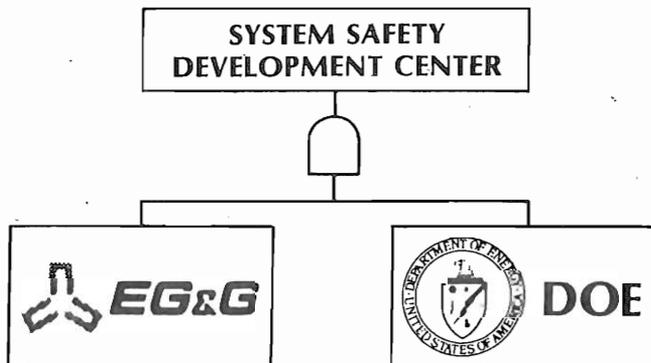


# MANAGEMENT FACTORS IN ACCIDENT AND INCIDENT PREVENTION (INCLUDING MANAGEMENT SELF- EVALUATION CHECKSHEETS)



**EG&G Idaho, Inc.**

P.O. Box 1625  
Idaho Falls, Idaho 83401

August 1978

UNITED STATES  
DEPARTMENT OF ENERGY  
DIVISION OF OPERATIONAL AND ENVIRONMENTAL SAFETY

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## ABSTRACT

This document is designed to provide a means for accident/incident prevention by familiarizing managers with management-related accident/incident causal factors which have been revealed in Department of Energy (DOE) supported accident investigation research.

It also helps to prepare managers for the DOE investigative process by making the manager aware of those factors which will be investigated in a formal DOE accident investigation.

Checklists are provided to assist the manager in determining his and his organization's "state of readiness" relating to accident prevention.

## GLOSSARY

Line Management: Those management positions whose responsibility is the accomplishment of the organization's primary mission(s), as distinguished from staff organization which supports the organization's primary mission(s).

Management or General Management: All personnel above the level of job and task supervisors serving in a command role within the organizational structure.

Mid-management: The management levels existing between top management and job-task supervisory levels.

Project Manager: The manager responsible for a specific project assignment, as distinguished from a line manager responsible for a general functional area.

Safety (Hazard) Analysis: The entire complex of safety (hazard) analysis methods and techniques ranging from relatively informal job and task safety analyses to large complex safety analysis studies and reports.

Staff Organization: The portion of the total organization which assists the line organization in performance of accomplishment of the organization's primary mission. This includes both individuals (e.g., staff assistants, coordinators, specialists) and entire organizational elements (e.g., safety, quality, reliability, legal groups).

Subordinate Management: For purposes of this document, all management subordinate to the particular management level under consideration.

Top Management: The individual manager or group of managers serving in a policy-making capacity for the total organization. These individuals may be, and usually are, also involved in policy implementation.

Trained Investigators: Those individuals who have satisfactorily completed the prescribed Department of Energy training in accident/incident investigation and have maintained their certification as trained investigators through appropriate participation in refresher courses.

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## I. INTRODUCTION

Serious accidents and incidents occurring within the Department of Energy (DOE) will be investigated by committees including DOE trained investigators. A part of the investigation includes evaluation of management systems as they relate to the accident[1,2,3].

The purpose of this guide is to outline, for general management, those management factors which have been found to be of importance in accident prevention. These factors will, of course, will be studied by investigating teams. The management factors have been selected, through a ten-year, world-wide consensus process, as those which individually and collectively may represent accident/incident causal factors. It is the task of the investigating board or committee to determine which of these factors are, indeed, involved in a given accident or incident.

Objectives of the guide are twofold:

- (1) To provide a means for accident/incident prevention by familiarizing managers with the management-related accident/incident causal factors which have been revealed in accident investigation research.
- (2) To help prepare line and project managers for the investigative process by making them aware of the factors which will be investigated.

The text is written in the context of those things which a DOE trained investigator will examine [objective (2), above]. The intent of the guide, as is the intent of accident investigation itself, is to prevent accidents. We have chosen this style because there are many policy considerations relating to "adequacy" which will vary from project to project and from organization to organization. Adequacy of the factors described must, therefore, be evaluated by each individual manager in terms of his individual management control systems and appropriate internal and governmental constraint systems.

Checklists are included to permit self-evaluation (in the absence of an accident or incident) by line and project management, i.e., to determine their and their organization's "state of readiness" for accident prevention and for accident investigation. Considerations included in this guide relate to general systems management. Those things relating directly to the specifics of individual accidents and incidents are outlined and are related to these management factors in the MORT User's Manual[3].

It is hoped that the large number of considerations discussed here will not overwhelm the manager, whose primary assignment is to complete specific tasks and jobs of work. The unfortunate fact of the matter is that most, if not all, accidents occur as a result of compounding inadequacies in a number of the managerial areas indicated in this document. This is real-life and all the factors must be considered if accidents are to be prevented.

