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**A comparison of electrical utilities to determine root causes of  
increasing electrical contact accidents**

**Thompson, Guy T., M.S.**

**Middle Tennessee State University, 1989**

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A Comparison of Electrical Utilities to  
Determine Root Causes of Increasing  
Electrical Contact Accidents

Guy T. Thompson

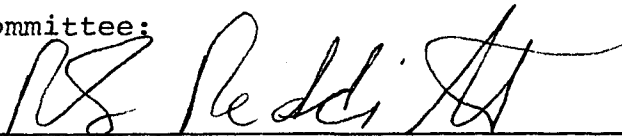
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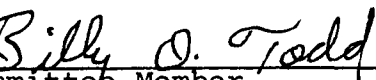
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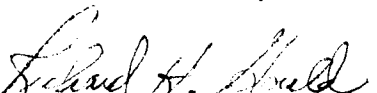
APPROVED:


Graduate Committee:

  
Major Professor

  
Committee Member

  
Committee Member

  
Chairman of the Department of Industrial Studies

  
Dean of the Graduate School

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GUY THOMPSON

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## Abstract

### A Comparison of Electrical Utilities to Determine Root Causes of Increasing Electrical Contact Accidents

by Guy T. Thompson

This study compared a representative sampling of utilities across the state of Tennessee to identify trends which might account for increasing electrical contact accidents by linemen. The results did not show that the use of a working foreman (a foreman who not only supervises the job but actively participates in the work) increased susceptibility to accidents. The results did indicate a need for structured apprentice training, supervisory training for foremen and a need for a formally adopted safety policy. There was no indication that geography has any part in accident rate. The ratio of experienced linemen per crew did seem to have an effect. There was only one contact accident reported from a crew with no apprentices. It also became obvious that the degree of involvement by management was paramount to safety.



### Acknowledgment

In the preparation of a work of this kind many debts of gratitude are incurred, and I wish to express my deep appreciation to those people whose help and understanding made this project possible.

I especially wish to thank Dr. Richard Redditt for his guidance and suggestions throughout this study. I also very much appreciate the help of my staff of instructors who collected the data for this project. And, most of all, to my wife, Vicki, I express my thanks and love for her patience and support.

### Dedication

This study is dedicated to the utility linemen across the state who risk their lives daily in order that people may enjoy the most important convenience developed by mankind--electricity.

Table of Contents

	Page
List of Tables . . . . .	v
List of Figures . . . . .	vi
List of Appendices . . . . .	vii
Chapter	
1. Introduction . . . . .	1
Background . . . . .	1
Purpose of the Study . . . . .	1
Limitations of the Study . . . . .	1
Problem Questions . . . . .	2
Definitions . . . . .	3
2. Related Information . . . . .	4
3. Methodology . . . . .	6
4. Results . . . . .	9
5. Summary, Conclusions, and Recommendations . . . . .	19
Appendices . . . . .	23
References . . . . .	54

List of Tables

Table	Page
1. Data Collection Summary . . . . .	10
2. Comparison of Selected Factors Between the Utilities Surveyed . . . . .	12

List of Figures

Figure	Page
1. Graphical Comparison Between Utilities Surveyed as to Number of Crews versus Electrical Contact Accidents . . . . .	11
2. Profile Scores for Questionnaire . . . . .	17

List of Appendices

Appendix	Page
A. Survey . . . . .	24
B. Stress Profile Questionnaire . . . . .	26
C. Summary and Order Statistics . . . . .	28
D. Safety Policy . . . . .	34

## Chapter 1

### Introduction

The most devastating work experience an electrical utility lineman is in danger of is an accidental electrical contact between a primary phase and neutral or a phase-to-phase contact when working in the field.

The victim, if he is fortunate enough to live, will most likely face a long recovery period with permanent disfigurement and varying degrees of disability.

### Background

During the period 1976-1986, the number of accidents of this type reported by Tennessee utilities ranged from a low of two to a high of six. In 1987, however, that number jumped to 14. This alarming increase warrants investigation.

### Purpose of the Study

The purpose of this study was to identify a root cause of electrical contact accidents and to determine if the number of accidents in 1987 was an unusual occurrence not likely to be repeated.

### Limitations of the Study

This study was limited because of the number and type of sampling techniques. Data are good only to the

extent they are provided by the foremen who completed the surveys. These results can be considered accurate with a confidence level of at least 90 percent (Dixon & Massey, 1969).

### Problem Questions

Several questions surface when injury reports and insurance data are reviewed.

1. Why were the majority of the casualties to foremen? (10 of 14)

2. Why, according to Federated Insurance Company, are 85 percent of the claims coming from 20 percent of the insured cooperatives?

3. Why do Middle Tennessee utilities seem to have more incidences than West or East Tennessee?

It should be noted that all utilities use basically the same safety procedures as defined in the American Public Power Association Safety Manual for electric utilities. All these utilities also receive identical training through the Tennessee Job Training and Safety Program for electrical utilities.

The researcher chose to do a demographic comparison of the foremen and crews for selected utilities in each major region of the state. Utilities with the best record and those with the worst record in each geographical region were selected. The survey instruments will be identified and discussed later.



### Definitions

Electrical contact accident. The term for an accidental electrocution or burn caused by a worker touching a live primary conductor.

Primary phase. The term identifying electrical power before it goes through a step-down transformer.

Lineman. The utility worker who installs and services electrical service to a home or business.

Neutral. That electrical line used as a reference point to each phase.

Tennessee Job Training and Safety Program. Designed to provide training and safety programs to electric utility workers co-sponsored by the State of Tennessee and the Tennessee Electric Cooperative Association.

Loss control consultant. A person who specializes in identifying unsafe work practices and accident investigation.

Cooperative. Utility system which is member owned, serving primarily rural customers.

Municipal. Utility system owned by the public which primarily serves urban consumers.

## Chapter 2

### Related Information

Information related to electrical contact accidents is very limited. Other than review of insurance claims data from Federated Insurance Company, the main sources of information for this project came from personal interviews with loss control consultants and utility safety directors (personal interviews with D. Collette, McMinnville Electric, McMinnville, TN, May 5, 1988, during Engineers Conference at Henry Horton State Park; L. Fortier, Loss Control Consultant, Nashville, TN, April 28, 1988; W. K. Johnson, Tri-County Electrical Membership Cooperative, Lafayette, TN, June 13 and 14, 1988; H. King, Upper Cumberland Electric Membership Cooperative, Carthage, TN, June 13, 1988; S. McMinn, Union City Electric Utilities, Union City, TN, May 5, 1988, during Engineers Conference at Henry Horton State Park; R. Neperud, Federated Insurance Company, Kansas City, KS, April 11 and 12, 1988, in Atlanta, GA; and R. Turner, Lewisburg Electric, Lewisburg, TN, various dates in 1988).

These interviews were very helpful, making it possible to determine the specific data to be collected. Additionally, the research conducted by Zealand and Holmes (1977) and Selye (1976) was extremely useful

in the organization of material for a stress profile questionnaire.

