QUALIFIED ELECTRICAL WORKER TRAINING

Liberty Electric's 4**-Day Training & Testing Program** is designed to teach workers how to maintain and repair electrical systems and components in a safe and efficient manner. At the conclusion of this training, testing will be conducted to determine Qualified or Task-Qualified Person status.

Schedule

Day one: NFPA 70E Electrical Worker Safety Training
Day two: AC Motor Controls and Troubleshooting
Day three: Three Phase A/C Motor Application and Troubleshooting
Day four: Fuses Circuit Breakers and Overloads

Who can benefit from this Qualified Electrical Worker Training?

- All multi-craft personnel working in manufacturing plants, waste water facilities, schools, shopping centers, commercial buildings, hospitals, government buildings and even those wanting a general knowledge of electricity, motors, motor controls and electrical troubleshooting.

This four day training is designed to help your facility's efficiencies; uptime and lower maintenance cost with explanations by the instructor, videos, PowerPoint's, detailed workbook and hands-on education so that your employees can go back to their workplace and apply what they learn immediately.

DAY 1

Electrical Worker Safety – 7 Hours

This training session focuses on working safely on and around electrical equipment and is designed for Qualified Persons. Each subject matter is designed to help workers comply with OSHA, NEC, NFPA 70E. Training includes lecture, videos and hands-on demonstrations for using PPE equipment properly.

Learning Objectives:

Electrical Worker Safety Standards

- OSHA 29CFR 1910 Subpart S (Electrical) Paragraphs 1910.331-335
- OSHA (Occupational Safety & Health Administration)
- CFR (Code of Federal Regulations)
- NFPA 70E

- **Assessing the Workplace Hazard**

- Equipment suitability
- Voltage and insulation rating
- Hazards equipment arcing
- Class of equipment (type, size & current capacity)

- **Safety Signs and Tags**

- OSHA 29 CFR 1910.145 (Standards for signs and tags in the workplace)
- What type of barricades are approved
- Attendants for Safety

- **Unsafe Acts**

- OSHA conducted study

- **Electrical Shock**

- Effects of an electrical shock
- Three factors of electrical shock
- Electrical Burns and Delayed Trauma

- **Arc Flash**

- Voltage system levels of concern
- Arc Flash Hazards - besides shock and electrocution; blast, heat, projectiles and pressure waves are explained in this presentation
- Incident energy
- NFPA 70E 130.3 (Arc Flash Hazard Analysis)
- Arc Flash Boundaries
- Arc Flash Factors

- **Video: ERI Electrical Safety (19:30)**

- **Protection against Arc Flash**

- Hazard Risk Categories
- FR (Fire Rated) clothing and PPE (Personal Protective Equipment)
- NEC & NFPA 70E labeling requirements
- Practices to avoid an Arc Flash

➢ **Arc Flash Compliance**

- OSHA, NFPA and IEEE regulations that govern electrical safety and arc flash

➢ **Voltage Sensors and Voltmeters**

- OSHA requirements
- Voltage rating
- Tester Types

➢ **Qualified Person**

- OSHA Subpart S rules and standards for qualified and unqualified persons

➢ **Lockout and Tagout**

- Procedures (1910.147 and 1910.333)
- Safe methods for de-energizing the circuit
- Positive disconnecting means
- Stored electrical energy
- Non electrical energy
- Multiple or gang lock attachments
- Qualified person
- Testing and visual inspections

➢ **Video: Donnie's Accident (4:00)**

➢ **Key Interlocking Systems**

- Standard lockout devices only allow for localized lockout of a specific device. (This part of the presentation explains how a keyed interlock system is used

➢ **Grounds**

- IEE Standards for grounding systems; solidly grounded, impedance grounded and ungrounded
- Equipment grounding
- Grounding, grounded conductors and their connection
- Static grounding conductors, connections, identification and why and where it's needed
- Ground adaptors
- Sizing equipment grounding cables
- (GFR) Ground Fault Relays, (GFI)Ground
- Fault Interrupters, construction, where and why they are needed

- Temporary Protective Grounds and Shunts; clamps, cables inspection, connection and removal

➢ **Working On or Near Exposed Energized Parts OSHA Subpart S 1910.333**

- OHSA 1910.333
- Qualified Persons
- Testing
- Unqualified Persons
- Voltage levels and working distances
- Proper PPE
- Illumination
- Conductive Material and Equipment
- Insulated Tools and Equipment (NFPA 70E)
- Protective Shields
- Portable Ladders

