed increases to 0.000035 during a working life and the probability for being injured increases to 0.25 during a working life. The exposure interval is now “working life” which was stated as 50 years.

(3) The exposure interval does not always have to be expressed in years or some time interval; other units can be used. The following example shows how another unit can be associated with a probability. In 2003, aircraft model A experienced 47 events in which one passenger died due solely to the operation of an aircraft. During that same period, aircraft model B had one such event. However, the probability of being killed on aircraft model A is 0.000000005 ($5x10^{-9}$) per passenger-mile flown, while on aircraft model B, the probability is 0.00000012 ($1.2 \times 10^{-7}$) per passenger-mile flown. In this example, the exposure interval is “per passenger-mile flown.” The longer the trip or the more miles a passenger flies in a year, the greater the probability of death. This increasing probability per passenger-mile is shown in the table 3–1, below. Table 3–1 also demonstrates that as the exposure, (miles flown by a passenger, increases), the probability of that passenger being killed increases.

**Table 3–1**
**Increasing probability versus passenger mile**

| | Probability of passenger dying | |
|---|---|---|
| **Miles flown per year by passenger** | **Aircraft Model A** | **Aircraft Model B** |
| 1,000 | 0.00001 | 0.00012 |
| 5,000 | 0.00003 | 0.00060 |
| 25,000 | 0.00013 | 0.00300 |
| 75,000 | 0.00038 | 0.00900 |
| 375,000 | 0.00188 | 0.04500 |
| 1,000,000 | 0.00500 | 0.12000 |
| 1,500,000 | 0.00750 | 0.18000 |

**Table 3–1**
**Increasing probability versus passenger mile—Continued**

| | | |
|---|---|---|
| 2,000,000 | 0.01000 | 0.24000 |
| 2,500,000 | 0.01250 | 0.30000 |
| 3,000,000 | 0.01500 | 0.36000 |

(4) The terms "10 year", "50 year", "100 year" and "500 year" floods are used to describe the estimated probability of a flood event happening in any given year. They use an exposure interval expressed a little differently. A one-hundred year flood is calculated to be the maximum level of floodwater expected to occur on average once every one hundred years. The 100-year flood is sometimes referred to as the 1 percent flood; see table 3–2, below, since there is a 1 percent chance of it occurring in any year. In fact, two 100-year floods can occur a year apart or even a month apart; it all depends on how much rain is falling or how quickly the snow melts.

**Table 3–2**
**Flood-year terms**

| X-Year Flood | Probability per year |
|---|---|
| 10 | .10 |
| 20 | .05 |
| 50 | .02 |
| 100 | .01 |
| 500 | .002 |

(5) This demonstrates another important concept when dealing with probabilities. Probabilities are estimations and only estimations. The better the knowledge of the situation, the more factual and historical information used, and the greater the experience of the evaluator, the more accurate the estimation will be. Except in extremely technical evaluation, the probabilities should be considered as falling within a range.

*c.* In the real world, it is often very hard to determine objective or numerical probability values. The information necessary to derive these values is often missing, or more often than not, there is just not enough time to make the necessary studies. When the information and time is available, an effort should be made to use the numerical probability values. However, in the other situations, it becomes necessary to make subjective decisions in estimating the probability. To aid evaluators, probability ranges have been established using keywords and phases to help estimate the likelihoods for the occurrence of a mishap. Table 3–3, below, shows these probability ranges.

**Table 3–3**
**Mishap Risk Management Process probability categories**

| Probability | Symbol | Definition |
|---|---|---|
| Frequent | A | Occurs very often; known to happen regularly. |
| Likely | B | Occurs several times; a common occurrence. |
| Occasional | C | Occurs sporadically, but is not uncommon. |
| Seldom | D | Remotely possible; could occur at some time. |
| Unlikely | E | Can assume will not occur but not impossible. |

*d.* When using probability ranges, it is recommended that you begin at the top of the table. Then using the descriptions, ask is this how often it will happen. If the answer is no, then go down to the next row and repeat the question. When you can no longer answer “no” to the question, reach the bottom of the table or are unsure, then select that probability range just above. A discussion of selecting probabilities is presented in the PHA example in appendix C.

## 3–4. Severity

Severity approximates the amount of potential harm, damage, or injury associated with a given hazard scenario or mishap occurring. It is the second of two risk components.

*a.* Severity and probability are independent of each other. In other words, determining severity has no relationship to determining the probability.

*b.* It is often hard to determine an objective amount or cost for the hazard's outcome. Therefore, severity ranges have been established to aid in this process. They delineate a range of mishap outcomes similar to the probability ranges. They are shown in table 3–4, below.

**Table 3–4**
**Mishap Risk Management Process severity categories**

| Severity | Symbol | Quantitative Value | Quantitative Value | Definition |
|---|---|---|---|---|
| Catastrophic | I | 1 or more deaths or permanent total disabilities. | Loss exceeding $1M | Loss of ability to accomplish the mission or mission failure. Death or permanent total disability (accident risk). Loss of major or mission-critical system or equipment. Major property (facility) damage. Unacceptable collateral damage. |
| Critical | II | 1 or more permanent partial disabilities or temporary total disability resulting in more than 3 months lost time | Loss exceeding $200K but less than $1M | Significantly (severely) degraded mission capability or unit readiness. Permanent partial disability, temporary total disability exceeding 3 months time (accident risk). Extensive (major) damage to equipment or systems. Significant damage to property. Significant collateral damage. |
| Marginal | III | 1 or more injuries or illnesses resulting in less than 3 months lost time | Loss exceeding $20K but less than $200K | Degraded mission capability or unit readiness. Minor damage to equipment or systems, or property. Lost days due to injury or illness not exceeding 3 months (accident risk). |
| Negligible | IV | 1 or more injuries or illnesses requiring first aid or medical treatment | Loss less than $20K | Little or no adverse impact on mission capability. First aid or minor medical treatment (accident risk). Slight equipment or system damage, but fully functional and serviceable. Little or no property damage. |

*c.* Once more, the recommended procedure is to start at the top and work down the table, selecting the range representing the maximum credible damage or loss.

*d.* When selecting, the assessor must consider the impact on the mission, possible human loss and equipment or system damage. For instance, an accident might result in no one hurt, but a simple piece of equipment, worth only a few hundred dollars, is broken. While this might be classified as marginal from standpoint of human and equipment loss, its loss could result in having to cancel the mission, task, and job.

*e.* The PHA example in appendix C discusses selecting severities.

### 3–5. Matrices

Using the Army's standard risk assessment matrix at table 3–5, probability and severity for each identified hazard are converted into a specified level of risk. This matrix provides an assessment of probability and severity expressed in terms of a standard level of risk. This assessment is an estimate, not an absolute. It may or may not be indicative of the relative danger of a given operation, activity, or event. The levels of risk are listed in table 3–6.

*a. Extremely high risk.* Loss of ability to accomplish the mission or the mission produces extremely severe outcomes. This implies that the risk associated with this mission, activity, or event may have severe consequences beyond those associated with this specific operation or event. The decision to continue must be weighted carefully against the potential gain to be achieved by continuing this course of action. It must be approved at an appropriate level of command.

*b. High risk.* Significant degradation of mission capabilities in terms of the required mission standard, inability to accomplish all parts of the mission, high potential for serious injury to personnel, or inability to complete the mission to standard if hazards occur during the mission. This implies that if a hazardous event occurs, serious consequences will occur. The decision to continue must be weighted carefully against the potential gain to be achieved by continuing this course of action. It must be approved at an appropriate level of command.

*c. Medium risk.* The ability to complete the mission will be slightly degraded in the event this hazard occurs. If a hazardous event occurs it will only slightly impact on the mission, result in only minor injury or loss, and not affect overall readiness.

*d. Low risk.* Expected losses have little or no impact on accomplishing the mission. Injury, damage, or illness will be minor and have no long-term impact or effect.

## 3–6. Tolerable risk threshold

*a.* It is possible the selected corrective actions eliminated or controlled a hazard to such a degree that no residual risk remains or the remaining risk is so near zero it cannot be distinguished from zero.

*b.* Another situation is where the evaluator considered a hazard and upon further investigation found that there was no risk or the risk was very near zero.

*c.* A further situation would be where a nationally recognized standard was used as the solution. While not eliminating the hazard, it did lower the risk to a level accepted by recognized national authorities on the subject.

*d.* Courts, including the Supreme Court, have ruled that a certain level of risk exists below which the risk does not warrant any expenditure of resources to mitigate due to the risk's extremely low probability of occurrence. The courts consider the risk as a "de minimis" risk, from the Latin phrase, "*de minimis noncurat lex,*" meaning "the law does not concern itself with trifles." Therefore, when the probability of a hazard no longer can be defined by the terms in table 3–3, since its probability is near zero or resolution meets a national standard, the risk associated with that hazard may be considered as "de minimis" risk or a tolerable risk. Below that threshold, there is no requirement to track the hazard though it may be mitigated if minimal resources are required. Hazards above the de minimis level are the focus of the Mishap Risk Management Process. See table 3–5, below, for a standard Army risk matrix and table 3–6 for risk matrix codes and descriptions.

**Table 3–5**
**Standardized Army risk matrix**

| | Probability | | | | |
|---|---|---|---|---|---|
| **Severity** | **Frequent A** | **Likely B** | **Occasional C** | **Seldom D** | **Unlikely E** |
| Catastrophic I | E (1) | E (1) | H (2) | H (2) | M (3) |
| Critical II | E (1) | H (2) | H (2) | M (3) | L (4) |
| Marginal III | H (2) | M (3) | M (3) | L (4) | L (5) |
| Negligible IV | M (3) | L (4) | L (4) | L (5) | L (5) |

**Table 3–6**
**Risk Matrix codes and descriptions**

| Symbol | Risk Assessment Code (RAC) | Description |
|---|---|---|
| E | 1 | Extremely High |
| H | 2 | High |
| M | 3 | Moderate |
| L | 4 | Low |
| L | 5 | Low |

## 3–7. Risk summation

There is no definite, agreed upon method for summing risk. Therefore, in order to provide an indication of the total risk of an operation, process, system or equipment, several indicators may be used.

*a. Maximum credible risk.* Maximum credible risk would be the risk associated with the hazard that is the most severe and the most credible. It is possible in a given analysis, that several risks of the same magnitude would be identified. For instance, during analysis of a process, the assessor identified two extremely high, seven high, five medium, and 26 low risks. In this example, one of the two extremely high risks events would be the maximum credible risk. To decide which, the following should be considered:

(1) The one with the greatest severity would be used as maximum credible risk.

(2) If the severities are the same, then the one with the greatest probability should be used.

(3) If severity and probability are the same for both, additional hazard analysis techniques should be used to identify the maximum credible event.

*b. Common outcome.* The common outcome considers those hazards that provide the same type of result, (that is, same type of Soldier injury, same system part failure, part of mission failure, same equipment breakdown, same lost time accident, and so on).

*c.* Another method would be a frequency chart, which pictorially depicts all hazards by risks, figure 3–1, below.

