NIOSH

PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

Guidelines for Controlling Hazardous Energy During Maintenance and Servicing

GUIDELINES FOR CONTROLLING HAZARDOUS ENERGY

DURING MAINTENANCE AND SERVICING

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health
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Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

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PREFACE

The Occupational Safety and Health Act of 1970 emphasized the need for standards to protect the health and safety of workers exposed to an ever increasing number of potential hazards in the workplace. Section 22(d)(2) of the Act authorizes the Director of the National Institute for Occupational Safety and Health (NIOSH) to make recommendations to the Occupational Safety and Health Administration (OSHA) concerning improved occupational safety and health standards. The purpose of this document is to provide recommendations for preventing injuries and disease caused by hazardous energy.

The document was developed through the use of "systems analysis" so as to provide a logical means of performing maintenance and servicing activities safely, with energy present, with energy removed, and during the process of reenergizing.

We gratefully acknowledge the contributions to this document made by representatives of other Federal agencies or departments, labor unions, trade and professional associations, consultants, and the staff of the Institute.

Whatever the contributions made by others, conclusions expressed in this document are those of the Institute, and we are solely responsible for them. However, all comments made by those outside NIOSH, whether or not incorporated, were considered carefully and were sent with the document to the Occupational Safety and Health Administration.

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The Division of Safety Research, NIOSH, had primary responsibility for development of the recommended guidelines for controlling hazardous energy during maintenance and servicing. Ted A. Pettit served as project officer and document manager. Boeing Aerospace developed the basic information for consideration by NIOSH staff and consultants under contract No. 210-79-0024.

The NIOSH division review of this document was provided by David L. West, Ph.D., Robert G. McDonald (Division of Standards Development and Technology Transfer), David J. Huebener (Division of Physical Sciences and Engineering), John R. Etherton, Murray L. Cohen, Ph.D., and James A. Oppold, Ph.D. (Division of Safety Research). Technical editing for the document was provided by Herbert Linn (Division of Safety Research).

ABSTRACT

This document has been developed to provide guidelines for controlling hazardous energy during maintenance and servicing operations. The guidelines were developed by associating work practices with attendant risks. Methods of obtaining information which contributed to the development of the guidelines included site visits to various industrial facilities, the collection and analysis of data related to maintenance techniques and processes, evaluation of accident case studies and incident report information, extensive searches of literature, and review of other pertinent data. The guidelines emphasize recognition of hazards and safe work procedures.

This document provides a logical system for performing maintenance and servicing activities safely, and recognizes that such activities can be performed safely with energy present, with energy removed, and while reenergizing. The recommended guidelines were developed through a systems analysis approach. The logic tree (Figure I) provides a step-by-step diagram for controlling hazardous energy that should be utilized in the formulation of specific maintenance and servicing procedures.

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I. INTRODUCTION

This document is primarily intended to outline methods of protecting workers engaged in maintenance and servicing of machines, processes, or systems from injury by the unexpected and unrestricted release of hazardous energy.

Maintenance activities can be performed with or without energy present. A probable, underlying cause of many accidents resulting in injury during maintenance is that work is performed without the knowledge that the system, whether energized or not, can produce hazardous energy. Unexpected and unrestricted release of hazardous energy can occur if: 1) all energy sources are not identified; 2) provisions are not made for safe work practices with energy present; or 3) deactivated energy sources are reactivated, mistakenly, intentionally, or accidentally, without the maintenance worker's knowledge.

Problems involving control of hazardous energy require procedural solutions. The logic of the guidelines proposed in this document for controlling hazardous energy is graphically represented in Figure I, Diagram for Controlling Hazardous Energy During Maintenance and Servicing. This diagram should be utilized by those personnel responsible for the design of safe work procedures specific to individual employer requirements.

Employers must adopt such procedural solutions for controlling hazards to ensure worker safety during maintenance. However, such procedures are effective only if strictly enforced. Employers must, therefore, be committed to strict implementation of such procedures.

