i. Multiple Roles

A creating, correcting or controlling employer will often also be an exposing employer. Consider whether the employer is an exposing employer before evaluating its status with respect to these other roles.

Exposing, creating and controlling employers can also be correcting employers if they are authorized to correct the hazard.

4.4 CROSS REFERENCE LIST OF OSHA AND CONSENSUS ELECTRICAL STANDARDS

Many construction workers, field safety professional, and job site inspectors have trouble understanding, interpreting, and applying the various OSHA and national consensus electrical standards. A cross reference list of OSHA and consensus electrical standards should be a useful aid in making their job easier.

The table of contents for the NFPA 70E, Electrical Safety for Employee Workplace Standard - 2000 Edition, has been used to develop a cross reference list of OSHA 1910 and 1926 electrical safety standards and various consensus electrical standards - see Exhibit 14.6 on page 109.

5.0 PROJECT ELECTRICAL SAFETY REQUIREMENTS

5.1 VARIOUS PROJECT ROLES & RESPONSIBILITIES FOR ELECTRICAL CONTRACTORS

There are about 72,000 electrical contracting firms employing 865,000 skilled electrical craft workers, supervisors, estimators, purchasing agents, and home office support staffs or almost 13% of the entire construction industry workforce.

For many electrical contractors, the ability to stay profitable and grow the company will be directly related to how well the company meets the demands of Customers to provide full-scope electrical services.

The transformation from a purist electrical contractor to a multi-service provider electrical contractor also will directly impact the safety roles and responsibilities for an electrical contractor. Future work if not already being performed may include the following.

a. *Design/Build*

1. Notable Factors from the 2000 Profile (Survey) of Electrical Contractors

- Electrical contractors play a major role in the design phase of projects.
- Electrical contractors performed design/build work on 31% of their projects.
- Electrical contractors recommended major changes to the project's specifications and plans on 20% of their projects.
- On 90% of their projects, electrical contractors have been given very broad purchasing responsibilities by their Customers to select the brand and type of electrical product to be installed.

2. Increased Company Liability Exposures.

Whether the Company performs design/build work, makes changes to project plans and specifications, and/or selects the electrical products, there will be an additional Company exposure to liability claims and lawsuits.

The extent of the Company's exposures as a design/build firm will depend upon whether:

- Work is performed by the Company's in-house electrical engineers.
- Work is sublet to an outside electrical engineering firm.
- Scope of the Customer's contract document, i.e., Company's liability for improper design review, cost and time overruns, inadequate contract preparation and letting, improper or faulty scheduling, delays, improper approvals, and inadequate supervision and/or inspection.
- The Company's design/build professional liability insurance policy coverages and exclusions.

3. Company's Home Office Project Coordinator's Roles and Responsibilities

Company personnel, who select the project's electrical products; recommend changes to project plans and specs; design and engineer the project's electrical systems, components, controls; and/or perform the project installation, testing, and start-up work must be provided with the following documents:

- Copy of the Company's Safety & Loss Control Manual and any revisions or additions.
- Current copies of OSHA 1910 General Industry and 1926 Construction Industry Safety & Health Standards.
- Current copy of electrical consensus standards.
- Current copy of applicable local, city, or state building codes, permits and inspection requirements.
- Customer's project contract document term and conditions, specifications, plans, drawings, building codes, safety standards, and consensus electrical codes requirements.
- Customer's and/or Company's Project Quality Assurance, and Quality Control Procedures Manual.
- Customer's and/or Company's Project Check-Out and Start-Up Procedures Manual.

The Company's home office Project Coordinator should be responsible for insuring that each member of the Company's design/build team has been provided with his or her own copy of each of these listed documents, and has planned, designed or built the project in full compliance with the applicable electrical safety codes and standards as required by the Customer's contract document, project plans, and specifications.

