Session No. 542

Industrial Electrical Safety Inspections

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Introduction

The Occupational Safety and Health Administration (OSHA) concluded that effective management of worker safety and health protection is a decisive factor in reducing the extent and the severity of work-related injuries and illnesses. Effective management addresses all work-related hazards, including those potential hazards that could result from a change in worksite conditions or practices. It addresses hazards whether or not they are regulated by government standards. OSHA has reached this conclusion in the course of their evaluation of worksites in their Enforcement Programs, their State-Operated Consultation Programs, and their Voluntary Protection Programs (VPP). These evaluations have revealed a basic relationship between effective management of worker safety and health protection, and a low incidence and severity of employee injuries. Such management also correlates with the elimination or adequate control of employee exposure to toxic substances and other unhealthful conditions.

OSHA's experience in the Voluntary Protection Programs has also indicated that effective management of safety and health protection improves employee moral and productivity, as well as significantly reducing workers' compensation costs and other less obvious costs of work-related injuries and illnesses.

Electrical Inspection Program

The OSH Act of 1970 requires the employer to provide a safe and healthful workplace for every working man and woman. Section 5(a)(1) of the OSH Act, referred to as the "General Duty Clause," requires each employer to furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees and requires the employer to comply with occupational safety and health standards promulgated under the OSH Act. To assist in accomplishing this, the employer should implement self-assessment or inspection programs to ensure that the electrical systems and equipment are properly designed, installed, operated, and maintained in a safe and reliable condition.

Electrical safety inspections should be conducted to verify full compliance with OSHA 29 CFR 1910 electrical related regulations, which include the following:

- 29 CFR 1910, Subpart I, *Personal Protective Equipment*
  - 1910.132, *General Requirements*
  - 1910.137, *Electrical Protective Equipment*
- 29 CFR 1910, Subpart J, *General Environmental Controls*
  - 1910.146, *Permit-Required Confined Spaces* (as applicable)
  - 1910.147, *The Control of Hazardous Energy (lockout/tagout)*
- 29 CFR 1910, Subpart R, *Special Industries* (as applicable)
  - 1910.269, *Electric Power Generation, Transmission, and Distribution*
- 29 CFR 1910, Subpart S, *Electrical Standards*:
  - 1910.302-.308, *Design Safety Standards for Electrical Systems*
  - 1910.331-.335, *Electrical Safety-Related Work Practices*
  - 1910.399, *Definitions*

There are also several industry consensus standards that must be adhered to, such as:

- NFPA 70, *National Electrical Code*
- NFPA 70E, *Standard for Electrical Safety in the Workplace*
- NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*
- ANSI/IEEE C2, *National Electrical Safety Code* (NESC) (as applicable)

Compliance with these regulations and standards will help to ensure that employers are installing and maintaining electrical systems and equipment in proper and safe working condition, as well as verifying each employee's utilization of safe work practices and appropriate personal protective equipment for shock and arc flash. Inspections also assist supervisors and managers in meeting electrical safety goals set by the company for regulatory compliance.

NFPA 70E, Section 110.3(H), Electrical Safety Auditing, provides additional direction on auditing the electrical safety program and field work on a frequency not to exceed three (3) years and must be documented. This audit is required to contain at least the following four components:

1. Employee implementation of the electrical safety program
   a. Understanding the program
   b. Identify how much supervision emphasizes the program
   c. Describe the condition of the program
2. Does the electrical safety program address all hazards
   a. Determines if employees are exposed to other risks not addressed in the program
3. The audit must address the process for revising procedures as needed
   a. Where incidents or injuries occur, a review of procedures must take place
   b. Procedure revisions or a new procedure may be needed
4. Define how procedure revisions are communicated to employees

These inspection and audit programs should be carried out by an electrically knowledgeable, qualified person in order to identify deficiencies in electrical equipment or systems, and to correct or properly document any deficiencies found. One way to ensure that the inspection program is on target is to have electrically qualified company safety personnel conduct the inspections, or another option is to hire a contracted third-party electrical safety inspector.

Using a person from outside the facility will often lead to discovery of issues and deficiencies that may be overlooked by self-inspecting.

The written electrical safety inspection program should be reviewed on a periodic basis, by qualified persons, to ensure that the checklists are current and are being utilized. Inspections should include a review of the entire electrical safe work program for energized and deenergized work, which includes the energy control or lockout/tagout program. Written work practices (programs and procedures), personal protective equipment (PPE), and installed electrical equipment and systems' physical condition and maintenance should be inspected for compliance with regulations and industry consensus standards. Inspections should also include "work in progress" to ensure that each worker understands and is implementing electrical safe work practices and procedures, and utilizing the proper PPE and insulated tools.