A. MANAGEMENT COMMITMENT

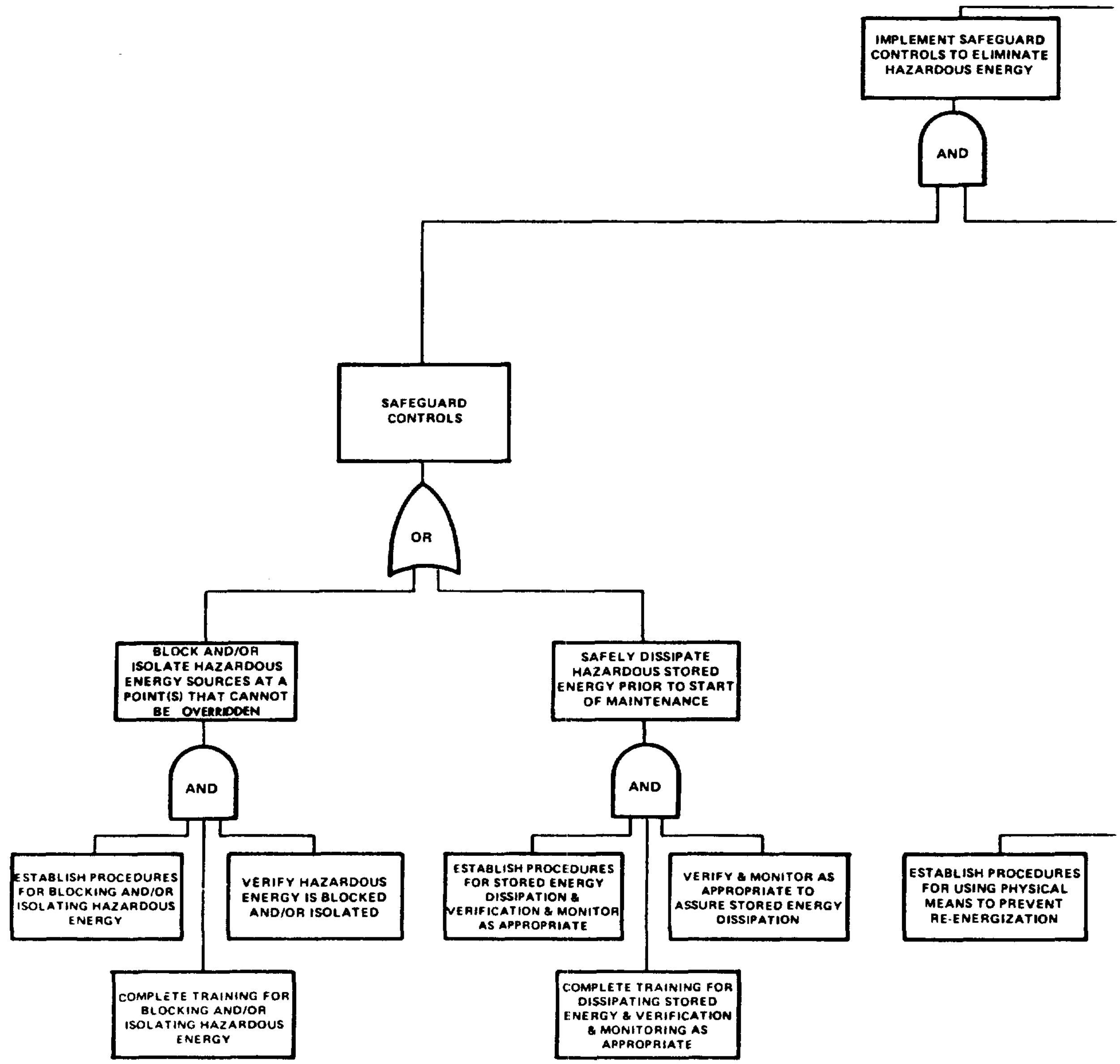
During visits to several plants conducted as part of this study, employers stressed that cooperation between management personnel and employees is essential to the implementation of safety programs, including energy control measures. Many employers believe that first line supervisors and employees comprise weak links in safety programs. Presumably, these employees remain unconvinced that employers really want to implement strict safety rules. Employee perception of management attitudes toward safety procedures, training, or motivation campaigns forms a basic, though intangible, influence upon the relative success or failure of any safety program. Safety programs are more likely to be effective if management demonstrates to employees a firm commitment to achieve safe working conditions.