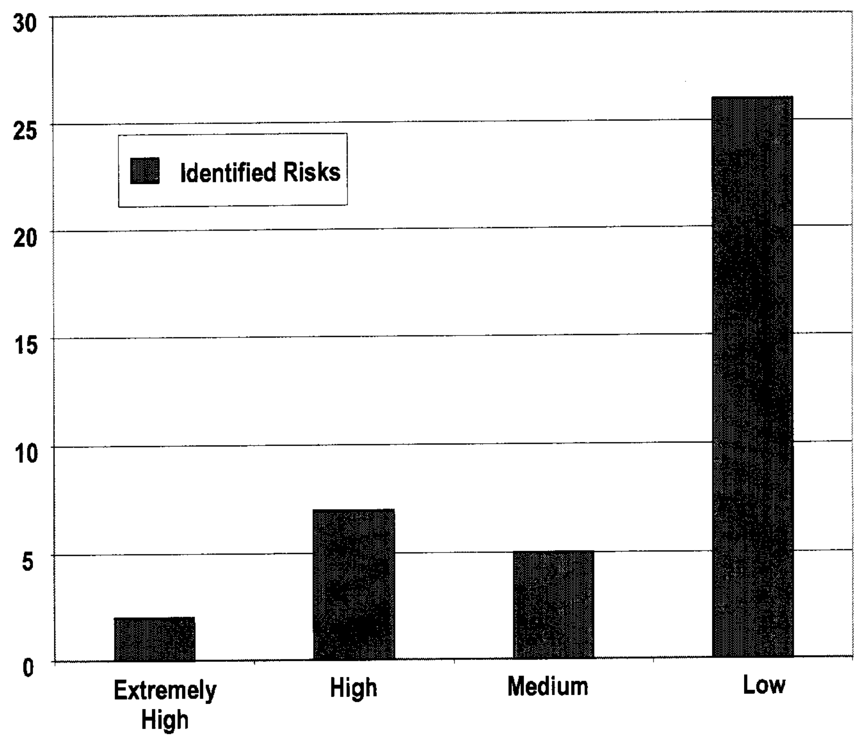


**Figure 3–1. Example of frequency chart depicting risks**

*d. Special purpose matrices.* When special purpose matrices are required for the development of systems, use the guidance provided in MIL–STD 882. Every effort should be made to work within the framework of the Army's standard matrix in order to permit Army leaders to compare risk across the Army. When using special purpose matrices, they will be part of an approved, written System Safety Program.

## Chapter 4
## Step 3 — Development of Controls and Decision Making

### 4–1. Developing controls and decisionmaking

Step 3 is accomplished in two sub-steps. The first sub-step is to develop controls and the second is to make risk decisions.

*a. Sub-step A — Develop controls.* After assessing each hazard, the assessor develops one or more controls that either eliminate the hazard or reduce the risk (probability or severity) of a hazardous incident. When developing controls, the assessor considers the reason for the hazard not just the hazard itself.

*b. Sub-step B — Make risk decision.* A key element of the risk decision is determining if the residual risk is justified. The appropriate decision maker based upon the level of risk associated with the mission must compare and balance the risk against mission expectations. The decision maker alone decides if controls are sufficient and acceptable and whether to accept the resulting residual risk. If the decision maker determines the risk level is too high, the decision maker can direct the development of additional controls or alternate controls, or the decision maker can modify, change, or reject the course of action.

### 4–2. Development of controls

When developing controls, it is important to try to implement controls based on the mitigation order of precedence. The mitigation order of precedence is a prioritized ranking of methods for instituting countermeasures and controls ranked by effectiveness in reducing the risk associated with an identified hazard.

*a.* The mitigation order of precedence is—

(1) *Design approach.* Fundamental change in the design, process, task, or operation.

(2) *Incorporate safety devices.* Full-time, on-line, interlocks, or active devices.

(3) *Provide warning devices.* Physical barriers, guards, or barricades.

(4) *Develop procedures and provide training.* Moderating or inhibiting unsafe personnel behavior with “education” to guide and condition performance.

(5) *Provide personal protective equipment (PPE).* Hard hats, safety glasses, respirators, steel-toed shoes, and other equipment for the Soldier or civilian employee to wear.

*b.* Of the five groupings of hazard remedies, the first two are the most positive and do not require the Soldier or operator to respond. Therefore, the first two groupings give Army leadership the greatest control over the hazard. However, they take the longest to incorporate and are usually the most expensive. The third is more passive and depends upon the Soldier or operator to react to a given situation. The last two are totally dependent upon the Soldier or operator to execute. Since the last two depend on the Soldier or operator, their use depends upon supervising the Soldier and operator to ensure they are being followed. If SOPs and standards are not enforced, the hazards and their associated risk will be present waiting to disrupt the mission or process and cause the system or equipment to fail.

### 4–3. Design to eliminate hazards

The most effective method of controlling a hazard is to eliminate it from the mission, process, system, or equipment by making fundamental changes in the design, process, system, equipment, or task.

*a.* For instance, the example in appendix C, the dropping and breaking of the coffee pot was identified as a potential hazard. This hazard could be eliminated by replacing the glass coffee pot with a carafe-type coffee pot which will not shatter when dropped.

*b.* Another example is situations or operations where an explosive environment is likely, such as paint booths, solvent cleaning areas, or storage and processing areas for ammunition and explosives. The presence of electricity increases the probability of an explosion occurring, therefore by substituting pneumatic or hydraulic powered tools for the electrically powered tools reduces the probability of an explosion. Another solution would be to change to paints or solvents that are not flammable.

*c.* Engineering or design controls can be used when dealing with traffic situations. One example would be routing unnecessary traffic around heavily populated areas on limited access roads.

*d.* Often a simple substitution will eliminate a hazard. For instance when selecting paint, choosing a water-based paint results in eliminating personnel exposures. Another substitution would be replacing the use of a hazardous solvent in the maintenance area with a nontoxic solvent.

*e.* Each situation must be viewed considering not only the hazard being addressed but also the total situation. An excellent control used in another situation might seem appropriate, yet when viewed, holistically in the context of the current mission or task it not only does not work but also introduces new hazards.

### 4–4. Incorporate safety devices

When the hazards cannot be designed out or eliminated from the mission, process, system or equipment, then safety devices need to be incorporated. The following are examples of safety devices:

*a.* Returning once more to the coffee making process, appendix C, a hazard identified was a wet floor and slipping of personnel. A simple safety device to use in this situation is a mat in front of the sink. It eliminates the slippery floor by absorbing the water.

*b.* During execution of a mission, it might be necessary to cross a river. Either of two simple safety devices could be used. The first would be a rope stretched across the river for the Soldiers to grip as they cross. Another safety device would be flotation devices, which could be as simple as logs to use, to aid the Soldiers in crossing.

*c.* For traffic situations, a safety device would be installing stop signs on every corner to slow traffic moving through congested areas. These signs cause the vehicle to slow down due to stopping often.

*d.* For systems, processes and equipment, safety devices include such devices as guards and lock-devices at the point-of-operation to protect Soldiers and operators. An example is the dead-man-switch on lawn mowers. If the operator trips or falls and releases the switch, the lawn mower's engine automatically stops.

*e.* Employing release devices that open automatically when certain conditions are reached. Electrical fuses are examples; they fail open to break the electrical circuit and protect electrical equipment from being overcharged. Another example is the release pressure valve on hot water heaters. When the pressure in the water tank becomes too great, they open, relieving the pressure before the tank explodes.

*f.* Safety devices have even been created for sports activities such as breakaway bases and padding on goal posts.

*g.* All of the above are active controls and do not rely on the Soldier or operator to react to a given situation. However, safety devices can be circumvented, such as the dead-man-switch being tied down. Therefore, leaders and supervisors need to constantly check safety devices to make sure they are in working order and not being bypassed.

### 4–5. Provide warning devices

Warning devices are passive. While they provide notification that a hazardous situation exists, they require the Soldier or operator to react to a given situation. Warning devices consist of bells, whistles, announcements, lights, and other such devices. The following are examples of warning devices.

*a.* In the coffee making process example, appendix C, a warning device would be the "on" light indicating that the heating plate is on and could be hot.

*b.* Flashing yellow lights are an example of a warning device. They are normally associated with a situation requiring extra caution, such as warning of high pedestrian traffic. Since they are passive, they depend upon the operator-heightened level of caution for protection.

*c.* Flashing red lights are another warning device that is often used to restrict or prohibit entry into areas where dangerous equipment is being used.

*d.* Even when using devices such as gauges to inform the operator of conditions, it is best to have hazardous areas indicated on the gauge. For example, if the line pressure is not to exceed a 160 psi, rather than have the operator remember that value, use a gauge where the hazardous area is marked with a red-band. When such gauges are not available, the correct area can be denoted on the existing gauge with paint, tape, or other markings. This aids the operator by visually showing when the pressure is too great without the operator having to remember the value. This is especially important when many gauges are used and each has its own hazardous range.

### 4–6. Develop procedures and provide training

Procedures rely upon the Soldier or operator executing them.

*a. Initial training.* This requires initial training as well as periodic training to ensure that the Soldier or operator understands the "why" and the "how" of the procedures. They should be trained in what the hazards are, how to recognize the hazards and what the control procedures are. If they do not understand the consequences, they are less likely to follow them.

*b. Implementing procedures.* When implementing procedures the following factors need to be considered prior to their development.

*c. Targeted community.* What are the demographics of the audience? What is the at-risk group and how large is the group.

*d. Intervention.* Are the reasons for application clearly defined, are the results repeatable.

*e. Outcome measurement.* How do we measure the effectiveness? Have measurable goals and objectives been established.

*f. Implementation process.* What are the implementation issues and are there unresolved issues and questions.

*g. Developing training.* When developing training, make use of the performance model provided in the following equation:

P = (A+S+K)*ME
Where:
P = performance
A = ability
S = skills
K = knowledge

ME = motivation and emotion

*h. Performance model.* To take advantage of this performance model, one begins by developing a matrix like the one shown in table 4–1.

*i. Factors.* First, it establishes what factors to address in the training and then how to address those factors. For instance, does the Soldier or civilian employee need new knowledge to do the procedure? If so, then what is that new knowledge?

*j. Impact.* Secondly, the matrix establishes how to measure required impact on the Soldier or civilian. For knowledge, measurement might be achieving a certain test score. For skills, measurement might be demonstrating the new skill proficiently several times.

*k. New skills.* In some situations, more than one row may be necessary for each factor. For instance, more than one new skill may be required.

*l. Training plans.* Additional information for developing training plans, programs of instruction, and other education development tools are beyond the scope of this pamphlet. AR 350-series publications provide Army guidance. The Internet provides other informational sources for developing them as well.

*m. Leadership.* In addition to the training, Army leadership must supervise their Soldiers and operators to enforce the standards and SOPs. If Army leadership does not place value and importance on them, their Soldiers and operators will not value them or implement them.

***Fire Extinguisher Training, sample***

| Factors to Impact | Identified Root Causes | |
|---|---|---|
| | Requirement | Measurement |
| Knowledge | P.A.S.S. technique | Post-training test score ≥ 70%. |
| Skills | Physical operation of extinguisher. | Hands-on student participation. |
| Attitudes, motivation, or desires | Willingness to fight small fires. | Post-training survey score. |
| Culture or climate | High employee buy-in of fire prevention program. | Post-training survey score. |

SAMPLE

**Figure 4–1. Sample factors to impact planning**

## 4–7. Provide personal protective equipment

*a.* The use of PPE is totally dependent upon Soldier and operator to use. Therefore, it is the responsibility of Army leadership, at all levels, to inspect and enforce their Soldiers' and operators' use of PPE.

*b.* Personal protective equipment can take all shapes and forms. From the traditional industrial PPE of hard hats, safety glasses, safety vests, hearing protection plugs and muffs, and steel-toed shoes to seat belts not only in a Soldier's or civilian employee's private car but in Army vehicles as well. For Soldiers, PPE can be glasses and hearing protection worn on the range or just heavy gloves worn when moving heavy objects or working with sharp objects. There is PPE designed for sports as well, such as the goggles for handball and racket ball, flotation devices for boating, helmets for motorcyclists and bicyclists, and even wrist, elbow, and knee guards for people roller blading. PPE exists for every facet of life.

*c.* A prime example of PPE dependence on the user is seat belts. While mandatory in all passenger cars and even accompanied by a warning device to put them on, they still depend upon the driver to use them. Even when mandated by state laws, thousands of drivers and passengers are killed each year due to not wearing their seatbelts (National Safety Council, 1999).

*d.* However, for Soldiers and civilian employees to benefit from the PPE, they must—

(1) Have the PPE at hand when it is required.

(2) Know how to use it correctly.

(3) Use it.

*e.* For the above reasons, OSHA views the use of PPE as a temporary solution until engineering controls eliminate the industrial hazard.

