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## STANDARDS/PROCEDURES MANUAL

Approved: /s/ Bill Davis  
/s/ Jeff Rosenfelt

### ELECTRICAL SAFETY

#### I. PURPOSE/SCOPE

The purpose of the procedure is for the safe use of electrical equipment and tools, also to comply with NFPA 70E requirements.

#### II. APPLICATIONS

This procedure applies to all Key Technology Inc. employees, temporary and contractors in the United States.

When work is performed on a non-owned or operated site, the operator's process shall take precedence. This procedure covers Key Technology employees and contractors hired by Key Technology and shall be used on owned premises, or when an operator's process does not exist or is less stringent.

1. Key Technology shall advise the host employer of:
  - a) Any unique hazards presented by the contract employer's work.
  - b) Any unanticipated hazards found during work by Key Technology the host employer did not mention.
  - c) The measures Key Technology took to correct any hazards reported by the host employer to prevent such hazards from recurring in the future.

#### III. PROCEDURE

##### **1. Responsibilities of Managers and Supervisors**

- a) The Environmental Health and Safety Manager will develop an Electrical Safety Procedure in accordance with OSHA requirements and/or as indicated by events and circumstances, they shall be a competent person capable of identifying existing and predictable hazards in the surroundings or working conditions which are hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

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- b) Ensure that only qualified employees and/or qualified contractors perform electrical repairs or installations. Unqualified persons shall not be permitted to enter spaces that are required to be accessible to qualified employees, unless the electric conductors and equipment involved are in an electrically safe work condition.
- c) Ensure a documented job briefing is held before starting each job and will include all employees involved, unless covered by a standard work direction. The briefing will cover hazards associated with the job, work directions involved, special precautions, energy source controls, PPE requirements and information on energized electrical work permit if required. Additional job briefings will be held if changes that might affect the safety of employees the would occur during the course of work.
- d) Ensure all applicable electrical safety programs are implemented and maintained at their locations.
- e) Ensure audits are performed every year to ensure the requirements in the written program are being performed by the employees. The written program must be updated if auditing determines that employees are not following it or if another issue is identified with potential hazardous exposure.

### **2. Responsibilities of Employees**

- a) To use electrical equipment, tools and appliances according to this procedure.
- b) To attend required training sessions when directed.
- c) Report any unsafe conditions to their Supervisor or Lead immediately.

### **3. Safe Work Practices**

- a) Safe work practices are to ensure the prevention of electrical shock or other injuries that may result by either direct or indirect contact when work is performed on or near equipment or circuits that may be energized. De-energized parts that have not been locked out/tagged out in accordance with established procedures are considered energized.
- b) Qualified employees only shall perform testing, troubleshooting and voltage measuring within the Limited Approach Boundary of energized electrical conductors or circuit parts operating at 50v or more, or where an electrical hazard exists.
- c) Qualified employees shall be responsible for reinstalling all permanent barriers or covers once work has been completed.

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- d) Conductive items of jewelry or clothing shall not be worn unless they are rendered nonconductive by covering, wrapping or other insulating means.
- e) Alert employees of potential hazards by the use of safety signs, tags, barricades and attendants. Safety signs must meet the requirement of NFPA 70E ANSI Z535 Table 130.7(F). Barricades must be used in conjunction with safety signs and never by themselves.

### **4. Safe Work Practices within the Limited Approach Boundary**

- a) The Limited Approach Boundary is the minimum distance from the energized item where unqualified personnel may safely stand.
- b) Prior to work being done within the Limited Approach Boundary, a Hazard Risk Analysis must be performed. The HRA will contain event severity, frequency, probability and avoidance to determine the level of safe practice to follow.

### **5. Safe Work Practices within the Restricted Approach Boundary**

- a) The Restricted Approach Boundary is the closest distance to exposed live parts a qualified person can approach with or without proper PPE and tools. Inside this boundary, accidental movement can put a body part or conductive tool in contact with a live parts or inside the Prohibited Approach Boundary. Due to its proximity to a shock hazard, the use of shock protection techniques and equipment are required. The Restricted Approach Boundary in a restricted space can only be crossed by a qualified person who has completed the required training.

### **6. Safe Work Practices within the Prohibited Approach Boundary**

- a) The Prohibited Approach Boundary is the minimum approach distance to exposed live parts to prevent flashover or arcing. Approaching any closer is comparable to making direct contact with a live part. To cross the Prohibited Approach Boundary the qualified person must have specified training to work on exposed live parts.