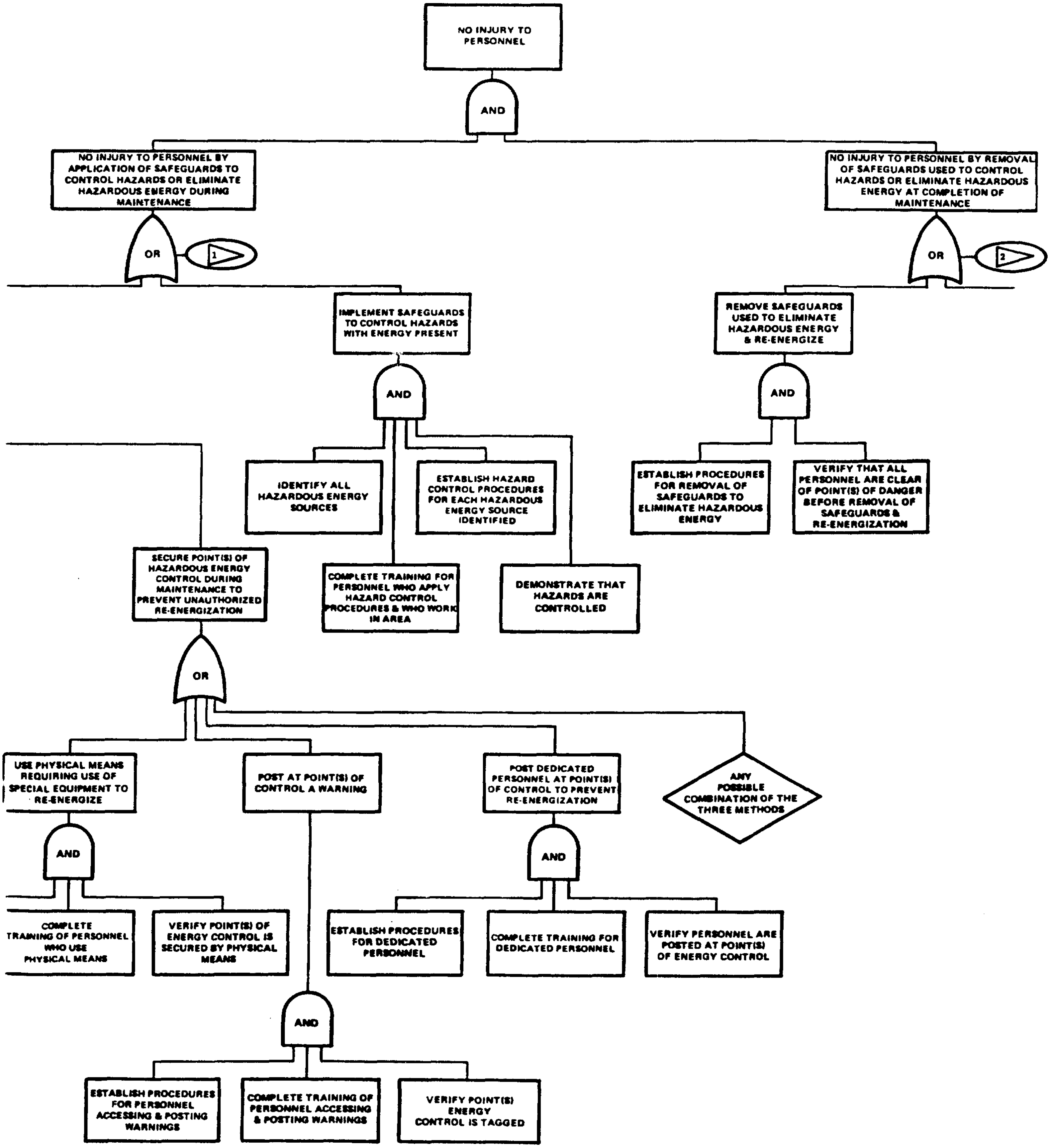
B. DEFINITIONS

Certain terms used throughout these guidelines may have different meaning to different people and may be topics of disagreement. A term may be self-explanatory for some industrial applications, but controversial in other applications. The terms below have the following definitions for the purpose of this document.