For those Company design/build projects that the design phase of the work will be performed by an outside electrical engineering firm, the Company's home office Project Coordinator should ensure that documents listed above have been provided to each member of the engineering firm's project design team. The Company's contractual agreement with the outside electrical engineering firm should clearly state that the project is being planned, designed, and engineered to comply with the most stringent electrical safety codes and standards. Any newly-issued and/or changes to governmental and consensus electrical safety codes or standards, after the start of the design project, will be addressed with the Customer, on a case by case basis, to determine if the Customer will pay for cost to redesign the project.

b. *Prime/General Contractor*

As the project's prime or general electrical contractor, the Company's safety roles and responsibilities will increase starting from the early interface with local electric utility company to bring power lines onto the project site to check-out, start-up, and testing of project's newly installed electrical systems and components.

The key to the success of the project will be the work performed by the Company's Subcontractors. The Customer will measure the Company's job and safety performance as a whole as well as the successes or failures of the Company's Subcontractors, which will reflect upon the Company's perceived overall project performance.

Therefore, the Company should pre-qualify potential Subcontractors based upon their last three years of delivering similar types of projects focusing on whether the Subcontractors performed with a high degree of quality, within their original project budget, and without any serious injuries or accidents.

Subcontractors bidding the work should also be required to submit to the Company for review and approval, their proposed Site Superintendent's professional qualifications to include a current resume, and the names, contacts, telephone numbers of all previous project Customers, project OSHA 200 summary logs, project OSHA inspections, citations and fines, covering the last three (3) years.

Prior to starting any on-site work activities, each Subcontractor will be required to submit to the Company's Site Superintendent for review and comment, the Subcontractor's project-specific safety program manual and all required verification of insurance policies.

c. *Subcontractor/Sub-Subcontractor*

When the Company performs work as a Subcontractor or Sub-Subcontractor, it is typical that the project's safety program requirements in the contract document or purchase order agreement and usually only state that the Company must comply with applicable federal or state OSHA safety and health standards. The majority of the time project electrical safety program requirements are not defined in the Customer's or General Contractor's contractor document or purchase order agreement.

However, the project's electrical scope of work document, specifications, drawings, plans, and equipment vendor informational packages will usually address specific electrical safety codes and standards' requirements. When a review of these documents shows that specified electrical safety codes and standards are incorrect or outdated, the Company's Site Superintendent should notify, in writing, the Customer's or General Contractor's Project Manager stating the deficiencies and provide the recommended code changes to the project documents.

5.2 PROJECT PRE-BID AND PRE-JOB MEETINGS

a. *Customer's Request for Proposal*

The Customer's request for proposal, bid specifications, project drawings, and equipment vendor information packages should be reviewed by the President, or his/her designee, and Site Superintendent to determine the Company's scope of work involving actual and potential hazardous associated with the installation, testing, and start-up of the project's electrical systems, equipment, controls, and components.

b. *Customer's Pre-Bid Meeting*

During the pre-bid meeting, the President and/or Site Superintendent should request a copy of the Customer's project and operating facility documents that the Company would be required to be in compliance, while performing work on the project, to include:

- Safety & health manual
- Lockout/tagout procedure
- Contractor work permit procedure
- Quality assurance & quality control manual
- Confined space entry procedure
- Check-out and start-up procedure

When the Customer's Project Representative does not conduct a pre-bid meeting, the President, or his/her designee, or Site Superintendent should obtain these Customer project and/or operating facility documents, whenever possible.

c. *Company's Bid Proposal Document*

Prior to submitting the Company's bid proposal document, the President, or his/her designee, and Site Superintendent should review the Customer's project and/or operating facility lockout/tagout and work permit procedures. Questions pertaining to lockout/tagout should include:

- Will the Company's authorized employees be required to work under a group lockout/tagout program? If so, how much of the Company's scope of work will be performed under the protection of the group lockout/tagout program?

.v much of the Company's lockout/tagout work will be performed on back-to-back shifts?