Contact was made with several other statewide Job Training and Safety Programs to ascertain if a study similar to this one had been conducted in their areas. From these sources, it was learned that an evaluation of this type has not previously been made. The persons interviewed expressed interest in the results of this study.

## Chapter 3

### Methodology

There are 81 electric utilities in the state of Tennessee. Of these 81 utilities, 77 of them participate in a training and safety program co-sponsored by the Tennessee State Board of Regents through a grant provided by the Tennessee Electric Cooperative Association. This program is called the Tennessee Job Training and Safety Program. The four utilities in the state which do not participate are the systems serving Chattanooga, Knoxville, Nashville, and Memphis. They are large enough that they have in-house programs to deliver the services of the Tennessee Job Training and Safety Program.

These 77 systems are composed of 23 rural electric cooperatives which serve 45 percent of the consumers and 54 municipals which serve 55 percent of the consumers. In order to obtain a representative sampling of the utilities, data were collected from 10 of them. This number exceeds 10 percent of the total (13 percent). The systems surveyed were divided evenly between cooperatives and municipals. The selected systems represent the three main geographical regions of the state. Both large and small utilities, representing those with not only the best but

also the worst safety records, were selected. The systems are identified by code letters; A through E are cooperatives and F through J are municipals.

The procedure for gathering data was for the Job Training and Safety instructor who services the system being surveyed to request the foremen to complete survey forms at the time of the instructor's scheduled visit. The sole source for the data on the forms was the input by the linemen. There were no names or systems identified on the forms. This anonymity allowed the men filling out the surveys to be more at ease and to provide more accurate data since they felt the information would not be traceable directly to them. There was, however, a code letter on the survey that identified the system. The timetable for gathering data for this study was the months of January and February 1989.

Survey forms were designed to gather specific data on individual crews and foremen. One form was devised to gain insight into each system's safety attitude by management. Another instrument was a questionnaire consisting of 15 questions relating to stress experienced by each foreman. These instruments identify whether or not a system has safety incentive programs or safety policies, and if, in general, it places emphasis on safety of personnel.

After the data from these two forms were assimilated, a comparison was made between number of crews and the electrical contact accidents of each utility. Also, a graphic comparison was made between the utilities surveyed.

The limitations of this type of sampling technique are obvious. The data are only as reliable as the information provided by the foremen completing the surveys. Although the results are not exact, they are accurate to a minimum confidence factor of 90 percent (Dixon & Massey, 1969).

## Chapter 4

### Results

Data on individual crews and foremen were gathered by means of a survey. The survey was designed to gain insight into each system's safety attitude by management (see Appendix A). To determine the stress experienced by each foreman, a questionnaire consisting of 15 questions was prepared (see Appendix B). The information collected through use of these two instruments is reflected in the data collection summary (see Table 1).

All data collected in this study were subjected to statistical analysis which was then summarized, charted, and graphed. Figure 1 compares number of crews to electrical contact accidents of each utility. Table 2 compares compares selected factors between the utilities surveyed.

Each data point was factored into summary statistics, order statistics, frequency distribution, cumulative distribution, and ordered array (see Appendix C). The following information had to be considered before the data was analyzed.

Utilities A through E are rural electric cooperatives which are member owned. They have several branch offices as well as a main office and, therefore, have a greater

Table 1

Data Collection Summary

Question	Summary Codes:	A	B	C	D	E	F	G	H	I	J
1. Avg. Size of Crew		3.3	2.7	5	5	4.5	4	5	3	3	3
2. Avg. Crew Age		42.5	41	48	36	46	46.5	35	43	-	41
3. Crew--Journeyman		3.3	2.2	4.5	3	2.5	3.5	3.5	3	3	3
--Apprentices		0	.5	.5	2	2	.5	1.5	0	0	0
4. Crew Avg. Education (Years)		11.4	11.6	10	12	11.8	10.8	11.8	11	-	11.3
5. Experience together as a Crew (Avg.) (Mos.)		80.7	45	175	19	17	58	18	24	-	66
6. Percent Hot Work		31	32	68	49	41	37	43	38	75	45
7. Crew Elect. Contact											
Last 5 Years		0	1	1	1	1	1	0	1	0	0
Near Miss		0	0	0	0	0	0	0	0	0	0
8. Field Communications											
Electronics											
Manual											
9. Safety Incentives		Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No
10. System Safety Policy		Yes	Yes	No	Yes	No	No	No	No	No	No
11. Avg. Foreman Stressor Score		4.4	6	8.3	9.8	8.4	17	4.8	9	17	9.5



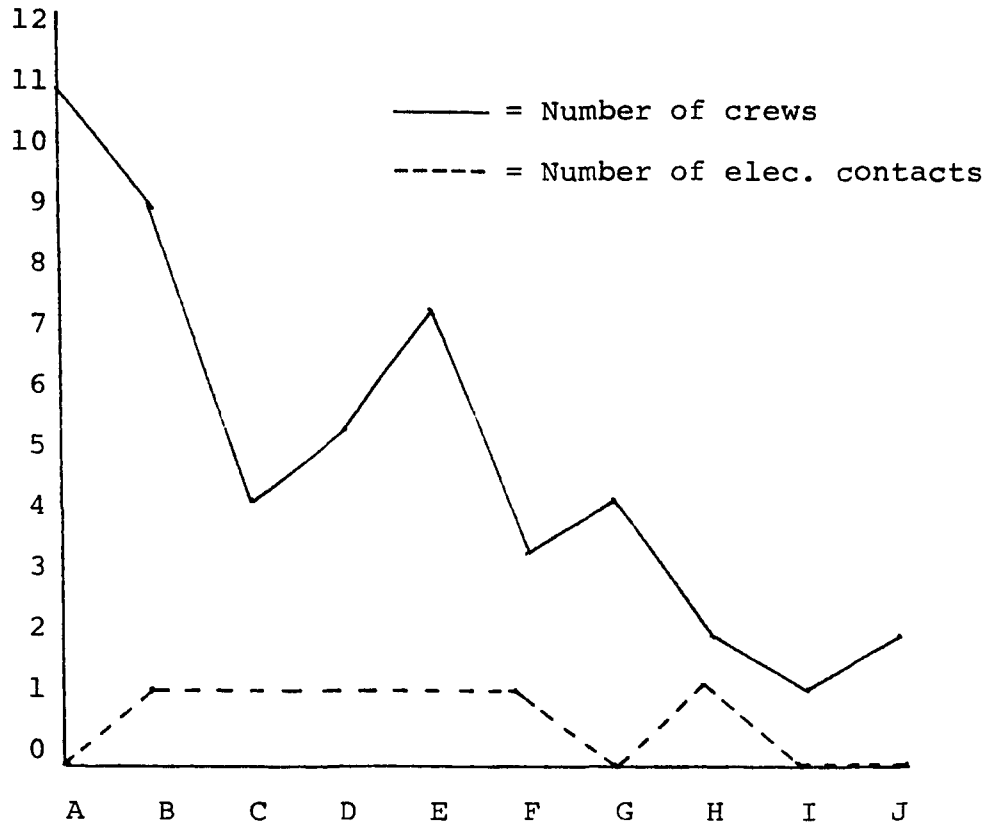


Figure 1. Graphical Comparison Between Utilities Surveyed as to Number of Crews versus Electrical Contact Accidents