*f.* The use of PPE requires that supervisors constantly observe their Soldiers and civilians to assure the use of PPE and when necessary provide counseling and additional training.

### 4–8. Selecting controls

The first step in devising hazard countermeasures and controls is understanding the hazard, its source, mechanism, and effect.

*a.* For each hazard, determine what the sources are that create the hazard and risk. A good understanding of the risk mechanisms facilitates effective development, selection, and prioritization of risk countermeasures and controls.

*b.* By understanding how the hazard occurs and what allows it to happen, controls and countermeasures can be developed.

*c.* The concept is to either eliminate the source or change the mechanism. An excellent analysis to use is the barrier analysis because it allows the user to identify where barriers, both physical and procedural, can be used to change the hazard scenario.

### 4–9. Developing controls

Once the hazard is understood, various controls and countermeasures should be developed. In this Mishap Risk Management Process step, the idea is to brainstorm as many controls and countermeasures as possible.

*a.* For instance, in the coffee making process, appendix C, one hazard was a slippery floor in front of the sink. This hazard was caused by water being spilled on the floor. Therefore, the goal would be to eliminate the wet floor by introducing barriers. The one solution is to eliminate the water faucet. The next solution would be to increase the depth of the sink and move the faucet deeper so no splashing can occur. Another solution is to install a grille and drain in front of the sink to capture the spilled or splashed water. Another solution is to place a mat in front of the sink to catch the water and keep the floor from becoming slippery.

*b.* Rerouting of a road through a housing area during pavement can result in heavier traffic around a playground area. The hazard would be children running into traffic. One control would be not to reroute traffic by the playground. Another would be to erect fences along the route, restricting the children’s access to the road. A third control would be installing stop signs at intervals to force traffic to move slower. Other controls include flashing lights and warning signs or providing crossing guards or police officer to control the children and the traffic flow.

*c.* During planning of a Family outing for a vacation at the lake, the parents were concerned about their two, young children and presence of water since their children could not swim. A possible control measure would be to change destinations and go to the mountains or a city. Another would be to require their children to wear personal flotation devices whenever near the water. Another would be to select only lake resorts that had lifeguards on duty or those with fenced-in beaches or both. Another solution would be for each parent to assume responsibility for a child and never leave the child unsupervised at the lake.

### 4–10. Evaluation of controls

Once a list of possible controls or countermeasures has been developed for each hazard, the next step is to evaluate them. The selection should be made based on how well it mitigates the risk, its cost, feasibility and management controls required.

*a.* Consider the example of rerouting a road through a housing area during pavement which could result in heavier traffic around a playground area.

*b.* The first control identified would be not to reroute traffic by the playground. If another route could be selected, then the probability of a child being struck by a rerouted car near the playground would be zero, a tolerable risk. However, this solution was not possible since the road by the playground was the only other route leading to the gate and the cost of building a temporary road was too great.

(1) A second solution was to erect fences along the route, restricting the children’s access to the road. After investigation, it was found that public works had orange snow fence available, and the cost to put it in place was minimal. This would restrict the children to crossing only at the intersections. It was determined that the probability would be “occasional” and with the severity being a child being killed, resulting in a “high” risk.

(2) A third control would be installing speed bumps at intervals to force traffic to move slower. Temporary speed bumps could be purchased, but delivery took too long; so this solution was eliminated.

(3) Using flashing lights and warning signs were determined only to inform drivers of the hazard and provided little control. However, these could be used in conjunction with stop signs and the fencing. This further reduced the probability to seldom; however, this still resulted in a high risk.

(4) To further reduce the risk, it was determined to use crossing guards or police officers during peak traffic hours in the morning, at noon, and in the afternoon to control traffic and the children. This reduced the probability to unlikely and the risk to medium.

(5) As demonstrated above, risk mitigation is an iterative process that culminates when the mishap risk has been

reduced to a level as low as reasonably practicable. The remaining risk is called residual risk. It is derived just as the initial risk was using the combination of probability and severity discussed earlier.

*c.* When the probability of an incident is such that it does not meet the probability category definitions, in other words, the risk is so close to zero, the risk can be classified as below the tolerable risk threshold. This indicates that the hazard has been alleviated and only needs to be tracked and verified to assure that its classification is accurate.

### 4–11. Make decisions

Once the various possible countermeasures and controls have been identified, this leads to the second sub-step: decisionmaking. This involves deciding which countermeasures to use, and in some special situations, requirements may dictate that the hazard and the risk be accepted due to constraints placed on the mission, process, system, or equipment.

*a.* In the first case of selecting countermeasures and controls, these decisions can be made at the lowest echelons often by the immediate leader, designer, or process developer.

*b.* However, when the hazard is not eliminated or controlled to tolerable limits, Army leadership needs to decide about the acceptability of the risk based upon mission requirements. Accepting risk is a serious matter; therefore, the appropriate level of Army leadership must weigh the increased danger to the mission, personnel, equipment, public, property, and environment against the operational requirement that necessitated acceptance of a significant level of risk.

*c.* Make risk decisions at the appropriate level. As a decision making tool, CRM is effective only when the information is passed to the appropriate level of command for decision. Commanders are required to establish and publish approval authority for decision making. This may be a separate policy, specifically addressed in regulatory guidance, or addressed in the commander's training guidance. Approval authority for risk decision making is usually based on guidance from higher headquarters. Table 4–2, below, shows the levels of required risk acceptance for all situations involving explosives or chemical agent safety where the explosives or chemical agent are the initial cause of the risk. Table 4-2 may be used for acceptance of installation/operational risk. The appropriate acceptance level is determined by three factors: the level of risk, the duration of the risk, and the ownership of the resources necessary to control, eliminate or correct the hazard in an appropriate time frame.

*d.* The length that the mission, personnel, equipment, property, or environment will be exposed to significant risk; duration of risk. When determining the duration of risk for table 4–2, consideration must be given to whether the mission is recurring or nonrecurring.

(1) *Recurring missions.* Recurring missions are those missions, which are anticipated to occur again in the near future, such as night-training flights, rifle-range training, and so on. For recurring missions, the duration should be based on anticipated total period to accomplish all recurring missions, for example, if the mission will be conducted for one week every month for three years, then the duration used would be three years, not one week or one month.

(2) *Nonrecurring missions.* Nonrecurring missions are missions that are not anticipated to occur again in the near future. Normally, these types of operations occur during contingency, wartime conditions or unique training situations.

*e.* The level of authority accepting the consequences of a given hazard is determined by the level of risk associated with that hazard. The greater the risk, the higher that decision must be elevated. In organizations lead by civilian leaders, equivalent civilian grades may be substituted for military ranks, see table 4–1, below.

**Table 4–1**
**Military–civilian equivalent grades**

<table>
<tr><td>Military rank</td><td>O–7 though O–10</td><td>O–6</td><td>O–5</td><td>O–4</td><td>O–3</td></tr>
<tr><td rowspan="2">Civilian grade</td><td rowspan="2">SES–1 through SES–6</td><td>GM–15/GS–15</td><td>GS–13 and GS–14</td><td>GS–12</td><td>GS–10 and GS–11</td></tr>
<tr><td>Supervisor/manager Pay band 3</td><td colspan="2">Supervisor/manager Pay band 2</td><td>Varies</td></tr>
</table>

Notes:
[1] OPNAVINST 11101.13J, 16 Dec 1992.

*f.* An important factor in risk acceptance is ownership of the resources necessary to control, eliminate, or correct the hazard in an appropriate time frame. In today's Army, risk ownership is no longer a simple decision since the installation's infrastructure may be managed by a Direct Reporting Unit (DRU), yet the installation may be devoted towards executing a mission that belongs to an Army Command (ACOM), Army Service Component Command (ASCC), or another DRU. Therefore, the ownership of the risk must be determined based upon—

(1) Whether the risk involves more than one organization on the installation; for example, risk associated with a bridge needing replacement; electrical wiring requiring upgrading; training ranges not meeting standards, or an

ammunition storage location used by several tenant's activities. If it does, then the risk owner is in the garrison commander's chain-of-command.

(2) Whether the risks involves only one of the tenant activities and does not expose any other organizations on the installation to danger, for example risk associated with: a unit arms room, a unit's training activity, an ammunition holding area (AHA). If it does, then the risk owner is in the mission commander's chain-of-command.

(3) Whether the risk involves only one of the tenant activities, but exposes other tenants to danger, for example the risk associated with AHA safe-separation arcs overlapping another tenant, unit arms room in a shared building, storage of hazardous material in a shared facility. If it does, then the risk owner is in the mission commander's chain-of-command, but garrison commander or his/her chain-of-command must concur with the risk acceptance.

*g.* Certificates of Risk Acceptance are required for violations of explosives and chemical agent safety standards and will be signed to document risk acceptance for noncombat situations of a duration greater than 7 calendar days.

(1) A Certificate of Risk Acceptance or System Safety Risk Assessment should be used for chartered system development programs unless another similar document has been identified in accordance with MIL–STD 882, DA Pam 385–16, or the approved System Safety Program Plan.

(2) A certificate of risk acceptance may cover multiple risks, if supported by accompanying documentation describing each hazard and associated risk covered.

(3) See appendix D for examples of a certificate of risk acceptance.

(4) Copies of the certificates of risk acceptance for greater than sixty-calendar days will be provided to the organization's ACOM, ASCC, and DRU safety office.

(5) Copies of certificates involving explosives or chemical agent for a period greater than 60 calendar days will be provided to U.S. Army Technical Center for Explosives Safety (USATCES).

**Table 4–2**
**Risk acceptance authority**

| Risk acceptance matrix[3,4] | | | | | |
|---|---|---|---|---|---|
| | **Duration of risk** | | | | |
| **Category of risk** | **1 month or less** | **Greater than 1 month, less than 1 year** | **Greater than 1 year, less than 5 years** | **Permanent or greater than 5 years** | **Chartered system development programs** |
| **Extremely high risk** | General officer | MSC CG – General officer | Army Headquarters CG | ASA(I&E) | Component Acquisition Executive (CAE) |
| **High risk** | Brigade CO or responsible O-6 | General officer[1] | MSC CG – General officer | Army Headquarters CG | Program Executive Officer (PEO) |
| **Moderate risk** | Battalion CO[1] or responsible O-5 | Brigade CO[1] or responsible O-6 | General officer[1] | General officer[1] | Program manager |
| **Low risk** | Company CO[2] or responsible O-3 | Battalion CO[2] or responsible O-5 | Brigade CO[1] or responsible O-6 | Brigade CO[1] or responsible O-6 | Program manager |
| **Tolerable risk** | Not required | Not required | Not required | Not required | Not required |

Legend for Table 4-2:
In organizations led by civilian leaders, equivalent civilian grades may be substituted for military ranks, see table 4–1.
The term "Army Headquarters" used in the table includes ACOMs, ASCCs, DRUs, and the Army National Guard.

Notes:
[1] May delegate in writing authority to accept at the next lower level.
[2] May delegate in writing authority to accept risk at lower levels.
[3] When the risk acceptance authority resides in a combatant command, refer to para C1.5 of DoD 6055.09–STD.
[4] Table 4–2 cannot be used for risk acceptance of new construction involving explosives and chemical agent violations; see para 4–12, below.

## 4–12. New construction

A certificate of compelling reason (CCR) is required for all new construction involving explosives and chemical regulatory violations. A CCR is written authority, granted by the Assistant Secretary of the Army (Installation and Environment) (ASA(I&E)), to build or perform a major modification on a structure that violates or will violate the provisions of AR 385–10 dealing with explosives or chemical agents, DA Pam 385–61 or DA Pam 385–64. The certificate will be developed, submitted through channels and signed prior to expenditure of funds for the project. ACOM, ASCC, or DRU commanders must certify such projects are essential because of operational necessity or other compelling reasons. A CCR package will be completed and submitted through the chain-of-command of the organization having responsibility and authority over the structure to be constructed.

