DOCUMENT RESUME

ED 350 463 CE 062 148

AUTHOR	Sappe', Hoyt; Kirkpatrick, Thomas
TITLE	Electrical Distribution. Project Report Phase I with Research Findings.
INSTITUTION	Georgia Univ., Athens. Div. of Vocational Education.
SPONS AGENCY	Georgia State Dept. of Technical and Adult Education, Atlanta.
PUB DATE	89
CONTRACT	GA-89-110013
NOTE	42p.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Competency Based Education; Curriculum Development; Educational Equipment; Educational Research; *Educational Resources; *Electrical Occupations; *Electricians; Energy Occupations; Equipment Maintenance; Instructional Materials; Job Analysis; Job Skills; Occupational Information; Postsecondary Education; Program Design; Program Development; Secondary Education; Skilled Occupations; Statewide Planning; *Task Analysis; Trade and Industrial Education; Troubleshooting
IDENTIFIERS	Georgia

ABSTRACT

This report provides results of Phase I of a project that researched the occupational area of electrical distribution, established appropriate committees, and conducted task verification. These results are intended to guide development of a program designed to train apprentice line workers. Section 1 contains general information: purpose of Phase I; description of the occupation, including nature of work, working conditions, and related occupations; direction of the occupation, including employment, training and other qualifications, advancement, job outlook, and earnings; program development committee; areas of concern; and State Technical Committee developmental recommendations. Section 2 presents research findings: accreditation and certification; list of typical job titles; and appropriate trade resources and sources, including references and textbooks, instructional materials, audiovisuals, trade and professional association journals, safety manuals, safety equipment, test materials references, state liaison representative, and sources of additional information. A verified occupational duty and task list is comprised of 16 duties: occupational orientation; tools; basic electricity; electrical systems; safety; materials; rigging; pole handling and installation; conductor installation; transformers, connections, banking; live-line work; bucket truck operations; digger/derrick truck operations; right-of-way maintenance; troubleshooting; and public relations. Other contents include a tools and equipment list and staff and facilities recommendations. (YLB)

GEORGIA DEPARTMENT OF TECHNICAL AND
ADULT EDUCATION
FY 89
CONTRACT # 89-110013

ELECTRICAL DISTRIBUTION

PROJECT REPORT

PHASE I

WITH

RESEARCH FINDINGS

ELECTRICAL DISTRIBUTION CONTRACT

PROJECT REPORT

PHASE I

WITH

RESEARCH FINDINGS

Developed by

Hoyt Sappe'
and
Thomas Kirkpatrick

University of Georgia
College of Education
Division of Vocational Education
Athens, Georgia

Table of Contents

Section One: GENERAL INFORMATION

Section Two: RESEARCH FINDINGS

SECTION ONE

GENERAL INFORMATION

PURPOSE OF PHASE I

Phase I focused on researching the occupation, establishing appropriate committees, and conducting task verification. The results of this phase have provided the basic information required to develop the program standards and guide and set up the committee structure to guide the project.

This program is designed to address the needs of the electrical distribution field that use or plan to use graduates as apprentice linemen.

DESCRIPTION OF OCCUPATION

Nature of the Work

A vast network of wires and cables links the electric power produced in generating plants to individual customers. This network is constructed and maintained by line installers, cable splicers, and their helpers.

To install new electric power of telephone lines, line installers, often referred to as outside plant technicians or construction line workers, install poles and terminals and place wires and cables that lead from the central office or generating plant to customers' premises. They usually use power-driven equipment to dig holes and set in the poles that support cables. Line installers climb poles or use truck-mounted buckets (aerial work platforms) and then use various handtools to attach the cables. When working with electric power lines, installers must bolt or clamp insulators onto the pole before the cable can be attached. They may add other equipment to the erected poles and towers, such as lightning arrestors, transformers, circuit breakers, or switches. Electrical utility line workers usually are required to splice cables at the time of installation.

In cities where power and telephone lines are below the streets, installers place cables in underground conduits. In newly developed residential and rural ares, installers use trenchers, plows, and other special power-driven equipment to bury cable directly underground.

Line installers and cable splicers spend much of their time maintaining and repairing power transmission and distribution lines. These service technicians do preventive maintenance by periodically checking to make sure lines are clear of tree limbs or other obstructions that could cause problems. They also routinely check to make sure that insulation on cables in in good condition and that insulators and other equipment on line poles and in underground distribution systems are workding properly. This preventive maintenance is extremely important, because a single defect in a cable may interrupt service for many customers. When wires or cables break, or when poles are knocked down or underground cables are damaged by construction work, these workers must make emergency repairs as rapidly as possible. These repairs are most common in parts of the country that have hurricanes, tornadoes, earthquakes, lightning storms, and heavy snowfalls and ice accumulations.

Working Conditions

Line installers and cable splicers usually work outdoors in all kinds of weather. They must do a lot of climbing and lifting, and often work in stooped and cramped positions. Electric power line workers have tasks to preform that are potentially very hazardous. They typically work at higher elevations than telephone and cable TV cablemen because electric cable is always above telephone and cable TV lines. Moreover, all of the voltages electric power line workers come in contact with can cause death if safety procedures are not strictly followed. Line installers and cable splicers also must wear safety equipment when entering manholes and underground vaults. In addition, they are required to test for the presence of gas before going underground. They may be exposed to hazardous chemicals from the

solvents and plugging compounds that they use when splicing cables. When installing or repairing underground cable, special procedures must be employed to ensure excavations do not cave in.

These workers are subject to 24-hour call. For example, when severe weather damages transmission and distribution lines, they may be called upon to work long and irregular hours to restore service. At times, they may travel to distant locations - and occasionally stay for a lengthy period to help restore damaged facilities or build new ones.

Related Occupations

Workers in other skilled crafts and trades who do manual work with tools and machines include communications equipment mechanics, biomedical equipment technicians, telephone installers and repairers, electricians, and sound technicians.