Will the Customer's project or operating facility personnel safely shutdown, de-energize, release stored energy, install blinds and grounding devices, place locks, and tag out of service machines or equipment prior to turning over to the Company to work on?

- What are the applicable OSHA control of hazardous energy and lockout/tagout standards?
- Will the Company's proposed project safety budget cover the cost for lockout/tagout training sessions, devices and equipment?
- Will any of the Company's Subcontractors work require lockout/tagout protection for their employees?
- Have the Company's Subcontractors included adequate cost estimates in their project bid quotation to provide their own site-specific lockout/tagout training sessions, devices and equipment?

d. *Customer's Pre-Job Meeting*

The Company's Safety & Loss Control Manual and the Company's project site-specific safety procedures should be provided to the Customer's Project Manager during the pre-job meeting for the Customer's review and comments.

A current copy of the "approved" Company site-safety procedures should be provided to the Customer's Project Manager prior to the start of any Company job task performed under the protection of the task-specific electrical safety procedure.

In addition, it is recommended that a copy of the Company Subcontractors' site-specific safety procedures will also be submitted to the Customer's Project Manager for review and comments prior to the start of any Subcontractors' work activities taking place on the project site.

5.3 PROJECT SPECIFICATIONS AND CONTRACT DOCUMENTS

The Company's policy should strongly consider not performing electrical safety services for other site contractors or vendors.

For example, the Company's Site Superintendents should not agree to the Customer's Project Manager request for the Company to take on the responsibility of performing inspections, repairs, or testing of other site contractors' electric power tools or equipment. Another example is the Company's employees performing tests for other site contractors to verify that electrical systems, lines, component, or equipment has been de-energized under a lockout/tagout program. Only the President should make an exception to this policy.

The Customer's contract document and/or purchase order agreement should be reviewed by the President and Site Superintendent to ensure that the Company's contractual and legal obligations do not include performing any testing and verification of sources of electrical energy for other site contractors, vendors, or facility personnel.

5.4 RESPONSIBILITIES

a. *President*

The President should:

Provide the direction, motivation and accountability to ensure successful electrical safety programs.
Develop, maintain, and enforce the Company's electrical safety program principles, controls, and procedures to provide electrical safe work conditions for employees.
Delegate to Site Superintendents the authority to provide successful electrical safety programs.

- Assist Site Superintendents in the formulation of task-specific electrical safety procedures.
- Establish adequate project budgets to fund the site safety programs, staffing, and training sessions.
- Hold Site Superintendents accountable for meeting Company safety and insurance performance goals.

b. *Site Superintendent*

The Site Superintendent should:

- Implement the Company's Safety & Loss Control Manual requirements and suggest revisions to ensure best practices are being used by the Company.
- Develop the Company's site-specific safety program that includes task-specific electrical safety procedures that comply with Customer, OSHA, and consensus electrical safety standards.
- Establish Company agreements with medical and emergency rescue service providers.
- Obtain and maintain current copies of OSHA 1910, 1926 standards, NEC, NFPA 70B, NFPA 70E, and consensus electrical safety codes and standards.
- Assign a Company Safety Coordinator to administer the site-specific safety program.
- Ensure Foremen have knowledge of the Customer and Company's site electrical safety programs.
- Schedule electrical safety train-the-trainer sessions for Foremen.
- Hold Foremen and Subcontractor Superintendents accountable for the safety in their respective areas.
- Delegate to Foremen the authority to provide successful task-specific electrical safety procedures.
- Set-up and maintain the Company's electrical safety training documentation files.
- Notify President and Customer's Project Manager of any serious accident or OSHA inspections.
- Conduct a weekly electrical safety inspection of the entire Company and Subcontractor's operations.
- Establish the disciplinary actions necessary to develop and enforce an effective electrical safety program.
- Cite Subcontractors for non-compliance with the Customer or Company electrical safety requirements.
- Hold safety meetings with Foremen to review and improve upon the site electrical safety procedures.
- Prepare site specific emergency procedures, provide telephone number list, evacuation routes, and assembly areas.

c. *Safety Coordinator*

On projects that do not have a Safety Coordinator, the Site Superintendent will either take on these responsibilities or assign a staff member to be the Safety Coordinator.