*a.* The submission package for a CCR will provide the following information:

(1) The cited mandatory requirements of AR 385–10, DA Pam 385–61, or DA Pam 385–64 it cannot fulfill.

(2) The estimated cost and military construction project number (if assigned).

(3) A drawing at a scale of one inch equals not more than 400 feet, showing the location of the facility to be constructed and its surroundings.

(4) A copy of all hazard analyses, trade-off studies, and statements of initial and final residual risk for each deviation of regulatory requirements.

(5) Estimated potential monetary loss, personnel exposed, potential injuries, and environmental damage due to each violation.

*b.* Submission process—

(1) The operational activity will submit requests for CCRs through the organizational safety office. The safety officer will assist in preparing the request, staff the request, and forward the complete package to the responsible organization's safety office for their recommendation.

(2) The commander of the organization having responsibility and authority over the structure will recommend approval or disapproval of the request.

(3) If approved, the request will be forwarded through the chain of command, the USATCES, Office of the Director of Army Safety (ODASAF) to the ASA(I&E).

(4) At each review level, the safety officer will coordinate the review and staffing of the request. Appropriate staff officers will provide information or review information on operational necessity, cost of correction, and other factors. The commander at each level must approve the request before it may be forwarded to the next review level. Disapproval requires immediate action to terminate the request.

(5) Requests for CCRs on other services' installations will be submitted through Army and the other service's chain-of-command. The ASA(I&E) will coordinate the approved submission package with the appropriate official for the other service.

(6) Requests for CCRs involving off-installation exposures in foreign nations will be coordinated with the host nations in accordance with applicable international treaties and status-of-forces agreements prior to submission.

# Chapter 5
# Step 4 — Implementation of Controls

## 5–1. Implementing controls

Once the commander or leader has selected controls, they must be effectively implemented or risk management does not occur. This involves putting selected control measures in place and undertaking those activities necessary to allow the measures to function or operate effectively.

## 5–2. Integrating controls

The critical part of this step is to ensure that controls are implemented. Army leaders and staffs must ensure that controls are integrated into SOPs; written and verbal orders and directions; job-safety briefings; safety meetings; mission briefings; and staff estimates. Communication is key to implementation—

*a.* Ensure controls are communicated and understood down to the lowest level. This is accomplished by integrating them into SOPs, written and verbal orders, demonstrations, rehearsals, emergency drills, during mission, task or job-safety briefings, safety committee meetings, and back-briefs.

*Note.* Situational awareness is gained when those personnel who will take part in the hazardous activity are briefed. The increase in situational awareness will result in awareness of the hazard, which will cause Soldiers and civilian employees to augment their actions in the completion of the hazardous activity which will HELP to mitigate the hazard.

*b.* Develop goals and objectives to measure the effectiveness of the controls.

*c.* Develop an action plan for implementing the controls.

## 5–3. Action plan

An action plan is a specific, written description of problems and solutions. A good action plan has three parts.

*a.* The first part is establishing measurements. In order to evaluate the effectiveness of the control, measurements must be established for how that will be determined. The purpose is to determine before hand how to measure the success of the controls. Table 5–1, below, shows a matrix that may be used.

*b.* Reaction refers to the measuring of how the affected personnel accepted the control.

*c.* Learning refers to measuring if the affected personnel learned how the control worked and how it involved them.

*d.* Behavior refers to measuring how their actions changed due to the implemented control - was it the behavior that was anticipated.

*e.* Results refer to measuring if the control measure achieved the goal it was designed to achieve.

***Install Gated Railing on Loading Dock, sample – see figure 2-3.***

| Level | Measurement | |
|---|---|---|
| Reaction | Percentage of positive survey responses from dock personnel. | Surveyed level of perceived safety benefit. |
| Learning | Time needed to train personnel to properly load dock using gated railing. | Learning curve characteristics for introduction of new procedure. |
| Behavior | Reduction in loading time due to opening/closing of gate. | Observed occurrences of procedural shortcuts. |
| Results | Decrease in loading dock forklift accidents. | Decrease in cost due to reduced worker compensation and equipment repair. |



**Figure 5–1. Sample measurement of control implementation**

*f.* The second part is listing the major changes or improvements needed to control identified hazards in the workplace. The plan assigns each item a priority and a target date for completion and identifies the person who will monitor or direct each action.

*g.* The last part of an action plan involves taking each major change or improvement listed and working out a specific plan for accomplishing that change. Write out what needs to be accomplished, the steps required, whom to assign it to, and when it should be finished. This part of the action plan helps track program improvement so that details do not slip through the cracks.

*h.* For instance, in an installation's spray-painting operation, a full-face, negative-pressure, air-purifying respirator was identified by the JHA as required. The action plan should address—

(1) Which respirator needs to be ordered, who is responsible for ordering it, as well as the date by which they are needed?

(2) Who will issue them to the painters and conduct fit-tests?

(3) Who will update the SOP for the painting operation to include use, care and storage of the respirators?

(4) Who will schedule medical physicals for employees?

(5) Who will develop employees' training in the respirators' use and care and the date by which it will be given?

(6) Who is responsible for arranging for employees to have a location to store their respirators?

### 5–4. Coordination

It is important to coordinate with adjacent units and organizations to ensure they understand the hazards identified and the controls to be implemented, especially if they will encounter the same hazards or play a role in implementing the controls.

### 5–5. Implementation steps

The most important aspect of implementing controls is clearly communicating how the controls will be put into effect, who will implement them, how they will fit into the overall operation, and how the commander expects them to be enforced.

*a.* First-line supervisors are key to implementing the controls specified in the operations order.

*b.* Examples of implementing controls are—

(1) SOPs, written and verbal orders.

(2) Job requirements, job descriptions, and physical requirements.

(3) Demonstrations, rehearsals, and emergency drills.

(4) During mission, task or job-safety briefings, safety committee meetings, and back-briefs.

(5) Conducting rehearsals, walking through processes, drills, and so on.

(6) Training on the hazards and controls.

*c.* For example, in the spray-paint booth example above, the supervisor must make sure employees are medically qualified and this requirement will have be added to their job descriptions and qualifications.

### 5–6. Developing work procedures

Develop work procedures in relation to the new control measures to make sure they are effective. Management, supervision, and worker responsibilities may need to be clearly defined in the work procedures (see DA Pam 385–10 for additional information on SOPs).

*a.* Procedures should be developed to apply to everyone and address areas such as PPE, appropriate clothing, expected behavior, and emergency procedures.

*b.* The supervisor and employees should periodically review and update all rules and procedures to make sure they reflect present conditions.

*c.* Procedures should be written for new hazard exposures when they are introduced into the workplace.

*d.* Safe and healthful work practices must be developed for each specific job based upon the JHA, PHA, or other hazard analysis and implement all control measures identified.

*e.* The procedures must address emergencies. The procedure must include a list of emergencies that could arise and a set of procedures in response to each situation. Some emergency procedures, such as those covering medical emergencies or fire evacuation, are mandated by OSHA regulations.

*f.* For operations involving hazardous substances, procedures or processes, emergency response teams must be designated, trained and equipped to handle possible imminent hazards.

### 5–7. Training and communication

The workers and others must be informed about the control measures to be implemented and the reasons for the changes.

*a.* This is accomplished by providing training and instruction on the new control measures and the hazards they are protecting against.

*b.* This training and instruction must, at a minimum, be provided to—

(1) All employees when the new control is first established.

(2) All new employees.

(3) All employees given new job assignments for which training has not been previously received.

(4) New substances, processes, procedures or equipment introduced to the workplace and present a new hazard.

(5) A new or previously unrecognized hazard is identified and controls implemented.

*c.* All supervisors have to be trained and understand the safety and health hazards to which employees under their immediate direction and control may be exposed.

## Chapter 6
## Step 5 — Supervision and Evaluation

### 6–1. Supervise and evaluate

Step 5 of the Mishap Risk Management Process ensures that risk controls are implemented and enforced to standard. It provides the means of validating the adequacy of the selected control measures in supporting objectives and desired outcomes. Like other steps of the Mishap Risk Management Process, supervision and evaluation must occur throughout all phases of any operation or activity. This continuous process provides the ability to identify weaknesses and to make changes or adjustments to controls based on performance, changing situations, conditions, or events.

### 6–2. Supervision

*a.* Supervision is a form of control measure. It ensures subordinates understand how, when, and where controls are implemented. It also ensures that controls are implemented, monitored, and remain in place. It ensures that complacency, deviation from standards, or violations of policies and risk controls are not allowed to threaten success. Supervision also provides Army leaders with the awareness necessary to anticipate, identify, and assess any new hazards and to develop or modify controls as circumstances unfold. It takes an extraordinary degree of discipline to avoid complacency from boredom and overconfidence when personnel are performing repetitive tasks. Turnover in military units places an extra burden on supervisors to ensure awareness, training, and compliance.

*b.* Controls established and implemented for a prolonged period are especially "at risk" to be ignored due to overconfidence or complacency. Supervisors should—

(1) *Focus on process.* Supervisor must hold employees accountable for accomplishing process activities that prevent injuries. Supervisors must reinforce their employees' efforts and contributions towards preventing injuries.

(2) *Educate.* Supervisors explain the principles and rationale for the controls and demonstrate how the controls work;

(3) *Promote ownership.* Allow their employees to participate in the implementation of controls and procedures and take control;

(4) *Set expectations.* Supervisors can facilitate a shift from other-directed to self-directed motivation by initiating a process or action with stated expectations;

(5) *Support and reward.* Support employees following safety procedures and reward them for their efforts;

(6) *Model appropriate safety-related behavior.* Supervisors must model the behavior they expect of their employees. For instance, a supervisor should always wear the appropriate PPE for any area the supervisor is visiting. If hearing protection is required, then the supervisor should be using hearing protection, too.

(7) *Conduct spot checks and unannounced visits.* Supervisors should conduct periodic spot checks and unannounced visits to the various work areas under their direction. During the visits, the supervisor should be observing adherence to safety requirements for that area and checking to assure that controls are still in place.

(8) *Report-in periodically.* Supervisors should periodically report to their supervisors on the status of the controls and how effective they are.

### 6–3. Evaluation

The evaluation process occurs during all phases of the operation. The evaluation process accomplishes the following:

*a.* Identify any hazards that were not identified as part of the initial assessment.

*b.* Assess how well the controls work.

*c.* Determine if the controls have affected the job, task, or mission accomplishment.

### 6–4. Hazard control

Hazards will be eliminated on a worst-first basis. An abatement plan must be prepared for each hazard whose correction will exceed 30 days. Individual deficiencies of an identical character may be grouped together into a single abatement plan solution or into an associated abatement project. The plans will be kept current by adding new projects and by placing completed projects in a completed projects section. Corrections of violations that have a high dollar cost can be included in the abatement plan. The command element involved will approve abatement plans.

*a. Management of hazards.*

(1) Procedures such as spot checking or sampling will be used to ensure that interim control measures are being implemented.

(2) Copies of abatement plans will be placed in each unit in the place where personnel notices are usually posted.

(3) Violations of regulatory standards or Federal, state, and local laws that are the responsibility of another ACOM or installation, DOD, or outside agency will be brought to the attention of the responsible official for action.

(4) Quarterly, a complete listing of all existing hazards, including accepted hazards, will be provided to the installation commander.

(5) Upon change of command at any level of command or installation, a complete listing of all current risk acceptance certificates will be provided the new commander for his information. Additional information will be provided upon request.

(6) The installation's command representatives will review the installation's risk tracking and abatement programs at least annually to ensure adequate resource allocation and ensure non-resource-intensive corrective actions are accomplished. These plans are also subject to review by HQDA, OSHA, and union representatives.

*b. Funding for risk abatement.*

(1) Operating plans and budgets will include appropriate planning, programming, and resources to correct all significant hazards from the Hazard Tracking and Abatement Program according to the risk involved. When abatement projects require military construction funds or exceed local funding ceilings, the local commander will submit appropriate funding requests through command channels.

