

- Whether hazardous situations are simple or complex, the process for making a hazard analysis will address the following questions:

1. Is there potential for harm deriving from aspects of the technology or activity, the characteristics of things, or the actions or inactions of people?
 2. Can the potential be realized?
 3. Who and what are exposed to harm or damage?
 4. What is the frequency of endangerment?
 5. What will the consequences be (i.e., the severity of harm or damage) if the potential of a hazard is realized?
- Making a hazard analysis is necessary to and precedes making a risk assessment. William Johnson said this about hazard analysis in *MORT Safety Assurance Systems*: "Hazard analysis is the most important safety process in that, if that fails, all other processes are likely to be ineffective." Johnson's premise is stated soundly.
 - *Risk* is defined as an estimate of the probability of a hazards-related incident or exposure occurring and the severity of harm or damage that could result. (Z10 defines risk as *an estimate of the combination of the likelihood of an occurrence of a hazardous event or exposure(s), and the severity of injury or illness that may be caused by the event or exposures.*)
 - *Probability* is defined as the likelihood of a hazard's potential being realized and initiating an incident or exposure that could result in harm or damage for a selected unit of time, events, population, items, or activity being considered.
 - *Severity* is defined as the extent of harm or damage that could result from a hazard-related incident or exposures.
 - *Risk assessment* is a process that begins with hazard identification and analysis, followed by an estimate of the probable extent of severity of harm or damage if an incident or exposure occurs, concluding with an estimate of the probability of the incident or exposure occurring.

In a statement indicating risk level, both probability of occurrence and severity of outcome must be included. After determining the severity of expected damage or harm through a hazard analysis, estimating the probability of an incident or exposure occurring is the additional and necessary step in concluding a risk assessment.

These excerpts from the *Framework for Environmental Health Risk Management* issued by The Presidential/Congressional Commission on Risk Assessment and Risk Management are an indication of the widespread adoption of the foregoing definitions.

What Is "Risk"

Risk is defined as the probability that a substance or situation will produce harm under specified conditions. Risk is a combination of two factors:

- The *probability* that an adverse event will occur;
- The *consequences* of the adverse event.

Risk encompasses impacts on public health and on the environment, and arises from *exposure* and *hazard*. Risk does not exist if exposure to a harmful substance or situation does not or will not occur. Hazard is determined by whether a particular substance or situation has the potential to cause harmful effects.

MAKING A HAZARD ANALYSIS/RISK ASSESSMENT

For many hazards and the risks that derive from them, knowledge gained by safety professionals through education and experience will lead to proper conclusions on how to attain an acceptable risk level without bringing teams of people together for discussion. For the more complex situations, it is vital to seek the counsel of experienced personnel who are familiar with the work or process. Reaching group consensus is a highly desirable goal. Sometimes, for what a safety professional considers obvious, achieving consensus is still desirable so that buy-in is obtained for the actions to be taken. A general guide follows on how to make a hazard analysis and how to extend the process into a risk assessment.

This guide is applicable to every phase of the life cycle of facilities, equipment, processes, and materials (e.g., design, construction, operation, maintenance, and disposal).

Whatever the simplicity or complexity of the hazard/risk situation, and whatever analysis method is used, the following thought and action process is applicable.

A Hazard Analysis and Risk Assessment Guide.

1. Select a risk assessment matrix. A risk assessment matrix provides a method to categorize combinations of probability and severity, thus establishing risk levels. A matrix helps in communicating with decision makers and influencing their decisions on risks and the actions to be taken to ameliorate them. Also, risk assessment matrices can be used to compare and prioritize risks and to effectively allocate mitigation resources.

Definitions of the levels of probability and severity used in risk assessment matrices vary greatly. That reflects the differences in the perceptions people have of risk. Since a risk assessment matrix is a management decision tool, management personnel at appropriate levels must agree on the definitions of the terms to be used. In so doing, management establishes the levels of risk that require reduction and those that are acceptable.

Repeating for emphasis: Safety professionals must understand that definitions of terms for incident probability and severity and for risk levels vary greatly. Thus, they should tailor a risk assessment matrix to suit the hazards and risks and the management tolerance for risk with which they deal. Examples of definitions used for incident probability and severity are presented here as well as for risk categories and risk assessment matrices.