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MORT BASED RISK MANAGEMENT

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DISCLAIMER

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MORT BASED RISK MANAGEMENT*

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Risk Management is the optimization of safety programs. This requires a formal systems approach to hazards identification, risk quantification, and resource allocation/risk acceptance as opposed to case-by-case decisions. The Management Oversight and Risk Tree (MORT) has gained wide acceptance as a comprehensive formal systems approach covering all aspects of risk management. It (MORT) is a comprehensive analytical procedure that provides a disciplined method for determining the causes and contributing factors of major accidents. Alternatively, it serves as a tool to evaluate the quality of an existing safety system. While similar in many respects to fault tree analysis, MORT is more generalized and presents over 1500 specific elements of an ideal "universal" management program for optimizing occupational safety. The top two branches (Figure 1) are as follows:

1. Assumed Risks (Anticipated and Acceptable Losses)

   - Assumed risk is defined as residual risk quantified and accepted at the proper level of management at the current level of resource allocation

2. Oversights and Omissions (Losses Due to System Inadequacies)

   - Specific inadequacies and control factors
   - Inadequacies in management deterministic factors

The policy that all identified risks must be eliminated, or reduced as far as possible, can only lead to excessive costs. (If absolute safety is literally accepted as having priority, with no acceptance of risk, operation is not possible, for all activity involves some risk.) Safety must be balanced with cost, mission, and other programmatic considerations. MORT provides this

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The Basic Management Oversight and Risk Tree