The Safety Coordinator should:

- Implement the Company's Safety & Loss Control Manual requirements and suggest revisions to ensure best practices are being used by the Company.
- Obtain and maintain current copies of OSHA 1910, 1926 standards, NEC, NFPA 70B, NFPA 70E, and consensus electrical safety codes and standards.
- Obtain and maintain current copies of the Customer's project and operating facility safety procedures.
- Conduct electrical safety train-the-training sessions for Foremen.
- Assist Foremen in the development of task-specific electrical safety procedures that comply with Company, Customer, OSHA, and Consensus Electrical Safety Standards.
- Coordinate Company agreements with medical and emergency rescue service providers.
- Maintain awareness of current electrical testing devices and techniques.
- Conduct daily site electrical safety inspections and ensure electrical protective equipment inspections.
- Implement the Company's site-specific lockout/tagout procedures and conduct training sessions.
- Implement the Company's site-specific confined space entry procedures and conduct training sessions.
- Conduct electrical safety training sessions for crew members and document training sessions.
- Prepare safety talks for the Foreman's weekly safety meetings, audit meetings to ensure effectiveness.
- Conduct project electrical safety orientation sessions for all new employees.
- Maintain close liaison with the project start-up team to provide for safe check-out and start-up activities.
- Provide liaison with Customer project and facility personnel on electrical safety matters.
- Conduct accident investigations; analyze causes and formulate recommendations.
- Prepare site safety, workers compensation, and insurance reports.
- Advise Site Superintendent of any problems with task-specific electrical safety procedures.
- Prepare site specific emergency procedures, provide telephone number list, evacuation routes, and assembly areas.

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ach Foreman in discharging their electrical safety responsibilities has among their principal duties to:

- Attend the Company's electrical safety procedures train-the-trainer session.
- Review and implement the Company's site-specific electrical safety procedures.
- Review the Customer's Project Safety Program requirements and ensure crew member compliance.
- Review and maintain current copies of OSHA 1910 & 1926 standards, NEC, NFPA 70B, NFPA 70E, and other applicable consensus electrical safety codes and standards.
- Teach each employee what electrical hazards are on the job and how to avoid them.
- Impart to employees that a violation of established electrical safety procedures will not be tolerated.
- Provide for each crew member with the needed electrical safety equipment and protective devices.
- Take prompt corrective action, whenever unsafe conditions or unsafe actions are noted.
- Teach employees that electrical accidents can be prevented by proper planning and safe practices.
- Investigate and correct the causes of all accidents, which result in minor injuries.
- Have all injuries reported and properly treated.
- Conduct weekly tool box meetings with written reports submitted for the Safety Coordinator's review.
- Perform daily job inspections to ensure that task-specific electrical safety procedures are followed.
- Prepare and promptly submit to the Safety Coordinator safety, medical, and other reports, as required.
- Prepare site specific emergency procedures, provide telephone number list, evacuation routes, and assembly areas.

e. *Employees*

Each employee will:

- Consider every electrical conductor or circuit part energized, until proven otherwise.
- Not make bare-hand contact with exposed energized electrical conductors or circuit parts above 50 volts to ground, unless the "bare-hand method" is properly used.
- Be aware that de-energizing an electrical conductor or circuit part and making it safe to work on is in itself a potentially hazardous task.
- Fully comply with the Company's task-specific lockout/tagout procedures.
- Comply with Company, Customer and OSHA electrical safety rules and requirements.
- Fully comply with the Company's confined space entry procedures.
- Obtain and properly use testing devices, tools and personal protective equipment for the job at hand.
- Report all unsafe acts and conditions to their Foremen.
- Maintain a safe work area by frequently cleaning up job task scrap materials and debris.
- Perform each job task and operate equipment, tools and vehicles in a safe manner.
- Anticipate and plan for unexpected events that directly impact the working environment.
- Report all accidents and injuries immediately to their Foreman.
- Know site emergency procedures, telephone numbers, evacuation routes, and assembly areas.