Finally, each manager must consider these factors from his own position in the overall management system. If inadequacies are discovered through use of the checklists provided, they must be separated for appropriate corrective action.

- (1) Those things that the individual manager can fix himself.
- (2) Those things which may be fixed through transverse referral (for example, to the safety, quality assurance, legal, industrial relations organizations).
- (3) Those things which must be referred upward in the organization (staffing, budget, policy, etc.).

In the absence of corrective action, the MORT safety system indicates that risks resulting from system inadequacies be referred to proper management levels for risk acceptance.

It should be noted that the management factors discussed in this monograph are not specific to safety-related problems. They represent potential causal factors for ineffective performance of any kind. It is therefore not unusual for an accident/incident investigation team to find that the accident/incident causal factors had also compromised performance in other cost-schedule-product quality areas.

## II. THE LINE MANAGER'S ROLE IN SETTING AND IMPLEMENTING POLICY

### 1. ORGANIZATIONAL SAFETY POLICY

#### 1.1 Top Management

Effectiveness of top management in stating basic organizational safety policy will be evaluated. This would ordinarily be expected to clearly express in writing such policy elements as:

- (1) Provide, for every employee, a place of employment that is free from recognized hazards that are likely to cause death, serious physical harm, or illness.
- (2) Conduct its operations safely and instruct and encourage its employees to work in such a manner that no one is exposed to significant risk of injury or illness.
- (3) Develop, operate, and maintain its facilities and the customer's facilities and installations for which it is contractually responsible, in such a manner that the health and safety of the public is protected, accidental damage to Government or private property is minimized, effects upon the environment are controlled, and effective community relations are maintained with respect to health and safety matters.
- (4) Adhere to generally recognized and accepted high standards of performance in the areas of occupational health and nuclear, radiological, industrial, and fire safety.

The degree to which the basic policy is backed up by safety manuals and other material which provides official policy interpretations and details will also be considered.

#### 1.2 Subordinate Management

Effectiveness of line managers and supervisors will be considered in four basic areas:

- (1) Knowing the policy and what is in the safety manuals.
- (2) Applying the policy and safety manual material to work done under their management and supervision. This means, among other things, putting the policy in terms that all of their people can understand and apply to everyday work.

- (3) Checking out and validating their interpretations of the policy and manual with their superiors.
- (4) Checking out and validating their employees' understanding of the policy.

## 2. IMPLEMENTATION OF ORGANIZATIONAL SAFETY POLICY

### 2.1 Methods, Criteria, and Analysis

Management effectiveness in implementing the organizational safety policy will be considered. This means things like:

- (1) Defining what is good and bad (desired) safety performance in their groups.
- (2) Setting up and communicating rules and definitions indicating what risks can be accepted by their people and which risks should be referred up to higher authority.
- (3) Setting up safety monitoring systems and analyzing safety performance data in their groups or organizations.
- (4) Setting up work methods and plans that are in compliance with the organizational safety policy.
- (5) Performing necessary safety analyses for work under their direction.

### 2.2 Line Responsibilities

Effectiveness in delegating responsibilities in a way that makes the organization's safety policy happen will be investigated. This means tracking application of the policy down the organization chart to individual workers. Investigation will include safety-related consideration of such things as the group's job descriptions, performance appraisals, directives and procedures, and training programs, as these elements relate to implementation of the organization's safety policy.

### 2.3 Staff Responsibilities

This includes consideration of effectiveness in:

- (1) Setting up the necessary staff functions and responsibilities in line and project organizations to comply with the organizations' safety policy.
- (2) Setting up necessary liaison and interfaces with any other staff groups and people (Safety, Legal, Quality Assurance, Industrial Relations, etc.).

## 2.4 Information Flow

Flow of safety information will be considered. This includes:

- (1) Flow of safety-related information from the work areas up to higher management and supervision (hazards and risks). This should be a system which actually encourages employee participation in notifying management of hazards, near-misses, etc., without fear of recrimination or reprisal.
- (2) Flow of safety information down organizational lines to work areas. This includes general safety program information and technical information on safety of materials, hardware, and processes.
- (3) Lateral flow of safety information to and from other organizations and groups. In addition to safety information on how to do work safely, this includes compliance with formal safety reporting requirements, involvement of safety support groups, and reporting matters of safety significance which are not covered by specific requirements.

The degree to which information is reduced to a form which permits establishment of effective management control loops will be considered.

## 2.5 Directives

Existence of proper directive material to make the organization's safety policy work will be considered. This includes:

- (1) Rules and regulations
- (2) Standard practices
- (3) Manuals
- (4) Operating limits and restrictions
- (5) Other directives.