Maintenance and Servicing. The tasks necessary to keep a machine, process, or system in a state of repair or efficiency. This activity includes inspection, servicing, repair, troubleshooting, setup, clearing jams, and other related activities. These activities are not considered to commence on a new system

Figure I. DIAGRAM FOR CONTROLLING HAZARDOUS ENERGY DURING MAINTENANCE AND SERVICING





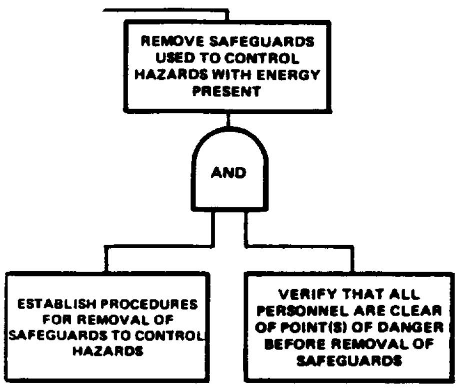
NO INJURY TO PERSONNEL
AND
NO INJURY TO PERSONNEL BY APPLICATION OF SAFEGUARDS TO CONTROL HAZARDS OR ELIMINATE HAZARDOUS ENERGY DURING MAINTENANCE
OR
1
NO INJURY TO PERSONNEL BY REMOVAL OF SAFEGUARDS USED TO CONTROL HAZARDS OR ELIMINATE HAZARDOUS ENERGY AT COMPLETION OF MAINTENANCE
OR
2
IMPLEMENT SAFEGUARDS TO CONTROL HAZARDS WITH ENERGY PRESENT
AND
IDENTIFY ALL HAZARDOUS ENERGY SOURCES
ESTABLISH HAZARD CONTROL PROCEDURES FOR EACH HAZARDOUS ENERGY SOURCE IDENTIFIED
COMPLETE TRAINING FOR PERSONNEL WHO APPLY HAZARD CONTROL PROCEDURES & WHO WORK IN AREA
DEMONSTRATE THAT HAZARDS ARE CONTROLLED
REMOVE SAFEGUARDS USED TO ELIMINATE HAZARDOUS ENERGY & RE-ENERGIZE
AND
ESTABLISH PROCEDURES FOR REMOVAL OF SAFEGUARDS TO ELIMINATE HAZARDOUS ENERGY
VERIFY THAT ALL PERSONNEL ARE CLEAR OF POINT(S) OF DANGER BEFORE REMOVAL OF SAFEGUARDS & RE-ENERGIZATION
SECURE POINT(S) OF HAZARDOUS ENERGY CONTROL DURING MAINTENANCE TO PREVENT UNAUTHORIZED RE-ENERGIZATION
OR
USE PHYSICAL MEANS REQUIRING USE OF SPECIAL EQUIPMENT TO RE-ENERGIZE
AND
COMPLETE TRAINING OF PERSONNEL WHO USE PHYSICAL MEANS
VERIFY POINT(S) OF ENERGY CONTROL IS SECURED BY PHYSICAL MEANS
POST AT POINT(S) OF CONTROL A WARNING
AND
ESTABLISH PROCEDURES FOR PERSONNEL ACCESSING & POSTING WARNINGS
COMPLETE TRAINING OF PERSONNEL ACCESSING & POSTING WARNINGS
VERIFY POINT(S) ENERGY CONTROL IS TAGGED
POST DEDICATED PERSONNEL AT POINT(S) OF CONTROL TO PREVENT RE-ENERGIZATION
AND
ESTABLISH PROCEDURES FOR DEDICATED PERSONNEL
COMPLETE TRAINING FOR DEDICATED PERSONNEL
VERIFY PERSONNEL ARE POSTED AT POINT(S) OF ENERGY CONTROL
ANY POSSIBLE COMBINATION OF THE THREE METHODS

Decision Criteria

[1] IMPLEMENTATION OF SAFEGUARDS TO CONTROL HAZARDS WITH ENERGY PRESENT MAY BE CHOSEN INSTEAD OF HAZARDOUS ENERGY ELIMINATION BY DEVICES OR TECHNIQUES, WHEN IT CAN BE DEMONSTRATED THAT HAZARDS ARE CONTROLLED WITH ENERGY PRESENT BY:

1. IDENTIFYING ALL HAZARDOUS ENERGY SOURCES AND HAZARDOUS RESIDUAL ENERGY, AND
2. DOCUMENTING A PROCEDURE FOR AND DEMONSTRATING THAT THE PROCEDURE WILL CONTROL HAZARDS RESULTING FROM EACH HAZARDOUS ENERGY IDENTIFIED.