DIRECTION OF THE OCCUPATION

Employment

Line installers and cable splicers held about 227,000 jobs in 1986. Nearly all worked full time for telephone companies, publicly and privately owned power companies, and construction companies specializing in power line and cable TV construction.

Training, Other Qualifications, and Advancement

Line installers often begin as helpers or ground workers. Although local policies vary, most employers prefer high school graduates. High school courses help develop the reading and arithmetic skills essential for understanding company manuals and work orders. Many employers test applicants for basic verbal, arithmetic, and abstract reasoning skills. In addition, there are entry tests of physical ability such as balance, coordination, and strength. Applicants also may be tested for mechanical aptitude. Knowledge of the basic principles of electricity and training in installing telephone systems obtained in the Armed Forces or vocational education programs may be helpful. Because the work entails a lot of climbing, applicants should have stamina and must be unafraid of heights. The ability to distinguish colors is necessary because wires and cables are usually coded by color. Motivation, self-discipline, and the ability to work as part of a team are needed to work efficiently and safely.

The types of training programs vary by employer. Line installers and cable splicers in electric companies and contruction firms specializing in cable installation generally complete a formal apprenticeship program. The are administered jointly by the employer and the union representing the workers, either the International Brotherhood of Electrical Workers or the Communication Workers of America. These programs last several years and combine formal instruction with on-the-job training. A growing number of employers are using other teaching aids to supplement or replace classroom instruction. These may include computer-assisted instruction, video cassettes, movies, or "programmed" workbooks. Some classrooms are equipped with actual equipment, such as poles cable-supporting clamps, and other fixtures, to simulate working conditions as closely as possible. Trainees learn to work on poles while keeping their hands free to work. In one laboratory exercise, for example, they play catch with a basketball while on the poles. Trainees are also taught safety procedures to avoid falls, and contact with energized power lines. Formal training, which also includes instruction in electrical codes, blueprint reading, and beginning electrical theory, is followed by informal, on-the-job training. Trainees are assigned to a crew to work with experienced line installers under a line supervisor.

In addition to the training by employers, line and cable workers may attend a training school provided by manufacturers who sell cable installation equipment to telephone, cable TV and electrical power companies. At other times, manufacturers send instructors to the job site. Some smaller companies, particularly those in rural areas, do not have adequate facilities to train their employees. Therefore, they may rely on local vocational and technical schools to provide classroom training to their workers.

Line installers and cable splicers continue to receive training throughout their careers to qualify for more difficult assignments and to keep up with technological changes. For

example, crews of cable splicers are introduced to the techniques of terminating underground distribution cable by having several days of training and several additional days of field supervision.

Increasingly, workers interested in advancing are responsible for getting their own training to develop new skills. Necessary training not provided by the employer has to be obtained at employee expense from community colleges and post-secondary vocational schools.

Cable splicers may transfer to other highly skilled jobs - most of which are in the telephone industry. Promotion also is possible to positions such as crew supervisor or instructor of new employees.

Job Outlook

A moderate increase is expected in the employment of line installers and cable splicers through the year 2000. The increases in productivity through technical innovation that have caused workforce reductions in telephone and cable TV cable installers and splicers are projected to have little impact on the electrical power company workforce.

Earnings

Pay rates for line installers and cable splicers vary greatly across the country. Earnings also vary depending on the length of service. It generally takes about 5 years to go from the bottom to the top of the pay scale. Nationally, in 1986 line installers and cable splicers earned a median weekly wage of $527. The middle 50 percent earned between $432 and $616. The bottom 10 percent earned less than $331; the top 10 percent earned more than $701 a week. In Georgia, a 1989 survey conducted by the Georgia Electrification Council reported a starting salary range of from $240 per week to $566 a week. Top salary positions in Georgia also vary greatly, from a low of $360 to a high of $739 for a 40 hour work week.

Most line installers and cable splicers belong to unions, principally the International Brotherhood of Electrical Workers. For these workers, union contracts set wage rates, increases, and the time required to advance from one step to the next. These contracts require extra pay for overtime and for all work on Sundays and holidays. Most contracts provide for additional pay for night work. Time in service usually determines the length of paid vacations. Other provisions in contracts include many or all of the following: Paid sick leave; group life, medical, and dental insurance; sickness and accident benefits; vision care; retirement and disability pensions; a savings plan; educational benefits; and an employee stock ownership plan.

The information presented in **Description of the Occupation** and **Direction of the Occupation** is adapted from public domain material, originally published in the *Occupational Outlook Handbook*, Bulletin 2300, by the Bureau of Labor Statistics, U.S. Department of Labor, Washington, DC 20212.

ELECTRICAL DISTRIBUTION

PROGRAM DEVELOPMENT COMMITTEE

Mr. Tom Chandler
P.O. Box 731
Pine Mountain, GA 31822
(404)-663-2705

Mr. Duren Payne
Vice President, Operations
Oconee EMC
P.O. Box 37
U.S. Highway 80
Dudley, GA 31022-0037
(912)-676-3191

Mr. Glenn Dobson
Floyd S. Pike Electrical Contractor
P.O. Box 63
Monroe, GA 30655
(404)-267-6541

Mr. Phillip Combs
Floyd S. Pike Electrical Contractor
P.O. Box 63
Monroe, GA 30655
(404)-267-6541

Mr. Jack L. Lacey
Georgia Power Company
1230 Walton Way
Augusta, GA 30903
(404)-724-7441

Mr. Steve Timmons
Amicalola EMC
P.O. Box 10
Jasper, GA 30143
(404)-692-6471

Mr. Kelly Cornwell
Electrical Department Supt.
City of Calhoun
P.O. Box 248
120 N. Louise Ave.
Calhoun, GA 30701
(404)-629-2276

Mr. David Hudson
Electrical Department Supt.
City of Elberton
234 N. McIntosh St.
Elberton, GA 30635
(404)-283-2574

Mr. James Norsworthy
Electrical Department Supt.
City of LaGrange
303 W. Industrial Dr.
LaGrange, GA 30240
(404)-883-2130