Table 2

Comparison of Selected Factors Between the Utilities  
Surveyed

Selected Factors	Utility									
	A	B	C	D	E	F	G	H	I	J
Safety Incentives	x	x		x	x	x	x			
Safety Policy	x	x		x						
Safety Director	x	x			x	x	x			
Line Foremen		x	x	x	x		x		x	
Working Foremen	x	x	x	x	x	x	x	x		x
Three-Man Crews	x	x						x	x	x
Four-Man Crews					x	x				
Five-Man Crews			x	x			x			
East Tennessee				x			x			x
Middle Tennessee	x	x			x	x				
West Tennessee			x					x		
Electrical Contacts		x	x	x	x	x		x		

number of employees on average. They belong to a strong state organization called the Tennessee Electric Cooperative Association as well as to the National Rural Electric Cooperative Association. They are also served by the Rural Electrification Association, a federal agency. Their general manager serves a board of directors which is elected by the membership.

Utilities F through J are municipal electric systems which are public utilities governed by the city government. They serve the residents inside the city limits and operate from one location. They belong to a statewide organization called the Tennessee Municipal Electric Power Association. Many also belong to the Tennessee Valley Public Power Association and the American Public Power Association. Their manager is often appointed by the mayor and may serve only until election time if the mayor is unseated. Some have a board, but usually the board covers all city utilities (electric, gas, water, sewer, trash collection), so their focus is not as directed as it could be.

Of the six electrical contact accidents reported, two happened on a three-man crew, one on a four-man crew, and three on a five-man crew. Four of these accidents were reported from cooperatives and two were from municipals.

Four of the systems reporting electrical contact accidents do not have a comprehensive written safety policy. This is significant enough that this researcher has prepared a safety policy applicable to all utilities (see Appendix D).

Of the six electrical contacts reported, five involved crews with apprentices. Three of the injured parties were apprentices. In a fourth incident, although an apprentice was not injured, the crew consisted of one journeyman and two apprentices. From this data, 60 percent (confidence level 90 percent) of the utilities in Tennessee have had an electrical contact accident in the last five years.

Apprentices in most utilities get their training on the job. This concept puts the new man at risk of picking up his trainer's bad habits. In situations of this kind, there can be no standardization of training. The researcher, in polling the Job Training and Safety instructor staff, found only two of the ten utilities surveyed used a formal apprentice training program in conjunction with on-the-job training.

At the outset, it was believed that the Workman's Compensation Insurance rate would be a good indicator of overall safety performance. This became a mute issue when it was discovered that the municipal electric departments cannot shop for premiums. Since these departments are

a function of the city government, their insurance is included with that of other service functions and must be purchased from a local agent. The cooperatives on the other hand take out insurance on the utility only and receive a much better rate.

The age of the workforce is well proportioned. The sample size was 126. The arithmetic mean was 41.15 years with a standard deviation of 10.43 years. Over 65 percent of the workforce are in their most productive period, ages 30-50.

The education level was a pleasant surprise. The arithmetic mean was 11.5 years with a standard deviation of 1.64.

The data show statistical average of eight years' experience on a crew for the total workforce.

The percent of work across the state that is done "hot," that is, with the power on, is 40 percent. A complete breakdown of the data analysis is included in Appendix C.

For evaluation of the foreman psychological profile, values were assigned of +2 for 1, +1 for 2, 0 for 3, -1 for 4, and -2 for 5. With 15 questions on the questionnaire, the maximum scoring range was -30 to +30. While zero would be a middle-range score, it must be remembered that these are foremen. Good leadership qualities and training should have produced scores averaging 15.

Results show an arithmetic mean of 7.64 and a standard deviation of 9.25 (see Figure 3).

Several factors could account for the low scores. The selection process could be flawed; or management may not be providing necessary indoctrination for new foremen, in which event they may not have a proper understanding of their new responsibilities and/or management may not be providing an avenue for the foremen to continue development of their supervisory skills. Foremen need to know not only what their responsibilities are but why management assigns priorities in the order they do. Foremen need to know that they are on the management team.

One of the most interesting findings is that, as the number of crews increase, the exposure should increase; however, results of this research do not support this assumption; in fact, they appear to be inversely proportional.

This researcher discovered that the published data of insurance companies is a poor yardstick for gauging overall safety performance of utilities. It was found that accident reports are not utilized uniformly by the utilities. Some consider a lost time accident as any accident which will prevent an employee from performing any duty that he or she was hired to do. Other utilities do not report any accident or injury that only limits an