[2] THE DECISION AT THIS POINT IS PREDETERMINED BY THE ORIGINAL OPTION CHOSEN IN [1].



Legend

RECTANGLE SYMBOL – IDENTIFIES AN EVENT THAT RESULTS FROM THE COMBINATION OR EXCLUSION OF ACTIVITIES OR EVENTS.

AND GATE – DESCRIBES AN OPERATION WHEREBY CO-EXISTENCE OF ALL INPUTS ARE REQUIRED TO PRODUCE AN OUTPUT EVENTS.

OR GATE - DEFINES SITUATION WHEREBY AN OUTPUT EVENT WILL OCCUR IF ONE OF THE INPUTS EXIST.

DECISION GATE – EXCLUSIVE OR GATE WHICH FUNCTIONS AS AN OR GATE BUT PROVIDES A FOOTNOTED (▷) LIST OF DECISION CRITERIA ARE NOT SELF EVIDENT.

DIAMOND – DESCRIBES AN EVENT THAT IS CONSIDERED BASIC IN A GIVEN LOGIC SEQUENCE. EVENT IS NOT DEVELOPED FURTHER BECAUSE DEVELOPMENT IS OBVIOUS.

until it becomes operational. For simplification, "maintenance and servicing" are referred to as "maintenance" throughout much of the document.

"Inspection" is defined as checking or testing machinery, equipment, system, etc., against established standards. The definition suggests that the object being inspected has a function and should comply with a standard. From this, it is deduced that (1) a standard must exist that establishes the good or bad characteristics of the object being inspected and (2) the object must be complete so that it can perform its function; i.e., construction, assembly, or manufacture should be complete before the object can be maintained. If the object has more than one function, it may be necessary to change or add parts to the object so that it may perform the different functions. The activity required to make the changes or additions is considered maintenance. In some sectors of industry the term "set-up" is used to denote the activities needed to change the functions of the equipment.

"Service" is defined as repair or maintenance. The definition of service is synonymous with maintenance; however, service (as used in this report) refers to the activities needed to keep a machine, process, or system in a state of efficiency; e.g., changing crank case oil, greasing, cleaning, painting, adjusting, calibrating, etc.

Energy. For this document, "energy" means mechanical motion; potential energy due to pressure, gravity, or springs; electrical energy; or thermal energy resulting from high or low temperature.

As suggested by one of the approaches taken by industry, maintenance may be performed with power off or power on. Maintenance activities, however, are always performed with some form of energy on and some form of energy off. Thus, the concept of "power off" or "power on" implies that power, the time rate at which work is done or energy emitted or transferred, can be turned off. This concept is too restrictive because it does not consider gravity or temperature. The term "energy," as opposed to "power," is therefore suggested as an alternative, because current consensus standards and other literature on this subject use this term. The concept of energy (any quantity with dimensions mass times length squared divided by time squared), however, is too inclusive. The concept of energy, for the purpose of this document, is limited to:

1. Kinetic energy - energy possessed by a body by virtue of its motion.

2. Potential energy - energy possessed by a body by virtue of its position in a gravity field.

3. Electrical energy - energy as a result of a generated electrical power source or a static source.

4. Thermal energy - energy as a result of mechanical work, radiation, chemical reaction, or electrical resistance.

Radiation, the process by which electromagnetic energy is propagated, is not included because this type of energy affects internal organ tolerance, which is a health effect.

Personnel Hazard. A condition which could lead to injury or death. This condition should be recognized by a person familiar with the particular circumstances and facts unique to a particular industry. The following concept of personnel hazard was used to objectively identify hazards to humans: A personnel hazard exists when the environment, conditions, natural phenomena, or equipment characteristics may release levels of energy that exceed human tolerance. This concept encompasses the human physiological tolerance to trauma as well as internal organ tolerance to environment.