(2) Funding will be accomplished generally from local operations and maintenance monies or overhead funds in industrially funded activities. Installations that are funded from research, development, testing and engineering monies will program funding for hazard abatement.

(3) All construction and modernization projects are required to incorporate life safety, explosives safety, fire protection, environmental, and other appropriate safety and occupational health standards. Many existing hazards are

abated as a by-product of new construction that has been justified for other reasons. However, military construction projects whose paramount justification is abatement of such hazards normally do not involve new construction; they typically consist of retrofit of one or more existing facilities, such as the installation or replacement of ventilation systems in places where toxic chemicals present hazards. An exception to this general rule could occur when a life cycle analysis results in the determination that replacement or relocation of an existing facility is more cost effective than correction of multiple or gross existing hazards.

(4) ACOMs, ASCCs, and DRUs will make provisions to account for actual expenditures for hazard abatement projects at all echelons of command.

## Appendix A
## References

### Section I
### Required Publications

**AR 385–10**
Army Safety Program (Cited in paras 1–1, 4–12.)

**DA Pam 385–16**
System Safety Management Guide (Cited in para 4–11*g*.)

**DA Pam 385–61**
Chemical Agent Safety Program (Cited in para 4–12.)

**DA Pam 385–64**
Ammunition and Explosives Safety Standards (Cited in para 4–12.)

**DODI 6055.1**
DOD Safety and Occupational Health (SOH) Program (Cited in para 1–1.) (Available at http://www.dtic.mil/whs/directives/.)

**FM 5–19**
Composite Risk Management (Cited in paras 1–5*b*, 1–5*c*.)

**MIL–STD–882**
System Safety Program Requirements (Cited in paras 3–7*d*, 4–11*g*.) (Available at https://assist.daps.dla.mil/quicksearch/.)

### Section II
### Related Publications
A related publication is a source of additional information. The user does not have to read a related reference to understand this publication.

**DA Pam 385–24**
Army Radiation Safety

**DA Pam 385–69**
Safety Standards for Microbiological and Biomedical Laboratories

**29 CFR 1910.1200**
The Hazard Communications Standard (HCS), Primary topics include Material Safety Data Sheets (MSDS's), Labeling/Signage, and Training. (Available at http://www.gpoaccess.gov/cfr/index.html.)

**28 USC 2671**
Tort Claims Procedures; Definitions. (Available at http://uscode.house.gov/.)

**Occupational Safety and Health Administration (OSHA) 1910.1000**
Air Contaminants. (Available at http://www.osha.gov/pls/oshaweb/.)

**OPNAVINST 11101.13J**
Assignment and Utilization of Navy-Managed Military Family Housing (MFH). (Available at https://www.cecos.navy.mil/pdffiles/.)

### Section III
### Prescribed Forms
Except where otherwise indicated below, the following forms are available on the AKO, AHP, and APD Web sites.

**DA Form 7632**
Certificate of Risk Acceptance (Prescribed in para 1–5*d*.)

**Section IV**
**Referenced Forms**
This section contains no entries.

## Appendix B
## Hazard List

### B–1. Hazard reference list

The hazard reference list, in table B–1, below, is not all inclusive but the beginning for a more detailed list. Addition to the list is encouraged for your particular circumstances. See table B–2 for OSHA JHA hazard reference list.

**Table B–1**
**Hazard reference list**

| Hazard Areas | Things to look for as sources of hazards |
|---|---|
| Failure to Decelerate | Items in motion not stopping |
| | Falling or dropping objects |
| | Vehicle on down grade |
| | Failure to stop |
| Failure to Accelerate | Object does not move when suppose to move |
| Biological Agents | Disease |
| | Illness |
| | Food poisoning |
| Chemical Reactions | Gases |
| | Chemicals |
| Contamination | Presences of liquids, fumes, and vapors |
| | Outside activities |
| | Presence of moisture |
| Corrosion | Presence of moisture |
| | Dissimilar metals |
| | Presences of liquids, fumes and vapors |
| | Leaking of corrosive or reactive substances |
| | Salt environment |
| Electromagnetic | Power lines |
| | Generating equipment |
| | Radioactive sources |
| | Contact with live circuit |
| | Static discharge |
| | Lightning strikes |
| Explosion | Presence of explosives |
| | Combustible gasses |
| | Over pressurized boilers, tanks, and other pressure vessels |
| Fire | Combustible material and open flame |
| | Exposed electrical wires |
| | Heat source |

**Table B–1**
**Hazard reference list—Continued**

| Hazard Areas | Things to look for as sources of hazards |
|---|---|
| Heat and Temperature | Activities outside |
| | Presence of mechanical or electronic hazards |
| | Heat producing devices |
| Impact and Shock | Blast |
| | Handling and transportation damage |
| | Falling body |
| | Stopping prevented by wet, icy, oily or excessively smooth surface |
| Leakage | Cracks |
| | Permeable material |
| | Worn parts |
| | Overfilling of containers |
| Machine-Man Interface | Too complicated |
| | Lack procedures or standards |
| | Lack of training |
| | Fatigued |
| Machine Motions | Rotating parts |
| | Reciprocating parts |
| | Conveyor belts |
| | Cutting actions |
| | Punching, shearing and bending motions |
| Material Handling | Lifting of items |
| | Moving of items |
| | Placing of items |
| Moisture (Lack-of or too much) | Wet climate |
| | Hot, dry weather |
| | Large amount of vegetation |
| Physiological Stress | Restricted routes |
| | Inadequate data for decisionmaking |
| | Lifting heavy objects |
| | Viewing distance too great |
| | Lack of sleep |
| | Stress |
| Power Source Failure | Fuel exhaustion |
| | Failure of life support system |
| | Failure of safety monitoring and warning systems |
| Radiation | Radioactive materials |
| | Sunshine |
| | Highly heated surfaces |
| | Radiofrequency emitting devices (that is, communications equipment) |
| | Lasers |
| | X-ray machines |

**Table B–1**
**Hazard reference list—Continued**

| Hazard Areas | Things to look for as sources of hazards |
|---|---|
| Structural Damage or Failure | Rough handling |
| | Over tightening of nuts and bolts |
| | Overloading |
| Toxicity | Toxic gasses or liquids |
| | Lack of respiratory protection |
| | Inadequate personal cleanliness |
| Vibration and Noise | Vibrating tools |
| | Hydraulic pumps |
| | Pneumatic equipment |
| | Explosions |
| Walking and Working Surfaces | Irregular walking surfaces |
| | Objects left in walkway |
| | Wet floors |
| | Openings in floors |
| | Rough terrain |
| Weather and Environment | Extreme cold or heat |
| | Dew, rain, clouds, fog, hail |
| | Temperature changes |
| | Lightning |

**Table B–2**
**Occupational Safety Health Administration job hazard analysis hazard reference list**

| Hazard | Description |
|---|---|
| Chemical (toxic) | A chemical that exposes a person by absorption through the skin, inhalation, or through the blood stream that causes illness, disease, or death. The amount of chemical exposure is critical in determining hazardous effects. Check Material Safety Data Sheets (MSDS), and/or OSHA 1910.1000 for chemical hazard information. |
| Chemical (flammable) | A chemical that, when exposed to a heat ignition source, results in combustion. Typically, the lower a chemical's flash point and boiling point, the more flammable the chemical. Check MSDS for flammability information. |
| Chemical (corrosive) | A chemical that, when it comes into contact with skin, metal, or other materials, damages the materials. Acids and bases are examples of corrosives. |
| Explosion (chemical reaction) | Self explanatory. |
| Explosion (over pressurization) | Sudden and violent release of a large amount of gas/energy due to a significant pressure difference such as rupture in a boiler or compressed gas cylinder. |
| Electrical (shock/short circuit) | Contact with exposed conductors or a device that is incorrectly or inadvertently grounded, such as when a metal ladder comes into contact with power lines. 60 Hz alternating current (common house current) is very dangerous because it can stop the heart. |
| Electrical (fire) | Use of electrical power that results in electrical overheating or arcing to the point of combustion or ignition of flammables, or electrical component damage. |
| Electrical (static/ESD) | The moving or rubbing of wool, nylon, other synthetic fibers, and even flowing liquids can generate static electricity. This creates an excess or deficiency of electrons on the surface of material that discharges (spark) to the ground resulting in the ignition of flammables or damage to electronics or the body's nervous system. |
| Electrical (loss of power) | Safety-critical equipment failure because of loss of power. |
| Ergonomics (strain) | Damage of tissue due to overexertion (strains and sprains) or repetitive motion. |
| Ergonomics (human error) | A system design, procedure, or equipment that is error-provocative. (A switch goes up to turn something off). |

**Table B–2**
**Occupational Safety Health Administration job hazard analysis hazard reference list—Continued**

| | |
|---|---|
| Excavation (collapse) | Soil collapse in a trench or excavation because of improper or inadequate shoring. Soil type is critical in determining the hazard likelihood. |
| Fall (slip, trip) | Fall Conditions that result in falls (impacts) from (slip, trip) height or traditional walking surfaces (such as slippery floors, poor housekeeping, uneven walking surfaces, exposed ledges, and so on). |
| Fire/Heat | Temperatures that can cause burns to the skin or damage to other organs. Fires require a heat source, fuel, and oxygen. |
| Mechanical/vibration (chaffing/fatigue) | Vibration that can cause damage to nerve endings, or material fatigue that results in a safety-critical failure. (Examples are abraded slings and ropes, weakened hoses and belts.) |
| Mechanical failure | Self-explanatory; typically occurs when devices exceed designed capacity or are inadequately maintained. |
| Mechanical | Skin, muscle, or body part exposed to crushing, caught-between, cutting, tearing, shearing items or equipment. |
| Noise | Noise levels (>85 dBA 8 hr TWA) that result in hearing damage or inability to communicate safety-critical information. |
| Radiation (Ionizing) | Alpha, Beta, Gamma, neutral particles, and X-rays that cause injury (tissue damage) by ionization of cellular components. |
| Radiation (non-ionizing) | Ultraviolet, visible light, infrared, and microwaves that cause injury to tissue by thermal or photochemical means. |
| Struck by (mass acceleration) | Accelerated mass that strikes the body causing injury or death. (Examples are falling objects and projectiles.) |
| Struck against | Injury to a body part because of coming into contact of a surface in which the person initiated action. (An example is a screwdriver slipping.) |
| Temperature extreme (heat/cold) | Heat stress. |
| | Metabolic slow. |
| | Hypothermia. |
| | Cold injury. |
| | Exhaustion. |
| Visibility | Lack of lighting. |
| | Obstructed vision. |
| Weather phenomena (snow, rain, wind, ice) hazards | Self-explanatory. |

### B–2. Additional information
Additional information on job hazard analysis can be found in paragraph 2–12.

## Appendix C
## Example Mishap Risk Management

### C–1. Analysis example
For purposes of simplification and to show how Mishap Risk Management Process can be used in routine, everyday functions, the operation of making coffee will be used throughout this appendix. It is a simple operation and something done across the Army by Soldiers in the field and at the garrison as well as by civilian employees in the office or on the production line.

### C–2. Task analysis
Figure C–1, below, shows how the evaluator broke down the task of making coffee into steps and then sub-steps. The task analysis not only aids in identifying hazards but also serves as a tool for developing SOPs.

