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AIM: ACCIDENT INVESTIGATION METHODOLOGY

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The background to and development of an accident investigation methodology (AIM) to analyze occupational injuries are reviewed. On-site investigation of 125 fall accidents was conducted. Accident models, such as the management oversight and risk tree, the Royal Society for the Prevention of Accidents, and the Frase coding models, are described and the application of their concepts to AIM is discussed. AIM factors, such as sampling considerations, conduct of accident investigations, data collection and analysis, and procedures evaluation and modification are described, along with the conceptual basis of AIM. AIM components of organizational safety analysis, accident sequence analysis, and hazards/countermeasures analysis are summarized.

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ABSTRACT

The following report describes background to and development of AIM, an accident investigation methodology suitable for a NIOSH information system aimed at defining occupational safety research needs.

AIM was developed in an iterative fashion by a multidisciplinary team of experienced safety professionals, through, initially, on-site investigation of 125 actual fall accidents. (The results of these investigations are presented in a companion volume, separately bound, entitled "Occupational Fall Accident Patterns.")

Essentially, AIM has three components:

1. The organizational safety analysis component. This includes: 1) an "Establishment Background Data" form covering employee exposure data, management safety structure and program, operational characteristics, and accident history; and 2) an audit form called "Organizational Safety Analysis Checklist," which ranks as "lacking," "inadequate," "minimal," "okay" 43 organizational factors under 5 headings: general programs, management implementation, hazard analysis activity, hazard control, and personnel characteristics.

2. The accident sequence analysis component. This includes: 1) an injury notification system, 2) an accident investigation report, 3) an accident sequence analysis chart, and 4) detailed coding of multiple factors and events (using FRASE) and preparation of computer processable data. The accident investigation report is divided into four sections covering details about the injured employee, the work environment, the work task and the events in the accident sequence. This data is charted to enable a clearer

analysis and to identify areas where data is missing. The coding method enables computer processing of all data and enables "searches" of all objects, characteristics, conditions, events, relationships between factors, or combinations of these through the use of a computer.

3. A hazard/countermeasures analysis component. This includes: 1) countermeasure identification, and 2) countermeasure evaluation. Using a highly structured and formatted method, each event and condition/characteristic of the work environment/employee/task is evaluated (using the data identified on the accident sequence analysis chart) and the appropriate general countermeasure type is identified (out of a list of 14 types of countermeasures). This general countermeasure is then developed into a specific countermeasure to treat the particular event or condition/characteristic which resulted in the accident. An evaluation is then made of whether the countermeasure is a management-oriented countermeasure, a worker-oriented countermeasure, or a countermeasure requiring further research and development for its implementation. Finally, each countermeasure is evaluated in terms of its long and short term feasibility using 10 implementation criteria (e.g., technological/cost feasibility, management/employee acceptance, etc.).

The fact that AIM includes identification and evaluation of countermeasures is unusual among accident investigation protocols, nearly all of which end with the collection of data and do not include identification and analysis of countermeasures as part of their methodology.

Recommendations for expanded development are offered in order to make AIM a fully operational system routinely used by trained NIOSH, as well as industry, investigators.

I. INTRODUCTION

The following represents the first volume of a two volume final report. It discusses background to and development of an Accident Investigation Methodology (AIM) directed toward analysis of occupational injuries. The second volume (bound separately) analyzes data obtained in the investigation of 125 occupational fall accidents during which AIM was developed. In addition, suitable fall accident countermeasures are evaluated and discussed in the second volume based upon the experience gained in developing the investigative approach.

Section I of this report presents a brief introduction reviewing NIOSH's need for and precedents to an accident investigation methodology suitable for occupational safety research. Section II briefly reviews significant concepts and procedures contributing to the development of AIM. Section III presents the study approach. Section IV discusses the specific investigative and analytical procedures of AIM. Section V offers conclusions and recommendations concerning implementing AIM.

1.1 NEED FOR AN ACCIDENT INVESTIGATION METHODOLOGY

Recognizing the need to establish an information data base for better defining occupational safety research needs and priorities, the National Institute for Occupational Safety and Health (NIOSH) contracted two independent studies both performed by SAFETY SCIENCES, Division of WSA Inc. The first, Feasibility of Securing Research-Defining Accident Statistics provided background suitable for establishing an information system based on available occupational injury reports.[1] In addition, the study evolved a model system for analyzing and coding existing occupational injury reports. Subsequent work for OSHA[2,3] refined the approach, resulting in a system called FRASE (Factor Relationship and Sequence of Events) coding. The advantages of FRASE over previous coding approaches are discussed in a later section of this report.

The second contract study is the subject matter of this report. To complement an accident information system which analyzes available injury reports, NIOSH needed as well a method for in-depth investigation of select worker accidents. Although much more information is discernible from injury reports than conventional coding systems presently utilized (as the first study showed),[1] often more detailed information is required in order to ascertain the impact of a wider variety of hazards. In particular, injury reports are typically lacking in detail concerning the role of human factors in accident occurrence. While analysis of injury reports provides a limited amount of information on a great many cases, accident investigations provide detailed analysis of relatively few cases. Hence the two approaches (analysis of injury records and accident investigations) complement one another and together form essential components of a comprehensive, occupational accident information system. In fact, an optimally cost effective approach, both in terms of time and money, is to utilize injury reports to assist in establishing research priorities and identifying specific problems requiring more in-depth study through investigation of select accidents or other special studies.

1.2 PRECEDENTS

Accident investigations have been used by other federal government agencies and private industry for a variety of purposes. Each application has its own unique approach tailored to meet its specific needs. Some are better developed than others, but from these approaches have emerged several useful concepts and procedures.

The Civil Aeronautics Board (CAB) and its predecessors within the Federal Aviation Administration (FAA) has been performing investigations of fatal air crashes for many years. More recently, the National Transportation Safety Board (NTSB) within the Department of Transportation (DOT) has been investigating serious vehicle crashes. From such studies has emerged concepts and procedures, such as multidisciplinary investigation teams, quick-response on-site investigation, accident reconstruction, and pilot-induced (human) error. In fact, the concept of design-induced error forged the development of the field of human factors engineering during Work War II.

With the development of space exploration and a corresponding highly sophisticated technology, system safety analysis methods emerged out of the National Aeronautics and Space Administration's (NASA's) need to avert potentially catastrophic failures. More recently, the Department of Energy (formerly ERDA and AEC) adopted a similar approach to disaster control. The most useful systems safety analysis method, MORT (Management Oversight and Risk Tree) analysis, will be discussed in the next section.

Over the years the various branches of the military through the Department of Defense performed accident investigations in a variety of operational settings reviewing many classic human factors design deficiencies. From such studies emerged much of the criteria and principles of classic human factors engineering design handbooks. One of the most useful concepts emerging from these studies is the so-called "critical-incident technique." The critical-incident approach demonstrates that much valuable predictive information can be obtained from study of near accidents. In fact, studies have shown that investigation of only fatal or very serious injuries is insufficient, since such severe injuries occur quite infrequently and thus are not representative of recurrent accident patterns, which in the aggregate may be more of a problem.

Only in the last decade with recent congressional legislation has attention begun turning toward the consumer and the worker. The Consumer Product Safety Commission (CPSC) has an accident investigation program which is used for in-depth studies of products identified as being hazardous through the National Electronic Injury Surveillance System (NEISS). CPSC has evolved in just a few years a bi-level (injury record/accident investigation) system, as mentioned earlier, to meet their needs. It should be noted that although the system is yet far from perfected and is still evolving, a good deal of useful information is being generated upon which further research or regulatory action can be taken, i.e., CPSC's work is goal-directed.

Surprisingly, until recently OSHA did not routinely collect any data on occupational injuries and illnesses, except for fatalities and catastrophes. In particular, OSHA does not have access to the injury rates for each establishment collected by BLS and therefore cannot use these to set priorities for inspections. The data collected by OSHA through its Management Information System (MIS) is confined to data on compliance activity, such as the number of citations and the types of standards violated, and until only very recently did not include any data on the number of characteristics of accidents.

The only routine data collection system previously operated by OSHA was the OSHA/FAT-CAT system which is limited to data collection on fatalities and catastrophes (i.e., cases in which five or more persons are hospitalized). The OSHA/FAT-CAT system is based on the mandatory requirement for employers to report all occupational fatalities and catastrophes to OSHA within 48 hours. Normally this notification is made by phone and an OSHA staff member records accident characteristics data on the OSHA-36 form.

Unfortunately, this system makes little use of the opportunity afforded to OSHA through on-site investigations to obtain detailed data on accident characteristics. The OSHA-36 form was conceived as purely a means of recording that the required notification of a fatality had been performed. The form requests very little nonadministrative data, and it is usually completed in a very sketchy manner. No routine analysis of data on this form is performed, because it is assumed that an investigation of the fatality will take place following this notification. However, this form actually contains the majority of the accident characteristics data obtained from the OSHA/FAT-CAT system, due to the extremely limited data collection efforts included in the accident investigations.

The originally planned in-depth reporting form for OSHA fatality investigations (i.e., the OSHA-4 form) has never been implemented, and no narrative data is routinely obtained from OSHA's fatality investigations. Only a very few pieces of coded data are recorded about the investigation on the OSHA-1 form which is the basic form used for recording OSHA inspection activities. The data coded on the fatality are based on an ANSI Z16.2 (17) standard adaption that uses far more limited categories than the standard. Moreover, ANSI Z16.2 standard codes are especially low in utility for the classification of occupational fatalities. For example, in its coding system for part of body and nature of injury many of the classifications are not applicable.

The result is that, from an accident characteristics data collection standpoint, it is the very sketchy data on the OSHA-36 form that is most valuable. Furthermore, it is not possible to determine with certainty from the investigation data which violations cited as a result of the investigation were related to the fatality. Thus, the opportunity for linking data on standards and compliance activities to data on accident characteristics is not used. It is perhaps illustrative of the current status of occupational injury information that the one routine contact of the federal government with on-site investigation of actual injuries occurring in the workplace is poorly used from the standpoint of data collection. For further discussion of problems with the current OSHA fatality notification system, see a recent report prepared for OSHA. (4)

Recently OSHA has made a move toward improved accident characteristics data collection by developing an information system called the <u>OSHA Hazard Analysis and Evaluation System</u> (OSHA-HAES). This system, developed for OSHA by SAFETY

SCIENCES, is being used on a pilot basis as a part of the National Emphasis Program (NEP) in foundries, but may be used in other industries following a field test. The OSHA/HAES program was designed to serve three functions: identification of significant hazards and setting of program priorities, identification of countermeasures and development of OSHA program specifications, and estimation of OSHA's safety and health incident reduction potential and measurement of program impact. For further discussion of the OSHA/HAES system, see a recent report prepared for OSHA. (5)

For a complete discussion of occupational injury information systems, problems, options for improvement, and areas for action, see a recent report prepared for the National Safety Council by SAFETY SCIENCES.(6) Included is discussion of the need for accident investigations as part of a comprehensive injury information system.

Accident investigations are regularly performed by private industry. However, there is no unified set of procedures developed or utilized by which this potential storehouse of information can be tapped. Companies perform accident investigations on an individual basis; there is no national information network. Consequently, such investigations vary in quality and thoroughness. Furthermore, they are usually performed only in instances of serious injury or significant property damage.

Since there is no uniform, national accident investigation program, whatever information exists is presently unretrievable, hence unusable by NIOSH or OSHA. Another problem, mentioned earlier, is that investigation of "serious" accidents alone yields a highly skewed view of accident circumstances in general.

In our numerous discussions with representatives of industry, a consensus for better accident information/investigation procedures consistently surfaces.(6) In particular, better, more uniform accident investigation procedures are continually cited as a primary industry need.

To this end, this report describes the development of an Accident Investigation Methodology (AIM), complementing earlier work performed for NIOSH concerning a model injury information system (FRASE). The two together form the basic methodological building blocks for establishing a comprehensive injury record/accident investigation information system for occupational safety research.

II. BACKGROUND TO THE DEVELOPMENT OF AIM

The following discussion is not intended to be a complete nor exhaustive review of all accident research models documented in the literature. The accident research literature abounds with several conceptual models. No single one is perfect, nor complete. Most are only of theoretical interest offering little in the way of an information framework or set of analytical procedures. However, several useful concepts have evolved over the years. Those most useful to the development of AIM are discussed in this section of the report.

2.1 DESCRIPTIVE MODELS

The earliest accident models were little more than attempts at understanding accident circumstances. These models are, therefore, merely descriptive of certain features viewed as common to accident circumstances. Typically, such accident models evolved from separate disciplinary perspectives. Therefore, each is limited in its conceptual approach, yet each, in turn, offers some useful features.

Perhaps the earliest accident model, although never formalized as such, can be considered to be a medical scientific model. Emanating from traditional medical science approaches is the concept of "cause and effect" relationships. Medical science, over the years, has searched for and found solutions to many biological cause and effect relationships. Typically, a certain virus or bacteria strain is isolated as "causing" the disease under study. This approach attempts to establish single causal relationships.

However, it has become evident over the years that accidents are not uni-causal phenomena. Rather, several factors interact in often complex ways to precipitate accident events. In fact, it is generally agreed amongst accident investigators today that the concept of "cause" should be eliminated altogether from the terminology of the safety field. The primary reasons are that the term "cause" is misleading and unnecessary. It is misleading because it implies fault or punity. Determinations of accident "cause" are often arbitrary and wholly judgmental. Safety investigators today prefer to use the term "hazard." Determination of hazards is objective. No fault or punity is implied. Furthermore, hazards can be directly linked to countermeasures. "Cause" is an unnecessary intervening construct and, therefore, is not used in AIM.

Another common, early conceptual model in accident research is that describing a temporal sequence. According to the chain of events theories, an "accident" is the overall description of a series of events, decisions, and situations which culminate in injury or damage. Each and every accident has a different "causal chain" or "web," the only common element being the undesirable injury or damage. The antecedent events of an injury are usually common and do not ordinarily lead to accidents. However, some particular combination turns a safe act into an unsafe act.

The chain of events accident model inherently assumes the existence of many factors influencing accidents. No single "cause" exists, other than the global term "human factor."[7] Although the notion of sequential chain of events was an important and useful concept, it remained for later models to systematize the multiplicity of factors.

The epidemiological approach to accident research arose out of the formalized study of epidemics, i.e., the path of communicable diseases among humans and the characteristics of the disease carrier (agent), the victim (host), and the environment.[8] Although the epidemiological model is useful as a simple descriptive scheme for classifying various factors associated with accidents, it is not useful for analyzing why accidents happen and what can be done to prevent them. Furthermore, the analogy of accidents to epidemics is not a particularly good one, since accident occurrences do not behave as epidemics, i.e., accidents are not communicable.

However, several significant concepts emerged from the epidemiological approach. Above all, the notion of multiple factors contributing to accident occurrence was firmly established. The epidemiological approach also introduced multidisciplinary investigations. In effect, the host-agent-environment framework was the forerunner of the current man-machine-environment systems concept popularized by modern human factors engineering studies. The epidemiological model, therefore, made significant contributions toward formalizing and systematizing accident research.

There have been a number of behavioral models proposed, but all tend to be rather narrow since they only explore one aspect of the accident problem, i.e., human behavior. Nevertheless, behavioral models focused attention on the significance of certain human factors in accident occurrence.

For example, several authors have suggested models of risk-taking behavior. Whenever a decision for action must be made in the presence of hazards, a degree of risk enters. Two factors affect the degree of risk: the amount of uncertainty concerning the present situation re. possible outcome and the absolute danger of the situation.

Risk-taking models focus on individual differences. They suggest that different persons at different times will assume more or less risk depending upon the particular circumstances and probability of a successful outcome. The assumption is that those taking higher risks are more liable to accidents. However, risks can only be taken by persons who are aware of the attending hazards and who have made conscious decisions concerning their actions. This limits the universality of the concept of risk-taking, since many actions resulting in injury are taken without forethought or knowledge about hazards present and potential outcome. However, risk-taking behavior can be a contributing factor to accident occurrence, and hence is a significant conceptual contribution.

A historically significant behavioral model is that of accident proneness. Today largely discredited, the concept of accident proneness once enjoyed much acclaim. The theory holds that certain individuals are more likely to become involved in accidents due to an enduring, predisposing personality trait. Modern statistical studies have disproven the existence of a significant number of accidents attributable to accident repeaters.

However, the once popular theory of accident proneness has, in turn, spun off some useful concepts. It is important to focus on certain behavioral conditions which can predispose accident occurrence, such as the victim's attitude and states of stress and fatigue. Much recent accident research has shown that such transient conditions can influence or impair one's judgment causing him to be more susceptible to error. Proneness is, therefore, viewed today as an occasional condition, rather than enduring personality trait, to which all are subject at certain times. Another useful conceptual spinoff from the once popular concept of accident proneness is what Swain[9] refers to as "situation proneness." Swain argues convincingly that it is more fruitful to control workplace hazards through application of human factors engineering principles (i.e., make the job safer) than to attempt to modify worker behavior. The former approach, it is argued, is more effective and the results more enduring.

Surry[10] adopted a human factors/information processing model to accident occurrence. Human factors engineering approaches view man as a systems component along with the machine(s) (or tools) he operates and the working environment. The worker, in turn, can be viewed as an information processing system (see FIGURE II-1). Therefore, according to Surry's model accidents can result from either perceptual, cognitive, or motor failures, i.e., failure of the worker to perceive, recognize, or avoid hazards resulting in injury. Unlike its predecessors, Surry's model is not preoccupied with "causal factors," but rather attempts to determine functional mechanisms and failures. Unfortunately, Surry's approach is merely descriptive. No supportive data or analytical method is offered.

Wigglesworth[11] offers a human error/decision model of accident occurrence. He insightfully points out that an accident model should lead to selection of countermeasures. In addition, Wigglesworth includes "non-culpable error as an initiating factor in the injury sequence." According to Wigglesworth's model, errors of omission and commission can occur in either of three stages of information processing (see FIGURE II-2). Although the model points to the need to identify countermeasures, it fails to discuss possible accident countermeasures, nor a method for their selection. This could only be accomplished through an analytical framework such as AIM.

2.2 ANALYTICAL FRAMEWORKS

A number of useful concepts evolved out of several descriptive models, such as those discussed above. Each offered an additional dimension of understanding to the accident process. However, without a system for analyzing accidents, all were of limited utility in solving accident problems. Only in recent years have some analytical methods been developed which offer potential accident investigation approaches suitable for information systems.

With the advent of space technology and the concomitant potential for significant losses in life and property, systems safety analysis methods emerged, such as fault tree and failure mode and effects analysis. The purpose of these methods was to thoroughly analyze potential systems hazards in order to avert space flight disasters.