A root cause analysis of the deficiencies identified should be a part of the inspection program. Changes or corrections in processes, practices, and procedures should be analyzed to help prevent a reoccurrence. Any items identified in the inspection or lessons learned should be communicated to others in the organization that may benefit from the information.

Management Role

Management ultimately bears the burden of effectively administering the electrical safety inspection programs. Their involvement in the development and implementation of the electrical safety inspection program is vital to its success. There are several areas that must be considered when developing the inspection program; they include, but are not limited to: hazard assessments, inspections and audits, electrical safety training for all personnel (qualified and unqualified or electrical and non-electrical personnel), and evaluation of the existing safety management system.

To assist employers and employees in developing effective safety and health management systems, OSHA published recommended *Safety and Health Program Management Guidelines* (*Federal Register* 54(16): 3904-3916, January 26, 1989). These voluntary guidelines can be applied to all places of employment covered by OSHA. The guidelines identify four general elements that are critical to the development of a successful safety and health management system:

1. Management leadership and employee involvement
2. Worksite analysis
3. Hazard prevention and control
4. Safety training

Inspection Guidelines

Employers should perform a self-assessment or inspection to determine the adequacy of their written electrical safety program and procedures, including electrical protective equipment, and to ensure that they are being implemented. It should also include an inspection of the facility's electrical systems and equipment to ensure compliance with the installation and maintenance regulations and standards.

There are numerous subjects and items that should be addressed in an electrical safety inspection. The list below identifies several typical deficiencies that are commonly found during electrical safety and compliance inspections of industrial and commercial facilities:

1. Operations and electrical safety one-line diagrams, drawings, and identification tags
   a. Must be up-to-date per the requirements of NFPA 70E, Section 120.1(1)
   b. Must be maintained up-to-date per NFPA 70E, Section 205.2, *Single-Line Diagram*
2. Electrical Hazard Analysis performed
   a. OSHA 1910.132(d)(1) requires an overall hazard assessment to determine if hazards are present or are likely to be present
   b. NFPA 70E, Section 130.3 requires an electrical hazard analysis be performed
   c. NFPA 70E, Section 130.4 provides the requirements for the Shock Hazard Analysis
   d. NFPA 70E, Section 130.5 provides the requirements for the Arc Flash Hazard Analysis and arc flash hazard warning label requirements
3. Trained and qualified operators and maintenance technicians
   a. OSHA 1910.399 *Definitions – Qualified Person*
   b. OSHA 1910.332, *Training*
   c. OSHA 1910.269(a)(2), *Training*
   d. OSHA 1910.132(f), *Training* (PPE)
   e. NFPA 70E, Section 110.2, *Training Requirements*
4. De-energized work procedures
   a. Lockout/tagout policy and procedures per OSHA 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*
   b. Additional requirements for electrical lockout/tagout per OSHA 29 CFR 1910.333(b), *Working on or near exposed deenergized parts*
   c. The requirements of NFPA 70E, Article 120 for *Establishing an Electrically Safe Work Condition*
5. Electrical safety program
   a. NFPA 70E, Section 110.3, *Electrical Safety Program*
   b. OSHA 29 CFR 1910.333(a)(2), *Energized Parts*
   c. Additional resource
      i. The NFPA *Electrical Safety Program Book*
6. Energized safe work procedures
   a. OSHA 29 CFR 1910.333(a)(2), *Energized Parts*
   b. OSHA Instruction STD 1-16.7, Directorate of Compliance Programs, paragraph I(2)(d)(2)… "suitable safe work practices for the conditions under which the work is to be performed shall be included in the written procedures and strictly enforced. These work practices are given in 1910.333(c) and 1910.335."
7. Energized Electrical Work Permit
   a. NFPA 70E, Section 130.2(B), *Energized Electrical Work Permit*
8. Shock and Arc Flash Personal Protective Equipment (PPE)
   a. OSHA 1910.132(d) requires a hazard assessment to determine what PPE is required
   b. OSHA 335, *Safeguards for Personnel Protection* provides the minimum requirements to provide PPE for electrical hazards and the required use of insulated hand tools
   c. NFPA 70E, Section 130.4 determines what shock protection PPE is required

d. NFPA 70E, Section 130.5 provides information for selecting arc flash clothing and PPE
e. NFPA 70E, Section 130.7 provides specific PPE requirements for all parts of the body for shock and arc flash