No. of Foremen

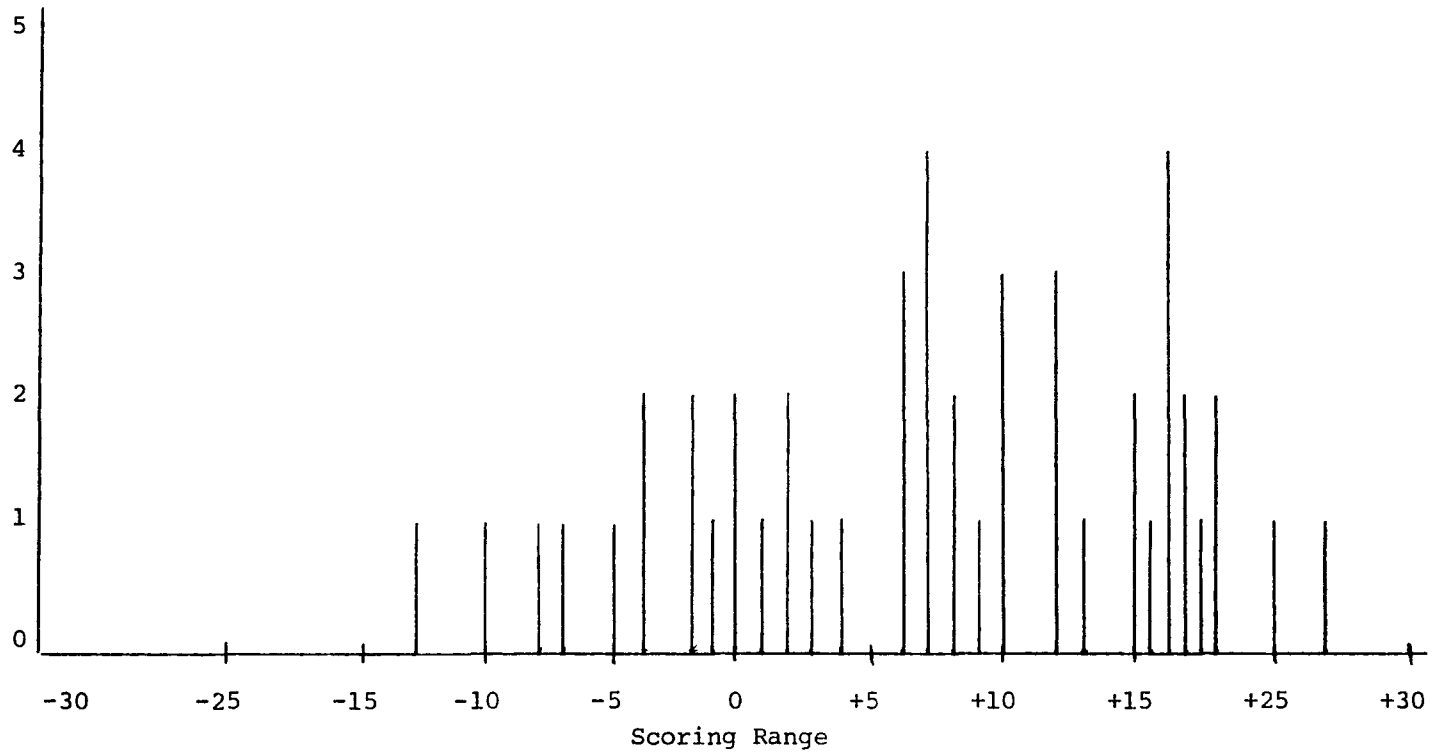


Figure 2. Profile Scores for Questionnaire

employee's capabilities to perform normal duties (anything short of hospitalization is not reported). This latter approach enhances the safety record on paper and helps keep insurance cost down.



## Chapter 5

### Summary, Conclusions, and Recommendations

#### Summary

This study compared various utilities across the state of Tennessee in an effort to identify a root cause for the increasing electrical contact accidents by utility linemen. The utilities varied in size, geographical area, and type of operation (cooperative and municipal). Identical survey instruments were sent to each facility. Forty-eight foremen from the 10 utilities surveyed responded.

Of the 10 utilities surveyed, six reported an electrical contact accident during the past five years involving one of its employees. This would mean that it could be expected that 46 of the 77 systems across the state (not including Nashville, Chattanooga, Knoxville, and Memphis) have had at least one electrical contact accident during the past five years.

#### Conclusions

This researcher feels that six out of ten utilities reporting an electrical contact accident during the last five years is entirely too high a number, and a fresh approach to training is indicated for the Tennessee Job Training and Safety Program as well as in-house training

and safety programs at the individual utilities. Educational materials can be selected to address high school graduate level or just below with confidence that the material will be at a level of comprehension for the majority of the workforce.

Utility crew size is steadily shrinking due to economic considerations. The trend is to three-man crews which fact forces the foreman into a "working foreman" situation. According to the data, this is not a serious problem. However, it does present a problem when a crew has work on, or adjacent to, a public road. There are no people available to control traffic and this lack poses a threat to both the crew and motorists. It is imperative that Department of Transportation regulations be followed at any time work of this nature is in progress. If utility personnel are not available, the work could perhaps be coordinated with law enforcement officials and they could support the activity in progress.

While no root cause surfaces from this study, several contributing factors do emerge that could, by themselves and in combination, lead to an electrical contact accident. These are lack of (a) an adopted and enforced company safety policy, (b) indoctrination and supervisory training for foremen, and (c) a formal structured training program for apprentices. Each of these factors is a function of management. Until top management accepts its

responsibilities and directs emphasis for safety in these areas, electrical contact accidents will not be brought under control. If a root cause of these accidents was identified, it was apathy on the part of the manager. He is the catalyst.

This study also supports the conclusion that the larger the organization, the better the safety record, at least where electrical contact accidents are concerned.

The utility workforce is well balanced and indicates personnel augmentation is in good shape. Sixty-six percent of the linemen are in their production prime (between ages 30 and 50). Approximately half of the remainder are under age 30 and the rest are approaching their last decade before retirement.

#### Recommendations

This researcher feels that further research should be done in the area of electrical contact accidents. A supervisory training program for foremen should be developed, and the possibility of a structured indoctrination process for newly appointed foremen as well as continued education in the supervisory skills should be investigated.

Additional study should be made of the available apprentice training programs. If none are acceptable, it is felt that one should be developed for use.

Consideration should be given to expansion of the present Tennessee Job Training and Safety Program to include investigation of reasons why larger organizations have better safety records and the feasibility of standardizing accident reporting procedures. Control of a program like this could possibly be through the State Insurance Commissioner's office. Although reports and procedures are now in place, they are not being followed to the letter by all utilities as evidenced by insurance data. This places an undue burden on the systems honestly reporting their injuries by unfavorably influencing their insurance rates when compared to like systems which do not report all injuries.

Included as Appendix D is a copy of a safety policy written by this researcher during the course of this study. This policy has already been adopted by two of the utilities used in the research that did not previously have a written policy.

## Appendices

## Appendix A

## SURVEY

Line Crew Profile  
(To be completed by foreman)

- |   | #1    | #2    | #3    | #4    | #5    |
|---|-------|-------|-------|-------|-------|
| 1. Crew Member  |       |       |       |       |       |
| a. Age  | _____ | _____ | _____ | _____ | _____ |
| b. Years experience   | _____ | _____ | _____ | _____ | _____ |
| c. Education in years   | _____ | _____ | _____ | _____ | _____ |
| d. Years on this crew   | _____ | _____ | _____ | _____ | _____ |
| 2. Percent of time this crew does hot work. _____   |       |       |       |       |       |
| 3. How long have you been foreman on this crew? _____   |       |       |       |       |       |
| 4. Has your crew had an electrical contact accident or a "near miss" in the past five years? Yes _____ No _____ |       |       |       |       |       |
| If yes, please give details. _____  |       |       |       |       |       |
| _____   |       |       |       |       |       |
| _____   |       |       |       |       |       |
| _____   |       |       |       |       |       |
| _____   |       |       |       |       |       |
| 5. Please indicate type of field communications (check all that apply):   |       |       |       |       |       |
| Voice   | _____ |       |       |       |       |
| Hand signals  | _____ |       |       |       |       |
| Radios  | _____ |       |       |       |       |
| Head sets   | _____ |       |       |       |       |
| 6. Does your system have a safety incentive program?<br>Yes _____ No _____                                      |       |       |       |       |       |
| 7. Has your utility adopted a written safety policy?<br>Yes _____ No _____                                      |       |       |       |       |       |
| 8. Are you a "working" foreman or a "line" foreman?<br>Working foreman _____ Line foreman _____                 |       |       |       |       |       |

Appendix B



## STRESS PROFILE QUESTIONNAIRE

Directions: Rank each activity according to the following scale:

Never	1	Often	4
Infrequently	2	Almost all the time	5
Sometimes	3		

Please circle the number that applies.