➢ **Confined or Enclosed Work Spaces**

- Confined space permits required per OSHA

➢ **Housekeeping and Janitorial Duties**

- Cleaning procedures and proper material

➢ **Interlocks**

- Qualified persons

➢ **Use of Equipment**

- Portable electrical equipment
- Electric power and lighting circuits
- Test instruments and equipment

➢ **Occasional Use of Flammable or Ignitable Materials**

- Extinguishing Electrical Fires
- Safeguards for Personnel Protection (1910.335)

➢ **Personal Protective Equipment**

- General protective equipment and tools
- Fuse handling equipment
- Ropes and handlines
- Electrical “Linemen’s” Gloves and Insulated Blankets

- **General Electrical Safety**

- **Explosion Proof & Dust Ignition Proof Applications**
- Class I, II, and III
- Division I and II

- **Review test questions**
- **Certificate of Completion**

DAY 2

AC Motor Controls and Troubleshooting – 7 Hours

This training session focuses on understanding electrical systems and troubleshooting electrical systems in a safe and efficient method and is designed for Qualified Persons. Subject matter is designed to help workers comply with OSHA / NEC, NFPA 70E. Training includes lecture, videos and hands-on training labs for wiring and circuits.

Learning Objectives

AC Motor Controls

What is a Motor Control Circuit?
This training concentrates on AC induction motor controls

- Motor Circuit Components
- Disconnecting means
- Circuit protection
- Magnetic contactors
- Thermal overload relays
- Start/stop stations
- Selector switches
- Pilot devices
- Temperature switches
- Pressure switches
- Relays

- **Three Phase Starter Sizes**
- NEMA's standard for motor starter sizes that defines the electrical and mechanical requirements of a starter will be discussed in this presentation

- **Motor Starting Requirements**

- Full voltage starting
- Reduced voltage starting
- Multi-speed starting
- Reverse starting

- **Components and Symbols**

- Contacts
- Connection points
- Coils
- Heater elements
- Limit switches
- Pressure switches
- Temperature switches

- Single phase motors
- Three phase motors

- **Manual Motor Starters**

- Operation and physical characteristics

- **Magnetic Motor Starters**

- Operation and physical characteristics

- **Basic Two-Wire Control Circuits**

- Operating characteristics; pros and cons

- **Basic Three-Wire Control Circuits**

- Operating characteristics; pros explained

- **Wiring Diagrams vs. Ladder Diagrams**

- Comparison of wiring and ladder diagrams
- Variations on the basic motor control circuits

- **Single Phase Motor Starting**

- **Combination Motor Starters**

- **Troubleshooting a Control Circuit**

- **Review test questions**
- **Certificate of Completion**

DAY 3
Three Phase AC Motors – 7 Hours

Learning Objectives

Three Phase AC Motors

- **Polyphase Induction Motors**
- How it works
- How it's made

- **Rated Voltage**
- Operating under or over the rated voltage
- Unbalanced voltages
- Motor horsepower derating factors due to unbalanced voltage

- **Correcting Motor Voltage Problems**
- Transformer taps
- Cable sizing
- Connections
- Supply voltage
- Motor condition
- Motor loads

- **Motor Full Load Amps**
- Motor nameplate information
- Motor designs

- **Frequency and Phase**
- Rated frequency
- Phase

- **Rated Full Load Speed**
- Determining the speed characteristics of a 3 phase motor

- **Magnetic Motor Starters**
- Operation and physical characteristics
- Multispeed motors

- **Horsepower**

- Estimating motor load
- Drive limitation on nameplate horsepower
- Altitude de-rating of nameplate horsepower

➢ **Enclosure Types**
- Open enclosure motors (indoor service)
- Totally enclosed motors
- Explosion-proof and dust ignition-proof motors
- Mill and chemical duty motors

➢ **Frame Size**
- NEMA frame size
- NEMA Motors
- IEC Motors
- NEMA Rerates

➢ **Duty or Time Rating**
- Standard time rating for polyphase induction motors

➢ **NEMA Design Letter**
- Starting torque characteristics using NEMA design letters