f. *Subcontractor Superintendents*

Each Subcontractor Superintendent, through his or her Foremen, should:

- Assure development of the Subcontractor's site-specific safety program that includes task-specific electrical safety procedures that comply with Company, Customer, OSHA, and consensus standards.
- Submit Subcontractor's site-specific electrical safety procedures to the Company, for review and comments, prior to the start of any on-site work activities.
- Establish agreements with medical and emergency rescue service providers.
- Provide the direction, incentive, and motivation to ensure a successful site electrical safety program.
- Delegate to Foremen the authority to provide safety equipment and a safe working environment.
- Promote safety awareness through personal safety contacts and by employees safety meetings.
- Inspect entire work area on a daily basis to ensure adequate safety and compliance by crew members.
- Provide weekly and monthly safety reports to the Company's Site Superintendent.
- Inform the Company's Site Superintendent of all accidents as soon as known.
- Give Company's Site Superintendent a copy of workers compensation state form and serious accident investigation report form within 24 hours of an accident.

5.5 COMPANY TASK-SPECIFIC ELECTRICAL SAFETY PROCEDURES

The Company's task-specific electrical safety procedures are just one component of the Company's site-specific safety procedures. The Site Superintendent, Safety Coordinator, and Foremen will formulate the electrical safety procedures to address the following job factors:

- Purpose of job task.
- Qualification and number of employees to be assigned.
- Hazardous nature and duration of each job task.
- Limits of approach.
- Testing devices.
- Task-specific safe work practices to be utilized.
- Personal protective equipment required.
- Insulating materials and tools involved.
- Special precautionary techniques.
- Electrical diagrams, plans, and specifications.
- Equipment details and manufacturers' installation instructions.
- Employee safety training requirements.

Copies of applicable sections of NFPA 70E, OSHA, consensus electrical safety codes/standards and pertinent parts of the Company's site-specific safety procedures, sketches or drawings of unique features should be attached.

6.0 ELECTRICAL HAZARDS

6.1 WHAT CAUSES ELECTRICAL HAZARDS

Construction electrical hazards can include poor work conditions, equipment or practices. It may also include careless, inadvertent actions made on the part of individuals. Avoiding hazards requires that the Foreman first identify the electrical safety hazard and take every reasonable precaution to provide crew members with a safe work environment. This includes the review of designs and specifications of the electrical components and equipment to be installed, checked-out, tested, started-up, or maintained.

Many electrical circuits do not directly pose serious shock or burn hazards by themselves. However, many of these circuits are found adjacent to circuits with potentially lethal levels of energy. Even a minor shock can cause a qualified electrician to rebound into a lethal circuit or cause the electrician to drop a tool into the circuit. Involuntary reaction to a shock may also result in bruises, bone fractures, and even death from collisions or falls.

6.2 THREE TYPES OF HAZARDS

There are three basic electrical hazards that cause injury and death - *shock, arc flash* and *arc blast.*

a. *Shock* - Current can pass through the human body's nervous or vascular systems, and across the surface of the body.

- The current required to light a 7.5 watt, 120-volt lamp, passing through the chest can cause death.
- Of those killed while working on voltages below 600 volts, half were performing work on "hot" energized equipment.
- Most electrocutions can be avoided with proper training, planning, job preparation, procedures and proper equipment.

b. *Arc Flash* - Extremely high temperature conductive plasma and gases.

- As much as 80% of all electrical injuries are burns resulting from an arc flash contact and ignition of flammable clothing.
- Arc temperatures can reach 35,000ºF - four times hotter than the sun's surface.