Isolated or Blocked Energy. Energy is considered isolated or blocked when its flow would not be reactivated by a foreseeable unplanned event. The term "isolate" means to set apart from others. The term "block" (noun) means an obstacle or obstruction; or, (verb) to make unsuitable for passage or progress by obstruction, to prevent normal functioning.

These terms are similar in meaning, but they cannot be used synonymously in all instances. Although they may describe the same function (i.e., prevention of the normal flow of energy), the way in which the function is performed is different. For instance, to control gravitational energy, the energy should be blocked in the sense that an obstacle or obstruction is placed. It would be incorrect to use the term "isolate" when referring to the control of gravitational energy. Electrical energy should be controlled by isolating it in the sense that it is set apart, or disconnected. It would be incorrect to use the term "blocked" when referring to the control of electrical energy.

The terms may be used synonymously in some cases, such as when referring to blocking the passage of fluid or isolating the pressure in a pipe. Sometimes the difference in meaning becomes evident only by the method used to implement the function.

Point(s) of Control. The point or points from which energy-blocking, -isolating, or -dissipating devices are controlled.

Securing the Point(s) of Control. The point(s) of control are secured to prevent unauthorized persons from reactivating the flow of energy. Securing is a separate and distinct action from isolating or blocking the energy sources. The use of locks, tags, or posting a qualified person or a combination thereof are methods of accomplishing these criteria.

Dissipate Energy. To cause energy to be spread out or reduced to levels tolerable by humans. When the word "dissipate" is applied to the word "energy," the term may be interpreted differently. The following concepts should be used to determine the dissipation activities:

1. Dissipate Mechanical Motion - Motion tends to continue because of inertia after removal of energy; therefore, mechanical motion should be dissipated. For example, a flywheel should be allowed to come to rest before starting work.

2. Dissipate Potential Energy - Potential energy can be manifested in the form of pressure (above or below atmospheric), springs, and gravity. Gravity

can never be eliminated or dissipated; it can only be controlled. Springs under tension or compression can be released (to dissipate stored energy) or the stored energy can be controlled. Pressure may be blocked, isolated, or dissipated. The term "dissipate pressure" implies reducing pressure to a level that would not harm humans. Normally, this pressure value is atmospheric.

3. Dissipate Electrical Energy - Dissipation of electricity may be accomplished by "grounding" the deelectrified portion of the circuit after it has been isolated. Grounding live circuits may be catastrophic. Dissipation of electrical energy includes the actions necessary to prevent the buildup of electrical potential (static electricity).

4. Dissipate Chemicals - Chemical reactions are exothermic or endothermic. Exothermic reactions raise temperatures, which may cause a variety of effects such as fires, explosions, burns, etc. Endothermic reactions lower temperatures and cause the need for additional heat. Some elements manufactured by endothermic reaction are used as explosives or have explosive characteristics because of their instability and rapid release of energy. For the purpose of this document, emphasis is placed on the effort necessary for the prevention or control of chemical reactions. Thus, the term "dissipation of chemicals" implies those actions needed to prevent chemical reactions that would (1) raise or lower temperatures or (2) cause effects which humans cannot tolerate.

5. Dissipate Thermal Energy - Human tolerance to temperature is very limited. Human tissue is harmed when it is exposed to temperatures above 45°C (113°F) or below 4°C (39°F). Since temperature cannot be isolated or blocked, the only way to control its effects on humans is through dissipation or employee protection. Mechanical motion, electrical resistance, chemical reactions, and radiation will raise the temperature of materials which, in turn, can burn or damage human tissue. Therefore, when energy sources that affect temperature are identified in equipment, processes, or systems, controls of the energy source should be effected to allow the temperature to dissipate to a tolerable level.

C. WORKING WITH OR WITHOUT ENERGY PRESENT

The basic decision that must be made before maintenance begins is: Can the task be accomplished safely with or without energy present or is it necessary to deenergize before initiating maintenance?

Concepts which should be considered in this decision include: 1) Energy is always present; 2) energy is not necessarily dangerous; and 3) danger is present only when energy is released in quantities which exceed human tolerances. Further, prior to the development of specific energy control measures, all energy sources should be: 1) identified; 2) analyzed independently; and 3) analyzed in combination with any other energy sources present.

The following paragraphs present criteria which should be considered during analysis of specific energy sources.