Mr. Gene Parson
Marietta Board of Lights and Water
627 Page St.
Marietta, GA 30061
(404)-429-4393

Mr. Harold Harbin
Jackson EMC
P.O. Box 38
Commerce Highway
Jefferson, GA 30549
(404)-367-5281

Mr. Benny Bagwell
Jackson EMC
P.O. Box 1189
Gainesville, GA 30503
(404)-536-2415

Mr. Damon Wilbanks
Jackson EMC
P.O. Box 38
Commerce, Highway
Jefferson, GA 30549
(404)-367-5281

Mr. Bob Pirkle
Marable-Pirkle, Inc.
P.O. Box 310023
2515 Fairburn Rd., SW
Atlanta, GA 30331
(404)-344-4411

Mr. Dennis Moody
Selcat Inc.
P.O. Box 927
Fairburn, GA 30213

Mr. Cameron Shepard
Carroll EMC
P.O. Box 629
155 Temple Rd.
Carrollton, GA 30117
(404)-832-3552

Mr. Lamar Norman
Colquitt EMC
P.O. Box 400
Rowland Dr.
Moultrie, GA 31776
(912)-985-3620

Mr. Peter Dall
Cobb EMC
P.O. Box 369
Church St. Extension
Marietta, GA 30061
(404)-424-1504

Marshall J. Collins
AUSI
P.O. Box 850
Marietta, GA 30061
(404)-426-7743

Mr. Neal Hayslip
Crisp Co. Power Commission
P.O. Box 1218
Cordele, GA 31015
(912)-273-3811
(912)-273-0499 (h)

EDUCATOR

Mr. Lamon Kinsey
Instructional Supervisor, Day Programs
North Georgia Technial Institute
Lake Burton Road; GA 197
Clarkesville, GA 30523
(404)754-7700

ADVISOR

Mr. Cecil Beggs
Executive Director
Georgia Electrification Council
University of Georgia
Driftmeir Engineering Center
Athens, GA 30602
(404)-542-3293

AREAS OF CONCERN

The State Technical Committee reached consensus that there is a shortage of job applicants:

a. having work habits and attitudes consistent with employment in a service industry.

b. willing to continue to learn and maintain a positive attitude.

c. free of, or willing to overcome, a fear of heights.

d. with mathematical and reading skills sufficient to comprehend information on new products, work, and safety procedures.

e. skilled in the use of electrical test instruments.

f. having a thorough knowledge of equipment, tools, and materials used in the construction, maintenance, and repair of overhead and underground electrical distribution systems.

STATE TECHNICAL COMMITTEE RECOMMENDATIONS

The State Technical Committee recommended that the program:

1. be approximately four quarters in length.

2. final exit point should be called a lineworker trainee.

3. initial training should concentrate on the nature of the occupation; developing an understanding of terms, concepts, tools, equipment, materials used in the industry; and, safe working practices.

4. include, but not be limited to, these areas of training:

   Job Characteristics, Duties, and Responsibilities,

   Tools and Equipment,

   Materials,

   Pole Climbing, and

   Safety.

SECTION TWO

RESEARCH FINDINGS

ACCREDITATION AND CERTIFICATION

There are no national or state requirements for program accreditation or certification established. There are no individual certification or licensure requirements which job applicants must meet prior to entry into occupations in the electrical distribution field.

The Electrical Distribution program must conform to the institutional accreditation requirements of the Southern Association of Colleges and Schools by meeting Commission on Colleges (COC) or Commission on Occupational Education Institutions (COEI) accreditation requirements and must not conflict with the accreditation criteria established by COC or COEI.

TYPICAL JOB TITLES

Phase I research has included an examination of the occupational areas for the Electrical Distribution field and has revealed 13 job titles for which training may be required. The *Dictionary of Occupational Titles* code and title are as follows:

OCCUPATIONS IN ASSEMBLY, INSTALLATION, AND REPAIR OF TRANSMISSION AND DISTRIBUTION LINES AND CIRCUITS

This group includes occupations concerned with erecting and repairing powerlines and circuits for transmission and distribution of electricity, and assembling and erecting related equipment and structures.

821.261-014	LINE MAINTAINER (any ind.)
821.261-026	TROUBLESHOOTER (light, heat & power) II
821.361-010	CABLE INSTALLER - REPAIRER (light, heat & power) electrician, underground.
821.361-026	LINE REPAIRER (light, heat, & power) hiker; line servicer
821.361-038	TOWER ERECTOR (constr.; light, heat, & power)
821.684-014	TOWER ERECTOR HELPER (constr.; light, heat, & power)
821.667-010	HELPER, ELECTRICAL (light, heat, & power) electrician helper.

OCCUPATIONS IN ASSEMBLY, INSTALLATION, AND REPAIR OF COMMUNICATION, DETECTION, AND SIGNALING EQUIPMENT

This group includes occupations concerned with erecting, installing, or repairing overhead and underground telephone and telegraph lines and equipment; and installing or repairing wiring and equipment within buildings to provide communication, detection, and signalling services.

822.381.014	LINE INSTALLER - REPAIRER (tel. & tel.)

OCCUPATIONS IN INSTALLATION AND REPAIR OF ELECTRICAL PRODUCTS, N.E.C.

This group includes occupations, not elsewhere classified, concerned with assembling, installing, erecting, and repairing electrical equipment and related structures.

829.361-010	CABLE SPLICER (constr.; light, heat & power; tel. & tel.) electrician, cable-splicing; splicer.

829.684-018	CABLE PULLER (constr.; light, heat, & power) cable placer; cable rigger.
829.667-010	CABLE - SPLICER HELPER (constr.; light, heat & power; tel. & tel.)

OCCUPATIONS IN PRODUCTION AND DISTRIBUTION OF UTILITIES, N.E.C.

This group includes occupations, not elsewhere classified, concerned with assembling, installing, erecting, and repairing electrical equipment and related structures.

959.367-010	ELECTRIC POWERLINE EXAMINER (light, heat, & power)
959.684-010	POLE FRAMER (light, heat, & power; wood preserving) line-and-frame poler.