1. How often do you feel you have too little authority to carry out your responsibilities? 1 2 3 4 5
2. How often do you feel unclear about what the scope and responsibilities of your job are? 1 2 3 4 5
3. How often do you not know what opportunities for advancement or promotion exist for you? 1 2 3 4 5
4. How often do you feel you have too heavy a workload that one could not possibly finish during an ordinary working day? 1 2 3 4 5
5. How often do you think that you will not be able to satisfy conflicting demands of people around you? 1 2 3 4 5
6. How often do you feel you are not fully qualified to handle your tasks? 1 2 3 4 5
7. How often do you not know what your supervisor thinks of you, how he/she evaluates your performance? 1 2 3 4 5
8. How often do you find yourself unable to get information needed to carry out your assigned duties? 1 2 3 4 5
9. How often do you worry about decisions that affect the lives of people you know on the job? 1 2 3 4 5
10. How often do you feel unable to influence your immediate supervisor's decisions and actions that affect you? 1 2 3 4 5
11. How often do you feel you might not be liked and accepted by people at work? 1 2 3 4 5
12. How often do you not know just what the people at work expect of you? 1 2 3 4 5
13. How often do you feel you have to do tasks on your job that are against your better judgment? 1 2 3 4 5
14. How often do you think the amount of work you have to do might interfere with how well it's done? 1 2 3 4 5
15. How often do you feel your job interferes with your family life? 1 2 3 4 5

Appendix C

## CREW AGE

## SUMMARY STATISTICS

NUMBER OF VARIATES	=	126
ARITHMETIC MEAN	=	41.1508
STANDARD DEVIATION	=	10.4305
VARIANCE	=	108.795
COEFF. OF VAR. (PCT)	=	25.347
STANDARD SKEWNESS	=	.443
STANDARD EXCESS	=	-.816

## ORDER STATISTICS

SMALLEST VARIATE	=	22
LOWER DECILE	=	29
FIRST QUARTILE	=	33
MEDIAN	=	39
THIRD QUARTILE	=	49
UPPER DECILE	=	58
LARGEST VARIATE	=	65
TOTAL RANGE	=	43
DECILE RANGE	=	29
SEMI-QUARTILE RANGE	=	8

## CREW EXPERIENCE IN MONTHS

## SUMMARY STATISTICS

NUMBER OF VARIATES	=	126
ARITHMETIC MEAN	=	115.232
STANDARD DEVIATION	=	106.886
VARIANCE	=	11424.6
COEFF. OF VAR. (PCT)	=	92.757
STANDARD SKEWNESS	=	1.646
STANDARD EXCESS	=	2.946

## ORDER STATISTICS

SMALLEST VARIATE	=	2
LOWER DECILE	=	12
FIRST QUARTILE	=	24
MEDIAN	=	96
THIRD QUARTILE	=	168
UPPER DECILE	=	252
LARGEST VARIATE	=	492
TOTAL RANGE	=	490
DECILE RANGE	=	240
SEMI-QUARTILE RANGE	=	72

## CREW EDUCATION IN YEARS

## SUMMARY STATISTICS

NUMBER OF VARIATES	=	127
ARITHMETIC MEAN	=	11.5039
STANDARD DEVIATION	=	1.6452
VARIANCE	=	2.70668
COEFF. OF VAR. (PCT)	=	14.301
STANDARD SKEWNESS	=	-1.917
STANDARD EXCESS	=	4.159

## ORDER STATISTICS

SMALLEST VARIATE	=	5
LOWER DECILE	=	8
FIRST QUARTILE	=	12
MEDIAN	=	12
THIRD QUARTILE	=	12
UPPER DECILE	=	12
LARGEST VARIATE	=	16
TOTAL RANGE	=	11
DECILE RANGE	=	4
SEMI-QUARTILE RANGE	=	0

PERCENT HOTWORK  
SUMMARY STATISTICS

NUMBER OF VARIATES = 47  
ARITHMETIC MEAN = 40.5319  
STANDARD DEVIATION = 27.0192  
VARIANCE = 730.036  
COEFF. OF VAR. (PCT) = 66.662  
STANDARD SKEWNESS = .248  
STANDARD EXCESS = -1.155

ORDER STATISTICS

SMALLEST VARIATE = 0  
LOWER DECILE = 5  
FIRST QUARTILE = 15  
MEDIAN = 45  
THIRD QUARTILE = 60  
UPPER DECILE = 80  
LARGEST VARIATE = 90  
TOTAL RANGE = 90  
DECILE RANGE = 75  
SEMI-QUARTILE RANGE = 22.5

## FOREMAN PSYCHOLOGICAL PROFILE

## SUMMARY STATISTICS

NUMBER OF VARIATES	=	48
ARITHMETIC MEAN	=	7.64583
STANDARD DEVIATION	=	9.25898
VARIANCE	=	85.7287
COEFF. OF VAR. (PCT)	=	121.098
STANDARD SKEWNESS	=	-.146
STANDARD EXCESS	=	-.614

## ORDER STATISTICS

SMALLEST VARIATE	=	-13
LOWER DECILE	=	-5.2
FIRST QUARTILE	=	.25
MEDIAN	=	7.5
THIRD QUARTILE	=	15.75
UPPER DECILE	=	19.1
LARGEST VARIATE	=	27
TOTAL RANGE	=	40
DECILE RANGE	=	24.3
SEMI-QUARTILE RANGE	=	7.75

Appendix D



**SAFETY POLICY**

**FOR**

**ELECTRIC UTILITIES**

## INTRODUCTION

The purpose of this safety policy is to promote and to conduct operations with the utmost regard for the safety of employees and the public. For this reason, the policy provides specifications and working conditions designed to promote efficient operations, to eliminate accidents, and to minimize hazards toward the safety of employees and the public.

The safety rules contained herein were formulated to assist and to protect employees in their work. They will be revised to keep abreast of the latest technological developments, changing conditions, and improvements in equipment and procedures.

Each employee must comply with the safety policy of (name of utility); American Public Power Association (APPA) Safety Manual for the guidance of employees of electric systems, and the Tennessee Occupational Safety and Health Standards, and others which are applicable to his own actions and conduct.

TO ALL EMPLOYEES

SUBJECT: SAFETY

OBJECTIVE: To implement a Safety Program for All  
Employees according to Board Policy.  
Date adopted: \_\_\_\_\_

A. GENERAL

1. Planning. Each employee connected with a job should plan for safety. This planning will begin with the engineer and/or serviceman in the field and be completed at the job site by the lineman or crew who does the job. The foreman or crew leader is responsible for the safety of the crew. In order to achieve the ultimate safety possible, the foreman is responsible for holding a tailgate conference with his entire crew to discuss the work to be done and enhance the overall safety by discussing any peculiarities of that particular job, material to be used, assignments to each individual crew member, the location of the job, and receive suggestions or comments from crew members in order to enhance the overall safety and efficiency. Generally, these tailgate conferences should be held prior to starting each job, except jobs which are prolonged for more than one day at a time. In instances such as these, each facet of that job to be done on that day should be discussed with the crew at the beginning of the work day. These rules do not, however, relieve the responsibility of safety from any individual employee.
2. Prescribed Safety Manual. APPA (American Public Power Association) is the recognized official Safety Manual to be used as a guide on safety and will be issued to each craft employee, and a receipt therefor will be obtained.