FIGURE II-1

CONCEPTUAL MODEL OF MAN AS AN

INFORMATION PROCESSING SYSTEM

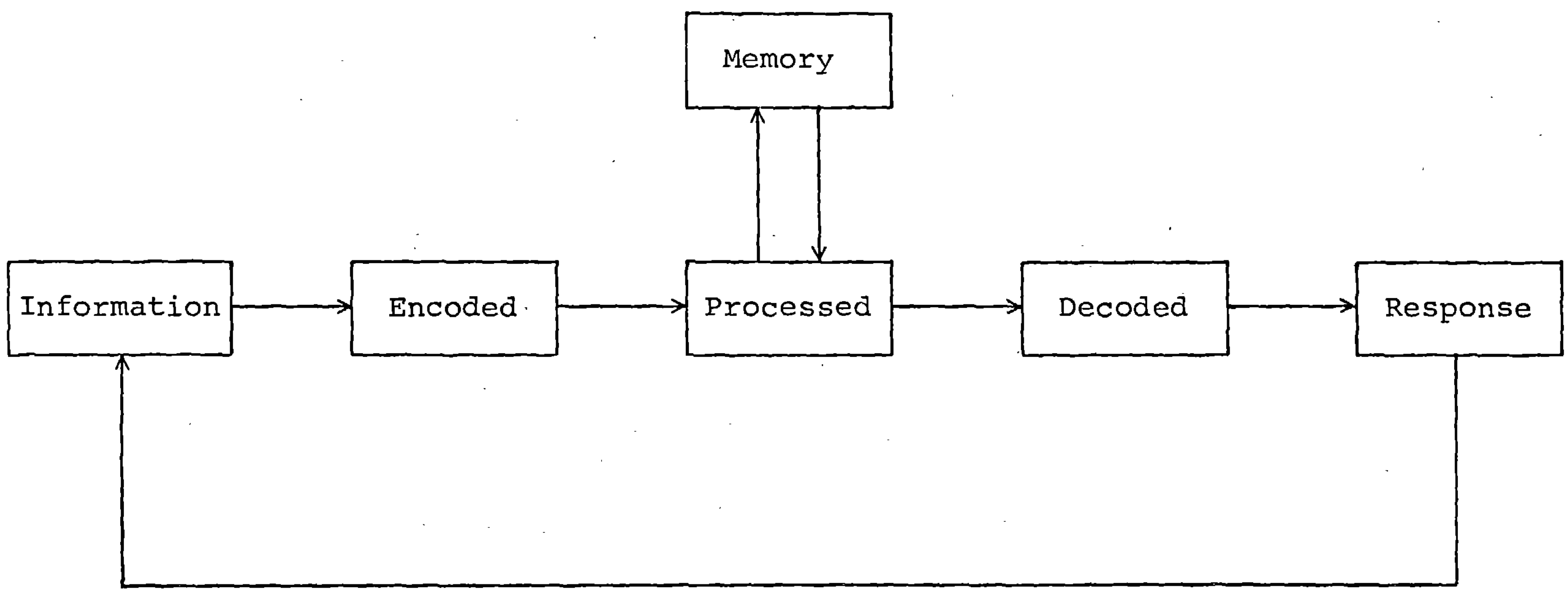


FIGURE II-2

WIGGLESWORTH MODEL

TYPICAL HUMAN ERRORS AND THEIR CAUSES

Reception of information

1 *Failure of detection*
  a input overload b input underload c poor contrast

2 *Incorrect identification*
  a as 1 above b conflicting cues

Decision

1 *Failure to reach decision*
  a lack of information

2 *Incorrect decision*
  a lack of information b incorrect priorities c correct action inhibited

Action

1 *Failure to act*
  a underlearned sequence b inability to reach

2 *Incorrect control selection*
  a lack of uniform layout b inadequate separation or coding c unintentional activation

3 *Incorrect control adjustment*
  a presence of non-controlling position b non-conformity with stereotype

In addition to demonstrating that detailed, prospective hazard analysis is a powerful accident prevention tool, systems safety methods contributed several useful concepts and procedures. Systems safety approaches demonstrate the value of using analytical charting methods. Events and conditions are displayed on a chart and the structure is guided by logic and/or gates and linked with lines to show relationships. Systems safety methods require documentation of multiple factors and, by displaying systematically the events and conditions analyzed, give visibility to the relationships involved among the described factors. In addition, conditions are directly linked to their related events. With the advent of systems safety analysis, a more detailed and potentially powerful method yielding branched event sequences replaced simple, linear sequence of events procedures.

System safety approaches, however, are not without their limitations as prototypes for an occupational accident investigation method. Systems safety methods offer:

- no structured method for discovering the relevant factors involved,
- no criteria for defining events and conditions used in the charting methods and,
- no method for ordering the chronological relationship of events.

In addition, the charts are not easily readable nor readily understandable. The approach requires the analyst to make judgments in the form of logic decisions, rather than simply diagramming the accident facts. Furthermore, accident events retrospectively do not necessarily follow decision logic. In any event, systems safety approaches added an expanded dimension to accident investigations, namely graphically analyzing multifactor relationships.

Management Oversight and Risk Tree (MORT) analysis is a very recent adaptation of the systems safety logic tree.[12] The MORT system was developed for ERDA (now a part of the Department of Energy). Fully applied, MORT is both a disciplined method for determining multiple factors involved in major accidents and a structured way of evaluating the quality and comprehensiveness of a specific safety program within an organization. The ERDA/MORT system is unique in the degree to which the entire data collection and analysis process has been carefully structured, in the comprehensiveness and thoroughness of the program, and in its emphasis on finding structural or systemic problems (sometimes called "management errors") that result in accidents and injuries. In this regard, MORT adds a new dimension to accident investigation and analysis procedures: it explicitly includes management accountability. It makes clear that the "human error" traditionally blamed as the cause of accidents can be the operational error of the worker on the line or the policy setting error of higher management.

The MORT system provides, in the form of a decision tree, a point-by-point method for examining three major areas of concern:

- specific oversights and omissions connected with the accident under investigation,
- assumed risks, many of which remain unquantified, and
- general management system weaknesses

All of these can reveal situations and procedures that are less than adequate, i.e., unsafe. MORT is usually applied to the investigation of major accidents.

MORT represents a major conceptual and procedural advance for accident investigations. Notable contributions are:

- it provides a disciplined method and orderly pattern of investigating, analyzing, and recording findings on serious accidents
- it provides a comprehensive framework for the assessment of a company's safety program

Some difficulties exist, however, with adopting MORT as a model for accident investigations suitable for an occupational accident information system:

- MORT is quite complex and consequently not practical for use with recurring occupational injuries. The system is directed toward investigation of serious injuries, including disaster potential situations, e.g., nuclear power plant accidents, and hence, suffers from some of the same methodological difficulties and complexities as other precursor systems safety analysis methods.

- MORT is not an objective system. It requires extensive value judgments as to the adequacy/inadequacy of conditions. In order to make such judgments requires generation and specification of a multitude of criteria. Unfortunately, such criteria of adequacy/inadequacy will vary between industries and establishments of various sizes.

- Management oversights are general organizational problems or conditions. Although important as background information, they are not specific nor unique to the particular accident circumstances. Consequently, it is not practical, nor necessarily useful, to perform an organizational safety analysis when investigating recurring accidents. It may, however, be desirable to update organizational deficiencies when investigating serious or fatal accidents.

- MORT provides no method for encoding and retrieval of analyzed information. Consequently, an accident information data base is not possible with MORT.

Therefore, the practical utility of the MORT system for general occupational safety appears to be quite limited. MORT appears to be more useful as a single establishment tool (microlevel application) than as a component of a national information system (macrolevel application).

Benner[13] describes a multilinear events sequence charting method which is another variation of the systems safety logic tree. Although the procedures described add very little to the methodological developments already discussed, Benner's paper is useful in pointing out some new conceptual needs for accident investigation approaches. In his paper, Benner discusses the importance of classification of sequences of events in accidents for use in collecting and analyzing data from accident investigations. He describes the many problems of collecting the data from accident investigations, such as defining the beginning and end of an accident sequence, determining which facts are relevant, and portraying the findings of an accident investigation. The aim of Benner's paper is to discuss approaches for developing "complete, reproducible, conceptually consistent, and easily communicated explanations of accidents." He calls for the development and use of an events indexing system and recommends the use of accident event sequence models by accident researchers and safety professionals in the future. The article stresses the impact that a more analytical method for recording, coding, and portraying data will have, not only on statistics, but on the entire safety effort.

An article in the Royal Society for the Prevention of Accidents Journal(14) presents a framework useful for classifying and coding data on sequences of events. Unlike those previously discussed, the RoSPA model prescribes a method for classifying injury data, including multiple events and contributing factors, using English language phrases (see FIGURE II-3). Systematically charting factor relationships and event sequences in phrases is a significant conceptual breakthrough of the RoSPA model. Unlike decision tree analytical methods previously discussed, use of phrases permits data encoding and retrieval suitable for an information system. Furthermore, use of phrases permits a simple, easy to read and interpret and highly practical means for analyzing accident patterns from a large array of accident reports or investigations. The RoSPA model is based primarily on a description of each event in an accident sequence by recording the movement and position of persons and objects as well as the factors causing movement and position.

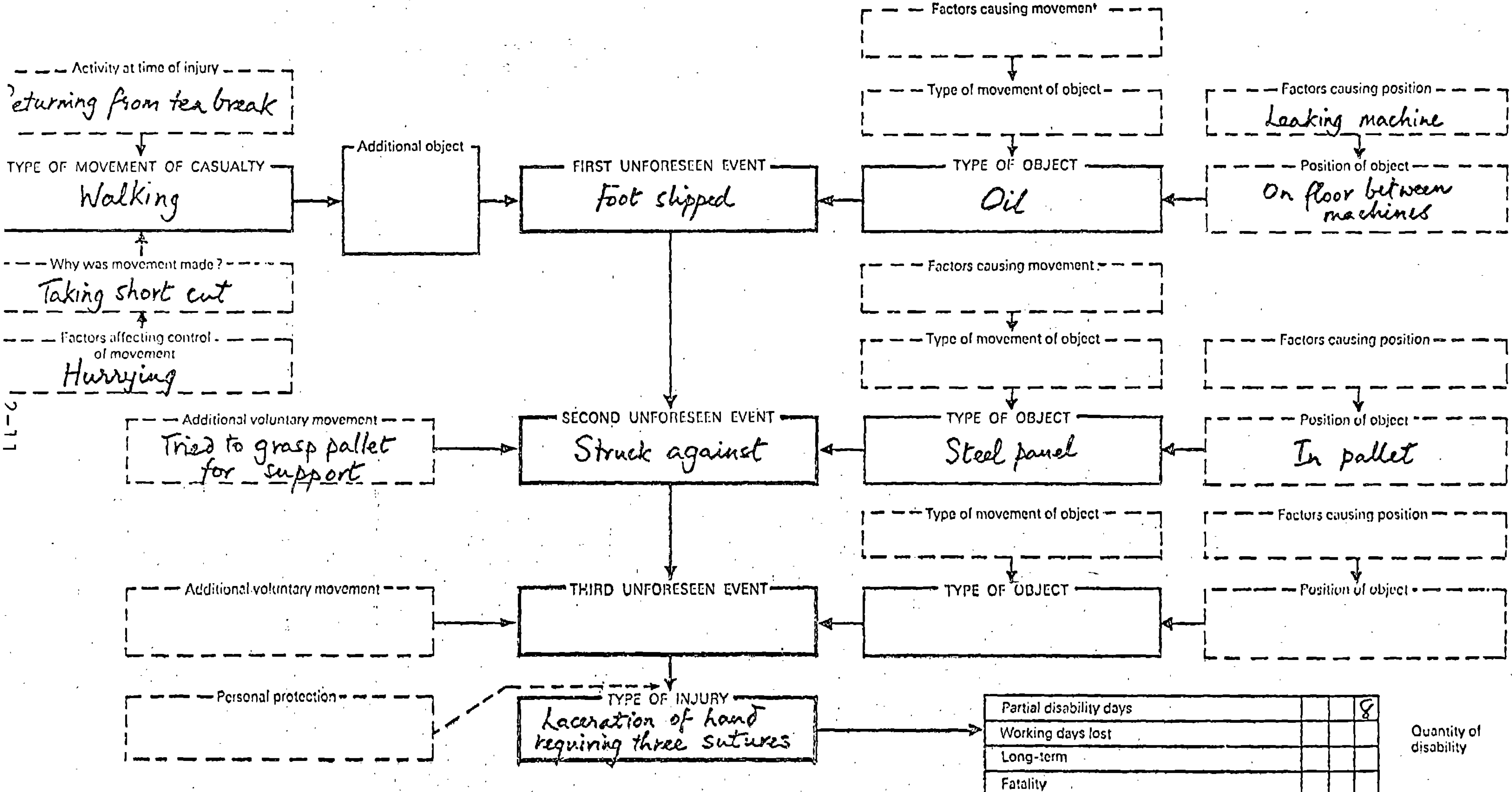
Although quite useful as an analytical framework, no basic definitions, investigation method, instructions, or supportive data are offered for implementing the approach. More information detail is also possible than the RoSPA approach permits. Nevertheless, the key ingredients for a comprehensive injury report/accident investigation analysis and coding system suitable for information systems had conceptually evolved. It remained for FRASE coding and AIM to fully develop and implement these concepts and procedures into a workable method.

2.3 FRASE CODING

FRASE coding, based in part on the RoSPA Model and its predecessors, has been developed and used in several recent NIOSH and OSHA studies (previously cited). The method is based on the use of phrases (hence the acronym FRASE), that are constructed by coding individual words in a structured format with defined relationships rather than using a single code for an entire phrase. This makes it possible to access cases by key words and to code more nearly what happened rather

FIGURE II-3

RoSPA MODEL



than relate it to some generalized concept. It also makes it possible to code an almost infinite variety of circumstances with a small number of codes. A "dictionary" with approximately 1,100 words is used, including different codes for different verb tenses (e.g., lifting, lifted, was lifted) and codes to show relationships such as "in," "down," etc.

There are four types of phrases in FRASE, each with a predetermined set of elements and structure (see FIGURE II-4). Each phrase type is used to show a particular relationship between objects, persons, and events in an accident sequence. These are: (1) a phrase to describe persons and objects, including their characteristics and their parts (e.g., broken, inexperienced, unguarded, wearing safety glasses, etc.). The phrase structure for coding objects and persons is used as a subphrase in the other three phrase types. (2) A phrase to describe locations and positions of persons or objects (e.g., "riding on a conveyor," or "protruding from a container." (3) A phrase to describe places of movement (to and from) of persons or objects, e.g., "a box fell <u>from</u> a hoist <u>to</u> the walking surface," or "the employee stepped <u>from</u> the loading dock <u>to</u> the vehicle." (4) Phrases to describe events (and activities) affecting persons or objects. Up to six events can be coded. These include not only the injuring event but the precipitating events that did not injure the employee but led up to the injuring event. Events can happen to the injured employee, to objects, or to the employee coworker. Up to five activities of the injured employee can be coded for a single accident. These four phrase types can be used numerous times, in varying order, for a single accident sequence.

The output of the coding method is in the form of computer-generated sentences in which the phrases are linked together to show a sequence of events and the relationship of each object or person to the sequence. These computer-generated sentences, called "profiles," <u>have the advantages of narrative descriptions</u> of accidents in being able to show the complete picture and relationships, but have the <u>added advantage that the computer can be used to identify and tabulate any single factor or pattern of factors</u>. It is possible to tabulate cases by: (1) any single code (e.g., all accidents involving a particular object, location, activity, event, or characteristics), or (2) any combination of codes (e.g., all accidents involving "walking on a conveyor," i.e., an activity and a location; or all accidents involving a sequence of events such as equipment broke/box fell from equipment/box struck injured employee"). The advantages of this method are that it includes multiple events (including the precipitating events that are often more important in the development of countermeasures than the injuring event), multiple activities

FIGURE II-4

TYPES OF PHRASES USED IN FRASE CODING METHOD

Type of Phrase	Use of Phrase	Components of Phrase	Examples of Codes
I. Subject/Object Description Phrases	• employees when they are the subject • objects in activities, events, or which are locations or places of movement	1. Parts of objects or subjects:	belt (of conveyor), top (of table), blade (of saw), hand (of injured employee)
		2. Objects/subjects:	conveyor, saw, table, coworker, supervisor, hammer, ladder
		3.& 4. Characteristics of objects and subjects:	hot, slippery, sharp, unguarded, wearing gloves
II. Location Phrases	In activities or events describes: • location of employees • location of objects • location of location (as when it is important to note that a box, which was the location for some parts, is located on a conveyor)	1. Position:	hanging, protruding, standing (as in employee standing on a conveyor, or, box standing next to conveyor)
		2. Preposition/Direction:	next to, under, around
		3. Part of Location:	
		4. Location:	same as those used in Type II - Subject/Object Description Phrases
		5.& 6. Characterisitcs of Parts and Locations	

Type of Phrase	Use of Phrase	Components of Phrase	Examples of Codes
II. Places of Movement	In activities or events, describes places from and to which employees or objects move.	Connecting Phrase "from"	
		Place employee or object moved FROM:	("employee" or "object fell from" or "employee lifted box from") moving belt of conveyor
		1. Part of place:	
		2. Place:	same as for Type II
		3.& 4. Characterisitcs of part of place:	
		5. Preposition/direction:	
		Place employee or object moved TO:	"broken top of rolling pallet"
		6. Part of Place:	
		7. Place:	
		8. Characteristics of part of place:	same as for Type II
IV. Activity/Event Phrases	• activities of injured employee including general and specific tasks and body positions and movements • precipitating events which lead up to an injuring accident (can involve employees or objects). • accident type events	1. Qualifier:	attempted to, failed to, warned not to
		2. Characteristics of activities or events:	repeatedly, unintentionally, suddenly, over the course of the day
		3. Activities:	lifting, carrying, throwing, stepping
		4. Events:	struck, caught, fell (as in "box fell" or as in "employee fell")
		5. Preposition/Direction:	in, under, by, against

(important in identifying training countermeasures) and multiple objects (important for the development of standards). Also its sentence structure method of tabulation shows the relationship of objects, persons, and events to the accident sequence, i.e., how objects and persons contribute to the occurrence of the injury.

2.4 SUMMARY

The preceding discussion has shown the historical evolution leading up to the development of AIM. It can be seen that previous accident models and analytical frameworks have contributed several significant concepts and procedures. AIM incorporates the most useful of these. The developments as well as the limitations of previous approaches point to several needed features AIM was specifically designed to fulfill. These features are discussed in Section IV along with a detailed description of the investigative and analytical forms comprising AIM. Next, the study approach through which AIM was developed is discussed.

III. STUDY APPROACH

This section describes the study approach through which AIM was developed. The NIOSH protocol called for the development of an accident investigative and analysis procedure through on-site study of 125 select worker accidents. In order to delimit the study to manageable proportions, investigations were to be restricted to one accident type of the contractor's choosing. Slips and falls were chosen by SAFETY SCIENCES for initial application of AIM because:

- they are conceptually complex, involving multiple ANSI accident types in an injury producing sequence of events,
- they typically show a high involvement of human factors,
- they are among the most important types in terms of frequency and severity,
- working surfaces and footwear are a high-priority research area as established by previous NIOSH research(15)

The following discussion includes sampling considerations, conduct of accident investigations, data collection and analysis, and procedures evaluation and modification.

3.1 SELECTION OF PARTICIPANTS

All work establishments participating in the study were selected from the San Diego area in order to affect quick response to alerts of accidents and because of SAFETY SCIENCES' familiarity with members of the local safety community. It was decided to select companies which would represent at least six industry types so as to obtain a broad range of accident circumstances. It was further decided to select approximately 18 establishments to provide some intercomparisons within the six industry types for differences such as organizational factors and to provide a variety of accident experience.