APPROPRIATE TRADE RESOURCES

References and Textbooks

A. B. Chance Co. (1974). *Hot sticks: A manual on high voltage line maintenance*. Centralia, MO: Author.

Alerich, W. N. (1986). *Electricity 3: Motors, generators, controls, transformers*. (4th Ed.) Albany, NY: Delmar Publishers.

American Public Power Association (1988). *Safety manual for an electric utility* (8th Ed.). Washington, D.C.: Author.

American Red Cross (1987). *Cardiopulmonary resuscitation CPR*. Ft. Wayne, IN: Author.

Brown, W. C. (1986). *Basic mathematics*. South Holland, IL: Goodheart-Wilcox.

Center for Occupational Research & Development (1981). *Electrical power transmission & distribution safety*. Waco, TX: Author.

Center for Occupational Research & Development (1985). *Electrical power & illumination systems*. Waco, TX: Author.

Edison Electrical Institute (1970). *Glossary of electrical utility terms*. Washington, D.C.: Author.

Fardo, S. W. & Patrick, D. R. (1985). *Electrical power system technology*. Englewood Cliffs, NJ: Prentice-Hall.

Fulton, S. R. & Rawlins, J. C. (1981). *Basic AC circuits*. (Lueke, C. & Battle, C., eds.) Indianapolis, IN: Howard W. Sams & Co.

Garland, J. D. (1987). *National electrical code reference book* (5th Ed.). Englewood Cliffs, NJ: Prentice-Hall.

Gebert, K. L. (1986). *National electrical code blueprint reading* (10th Ed.). Homewood, IL: American Technical Publishers.

Garland, J. D. (1987). *National electrical code: Questions & answers* (5th Ed.). Englewood Cliffs, NJ: Prentice-Hall.

General Electric Co. (1987). *Distribution transformers manual* (GET-2485Q). Hickory, NC: Author.

Gerbert, K. L. & Edwards, K. R. (1974). *Transformers*. Homewood, IL: American Technical Publishers.

Gerrish, H. M. & Dugger, W. E. (1983). *Electricity*. South Holland, IL: Goodheart-Wilcox.

APPROPRIATE TRADE RESOURCES

References and Textbooks

Gwyther, H. F. (1988). *Solving problems in electrical power and power electronics*. New York: John Wiley & Sons.

Kaiser, J. (1982). *Electrical power*. South Holland, IL: Goodheart-Wilcox.

Kubla, T. S. (1986). *Electricity 2: Devices, circuits, and materials*. Albany, NY: Delmar.

Kurtz, E. B. & Shoemaker, T. M. (1986). *The lineman's and cableman's handbook* (7th Ed.). New York: McGraw-Hill.

Matt Stephen R. (1988). *Electricity and basic electronics*. South Holland, IL: Goodheart-Wilcox Co.

Matt Stephen R. (1988). *Instructor's guide and answer keys: Electricity and basic electronics* South Holland, IL: Goodheart-Willcox Co.

Matt, Stephen R. (1988). *Workbook: electricity and basic electronics*. South Holland, IL: Goodheart-Wilcox.

Miller, Rex, & Culpepper, Fred W. Jr. (1980). *Mathematics for electrical and electronics*. Mission Hills, CA: Glencoe Publishing Co.

Miller, R. (1978). *Basic electricity*. Mission Hills, CA: Glencoe Publishing.

National Fire Protection Association (1990). *National electrical code*. Quincy, MA: Author.

Robert A. Billing (1983). *Distribution transformer theory for line people*. Champaigne, IL: Author.

Steinberg, W. B. & Ford, W. B. (1972). *Electricity and electronics basics* (4th Ed.). Homewood, IL: American Technical Publishers.

The Institute of Electrical and Electronics Engineers, Inc. (1988). *National electrical safety code, 1988 edition*. New York: Author.

Traister, J. E. (1982). *Handbook of power generation: Transformers and generators*. Englewood Cliffs, NJ: Prentice-Hall.

Westinghouse Electric Corporation (1975). *Workbook for the westinghouse sales training course: Introduction to basic electricity and power systems* (MA236B). Pittsburg, PA: Author.

APPROPRIATE TRADE RESOURCES

Instructional Materials

The following materials are available from:

Industrial Training Corporation
13515 Dulles Technology Drive
Herndon, VA 22071
1-800-638-3757

Format: Color video tape, workbook, facililator's guide and overhead transparency set.

Electric Motor and Control Maintenance
Electrical Maintenance Fundamentals
Electrical Switchgear Maintenance
Applied Industrial Mathematics
Electrical/Electronic Theory
Hand Tools and Measuring Instruments

The following materials are available from:

Educational Department, Associated Builders and Contractors, Inc.
729 15th St. N.W.
Washington, D.C. 20005
(202) 637-8800

Format: Modular instructional series

Wheels of Learning, Series
Basic Rigging (module 13201 of the *Introduction to Construction* Program)

APPROPRIATE TRADE RESOURCES

Audiovisuals

The following materials are available from:

Vocational Media Associates
Box 1050
Mount Kisco, NY 10549-0050
1-800-431-1242

Format: Filmstrip-on-video or Filmstrip

Electrical Circuits
Components of AC Circuits
Measuring Electrical Quantities
Safety at Work

Format: Filmstrip

Introduction to Electricity
Fundamentals of Alternating Current
Solving Basic DC Circuit Problems
Safety in Electrical Work
Electrical Fundamentals
Introduction to power
Electrical Safety: Systems and procedures
Introduction to Electrical Power
What You Should Know Before Going To Work
Electrical Systems: Residential/Commercial

APPROPRIATE TRADE RESOURCES

Audiovisuals

The following materials are available from:

Bergwall Productions, Inc.
P.O. Box 238
Garden City, NY 11530-0238
1-800-645-3565

Format: Videotape

Multimeters Explained
Basic Electricity: Direct Current

Format: Computer Assisted Instruction

Basic Electricity and Electronics: Direct Current
Basic Electricity and Electronics: Alternating Current

Format: Filmstrip

Basic Electricity and Electronics: Direct Current
Basic Electricity and Electronics: Alternating Current
Basic Electronic Test Instruments
Basic Electricity and Electronics: Reactive Circuits
Tools for the Electrical Trades

The following materials are available from:

American Association for Vocational Instructional Materials
120 Driftmeir Engineering Center
Athens, GA 30602
1-800-228-4689

Format: Videotape

Basic Electric Circuits (VHS-26 min.)