### **7. Safe Work Practices within the Flash Protection Boundary**

- a) Flash Protection Boundary is the approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur. The Flash Protection Boundary is the distance at which PPE is needed to prevent incurable burns, 2<sup>nd</sup> degree or worse, if an arc flash occurs. (It is still possible to suffer 1<sup>st</sup> or 2<sup>nd</sup> degree burns.) Persons crossing into the Flash Protection Boundary are required to wear the appropriate PPE and be properly trained.

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- (1) Arc Flash is a release of thermal energy from an arc by vaporization and ionization of materials, reaching temperatures up to 35,000° F. Exposure burns the skin directly and can ignite clothing.
- (2) Conduct Arc flash risk assessment to determine appropriate safety related work practices, Arc flash boundary requirements, and the PPE required to minimize the risk of electric shock.
- (3) Assessments must be documented and equipment marked with a label and the risk assessments must be reviewed prior to beginning work.
- (4) Arc Flash Hazard Analysis is to determine the proper PPE in case of exposure.
  - (a) Key employees will not be authorized to conduct work on equipment rated at a Class 2 or above unless they are a licensed and certified electrician.

### **8. Inspections**

- a) Electrical equipment, tools and appliances must be inspected prior to each use.
- b) In high humidity or wet environments, the use of a hard fixed GFCI or a portable GFCI adapter must be used with all portable hand tools, electric extension cords, drop lights and all 110v equipment.
- c) Faulty equipment, tools or appliances must be tagged “Out of Service”, dated and signed by the employee and removed from service.
- d) All equipment grounding conductors shall be tested for continuity & shall be electrically continuous.
- e) Each receptacle and attachment cap or plug shall be tested for correct attachment of the equipment grounding conductors.
- f) The equipment grounding conductor shall be connected to its proper terminal:
  - (1) Before each use
  - (2) Before equipment is returned to service following any repairs
  - (3) Before equipment is used such as when a cord has been damaged.
  - (4) Cord sets and GFCI receptacles, which are fixed and not exposed to damage, shall be tested at intervals not exceeding 6 months.

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- g) Tests performed as required by this program shall be recorded as to the identity of each CFCI receptacle, cord set, and cord and plug connected equipment that passed the test and shall indicate the last date tested or interval for which was tested. This record shall be kept by means of logs, color coding, or other effective means and shall be maintained until replaced by a more current record. These records shall be made available at the job site for inspection by the Maintenance Department and any affected employees.

### **9. Ladders**

- a) Approved, nonconductive ladders must be used near electrical equipment, to include changing light bulbs.
- b) Ladders must be wood, fiberglass, or have nonconductive side rails.
- c) Wood ladders must not be painted, which can hide defects, unless with clear lacquer.
- d) Must be free from moisture, oils and greases.

### **10. Equipment**

- a. Test instruments, equipment and their accessories must meet requirements of: ANSI/ISA-61010-1: Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1 – General Requirements for Rating and Design Requirements for Voltage Measurement and Test Instruments Intended for use on Electrical Systems 1000v and below.
- b. When test instruments are used for the testing for the absence of voltage on conductors or circuit parts operating at 50v or more, the operation of the test instrument shall be verified before and after an absence of voltage test is performed.

### **11. Personal Protective Equipment (PPE)**

- a) All PPE used must meet the requirements in NFPA 70E Table 130.7(C) (14)
- b) All insulating PPE must be inspected before each shifts use and immediately following any incident that could reasonably be suspected of having caused damage. Insulating gloves must be given an air test, along with the inspection Per 29 CFR 1910.137 (c) (2) (ii).

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- c) Maximum test intervals for rubber insulation PPE must include:
  - (1) Blankets: before first issue then every 12 months thereafter.
  - (2) Gloves: before first issue then every 6 months thereafter.
  - (3) Sleeves: before first issue then every 12 months thereafter.
  - (4) Covers and line hose to be tested if insulating value is suspect.

### **12. Energized Electrical Work Permit**

- a) Work on energized electrical conductors or circuit parts not placed in an electrically safe work condition will be considered energized electrical work and must be performed by written permit, unless work is normally covered by a standard work directions/procedure.

### **13. Lighting**

- a) Employees must not enter spaces containing electrical hazards unless appropriate lighting enables them to perform work safely. If lack of lighting or an obstruction exists, employees must not perform a task within Limited Approach Boundary of energized electrical conductors or circuit parts operating at 50v or more or where electrical hazard exists.