➢ **Thermal Overload Protection and Motor Starting Torque**

➢ **Starting Under Reduced Voltage Conditions**

➢ **Insulation Class**
- Insulation life
- Insulation ratings
- Estimating insulation temperatures

➢ **Motor Service Factor**
- Determining extra horsepower a motor can deliver

➢ **KVA Code Letter**
- Motor startup current draw
- Locked –rotor current

➢ **Bearings**
- Anti-friction bearings

- Bearing numbers
- Sealed and shielded bearings
- Bearing fits
- Lubrication
- Sleeve bearings
- Clearances

➢ **Efficiency and Power Factor**
- Winding losses
- Core losses
- Mechanical losses
- Stray-load losses
- Determining motor efficiency

➢ **Connection Diagrams**
- High voltage connections
- Low voltage connections
- Y-connected motors
- Delta-connected motors
- Variable torque motors

➢ **Motor Modifications**
- Over-temperature protection

➢ **Review test questions**
➢ **Certificate of Completion**

DAY 4

Fuses, Circuit Breakers & Overloads – 7 Hours

Learning Objectives

Fuses, Circuit Breakers & Overloads

➢ **Electrical Protective Devices**
- Short circuits vs. overloads
- Short circuit conditions

➢ **Symmetrical and Asymmetrical Fault Current**
- Utility
- Generators

- Synchronous motors
- Induction motors
- DC components
- Total short circuit wave

➢ **Fuse and Circuit Breaker Short Circuit Ratings**

- RMS
- Symmetrical current
- Average 3-phase
- RMS current
- Maximum single-phase RMS current
- Peak instantaneous current

➢ **Short Circuit Calculations (standards)**

- American National Standard Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- “Back-of-envelope” method

➢ **Low Voltage Fuses**

- Fuse construction
- UL classification of fuses
- Time vs. Current characteristics

➢ **Circuit Breakers**

- Thermal
- Magnetic
- Thermal and magnetic
- Fused
- Electronic trip
- Replacing circuit breakers
- Time vs. Current characteristics
- Overcurrent testing of circuit breakers
- Other circuit breaker tests (megohm meter)

➢ **Low Voltage Metal Clad Switch Gear**

- Overload relay elements
- Ground fault circuit interrupters
- Circuit breaker checks
- Thermal imaging circuit breaker checks

➢ **Motor Overload Protection**

- Motor losses and heating
- Motor insulation classes
- Motor destruction due to heat

- Bimetallic overload relays
- Solder-ratchet overload relays
- Electronic overload relays
- Ambient temperature correction

➢ **Sizing Motor Overload Heater Elements**

- Motor starter table

➢ **Purpose of Thermal overload Protection in a Motor Circuit**

- Protection from an extended running overload
- Protection from too long a start-up
- Protection from burn out in a locked rotor condition

➢ **Testing Overload Protective Devices**

- Manufacturing recommendations

➢ **Review test questions**

➢ **Certificate of Completion**

Training and Testing for Qualification:

Qualified and Task Qualified Persons will be tested using the following methods:

- Demonstrating their skills in a hands-on environment using a trainer board (shown in this proposal)
- Interview with the examiner to answer questions

Testing will be conducted to cover the following areas:

Understanding of Codes & Regulations

1. Work on Energized Equipment & Hot Work Permits
2. NFPA 70E
3. OSHA Subpart S

Proper use of Test Equipment:

1. Voltage Meter
2. Amp Probe
3. Megger
4. Proper Care of Equipment
5. Proper Inspection of equipment

PPE Requirements

1. Identification of Proper PPE for the Hazard

2. Proper Care of PPE
3. Proper Inspection of PPE
3. Insulated Tools Requirements

Identification of Circuit Voltage

1. 24vdc
2. 110vac
3. Control voltage high or Low
4. 3 phase 480 phase to phase
5. 3 phase 480 phases to ground
6. 3 phase 208 phase to phase
7. 3 phase 208 phases to ground

Proper Troubleshoot Methods

1. Circuit Isolation
3. Machine Specific Lock-out / Tag-out
4. Low Voltage
5. High Voltage (nothing above 480vac)
6. Ohm Fuses
7. XFMR input output
8. Contactor Operation

Proper Sizing of Circuit Feed, Control and Overload

1. Fuses
2. Breakers
3. Control wiring
4. Feeder Circuits
5. Contactors
6. Overloads

This hands-on trainer board is used for testing and qualification