A preliminary list of 57 potential participants was compiled. Twenty of these which employed less than 200 employees were eliminated from consideration as being too small to yield a sufficient number of falls within the approximately 12 month investigation period. The remaining establishments, comprising a pool of potential participants, were contacted by telephone regarding their voluntary cooperation. The purpose of the phone call was to briefly introduce the project to whomever was responsible for safety activities at the establishment and to seek a personal appointment to explain the details of the project with that person. Some establishment representatives at this point declined to participate in the study citing a variety of reasons, such as current labor disputes, proprietary reasons, disruption of plant routine caused by outsiders, etc.

Meetings with safety management personnel from the establishments were then organized in order to explain the purposes and benefits to be derived from the study as well as to detail the procedures to be involved and the exact role of the participants. A brochure summarizing the main points of the study was prepared for distribution at these meetings.

Methodology development was stressed as the primary purpose of the study. The explanation of the study approach included limitation to falls type accidents only. It was explained that the methodology was to be developed by means of field administration of the data collection instruments at 125 actual accident sites, that employee interviews were to be an integral part of the procedures, and that approximately 5 to 20 investigations were expected to be conducted at each establishment. The need for a timely notification of falls accident occurrences to SAFETY SCIENCES was stressed. The requirement for the collection of records on prior falls accidents for Track Record purposes and the need for the notification of a total of 500 fall accidents during the course of the study was outlined. The purpose of the collection of both sets of additional data was to ensure that the group of accidents which had been investigated were representative of a broad range of fall accident factors.

A flow chart, "FALLS STUDY ACTIVITY SEQUENCE" (FIGURE III-1) was exhibited to demonstrate the activities required of participants to facilitate the conduct of the accident investigations. All activities required were explained as summarized below:

- provide Track Record data (prior falls experience)

- provide First Reports of fall accidents during the course of the study

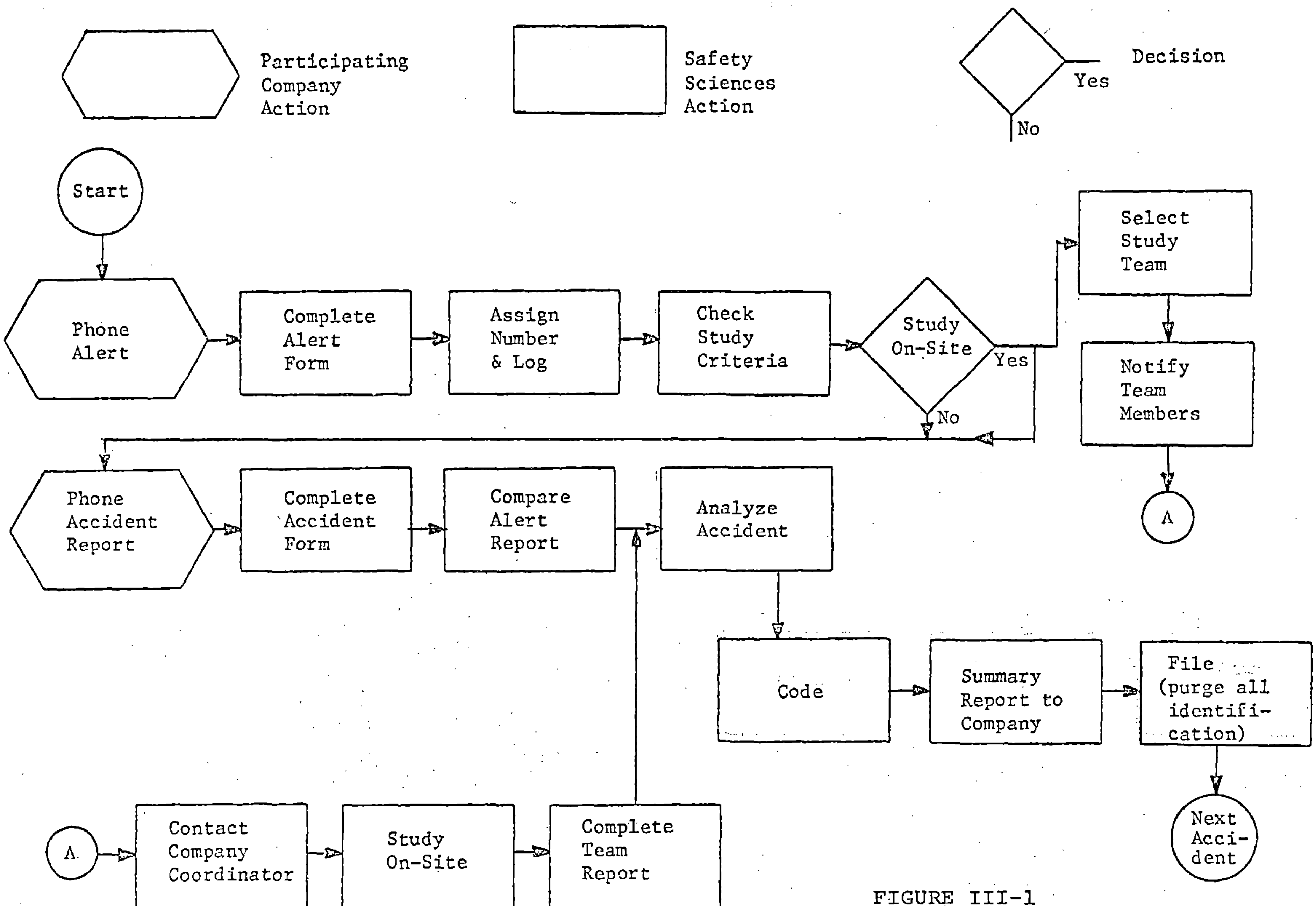


FIGURE III-1

FALLS STUDY ACTIVITY SEQUENCE

- provide timely telephone alert of fall accident occurrences to SAFETY SCIENCES

- assign a representative, if necessary, to contact interviewees and accompany the investigation team members

- provide access to establishment facilities and personnel

The benefits to be derived by the participants were explained as follows:

- data analysis of their companies' fall injury experience including two reports: the Track Record data and fall accident investigation data collected during the course of the study

- hazards and countermeasures related to falls in general from analysis of data pooled by all establishments

- work surface coefficient of friction testing of applicable accident sites and other areas of interest to the safety management

- a copy of and training in the use of the finalized Accident Investigation Methodology (AIM) as developed for fall type accidents

The presentation was concluded by an offer from SAFETY SCIENCES to further brief other interested persons from the establishment whose approval or cooperation may be needed. These persons were typically department heads or from upper management.

Eighteen establishments initially agreed to participate. Three of these declined participation within a one month period. These were relatively small establishments and it was felt that the remaining 15 participants represented sufficient size and industrial diversity to provide a variety of fall accident circumstances. FIGURE III-2 shows a listing of the study participants.

One participant, establishment #4409, reported that only four falls had occurred during the previous year.

FIGURE III-2

DESCRIPTION OF PARTICIPANT ESTABLISHMENTS

Code #	SIC	Approximate Number of Employees	Approximate Number of Falls per Year	Operational Description
4401	8062	920	20	Medical and surgical hospital
4402	9199	6,000	230	Local government
4409	5211	500	4	Wood products manufacture and sale
4413	3511 2899 3563	700	unavailable	Manufacturer of chemicals, engines and turbines and air compressors
4417	8221	5,000	30	College, university
4418	3661	500	20	Manufacturer of telecommunications apparatus
4426	37	6,160	125	Manufacturer of transportation vehicles
4427	7349	150	10	Building maintenance service
4431	3728	5,000	unavailable	Manufacturer of aircraft parts
4452	3731	6,000	216	Ship construction, repair, conversion
4466	9199	9,000	35	Local government
4467	7999	unavailable	35	Amusement and recreation services
4471	8062	1,900	25	Medical and surgical hospital
4491	8221	2,700	37	College, university
4496	2099	2,000	41	Fast food restaurant chain
		46,230	788	

Establishment #4409 was included as a participant, however, because it was felt they had some interesting and unique operational characteristics. Further, it was suspected that the small number of falls might be an underestimate, especially with 500 employees, and that this was possibly a result of differences in definitions.

3.2 ESTABLISHMENT FAMILIARITY

Initial visits were paid to participants for the purpose of familiarizing the study team with the establishment. Analysis of establishment characteristics was accomplished by interviews with safety management, walk-through familiarization tours of the plants, and analysis of accident records.

Safety management was interviewed to determine such establishment background data as (see EXHIBIT 2, Establishment Background Data form):

- establishment organizational structure
- safety organizational structure
- extent of safety programs and policies
- how programs and policies are communicated
- recordkeeping systems and procedures
- particular establishment problems related to fall type accidents
- changes in accident experience as a result of particular safety policies and programs
- trends in distributions of falls such as by specific locations, operations, time of day, etc.
- operational characteristics, such as shifts and hours, task activities, job classifications, layout of facilities
- employee characteristics, such as hours of exposure, various distributions by departments and job classifications, absenteeism, turnover rates, etc.

Walk through tours of plant facilities were conducted by the safety representative or his designate. One purpose was to distinguish significant areas of interest to the study such as various work surface types and hazards of specific locations such as machinery, high energy sources, types of equipment and storage facilities, etc. Another purpose for the tours was to familiarize study team members with plant facilities and layout so as to provide ready knowledge of the locations of such places as administration, safety offices, production facilities, medical facilities, indoor and outdoor routes of travel. It was also desirable to familiarize study team members with relevant establishment design and environmental characteristics, such as lighting, flooring materials and work surface design, availability of work space, housekeeping, noise, etc.

Fall accident experience data (Track Records) was analyzed for three purposes:

- study team familiarization with establishment's "falls" history

- report to NIOSH on establishment operational characteristics and fall accident experience to show representativeness to general industries and availability of data (see FIGURE III-3 for an outline showing Track Record outputs to NIOSH - detailed in Volume II of this report)

- analysis of injuries relevant to safety management needs for the participating establishment in consideration of their participation (see FIGURE III-4 for an outline showing Track Record outputs to establishments)

Accessing of data was comprised of the review of First Reports of Injury with fall as the accident type from establishment records. Generally one year's experience was accessed except in the case of some smaller establishments for which more than one year's experience was reviewed. All relevant factors, including available severity data, were analyzed. When other records were available, such as establishment investigation reports and medical treatment records, they also were analyzed. During periodic establishment visits throughout the course of the study, attempts were made to update Track Record data and, especially, to follow-up on severity data.

FIGURE III-3

OUTLINE OF TRACK RECORD OUTPUTS FOR NIOSH

I. Background

  A. Representativeness to general industry

    1. activities
    2. SIC

  B. Size

    1. # of employees
    2. distribution of employees by activities (if available)

  C. Safety organization

    1. safety policy (not included in Track Record)

  D. Types of data available

    1. injury report form (I.D. deleted)
    2. other applicable forms

II. Determination of Establishment Suitability for Study (Analysis of Fall Accidents)

  A. Injury experience

    1. incidence rates for falls (if basing data available)
    2. incidence rates for all types (if data available)

  B. Scheduling

    1. number of injuries to be expected during course of study
      a. falls by month (graph)
    2. availability of falls during business hours
      a. falls by hour of the day (graph)

  C. Accident circumstance factors

    1. types of falls
      a. definitions
      b. distribution
    2. hazards (chart)
      a. categorical hazards (broad)
      b. specific, actual hazard
    3. work tasks (chart)
      a. broad
      b. specific activity
    4. action - body position (chart)
      a. hands
      b. feet
      c. trunk
    5. location types (chart)
    6. injury types (chart)
      a. part of body
      b. nature of injury

FIGURE III-4

OUTLINE OF TRACK RECORD OUTPUTS FOR ESTABLISHMENTS
(Safety Management Information)

I. Analysis of Fall Accidents

   A. Injury experience analysis including:

      1. incidence rates for falls (if basing data available)
      2. incidence rates for all types (if basing data and data on other AT's available)
      3. falls by month of the year (graph)
      4. falls by hour of the day (graph)
      5. falls by hour into the shift (if available)

   B. Employee characteristics

      1. falls by age groups (graph)
         a. use "ogive" if basing data is available
      2. falls by experience groups (graph)
         a. use "ogive" if basing data is available
      3. falls by department and occupation (chart)

   C. Accident circumstances

      1. types of falls (chart)
         a. definitions
         b. distributions
      2. hazards (chart)
         a. categorical (broad types)
         b. specific
      3. work tasks (chart)
         a. broad
         b. specific activity
      4. action - body position - how task was performed (chart)
         a. broad types
         b. specific positions
            a) hands
            b) feet
            c) trunk
      5. location types (chart)
      6. injury types (chart)
         a. part of body
         b. nature of injury

An Organizational Safety Analysis Checklist (see EXHIBIT 2) evaluating the establishment was completed at this time or at a time when sufficient information on the organization had been gained. This checklist was later used as an adjunct to accident analysis.

3.3 FALL ACCIDENT EVENT NOTIFICATION

During the establishment familiarization visits the exact details of the participants' role regarding injury notification to SAFETY SCIENCES was discussed. The establishment contact person was identified, generally the person in charge of recordkeeping, and the study was explained to them. A set of operational definitions was provided to ensure notification would be informed and follow standardized guidelines and so that no desired data would be lost because of differences of definitions.

The types of data required for notification were explained and a sample "Falls Alert Form" (see FIGURE III-5) was provided for this purpose. The established procedure involved a telephone alert. Timeliness of telephone contact was emphasized. When SAFETY SCIENCES was alerted to a fall occurrence, a Falls Alert Form was filled out for each of the 500 accidents reported and put on file. Each accident was assigned an identification number which included the date and the sequence of the occurrence. This number was entered in a log which included other identifying data, such as establishment code number and fall accident type.

3.4 CRITERIA FOR SELECTION OF INVESTIGATED ACCIDENTS

Once SAFETY SCIENCES had been alerted to a fall accident, a decision whether to perform an in-depth on-site investigation was made.

No attempt at random or stratified sampling was made since the primary purpose of the study was methodology development and not the acquisition and statistical analysis of "falls" data. A statistical study would have required sampling in order to constitute a representation of the "universe" of falls accidents.

FIGURE III-5

FALLS ALERT REPORT

SAFETY SCIENCES
(714) 452-1010

Data to Report:

1. Company name or code number: ____________________

2. Your name and telephone no.: ____________________

3. Accident date and time: ____________________

4. Accident Location - address if different from company address:

5. Accident Site - specific area, e.g., loading dock, stairs to office:

5. Employee Name (if given):
   Job:
   Injury:
   Condition:
   Location next 24 hours:

6. Names and availability of witnesses, employee's supervisor:

7. What was employee doing at time of accident?

8. Describe accident briefly:

9. Describe surface involved, e.g., tiled floor, graveled lot, concrete floor:

   Describe condition, e.g., wet, oily, dry, coarse material, etc.:

10. If outside - weather and lighting:

    If inside - lighting:

11. Is accident site accessible to SAFETY SCIENCES Team?
    When?:
    Contact:

Criteria for the decision to investigate a particular fall accident included:

- authorization by the participating establishment
- representativeness of a broad mix of workplace conditions, fall accident types and factors
- fall accidents representative of general industry work tasks and situations, e.g., no fall accidents involving recreational activities and situations such as violent acts
- a minimal elapsed time between occurrence of the event, the alert, and the subsequent mobilization of the investigation team, typically about 48-72 hours
- scheduling availability of interviewees at time convenient to the study team and the availability of team members
- fall accidents which promised to be reasonably reconstructable in order to adequately develop the methodology
- fall accidents not involving permanent disability or death, so as not to be burdensome to the victim and participating establishment

3.5 MOBILIZATION OF INVESTIGATION TEAM

Once an accident occurrence was selected for in-depth study arrangements were made by the project coordinator to schedule the investigation. These arrangements included:

- select composition of study team from specialties appropriate to accident circumstances. The study plan required a multidisciplinary team in order to yield a comprehensive accident investigation methodology. Development of AIM relied on continuous interaction and input from the team. Study team members included:

1) a physician, highly experienced in accident epidemiology

2) an industrial psychologist, experienced in interview techniques and organizational analysis

3) a safety engineer, with a wide variety of plant safety experience

4) a human factors engineer, experienced in a variety of work site evaluations

5) a safety management and injury records specialist, experienced in analyzing occupational injury records

- contact selected study team members to determine their availability

- contact the establishment representative or the injured employee's immediate supervisor to schedule a mutually convenient appointment time

- recontact study team members and/or contact alternates to confirm meeting times and places

- assemble necessary forms and equipment for conduct of the investigation

A maximum of three team members participated in any single investigation so as to prevent disruption of the establishment's routine. The safety management and injury records specialist participated in all investigations, for the purposes of continuity and project coordination.

3.6 MODIFICATION OF NOTIFICATION PROCEDURE

After several months it became apparent that the specific falls alert notification procedure established was not functioning adequately for meeting criteria of timely notification. It was found that, for a variety of reasons, establishment representatives were not always able to affect a timely telephone alert to SAFETY SCIENCES regarding a fall accident occurrence.

An alternate procedure agreeable to all the participants was arranged whereby telephone alerts by the establishments was discontinued and the project coordinator contacted each establishment representative on a regular basis to determine if any fall accidents had occurred since the last phone contact. Establishments were contacted semi-weekly, weekly and bi-weekly, depending in their fall accident experience as established by review of Track Record data. Alerts were then filled out as before and the procedure followed as established in Sections 3.4 and 3.5.

3.7 CONDUCT OF IN-DEPTH INVESTIGATIONS

A number of sources were generally available for accident data collection. These sources included the injured employee, witnesses, immediate supervisors, medical treatment personnel, personnel officer, safety officer, employee records, and accident site. Rather than design separate instruments to administer to each source, one instrument, covering all accident factors, was developed to be administered to the sources most able to provide or confirm the accident facts. (See EXHIBIT 2 for Fall Accident Investigation Report.)

The source which could routinely provide the greatest number of facts was the injured employee. The accident victim was not only a witness to the accident circumstances and the sequence of events, but was the most informed source on some factors such as vital data, temporary health, footwear and could also provide completed related background information on factors such as chronic health conditions, behavioral states, job experience and other contributing or predisposing conditions. Consequently, the injured employee interview was considered to be a crucial component of AIM.

Injured employee interviews entailed:

- introduction and identification of study team members

- explanation of purpose and activities of the study. Anonymity of both individuals and companies was ensured. (See FIGURE III-6 for a standardized statement which was always used in addition to personalized explanation.)

FIGURE III-6

PERSONNEL INTERVIEW INTRODUCTORY STATEMENT

Hello, we are _______________ and _______________ from SAFETY SCIENCES, a private company who has been contracted by the federal government to develop procedures for studying causes of workplace accidents and to try out these procedures in looking at occupational fall accidents. Your company's management has agreed to join in this study together with about 15 other companies in the San Diego area. Your participation is purely voluntary and no identifying information about you or your company will be recorded anywhere. The information you give will be held in confidence and will be used for statistical purposes only.

- administration of the Fall Accident Investigation Report. This instrument was structured to follow the temporal sequence of activities and events. Administration, however, required an introductory item which asked for a description of the accident in the employee's own words. This item was designed to verify that the accident indeed met study criteria and to establish a basis for investigation into personal areas and also to immediately establish a rapport by allowing the investigators to exhibit sympathy for the sustained injury.

- evaluation of accident site including reenactment walk-through of the accident sequence

- administration of the OMB participant consent form (see EXHIBIT 1 for a copy of the form and FIGURE III-7 for the standardized statement introducing the form).