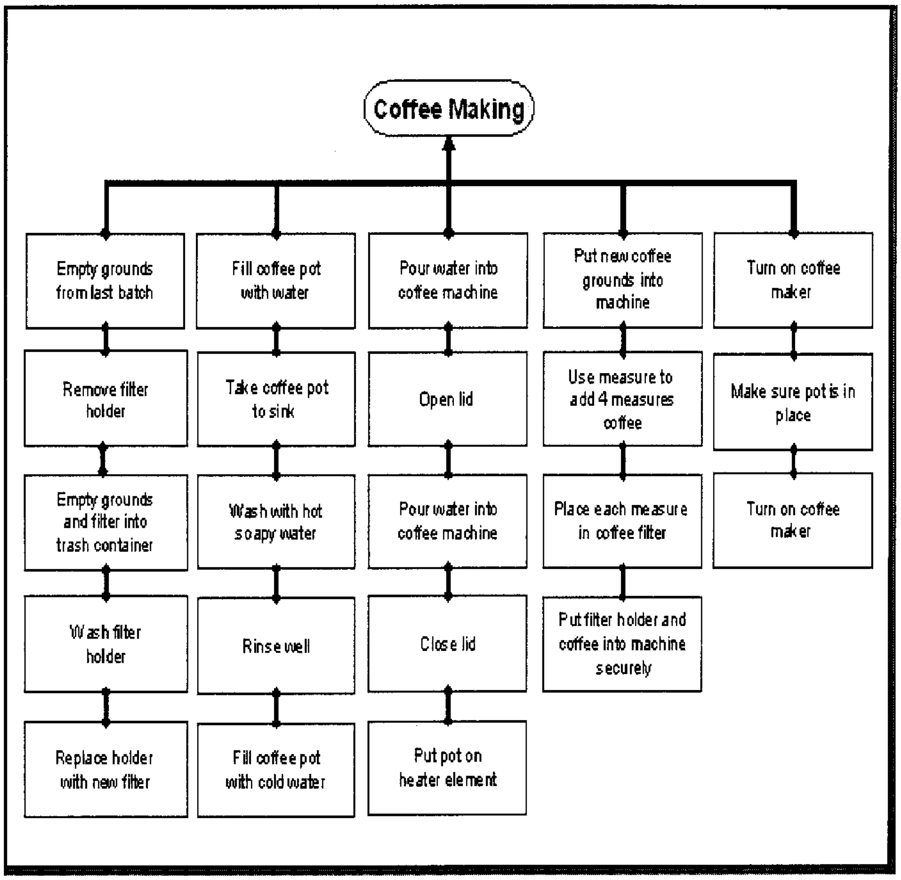


**Figure C–1. Example of a task analysis**

## C–3. Hazard list

The example in table C-1, below, the system is defined as the process of making coffee and does not consider the hazards in the design of the coffee pot beyond how they affect making coffee. The evaluator developed this list using the hazard reference list (see table B–1).

*a.* Beginning with the first listed hazard, the evaluator asked, “Can this hazard occur in the process?”

*b.* If the hazard could be present, the hazard was added to the hazard list along with its possible source.

*c.* The evaluator then went on to the next hazard working down the list until all possible hazards were covered.

*d.* This process uses the brainstorming concept. In other words there is no decision about how likely the hazard is to be present or how severe an accident due to the hazard. These determinations are made later using another analysis.

**Table C–1**
**Example of hazard list**

| Hazard list for office coffee maker | |
|---|---|
| **Hazard areas** | **Things to consider as sources** |
| Failure to decelerate | Falling or dropped objects |
| Biological agents | Food poisoning |
| Contamination | Presences of liquids, fumes, and vapors |
| Corrosion | Presences of liquids, fumes, and vapors |
| Electromagnetic | Power lines |
| Fire | Heat source |
| Heat and temperature | Heat producing devices |
| Impact and shock | Handling and transportation damage |
| Leakage | Cracks |
| Leakage | Overfilling of containers |
| Machine-man interface | Procedural problems |
| Material handling | Lifting of items |
| Material handling | Moving of items |
| Material handling | Placing of items |
| Physiological stress | Inadequate data for decisionmaking |
| Power source failure | Failure to operate |
| Structural damage or failure | Rough handling |
| Toxicity | Inadequate personal cleanliness |
| Walking and working surfaces | Wet floors |
| Weather and environment | Lightning |

## C–4. Hazard matrix

The hazard matrix uses the hazard list to develop the hazard scenario. The scenario can be as simple as stating the type of hazard, what could cause the hazard and what the outcome of the hazard might be. The hazard matrix associates generic hazards from the hazard list with a potential failure.

*a.* Figure C-2, below, provides an example of a hazard matrix for the process of making coffee. The potential failure area represents those areas where if the hazard occurred, it would most likely effect the activity.

*b.* For instance, in figure C-2, the hazard of contamination is marked under personnel. The evaluator's rationale for this selection is that if contaminated water or coffee were used, then it would affect the drinkers. The evaluator did not believe that the contaminated water or coffee would affect the structure of the coffee pot, the electrical systems, procedural performance, cause a leak or a spill.

*c.* Similarly, the evaluator listed several rows for material handling. The evaluator felt that material handling could manifest in several different issues, each requiring further consideration. Further, the evaluator marked three columns in the row for material handling; moving of items. He felt that moving of the item could result in structural damage (breakage) to the coffee pot, leakage of the coffee pot, or even injury to personnel due to spilled hot coffee.

*d.* Finally, in the same example, since the coffee machine does not depend on pressure or mechanical systems, the evaluator eliminated them from consideration leaving those columns blank.

## C–5. Developing a preliminary hazard analysis

The next step in the process would be development of a PHA that builds on the hazard matrix. Either of two methods can develop a PHA. The first method is to expand on the hazard list or hazard matrixes developed earlier; the second is to bypass those two aids and develop the PHA using a hazard reference list. This example will build on the hazard list or hazard matrix.

*a.* The evaluator began by listing the various hazards from the list or matrix in the first column. For instance, the first hazard identified is failure to decelerate.

*b.* Next, the evaluator listed the cause for each in the second column under "Cause." The cause listed for the first hazard on the hazard list, table C–1, or hazard matrix, figure C–2, is a falling or dropped object. In this case, the evaluator determined it would be the dropping coffee pot. The wording was changed to be more specific to the operation.

| Process of Making Coffee | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Hazard List for Office Coffee Maker** | | **Potential Areas For Failure** | | | | | | | |
| **Hazard Areas** | **Things to consider as sources** | Structural | Power | Systems | Pressure | Leakage - Spill | Mechanical | Personnel | Procedural |
| Failure to accelerate or decelerate | Falling or dropped objects | X | | | | | X | | |
| Biological agents | Food poisoning | | | | | | X | | |
| Contamination | Presences of liquids, fumes | | | | | | X | | |
| Corrosion | Presences of liquids, fumes and vapors | | | | X | | | | |
| Electromagnetic | Power lines | | X | | | | X | | |
| Fire | Heat source | | | | | | X | | |
| Heat and temperature | Heat producing devices | | | | | | X | | |
| Impact and shock | Handling and transportation damage | X | X | | | | | | |
| Leakage | Cracks | X | | | | | | | |
| Leakage | Overfilling of containers | | | | X | | | | |
| Machine-man interface | Procedural problems | | | | | | X | X | |
| Material handling | Lifting of items | | | | | | X | | |
| Material handling | Moving of items | X | | | X | | X | | |
| Material handling | placing of items | X | | | X | | X | | |
| Physiological stress | Inadequate data for decision making | | | | | | | | |
| Power source failure | Failure to operate | | | | X | | | X | |
| Structural damage or failure | Rough handling | X | | | X | | | | |
| Toxicity | Inadequate personal | | | | | | X | | |
| Walking and working surfaces | Wet floors | | | | | | X | | |
| Weather and environment | Lightning | | X | | | | | | |

**Figure C–2. Example of hazard matrix**

(1) However, as noted on figure C–1, there were two possible credible outcomes; one for structural, and one for personnel.

(2) First, the evaluator felt that the coffee pot would break. But also, the evaluator believed that personnel could be burned due to the dropped coffee pot. Therefore, the hazard is listed on two separate lines each with the different outcome.

*c.* If the evaluator had begun the PHA from scratch, using a reference list of hazards or other such source, the evaluator would begin working his or her way down the list (see figure C-3, below, for example PHA).

(1) For each hazard, the evaluator would ask is this hazard possible, even remotely. For instance, for the first hazard, the evaluator would ask, “Is there anything in the process that can be dropped or fall?” If the answer is yes, then the evaluator would enter the hazard of “Failure to decelerate” in the first column.

(2) Then the evaluator would ask, “What could be dropped?” In this case, the coffee pot is the most likely item to be dropped. Therefore, in the column under “Cause,” the evaluator would enter “Coffee pot dropped.”

(3) Next, the evaluator would ask, “What would the outcome be if the coffee pot were dropped?” The evaluator determined there were two credible outcomes; one, the coffee pot being broken and the other being personnel burned.

*d.* Since the hazard involved a group of people, the evaluator used the column under “All Soldiers exposed to the hazard” in table 3–3. If the group were composed of civilians, this column would still be used.

(1) The first row lists “Occurs continuously during a specific mission or operation” as the key phase and the keyword is “frequent.” Is the coffee pot going to be dropped and broken frequently? The evaluator decided no.

(2) The next row lists “Occurs at a high rate, but experienced intermittently” and “likely.” Again, the answer is no.

(3) Working down the table, arriving at the last row, the key phase is “Occurs very rarely, but not impossible in specific mission or operation” and the keyword is “unlikely.” The evaluator selected this value by the process of elimination. Therefore, the probability for this hazard is “unlikely.” The evaluator then placed the symbol “E” in the column under “Prob.”

(4) In certain situations, even the last row might not apply, since the probability is so close to zero. When this occurs, the risk can be considered below the tolerable risk threshold. In which case a “T” or the word “tolerable” written.

*e.* The evaluator then turned to table 3–4 to determine the severity.

(1) Again, beginning at the top, the evaluator asked is the result of the coffee pot being broken catastrophic. Since the loss did not cause death or damage greater than 1 million dollars, the evaluator decided no, it was not a catastrophic event.

(2) Working down the list, the evaluator concerned each severity category. Finally, at negligible and deciding that category matched the gravity of the outcome.

(3) The evaluator then entered the symbol “IV” in the column under “Sev.”

*f.* The evaluator then used the Army’s standard risk matrix to determine the risk based on the probability and severity.

(1) Going to the table, the evaluator found the intersection of the column, “Unlikely” and the row, “Negligible.”

(2) The risk was considered as “L(5)”. Using table 3–6, the found that “L(5)” was a low risk. Therefore, the evaluator entered “L” under the column for “Risk.”

*g.* Using the order of precedence, the evaluator selected replacing the coffee pot with a nonbreakable carafe.

*h.* Once the control measure is determined, it is necessary to evaluate the effect of the control measure on the risk. This remaining risk is called residual risk. The same process is used as before to determine the probability and the severity.

(1) Control measures normally reduce either the probability or the severity; they do not normally reduce both. For instance, change from electrical power to hydraulic power eliminates the probability of being electrocuted it does not eliminate the severity of electrocution, since electrocution could still be fatal.

(2) In this case the evaluator asks the question, “Can the coffee carafe be dropped and broken?” Since the carafe is unbreakable, the evaluator finds that the probability is zero. Hence, the risk does not fit the matrix and there can be considered as tolerable. The severity remains the same, but it is an impossible outcome. Therefore, a “T” is entered under “Residual Risk.” This indicates that the risk does not require being tracked or being referred for acceptance.

*i.* Not all risk will be reduced to below the tolerable level. When this case occurs, the acceptance of the risk must be elevated to the appropriate level of authority for acceptance.

| Activity: | Coffee Making | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Analyst: | John Smith | | | | Date: 05 Mar 2007 | | | | |
| Hazard (Source) | Cause (Mechanism) | Outcome (Mishap) | Initial | | | Control Measure | Residual | | |
| | | | Prob | Sev | Risk | | Prob | Sev | Risk |
| Failure to decelerate | Coffee pot dropped | Broken coffee pot | E | IV | L | Replace with non-breakable carafe | Near 0 | IV | T |
| Biological agents | Presence of germs in coffee grounds | Personnel become sick | | | | | | | |
| Biological agents | Dirty coffee pot | Personnel become sick | | | | | | | |
| Electro-magnetic | Power cord disconnected by cleaning crew | Lack of coffee | | | | | | | |
| Electro-magnetic | Power cord becomes worn | Personnel touching exposed wires | | | | | | | |
| Fire | Power cord becomes worn | Personnel burned by fire | | | | | | | |

SAMPLE

SAMPLE

**Figure C–3. Sample of preliminary hazard analysis**

## C–6. Example job hazard analysis

Figure C-4, below, shows an example of the JHA for the task of making coffee. The process is very similar to that of a PHA.