Employees are expected to be familiar with the contents of this Safety Manual and will be tested on it from time to time. There will be a manual issued and kept in each vehicle's glove compartment for ready reference.

3. First Aid Care of Injured. Insured or sick employees should obtain first aid, medical and/or surgical relief as quickly as possible. First aid kits shall be kept in all vehicles and offices. The telephone numbers of area hospitals; ambulance services; doctors; City, County and State Police; and local Fire Departments will be included with the telephone list. This list is to be stapled to the telephone directory. Every phone is to have a directory.
4. Safety Training. Employees will participate in the regularly scheduled Tennessee Safety and Job Training Programs and in such other safety programs as provided by the safety director from time to time.
5. Trainee. All new employees on their first day of employment shall receive orientation on Safety with special emphasis on safety in the area in which they will be working. All linemen and other employees in training shall have safety emphasized in their training programs. Their personal responsibility for safety in the use and care of personal and company equipment and in housekeeping practices shall be stressed.
6. Fire Control. Good fire control practices, which includes the proper storage of flammable materials and the disposal of waste, rags, shavings, rubbish, weeds, etc., will be observed. Approved fire extinguishers will be mounted in all trucks and at strategic locations in buildings and serviced periodically. All employees will be informed of the location of fire extinguishers and will be drilled in their proper use. After use of fire extinguishers in vehicles, a call should be made immediately for a replacement to be brought to the field.

Good housekeeping practices will also be observed on all vehicles with reference to keeping grease, dirt, and/or flammable wastes free of vehicle. Good housekeeping practices will also be utilized on customer's property, including the cleaning up of any excess or waste materials at the job site, obtaining of proper permission to do the work on customer's property, and the constant practice of common courtesy of customers based upon the principle of treating the customer was one would want to be treated.

7. Accident Reports. Field Reports will be completed by the foreman or employee as soon as possible after the accident. When feasible, all witnesses and the injured will give a statement to the foreman or person in charge as to how the accident occurred, etc. This includes PERSONAL INJURY, VEHICLE ACCIDENT, AND PROPERTY DAMAGE (Utility and Public).

To be effective, preventive measures must be based on complete and unbiased knowledge of the causes of an accident. The primary purpose of an accident report is to give this information, not to fix blame. Since the completeness and accuracy of the entire accident system depends upon the information transmitted in the individual accident reports, simple field forms which contain all essential information must be used. Because it is often impossible to recall with accuracy the details of an accident, details should be recorded accurately and completely at once, or they may be lost forever.

In the event of a recordable accident, the safety director will be called at once for the purpose of obtaining current information and details regarding the accident. This applies only to personal injury accidents which require medical attention beyond normal first aid; i.e., the treatment by a physician. However, any accident involving property damage will necessitate the calling of the safety director so that details may be obtained.

8. Handling of Materials. Where hazards to employees exist, tag lines or other suitable devices shall be used to control loads handled by hoisting equipment. For further information in the use of handling of materials and equipment, please refer to the appropriate portions of the Safety Manual.

## B. SPECIFIC OPERATION RULES

### 1. Use of Rubber Gloves

It is the responsibility of the operators, line foreman, and crew leaders to have their employees thoroughly instructed in the following rules on the use of rubber gloves and to make certain that these rules are enforced.

- a. Rubber gloves must be worn at all times from the ground up, when working on energized lines, equipment, poles, structures, or trees being trimmed or felled within reach of energized lines.
- b. Rubber gloves must be worn when working with Hot Line Tools.
- c. Rubber gloves must be worn by all persons on the ground while working on energized structures, operating a wire reel or otherwise handling conductors to an energized structure, guys being installed, ground wire being installed, connecting ground rods, setting or removing poles in an energized line or working with vehicles with derricks or "A" Frames near energized lines.
- d. Rubber gloves are to be worn on the hands for which they are designed. When a glove for one hand is turned inside out so that it will fit the opposite hand, a strain in the rubber is produced with a consequent reduction in protection value.
- e. Only one rubber glove is to be worn on each hand; any additional gloves add only a false sense of security.

## 2. Care of Rubber Gloves

- a. It is the responsibility of each individual to take care of his rubber gloves. The life he saves may be his own.
  - (1) Gloves must be kept clean. This can be done by washing in warm water, using a mild toilet soap. After being washed, they should be thoroughly dried and dusted with talcum powder.
  - (2) Rubber gloves should never be used without proper size protectors. The protectors help prevent splinters, oils, grease, and rough surfaces from damaging the gloves.
  - (3) Glove protectors should not be used as ordinary work gloves or allowed to become soaked with oil, grease, etc.

- (4) The proper size rubber gloves should be selected to fit the workman's hand. Too large a glove will be cumbersome and subject to pinching, while a glove too small will stretch and result in a decrease in the insulating value.
- (5) Glove liners used with work gloves should not be used in rubber gloves.
- (6) Liners used in rubber gloves must be clean, free from grease, splinters, and dirt.
- (7) Testing of Rubber Gloves. It is the responsibility of the operators, line foremen, and crew leaders to see that rubber gloves are replaced each sixty days or more often, depending on amount of use.
  - (a) Rubber gloves are to be tested every sixty days from the date of issue for those gloves in use, except rubber gloves used by linemen assigned to bucket trucks should be changed every 30 days. Gloves may be changed more often in some cases, depending upon the amount of use to which the gloves have been subjected, and upon the care given them. Should an employee become dissatisfied with the condition of his gloves at any time, he should turn them in for a re-test and another pair issued to him.

Rubber gloves will be tested by a bona fide and duly authorized testing laboratory. This includes both old and new gloves.

- (b) Paragraph (a) above does not relieve the individual employee from air testing his gloves at intervals throughout the day based on time used.

- (c) All tested rubber gloves are numbered. A record is kept of test dates, issue dates, serial numbers of each glove and employee to whom the glove is issued. This record is to be kept on the rubber glove sheet issued for this purpose and these sheets are to be kept in a hardback binder.

### 3. Use and Care of Rubber Blankets

Rubber blankets shall be rolled and never folded or creased when in storage or being transported. When rubber blankets are being rolled, their surfaces shall be brushed clean to prevent dirt or other foreign matter from becoming embedded in the surface of the rubber.

Workmen shall not wear climbers when standing or stepping on a rubber blanket.

Rubber blankets shall never be used on the ground without protecting them from physical damage and moisture by means of a tarpaulin, canvas, or protective mat.

Rubber blankets shall be visually inspected each time they are used and shall be discarded if cracks, holes, snags, blisters, or other defects render them unsafe for further use.

Rubber blankets shall be electrically tested every twelve months.

### 4. Use and Care of Line Hose and Insulator Hoods

When line hose and hoods are stored in compartments, they shall be laid so that no part is strained or distorted.

Line hose and hoods shall be visually inspected each time they are used and electrically tested every twelve months. They shall be discarded if physical defects render them unsafe for further use.