The time required for interviewing establishment personnel was usually no greater than 20 minutes and the total site investigation was generally completed in less than an hour. In some cases, however, additional time (sometimes at a later date) was required for obtaining follow-up data, e.g., severity, total cost and lost time.

Other sources were routinely used to supplement and confirm data provided by the injured employee. The physical parameters of all the accident sites were evaluated, measured, and documented by the team members.

The following equipment was made available for site investigations:

- tape measure

- work surface COF tester

- light meter

- psychrometer (humidity)

- inclinometer

FIGURE III-7

OMB PARTICIPANT CONSENT FORM INTRODUCTORY STATEMENT

This is a participant consent form required for all federal government research studies because of all the recent interest in protecting people's right to privacy. This standard form explains that you have participated voluntarily and that absolutely no disclosure of the information you have provided will be made to anyone. Please read this and sign in the appropriate places.

- sound level meter

- polaroid camera, where allowed by the establishment, to document site features. Where cameras were not allowed, diagrams of the site features were drawn.

Witnesses, if any were present, were questioned concerning the work environment and sequence of events. The injured employee's immediate supervisor was interviewed when it was desirable to learn more about the injured employee's training, experience, safety supervision, attitude and other predisposing conditions. Employee records were occasionally consulted to determine personal fall accident history, although the injured employee was found to be a reliable and immediate source of such data. The establishment's safety officer was consulted concerning evaluations of specific hazards and the feasibility and likely effectiveness of countermeasures which might be planned by the establishment or which were suggested by SAFETY SCIENCES.

3.8 ANALYSIS OF METHODOLOGY AND APPROACH

Accident investigation results were informally reviewed by the team members immediately following the investigation. The purpose of this procedure was to ensure that all team members agreed on the accident sequence of events, factor relationships, characteristics and conditions and that a multidisciplinary perspective was taken into account.

An iterative approach was taken in the development of AIM, that is, the investigation and analysis procedures developed during the course of studying 125 fall accidents in-depth were replicated, evaluated and revised numerous times to evolve a final set of procedures. With each evaluation, items which were determined to be unnecessary or unsuitable were winnowed out. Items which solicited data on valid factors but which were not satisfactory in accessing that data were restructured. Factors which were absent from the Fall Accident Investigation Report, but had been discovered as possibly relevant were structured into items and added.

Informal meetings for the purpose of reviewing completed accident reports were periodically convened with the project staff. These reviews were conducted for the purpose of revising the methodology and approach. This systematic content analysis was aided by each team member's growing fall accident investigation experience and insights during the course of the study.

Iterative analysis of the methodology was predicated on satisfying the following general criteria:

- availability of data
- universality of data
- accessibility of data
- relevance of data to determination of hazards
- readiness with which approach suggested countermeasures
- time required to adequately conduct investigation

3.9 ANALYTICAL PROCEDURES

Data obtained from the 125 fall accident investigations was analyzed so as to isolate hazards, determine and evaluate countermeasures. The analytical procedures developed for data analysis are discussed in Section IV.

3.10 ANALYSIS OF DATA

Analysis of the fall accident data is the subject of Volume II of this report. Analysis of the data served three purposes:

- partial validation of AIM, i.e., with respect to fall accident occurrence
- report to NIOSH on the characteristics of accidents related to work surfaces and footwear, two priority research areas as established by previous NIOSH research
- feedback to participating establishments of fall accident experience in consideration of their participation in the study

For more information concerning work surface related injuries, see another recent report performed for NIOSH. (16)

IV. ACCIDENT INVESTIGATION METHODOLOGY (AIM)

Preceding sections have discussed background to the development of AIM as well as the study approach by which the development of AIM was accomplished. This section discusses the specifics of AIM - its conceptual basis, features, components and utilization procedures.

4.1 CONCEPTUAL BASIS OF AIM

FIGURE IV-1 presents diagramatically the conceptual basis of AIM. AIM is a set of accident investigative and analytical procedures emphasizing multifactor relationships and sequence of events. It is designed to be used in conjunction with FRASE coding. As can be seen in FIGURE IV-1, multiple hazards combine in a series of events to disrupt normal work activity. When this happens, an accident occurs. By utilizing AIM in the investigation and analysis of the specific accident circumstances, hazards are analyzed and linked directly to specific and practical countermeasures. If applied, the countermeasures will mollify the attendant hazards to prevent reoccurrence of similar accident circumstances.

In discussing the conceptual basis of AIM, it is useful to consider certain basic distinctions:

- An accident is considered to be any untoward series of events which disrupt ongoing work activities resulting in injury.

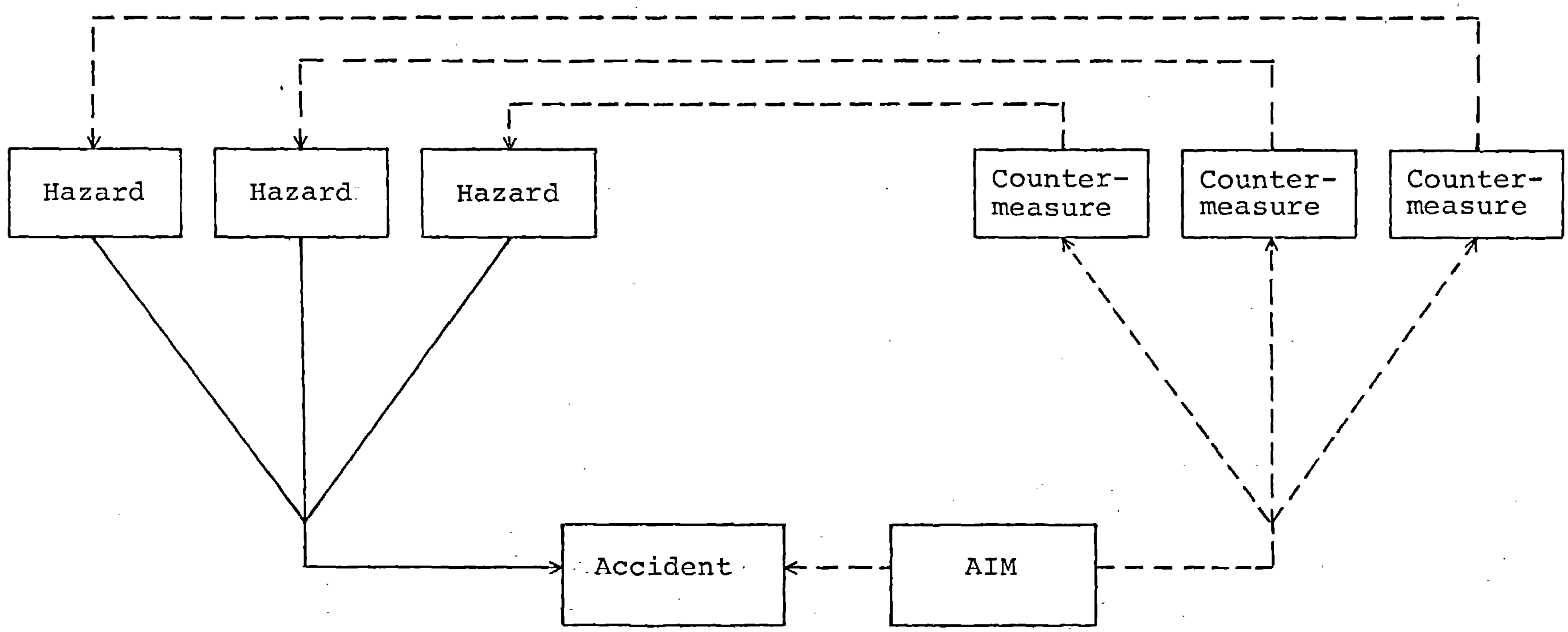
- An incident, on the other hand, is any untoward series of events disrupting ongoing work activities, but not resulting in injury.

- An activity, as opposed to an event, is a regular task operation which may or may not be a part of the injured employee's usual job.

- AIM distinguishes an event as the untoward disruption of normal work activity. Events may be movements of either persons or objects.

FIGURE IV-1

CONCEPTUAL BASIS OF AIM



- An error is considered to be either a missing or inappropriate response. Errors may be either worker or management induced.

- A hazard is any characteristic or condition which increases the risk of injury.

- A characteristic or condition can be a distinguishing trait, feature, or quality of an activity, event, location, organization, person, or object. It is important to note that aspects of organizations and persons, as well as objects, etc. can be hazardous, e.g., inadequate training, inadequate supervision, overweight, fatigued.

- A countermeasure is any action taken to prevent accident reoccurrence. Countermeasures ameliorate or control specific hazards.

For the purposes of this study, a fall is considered to be any event in which a person loses postural control. The following eight fall accident types are distinguished:

- Slip - a type of fall induced by loss of friction on the supporting surface or subsurface resulting in loss of postural control (includes sliding and rolling friction).

- Trip - a type of fall induced by an object(s) or structure(s) protruding into the path of the foot and arresting its movement prematurely resulting in a loss of postural control.

- Stumble - a type of fall induced by excessive friction (surface, bump-grade, change of gait) in which the motion of the foot is prematurely arrested resulting in the loss of postural control.

- Misstep - a type of fall in which the foot is put down where there is no support, as in putting foot down wrong or in abnormal angle (turning ankle), beyond surface (step) edge, or stepping in hole.

- External Force - a type of fall induced by an external force being applied to the body sufficient to cause loss of postural control.

- Postural Overextension - a type of fall in which postural control is lost due to over-extension of body in which the center of gravity passes beyond the center of support or mass.

- Support Loss - a type of fall induced by failure or movement of supporting structure.

- Organic - a type of fall induced by loss of perceptual-motor capability.

4.2 FEATURES OF AIM

AIM has several distinguishing features. These are summarized in FIGURE IV-2 and discussed below:

- AIM is analytical. It provides a structured framework for accident investigation and analysis useful in establishing an accident information data base. It goes far beyond traditional narrative approaches. AIM is designed to be used in conjunction with FRASE coding. Consequently, factor relationships and event sequences can be encoded and retrieved.

- AIM is systematic. It directs the investigator through the accident sequence. Information is both gathered and analyzed sequentially. Thus, factor relationships and sequences of events are preserved. A simple charting method using English language phrases provides a direct, easy to read account of all pertinent accident circumstances. The analyzed information FRASE coded, along with other investigations and injury reports, can be used to reveal overall accident patterns for a variety of research or program evaluation purposes.

FIGURE IV-2

FEATURES OF AIM

- Analytical
- Systematic
- Objective
- Countermeasures-Oriented
- Comprehensive
- Detailed
- Practical
- Eclectic

- AIM is objective. It stresses the gathering of accident facts. Hazards are directly analyzed without determination of cause or fault. AIM requires no value judgments. Hazards are not judged to be "primary" or "contributing." They are numbered for procedural purposes only in order of occurrence in the accident sequence. Thus, all hazards are analyzed equivalently.

- AIM is countermeasures-oriented. It is directed toward problem solutions, not simply problem understanding. Analysis of hazards leads directly to identification of countermeasures. Novel analytical procedures provide insights into non-obvious countermeasures. Potential countermeasures are objectively evaluated according to ten implementation criteria.

- AIM is comprehensive in scope. It stresses multi-factor involvement. All potentially applicable accident factors are obtained and analyzed, including facts concerning the organization, injured employee, work environment, work task, accident events and consequences. AIM emphasizes the involvement of human factors in accident occurrence. Both management oversights and worker errors are evaluated with impunity. To insure its comprehensiveness and multidisciplinary perspective, a team of safety experts contributed to its development.

- AIM is detailed in content. It is designed to be in-depth and thorough so that all accident facts can be ascertained in a single site visit. Information is obtained by a combination of interview and observation methods. Essentially, all individuals who can provide useful data are interviewed, including the injured employee, coworkers, witnesses, employee's supervisor, and company safety officer. Observations of the accident site and of pertinent company records are made. A variety of environmental and descriptive measurements are likewise recorded as appropriate.

- AIM is practical in approach. It is capable of obtaining a great deal of useful information in a short amount of time. Typically, investigations take less than one hour total to complete, with only about 20 minutes necessary for interviewing personnel. AIM was developed by a multidisciplinary team of safety experts in order to insure comprehensiveness and practicality. However, investigations can be performed by a single trained investigator. The investigative and analytical methods are sufficiently easy to use and to interpret.

- AIM is eclectic. It incorporates several useful concepts of earlier, less complete, accident models and investigation frameworks, e.g., multi-factor involvement, management oversight, non-culpable error, risk-taking, situation proneness. Furthermore, AIM adopts useful procedural approaches, e.g., phrase charting of factor relationships and event sequences, FRASE coding, multidisciplinary perspective.

4.3 COMPONENTS AND UTILIZATION PROCEDURES OF AIM

AIM is composed of three parts. These are summarized in FIGURE IV-3. The three components, 1) organizational safety analysis, 2) accident sequence analysis, and 3) hazards/countermeasures analysis, are organized from the most general to the most specific levels of analysis. First, overall organizational safety is analyzed. Next, the particular accident sequence is analyzed pointing to associated hazards. Lastly, all identified hazards are analyzed in a manner suggesting specific countermeasures. Potential countermeasures are then evaluated according to several implementation criteria. This process aids the investigator by providing a structured and objective analytical method for revealing insights into safety problems and fixes.

FIGURE IV-4 presents an outline of the Organizational Safety Analysis component of AIM. This component, in turn, is composed of two parts: 1) an Establishment Background Data form, and 2) an Organizational Safety Analysis Checklist. (Copies of all forms comprising AIM and an example of their use are presented as EXHIBITS 2 and 3 respectively at the back of the report.)

FIGURE IV-3

AIM (ACCIDENT INVESTIGATION METHODOLOGY)

- Organizational Safety Analysis
- Accident Sequence Analysis
- Hazards/Countermeasures Analysis

FIGURE IV-4

ORGANIZATIONAL SAFETY ANALYSIS COMPONENT OF AIM

Establishment Background Data → **Organizational Safety Analysis Checklist**

Establishment Background Data

- Demographic
- Exposure
- Management Safety Structure
- Operational Characteristics
- Accident Track Record

Organizational Safety Analysis Checklist

- General Safety Program
- Management Implementation
- Hazard Analysis Activities
- Hazard Control
- Personnel Characteristics

The Establishment Background Data form is designed to collect essential baseline information. Included is information concerning:

- demographic characteristics
- employee exposure
- management safety structure
- operational characteristics
- accident history (track record)

The Organizational Safety Analysis Checklist is designed to evaluate a company's overall safety program. Since management oversights are frequently associated with specific accident circumstances, it is essential to analyze the extent and quality of a company's particular safety program. Such an evaluation provides useful insights for specific accident countermeasures. The Organizational Safety Analysis Checklist assesses 42 specific items concerning five basic organizational areas:

- general safety program
- management implementation
- hazard analysis activities
- hazard control
- personnel characteristics

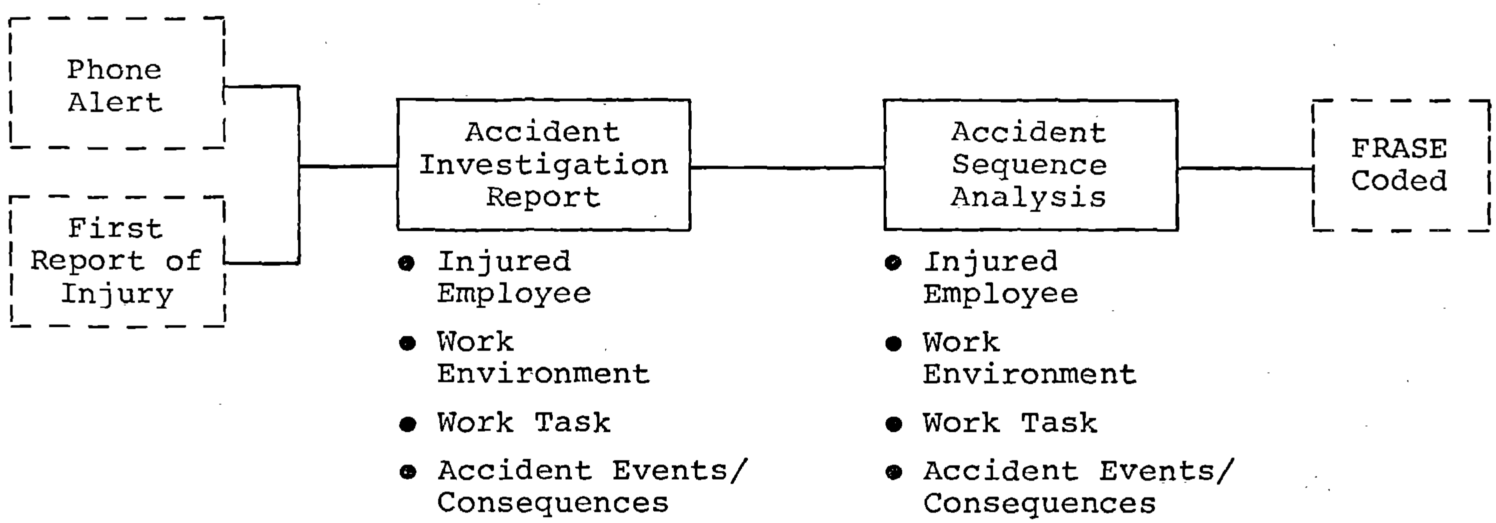
An analysis is made as to whether specific items are lacking, inadequate, minimal, or OK. Items checked "lacking" or "inadequate" pose an immediate safety hazard. Items checked "minimal" require less immediate attention, however, should eventually be upgraded. Those items checked "OK" are evaluated as being adequate or non-hazardous with respect to accident potential.

The organizational Safety Analysis Checklist should be used each time a serious or fatal accident occurs. If few severe accidents occur, yearly updates should be the minimum requirement.

FIGURE IV-5 presents a summary of the Accident Sequence Analysis component of AIM. This component is, also,

FIGURE IV-5

ACCIDENT SEQUENCE ANALYSIS COMPONENT OF AIM



composed of two parts: 1) an Accident Investigation Report, and 2) an Accident Sequence Analysis flowsheet. It is through these two forms that the specific accident circumstances are investigated and analyzed.

As discussed in Section III, basic information about the accident circumstances is available from either a Phone Alert and/or review of the establishment's First Report of Injury. It is good procedure for the accident investigator to familiarize himself with the reported circumstances before conducting the investigation.

The (Fall) Accident Investigation Report is designed to gather information about a variety of potential accident factors, including information about the injured employee, work environment, work task, specific accident events and consequences.

Information about the injured employee includes:

- vital data
- chronic health
- acute health
- behavioral state
  - attitude
  - stress
  - fatigue
- job classifications
- experience
- fall history
- safety training
- supervision

This information provides background data on the accident victim as well as on predisposing conditions which may have contributed to accident occurrence.

Information about the work environment includes:

- accident site
- characteristics or conditions of accident site
- ambient environment

This information fills in additional background and possible contributing factors.

Information concerning the work task includes:

- general task function
- specific activity
- exposure
- characteristics or conditions of specific activity
- hands action
- objects held or tools used
- characteristics or conditions of objects held or tools used
- location of movement
- body position
- feet action
- footwear (type)
- characteristics or conditions of footwear
- surface type(s)
- characteristics or conditions of surface type(s)

This information provides specific activities prior to initiation of accident events, information specific to fall accident occurrence, and precipitating events leading to a fall accident occurrence. Most of the information specific to falls is contained in this part. The other three parts of the (Fall) Accident Investigation Report largely concern information general to all accident types. Consequently, expanding AIM to cover additional accident types would mainly involve modification of Part III, Work Task.