Criteria in judging the quality of directive material will include style, establishment of guidelines and standards, clarity, conciseness, completeness, use of schematics, establishment of responsibilities and authorities, etc.

## 2.6 Management Services

Availability of proper services to help employees work in accordance with the organization's safety policy will be investigated. This includes:

- (1) Research and fact-finding services .
- (2) Information exchange services (inside and outside the organization)
- (3) Standards and directives preparation services
- (4) Training services
- (5) Technical assistance services
- (6) Any necessary program aids
- (7) Performance measurement services
- (8) Guidelines and consultive services which will lead to proper assignments of resources (money, people, hardware, etc.)
- (9) Proper acknowledgment and action for hazards and risks reported by subordinates.

## 2.7 Budgets

Existence of adequate funding to keep work in compliance with the organization's safety policy will be considered. This includes the whole life cycle of each job from conception to termination (cleanup, disposal, decommissioning). In cases when there are budget insufficiencies, the degree to which impact statements that highlight the risks and inadequacies have been prepared and referred to proper management levels will be investigated. This factor is closely related to 2.6 (8), above.

## 2.8 Delays

Delays in carrying out safety-related work and improvements will be investigated. The effectiveness in evaluating the consequences of delayed safety improvements and for referring the delays to proper management levels for risk acceptance if violations of safety policy are involved will be considered.

## 2.9 Accountability

The degree to which employees are held accountable for compliance with the organization's safety policy will be investigated. This includes both safe performance of the work they are doing and the safety of the products they are producing. This includes consideration of safety policy compliance in:

- (1) Personnel performance evaluation
- (2) Review and evaluation of work products
- (3) Review and evaluation of actual work in progress
- (4) Personnel counseling and guidance programs.

## 2.10 Vigor and Example

The degree to which managers and their staff provide outstanding and highly visible examples to their people in support of the organization's safety policy will be investigated. This includes personal participation in such activities as:

- (1) Safety meetings
- (2) Safety inspections and unannounced worksite visits
- (3) Safety problem diagnosis and solution
- (4) Accident/incident follow-up
- (5) Safety training programs
- (6) Personal use of protective equipment
- (7) Support of employee participation programs
- (8) Similar safety-related functions and activities.

## 3. DOE RELATIONSHIPS

### 3.1 DOE Safety Documentation

An important aspect of investigation involves determination if activities were being conducted in accordance with the DOE contract safety clause and with other DOE requirements. This is much more complicated than it appears. The basic requirements in the DOE management directives lead on to a requirement for compliance with hundreds of specific codes, standards, and regulations. Many of these are written in a complex form and have interpretations that are not always obvious.

This leads to an evaluation of a second managerial responsibility. The degree to which line managers utilized help of the Safety organization to assist them in determining which codes and standards apply to the work they were doing and to assist them in interpreting the codes and standards will be evaluated.

### 3.2 Safety Data and Information

Participation of managers in providing safety data and information required by DOE and for complying with DOE reporting requirements will be evaluated. Both adequacy and timeliness will be considered.

### 3.3 Appraisal and Investigating Activities

Previous participation in DOE appraisal and investigating activities (in accordance with organizational rules relating to this subject) will be considered. This will include cooperation with the actual appraisal-investigation efforts as well as follow-up activities.

### 3.4 Safety-Related Deficiencies

Safety-related deficiencies that have been detected by previous DOE appraisals, audits, and investigations will be considered.

### 3.5 Corrective Actions

The degree to which the organization has corrected prior safety-related deficiencies detected by DOE will be considered.

Checklist for Part II

The Line Manager's Safety Role in Setting and Implementing Policy

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
1. Have I described the methods by which the safety policy shall be implemented in my group or organization?		
2. Have I described the criteria for adequate safety performance? (How good is "good", how bad is "bad" performance?)		
3. Have I instituted the necessary analysis to know how my group is doing and should be doing in safety performance?		
4. Have my safety responsibilities been adequately described to me by my boss?		
5. Have I told the people who work for me what their safety responsibilities are?		
6. Are the necessary staff personnel to implement the safety policy available in my organization and are they properly instructed in how to handle safety-related staff work, e.g., safety approval of requisitions, obtaining safety review, safety coordination, etc.?		
7. Is liaison properly established with other staff people and groups to handle safety-related problems, e.g., Q/A, Safety, Personnel, Legal, etc.?		

Checklist for Part II (cont.)