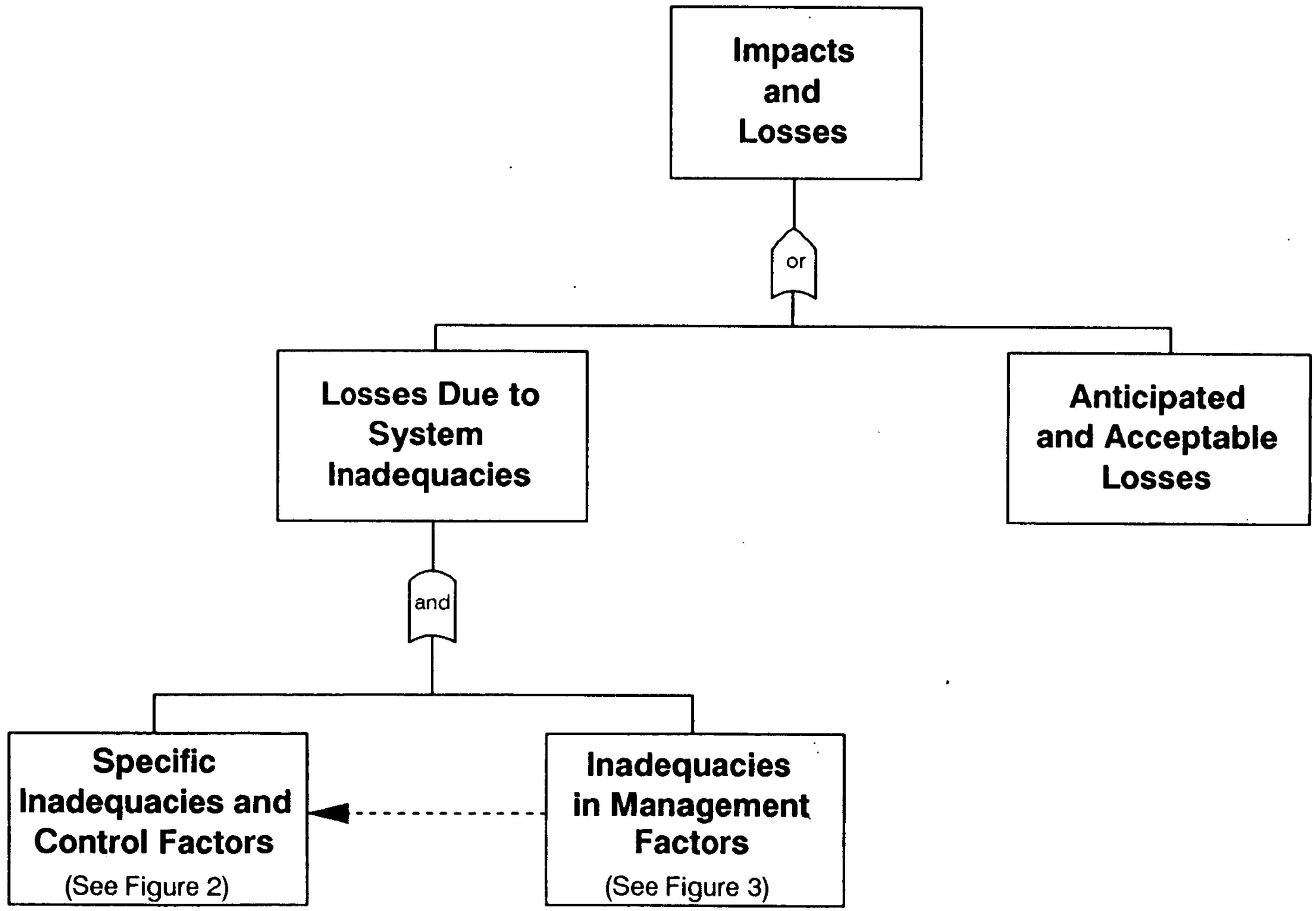

Figure 1

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balance with assumed risk being one of the top two branches of the tree. The other top element, Losses Due to System Inadequacies (Oversights and Omissions), has two branches - Specific Inadequacies and Control Factors and Inadequacies in Management Factors, which are further developed in Figures 2 and 3, respectively. Less-than-adequate specific controls will result in accidents. Examination of the lower tiers (not shown) will explain "what" happened and the immediate or surface cause. Examination of the Inadequacies in Management Factors will explain "why" the event occurred and the root cause of the accident; e.g., the management failure to assure adequate specific control factors. The three branches of the Inadequacies in Management Factors are: Inadequacies in Policy, Implementation of that Policy, and Risk Assessment. These inadequacies provide focus and direction for upgrading policy, design, and implementation. The three branches of the Risk Management Factor Branch (policy, implementation, and risk assessment) are discussed below.

POLICY

The MORT Users Manual[1] asks, "Is there a written, up-to-date policy with a broad enough scope to address the major problems likely to be encountered?" The typical safety policy statement includes words to the effect that safety is a major consideration, or that safety is given first consideration, or that the company will be a leader in safety. Few policy statements address the problems that are likely to be encountered such as:

1. Cost of Safety - Managerial risk includes the risk of failure to produce at an acceptable cost, as well as the risk of unacceptable accident costs. Specific guidelines for balancing the cost of accidents, the cost of safety, and the total cost of operations with other considerations will increase the optimization of safety programs.

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[1]R. W. Eicher, N. W. Knox, The MORT User's Manual, DOE 76-45/4, SSDC-4, Revision 2, May 1983.