In applying rubber protective equipment, the nearest and lowest wires shall be covered first, the employee protecting himself as he progresses. In removing protective equipment, the reverse order shall be maintained. Protective equipment shall be applied from a position underneath the conductor whenever possible.

Employees shall avoid touching or leaning against protective devices covering energized lines or apparatus.

5. Hard Hats

Electrical workers' hard hats will be issued to all outside employees and they will be required to wear these hats at all times while working on the job and will be expected to keep them clean. Inside employees who go outside on the job will also wear hard hats while working or visiting on the site of an outside job.

Employees will not be required to wear hard hats while riding in vehicles.

6. Safety Glasses

Management has ascertained that a reasonable probability of eye injury may occur. The utility will furnish, without charge to the employee, non-prescription safety glasses. For those employees requiring prescription lenses, the utility will pay for those glasses, and the employee will pay for the prescription. Therefore, safety glasses will be worn under the following conditions:

- a. Safety glasses with side shields will be issued to each member of the right-of-way crews and they will be worn when anyone who is:
  - (1) Using the chipper
  - (2) Using a chain saw
  - (3) Using a hand tree saw or pruner, or
  - (4) Any other time there is a probability that any member may receive an eye injury.

- b. Tinted safety glasses shall be issued to bucket linemen and the glasses will be worn while the lineman is working out of the bucket.
- c. Proper safety glasses will be at a ready accessible location near grinders and these glasses will be worn by anyone using the grinding machine.
- d. All members of the air compressor crew will be issued safety glasses and these glasses will be worn when members are using the jack hammer.
- e. A set of safety glasses will be placed on each trailer air compressor and they will be worn by anyone operating the air tools.
- f. Three sets of safety glasses shall be placed in the glove compartment of each line truck. A pair of the glasses shall be worn by any member of that crew when he is doing the following:
  - (1) Chipping
  - (2) Using chain saw
  - (3) Using hand tree saw or trimmers
  - (4) Using jack hammer
  - (5) Any other time there is a probability of receiving an eye injury

#### 7. Grounding of Lines and Equipment

- a. Protective ground jumpers shall not be smaller than No. 2 Copper.
- b. Before work is started on any de-energized circuits, protective No. 2 Copper grounds shall be installed within sight on both sides of work area.
- c. Supposedly dead lines should not be grounded with first "feeling out" with a hot stick for "static discharge" to determine if line is dead. The absence of a static discharge is not a positive indication that the circuit is dead. The instructions on grounding of lines in the Safety Manual should be read and studied.

- d. Running grounds are to be used on conductors being pulled in close to energized circuits.

8. Grounding of Line Vehicles Near Power Lines

- a. The work to be done should be planned thoroughly and plans discussed in detail with all workers. There is no substitute for a tailgate conference.
- b. The vehicle shall be grounded whenever work is to be done with a raised "A" Frame, Boom, or Digger, if this aerial device could contact an energized line or when poles are being set in or near energized lines.
- c. The vehicle shall be grounded to the multi-grounded neutral of the system.
- d. Before lowering outriggers, operator shall visually check that obstructions and personnel are out of the way and that outriggers will be on a solid footing or outrigger pads. Normally, only the operator of the vehicle shall be permitted on the truck while the aerial device is being operated, including times when an employee is working from the bucket, and all others shall stay clear of the vehicle.
- e. All workers on the ground shall use rubber gloves at all times in guiding and positioning hooks, cables, poles, etc., and care should be taken that the unprotected parts of the body do not make contact with the pole or other material being moved by the boom when either the boom, pole, or any other materials are within falling distance.

9. Seat Belts

The only employees exempt from wearing seat belts are meter readers on their route.

10. Pole Testing

All linemen will test poles for soundness before climbing. A pole judged unsafe for climbing for any reason will not be climbed until made safe. The utility shall have a planned pole testing program and shall replace those poles found to be unsafe.

11. Line Patrol

A pole tester is to patrol line when testing poles. All other employees will report any unsafe line condition they may see or hear about.

12. Inspection of Utility Tools and Equipment

All utility tools, equipment, safety devices, and first aid kits shall be inspected by the safety director semiannually. Any tools, equipment, or safety devices found to be in an unsafe condition shall be repaired or replaced immediately. A record shall be made of these inspections and a report made to the manager. This is not in any way to be construed to alter the fact that each individual is responsible for the daily inspection of utility tools, equipment, safety devices, and first aid kits.

13. Wheel Chocks

Vehicles to which wheel chocks are assigned will use them each time the vehicle is parked, regardless of slope or terrain.

14. Road Signs and Highway Permits

Proper road signs will be used to signify utility work being done by the utility each time work is being done on a location at which such signs are required to be used as prescribed by the Tennessee Department of Transportation Rules and Regulations.

C. TRANSMISSION AND SUBSTATION, MAINTENANCE AND OPERATION

1. Transmission

- a. The safety and health standard in this subpart shall apply to the maintenance and operation of Transmission and Substations combined with the rules and regulations of the Safety Policy of this utility.
- b. The standards set forth in this subpart are minimum requirements. It is impossible to include rules to meet all conditions that might arise. Therefore, in an emergency, the foreman or person in charge shall issue such other rules or instructions as may be necessary, with the understanding that they shall not be contrary to or lower than the minimum requirements outlined here.

2. Clearances.

The provision of this paragraph is to provide information pertaining to the minimum working distances.

The minimum working distance and minimum clear hot stick distances stated in the table are recommended. The minimum clear hot stick distance is that for the use of live line tools held by linemen when performing live-line work.

ALTERNATING CURRENT--MINIMUM DISTANCES

Voltage range (phase to phase) kilovolt	Minimum work and clear hot stick distance
2.1 to 15 . . . . .	2 ft. 0 in.
15.1 to 35 . . . . .	2 ft. 4 in.
35.1 to 46 . . . . .	2 ft. 6 in.
46.1 to 72.5 . . . . .	3 ft. 0 in.
72.6 to 121 . . . . .	3 ft. 4 in.
138 to 145 . . . . .	3 ft. 6 in.
161 to 169 . . . . .	3 ft. 8 in.
230 to 242 . . . . .	5 ft. 0 in.
*345 to 362 . . . . .	7 ft. 0 in.
*500 to 552 . . . . .	11 ft. 0 in.
*700 to 765 . . . . .	15 ft. 0 in.

\*Note: For 345-362 kv., 550-552 kv., and 700-765 kv., the minimum working distance and the minimum clear hot stick distance may be reduced, provided that such distances are not less than the shortest distance between the energized part and a ground surface.

### 3. Live-Line Work

The final decision about whether live-line work may be done safely will be the responsibility of the supervisor who is to have direct charge. It is the supervisor's responsibility to know that the crew is properly trained for the work on energized equipment that the proper tools and equipment are used and the correct safety measures are taken.

- a. Electrical circuits and equipment shall be considered energized until they are properly grounded.
- b. A caution order shall be obtained on any transmission line or substation equipment being worked on while energized.
- c. Employees performing energized work on the same structures shall not work on different phases at the same time.
- d. Rubber gloves shall not be used with hot sticks for hot line work on voltage above 13.2 KV.