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
8. Does sufficient safety-related information flow up to me from the people who work for me? Do I really know the field safety problems?		
9. Do I flow sufficient safety-related information down to people who work for me? Is this information in a form they can understand and use?		
10. Am I getting enough safety-related information from sources outside of my organization or group? In company sources? Outside the company?		
11. Am I transmitting sufficient safety-related information to interested or involved personnel outside my own organization or group?		
12. Have I generated enough safety directive material to implement the safety policy within my organization or group?		
13. Are proper management services provided to permit my people to comply with the company safety policy?		
a. Research and Fact-finding which THEY need?		
b. Information Exchange which THEY need?		
c. Standards and Directives which THEY need?		
d. Training which THEY need?		

Checklist for Part II (cont.)

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>e. Technical Assistance which THEY need?</p> <p>f. Program Aids which THEY need?</p> <p>g. Performance Measurement and Feedback which THEY need?</p> <p>h. Hardware which THEY need?</p> <p>14. Are my resources devoted to safety deployed properly (big hazards-big resources; minor hazards-small resources)?</p> <p>15. Do I respond properly and promptly to risks and hazards referred up to me by my subordinates (direct correction <u>or</u> accept the risk personally <u>or</u> refer the risk up to my boss as appropriate)?</p> <p>16. Do I request adequate budgeting for safety for the entire life cycle of a job or project? Do I file impact reports if I don't get it?</p> <p>17. Do I make regular inspections of the facilities for which I am responsible?</p> <p>18. Do I participate in the training and qualification of my subordinates?</p> <p>19. Do I try to fix safety problems promptly? Do I indicate the risks of delay to my boss if prompt correction is not possible?</p>		

Checklist of Part II (cont.)

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>20. Have I related my safety program implementation properly to company insurance carriers, workmen's compensation programs, and other accident protective considerations?</p> <p>21. Do I provide a good and visible example for my people in support of the company safety policy?</p> <p>22. Do I hold myself and my subordinates accountable for the safety policy implementation and for all the areas indicated in this checksheet?</p>		

### III. THE LINE MANAGER'S ROLE IN SAFETY GOAL SETTING, ESTABLISHMENT OF SAFETY CONCEPTS AND REQUIREMENTS, AND TECHNICAL INFORMATION FLOW

#### 1. GENERAL SAFETY GOALS AND OBJECTIVES

##### 1.1 Top Management

The effectiveness of top management in setting organizational safety goals and objectives will be considered.

##### 1.2 Line and Project Managers

The effectiveness of line and project managers setting their own group's safety goals and objectives will be evaluated. Correlation of individual group's goals and objectives with those of the organization and the the organization's safety policy will be considered.

#### 2. ESTABLISHMENT OF SAFETY CONCEPTS AND REQUIREMENTS

The degree to which proper hazard analyses were performed will be considered. This evaluation will be in the context of forming a basis for hazard and risk acceptance by the proper management levels within the organization.

##### 2.1 Safety Goals and Tolerable Risks

The degree to which safety goals and tolerable risks were defined will be investigated. In particular, the understanding of involved employees as to the risks they were allowed to take and what risks should have been referred to higher management for acceptance will be considered. Groundrules for making safety-time-schedule trade-off decisions will be investigated.

##### 2.2 Safety Analysis Criteria

Rules and criteria to assure that proper hazard and safety analyses be performed will be investigated. This includes:

- (1) Assignment of responsibilities for performance of adequate hazard and safety analyses.
- (2) Setting up change controls to be sure that hazard analyses are still valid if people, hardware, or procedures are changed.

- (3) Seeing that proper analytical methods are used in performing hazard and safety analyses.
- (4) Setting up rules that result in proper scaling (i.e., a big hazard analysis effort for the more dangerous jobs and a lesser effort for the less dangerous work).
- (5) Seeing that safety was built into the work on the following priority sequence:
  - (a) FIRST - Insistence on safe designs with built-in safety. This should include human error reduction considerations and human engineering principles.
  - (b) THEN - Addition of safety devices like guards, barriers, etc.
  - (c) THEN - Provision of warnings in the form of labels, signs, alarms, "flagged" procedural steps, etc.
  - (d) THEN-AND-ONLY THEN - Providing procedures to reduce the remaining risks and hazards.
- (6) Advising proper levels of management of the remaining risks and hazards:
  - (a) If procedures are followed.
  - (b) In the event of procedural deviations.

### 2.3 Procedures Criteria

Adequacy of rules relating to written procedures and ways to create them will be considered. Relationship of these procedural rules to the amount and kind of training and direct supervisory attention which are provided for the workers will be considered.

Particular attention will be directed to investigation of the following definitions:

- (1) When formal procedural material is required.
- (2) Specifications on the way that the procedures should be written (format, content, approval cycles, review criteria, etc.).
- (3) Availability of the procedural material to personnel.