Information concerning accident events and consequences is contained in the fourth and last part of the Accident Investigation Report. As can be seen, this information is generally less structured than that comprising the other three parts. That is because specific accident events vary considerably, whereas antecedent factors can be more easily structured. The Accident Investigation Report ends with a full documentation of measurement and illustrative data including:

- weather
- noise
- lighting
- toxic fumes
- coefficient of friction
- tape measure data
- standards violations
- planned countermeasures
- diagram of accident site and pictures

All items of the Accident Investigation Report are a combination of checking those that are applicable and describing all potentially relevant details. The object at this stage of data collection is to obtain all potentially relevant background and descriptive information. Those items specifically involved in the accident occurrence are sifted out during subsequent data analysis. During the actual investigation, however, any piece of information obtained might later prove crucial to the accident sequence analysis.

It should be mentioned that the items contained in the (Fall) Accident Investigation Report are the product of extensive trial and testing. However, occasionally other follow-up issues seem appropriate in specific cases and should be pursued. The items contained are sufficiently comprehensive for the vast majority of cases. However, when deemed necessary other lines of inquiry should be encouraged using those offered as a basis.

Also, not all areas of inquiry are appropriate for all accident circumstances. For example, it serves little purpose belaboring employee health information if a work surface collapses or the victim is pushed. In the first instance, characteristics of the work surface, work environment, maintenance and inspection procedures, etc. should be closely scrutinized. In the second case, involving horseplay, worker's attitude and extent of supervision, training, etc. should be emphasized. Therefore, use of the form should be adapted to the apparent circumstances gained from preliminary information, e.g., First Report of Injury, Phone Alert, description in employee's own words.

The information to be charted on the Accident Sequence Analysis flowsheet directly parallels that in the Accident Investigation Report. The numbers in each box correspond identically to like items in the investigation report within each major heading:

- I. Injured Employee
- II. Work Environment
- III. Work Task
- IV. Accident Events/Consequences

Looking at the example case (EXHIBIT 3), it can readily be seen that these numbers follow the flow of circumstances and events in easy to read and interpret narrative English. A major advantage of AIM, over unstructured accident investigation narratives, is that factor relationships and event sequences can be encoded, through FRASE coding, and the information can later be retrieved. Consequently, results of accident investigations, like injury reports, can become part of a comprehensive, accident data base.

A comparison of a FRASE coded accident investigation and its corresponding First Report of Injury is shown in EXHIBIT 4. Note the difference in amount of detail and characterization of accident circumstances. In addition, generic types of hazards and countermeasures can be coded for later retrieval of all similar accident investigation profiles in the data base.

The Accident Sequence Analysis begins the analytical process by which specific hazards and countermeasures are determined. Only that information from an investigation report which specifically relates to the accident occurrence is entered onto the Accident Sequence Analysis. Hazards, it will be remembered, are defined by AIM as any characteristic or condition which increase the risk of injury. Characteristics or conditions are defined, once again, as a distinguishing trait, feature, or quality of an activity, event, location, organization, person, or object. Consequently, hazards can be ascribed to organizations and persons as well as situations and circumstances as traditionally conceived. It is at this point that reference back to the Organizational Safety Analysis Checklist is helpful for documenting specific management oversights. For example, inadequate safety training or safety supervision as well as being overweight or fatigued is every bit as much a hazard in AIM as a wet floor or steep incline. AIM makes no value judgments as to "primary" or "contributing" factors. Rather, all hazards are documented on the Accident Sequence Analysis flowsheet and are numbered for reference only in order of occurrence in the accident sequence. Appropriate countermeasures are then sought for all identified hazards, as will be shown in the next step. Only countermeasures are evaluated, but objectively with respect to a set of implementation criteria.

FIGURE IV-6 presents a summary of the Hazards/Countermeasures Analysis component of AIM. This component is also composed of two forms: 1) a Hazard/Countermeasure Analysis worksheet, and 2) a Countermeasure Evaluation form. This is the final and most specific analytical step of AIM.

Each hazard identified on the Accident Sequence Analysis flowsheet is then analyzed using an error decision model. It will be remembered that AIM defined an error as a missing or inappropriate response by either management or a worker. Therefore, both management oversights and worker errors are accounted for in AIM. The purpose of the Hazard/Countermeasure Analysis worksheet is to determine where the specific breakdown occurred. Five sequential questions requiring "yes" or "no" decisions are asked:

- Was the hazard detectable by management, injured employee, or both?
- If detectable, was the hazard detected by . . . .?
- If detected, was preventative action possible by . . . .?

FIGURE IV-6

HAZARDS/COUNTERMEASURES ANALYSIS COMPONENT OF AIM

Hazard

↓

Countermeasure → Countermeasure Evaluation

Countermeasure

- Equipment Design Modification
- Equipment Guarding
- Personal Protective Equipment
- Work Surface Modification
- Environmental Change
- Change in Workspace or Work Layout
- Operational Change
- Job Redesign
- Housekeeping
- Maintenance
- Hazard Recognition and Avoidance Training
- Specification/Enforcement of Work Rule
- Supervision
- Employee Selection

Countermeasure Evaluation

- Technological Feasibility
- Cost Feasibility
- Effects on Productivity
- Time Required to Implement
- Durability
- Extent of Enforcement/ Supervision Required
- Reliability
- Extent of Control
- Management Acceptance
- Employee Acceptance

- If preventative action were possible, was it taken by . . . .?

- If preventative action was taken, was it effective by . . . .?

Any "no" response points to a specific countermeasure need. To aid in delineating specific management-directed countermeasures, worker-directed countermeasures, or NIOSH-directed countermeasures (i.e., countermeasures requiring further research), a list of 14 generic countermeasure approaches is provided. They are:

- equipment design modification
- equipment guarding
- personal protective equipment
- work surface modification
- environmental change
- change in workspace or work layout
- operational change
- job redesign
- housekeeping
- maintenance
- hazard recognition and avoidance training
- specification/enforcement of work rule
- supervision
- employee selection

In the final step, each countermeasure is evaluated using the Countermeasure Evaluation form according to ten implementation criteria. They are:

- technological feasibility
- cost feasibility
- effects on productivity

- time required to implement
- durability
- extent of enforcement/supervision required
- reliability
- extent of control
- management acceptance
- employee acceptance

Each, in turn, is evaluated with respect to both short and long-term implementation. By using the Countermeasure Evaluation procedure, objective decisions concerning "best fixes" can be made.

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EXHIBIT 1

OBM Clearance No. 68-S75109
Expiration Date: December 31, 1977

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
HUMAN SUBJECTS RESEARCH PARTICIPANT DOCUMENT

I. PROJECT DESCRIPTION

1. Title and Number: Investigation of Causal Factors in Selected Worker Accidents, Contract No. 210-75-0017.

2. Sponsor: National Institue for Occupational Safety and Health (NIOSH)

   Contractor: Safety Sciences, Division of WSA Inc., 11772 Sorrento Valley Road, San Diego, California 92121.

3. Purpose and Benefits: The aim of this study is to develop a procedure for investigating causes of workplace accidents and to try out such techniques in studying occupational falls. Ultimate benefits of the study will be better understanding of accident causes leading to improvements in occupational safety.

II. CONSENT TO PARTICIPATE

I, ______________________, age 18 or over, hereby voluntarily agree to cooperate in the above named study described in Attachment A. The study has been discussed with me and I have been given a copy of this document. I understand that

1. The procedures to be followed are as stated in Attachment A.

2. The benefits of my participation are as indicated in the "Purpose and Benefits" section described above in item 3 of Part I.

3. Any inquiries that I have concerning any aspect of my participation in this study will be answered by the project director, Dr. D.M.J. Compton, 755-9359.

4. I am free to terminate my consent and to discontinue participation in the project at any time without prejudice to myself.

5. My identity and my relationship to any information disclosed by or about me is not being recorded and so no information concerning me will be disclosed in a manner which identifies me with such information. The information that is being recorded will be used for statistical and research purposes. Finally, since my employer may have knowledge about the factual information disclosed, no

information given by me or others for purposes of this study will voluntarily be disclosed to the employers whose employees are participating in the study although the final report, which will be published in a manner which makes it impossible to identify individuals with the information they furnish, will be public information.

6. I understand that my company medical and personnel records will be reviewed by the contractor for the purpose of this study.

SIGNATURE________________________ DATE______________
Subject

INVESTIGATOR______________________________________
Name

____
Title

____
Signature

SAFETY SCIENCES, Division of WSA Inc.

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
HUMAN SUBJECTS RESEARCH PARTICIPANT DOCUMENT
ATTACHMENT A

A. Project Title and Number: Investigation of Causal Factors in Selected Worker Accidents. Contract No. 210-75-0017.

B. Procedures:

The National Institute for Occupational Safety and Health (NIOSH) has contracted Safety Sciences, Division of WSA Inc., located in San Diego, to carry out a study on "Investigation of Causal Factors in Selected Worker Accidents."

The aim of this study is to develop procedures for investigating causes of workplace accidents and to try out such techniques in studying occupational fall accidents. Your company management has agreed to join in this study together with about 20 other companies in San Diego County.

When a fall accident occurs, trained safety experts may make an investigation at the site. Members of the team will then interview management personnel, the employee involved, and witnessess to the accident.

Your participation will involve answering questions either as the employee involved in a fall accident or as a witness. The questions are designed to develop and test the investigation process and to analyze the causes of fall accidents in general, rather than to affix a specific cause to any individual accident. No question of "blame" or "fault" will arise as a result of the investigation. Your participation is purely voluntary and you are free to withdraw from the study at any time. What you say will be held in confidence. The information you give will be written down, but neither your name, your social security number, nor other identifying information will be written down anywhere. A description of the accident and of the factors thought to be involved will be published (with 124 other accidents) in a final report, but neither you nor your employer will be identified.

This study will not affect your job status, health, or well-being. In addition, your company medical and personnel records may be reviewed as a part of this study.

A copy of the Consent Form and this explanatory attachment will be left with you.

6

Summary:

Safety measures must be based on facts, not guesses or some convenient catch-all "reason", if they are to work. The information you provide may help to develop important new methods for preventing occupational injuries.

To join in, you must be of age to give consent (over 18), and you must express your written consent. This is required by government regulations for all government research studies. You may end your participation in this study at any time without any effects on you.

7

EXHIBIT 2

8

ESTABLISHMENT BACKGROUND DATA

Establishment No. ______

I. DEMOGRAPHIC CHARACTERISTICS

1. Primary standard industrial code (SIC) ______
2. Brief operational description ______
3. Other SICs represented and brief description:

   SIC

   ______ ______

   ______ ______

   ______ ______

   ______ ______
4. Establishment's primary product(s) ______

   ______
5. List locations and functions of separate facilities (if applicable):

Locations	Functions

II. EMPLOYEE EXPOSURE

1. Total employees ______
2. Total production employees ______
3. Total hours of exposure ______
4. List departments and number of employees in each:

Dept.	Employees	Dept.	Employees

5. List job classifications and number of employees in each:

Job	Employees	Job	Employees

6. Give hours and distribution of employees by shift:

	Hrs.	# of Employees
a. ☐ Day shift	______	__________
b. ☐ Swing shift	______	__________
c. ☐ Graveyard	______	__________

7. Are company's operations seasonal? ☐ Yes ☐ No
8. If yes, when are the peak periods? ______________________________

____

____

III. MANAGEMENT SAFETY STRUCTURE

1. Describe organizational structure (obtain copy of organizational chart, if available):

2. Obtain copy of company safety policy, if available.
3. Name of person with primary safety responsibility ________________

   Title ____

4. To whom does person responsible for safety report?
   - ☐ Top management
   - ☐ Personnel manager
   - ☐ Plant manager
   - ☐ Other ______________________
5. Describe safety responsibility of line supervisors ______________

____

____

6. Type(s) of safety committees:
   - ☐ Company safety committee
   - ☐ Departmental safety committee
   - ☐ Foreman's safety committee
   - ☐ Workman's safety committee
   - ☐ Joint labor-management safety committee
   - ☐ None
   - ☐ Other ______________________
7. What are the functions of safety committee(s)?
   - ☐ Formulate, recommend safety policy
   - ☐ Accident review
   - ☐ Plant safety inspection surveys
   - ☐ Relay and discuss employee safety problems
   - ☐ Other ______________________________________
8. Describe specific job safety training available to new employees _____

____

____

9. Describe specific ongoing job safety training ______________________

10. What is the policy for plant safety inspection? ______________________

11. What is schedule of safety inspections? ______________________

12. Who performs safety inspections? ______________________

13. How is safety policy communicated to employees? ______________________

14. What educational/motivational techniques are employed:
    - [ ] Contests
    - [ ] Posters
    - [ ] Safety suggestion system
    - [ ] Audio-visual programs
    - [ ] In-plant publications
    - [ ] Lectures
    - [ ] Group discussions
    - [ ] Other ______________________

15. What contingencies exist for emergency treatment of injuries? ______________________

16. Are injury records analyzed for accident prevention purposes? [ ] Yes [ ] No

17. Name and title of person responsible for compiling injury records and maintaining logs ______________________

18. Describe how this person is notified of an injury producing event ______________________

19. Is company self-insured? [ ] Yes [ ] No
    If no, give name of insurer ______________________

20. Describe work injury benefits program ______________________

IV. OPERATIONAL CHARACTERISTICS

1. Diagram plant layout (obtain plant map, if available):

2. What particular hazards related to work surfaces and fall type accidents exist as a result of company operations? ______________________

3. How do these hazards compare with the hazards of other companies in the same standard industrial code? ______________________________

4. What hazards related to other accident types exist as a result of company operations? ______________________________

5. Is personal protective equipment required by company? ☐ Yes ☐ No
If yes, specify:

Type	Location	Who Provides?

V. FALL HISTORY - TRACK RECORD DATA

1. Obtain blank copies of every form used to report injuries.
2. What is experience modification rate for each of the last three years:

Year	Rate

3. What is the average experience modification rate for other establishments in the same SIC (for the most current year)? ______________
4. What are frequency, severity, incidence rates for the establishments?

Year	Frequency	Severity	Incidence

5. What are frequency, severity, incidence rates for average establishments in the same SIC? (Use same years.)

Year	Frequency	Severity	Incidence

6. Obtain any available tabulations of injury data.
7. Obtain photocopies of or access the descriptive and circumstantial factor data on injury reports with fall as an accident type. Obtain up to three year's fall injury experience depending on the size of the establishment. Review all relevant records pertaining to each injury such as:

- Employer's First Report of Injury
- Supervisor's Report
- Employee's Statement
- Medical Treatment Form
- Accident Investigation Form
- Log or other summary of days lost and other severity data

ORGANIZATIONAL SAFETY ANALYSIS CHECKLIST

Instructions: Evaluate organizational safety factors using the check boxes provided. Items checked "lacking" or "inadequate" pose an immediate safety hazard. Items checked "minimal" require less immediate attention, however, should eventually be upgraded. Items checked "OK" are adequate with respect to accident potential.

Establisnment No. ______

ORGANIZATIONAL SAFETY HAZARD

	Lacking	In-adequate	Minimal	OK
I. GENERAL SAFETY PROGRAM				
1. Safety policy	☐	☐	☐	☐
2. Defined safety goals	☐	☐	☐	☐
3. Evaluation of safety program effectiveness	☐	☐	☐	☐
4. Skills of safety program staff	☐	☐	☐	☐
5. Safety staff manpower	☐	☐	☐	☐
6. Worker participation in safety program development	☐	☐	☐	☐
7. Specification of safe work rules	☐	☐	☐	☐
8. Emergency procedure	☐	☐	☐	☐
9. Facilities for emergency care	☐	☐	☐	☐
II. MANAGEMENT IMPLEMENTATION				
1. Line safety supervision	☐	☐	☐	☐
2. Safety accountability	☐	☐	☐	☐
3. Enforcement of safe work rules	☐	☐	☐	☐
4. Safety communications	☐	☐	☐	☐
5. Safety budget	☐	☐	☐	☐
6. Supervisory safety training	☐	☐	☐	☐
7. High priority given to implementation of safety countermeasures	☐	☐	☐	☐
8. Management vigor and example	☐	☐	☐	☐
III. HAZARD ANALYSIS ACTIVITIES				
1. Procedures for hazard identification (such as job safety analysis)	☐	☐	☐	☐
2. Safety priorities	☐	☐	☐	☐
3. Use of criteria other than mandatory OSHA standards	☐	☐	☐	☐
4. Use of injury data analyses	☐	☐	☐	☐
5. Procedures for hazard reporting	☐	☐	☐	☐

Establishment No.

IV. HAZARD CONTROL

	Lacking	In-adequate	Minimal	OK
1. (Fall) hazard controls	☐	☐	☐	☐
2. Pleasant environmental conditions	☐	☐	☐	☐
3. Use of personal protective equipment	☐	☐	☐	☐
4. Equipment hazard guarding	☐	☐	☐	☐
5. Provision for sufficient workspace	☐	☐	☐	☐
6. Consideration given to safe task design/organization	☐	☐	☐	☐
7. Housekeeping	☐	☐	☐	☐
8. Preventive maintenance	☐	☐	☐	☐
9. Worksite inspections	☐	☐	☐	☐
10. Hazard warnings	☐	☐	☐	☐
11. Procedures for handling and storage of chemicals	☐	☐	☐	☐

V. PERSONNEL CHARACTERISTICS

	Lacking	In-adequate	Minimal	OK
1. Absenteeism rate	☐	☐	☐	☐
2. Turnover rate	☐	☐	☐	☐
3. Personnel selection criteria	☐	☐	☐	☐
4. Job safety training	☐	☐	☐	☐
5. Safety incentives	☐	☐	☐	☐
6. Labor/management relations	☐	☐	☐	☐
7. Average wage rates/benefits	☐	☐	☐	☐
8. Personnel programs	☐	☐	☐	☐
9. Worker motivation	☐	☐	☐	☐

FALL TYPE
☐ Slip
☐ Trip
☐ Stumble
☐ Misstep
☐ External Force
☐ Postural Over-extension
☐ Support Loss
☐ Organic

FALL ACCIDENT INVESTIGATION REPORT

Case No.

Establishment No. ____________

SIC ____________

Department ____________

Accident Date (mo/day/yr) ______

Day of Week ____________

Time of Day ____________

Instructions: Check all applicable factors and describe in as much detail as possible.

Using the injured employee's own words, describe the events that led to the fall accident and the injury that was sustained ______________________________

____

____

____

I. INJURED EMPLOYEE

1. Vital Data
   - a. Age ________ b. Sex ________ c. Marital Status ______
   - d. Height ______ e. Weight ______ f. Overweight? ______
2. Chronic Health
   - ☐ Allergy ________ ☐ Arthritis _____ ☐ Diabetes ______
   - ☐ Epilepsy ________ ☐ Heart Ailment __ ☐ High B.P. ______
   - ☐ Varicose veins ___ ☐ Stroke ________ ☐ Nerves ______
   - ☐ Ulcers ________ ☐ Fainting, blackouts, loss of consciousness ____________
   - ☐ Concussions, blows to head ____________
   - ☐ Difficulties with coordination, balance, dizziness ________
   - ☐ Previous knee, leg, angle, back injuries or strains ________
   - ☐ Foot trouble ____________
   - ☐ Physical handicaps ____________
   - ☐ Muscular weakness, paralysis ____________
   - ☐ Visual acuity ____________
   - ☐ Glasses/contacts. How long? ______ ☐ Wearing at time of accident? ______
   - ☐ Hearing acuity ______ ☐ Difficulty localizing sounds, ringing in ears ________
   - ☐ Smoker? How much? ______________.
   - ☐ Other ailments ____________
3. Acute Health
   - ☐ Cold ☐ Flu ☐ Ear infection ______
   - ☐ Other infection ____________
   - ☐ Headache ______ ☐ Stomach ache ____________
   - ☐ Other ache or pain ____________
   - ☐ Dizziness ____________
   - ☐ Diarrhea ____________
   - ☐ Menstrual period ____________

15

Case No.