Format & Code: Manual (M) Teacher guide (TG) Student workbook (SW)
Filmstrip (F) Slides (S) Transparency masters (TM) Teacher key (TK)

Understanding Electricity and Electrical terms (M, TK, S)
Electric Motors (M, TG, SW, S, TM)
How Electric Motors Start and Run (M, S, F)

Format: Computer Assisted Instruction

Safety (Apple II series)

APPROPRIATE TRADE RESOURCES

Journals

The following trade and/or professional associations produce publications of interest to his occupational area:

Title(s) Currents

Source: Electrical Appratus Service Association
1331 Baur Blvd.
St. Louis, MO 63132
(314) 993-2220

Title(s) Powerline

Source: Electrical Generating Systems Association
P.O. Box 9257
Coral Springs, FL 33065
(305) 755-2677

Title(s) Newsletter, ICWA

Source: International Coil Winding Association
Box 1107
Ann Arbor, MI 48106
(313) 971-9494

Title(s) IAEI News

Source: International Association of Electrical Inspectors
930 Busse Hwy.
Park Ridge, IL 60068
(312) 696-1455

Title(s) Rural Electric Newsletter

Source: National Rural Electric Cooperative Association
1800 Massachusetts Ave, N.W.
Washington, D.C. 20036
(202) 857-9500

Title(s) TEC Report

Source: The Electrification Council
1111 19th ST. N.W.
Washington, D.C. 20036
(200) 778-6901

APPROPRIATE TRADE RESOURCES

Safety Manuals

Bartsch, J.H. (1987). *School materials safety manual.* Schenectady, NY: Genium Publishing Co.

NIOSH, (1981). *Work practices guide for manual lifting.* Cincinnati, OH, National Institute for Occupational Safety and Health.

Safety Equipment

Michigan First Aid and Safety Co.
22900 E. Industrial Dr.
St. Clair Shores, MI 48080
1-800-221-9222
FAX (313)774-2760

APPROPRIATE TRADE RESOURCES

Test Materials References

Lewis, M.V., and Martin, S.C. (1986). *Measures of occupationally specific and nonoccupational specific knowledge and skills: a compendium.* Columbus, OH: The National Centre for Research in Vocational Education, The Ohio State University.

Norton, R.E., & Others, (1988). *Competency-based testing for occupational students: A resource guide.* Athens, GA: American Association for Vocational Instructional Materials.

Competency-Based Testing Materials

Area: Electrical Occupations

Source: National Occupational Competency Testing Institute (NOCTI)
Ferris State College
318 Johnson hall
Big Rapids, MI 49307
(616) 796-4695

APPROPRIATE TRADE RESOURCES

State Liaison Representative

Norma G. Spivey
Georgia Department of Education
2054 Twin Towers, East
Atlanta, Ga 30;334-5040

APPROPRIATE TRADE RESOURCES

Sources of Additional Information

For more details about employment opportunities, contact the electric power company in your community or local offices of the unions that represent these workers (International Brotherhood of Electrical Workers). For general information on line installers employment opportunities, write to:

International Brotherhood of Electrical Workers
1125 15th St. N.W.
Washington, D.C. 20005

ELECTRICAL DISTRIBUTION VERIFIED TASK LIST

DUTY A: OCCUPATIONAL ORIENTATION

01 Describe the power lineman.
02 Describe the work environment associated with the power lineman.
03 Identify potential hazards associated with the power lineman field.
04 Identify employment opportunities available to a power lineman.
05 List salary and benefits associated with the power lineman field.
06 Describe personal attire and equipment used by a power lineman.
07 Demonstrate a willingness to learn.
08 Exhibit dependability.
09 Demonstrate punctuality.
10 Demonstrate the ability to communicate with customers in an approved manner.
11 Demonstrate personal hygiene and cleanliness.
12 Demonstrate a willingness to comply with health and safety rules.
13 Exhibit pride and loyalty.
14 Demonstrate an understanding of the importance of job site cleanliness.

DUTY B: TOOLS

01 Identify personal climbing tools.
02 Adjust personal climbing tools for proper fit.
03 Climb poles using personal climbing tools.
04 Identify hand and power tools.
05 Identify line tools.
06 Identify and use volt-amp meters.
07 Describe the care of hand and line tools.
08 Select correct tools and equipment.
09 Utilize equipment and tools appropriately.
10 Identify and use underground distribution cable and fault locating equipment.
11 Identify and use continuity testers.
12 Identify Baker boards.
13 Identify hot line tools.
14 Identify wire tong saddles.

DUTY C: BASIC ELECTRICITY

01 Identify electrical concepts, terms and symbols.
02 Solve problems using Ohm's Law.
03 Use voltmeter to measure secondary voltage.
04 Use ammeter to measure secondary amperage.
05 Use continuity tester to check continuity.
06 Use Ohmmeter to measure resistance.
07 Connect batteries in series.
08 Connect batteries in parallel.

ELECTRICAL DISTRIBUTION VERIFIED TASK LIST (continued)

09 Read kilowatt hour meters (single phase).
10 Read demand meters.
11 Identify the fundamental functions of transformers (both current and potential transformers).