## 2.4 Safety Requirements

Adequacy of controls to assure that work is conducted in accordance with applicable codes, standards, and regulations (CS&R) will be evaluated. There are literally thousands of these which include:

- (1) DOE-prescribed CS&R
- (2) OSHA-prescribed CS&R
- (3) Other federal and national CS&R
- (4) State and local CS&R
- (5) Company standards.

This will include enforcement and consistency of application of rules (group to group and time to time).

## 2.5 Information Searches

The degree to which appropriate information searches were performed to search out and use previous safety-related experience will be considered. This will include:

- (1) The materials being worked with
- (2) The hardware involved
- (3) The processes involved.

## 2.6 Life Cycle Safety Studies

The degree to which complete "life cycle" safety studies are conducted for the work will be investigated as appropriate. This includes analyzing the whole operation from a "gleam in the eye" through operation to eventual decommissioning and disposal. The degree to which attention was given to the safety of temporary activities, like installation, modification, pre-operational testing, etc., will be evaluated as appropriate.

## 3. TECHNICAL INFORMATION SYSTEMS (SAFETY-RELATED)

The flow of technical information down to the people doing the work, up to the involved managers, and to others with a "need to know" will be evaluated. This includes both information on the local system and relevant information from outside the organization or group.

### 3.1 Availability of Technical Information

The degree to which proper technical information was made available to those who needed it will be evaluated. This includes:

- (1) Proper files, liaison with technical support personnel, contacts with experts inside and outside the organization, etc.
- (2) Communication of needed information to and from the people who were doing the work.

### 3.2 Safety Monitoring Systems

The degree to which safety monitoring systems were established and maintained and whether the work being done was included in existing monitoring plans will be considered. This includes:

- (1) Establishment and use of supervisory observation plans.
- (2) Establishment and use of safety "searchout" functions.
- (3) Assuring adequate reporting, investigation, and documentation of accidents and incidents.
- (4) Conducting reported significant observation (RSO) studies and using the information obtained from the studies.
- (5) Establishing and using error sampling systems.
- (6) Conducting planned safety inspections.
- (7) Auditing the processes that provide the personnel, procedures, and hardware that were in use at the work locations.
- (8) Establishing and using general health monitoring programs.

### 3.3 Safety Data Systems

Existence and adequacy of safety data collection and analysis systems will be considered. This includes special systems for the group's own use and the organization's and DOE-wide systems. This subject is discussed in more detail in SSDC-9, Safety Information System Guide<sup>[4]</sup>, and SSDC-10, Safety Information System Cataloging<sup>[5]</sup>. Key factors from the line manager's point of view include:

- (1) The degree to which priority safety problems were defined and communicated to the central safety organization priority problem lists will be evaluated.
- (2) Participation in collection of appropriate safety performance statistics will be investigated.
- (3) The degree to which involved managers utilized statistical data and accident reports in order to understand the safety problems and correct them will be considered.
- (4) Existence and use of risk projection methods will be considered. This involves use of "insurance company" type studies to determine whether activities were "high premium" or "low premium" in terms of risks involved, maximum probable losses, special high risk activities, etc.
- (5) Involvement in the setting up of safety-related displays (e.g., signs, bulletin boards), establishing safety control centers, circulating safety reports, and other methods of communicating safety performance data will be considered.

#### 3.4 Safety Analysis and Fix Controls

Establishment of systems to perform appropriate safety analyses and for safety "fix controls" will be considered.

- (1) Performance of proper safety analyses will be considered. This ranges from large, formal safety analyses for large, "higher risk" projects down to safe work permits and job safety analyses for small jobs of work. Consideration will also be given to communication of safety control material developed in the safety analyses to the people who were doing the work (e.g., allowable pressures and temperatures, special hazards, etc.).
- (2) Performance of "fixes" for safety-related problems within the organization will be considered. This includes effectiveness in fixing "things" that have gone wrong and fixing the system so that similar things would not go wrong in the future.
- (3) Development and use of safety priority problem lists (PPLs) developed by the involved group, by the Safety organization, and by DOE in establishing work priorities will be considered. Handling of deviations from PPLs and other safety commitments and priorities will be considered.

- (4) Controls on safety-related changes in work will be considered. This includes both:
  - (a) Planned changes
  - (b) Unplanned changes.
- (5) Effectiveness in obtaining and making use of new safety information relating to materials, hardware, and processes used in the operation will be investigated.

### 3.5 Independent Audit and Appraisal

The degree to which the involved group was covered by the organization's inspection, audit, appraisal, and review activities will be considered. This particularly applies to the independent audits, inspections, appraisals, and reviews conducted by Safety and Quality Assurance organizations. Effectiveness in performing the necessary follow-up and fix actions recommended by these activities will also be investigated.