*a.* One major difference is that no initial or residual risk is calculated.

*b.* Another major difference is the focus. The JHA focus on the operator, while the PHA considers the operator, system, and the mission.

| Job Hazard Analysis | | |
|---|---|---|
| Job: Coffee Making | | Date of analysis: 03/05/07 |
| Job location: Office, Room 980 | | |
| Assessor: John Smith | | |
| **Step** | **Hazard** | **New Procedure or Protection** |
| 1. Empty grounds from last batch | 1a. Grounds dropped on floor creating slippery floor | Place a mat in front of coffee machine |
| | 1b. Coffee pot still hot from previous batch of coffee | Train operator that coffee pot may be hot and therefore to use caution when handling it |
| 2. Fill coffee pot with water | 2a. Wet slippery floor in bathroom | Place a mat in front of the sink |
| | 2b. Coffee pot dropped striking operator | Train operator to use care when handling the coffee pot |
| | 2c. Broken glass from coffee pot cuts operator | Provide broom and dustpan and train operator how to us them |
| | 2d. Burns due to hot water during washing of the coffee pot | Check hot water heater to insure water is not to hot |
| 3. Pour water into coffee machine | 3a. Water splashed on floor causing slippery floor | Place a mat in front of the sink |
| 4. Put new coffee grounds into machine | 4a. None identified | |
| 5. Turn coffee maker on | 5a. None identified | |



**Figure C–4. Sample of job hazard analysis**

## C–7. Example of a barrier analysis

Figure C-5, below, shows a barrier analysis for the task of making coffee. Its focus is different from that of the JHA or PHA. It looks at barriers and how they can fail and what can cause them to fail.

Operation/process: Coffee making

Analyst: John Smith

| Hazard-Energy Flow | Barrier or control | Possible factors contributing to barrier-control failure | Possible root cause of failure | Evaluation |
|---|---|---|---|---|
| Biological | Use of soapy water for washing pot and filter holder | Does not follow administrative step | Operator not trained in importance of step | Reviewed training and this is covered. |
| Biological | Contaminated coffee groups | Unknown or unqualified manufacturer | Buying cheapest brand | Change procedure to buy name brand only. |
| Electrical | Insulation on electrical cord | Wear and tear | Not inspected | Added to monthly checklist for inspections. |
| Kinetic | Mat in front of sink | Missing | Cleaning crew removes it | Added to daily checklist. |
| Thermal | Temperature setting on hot water heater | Control switch set too high | Maintenance raises temperature | Added to weekly checklist to check temperature. |
| Kinetic | Use two hands to carry filled coffee pot | Loses control | Uses only one hand | Added to training and operator watched for periodically. |



**Figure C–5. Sample of barrier analysis for coffee making process**

## Appendix D
## Certificate of Risk Acceptance

### D–1. Instructions for DA Form 7632, Certificate of Risk Acceptance

*a. Risk site information section.*

(1) *Date of issue.* Enter the date that the certificate was issued

(2) *Date of expiration.* Enter the date that the certificate will expire. The duration of the certificate is an important consideration in the level of authority required to sign the certificate.

(3) *Location of requiring certificate of risk acceptance.* Enter the complete mailing address for the location of the organization requiring certificate of risk acceptance.

(4) *Location originating certificate.* Enter the complete mailing address of the organization originating the certificate of risk acceptance.

*b. Risk information section.*

(1) *Original probability.* Enter the original probability for the risk involved. See table 3–3 for probability categories and definitions.

(2) *Original severity.* Enter the original severity for the risk involved. See table 3–4 for severity categories and definitions.

(3) *Level of original risk.* Enter the original risk based upon TABLE 3–5.

(4) *Estimated fatalities.* Enter the estimated number of fatalities due to the risk involved, if the incident occurred.

(5) *Estimated injuries.* Enter the estimated number of injuries due to the risk involved, if the incident occurred.

(6) *Estimated dollar value.* Enter the estimated dollar value of the loss associated with the risk, if the incident occurred.

*c. Hazard information section.*

(1) *Hazard category.* Enter the hazard category, suggested categories are found in table B–1 and table B–2.

(2) *Specific hazard.* Describe the specific hazard, such as: rain-slick roadway, inert gas, open-sided platform, exposed electrical wire, leaking chemical round, and so on.

(3) *Supplemental worksheets.* Supplemental worksheets are required for toxic chemical agent and ammunition and explosives hazards and their associated risk.

*d. Regulatory-policy noncompliance section.*

(1) *Number/title of regulatory-policy.* Enter the number and title of the requirement not being met. For instance, DA Pam 385–64.

(2) *Reference requirement.* Paraphrase the requirement. Example, "Lack of require safe separation distance between ammunition holding area and fence line."

*e. Mission impact section.*

(1) *Consequence on mission.* Describe the affect of the hazard on the mission.

(2) *Consequence on personnel.* Describe the affect of the hazard on the personnel.

(3) *Consequence on equipment.* Describe the affect of the hazard on the equipment.

(4) *Impact of not accepting risk on mission.* Describe the effect of not accepting the risk (for example, "Mission must be cancelled," "Mission must be postponed until hazard can be corrected," "Mission violates Army requirements").

*f. Permanent risk mitigation information section.*

(1) *Mitigating efforts (correction action).* Enter what steps can be done to mitigate the hazard or eliminate the hazard.

(2) *Residual probability.* Enter the residual probability for the risk involved. See table 3–3 for probability categories and definitions.

(3) *Residual severity.* Enter the residual severity for the risk involved. See table 3–4 for severity categories and definitions.

(4) *Level of residual risk.* Enter the residual risk based upon table 3–5.

(5) *Risk reduction factor.* The risk reduction factor is an indicator of reduction in risk achieved. Select the appropriate value from table B–1. For instance, if the original risk were "Extremely High" and the mitigating actions reduce it to a "Medium" risk, the factor would be 13.636. Rounding the value, the value would be 14.

**Table D–1**
**Risk reduction factor**

| Risk reduction factor | | | | | |
|---|---|---|---|---|---|
| | **Risk** | **Residual** | | | |
| | **Original** | **Extremely High** | **High** | **Medium** | **Low** |
| 1 | Extremely High | 1.000 | 2.500 | 13.636 | 150.00 |
| 2 | High | 0.400 | 1.000 | 5.455 | 60.00 |
| 3 | Medium | 0.073 | 0.183 | 1.000 | 11.000 |
| 4 | Low | 0.007 | 0.017 | 0.091 | 2. |

(6) *Cost of correction.* Enter the estimate cost of the corrective or mitigating actions.

(7) *Cost effective.* This is calculated by the following formula:

Cost/Benefit=Estimated Loss (Step 1) / (1/Risk Reduction Factor X Cost of Correction)
If the Cost/Benefit is greater than 1, then it is cost of the correct action is effective.
For example:
Cost/Benefit = $1,500,000 / (1/14 * $9,000)
= 1,500,000 / 642.9
= 2333.3
Cost/Benefit > 1, therefore, the benefit is cost effective.

(8) *Application.* Mark the box of either "Mitigation restricts mission too greatly;" "Implementation time too great;" or "No effective corrective action," depending upon which applies.

(9) *Explanation for above.* Explain the reason for the box selected in step 8.

*g. Interim risk mitigation information section (if applicable).* This section is used to list interim mitigation efforts that will be used to reduce the risk or until the permanent solution can be put into effect.

(1) *Interim mitigating efforts (correction action).* Enter what steps can be done to mitigate the hazard until permanently mitigated if applicable.

(2) *Residual probability.* Enter the residual probability for the risk involved. See table 3–3 for probability categories and definitions.

(3) *Residual severity.* Enter the residual severity for the risk involved. See table 3–4 for severity categories and definitions.

(4) *Residual risk.* Enter the residual risk of the interim mitigation efforts using table 3–5.

(5) *Risk reduction factor.* The risk reduction factor is an indicator of reduction in risk achieved. Select the appropriate value from table B–1.

(6) *Cost of correction.* Enter the estimate cost of the corrective or mitigating actions.

*h. Risk acceptance information section.* This section indicates the level of residual probability, severity, and risk being accepted.

(1) *Interim mitigating efforts (correction action).* Enter what steps can be done to mitigate the hazard until permanent mitigated if applicable.

(2) *Residual probability.* Enter the residual probability for the risk involved. See table 3–3 for probability categories and definitions.

(3) *Residual severity.* Enter the residual severity for the risk involved. See table 3–4 for severity categories and definitions.

(4) *Residual risk.* Enter the residual risk of the interim mitigation efforts using table 3–5.

*i. Analyst name section.* Enter the name of the analyst, the analyst's title, and office symbols.

*j. Recommendation of acceptance section.* Enter the organization, signature, printed or typed name, date of each reviewing official in the chain-of-command up to, but not including, the final accepting authority. Indicate if each reviewing official concurs with accepting the hazard and associated risk.

*k. Risk acceptance section.* The accepting authority signs the certificate of risk acceptance. Type the title and date of acceptance.

### D–2. Ammunition and explosives supplemental worksheet

This worksheet is required when the ammunition and explosives are associated with the hazard and are either initiated as a primarily effect or as a secondary effect.

*a. Description of explosives standard not being met.*

(1) Enter a description of the standard not being met.

(2) Enter specific information.

*b. Information on the potential explosion site (PES) section.*

(1) *PES identification.* Enter a unique identifier for the PES.

(2) *PES name.* Enter the name of PES.

(3) *PES function.* Describe the function of the PES.

(4) *Net explosives weight.* Enter the net explosives weight of the ammunition and explosives involved.

(5) *Major hazard.* Enter the hazard class and division for the ammunition and explosives involved (1.1, 1.2.1, 1.2.2, and so on).

(6) *Required blast distance.* Enter the calculated or tabulated blast distance based upon the net explosives weight, see DA Pam 385–64.

(7) *Required fragment distance.* Enter the calculated or tabulated fragment distance based upon the net explosives weight, see DA Pam 385–64.

(8) *Cost of facility and equipment (in thousands).* Enter the estimated replacement value for the facility and equipment.

(9) *Personnel at site.* Enter the maximum number of personnel at the site at one time.

*c. Information on the exposed sites section.* In this section, all sites, on and off the installation, that do not have the required type of safety separation distance are listed.

(1) *On-installation exposed sites subsection.*

*(a) Facility number.* Enter a unique identification number for the site.

*(b) Description.* Describe the site.

*(c) Required distance.* Enter the required calculated or tabulated distance required

*(d) Personnel exposed.* Enter the number of people exposed at the site.

*(e) Dollar value (in thousands).* Enter the estimated replacement value for the facility and any equipment located inside.

*(f) Safety distance violation.* Enter the type of distance require, such as inhabited building distance (IBD), public transportation distance (PTR), and so on, based on DA Pam 385–64.

*(g) Total.* Total the number of personnel and dollar value.

(2) *Off-installation exposed sites subsection.*

*(a) Facility number.* Enter a unique identification number for the site.

(b) *Description.* Describe the site.

(c) *Required distance.* Enter the required calculated or tabulated distance required

(d) *Personnel exposed.* Enter the number of people exposed at the site.

(e) *Dollar value (in thousands).* Enter the estimated replacement value for the facility and any equipment located inside.

(f) *Safety distance violation.* Enter the type of distance require, such as IBD, PTR, and so on, based on DA Pam 385–64.

(g) *Total.* Total the number of personnel and dollar value.

(h) *Grand total.* The total the number of personnel exposed on and off the installation and dollar value for those sites.

## D–3. Chemical supplemental worksheet

This worksheet is required when the ammunition and explosives are associated with the hazard and are either initiated as a primarily effect or as a secondary effect.

*a. Description of chemical standard not being met.* Enter a description of the standard not being met.