DUTY D: ELECTRICAL SYSTEMS

01 Identify transmission lines and stations by voltages, structures, and purpose.
02 Identify distribution substations by voltages and purpose.
03 Identify components of a substation.
04 Describe a single-phase and three-phase loop feed systems.
05 Identify the characteristics of a loop feed system and the role of a normal-open point.
06 Describe single-phase and three-phase radial feed systems.
07 Compare and contrast loop and radial feed systems in terms of applications and the effects on customers during service.
08 Demonstrate a knowledge of the types, construction and operating principles of current transformers.
09 Identify three-phase distribution.
10 Identify two-phase distribution.
11 Identify single-phase distribution.
12 Identify secondary lines and structures.
13 Identify underground residential distribution (URD) components and structures.
14 Demonstrate a knowledge of the construction specifications outlined in the National Electrical Safety Code.

DUTY E: SAFETY

01 Become certified in the use of cardiopulmonary resuscitation (CPR) techniques.
02 Become certified in multi-media first aid techniques.
03 Identify hazardous materials used in the electrical distribution industry.
04 Identify clean-up techniques for hazardous materials.
05 Demonstrate a knowledge of the provisions of the Hazardous Duty Standards Act (Right-to-Know legislation).
06 Identify techniques for pole-top, manhole, and bucket truck rescue.
07 Identify Department of Transportation requirements for operating vehicles over 10,000 lbs. gross weight.
08 Identify methods for setting up and operating a road-side work site.
09 Become certified in D.O.T. approved flagging techniques.
10 Demonstrate a knowledge of the National Electrical Safety Code.
11 Identify rubber glove classifications according to the American Society of Testing and Materials.
12 Identify methods for field testing rubber gloves.
13 Identify methods for electrically testing rubber gloves and shoes.

14 Identify personal protective equipment (i.e., hard hat, eye protection, rubber shoes and gloves).
15 Identify procedures for maintaining personal protective equipment.
16 Identify line grounding techniques (equalization of electrical potential, both single point and working between grounds).
17 Identify equipment grounding techniques.
18 Identify protective cover-up equipment (i.e., rubber blanket, rubber [flexible] line hose, rubber line guards).
19 Identify procedures for inspecting tools and personal protective equipment.
20 Identify the need for a dead line clearance.
21 Become certified in defensive driving.
22 Identify the importance of proper shoring during trenching and other excavation activities.
23 Identify safe positioning and procedures for set-up of vehicles and other equipment.

DUTY F: MATERIALS

01 Identify classes of poles.
02 Identify cross arms and braces.
03 Identify types of insulators.
04 Identify types of hardware.
05 Identify types and sizes of conductors.
06 Identify types of grounding devices.
07 Identify types of sleeves and connectors.
08 Identify types of overhead and underground conductors.
09 Identify types of ties, preforms, and armor rods.
10 Identify types of anchors.
11 Identify types of overhead and underground transformers.
12 Identify types of underground terminators.
13 Identify types of elbows.
14 Identify types of fuses.
15 Identify types of switches.
16 Identify types of interuptors (load buster tool).
17 Identify types of arrestors.
18 Identify types of capacitors.
19 Identify types of oil circuit breakers (OCB).
20 Identify types of oil circuit reclosers.
21 Identify procedures for by-passing
21 Identify procedures for by-passing an oil circuit recloser.
22 Identify switching cabinets and cubicles.
23 Identify transformer pads.
24 Identify electronic three-phase breakers.
25 Identify components of various types of lighting systems (e.g., area, street, and security lighting).

ELECTRICAL DISTRIBUTION VERIFIED TASK LIST (continued)

DUTY G: RIGGING

01 Identify types of rope.
02 Identify types of cable.
03 Identify types of slings.
04 Identify block and tackle assemblies.
05 Use block and tackle.
06 Calculate the safe working load of various ropes and cables.
07 Identify methods of inspecting ropes and cables.
08 Splice (end, eye and running) rope.
09 Tie a crown knot.
10 Tie a bowline knot.
11 Tie a clove hitch.
12 Tie a rolling bend.
13 Tie a square knot.
14 Tie a timber hitch.
15 Fabricate hand and tag lines.
16 Coil rope.
17 Identify the effects of knots on the strength of rope.
18 Identify standard methods of non-verbal communication (hand signals).
19 Become proficient in the use of hand signals.
20 Make up hand lines.
21 Make up two and three sheave blocks.

DUTY H: POLE HANDLING AND INSTALLATION

01 Load and unload poles on pole trailer.
02 Determine depth to set pole.
03 Dig pole hole using hand methods.
04 Install ground wire on pole.
05 Frame and install a three-phase single and double cross arms.
06 Frame and install various types of pole-top assemblies.
07 Set and align pole.
08 Install various types of anchors and guys.
09 Install ground rod and check electrical resistance.
10 Install personal protective ground on a de-energized three-phase line.
11 Rig a pole trailer for road transportation (both day and night).
12 Compare and contrast different pole framing specifications.
13 Inspect poles for unsafe conditions before climbing.

ELECTRICAL DISTRIBUTION VERIFIED TASK LIST (continued)

DUTY I: CONDUCTOR INSTALLATION

01 Install and sag primary conductors.
02 Compare and contrast different methods of sagging conductors.
03 Pull wire and make up a dead-end shoe.
04 Install armor rod and tie-in wire on pin-type insulator.
05 Install preformed tie.
06 Install a top groove conductor tie on a de-energized copper conductor.
07 Resag conductors and install aluminum conductor steel reinforced (ACSR) sleeve.
08 Install a secondary conductor.
09 Install a wire wedge clamp.
10 Install a secondary splice tri-plex service.
11 Make a dead-end on a secondary using U-bolts and preformed grips.
12 Connect 120/240 secondary to weatherhead/entrance cable.
13 Make a splices on underground secondary cables.
14 Make a splices on underground primary cables.
15 Make electrical connections in aluminum and copper cables.
16 Shore trenches and excavations in accordance with OSHA regulations.
17 Dig trenches using trenching equipment.
18 Tag (label) cables using accepted conventions.