Checklist for Part III

The Line Manager's Role in Goal Setting, Establishment of Safety Concepts and Requirements, and Technical Information Flow

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>1. Have I established group safety goals and objectives to back up company safety policy and company safety goals and objectives?</p> <p>2. Have I provided adequate guidance to my people in determining:</p> <ul style="list-style-type: none"> <li>a. Acceptable risks?</li> <li>b. Risks that they can accept on their own?</li> <li>c. Required approvals for accepting risks?</li> </ul> <p>3. Have I established rules regarding safety analysis? Safety Analysis Reports? Job Safety Analysis? Safe Work Permits?</p> <p>4. Have I established rules regarding procedures and methods to create them? When required? What kind? Content? Sign-off? Required approvals?</p> <p>5. Have I established rules relating to compliance with Codes, Standards, and Regulations?</p> <p>6. Do I require a safety information search when new materials, hardware, processes (or changes in processes) are used?</p> <p>7. Do I require full life cycle safety analysis for work - from concept to closeout, decommission, and disposal? Do I require preliminary hazard analyses for planning purposes?</p>		

Checklist for Part III (cont.)

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>8. Have I established availability of technical information systems so that I know what risks and hazards exist in work being done in my group or organization?</p> <p>a. Do my people have the technical information to do their work safely?</p> <p>b. Do my managers know what risks and hazards are involved in work that my group is doing?</p> <p>9. Have I established work monitoring systems so that I <u>really</u> know what my people are doing and what their safety problems are?</p> <p>10. Is the proper technical information for work being done in my group being collected and analyzed?</p> <p>11. When problems arise, do troubleshooting and analysis lead to:</p> <p>a. Fixing what went wrong?</p> <p>b. Fixing defects in the system that allowed things to go wrong?</p> <p>12. Is work done in my group or organization properly tied into the company's independent audit and appraisal systems (especially Q/A and Safety Review)?</p>		

#### IV. THE LINE MANAGER'S ROLE IN DESIGN, DEVELOPMENT, AND PLANNING

Safety considerations in design, development work, and planning activities will be investigated.

- (1) The degree to which safe energy control procedures were established so that unwanted transfers of energy would not result in excessive injury, property damage, or environmental damage will be investigated. This ranges from complex energy control schemes in large engineered systems down to seeing that people don't strain their backs or strike themselves with tools. This includes the following examples:
  - (a) Was substitution of safer materials and energy types considered (e.g., substitution of a non-toxic solvent for a toxic one, substitution of a hydraulic test for a pneumatic one)?
  - (b) Was available energy limited to that necessary to do the job (e.g., was 1000 psi used if 100 psi would have done the job, was 440 V used if 110 V would have worked?)?
  - (c) Were necessary automatic safety controls provided?
  - (d) Were appropriate warnings provided in the proper places?
  - (e) Were well-designed manual controls provided?
  - (f) Were provisions made for safe energy release (including such things as relief devices and proper isolation and diversion of released materials)?
  - (g) Were proper barriers and controls utilized to protect personnel, property, and the environment?
- (2) The degree to which human factors reviews and evaluations were performed to evaluate human error factors and to hold risks due to human error down to acceptable levels will be examined. This ranges from operability and maintainability of major equipment down to keeping "knuckle buster" type tools out of jobs.

- (3) The degree to which equipment was adequately maintained (both preventive maintenance and "call" maintenance) will be investigated. If equipment could not be maintained in a safe condition, the degree to which appropriate actions were taken (e.g., suspending operations, replacement, obtaining approvals for temporary operation, etc.) will be considered.
- (4) Adequacy of inspection for involved work and equipment will be evaluated. This includes:
  - (a) "Release" and "completion" inspections for work involved in the incident.
  - (b) "Receiving" and "acceptance" inspection for work that was accepted from outside the operation involved in the accident or incident.
  - (c) Independent inspection by groups like Quality and Safety Divisions (if appropriate).
- (5) The degree to which overall work arrangements gave adequate attention to safety and health will be examined.
- (6) Maintenance of proper work environments and provision of protective equipment, as required, will be evaluated.
- (7) Provision and maintenance of proper operational specifications for the work being conducted will be considered. This includes:
  - (a) Providing adequate equipment testing and qualification programs.
  - (b) Providing properly trained and instructed supervisors.
  - (c) Providing adequate task procedures.
  - (d) Setting up appropriate personnel selection systems.
  - (e) Providing appropriate personnel training and qualification programs.
  - (f) Motivating personnel to do good work.
  - (g) Establishing performance observation and work monitoring programs.