### 4. Deenergizing Lines and Equipment

When deenergizing lines and equipment and the means of disconnecting from electric energy is not visibly open or visibly locked out, the provisions of subdivisions a through e of this subparagraph shall be complied with:

- a. The particular section of line or equipment to be deenergized shall be clearly identified, and it shall be isolated from all sources of voltage.
- b. Notification and assurance from the designated employee shall be obtained that:

- (1) All switches and disconnectors through which electric energy may be supplied to the particular section of line or equipment to be worked have been deenergized;
  - (2) All switches and disconnectors are plainly tagged indicating that men are at work;
  - (3) And that where men of such switches and disconnectors permits, they have been rendered inoperable.
- c. After all designated switches and disconnectors have been opened, rendered inoperable, and tagged, visual inspection or tests shall be conducted to insure that equipment or lines have been deenergized.
  - d. Protective grounds shall be applied on the disconnected lines or equipment to be worked on.
  - e. Upon completion of work on deenergized lines or equipment, each employee in charge shall determine that all employees in his crew are clear, that protective grounds installed by his crew have been removed, and he shall report to the designated authority that all tags protecting his crew may be removed.

#### 5. Personal Protective Equipment

Personal protective equipment shall be in accordance with the provisions of part B, Specific Operating Rules, of this utilities Safety Policy unless

- a. The voltage being worked is higher than the test rated value of the insulating equipment being used.
- b. In grounding of transmission lines where a primary neutral does not exist. Then other means of protective grounding shall be utilized.

## 6. Clearance Procedure for Lines and Equipment

The clearance procedure is the method used by the Director of Operations for the protection of workers, the public, and equipment, whether it be electrical circuits, hydraulic equipment, mechanical equipment, or other devices.

- a. The request for all clearances for lines and equipment shall be made to and approved by the Director of Operations or a designated person by that Department.
- b. No work on such equipment shall be performed except under the applicable clearance procedure. Only authorized persons shall be responsible for the tagging of equipment with protective cards. Clearances shall be issued by them only to those persons whose names appear on official clearance lists.
- c. A clearance is identified by the use of colored protective cards placed so as to indicate the special operating limitations.
- d. Protective cards shall not be applied, altered, or removed except under applicable established procedures by authorized employees.
- e. Every person working around equipment that is involved in a clearance is responsible for recognizing the boundaries identified by protective cards and the conditions imposed by the protective cards and shall in no way violate the area conditions outlined.

## 7. Protective Cards

The following protective cards, applicable throughout the Director of Operations, illustrated in color, and their uses are briefly explained.

- a. HOLD ORDERS  
RED CARD

This red card is normally used as a master card for the clearance. It is usually installed on the main control point to isolate



equipment from all sources of energy and permit work to be safely performed. It also serves to protect the equipment itself from damage. A hold order must never be placed on any equipment which is energized or in service. Equipment must never be energized or placed in service until after the hold order has been released and the card removed. A single hold order card (red card) is used on any given clearance while additional clearance boundaries are identified by hold notice cards (white cards).

b. HOLD NOTICE  
WHITE CARD

This white card is used in conjunction with a hold order card (red) to identify the boundaries of the clearance. It always bears the same number as the hold order card. Any number of hold notice cards may be used as required to complete clearance.

c. CAUTION ORDER  
YELLOW CARD

This yellow card shall be attached to equipment, switches, or controls where hazardous or abnormal conditions exist. This card calls attention to the existence of unusual circumstances and gives information concerning the special circumstances.

8. Electrical Storage Batteries

During battery maintenance or other activity, if electrolyte spills on skin, the area should be rinsed with clear water promptly.

RULES

a. The following protective equipment shall be used by employees when performing battery maintenance:

- (1) Either goggles or plastic face shield
- (2) Protective gloves
- (3) Protective apron

- b. Before work on batteries is initiated, employees shall ensure that a fully operational eyewash is close at hand in case of an electrolyte splash to the eyes.
- c. The battery compartment or room should be well ventilated before a battery is placed on equalizing charge.
- d. Employees must not smoke or use open flames around batteries. "NO SMOKING" signs should be posted in battery rooms where they are clearly visible to anyone entering.
- e. Only spirit thermometers are to be used when electrolyte cell temperature is taken. Mercury thermometers could break, and mercury running into the cell between the plates will cause sparking and possible explosions.
- f. Cell vent plugs should be kept firmly in place at all times except when adding water or taking hydrometer readings. (These vent plugs should be the flame-arrester type).
- g. The handles of tools used for tightening connector bolts should be insulated. Rings, wristwatches, etc., should be removed before working on the battery.

D. ENFORCEMENT AND PENALTIES FOR VIOLATION

An employee may be disciplined for violating safety rules described in any portion of this policy by the following methods:

First offense. A verbal warning will be given by the employee's immediate supervisor for the purpose of making the employee aware of the violation, the dangers involved, and the remedies to correct that violation.

Second offense. A written warning containing the previously mentioned information will be issued with a copy being given to the employee, to the immediate supervisor, to the department head, and one copy will be placed in the employee's personnel file.

Third offense. A written warning containing the previously mentioned information will be issued to the employee, plus a five workday suspension without pay.

Fourth offense. A written warning to the employee, containing the previously mentioned information, which could result in dismissal.

The severity of penalty applied must be appropriate to the offense. The supervisor must take into account all mitigating or extenuating circumstances such as: Was the offense deliberate (a blatant challenge) or due to a lack of knowledge or information? What is the overall work record of the employee? How many and how frequent have previous offenses been?

Any supervisor who fails to properly instruct the employee under his supervision regarding the application of this policy to a particular job may be subject to the same disciplinary actions.

IT IS IMPOSSIBLE TO INCLUDE RULES TO MEET ALL CONDITIONS THAT MIGHT ARISE, THEREFORE, THESE RULES COVER ONLY THE MINIMUM REQUIREMENTS. IN AN EMERGENCY, NOT PROVIDED FOR UNDER THESE SPECIFIC RULES OR THE SAFETY MANUAL, THE SUPERVISOR SHALL ISSUE SUCH OTHER RULES OR INSTRUCTIONS AS MAY BE DEEMED NECESSARY WITH THE UNDERSTANDING THAT THEY SHALL NOT BE CONTRARY TO OR LOWER THE MINIMUM REQUIREMENTS AS OUTLINED IN THE ABOVE.

IT IS THE RESPONSIBILITY OF ALL EMPLOYEES TO STUDY AND ACQUAINT THEMSELVES WITH THESE SAFETY RULES AND PROCEDURES TO ENABLE THEM TO PERFORM EACH AND EVERY JOB SAFELY.

EMPLOYEES SHOULD ALWAYS KEEP IN MIND THAT IT IS THEIR RESPONSIBILITY TO PROTECT THEIR FELLOW WORKER, THE PUBLIC, AND THE EQUIPMENT THEY ARE USING AS WELL AS THEMSELVES IN EVERY ACT WHICH THEY PERFORM.

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