D. ENERGY SOURCES

Mechanical motion can be linear translation or rotation, or it can produce work which, in turn, produces changes in temperature. This type of energy can be turned off or left on.

Potential energy can be due to pressure (above or below atmospheric), springs, or gravity. Maintenance is always conducted with gravity on. Potential energy manifested as pressures or in springs can be dissipated or controlled; it cannot be turned off or on.

Electrical energy refers to generated electrical power or static electricity. In the case of generated electricity, the electrical power can be turned on or turned off. Static electricity may not be turned off; it can only be dissipated.

Thermal energy is manifested by high or low temperature. This type of energy is the result of mechanical work, radiation, chemical reaction, or electrical resistance. It cannot be turned off or eliminated; however, it can be dissipated or controlled.

Chemical reaction is manifested by exothermic or endothermic effects. In either case, the energy-on/energy-off approach does not apply. Any material which could chemically react should be eliminated, dissipated, or controlled. That is, some positive measures must be taken to (1) eliminate the chemical so that no chemical reaction can take place, or (2) control the reaction so that the energy released by the chemical reaction will not harm humans. Methods of controlling hazards due to chemicals or chemical reactions as energy sources have not been addressed in this document because of their complexity.

These criteria indicate that some energy sources can be turned off, some can be dissipated, other sources of energy can be eliminated, and some can only be controlled. The following examples illustrate how this concept is applied.

Example 1:

The task is the removal and replacement of a spring in a car. Potential energy is present due to the force of gravity and of the tension or compression of the spring. The force of gravity can be controlled only by blocking the car. The energy stored in the spring can be dissipated or controlled. It is usually controlled by blocking the release of the spring. Therefore, the decision logic indicates that maintenance must be done with energy present.

Example 2:

A large mixing drum with internal rotating blades is in need of repair. One of the mixing blades is out of alignment. The established maintenance procedure requires the entry of two men to realign the blade. The electrical energy source can be switched off and locked out and/or the mechanical linkages can be disconnected. The lockout at the switch will provide a physical barrier and a tag will identify the task being performed. In addition, if the mechanical linkages are disconnected, all energy sources, except gravity, will be removed from the system.

II. INVESTIGATION OF THE PROBLEM

Much of the data examined during this study did not include enough specific information to identify the factors causing or contributing to accidents which occur during maintenance as a result of inadequate energy control measures.

However, an extensive search of world literature related to maintenance hazards and maintenance hazard controls, revealed a number of accident scenarios which could be evaluated in the attempt to identify generic causes of maintenance-related accidents. Accidents which could be attributed to the presence of uncontrolled energy during maintenance activities were selected for closer study. Although the limited nature of the information precluded exact cause determination, the scenarios did provide a general indication of causes or contributing causes as well as illustrations of the types of accidents that can occur when hazardous levels of energy are not controlled.

A. THE ACCIDENT SCENARIOS

Out of 300 accident scenarios found in 14 different sources, 59 accidents were selected to illustrate that adequate energy control methods may have prevented the accidents. (A brief description of each accident is included in Appendix B.) Causes of these accidents have been categorized as follows:

1. Maintenance activities were initiated without attempting to deenergize the equipment or system, or control the hazards with energy present.

   Twenty-seven accidents fell into this category. Typical of these accidents was accident No. 10 (Appendix B), in which an experienced repairman saw a piece of wire stuck in a filter wheel. He attempted to remove the wire while the wheel was in motion. Losing his balance, he fell into the wheel. His leg was crushed and had to be amputated.

2. Energy blockage or isolation was attempted, but was inadequate.

   Six incidents were the result of ineffective energy isolation or blockage. An example was accident No. 30 (Appendix B), in which a worker attempted to prevent an elevator from moving by jamming the doors open with a plank while the elevator was on the second floor, and then turning off the outside panel switch on the main floor. He was killed while working on the main floor when the elevator returned to its home base rather than remaining on the second floor.

3. Residual (potential) energy was not dissipated.

   Accident No. 34 (Appendix B) resulted in injury due to failure to dissipate residual energy. The worker turned off the power to a packaging machine and attempted to remove a jam. Residual hydraulic pressure activated the holding device causing the injury.