9. Grounding and bonding
   a. Per NEC Article 250, *Grounding and Bonding*
   b. Per NESC Section 9, *Grounding Methods for Electric Supply and Communications Facilities*
   c. IEEE Standard 80, *IEEE Guide for Safety in AC Substation Grounding*
   d. IEEE Standard 142, *IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems*

10. Corrosion
    a. NEC 110.11, *Deteriorating Agents*

11. Maintenance practices (maintenance frequency, methods, and testing)
    a. Manufacturer's Instructions
    b. NFPA 70E, Chapter 2, *Safety-Related Maintenance Requirements*
    c. NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*
    d. ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*

12. Exposed live (energized) parts – covers left off or doors left open
    a. OSHA 1910.303(g)(2), *Guarding of live parts*
    b. NEC 110.27(A), *Live Parts Guarded Against Accidental Contact*

13. Unused openings not effectively closed
    a. OSHA 1910.303(b)(7), *Mechanical execution of work*
    b. NEC 110.12(A), *Unused Openings*

14. Working space around electrical equipment, 600-volts or less
    a. OSHA 1910.303(g)(1), *Space about electric equipment*
    b. OSHA 1910.303(g)(1)(ii) – "may not be used for storage"
    c. NEC 110.26, *Spaces About Electrical Equipment*
    d. NEC 110.26((B), *Clear Spaces*
    e. ANSI/IEEE C2, NESC, Section 125.A., *Working space about electric equipment*

15. Working space around electrical equipment, over 600-volts
    a. OSHA 1910.303(h)(3), *Work space about equipment*
    b. NEC 110.34(A), *Working Space*
    c. ANSI/IEEE C2, NESC, Section 125.B., *Working space about electric equipment*

16. Identification of disconnecting means
    a. OSHA 1910.303(f), *Disconnecting means and circuits*
    b. NEC 110.22, *Identification of Disconnecting Means*

17. Improper or unapproved extension cords
    a. OSHA 1910.303(a), *Approval*
       i. See definition of *Approved* in OSHA 1910.399
       ii. See OSHA Letter *Acceptable Job-Made extension cords,* June 17, 1992
    b. OSHA 1910.303(b)(1)(i), "suitability for installation and use"
    c. OSHA 1910.305(g), *Flexible cords and cables*
    d. OSHA 1910.305(g)(1), *Use of flexible cords and cables*

e. NEC 110.2, *Approval*
    i. See definition of *Approved* in NEC Article 100
f. NEC 110.3(A)(1), "suitability for installation and use"
g. NEC 400.8, *Uses Not Permitted*
h. NEC 400.9, *Splices*
i. NEC 400.10, *Pull at Joints and Terminals*

18. Damaged extension cords
    a. OSHA 1910.305(a)(2)(x), "Flexible cords and cables shall be protected"
    b. OSHA 1910.305(g)(1), *Use of flexible cords and cables*
    c. OSHA 1910.334(a), *Portable electric equipment*
    d. NEC 400.8, *Uses Not Permitted*
    e. NFPA 70E, 205.13, *Single and Multiple Conductors and Cables*
    f. NFPA 70E, 205.14, *Flexible Cords and Cables*
    g. NFPA 70E, 110.4(B), *Portable Electric Equipment*
19. Damaged cord- and plug-connected equipment
    a. All references for "damaged extension cords" also applies
    b. NFPA 70E, 245.1, *Maintenance Requirements for Portable Electric Tools and Equipment*
20. Availability and condition of electrical PPE
    a. OSHA 1910.132, *PPE General Requirements*
    b. OSHA 1910.137, *Electrical Protective Equipment*
    c. OSHA 1910.335, *Safeguards for Personnel Protection*
    d. NFPA 70E, 130.7, *Personal and Other Protective Equipment*

OSHA Electrical Self-Inspection Checklist

The following is an OSHA Electrical Self-Inspection Checklist for additional guidelines on what OSHA will likely look for when conducting an electrical safety inspection.

	Do you specify compliance with OSHA for all contract electrical work?
	Are all employees required to report as soon as practicable any obvious hazard to life or property observed in connection with electrical equipment or lines?
	Are employees instructed to make preliminary inspections and/or appropriate tests to determine what conditions exist before starting work on electrical equipment or lines?
	When electrical equipment or lines are to be serviced, maintained or adjusted, are necessary switches opened, locked-out and tagged whenever possible?
	Are portable electrical tools and equipment grounded or of the double insulated type?
	Are electrical appliances such as vacuum cleaners, polishers, and vending machines grounded?
	Do extension cords being used have a grounding conductor?