The Nature of Specific Control Factor Inadequacies

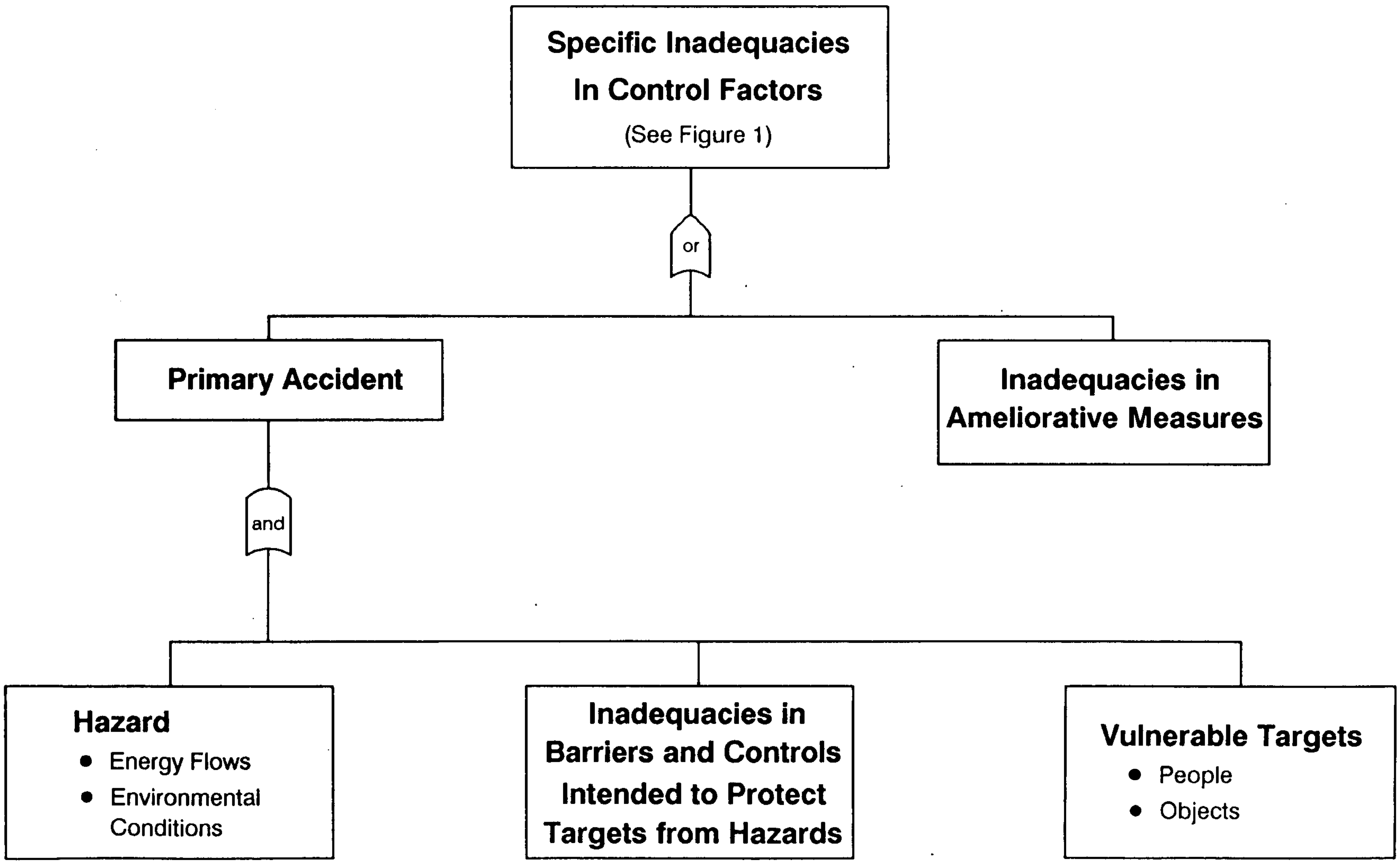

Figure 2

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The Nature of Management Deterministic Factor Inadequacies