4. Accidental activation of energy.

   Twenty-five of the accidents were caused by accidental activation. These accidents were caused by either (1) persons unintentionally actuating controls, or (2) by other persons activating the controls, not realizing that maintenance was in progress. The result, in either case, can be disastrous.

An accident typical of this category was accident No. 36 (Appendix B) in which a mechanic was repairing an electrically operated caustic pump. A co-worker dragged a cable across the toggle switch that operated the pump, and the mechanic was sprayed with caustic. Another incident, accident No. 38 (Appendix B), occurred when an employee was cutting a pipe with a torch and diesel fuel was mistakenly discharged into the line. The ensuing ignition of the diesel fuel resulted in a fatality.

These types of accidents are preventable if effective energy control techniques or procedures are available, workers are trained to use them, and management provides the motivation to ensure their use. Table I summarizes the accident causes and indicates the applicable guidelines from Chapter III which, if followed, would have eliminated the hazard and prevented the accident. In Appendix B, an energy control method that would have been effective is identified for each entry. The methods shown are only examples. For many cases, several energy control techniques could have been used to prevent the accident. In addition, Appendix B identifies the hazard types, energy sources, and accident causes as well as consequences of each accident.

TABLE I

ACCIDENT CAUSE SUMMARY*

ACCIDENT CAUSE		NUMBER OF ACCIDENTS	APPLICABLE GUIDELINES
1	INITIATED ACTIVITY WITHOUT ATTEMPTING TO CONTROL HAZARDOUS ENERGY	27	A.1., A.2., A.3., AND B.1., B.2., B.3.
2	ENERGY ISOLATION WAS ATTEMPTED BUT WAS INADEQUATE	6	A.2.a. and A.2.d.
3	RESIDUAL ENERGY WAS NOT DISSIPATED	1	A.2.b. and A.2.d.
4	ACCIDENTAL ACTIVATION OF ENERGY	25	A.2.a., A.2.c., A.2.d. and A.2.e.
	ALL CAUSES	59	

* See Appendix B for Accident Descriptions

B. STATISTICAL INVESTIGATION

Besides the literature search, a statistical investigation was undertaken in the attempt to obtain data that would help to identify factors causing or contributing to the type of accident under consideration.

It was planned that statistical accident data would be obtained that related to inadequate energy controls during maintenance. The data would help to identify ineffective control methods and particular problems that should be avoided. Manual and automated searches were conducted to locate the information. Most of the data found, however, did not include enough specific information to identify the factors causing or contributing to the accidents. This finding coincides with the results of a study conducted by the National Safety Council and reported on June 30, 1978 to the members of the National Safety Council President's Advisory Committee and Technical Work Session Participants of the National Program to Improve Occupational Injury Information. The report states:

> "Problems with the technical quality of current data. These include the lack of detail, consistency, and relevance for the development of countermeasures in current occupational injury data. Existing data are very limited.
>
> Occupational injury data are often gathered primarily for the purpose of processing worker's compensation claims rather than for developing countermeasures. Most current information systems emphasize data about the injury, not the accident, and about the end results of the accident sequence, rather than the precipitating events and conditions leading to the injuring event. Data of the latter type are often much more important for the development of countermeasures.
>
> The ANSI Z16.2 American National Standard Method of Recording Basic Facts Relating to the Nature and Occurrence of Work Injuries, or an adaptation of this coding method, is used almost exclusively among both the Federal and State Government agencies and private sector information systems. The ANSI Z16.2 method is extremely limited and is designed primarily as a monitoring tool for grouping accidents by major types and for flagging a limited number of isolated factors about accidents so that the cases can be recalled when data analysis begins. The ANSI Z16.2 method is not designed as an analytical tool for identifying the patterns, the precipitating events and conditions in an accident sequence, or the relationships among contributing causal factors in an accident that are normally needed for countermeasure development."

Attempts to obtain more specific data from such sources as associations, insurance companies, labor unions, and industry proved unsuccessful because of one or more of the following reasons:

1. Trade associations did not collect the data, or the data were not collected in a useful format or for specific enough instances.

2. Data from insurance companies, private companies, and unions are considered proprietary and/or involve liability considerations.

3. Changing format and editing the data would be too time consuming or costly (the data are considered proprietary without changing format and editing, and insurance companies are not interested in reworking the data).