DUTY J: TRANSFORMERS, CONNECTIONS, AND BANKING

01 Identify and interpret information on transformer name plates.
02 Identify and classify transformer types (potential and current transformers, additive and subtractive).
03 Identify metering components (self-contained, single phase, poly phase, and transformer rated types).
04 Identify loadbreak and non-loadbreak type bushings, bushing covers, elbows, oil switches, bayonet fuses, primary and secondary switches.
05 Tag pad-mounted transformer connections.
06 Install lightning arrestors.
07 Install and connect pole-mounted single-phase transformers 120/240.
08 Install and connect a pole-mounted wye-delta bank for three-phase, four-wire 120/240 volt service.
09 Connect a wye-delta bank for three-phase, three-wire 240 volt service.
10 Connect a wye-wye bank for three-phase, four-wire 120/208 volt service.
11 Connect a wye-wye bank for three-phase, four-wire 277/480 volt service.
12 Connect a open-wye, open-delta bank for three-phase, four-wire 120/240 volt service.
13 Connect a open-wye, open-delta bank for three-phase, three-wire 240 volt service.
14 Connect a open-delta, open-delta bank for three-phase, four-wire 120/240 volt service.
15 Connect a delta, delta bank for three-phase, four-wire 120/240 volt service.
16 Identify "arrow" systems for paralleling transformers.

17 Use a rotation meter to check rotation on three-phase service.
18 Change rotation on a three-phase service.
19 Identify procedures for by-passing current transformers.
20 Install and connect single and three-phase pad-mounted transformers.

DUTY K: LIVE-LINE WORK

01 Identify the basic principles of safely working on energized circuits (i.e., clearance, positive control, and care of tools).
03 Identify procedures to change insulators on a hot line conductor using hot line tools.
04 Change insulators using rubber gloves.
06 Install line guard from poles.
07 Install insulated blankets from pole.
08 Install insulated rubber line hose from pole.
09 Install insulator cover (hood).
10 Demonstrate knowledge of the use and care of hot sticks.
11 Phase a line using phasing sticks.
12 Demonstrate knowledge of the procedures to connect the source, load, and ground bushings of voltage regulators.
13 Operate voltage regulator controls.
14 Demonstrate the ability to disconnect, transport, and store capacitors.

DUTY L: BUCKET TRUCK OPERATIONS

01 Perform truck inspection.
02 Identify bucket truck controls.
03 Operate bucket truck using ground controls.
04 Operate bucket truck using bucket controls.
05 Install protective cover-up on three-phase lines.
06 Install three-phase single and double cross arms from bucket truck.
07 Hang a single transformer on pole from bucket truck.
08 Hang bells (insulators) from bucket truck.
09 Change insulator using rubber gloves from bucket truck.
10 Install equipment ground.

DUTY M: DIGGER/DERRICK TRUCK OPERATIONS

01 Perform truck inspection.
02 Identify digger/derrick controls.
03 Dig hole with digger.
04 Set and align pole with truck.
05 Pull pole with truck.

ELECTRICAL DISTRIBUTION VERIFIED TASK LIST (continued)

06 Inspect and hook up pole trailer.
07 Perform trailer backing techniques.
08 Set pole in energized line.
09 Identify situations where equipment ground must be installed.

DUTY N: RIGHT-OF-WAY MAINTENANCE

01 Demonstrate the knowledge of limb removal techniques.
02 Demonstrate the knowledge of limb removal techniques over energized conductors.
03 Demonstrate the knowledge of techniques for felling a tree.
04 Operate power saws and trimmers.

DUTY O: TROUBLESHOOTING

01 Troubleshoot secondary for low voltage.
02 Troubleshoot secondary for high voltage.
03 Troubleshoot secondary for blinking lights.
04 Troubleshoot potential on water pipes or appliances.
05 Troubleshoot frequent circuit breaker tripping.
06 Troubleshoot electrical equipment.
07 Troubleshoot primary line for low line voltage.
08 Troubleshoot primary line for high line voltage.
09 Troubleshoot primary line for blinking lights.
10 Troubleshoot primary line for extreme voltage swing.
11 Troubleshoot primary line for radio and television interference.
12 Troubleshoot primary line for line outage.
13 Use cable locator to locate primary and secondary URD cables.
14 Troubleshoot faults in primary URD cable.
15 Troubleshoot faults in secondary URD cable.
16 Troubleshoot area, security, and street lighting systems.

DUTY P: PUBLIC RELATIONS

01 Identify terms associated with customer contact.
02 Describe proper communication techniques involved with customer contact.
03 Demonstrate a knowledge of procedures for proper entry of private property with regard to damage of private property.
04 Demonstrate the ability to remove debris upon job completion.

TOOLS AND EQUIPMENT

Ammeter, 440v, clamp-on type
Arrester, lightning, 15kv, 6 ea.
Arresters, by-pass, 15kv, 3 ea.
Block, 2 sheave, w/hook and snap, w/thimble, 5 ea.
Block, 3 sheave, w/hook and snap, w/thimble, 5 ea.
Bolt, machine, 1/2" X 10", 3 ea.
Bolt, eye, 5/8" X 12", 2 ea.
Bolt, D.A., 5/8" X 16", 4 ea.
Bolt, machine, 1/2" X 6", w/nuts, 10 ea.
Bolt, carriage, 3/8" X 6", 2 ea.
Bolts, Carriage, 3/8 inch by 6 inch, 40 ea.
Bolts, machine, 3/4" X 14", w/nuts, 4 ea.
Bolts, lag, 20 ea.
Bolts, through, No. 12, 5/8 inch (with nuts), 20 ea.
Bolts, through, No. 10, 5/8 inch (with nuts), 10 ea.
Brace, wood, 28", 4 ea.
Brace, wood, 18" drop, 60" span, 4 ea.
Braces, 20 ea.
Cable, equipment ground, 12 ft.
Cable, ground, personal protective, 50 ft., 2 ea.
Cable fault locator, URD
Cable locator, URD
Capacitor bank assembly, 1 ea.
Caps, insulating, for elbows, 4 ea.
Clamp, hot-stick
Clamps, wedge, 10 ea.
Clamps, deadend, 12 ea.
Conductor, wire, No. 2, ACSR (all aluminum is acceptable if cheaper), 60 ft. length, 5ea.
Conductor, wire, No. 2, ACSR, 5000 ft. length, 1 ea.
Conductor, cable, URD, No. 2, aluminum, jacketed, w/concentric neutral, 450 ft, 1 ea.
Connector, equipment ground, 2 ea.
Connector, elbow, load-break, for 1/0 conductor, 4 ea.
Continuity tester
Cover, riser (for cable), galvanized, rigid steel, 60 ft., 1 ea.
Crossarm, 3 5/8" X 4 5/8" X 10', 6 ea.
Crossarms, 8 ft., 10 ea.
Cutter, hydraulic, wire and conductor, 2 ea.
Deadend assembly, neutral, 2 ea.
Deadend assembly, neutral, 3 ea.
Deadend assembly, primary, 6 ea.
Eye nut, oval, 5/8", 1 ea.
Eyebolt, 5/8" X 12", 1 ea.
Eyebolt, shoulder type, 5/8", 1 ea.
Eyenut, 5/8", 1 ea.
Fid, wooden, 6 inch, 3 ea.
Fid, aluminum, hollow, 6 inch length, 1/2 inch diameter, 6 ea.