- (8) Emergency plans and provisions for coordination of local plans with overall organizational and DOE plans will be evaluated.
- (9) Disposal plans for harmful wastes, residues, and effluents will be considered as appropriate. This includes both operational phases and final disposal at the end of the job or project.
- (10) Use of independent safety and quality reviews as required will be evaluated.
- (11) Adequacy of configuration and work control plans and procedures will be studied.
- (12) Maintenance of adequate logs, drawings, specifications, work histories, etc., will be evaluated.
- (13) Establishment of adequate controls to ensure fast, well-controlled reaction to hazardous conditions that emerged in the course of doing work will be considered as appropriate.
- (14) The following additional factors will be considered as appropriate:
  - (a) Code, standard, and regulation compliance.
  - (b) Obtaining adequate engineering and scientific backup studies.
  - (c) Parts standardization and identification.
  - (d) Design documentation.
  - (e) Setting up acceptance specifications.
  - (f) Testing and inspection to see that specifications were met or that deviations were evaluated. This includes protection of equipment from point (time) of inspection to point (time) of use as well as both component and system testing.
  - (g) Proper review and evaluation of changes in work plans, mechanical designs, personnel assignments, and procedures.

Checklist for Part IV

The Line Manager's Role in Design and Development

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>1. In systems under my control, do I insist that:</p> <ul style="list-style-type: none"> <li>a. Consideration be given to use of the safest energy <u>type</u> for a job?</li> <li>b. Energy sources used be limited to that <u>necessary</u> for the job?</li> <li>c. Automatic safety controls be provided if necessary?</li> <li>d. Warnings be posted and included in procedural materials?</li> <li>e. Proper manual controls be provided?</li> <li>f. Safe energy release methods be established before starting a job?</li> <li>g. Appropriate barriers be in place to protect personnel, property, and the environment from energy release?</li> </ul> <p>2. Do I set specifications on the operability and maintainability of equipment? Is human factors review provided to assure operability, maintainability, and required reliability?</p> <p>3. Do I require maintenance programs consistent with system functional requirements?</p> <p>4. Do I require adequate system inspection?</p> <p>5. Do I insist on safe work arrangements of hardware and personnel?</p>		

Checklist for Part IV (cont.)

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>6. Do I provide for consideration of the work environment (temperature, humidity, noise level, etc.)?</p> <p>7. Do I provide adequate operational specifications?</p> <p>a. Equipment testing and qualification programs?</p> <p>b. Supervisory training and qualification?</p> <p>c. Test procedures?</p> <p>d. Personnel specifications and selection?</p> <p>e. Personnel training and qualification?</p> <p>8. Do I specify system monitoring points and establish monitoring programs?</p> <p>9. Do I provide emergency plans and provisions?</p> <p>10. Do I establish disposal plans for:</p> <p>a. Operational residue and effluents?</p> <p>b. Final disposition of materials and hardware?</p> <p>11. Do I provide for independent quality and safety review?</p> <p>a. Initial?</p> <p>b. Periodic?</p> <p>c. Changes?</p> <p>12. Do I establish appropriate configuration control plans and procedures?</p>		

Checklist for Part IV (cont.)

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>13. Do I provide for documentation and records?</p> <ul style="list-style-type: none"> <li>a. Operational?</li> <li>b. Descriptive?</li> </ul> <p>14. Do I establish fast corrective action plans to respond to imminent hazards?</p> <p>15. Do I provide adequate characteristics for general design and planning processes?</p> <ul style="list-style-type: none"> <li>a. Code compliance?</li> <li>b. Engineering studies?</li> <li>c. Parts standardization and identification?</li> <li>d. Design documentation?</li> <li>e. Acceptance criteria?</li> <li>f. Testing-qualification?</li> <li>g. Change review?</li> <li>h. Quality assurance?</li> </ul>		

## V. THE LINE MANAGER AND HIS SUBORDINATE MANAGERS AND SUPERVISORS

- (1) The following factors will be considered in relation to a manager's subordinates:
  - (a) Providing necessary help and training so that they can do their work in accordance with the organization's safety policy.
  - (b) Providing enough time and resources (people and money) to fulfill their safety responsibilities.
  - (c) Providing adequate hardware and software (documents, directives, etc.).
- (2) Establishment of plans and controls so that newly appointed supervisors and "acting" or "temporary" supervisors are properly trained and qualified to perform their supervisory duties will be considered as appropriate.
- (3) Consideration will be given to providing training and making supervisory assignments in such a way that subordinate supervisors are able to:
  - (a) Detect hazardous conditions.
  - (b) Correct hazardous conditions.
  - (c) Maintain systems under their supervision in a safe condition.
- (4) Adequacy will be evaluated in the area of providing supervisory training and assistance to subordinate supervisors in such a way as to assist them in:
  - (a) Making proper task assignments.
  - (b) Performing adequate task safety analyses.
  - (c) Providing adequate pretask briefing and instruction.
  - (d) Using controls indicated by safety analysis (pressure, temperature, time limits, etc.).
  - (e) Assuring that task practices and procedures agree with the actual job site situation.