- ☐ Pregnant ____
- ☐ Under doctor care ____
- ☐ Taking medication ____ ☐ Taken prior to accident? ____
- ☐ Drinking alcohol ____

4. Behavioral State

a. Attitude

- ☐ 1) Do you like job? ____
- ☐ 2) Are working conditions good? ____
- ☐ 3) Are pay and benefits adequate? ____
- ☐ 4) Often bored? ____
- ☐ 5) Often frustrated? ____
- ☐ 6) Any problems with supervisor? ____
- ☐ 7) Any difficulties with co-workers? ____
- ☐ 8) Was horseplay or fighting involved? ____
- ☐ 9) Is job (perceived as) hazardous? ____
- ☐ 10) Does job require taking risks? ____
- ☐ 11) Did you take a known risk? ____
- ☐ 12) Were you careless? ____
- ☐ 13) Supervisory performance evaluation ____
- ☐ 14) Absenteeism record ____
- ☐ 15) Other pertinent personnel evaluation data (e.g., arrest record, traffic violations) ____

b. Stress

- ☐ 1) In a hurry? ____
- ☐ 2) Working too fast? ____
- ☐ 3) Under any work pressure? ____
- ☐ 4) Unusual work demands? ____
- ☐ 5) Worried or upset about anything? ____
- ☐ 6) Any recent changes at work (e.g., in work routine, job assignment, supervisors, work crew, layoffs)? ____
- ☐ 7) Any problems at home? ____
- ☐ 8) Any unusual circumstances at time of accident? ____
- ☐ 9) Trying to do something for which not adequately trained? ____
- ☐ 10) Excited about anything? ____
- ☐ 11) Startled? ____
- ☐ 12) Distracted by someone or something? ____

c. Fatigue

- ☐ 1) Tired? ____
- ☐ 2) No. hours working at time of accident ____
- ☐ 3) No. hours worked preceding 2 days ____
- ☐ 4) Recent change in shift schedule? ____
- ☐ 5) Normal night's sleep? ____
- ☐ 6) Work at another job? ____
- ☐ 7) Up late evening before? ____

Case No.

- [ ] 8) Time since last break ______
- [ ] 9) Time before next break ______
- [ ] 10) Time before/since lunch ______
- [ ] 11) Time before end of shift ______

5. Job Classification ______

6. Experience (years/months)

a. Company ______ b. Job ______ c. Activity ______

- [ ] d. Regular job? ______ - [ ] e. Why not? ______

7. Fall History

- [ ] a. Ever fallen before? ______
- [ ] b. Any similar fall accidents or near accidents? Location(s) ______
- [ ] c. Any similar fall accidents or near accidents to other employees? Location(s) ______

8. Safety Training

- [ ] a. Received any specific job safety instruction? (Have injured employee briefly describe) ______
  1) When? ______
  2) How often? ______
  3) By whom? ______
  4) Formal or on-the-job only? ______
  5) Periodic employee safety awareness meetings? How often? ______ What's discussed? ______
  6) Who communicates safety instructions? How? ______
- [ ] b. Adequate with respect to accident circumstances? ______
- [ ] c. Extent of safe work rules ______
- [ ] d. Any work rule ignored or short-circuited? ______
- [ ] e. Aware of rule? Why not? ______

9. Supervision

- [ ] a. Is supervisor usually close to where you work? ______
- [ ] b. How many contacts with supervisor do you have each day? ______
- [ ] c. Was supervisor close by at time of accident? ______
- [ ] d. Does supervisor emphasize safety? ______ How often? ______
- [ ] e. What was his last instruction? When? ______
- [ ] f. Was inadequate supervision a probable factor? ______

II. WORK ENVIRONMENT

1. Accident Site

a.
- [ ] Task related
- [ ] Not task related

b.
- [ ] Basement
- [ ] Bathroom
- [ ] Catwalk
- [ ] Construction site
- [ ] Delivery site
- [ ] Dock
- [ ] Employee restricted area
- [ ] Hallway
- [ ] Kitchen
- [ ] Laboratory
- [ ] Lunch/break area
- [ ] Maintenance area
- [ ] Office
- [ ] Parking lot
- [ ] Production area
- [ ] Storage area
- [ ] Warehouse
- [ ] Yard
- [ ] Other external site (off company grounds) ______
- [ ] Other internal site (on company grounds) ______

Case No.

2. Characteristics or Conditions of Accident Site

- [ ] Cluttered
- [ ] Crowded
- [ ] Elevated
- [ ] Inclined
- [ ] Inadequately designed
- [ ] Inadequately laid out
- [ ] Inadequately maintained
- [ ] Indoors
- [ ] In need of repair
- [ ] Lacking guardrails
- [ ] Lacking handrails
- [ ] Lacking toe boards
- [ ] Lacking warning
- [ ] Makeshift
- [ ] Narrow
- [ ] Old
- [ ] Outdoors
- [ ] Small
- [ ] Steep
- [ ] Tight
- [ ] Uneven
- [ ] Unguarded
- [ ] Unstable
- [ ] Undersized
- [ ] Worn
- [ ] Other ____________

3. Ambient Environment

a. Weather

- [ ] Bright sunny
- [ ] Cloudy
- [ ] Cold
- [ ] Dry
- [ ] Dusty
- [ ] Fog
- [ ] Hot
- [ ] Humid
- [ ] Rain
- [ ] Sleet/hail
- [ ] Snow
- [ ] Stormy
- [ ] Windy
- [ ] Other ______

b. Noise

- [ ] Constant
- [ ] Distracting
- [ ] Impact
- [ ] Intermittent
- [ ] Loud
- [ ] Startling
- [ ] Other ______
- [ ] Source ______

c. Lighting

- [ ] Bright
- [ ] Dark
- [ ] Flickering
- [ ] Glaring
- [ ] Other ______
- [ ] Source ______

d. Toxic fumes

- [ ] Faint/perceptible
- [ ] Inducing drowsiness
- [ ] Inducing dizziness
- [ ] Noxious
- [ ] Lethal
- [ ] Other ______
- [ ] Source ______

III. WORK TASK

1. General Task Function ____________________

2. Specific Activity ____________________

____

3. Exposure

a. Number of employees performing activity at this location ________

b. Performance frequency

1) By injured employee ____________________

2) By other employees at this location ____________________

c. Hours of exposure

1) For injured employee ____________________

2) For other employees at this location ____________________

4. Characteristics or Conditions of Specific Activity

- [ ] a. Any recent changes in work routine? ____________________
- [ ] b. Incentive pay? ____________________
- [ ] c. Much overtime? How much prior to accident? ____________________
- [ ] d. Many peak loads? ____________________
- [ ] e. Inadequate coordination/communication between employees? ________
- [ ] f. Requires awkward position? ____________________
- [ ] g. Requires exceptional

- [ ] Attention
- [ ] Caution
- [ ] Dexterity
- [ ] Decision making
- [ ] Endurance
- [ ] Judgment
- [ ] Motor coordination
- [ ] Perceptual discrimination
- [ ] Risk
- [ ] Skill
- [ ] Speed
- [ ] Strength
- [ ] Vigilance
- [ ] Other ____________

Case No.

h. Is activity especially

- ☐ Boring
- ☐ Complex
- ☐ Difficult
- ☐ Demanding
- ☐ Fatiguing
- ☐ Hazardous
- ☐ Monotonous
- ☐ Quickly paced
- ☐ Repetitive
- ☐ Slowly paced
- ☐ Tedious
- ☐ Variable
- ☐ Other ______________

5. Protective Equipment/Other Clothing

☐ a. Wearing any protective equipment? ______________

☐ b. Would use of any protective equipment have prevented injury? ______

____

☐ c. Did any safety device used fail to prevent injury? ______________

____

d. Characteristics of protective equipment or other clothing worn

- ☐ Baggy ______________
- ☐ Distorting ______________
- ☐ Encumbering ______________
- ☐ Heavy ______________
- ☐ Long ______________
- ☐ New ______________
- ☐ Obstructs vision ________
- ☐ Restricts movement ________
- ☐ Small ______________
- ☐ Tight ______________
- ☐ Uncomfortable ________
- ☐ Unknown ______________
- ☐ Other ______________
- ☐ Type ______________

6. Hands Action

- ☐ Applying force
- ☐ Catching
- ☐ Carrying
- ☐ Dropping
- ☐ Grabbing
- ☐ Handling
- ☐ Holding
- ☐ Picking
- ☐ Placing
- ☐ Pulling
- ☐ Pushing
- ☐ Throwing
- ☐ Turning
- ☐ Tying
- ☐ Using
- ☐ Other ________

7. Objects Held or Tools Used

a. Objects held

- ☐ Bag(s)
- ☐ Barrel(s)
- ☐ Basket(s)
- ☐ Bin(s)
- ☐ Bottle(s)
- ☐ Box(es)
- ☐ Bucket(s)
- ☐ Can(s)
- ☐ Case(s)
- ☐ Container(s)
- ☐ Cup(s)
- ☐ Drum(s)
- ☐ Flask(s)
- ☐ Package(s)
- ☐ Tray(s)
- ☐ Other ______________

b. Tools used

- ☐ Broom
- ☐ Crowbar
- ☐ Drill
- ☐ Hammer
- ☐ Hose
- ☐ Knife
- ☐ Mop
- ☐ Pliers
- ☐ Pneumatic hammer
- ☐ Pole
- ☐ Saw
- ☐ Scraper
- ☐ Screwdriver
- ☐ Shovel
- ☐ Sledgehammer
- ☐ Wrench
- ☐ Other ______________

8. Characteristics or Conditions of Objects Held or Tool Used

a. General

- ☐ Awkward
- ☐ Broken
- ☐ Defective
- ☐ Elevated
- ☐ Empty
- ☐ Encumbering
- ☐ Fragile
- ☐ Full
- ☐ Glass
- ☐ Guarded
- ☐ Heavy
- ☐ Hot
- ☐ Icy
- ☐ Jammed
- ☐ Large
- ☐ Loose
- ☐ Makeshift
- ☐ Muddy
- ☐ Narrow
- ☐ New
- ☐ Obstructing movement
- ☐ Obstructing vision
- ☐ Oily
- ☐ Old
- ☐ Oversized
- ☐ Portable
- ☐ Powered
- ☐ Rough
- ☐ Sharp
- ☐ Slippery
- ☐ Small
- ☐ Toxic
- ☐ Unguarded
- ☐ Unstable
- ☐ Wet
- ☐ Worn
- ☐ Other _____

Case No.

b. Measurements

1) Number of objects ______________

2) Size ______________

3) Weight ______________

4) Shape ______________

5) Other ______________

9. Location (of movement)

a. From ______________

b. To ______________

10. Body Position

- [ ] Bending
- [ ] Crawling
- [ ] Extending
- [ ] Kneeling
- [ ] Leaning
- [ ] Lying
- [ ] Overextending
- [ ] Reaching
- [ ] Reclining
- [ ] Sitting
- [ ] Straddling
- [ ] Straightening up
- [ ] Squatting
- [ ] Turning
- [ ] Twisting
- [ ] Other ______

11. Feet Action

- [ ] Jumping
- [ ] Kicking
- [ ] Running
- [ ] Stepping
- [ ] Standing
- [ ] Walking
- [ ] Other ______

12. Footwear (type)

- [ ] Bare feet
- [ ] Boots (leather)
- [ ] Boots (rubber)
- [ ] Flats
- [ ] High heels
- [ ] Oxfords
- [ ] Platform
- [ ] Pumps
- [ ] Sandals
- [ ] Slippers
- [ ] Socks
- [ ] Stockings
- [ ] Tennis shoes
- [ ] Thongs
- [ ] Wedgies
- [ ] Wellingtons
- [ ] Unknown ____
- [ ] Other ______

13. Characteristics or Conditions of Footwear

a. Sole construction

- [ ] Composition
- [ ] Cork
- [ ] Crepe
- [ ] Leather
- [ ] Neoprene
- [ ] Rubber
- [ ] Taps
- [ ] Wooden
- [ ] Unknown ______
- [ ] Other ______

b. Heel construction

- [ ] Composition
- [ ] Cork
- [ ] Crepe
- [ ] Leather
- [ ] Neoprene
- [ ] Rubber
- [ ] Wooden
- [ ] Unknown ______________
- [ ] Other ______________

c. Sole thickness ______________

d. Heel height ______________

e. Condition

- [ ] New
- [ ] Good
- [ ] Worn
- [ ] Needs repair
- [ ] Unknown ______
- [ ] Other ______

f. Characteristics

- [ ] Muddy
- [ ] Oily
- [ ] Poorly fitting
- [ ] Protective footwear (list brand name, model no., approximate date purchased/issued) ______________
- [ ] Tight
- [ ] Slippery
- [ ] Small
- [ ] Uncomfortable
- [ ] Wet
- [ ] Unknown ______
- [ ] Other ______

Case No.

14. Surface Type(s) (number applicable boxes 1 or 2)

a. ☐ Normal surface
☐ Elevated surface

b.

☐ Beam	☐ Ground	☐ Sidewalk
☐ Bench	☐ Ladder	☐ Step(s)
☐ Board	☐ Landing	☐ Stairs
☐ Boom	☐ Ledge	☐ Stool
☐ Bridge	☐ Pallet	☐ Support
☐ Chair	☐ Pavement	☐ Table
☐ Conveyor belt	☐ Pedestal	☐ Tailgate
☐ Conveyor rollers	☐ Platform	☐ Tower
☐ Curb	☐ Ramp	☐ Truck
☐ Desk	☐ Roof	☐ Truck bed
☐ Escalator	☐ Rung	☐ Other moving platform ___
☐ Floor	☐ Running board	
☐ Floot mat	☐ Scaffold	☐ Other stationary surface ___

15. Characteristics or Conditions of Surface Type(s) (number corresponding boxes 1 or 2)

a. Material	b. Conditions
☐ Asphalt	☐ Bumpy
☐ Asphalt tile	☐ Cluttered
☐ Carpeted	☐ Crowded
☐ Ceramic	☐ Frayed
☐ Concrete	☐ Freshly waxed
☐ Cork	☐ Holes
☐ Creosote wood block	☐ Icy
☐ Dirt	☐ Inclined
☐ Glass	☐ Makeshift
☐ Grass	☐ Muddy
☐ Gravel	☐ Narrow
☐ Linoleum	☐ New
☐ Lead	☐ Objects on ground
☐ Marble	☐ Objects protruding
☐ Metal	☐ Oily
☐ Metal mesh	☐ Rough
☐ Plastic	☐ Ruts
☐ Rubber	☐ Salt covered
☐ Sand	☐ Sandy
☐ Slate	☐ Snowy
☐ Steel	☐ Slippery
☐ Terrazzo	☐ Slanted
☐ Tile	☐ Slatted
☐ Vinyl tile	☐ Steep
☐ Wooden	☐ Uneven
☐ Other ______________	☐ Unstable
	☐ Wet
	☐ Worn
	☐ Other ______________

IV. ACCIDENT EVENTS/CONSEQUENCES

1. Describe fully accident sequence of events, accident type(s), surface/objects, characteristics/conditions ______________________________

____
____
____
____
____
____
____

Case No.

2. Nature of Injury(s) (number applicable boxes 1, 2, 3)

- [ ] Abrasion
- [ ] Amputation
- [ ] Avulsion
- [ ] Burn
- [ ] Chemical burn
- [ ] Concussion
- [ ] Contusion
- [ ] Dental injury
- [ ] Dislocation
- [ ] Electric shock
- [ ] Fracture
- [ ] Frostbite
- [ ] Hearing impairment
- [ ] Heart attack
- [ ] Hernia
- [ ] Infection
- [ ] Inflammation
- [ ] Laceration
- [ ] Nosebleed
- [ ] Sprain
- [ ] Torn cartilage
- [ ] Multiple injuries
- [ ] Other injuries ______

3. Part(s) of Body (number corresponding boxes 1, 2, 3)

- [ ] Head
  - [ ] Brain
  - [ ] Ear(s)
  - [ ] Eye(s)
  - [ ] Face
    - [ ] Jaw
    - [ ] Mouth
    - [ ] Nose
    - [ ] Teeth
    - [ ] Forehead
    - [ ] Chin
  - [ ] Scalp
  - [ ] Skull
- [ ] Neck
- [ ] Arm
  - [ ] Shoulder
  - [ ] Upper arm
  - [ ] Forearm
  - [ ] Elbow
  - [ ] Hand
    - [ ] Wrist
    - [ ] Finger(s)
    - [ ] Thumb
- [ ] Trunk
  - [ ] Abdomen
  - [ ] Back
    - [ ] Lower back
  - [ ] Chest
    - [ ] Breast(s)
    - [ ] Rib(s)
  - [ ] Hip(s)
  - [ ] Buttocks
  - [ ] Groin
- [ ] Leg
  - [ ] Thigh
  - [ ] Knee
  - [ ] Lower leg
    - [ ] Ankle
  - [ ] Foot
    - [ ] Toe
    - [ ] Big toe
- [ ] Multiple body parts
- [ ] Other body parts
- [ ] Part of body part
  - [ ] Hair
  - [ ] Heel
  - [ ] Instep
  - [ ] Joint(s)
  - [ ] Knuckle(s)
  - [ ] Nail(s)
  - [ ] Palm
  - [ ] Tendon

4. Severity

- [ ] First aid only
- [ ] No lost workdays
- [ ] Lost workdays
- [ ] Permanent disability
- [ ] Fatality
- [ ] Unknown ______

5. Total Lost Time ______________________

6. Documentation

a. Weather
   1) Temperature ______________
   2) Humidity ______________
   3) Barometer ______________
   4) Wind speed (chill factor) ______________

b. Noise
   1) Ambient db(A) ______________
   2) Periodicity ______________

c. Lighting
   1) Ambient foot-candles ______________
   2) Contrasts/glares ______________

d. Toxic fumes
   1) Type ______________
   2) Parts per million ______________
   3) TLV exceeded? ______________

Case No.

e. Work surface coefficient of friction

1) Test material ______________

2) List readings in order (take at least ten readings)____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____

3) Mean of readings ______________

4) Standard deviation ______________

f. Tape measure

1) Clearances ______________

2) Distance fallen ______________

3) Height guardrail, enclosure ______________

4) Span of opening ______________

5) Stair

a) Riser height(s) ______________

b) Step depth (contact surface) ______________

c) Step width ______________

d) Number of steps ______________

e) Number of landings ______________

f) Angle(s) of incline ______________

6) Other

7. Document any standards (mandatory or concensus) or other criteria violated ______________

____

8. Any countermeasures planned? ______________

____

____

9. Diagram accident site

Investigator's Name ______________ Date of Investigation ______________

Instructions: Number and specify hazard as per accident sequence analysis. Check appropriate boxes if either management oversight, worker error, or both. Cite general countermeasure approach(es) most applicable, then develop and indicate specific management-directed countermeasures, worker-oriented countermeasures, or countermeasures requiring further research.