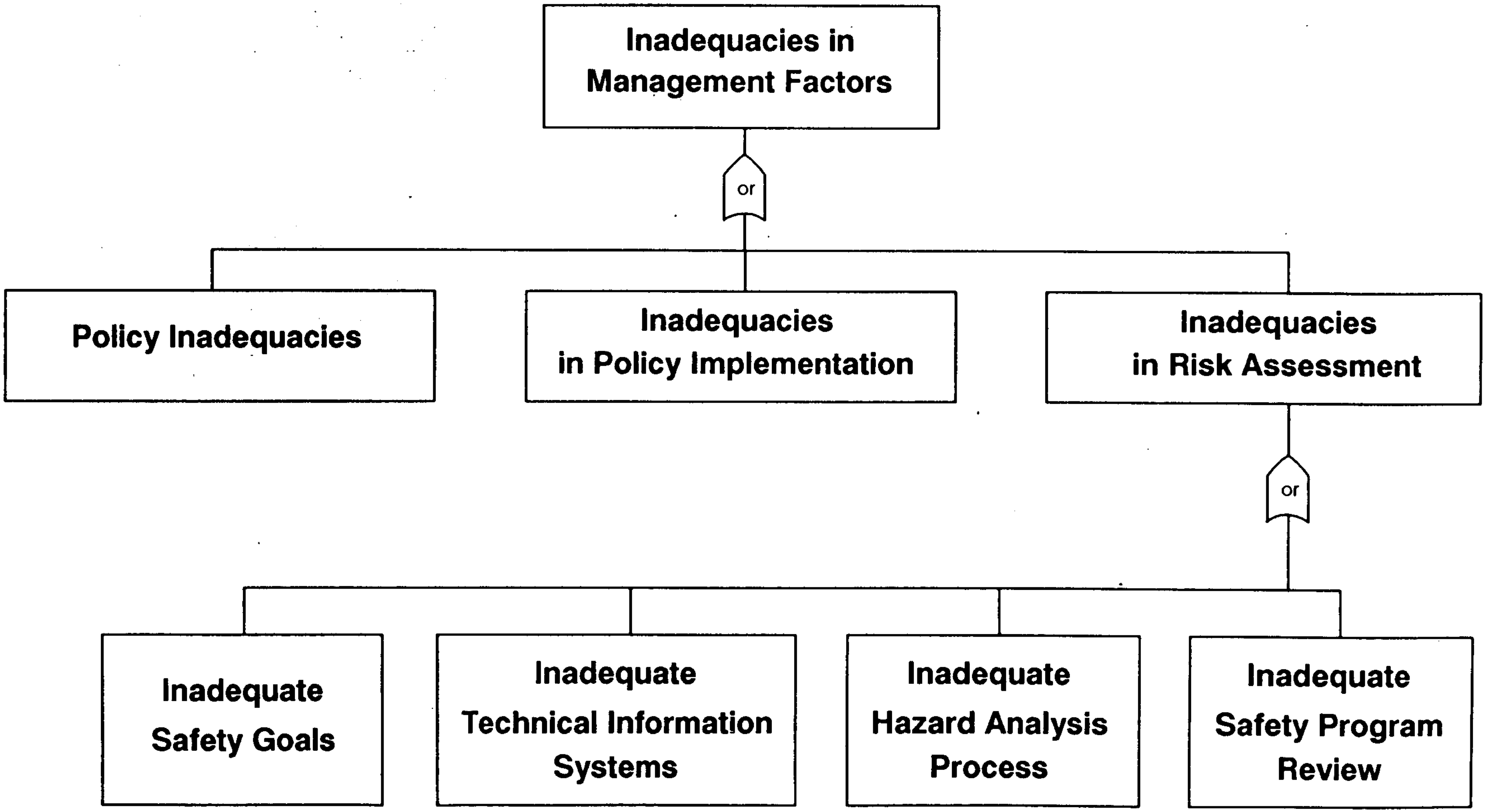

Figure 3

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2. Risk Equivalency - Environmental impairment, injury/loss of life, and property damage constitute different types of risk. To balance resources allocated to these different risks requires some type of equivalency. For example, what kinds of, and how much environmental impact, will generate the same degree of concern as a fatality?

3. Uncertainty - The terms "expected" and "risk" imply an uncertain future. Most probable value, worst case, range, and standard deviations are some terms used to describe uncertainty. Risk assessments and evaluations usually address this on an individual case basis with little policy direction. When should cost/benefit decisions consider worst case or most probable value. Policy should establish broad guidelines for uncertainty in risk decisions to ensure consistency.

4. Intangibles - Media attention, public perception and concern, etc. are important. Policy, with regard to how much additional funds will be spent to avoid these problems and how these funds will be used, needs to be addressed in specific policy statements. A policy that everything possible will be done to eliminate incidents that generate media attention may not be effective if the real purpose of the protester is to shut down the operation because no benefit is perceived, or it is perceived that the operation generates only risk; e.g., nuclear weapons.

5. Utility Theory - Is there a preference for a large number of small accidents over a single large accident with the same total cost? This is different than risk equivalency; it addresses severity-frequency within each type of risk (loss) and should be addressed in policy statements utilizing utility theory.

6. Time Value - To what extent should low probability losses be discounted using mean time to failure? Should current interest rates be used to discount future risk to present values using standard financial accounting methods? Failure to establish this policy could

result in an infinite cost being justified for a continuing risk, such as storage of hazardous waste.

7. Risk Acceptance/Responsibility - Since all activity involves some degree of risk, all employees from the worker to the top manager must assume or accept responsibility for risk appropriate to their function or task. SSDC-17,[2] Appendix A, "Applications of MORT to Review of Safety Analyses," lists different types of activities with suggested appropriate levels (individual worker, supervisor, safety professional, manager) of risk acceptance (approval). Thus, every employee assumes and is responsible for the risks inherent in those activities that he is authorized to perform. Safety review/approval is a formal risk acceptance function to assure that risks are accepted at the proper level within the company.

The above list is not intended to be all inclusive, nor is it suggested that each of these issues must be addressed explicitly in top level policy statements. However, these policy issues should be addressed at an appropriate organizational level if a consistent, balanced safety program is to be achieved. In addition, each employee at all levels should understand the policy as it relates to his/her functions and responsibilities. It is not satisfactory to have the individual employee feel that he/she is not authorized to accept any risk, nor is it satisfactory to have risk thought of as only the risk of nuclear incidents, environmental impairment, or some other unusual hazard. The workers and the public must be educated to understand that risk is the quantification of all hazards we face in daily life, including such events as automobile accidents and slips and falls.

POLICY IMPLEMENTATION

Implementation of a risk management program is fundamentally no different than implementation of any program. A plan must be developed, resources must

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[2]G. J. Briscoe et al., Applications of MORT to Review of Safety Analyses, DOE 76-45/17, SSDC-17, July 1979.

be allocated, and the responsibilities must be assigned. The major elements on the implementation branch of the MORT tree include:

1. Line/Staff Responsibility
2. Directives
3. Services
4. Budget/Resources
5. Vigor/Example/Accountability.

These requirements are the same whether implementing a risk management program or implementing specific preventive action and are a part of any effective management system and will not be discussed. However, very few actions proceed directly from the manager to the person who implements them. Generally, an action item will pass through a number of levels prior to implementation at the working level. As each person receives and retransmits the action item, feedback is necessary to assure that implementation reaches the working level where the risk is incurred.