- (f) Understanding and correcting the things that cause their personnel to make mistakes:
  - (i) Improper selection of personnel to do the work.
  - (ii) Inadequate training.
  - (iii) Motivational problems.
  - (iv) Problems with "error-provocative" procedures and hardware that do not match the people (human factors).
  - (v) Understanding that some level of human error exists in all systems and conducting work in such a manner as to be able to tolerate the consequences of human errors.

Checklist for Part V

The Line Manager and His Subordinate  
Managers and Supervisors

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<ol style="list-style-type: none"> <li>1. Do I provide the necessary help and training for my subordinates?</li> <li>2. Do I provide sufficient time for my subordinates?</li> <li>3. Do I provide the necessary hardware and software?</li> <li>4. Do I advise my supervisors of the hazards and risks involved if any of the above are compromised?</li> <li>5. Do I insist on properly qualified personnel on the job in the case of:               <ol style="list-style-type: none"> <li>a. Temporary or permanent personnel replacement or transfer within my group (vacation, sickness, etc.)?</li> <li>b. Use of personnel from other groups in "matrix" or temporary assignment situations?</li> </ol> </li> <li>6. Do I provide the necessary information, training, and technical backup to permit my people to detect hazardous situations?</li> <li>7. Do I provide assignments of responsibility which will lead to reporting and correction of hazardous situations (or risk acceptance at proper levels of management)?</li> </ol>		

Checklist for Part V (cont.)

Key Safety Responsibility	Yes? Sometimes? No?	What Should Be Done To Improve?
<p>8. Do I insist on review for operational readiness during initial startup of new processes and restart after significant changes?</p> <p>9. Do I insist on periodic review for operational readiness of ongoing processes?</p> <p>10. Do I control safety-related task errors through requiring:</p> <ul style="list-style-type: none"> <li>a. Proper task assignment?</li> <li>b. Use of Job Safety Analyses?</li> <li>c. Pretask briefing sessions?</li> <li>d. Integration of controls indicated by safety analyses into operating procedures?</li> <li>e. Proper correlation between procedural material and actual field conditions?</li> </ul> <p>11. Do I give attention to personal factors to reduce task errors?</p> <ul style="list-style-type: none"> <li>a. Personnel selection?</li> <li>b. Training?</li> <li>c. Motivation?</li> </ul> <p>12. Do I recognize that some level of personnel error is inevitable and take this into account in work planning?</p> <ul style="list-style-type: none"> <li>a. Know error rates?</li> <li>b. Know consequences of error?</li> <li>c. React accordingly?</li> </ul>		

## VI. OPERATIONAL READINESS

- (1) Evaluations will be conducted to determine what steps were taken to assure that all involved jobs and work were ready to go (operationally ready) when work was started or continued. This includes (as appropriate):
  - (a) Before starting a new operation.
  - (b) During a continuing operation.
  - (c) Following any safety-related changes in personnel, hardware, or procedures.
- (2) The degree of compliance with organizational methods for assuring operational readiness (e.g., operational readiness reviews) and for conducting any additional reviews, inspections, or appraisals that were necessary for the particular work will be evaluated.
- (3) Maintenance of adequate safety standards in areas and activities involved in the accident or incident will be evaluated. This includes (as appropriate):
  - (a) Temporary work such as testing, maintenance, or construction.
  - (b) Visitors, observers, and temporary workers involved in the event.
- (4) SSDC-1, Occupancy-Use Readiness Manual<sup>[6]</sup>, may be used as a basis in analyzing systems for operational readiness.

## VII. REFERENCES

- [1] W. G. Johnson, Accident/Incident Investigation Manual, ERDA-76-20 (August 1975).
- [2] W. G. Johnson, MORT - The Management Oversight and Risk Tree, SAN 821-2 (February 12, 1973).
- [3] N. W. Knox and R. W. Eicher, MORT User's Manual, ERDA-76-45-4, SSDC-4 (March 1976).
- [4] M. G. Bullock, Safety Information System Guide, ERDA 76-45/9, SSDC-9 (March 1977).
- [5] A. R. Kuffner, Safety Information System Cataloging, ERDA 76-45/10, SSDC-10 (May 1977).
- [6] R. J. Nertney, J. L. Clark, and R. W. Eicher, Occupancy-Use Readiness Manual - Safety Considerations, ERDA-76-45-1, SSDC-1 (September 1975).



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