HAZARD	Management-Directed Countermeasures	Worker-Directed Countermeasures	Countermeasures Requiring Further Research
Detectable by ☐ Management? ☐ Injured Employee? NO → ↓ YES			
Detected by ☐ Management? ☐ Injured Employee? NO → ↓ YES			
Preventive Action Possible by ☐ Management? NO → ☐ Injured Employee? ↓ YES			
Taken by ☐ Management? ☐ Injured Employee? NO → ↓ YES			
Effective by ☐ Management? ☐ Injured Employee? NO →			

List of General Countermeasure Approaches

- Equipment Design Modification
- Equipment Guarding
- Personal Protective Equipment
- Work Surface Modification
- Environmental Change
- Change in Workspace or Work Layout
- Operational Change
- Job Redesign
- Housekeeping
- Maintenance
- Hazard Recognition and Avoidance Training
- Specification/Enforcement of Work Rule
- Supervision
- Employee Selection

HAZARD/COUNTERMEASURE ANALYSIS

Case No.

COUNTERMEASURE EVALUATION

Evaluation Rating	Case No.

Countermeasure:		
Implementation Criteria	Short Term	Long-Term
Technological Feasibility		
Cost Feasibility		
Effects on Productivity		
Time Required to Implement		
Durability		
Extent of Enforcement/ Supervision Required		
Reliability		
Extent of Control		
Management Acceptance		
Employee Acceptance		
TOTAL		

Instructions: Rate countermeasure according to each of the above implementation criteria as follows: 4=excellent, 3=good, 2=fair, or 1=poor. To compute the overall evaluation rating, average the totals for both short- and long-term ratings. Relative weights can be assigned to implementation criteria by each establishment. Regardless, the higher the evaluation rating among alternative countermeasures, the better the potential effectiveness.

EXHIBIT 3

ESTABLISHMENT BACKGROUND DATA

Establishment No. 4402

I. DEMOGRAPHIC CHARACTERISTICS

1. Primary standard industrial code (SIC) 9199
2. Brief operational description LOCAL GOVERNMENT
3. Other SICs represented and brief description:

SIC	
9224	FIRE PROTECTION
9229	PUBLIC ORDER AND SAFETY
9511	SOLID WASTE MGNT.
ETC.	

4. Establishment's primary product(s) PUBLIC SERVICE
5. List locations and functions of separate facilities (if applicable):

Locations	Functions
DOWNTOWN	ADMINISTRATION MGNT.
FIELD OPERATION	FAB. AND REPAIR SHOPS, PARKS, LANDFILL
" " "	S/W COLLECTION, STREETS, UTILITY
" " "	S/W COLLECTION, ENGINEERING, COMMUNICATIONS, STREETS, UTILITY

II. EMPLOYEE EXPOSURE

1. Total employees 6,729
2. Total production employees 5474 314 HOURLY (PARTTIME) EMPLOYEES
3. Total hours of exposure 13343200 @YEAR FOR TOTAL EMPLOYEES MINUS HOURLY EMPLOYEES
4. List departments and number of employees in each:

Dept.	Employees	Dept.	Employees
FIRE	805	LIBRARY	290
PUBLIC ORDER & SAFETY	1397	ENGINEERING	178
SOLID WASTE	full 304	BUILDINGS	179
	hrly 40	BUILDING INSPECTIONS	132
PARK	273	PROPERTY	50
RECREATION	full 289	COMMUNITY RELATIONS	8
	hrly 273	TRANSPORTATION	
UTILITIES	608	- communications	83
EQUIPMENT	158	- streets	286

5. List job classifications and number of employees in each:

Job	Employees	Job	Employees

6. Give hours and distribution of employees by shift:

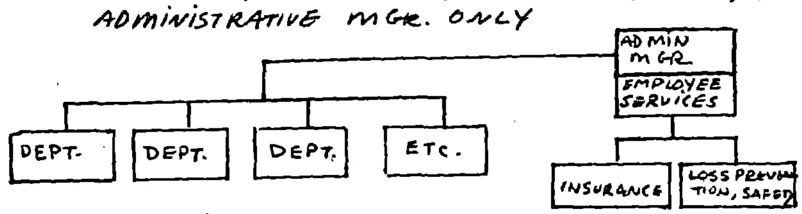
		Hrs.	# of Employees
a.	☑ Day shift		95 %
b.	☐ Swing shift		
c.	☐ Graveyard		

7. Are company's operations seasonal? ☑ Yes ☐ No

8. If yes, when are the peak periods? FOR FIRE DEPT. ONLY WHICH HAS INCREASED WORK VOLUME DURING LATE SUMMER AND FALL

III. MANAGEMENT SAFETY STRUCTURE

1. Describe organizational structure (obtain copy of organizational chart, if available): SAFETY DEPT. SERVES IN ADVISORY POSITION TO ADMINISTRATIVE MGR. ONLY



2. Obtain copy of company safety policy, if available.

3. Name of person with primary safety responsibility MR. RICK CUMMING
Title ______

4. To whom does person responsible for safety report?
☑ Top management
☐ Personnel manager
☐ Plant manager
☐ Other ______

5. Describe safety responsibility of line supervisors NO DEFINED RESPONSIBILITY

6. Type(s) of safety committees:
☐ Company safety committee
☑ Departmental safety committee
☐ Foreman's safety committee
☐ Workman's safety committee
☐ Joint labor-management safety committee
☐ None
☐ Other ______

7. What are the functions of safety committee(s)?
☐ Formulate, recommend safety policy
☐ Accident review
☐ Plant safety inspection surveys
☑ Relay and discuss employee safety problems
☐ Other ______

8. Describe specific job safety training available to new employees ______

9. Describe specific ongoing job safety training PUBLIC ORDER AND FIRE PERFORM IN-DEPT., OTHER DEPTS HAVE REGULAR TRAINING PROGRAMS AVAILABLE PROVIDED BY SAFETY OFFICE

10. What is the policy for plant safety inspection? ON-CALL FOR SPECIAL REQUESTS, OCCASSIONAL UNANNOUNCED WALL TO WALLS

11. What is schedule of safety inspections? UNKNOWN

12. Who performs safety inspections? SAFETY STAFF AND OUTSIDE CONSULTANTS AS NEEDED

13. How is safety policy communicated to employees? UNKNOWN

14. What educational/motivational techniques are employed:
    - [x] Contests
    - [x] Posters
    - [ ] Safety suggestion system
    - [x] Audio-visual programs
    - [x] In-plant publications
    - [ ] Lectures
    - [x] Group discussions
    - [ ] Other

15. What contingencies exist for emergency treatment of injuries? UNKNOWN

16. Are injury records analyzed for accident prevention purposes? [x] Yes [ ] No
    SAFETY ANALYZES FIRE AND PUBLIC ORDER INJURIES ONLY BECAUSE THESE 2 DEPTS. HAVE 70-75% OF INJURIES

17. Name and title of person responsible for compiling injury records and maintaining logs MS. MARGE THOMAS

18. Describe how this person is notified of an injury producing event DEPTS FILL OUT ACCIDENT REPORTS - SEND TO INSURANCE OFFICE, SEND TO SAFETY STAFF FOR PERUSAL, SEND TO MS. THOMAS.

19. Is company self-insured? [x] Yes [ ] No
    If no, give name of insurer

20. Describe work injury benefits program - 1ST 3 DAYS PAID BY WRK COMP, THEN 1 YR. SALARY CONTINUATION. BENEFITS DENIED IF EMPLOYEE FOUND AT FAULT OR COULD HAVE PREVENTED.

IV. OPERATIONAL CHARACTERISTICS

1. Diagram plant layout (obtain plant map, if available): HIGHLY SCATTERED LOCATIONS

2. What particular hazards related to work surfaces and fall type accidents exist as a result of company operations? MOBILE HEAVY EQUIPT.; FIRE SUPPRESSION SITES; UNFAMILIAR, HAZARDOUS FIELD LOCATIONS

3. How do these hazards compare with the hazards of other companies in the same standard industrial code? SAME

4. What hazards related to other accident types exist as a result of company operations? SOME I.H. PROBLEMS, CONFINED SPACES, HIGH MOTOR VEHICLE OPERATION EXPOSURE, RISKS INHERENT IN POLICE AND FIRE OCCUPATIONS

5. Is personal protective equipment required by company? ☐ Yes ☐ No
If yes, specify:

Type	Location	Who Provides?

V. FALL HISTORY - TRACK RECORD DATA

1. Obtain blank copies of every form used to report injuries.
2. What is experience modification rate for each of the last three years:

Year	Rate

SELF-INSURED

3. What is the average experience modification rate for other establishments in the same SIC (for the most current year)? UNKNOWN
4. What are frequency, severity, incidence rates for the establishments?

Year	Frequency	Severity	Incidence
UNAVAILABLE			
AT THIS			
PRINTING			

5. What are frequency, severity, incidence rates for average establishments in the same SIC? (Use same years.)

Year	Frequency	Severity	Incidence
1971-1973	32.99	1,241	
1973-1975	36.75	1,176	

6. Obtain any available tabulations of injury data.
7. Obtain photocopies of or access the descriptive and circumstantial factor data on injury reports with fall as an accident type. Obtain up to three year's fall injury experience depending on the size of the establishment. Review all relevant records pertaining to each injury such as:

- Employer's First Report of Injury
- Supervisor's Report
- Employee's Statement
- Medical Treatment Form
- Accident Investigation Form
- Log or other summary of days lost and other severity data

ORGANIZATIONAL SAFETY ANALYSIS
CHECKLIST

Instructions: Evaluate organizational safety factors using the check boxes provided. Items checked "lacking" or "inadequate" pose an immediate safety hazard. Items checked "minimal" require less immediate attention, however, should eventually be upgraded. Items checked "OK" are adequate with respect to accident potential.

Establishment No. 4402

ORGANIZATIONAL SAFETY HAZARD

I. GENERAL SAFETY PROGRAM

		Lacking	In-adequate	Minimal	OK
1.	Safety policy	☐	☐	☐	☑
2.	Defined safety goals	☐	☐	☑	☐
3.	Evaluation of safety program effectiveness	☑	☐	☐	☐
4.	Skills of safety program staff	☐	☐	☐	☑
5.	Safety staff manpower	☐	☑	☐	☐
6.	Worker participation in safety program development	☐	☑	☐	☐
7.	Specification of safe work rules	☐	☐	☑	☐
8.	Emergency procedure	☐	☐	☑	☐
9.	Facilities for emergency care	☐	☑	☐	☐

II. MANAGEMENT IMPLEMENTATION

		Lacking	In-adequate	Minimal	OK
1.	Line safety supervision	☐	☑	☐	☐
2.	Safety accountability	☑	☐	☐	☐
3.	Enforcement of safe work rules	☐	☑	☐	☐
4.	Safety communications	☐	☑	☐	☐
5.	Safety budget	☐	☐	☑	☐
6.	Supervisory safety training	☐	☐	☑	☐
7.	High priority given to implementation of safety countermeasures	☐	☑	☐	☐
8.	Management vigor and example	☐	☐	☑	☐

III. HAZARD ANALYSIS ACTIVITIES

		Lacking	In-adequate	Minimal	OK
1.	Procedures for hazard identification (such as job safety analysis)	☑	☐	☐	☐
2.	Safety priorities	☐	☑	☐	☐
3.	Use of criteria other than mandatory OSHA standards	☐	☐	☑	☐
4.	Use of injury data analyses	☐	☐	☐	☑
5.	Procedures for hazard reporting	☐	☐	☐	☑

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IV. HAZARD CONTROL

		Lacking	In-adequate	Minimal	OK
1.	(Fall) hazard controls	☐	☐	☑	☐
2.	Pleasant environmental conditions	☐	☐	☐	☑
3.	Use of personal protective equipment	☐	☐	☐	☑
4.	Equipment hazard guarding	☐	☐	☑	☐
5.	Provision for sufficient workspace	☐	☐	☐	☑
6.	Consideration given to safe task design/organization	☐	☐	☑	☐
7.	Housekeeping	☐	☐	☐	☑
8.	Preventive maintenance	☐	☑	☐	☐
9.	Worksite inspections	☐	☐	☑	☐
10.	Hazard warnings	☐	☑	☐	☐
11.	Procedures for handling and storage of chemicals	☐	☐	☐	☑

V. PERSONNEL CHARACTERISTICS

		Lacking	In-adequate	Minimal	OK
1.	Absenteeism rate	☐	☐	☑	☐
2.	Turnover rate	☐	☐	☐	☑
3.	Personnel selection criteria	☐	☐	☐	☑
4.	Job safety training	☐	☐	☐	☑
5.	Safety incentives	☐	☐	☑	☐
6.	Labor/management relations	☐	☐	☑	☐
7.	Average wage rates/benefits	☐	☐	☑	☐
8.	Personnel programs	☐	☑	☐	☐
9.	Worker motivation	☐	☑	☐	☐

FALL TYPE
☐ Slip
☐ Trip
☐ Stumble
☐ Misstep
☐ External Force
☐ Postural Over-extension
☒ Support Loss
☐ Organic

FALL ACCIDENT INVESTIGATION REPORT

Case No. 050517

Establishment No. 4402

SIC 9199

Department COMMUNICATIONS

Accident Date (mo/day/yr) 5/5/77

Day of Week THURSDAY

Time of Day 3:00 P.M.

Instructions: Check all applicable factors and describe in as much detail as possible.

Using the injured employee's own words, describe the events that led to the fall accident and the injury that was sustained while working on a ladder, I fell from the ladder onto a table saw blade suffering a bruised chest. I lost 15 days from work.

I. INJURED EMPLOYEE

1. Vital Data

a. Age 36 b. Sex M c. Marital Status MARRIED

d. Height 5'11" e. Weight 175 f. Overweight? No

2. Chronic Health

☐ Allergy ____ ☐ Arthritis ____ ☐ Diabetes ____

☐ Epilepsy ____ ☐ Heart Ailment ____ ☐ High B.P. ____

☐ Varicose veins ____ ☐ Stroke ____ ☐ Nerves ____

☐ Ulcers ____ ☐ Fainting, blackouts, loss of consciousness ____

☐ Concussions, blows to head ____

☐ Difficulties with coordination, balance, dizziness ____

☐ Previous knee, leg, angle, back injuries or strains ____

☐ Foot trouble ____

☐ Physical handicaps ____

☐ Muscular weakness, paralysis ____

☐ Visual acuity ____

☐ Glasses/contacts. How long? ____ ☐ Wearing at time of accident? ____

☐ Hearing acuity ____ ☐ Difficulty localizing sounds, ringing in ears ____

☐ Smoker? How much? ____.

☐ Other ailments ____

3. Acute Health

☐ Cold ☐ Flu ☐ Ear infection ____

☐ Other infection ____

☐ Headache ____ ☐ Stomach ache ____

☐ Other ache or pain ____

☐ Dizziness ____

☐ Diarrhea ____

☐ Menstrual period ____

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- [ ] Pregnant ____
- [ ] Under doctor care ____
- [ ] Taking medication ____ [ ] Taken prior to accident? ____
- [ ] Drinking alcohol ____

4. Behavioral State

a. Attitude

- [ ] 1) Do you like job? ____
- [ ] 2) Are working conditions good? ____
- [ ] 3) Are pay and benefits adequate? ____
- [ ] 4) Often bored? ____
- [ ] 5) Often frustrated? ____
- [x] 6) Any problems with supervisor? INADEQUATE RAPPORT
- [ ] 7) Any difficulties with co-workers? ____
- [ ] 8) Was horseplay or fighting involved? ____
- [ ] 9) Is job (perceived as) hazardous? ____
- [ ] 10) Does job require taking risks? ____
- [ ] 11) Did you take a known risk? ____
- [ ] 12) Were you careless? ____
- [ ] 13) Supervisory performance evaluation ____
- [ ] 14) Absenteeism record ____
- [ ] 15) Other pertinent personnel evaluation data (e.g., arrest record, traffic violations) ____

b. Stress

- [ ] 1) In a hurry? ____
- [ ] 2) Working too fast? ____
- [ ] 3) Under any work pressure? ____
- [ ] 4) Unusual work demands? ____
- [ ] 5) Worried or upset about anything? ____
- [ ] 6) Any recent changes at work (e.g., in work routine, job assignment, supervisors, work crew, layoffs)? ____
- [ ] 7) Any problems at home? ____
- [ ] 8) Any unusual circumstances at time of accident? ____
- [x] 9) Trying to do something for which not adequately trained? INADEQUATE TRAINING ON LADDERS
- [ ] 10) Excited about anything? ____
- [ ] 11) Startled? ____
- [ ] 12) Distracted by someone or something? ____

c. Fatigue

- [ ] 1) Tired? ____
- [x] 2) No. hours working at time of accident 7 1/2
- [ ] 3) No. hours worked preceding 2 days ____
- [ ] 4) Recent change in shift schedule? ____
- [ ] 5) Normal night's sleep? ____
- [ ] 6) Work at another job? ____
- [ ] 7) Up late evening before? ____

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- ☐ 8) Time since last break 1 HR.
- ☐ 9) Time before next break 1/2 HR.
- ☐ 10) Time before/since lunch 3 1/2 HR.
- ☑ 11) Time before end of shift 1/2 HR.