*b. Information on the potential chemical agent exposure/explosion site section.* (Note: if explosives are involve, the ammunition and explosives supplemental worksheet must be completed as well.)

(1) *Facility identification.* Enter a unique identifier for the facility/area housing the chemical agent.

(2) *Facility name.* Enter the name for the facility/area housing the chemical agent.

(3) *Facility function.* Describe the function of the facility/area housing the chemical agent.

(4) *Type chemical agent.* Enter the name of the type of chemical agent involve.

(5) *Enter.* Enter the WPL, STEL, IDLH, 1 percent lethality and GPL for the chemical agent involved.

(6) *Required blast distance.* Enter the calculated or tabulated blast distance based upon the net explosives weight, see DA Pam 385–64.

(7) *Required fragment distance.* Enter the calculated or tabulated fragment distance based upon the net explosives weight, see DA Pam 385–64.

(8) *Cost of facility and equipment (in thousands).* Enter the estimated replacement value for the facility and equipment.

(9) *Personnel at site.* Enter the maximum number of personnel at the site at one time.

(10) *Net explosives weight.* Enter the net explosives weight of the ammunition and explosives involved.

(11) *Major hazard.* Enter the hazard class and division for the ammunition and explosives involved (1.1, 1.2.1, 1.2.2, and so on).

(12) *Required blast distance.* Enter the calculated or tabulated blast distance based upon the net explosives weight, see DA Pam 385–64.

(13) *Required fragment distance.* Enter the calculated or tabulated fragment distance based upon the net explosives weight, see DA Pam 385–64.

## D–4. Information on the exposed sites section

In this section, all sites, on and off the installation, that do not have the required type of safety separation distance are listed.

*a. On-installation exposed subsection.*

(1) *Facility number.* Enter a unique identification number for the site.

(2) *Description.* Describe the site.

(3) *Required distance.* Enter the required calculated or tabulated distance required

(4) *Personnel exposed.* Enter the number of people exposed at the site.

(5) *Dollar value (in thousands).* Enter the estimated replacement value for the facility and any equipment located inside.

(6) *Safety distance violation.* Enter the type of distance require, such as IBD, PTR, and so on based on DA Pam 385–64 or WPL, GPL, or 1 percent, based on DA Pam 385–61.

(7) *Total.* Total the number of personnel and dollar value.

*b. Off-installation exposed subsection.*

(1) *Facility number.* Enter a unique identification number for the site.

(2) *Description.* Describe the site.

(3) *Required distance.* Enter the required calculated or tabulated distance required

(4) *Personnel exposed.* Enter the number of people exposed at the site.

(5) *Dollar value (in thousands).* Enter the estimated replacement value for the facility and any equipment located inside.

(6) *Safety distance violation.* Enter the type of distance require, such as IBD, PTR, and so on, based on DA Pam 385–64 or WPL, GPL, or 1 percent based on DA Pam 385–61.

(7) *Total.* Total the number of personnel and dollar value.

(8) *Grand total.* The total the number of personnel exposed on and off the installation and dollar value for those sites.

# Glossary

## Section I
## Abbreviations

**AHA**
ammunition holding area

**AR**
Army regulations

**ASA(I&E)**
Assistant Secretary of the Army (Installation and Environment)

**ASCC**
Army Service Component Commands

**CAE**
component acquisition executive

**CCR**
certificates of compelling reason

**COA**
course of action

**CRM**
composite risk management

**CSM**
command sergeant major

**DODI**
Department Of Defense Instruction

**DOE**
Department of Energy

**DRU**
Direct Reporting Unit

**ETA**
event tree analysis

**FM**
field manuals

**FTA**
fault tree analysis

**FTCA**
Federal Tort Claims Act

**IBD**
inhabited building distance

**IMA**
U.S. Army Installation Management Agency

**JHA**
job hazard analysis

**MORT**
management oversight and risk tree

**MSDS**
material safety data sheets

**OSHA**
Occupational Safety Health Administration

**ODASAF**
Office of the Director of Army Safety

**PEO**
program executive officer

**PES**
potential explosion site

**PHA**
preliminary hazard analysis

**PM**
program manager

**POC**
point of contact

**PPE**
personal protective equipment

**PTR**
public transportation distance

**SOP**
standing operating procedure

**TM**
technical manuals

**USATCES**
U.S. Army Technical Center for Explosives Safety

**USC**
United States Code

## Section II
## Terms

**Asset**
Something of value. Assets include but are not limited to Soldiers, personnel, facilities, equipment, operations, data, the public, the environment, equipment, and systems.

**Accident sequence or scenario**
One specific pathway through the event tree from the initiating event to an undesired consequence.

**Assumed risk**
A risk that management has determined acceptable to the mission being evaluated.

**Common outcome**
Those hazards which provide the same type of result (that is, Soldier injury, system failure, mission failure, equipment breakdown, lost time accident, and so on).

**Composite risk management process**
A continuous process applied across the full spectrum of Army training and operations, individual and collective day-to-day activities and events, and base operations functions to identify and assess hazards, develop and implement controls, and evaluate outcomes.

**Criticality**
Criticality can also be measured as the severity of the consequences and frequency of occurrence for a particular error, fault, or failure mode.

**Failure**
Loss of functional ability to perform as intended (for example, relay contacts corrode and will not pass rated current closed; the relay coil has burned out and will not close the contacts when commanded -the relay has failed; a pressure vessel bursts -the vessel fails; or operator does not perform as required). A protective device that functions as intended has not failed (for example, a blown fuse).

**Fault**
An abnormal undesirable state of a system, a system element, or process induced by—
*a.* Presence of an improper command or absence of a proper one.
*b.* A failure (see below). All failures cause faults; not all faults are caused by failures.
*c.* A system which has been shut down by safety features has not faulted.

**Frequency**
Rate of mishap occurrence. Frequency is sometimes substituted for probability as a component of risk (for example: loss events per 106 operating hours).

**3.2.19 Mishap probability**
Likelihood of mishap occurrence over a specified exposure interval. Probability is expressed as a value between zero and one. Probability is a component of risk and has no dimension but must be attached to an interval of exposure (for example, one operating year, a million vehicle miles).

**Hazard**
Threat of harm to an asset having value one would wish to protect.

**Hazard analysis**
A process refers to a number of methods for identifying process hazards, measuring their relative consequences, and deriving recommendations.

**Hazard list**
The hazard list is a simple listing of hazards that may exist in the activity under evaluation. The possible hazards are listed by possible source without regard for the mechanism, outcome, or any consideration of likelihood of being present.

**Hazard matrix**
An analysis technique where a table is developed listing potential hazards versus potential failures areas in the activity being evaluated. Examples of hazards are corrosion, fire, impact, shock, and so on. Examples of potential failure areas are mechanical, mechanical, personnel, or procedural.

**Independent events**
Two events are independent if the occurrence of one of the events gives us no information about whether or not the other event will occur; that is, the events have no influence on each other. The outcome of event A, has no effect on the outcome of event B. Such as "It rained on Tuesday" and "My chair broke at work." When calculating the probabilities for independent events you multiply the probabilities. You are effectively saying what is the chance of both events happening bearing in mind that the two were unrelated.

**Initiating event**
A term used in event tree analysis (ETA) to describe the occurrence of some failure with the potential to produce an undesired consequence. An initiating event is sometimes called an incident.

**Intermediate event**
(FTA) An event that is caused by preceding faults or conditions with in the process or system being analyzed.

**Line of assurance (LOA)**
A term used in ETA which is a protective system or human action that may respond to the initiating event

**Maximum credible risk**
The risk associated with the hazard which is the most severe and the most credible.

**Mishap**
An unplanned event or series of events resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

**Mishap Risk Management Process**
The process of identifying and providing recommendations on whether to resolve or to accept accident-producing hazards associated with a mission; the design of a system, facility, equipment, or processes; and their operation.

**Mitigation order of precedence**
A prioritized ranking of methods for instituting countermeasures and controls arranged by their effectiveness in reducing the risk associated with an identified hazard. The prioritized mitigation order is—
*a.* Design to eliminate hazards.
*b.* Incorporate safety devices.
*c.* Provide warning devices.
*d.* Develop procedures and provide training.
*e.* Provide PPE.

**Mutually exclusive event**
Two events are mutually exclusive (or disjoint) if it is impossible for them to occur together. If event A happens, then event B cannot, or vice-versa. The two events "it rained on Tuesday" and "it did not rain on Tuesday" are mutually exclusive events. calculating the probabilities for exclusive events you add the probabilities.

**Negligence (law)**
Failure to exercise the degree of care considered reasonable under the circumstances, resulting in an unintended injury to another party. Negligence uses the “reasonable man” standard. In cases involving negligence, which is an unintentional injury, the law asks whether or not a reasonable man in the position of the defendant would have anticipated and guarded against the risks inherent in his conduct.

**Node**
A term used in HAZOPS to identify the critical points of operation of the process

**Preliminary hazard analysis**
The PHA is for the evaluation of hazards during the beginning stages of an activity development. The PHA includes the hazard, cause and effect along with the initial and residual probability, severity, and risk.

**Probability**
An approximation of the likelihood of a hazard scenario occurring. Probability is one component of risk.

**Probability category**
A component of the risk assessment matrix. A categorization that provides a range of likelihoods for the occurrence of a mishap.

**Residual risk**
The risk associated with a hazard that remains after implementing all planned countermeasures or controls to eliminate or control the hazard. The residual risk can also be the initial risk. This situation happens when the initial risk was so low that it did not warrant expenditure of funds to correct.

**Respondeat Superior (law)**
A legal rule that the principal or employer is liable for harms done by agents or employees while acting within the scope of their agency or employment.

**Risk**
A measure of the expected loss from a given hazard or group of hazards. Risk is a combined expression of loss severity and probability. When expressed quantitatively, risk is the simple numerical product of severity of loss and the probability that loss will occur at that severity level.

**Risk assessment**
The process of characterizing hazards within risk areas and critical technical processes, analyzing them for their potential mishap severity and probability (or frequency) of occurrence, and prioritizing them for risk mitigation actions. The first two steps of the CRM process compose risk assessment.

**Risk category**
A specified range of risk associated with a given level (high, serious, medium, low) used to prompt specific action such as reporting hazards to appropriate management levels for risk acceptance.

**Risk decision**
The decision to accept or not accept the risk(s) associated with an action; made by the commander, leader, or individual responsible for performing that action and having the appropriate resources to control or eliminate the risk's associated hazard.

**Root or basic event**
Initiating fault or failure which is not developed further due to lack of information or a simple fault or failure state requiring no additional analysis.

**Safe workplace**
The Supreme Court has ruled that a safe workplace is not necessary a risk-free workplace (U.S. Supreme Court — Industrial Union Dept. V. American Petroleum Institute, 448 U.S. 607 (1980).) Accordingly, a safe workplace is one in which all the hazards have been identified, the risks determined, and those that can reasonably be expect to cause death, injury or damage have been eliminated, reduce, controlled or accepted due to impacts on the operation or equipment. In the latter case, the Soldier or employee is informed and trained on the hazards.

**Safety**
Safety can be defined as the freedom from those conditions that can reasonably be expected to cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

**Severity**
An approximation of the amount of potential harm, damage, or injury associated with a given hazard scenario or mishap. A component of risk.

**Severity category**
A component of the risk assessment matrix. A categorization that delineates a range of mishap outcomes.

**Tolerable risk**
The level of risk associated with a specific hazard below which a hazard does not warrant any expenditure of resources to mitigate. From a legal standpoint it would be consider as a "de minimis" risk, from the Latin phrase, "de minimis noncurat lex," meaning "the law does not concern itself with trifles."

**Top event**
The foreseeable, undesirable event (failure, incident, accident) toward which all fault tree logic paths flow.

**Unnecessary Risk**
A risk that can be reduced or eliminated without adversely affecting the successful accomplishment of the mission.

## Section III
## Special Abbreviations and Terms
No special abbreviations or terms in this section.