RISK ASSESSMENT

Risk assessment is the process by which information that is necessary for effective risk management is generated. This branch of the tree is large and comprehensive with about 150 elements. Technical safety program review, inspection, monitoring, communication, technical information exchange, and hazard analysis, as well as statistics and risk projection analysis, are all a part of risk assessment. Identification and risk quantification of selected specific hazards are only a part of an adequate risk assessment program.

To balance the safety program and put specific hazard risks in perspective, a total risk picture is needed. The risk classification matrix, Figure 4, provides a convenient format for compiling a total risk picture. Each agent or energy source is matched against each type of consequence or loss and thus provides a checklist of all possible risks that, if used, will prevent oversight. The Risk Management Guide[3] provides specific instruction on how to compile this risk summary. It includes the following steps:

1. Compile the available actuarial data for each cell in the table, and using integral calculus, sum the risk over the entire frequency-severity range, extrapolating the data on probability paper, as feasible, to include the large consequence-low frequency events that have not occurred. [The Computerized Accident Incident Reporting System (CAIRS)[4] is a DOE risk-based information system that categorizes and calculates costs of accidents consistent with the risk classification matrix in Figure 4 and can be used to rapidly compile the actuarial data.)]

2. Do a Preliminary Hazard Analysis (PHA) for all applicable cells in the operation. This will serve to validate the actuarial data and identify hazards in those cells where no reportable events have occurred. This requires a thorough knowledge of operations, and it may be useful to break the operation into smaller pieces, using functional flow block diagrams and/or other hazard identification tools.

3. Examine each of the significant consequences and subjectively estimate the likelihood of occurrence to get a preliminary risk estimate.

4. Perform Probabilistic Risk Assessments (PRAs) on significant hazards based on the preliminary estimates. Add the PRA results to the appropriate cell under "potential loss." Note that the frequency-severity characteristics of the actuarial data can provide insights into the reasonableness of the PRA results.

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[3]G. J. Briscoe, Risk Management Guide, DOE 76-45/11, SSDC-11, Revision 1, September 1982.

[4]A DOE-wide ES&H Information Management System, SPMS, DOE/EH-0105, November 1989.

The Risk Classification Matrix

Agency		Injury Actual	Injury Potential	Illness Actual	Illness Potential	Property Actual	Property Potential	Exposure Actual	Exposure Potential	Program Actual	Program Potential	Environment Actual	Environment Potential	Other Actual	Other Potential
Fire	A1 - Building														
	A2 - Brush														
	A3 - Vehicle														
	A4 - Other														
Explosion	B1 - Vapor														
	B2 - Chemical														
	B3 - Fluids														
	B4 - High Explosives														
	B5 - Dust														
Acts of Nature	C1 - Wind														
	C2 - Rain/Hail														
	C3 - Flood														
	C4 - Freezing														
	C5 - Lightning														
	C6 - Earthquake														
	C7 - Earth Movement														
	C8 - Other														
	D0 - Electrical														
	E0 - Transportation (Cargo)														
Mechanical	F1 - Linear Energy														
	F2 - Rotational Energy														
	F3 - Pressure														
	F4 - Falls (M/G/H)														
	F5 - Crane														
	F6 - Forklift														
	F7 - Strain/Sprain/Cut/Break														
Nuclear	G1 - Nuclear Radiation (Exposure)														
	G2 - Nuclear Radiation (Reactor/Criticality)														
Misc.	H1 - Thermal														
	H2 - Toxic/Pathological														
	H3 - Corrosion														
	H4 - Water Damage														
	H5 - All Other														
Vehicles	AF (Air-Fixed Wing)														
	AR (Air-Rotary Wing)														
	BU (Bus)														
	GC (Government Car)														
	MH (Material Handling)														
	MR (Marine)														
	PC (Private Car)														
	RR (Railroad)														
	TK (Truck)														

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Figure 4

5. Combine the actuarial (actual loss) and the PRA results (projected losses) to obtain the total estimated risk.

The specific analytical tools used in the PHA and the PRA are outside the scope of this discussion, but selection and application of these tools should be scaled appropriately to the degree of risk. Since the risk may be unknown to begin with, this is an iterative process. The information in the total risk picture can be used in management decisions related to allocation of resources to specific safety disciplines. The PRA information that is related to risks of specific activities provides input to the justification of risk acceptance and risk mitigation decisions. The perspective provided by the risk summary helps assure more balance in these acceptance/mitigation decisions related to specific hazards. Both types of information (the actuarial and the PRA) are needed in any systematic process for balancing risk with cost, mission, and other programmatic and safety considerations.