TOOLS AND EQUIPMENT (continued)

Gloves, insulating, rubber, long cuff
Grips, wire, aluminum, 10 ea.
Guy attachments, both through bolt-type and goat-head type, 15 ea.
Hoist, 4 ea., (for pulling guy and conductor wire) any type
Hose, line, rubber, 12 ft. length, 10 ea.
Hot sticks, assorted types
Insulator, suspension, 6", 18 ea.
Insulator, pin-type, 15kv, 1 ea.
Insulator, suspension, slim-line, 6", 6 ea.
Insulators, pole-top, 10 ea.
J6's (clevis), 10 ea.
Link, chain, 5/8" X 3 1/4", 3 ea.
Load-break output & lightening arrester (combination), solid blade, 6 ea.
Module, feed-through (URD), 2 ea.
Overshoes, insulating, rubber
Pin, lead adapter, 1 ea.
Pin, pole-top, 10 ea.
Platform, thick wood plank or channel steel or channel aluminum, 1 ea.
Pole, 40 ft., class 5, 30 ea.
Recloser, 3-phase, w/ conduit, control cabinet, and other hardware, 1 ea.
Regulator, voltage, step-type, w/remote control kit and mounting hardware, 3 ea.
Rod, ground, 5/8" X 8', steel, galvanized, 2 ea.
Rods, armor, No. 2, aluminum, 15 ea.
Rope, roller, polypropylene, 60 foot length, 1/2 inch diameter, 5 ea.
Rope, nylon, double-braided, 4 foot length, 1/2 inch diameter (for splicing)
Rope, nylon, 3-in-1 twist, 6 foot length, 1/2 inch diameter, 1 ea. per student (for knot tying and splicing).
Screw eyes, 4 ea.
Shackle, anchor, 5/8", 12 ea.
Shackles, anchor, 4 ea.
Sheave, hand line, w/hook and snap, 5 ea.
Staples, ground wire, 1000 ea.
Switch, airbreak, 3-pole unit w/operating mechanism and insulated spacers, 1 ea.
Switch, disconnect, underslung type, 3 ea.
Switch, voltage regulator, by-pass, 3 ea.
Terminator, cable, for No. 2 URD cable, 6 ea.
Tie, pre-formed, wire, aluminum, 15 ea.
Tie, wire, No. 6, aluminum, 100 ft.
Timber, structural, 4" X 12" X 10" 2", 2 ea.
Transformer, single-phase, pad mounted w/pads, 2 ea.
Transformer, potential, pole or platform mounted or, 3 ea.
Triplex (aluminum), No. 2, 30 ft. length, 5 ea.
Truck, digger/derrick
Truck, bucket
Voltmeter, 440v, clamp-on type

TOOLS AND EQUIPMENT (continued)

Washer, round, 1 3/8" X 9/16" hole, 20 ea.
Washer, square, 2 1/4" X 2 1/4" X 3/16" hole, 25 ea.
Washer, round, 1 3/8", 9/16" hole, 8 ea.
Washers, square, 2 1/4", 13/16" hole, 24 ea.
Wire, ground, No. 6 S.D. copper or No. 4 solid aluminum, 400 ft., 1 ea.
Wire, guy, 7/16" diameter, 400 ft., 1 ea.

STUDENT'S STANDARD TOOL KIT CONTENTS

Belt, body, lineman's
Boots, work, high-top
Climbers, pole
Gloves, leather palm, long cuff
Goggles, safety, full-cover
Hammer, lineman's, 24 ounce
Hard-hat
Knife, drawing
Pliers, side cutting, nine inch
Pouch, tool
Rope, nylon, braided, 5/8 inch, 40 foot (hand line)
Rule, folding, six foot
Screwdriver, flat-tip, 12 inch
Strap, safety
Wrench, adjustable, 12 inch
Wrench, adjustable, 10 inch

STAFF

Because the Electrical Distribution program is new it is anticipated that implementation of the program standards and the program guide will result in the need for additional staff, but will not change certification requirements. The State Technical Committee members have indicated that the instructor(s):

a. for this program should have broad experience in the power lineman field, and should have field supervisory experience.

b. be throughly acquainted with current safety-related procedures and should be sensitive to the institution's liability.

c. should have the capacity to develop and maintain links with occupational businesses and organizations, such as the Georgia Electrification Council.

FACILITIES

The State Technical Committee members recommended that the instructional facilities have adequate room for both indoor and outdoor laboratory experiences. An examination of several similar programs offered by other states revealed that, outdoor laboratory space requirements are 3/4 of an acre of relatively level ground. This area is used for a pole yard (for pole climbing practice), a model underground distribution system with pad-mounted transformers, an overhead distribution system model with a pole-mounted transformer bank, and for storage of poles, hardware, and other equipment. Indoor laboratory space requirements are more modest. Programs in other states report having as little as 1100 square feet to accomodate indoor laboratory experiences.