	Are multiple plug adaptors prohibited?
	Are ground-fault circuit-interrupters (GFCI) installed on each temporary 15 or 20 ampere, 120 volt AC circuit at locations where construction, demolition, modifications, alterations or excavations are being performed?
	Are all temporary circuits protected by suitable disconnecting switches or plug connectors at the junction with permanent wiring?
	Do you have electrical installations in hazardous dust or vapor areas? If so, do they meet the National Electrical Code (NEC) for hazardous locations?
	Is exposed wiring and cords with frayed or deteriorated insulation repaired or replaced promptly?
	Are flexible cords and cables free of splices or taps?
	Are clamps or other securing means provided on flexible cords or cables at plugs, receptacles, tools, equipment, etc., and is the cord jacket securely held in place? Are all cord, cable and raceway connections intact and secure?
	In wet or damp locations, are electrical tools and equipment appropriate for the use or location or otherwise protected?
	Is the location of electrical power lines and cables (overhead, underground, under floor, other side of walls) determined before digging, drilling or similar work is begun?
	Are metal measuring tapes, ropes, handlines or similar devices with metallic thread woven into the fabric prohibited where they could come in contact with energized parts of equipment or circuit conductors?
	Is the use of metal ladders prohibited in areas where the ladder or the person using the ladder could come in contact with energized parts of equipment, fixtures or circuit conductors?
	Are all disconnecting switches and circuit breakers labelled to indicate their use or equipment served?
	Are disconnecting means always opened before fuses are replaced?
	Do all interior wiring systems include provisions for grounding metal parts of electrical raceways, equipment and enclosures?
	Are all electrical raceways and enclosures securely fastened in place?
	Are all energized parts of electrical circuits and equipment guarded against accidental contact by approved cabinets or enclosures?
	Is sufficient access and working space provided and maintained about all electrical equipment to permit ready and safe operations and maintenance?
	Are all unused openings (including conduit knockouts) in electrical enclosures and

	fittings closed with appropriate covers, plugs or plates?
	Are electrical enclosures, such as switches, receptacles, and junction boxes, provided with tight fitting covers or plates?
	Are disconnecting switches for electrical motors in excess of two horsepower, capable of opening the circuit when the motor is in a stalled condition, without exploding? (Switches must be horsepower rated equal to or in excess of the motor hp rating.) Is low voltage protection provided in the control device of motors driving machines or equipment that could cause probable injury from inadvertent starting?
	Is each motor disconnecting switch or circuit breaker located within sight of the motor control device?
	Is each motor located within sight of its controller or the controller disconnecting means capable of being locked in the open position or is a separate disconnecting means installed in the circuit within sight of the motor?
	Is the controller for each motor in excess of two horsepower, rated in horsepower equal to or in excess of the rating of the motor it serves?
	Are employees who regularly work on or around energized electrical equipment or lines instructed in cardiopulmonary resuscitation (CPR) methods?
	Are employees prohibited from working alone on energized lines or equipment over 600 volts?

Summary

Electrical safety inspections are necessary in order to verify compliance with regulations and standards, as well as to help ensure that electrical installations and equipment are safe. Compliance with the OSHA regulations and NFPA standards, along with other industry consensus standards and electrical equipment manufacturer's instructions, will provide a means to reduce accidents, injuries, and fatalities in all segments of industry.

It is always important to ensure that employees are properly trained and qualified for a job. Not understanding the circumstances about the job or task can lead to accidents and injuries. Even properly qualified electrical workers are susceptible to accidents. That's why it's important to make safety an integral part of the planning process for every job.

Important safety tips to help avoid injuries include, but are not limited to:

- Identify the electric shock and arc flash hazards, as well as other hazards that may be present.
- Use the right tools for the job.
- Isolate equipment from energy sources.
- Test every circuit and every conductor every time before you touch it.
- Work on electrical equipment and conductors only when de-energized.
- Turn off, try, test, lockout/tagout, and ground before working on equipment.

- Treat de-energized electrical equipment and conductors as energized until properly lockout/tagout, tested, and ground procedures are implemented.
- Wear protective clothing and equipment and use insulated tools for electrical hazards.

Adherence to these basic inspection and safety tips can help avoid serious, or even life-threatening, injuries while working with electrical equipment and systems.

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