5. Job Classification ____________

6. Experience (years/months)
   - a. Company 2 YEARS b. Job SAME c. Activity NO PREVIOUS LADDER EXP.
   - ☐ d. Regular job? YES ☐ e. Why not? ____________

7. Fall History
   - ☐ a. Ever fallen before? ____________
   - ☐ b. Any similar fall accidents or near accidents? Location(s) ____________
   - ☐ c. Any similar fall accidents or near accidents to other employees? Location(s) ____________

8. Safety Training
   - ☑ a. Received any specific job safety instruction? (Have injured employee briefly describe) NONE ON ENTRY
     - 1) When? ____________
     - 2) How often? ____________
     - 3) By whom? ____________
     - 4) Formal or on-the-job only? ____________
     - 5) Periodic employee safety awareness meetings? How often? ONCE A MONTH
       What's discussed? CAN'T REMEMBER
     - 6) Who communicates safety instructions? How? ____________
   - ☑ b. Adequate with respect to accident circumstances? NO TRAINING FOR WORK ON LADDERS
   - ☐ c. Extent of safe work rules ____________
   - ☐ d. Any work rule ignored or short-circuited? ____________
   - ☐ e. Aware of rule? Why not? ____________

9. Supervision
   - ☐ a. Is supervisor usually close to where you work? ____________
   - ☐ b. How many contacts with supervisor do you have each day? ____________
   - ☐ c. Was supervisor close by at time of accident? ____________
   - ☑ d. Does supervisor emphasize safety? NO
     How often? ____________
   - ☐ e. What was his last instruction? When? ____________
   - ☑ f. Was inadequate supervision a probable factor? FAILED TO SUPERVISE LADDER SET-UP

II. WORK ENVIRONMENT

1. Accident Site
   - a. ☑ Task related
     ☐ Not task related
   - b.
     - ☐ Basement
     - ☐ Bathroom
     - ☐ Catwalk
     - ☐ Construction site
     - ☐ Delivery site
     - ☐ Dock
     - ☐ Employee restricted area
     - ☐ Hallway
     - ☐ Kitchen
     - ☐ Laboratory
     - ☐ Lunch/break area
     - ☐ Maintenance area
     - ☐ Office
     - ☐ Parking lot
     - ☐ Production area
     - ☐ Storage area
     - ☐ Warehouse
     - ☐ Yard
     - ☐ Other external site (off company grounds) ____________
     - ☑ Other internal site (on company grounds) UTILITY BLDG - TEMPORARY SITE

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2. Characteristics or Conditions of Accident Site

- [x] Cluttered
- [ ] Crowded
- [ ] Elevated
- [ ] Inclined
- [ ] Inadequately designed
- [x] Inadequately laid out
- [ ] Inadequately maintained
- [x] Indoors
- [ ] In need of repair
- [ ] Lacking guardrails
- [ ] Lacking handrails
- [ ] Lacking toe boards
- [ ] Lacking warning
- [ ] Makeshift
- [ ] Narrow
- [ ] Old
- [ ] Outdoors
- [ ] Small
- [ ] Steep
- [ ] Tight
- [ ] Uneven
- [ ] Unguarded
- [ ] Unstable
- [ ] Undersized
- [ ] Worn
- [ ] Other ______

3. Ambient Environment

a. Weather

- [ ] Bright sunny
- [ ] Cloudy
- [ ] Cold
- [ ] Dry
- [ ] Dusty
- [ ] Fog
- [ ] Hot
- [ ] Humid
- [ ] Rain
- [ ] Sleet/hail
- [ ] Snow
- [ ] Stormy
- [ ] Windy
- [ ] Other ______

b. Noise

- [ ] Constant
- [ ] Distracting
- [ ] Impact
- [ ] Intermittent
- [ ] Loud
- [ ] Startling
- [ ] Other ______
- [ ] Source ______

c. Lighting

- [ ] Bright
- [ ] Dark
- [ ] Flickering
- [ ] Glaring
- [x] Other LOW
- [ ] Source FLUOR.

d. Toxic fumes

- [ ] Faint/perceptible
- [ ] Inducing drowsiness
- [ ] Inducing dizziness
- [ ] Noxious
- [ ] Lethal
- [ ] Other ______
- [ ] Source ______

III. WORK TASK

1. General Task Function ELECTRICAL INSTALLATION
2. Specific Activity TIGHTENING A CONDUIT CLAMP ON THE INSIDE EAVE OF UTILITY BLDG.
3. Exposure
   a. Number of employees performing activity at this location 2
   b. Performance frequency
      1) By injured employee 0 % OF TIMES
      2) By other employees at this location 100 % OF TIMES
   c. Hours of exposure
      1) For injured employee NONE - SUPERVISOR (CO-WORKER) DID ALL LADDER WORK
      2) For other employees at this location 4-5 HRS A WEEK
4. Characteristics or Conditions of Specific Activity

- [ ] a. Any recent changes in work routine? ______
- [ ] b. Incentive pay? ______
- [ ] c. Much overtime? How much prior to accident? ______
- [ ] d. Many peak loads? ______
- [ ] e. Inadequate coordination/communication between employees? ______
- [x] f. Requires awkward position? REACHING ON LADDER
- [ ] g. Requires exceptional

- [ ] Attention
- [ ] Caution
- [ ] Dexterity
- [ ] Decision making
- [ ] Endurance
- [ ] Judgment
- [ ] Motor coordination
- [ ] Perceptual discrimination
- [x] Risk
- [ ] Skill
- [ ] Speed
- [ ] Strength
- [ ] Vigilance
- [ ] Other ______

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h. Is activity especially

- [ ] Boring
- [ ] Complex
- [ ] Difficult
- [ ] Demanding
- [ ] Fatiguing
- [ ] Hazardous
- [ ] Monotonous
- [ ] Quickly paced
- [ ] Repetitive
- [ ] Slowly paced
- [ ] Tedious
- [ ] Variable
- [ ] Other ______

5. Protective Equipment/Other Clothing

- [ ] a. Wearing any protective equipment? ______
- [ ] b. Would use of any protective equipment have prevented injury? ______
- [ ] c. Did any safety device used fail to prevent injury? ______

d. Characteristics of protective equipment or other clothing worn

- [ ] Baggy ______
- [ ] Distorting ______
- [ ] Encumbering ______
- [ ] Heavy ______
- [ ] Long ______
- [ ] New ______
- [ ] Obstructs vision ______
- [ ] Restricts movement ______
- [ ] Small ______
- [ ] Tight ______
- [ ] Uncomfortable ______
- [ ] Unknown ______
- [ ] Other ______
- [ ] Type ______

6. Hands Action

- [ ] Applying force
- [ ] Catching
- [ ] Carrying
- [ ] Dropping
- [ ] Grabbing
- [ ] Handling
- [x] Holding
- [ ] Picking
- [ ] Placing
- [ ] Pulling
- [ ] Pushing
- [ ] Throwing
- [ ] Turning
- [ ] Tying
- [ ] Using
- [ ] Other ______

7. Objects Held or Tools Used

a. Objects held

- [ ] Bag(s)
- [ ] Barrel(s)
- [ ] Basket(s)
- [ ] Bin(s)
- [ ] Bottle(s)
- [ ] Box(es)
- [ ] Bucket(s)
- [ ] Can(s)
- [ ] Case(s)
- [ ] Container(s)
- [ ] Cup(s)
- [ ] Drum(s)
- [ ] Flask(s)
- [ ] Package(s)
- [ ] Tray(s)
- [ ] Other ______

b. Tools used

- [ ] Broom
- [ ] Crowbar
- [ ] Drill
- [ ] Hammer
- [ ] Hose
- [ ] Knife
- [ ] Mop
- [ ] Pliers
- [ ] Pneumatic hammer
- [ ] Pole
- [ ] Saw
- [ ] Scraper
- [ ] Screwdriver
- [ ] Shovel
- [ ] Sledgehammer
- [x] Wrench
- [ ] Other ______

8. Characteristics or Conditions of Objects Held or Tool Used

a. General

- [ ] Awkward
- [ ] Broken
- [ ] Defective
- [ ] Elevated
- [ ] Empty
- [ ] Encumbering
- [ ] Fragile
- [ ] Full
- [ ] Glass
- [ ] Guarded
- [ ] Heavy
- [ ] Hot
- [ ] Icy
- [ ] Jammed
- [ ] Large
- [ ] Loose
- [ ] Makeshift
- [ ] Muddy
- [ ] Narrow
- [ ] New
- [ ] Obstructing movement
- [ ] Obstructing vision
- [ ] Oily
- [ ] Old
- [ ] Oversized
- [ ] Portable
- [ ] Powered
- [ ] Rough
- [ ] Sharp
- [ ] Slippery
- [ ] Small
- [ ] Toxic
- [ ] Unguarded
- [ ] Unstable
- [ ] Wet
- [ ] Worn
- [ ] Other ______

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b. Measurements

1) Number of objects ______

2) Size ______

3) Weight ______

4) Shape ______

5) Other ______

9. Location (of movement)

a. From LADDER - 40" TO WORK LOCATION

b. To ______

10. Body Position

- [ ] Bending
- [ ] Crawling
- [ ] Extending
- [ ] Kneeling
- [ ] Leaning
- [ ] Lying
- [x] Overextending
- [ ] Reaching
- [ ] Reclining
- [ ] Sitting
- [ ] Straddling
- [ ] Straightening up
- [ ] Squatting
- [ ] Turning
- [ ] Twisting
- [ ] Other ______

11. Feet Action

- [ ] Jumping
- [ ] Kicking
- [ ] Running
- [ ] Stepping
- [x] Standing
- [ ] Walking
- [ ] Other ______

12. Footwear (type)

- [ ] Bare feet
- [x] Boots (leather)
- [ ] Boots (rubber)
- [ ] Flats
- [ ] High heels
- [ ] Oxfords
- [ ] Platform
- [ ] Pumps
- [ ] Sandals
- [ ] Slippers
- [ ] Socks
- [ ] Stockings
- [ ] Tennis shoes
- [ ] Thongs
- [ ] Wedgies
- [ ] Wellingtons
- [ ] Unknown ______
- [ ] Other ______

13. Characteristics or Conditions of Footwear

a. Sole construction

- [ ] Composition
- [ ] Cork
- [ ] Crepe
- [ ] Leather
- [x] Neoprene
- [ ] Rubber
- [ ] Taps
- [ ] Wooden
- [ ] Unknown ______
- [ ] Other ______

b. Heel construction

- [ ] Composition
- [ ] Cork
- [ ] Crepe
- [ ] Leather
- [x] Neoprene
- [ ] Rubber
- [ ] Wooden
- [ ] Unknown ______
- [ ] Other ______

c. Sole thickness 1/4"

d. Heel height 1"

e. Condition

- [ ] New
- [x] Good
- [ ] Worn
- [ ] Needs repair
- [ ] Unknown ______
- [ ] Other ______

f. Characteristics

- [ ] Muddy
- [ ] Oily
- [ ] Poorly fitting
- [x] Protective footwear (list brand name, model no., approximate date purchased/issued) ______
- [ ] Tight
- [ ] Slippery
- [ ] Small
- [ ] Uncomfortable
- [ ] Wet
- [ ] Unknown ______
- [ ] Other ______

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14. Surface Type(s) (number applicable boxes 1 or 2)

a. ☐ Normal surface
☑ Elevated surface

b.
☐ Beam
☐ Bench
☐ Board
☐ Boom
☐ Bridge
☐ Chair
☐ Conveyor belt
☐ Conveyor rollers
☐ Curb
☐ Desk
☐ Escalator
☐ Floor
☐ Floot mat
☐ Ground
☑ Ladder
☐ Landing
☐ Ledge
☐ Pallet
☐ Pavement
☐ Pedestal
☐ Platform
☐ Ramp
☐ Roof
☐ Rung
☐ Running board
☐ Scaffold
☐ Sidewalk
☐ Step(s)
☐ Stairs
☐ Stool
☐ Support
☐ Table
☐ Tailgate
☐ Tower
☐ Truck
☐ Truck bed
☐ Other moving platform ___
☐ Other stationary surface ___

15. Characteristics or Conditions of Surface Type(s) (number corresponding boxes 1 or 2)

a. Material
☐ Asphalt
☐ Asphalt tile
☐ Carpeted
☐ Ceramic
☐ Concrete
☐ Cork
☐ Creosote wood block
☐ Dirt
☐ Glass
☐ Grass
☐ Gravel
☐ Linoleum
☐ Lead
☐ Marble
☑ Metal
☐ Metal mesh
☐ Plastic
☐ Rubber
☐ Sand
☐ Slate
☐ Steel
☐ Terrazzo
☐ Tile
☐ Vinyl tile
☐ Wooden
☐ Other ________________

b. Conditions
☐ Bumpy
☐ Cluttered
☐ Crowded
☐ Frayed
☐ Freshly waxed
☐ Holes
☐ Icy
☐ Inclined
☐ Makeshift
☐ Muddy
☐ Narrow
☐ New
☐ Objects on ground
☐ Objects protruding
☐ Oily
☐ Rough
☐ Ruts
☐ Salt covered
☐ Sandy
☐ Snowy
☐ Slippery
☐ Slanted
☐ Slatted
☐ Steep
☐ Uneven
☑ Unstable
☐ Wet
☐ Worn
☑ Other SAWDUST ON SURFACE

IV. ACCIDENT EVENTS/CONSEQUENCES

1. Describe fully accident sequence of events, accident type(s), surface/objects, characteristics/conditions LADDER SLIPPED, LADDER AND EMPLOYEE FELL (LOSS OF SUPPORT), EMPLOYEE STRUCK AGAINST CORNER OF METAL TABLE SAW TABLE

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2. Nature of Injury(s) (number applicable boxes 1, 2, 3)

- [ ] Abrasion
- [ ] Amputation
- [ ] Avulsion
- [ ] Burn
- [ ] Chemical burn
- [ ] Concussion
- [x] Contusion
- [ ] Dental injury
- [ ] Dislocation
- [ ] Electric shock
- [ ] Fracture
- [ ] Frostbite
- [ ] Hearing impairment
- [ ] Heart attack
- [ ] Hernia
- [ ] Infection
- [ ] Inflammation
- [ ] Laceration
- [ ] Nosebleed
- [ ] Sprain
- [ ] Torn cartilage
- [ ] Multiple injuries
- [ ] Other injuries ______

3. Part(s) of Body (number corresponding boxes 1, 2, 3)

- [ ] Head
  - [ ] Brain
  - [ ] Ear(s)
  - [ ] Eye(s)
  - [ ] Face
    - [ ] Jaw
    - [ ] Mouth
    - [ ] Nose
    - [ ] Teeth
    - [ ] Forehead
    - [ ] Chin
  - [ ] Scalp
  - [ ] Skull
- [ ] Neck
- [ ] Arm
  - [ ] Shoulder
  - [ ] Upper arm
  - [ ] Forearm
  - [ ] Elbow
  - [ ] Hand
    - [ ] Wrist
    - [ ] Finger(s)
    - [ ] Thumb
- [ ] Trunk
  - [ ] Abdomen
  - [ ] Back
    - [ ] Lower back
  - [ ] Chest
    - [ ] Breast(s)
    - [x] Rib(s)
  - [ ] Hip(s)
  - [ ] Buttocks
  - [ ] Groin
- [ ] Leg
  - [ ] Thigh
  - [ ] Knee
  - [ ] Lower leg
    - [ ] Ankle
  - [ ] Foot
    - [ ] Toe
    - [ ] Big toe
- [ ] Multiple body parts
- [ ] Other body parts
- [ ] Part of body part
  - [ ] Hair
  - [ ] Heel
  - [ ] Instep
  - [ ] Joint(s)
  - [ ] Knuckle(s)
  - [ ] Nail(s)
  - [ ] Palm
  - [ ] Tendon

4. Severity

- [ ] First aid only
- [ ] No lost workdays
- [x] Lost workdays
- [ ] Permanent disability
- [ ] Fatality
- [ ] Unknown ______

5. Total Lost Time 15 DAYS

6. Documentation

a. Weather
  1) Temperature ______
  2) Humidity ______
  3) Barometer ______
  4) Wind speed (chill factor) ______

b. Noise
  1) Ambient db(A) ______
  2) Periodicity ______

c. Lighting
  1) Ambient foot-candles ______
  2) Contrasts/glares ______

d. Toxic fumes
  1) Type ______
  2) Parts per million ______
  3) TLV exceeded? ______

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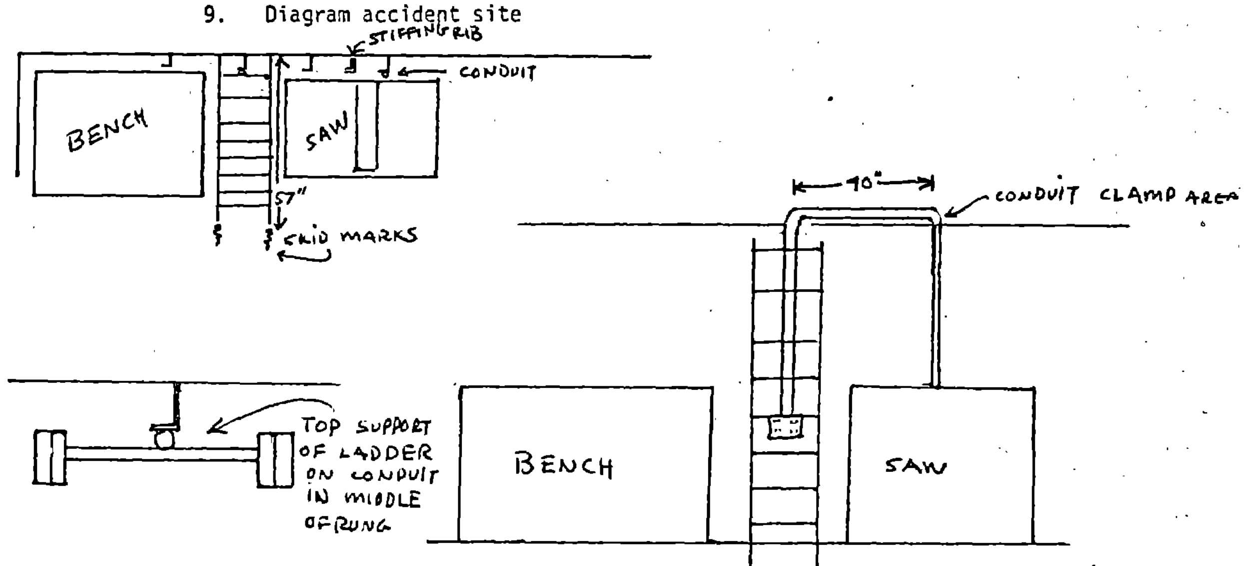
e. Work surface coefficient of friction
   1) Test material ACTUAL LADDER (RUBBER-FOOTED) c̄ 10 POUND WEIGHT ON FOOT.
   2) List readings in order (take at least ten readings) .31 .39 .37 .38 .38 .33 .44
   3) Mean of readings .37
   4) Standard deviation .023

f. Tape measure
   1) Clearances
   2) Distance fallen 2' TO TABLE SAW; 3' FROM THERE TO FLOOR
   3) Height guardrail, enclosure
   4) Span of opening
   5) Stair
      a) Riser height(s)
      b) Step depth (contact surface)
      c) Step width
      d) Number of steps
      e) Number of landings
      f) Angle(s) of incline $\alpha = 67^\circ$
   6) Other

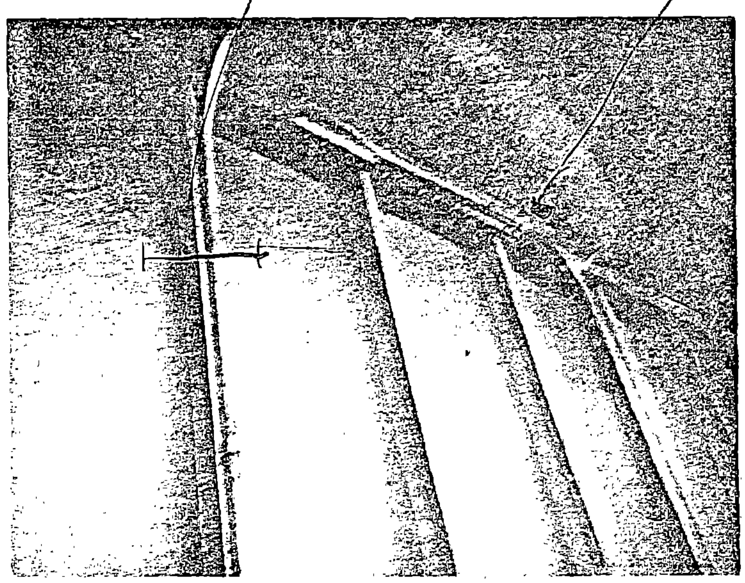
7. Document any standards (mandatory or concensus) or other criteria violated 1910.26(c)(3)(i) - LADDER ANGLE OF INCLINATION; 1910.26(c)(3)(iii) - IMPROPER SURFACE FOR FOOTING; 1910.26(c)(3)(iv) UNSTA[BLE] TOP SUP[PORT]

8. Any countermeasures planned?

9. Diagram accident site



Investigator's Name JOHN CHARLES/AL CLARK Date of Investigation 5/9/77


Ladder across this beam
Clamp