### **14. Extension Cords**

- a) Only three-wire grounded extension cords and cables that conform to a hard service rating of 14 ampere or higher, and grounding of the tools or equipment being supplied. Cords must have strain relief at both the plug and receptacle ends.
- b) Work lamps (drop lights) used to power electrical tools must have a 3 wire grounded outlet unless powering insulated tools.
- c) Cords must be service rated for hard to extra hard service and have S, ST, SO, SJO, SJT, STO or SJTO printed on the cord. S=Service, J=Junior, T=Thermal plastic, O=Oil resistant and Weather approved.
- d) Cords are not to be in doorways, under mats or carpets, across walkways or aisles, concealed behind walls, ceilings or floors, or run through holes in walls, or anywhere they could be a tripping hazard.

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- e) High current equipment or appliances should be plugged directly into a wall outlet whenever possible.
- f) When working in high humidity or a wet environment, all extension cords shall be plugged into one of the following:
  - (1) A GFCI outlet
  - (2) A GFCI built into the cord
  - (3) A GFCI adapter used between the wall outlet and cord plug
- g) Portable cord and plug connected to equipment and flexible cord sets (extension cords) must be visually inspected before use on any every shift for external defects, such as loose parts, deformed and missing pins, and damage to outer jacket or insulation. Also for evidence of possible internal damage such as pinched or crushed outer jacket. If damage is found the extension cord or electrical cord must be removed from service and repaired or replaced.
- h) Cord and plug connected equipment and flexible cord sets or extension cords, which remain connected once they are in place, are not exposed to damage need not be visually inspected until they are relocated.

### **15. Double Insulated Tools**

- a) Double insulated tools must have the factory label intact indicating the tool has been approved to be used without a three wire grounded supply cord connection.
- b) Double insulated tools must not be altered in any way, which would negate the factory rating.

### **16. Switches, Circuit Breakers and Disconnects**

- a) All electrical equipment and tools must have an on/off switch and must not be turned on or off by plugging or unplugging the supply cord at the power outlet.
- b) Circuit breaker panel boxes and disconnects must be labelled with the voltage rating.
- c) Each breaker within a breaker panel must be labelled for the service it provides.
- d) Disconnect switches “knife box” providing power for individual equipment must be labelled accordingly.

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### **17. Confined or Enclosed Work Spaces**

- a) When an employee or contractor work in a confined or enclosed space that contains exposed energized parts, they must isolate the energy source and turn off the source, then lock out/tag out the energy source.
  - (1) Only qualified Key Technology employees/contractors are to work on exposed energy sources.
- b) Protective shields, barriers or insulating materials will be provided by the employer and used by the employee/contractor.

### **18. Enclosures, Breaker Panels, and Distribution Rooms**

- a) A clear working space must be maintained in the front, back and on each side of all electrical enclosures and around electrical equipment for safe operation to allow access for maintenance and alteration.
- b) A minimum two foot working floor space in front of panels and enclosures must be painted yellow.
- c) Employees may not enter spaces containing exposed energized parts unless appropriate lighting allows a safe work condition.
- d) Housekeeping in distribution rooms must receive high priority and provide a safe working/walking area in front of panels, combustible materials must be kept to the minimum required to perform maintenance operations.
- e) All enclosures and distribution rooms must have “Danger: High Voltage – Authorized Personnel Only” posted on the front panel and entrance doors.

### **19. Lock Out/Tag Out**

- a) Refer to Procedure 03-10

### **20. Contractors**

- a) Only approved and certified electrical contractors perform construction and service work on Key Technology property.
- b) It is the responsibility of the Manager/Supervisor to verify the contractor’s certification.



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### **21. Fire Extinguishers**

- a) Approved fire extinguishers must be provided near electrical breaker panels and distribution centers.

### **22. Electric Shock – CPR**

- a) If someone receives an electric shock and is unconscious, first check to see if their body is in contact with an electrical circuit. Do not touch the person until you are sure there is no contact with an electrical circuit.
- b) When it is safe to make contact, begin CPR if the person's heart has stopped or they are not breathing.
- c) Call for help immediately.

### **23. Electric Welders**

- a) A disconnecting means must be provided in the supply circuit for each motor generator arc welder, and for each AC transformer and DC rectifier arc welder which is not equipped with a disconnect mounted as an integral part of the welder.
- b) A switch or circuit breaker will be provided so each resistance welder and its control equipment can be isolated from the supply circuit. The ampere rating of this disconnecting means will not be less than the supply conductor ampacity. (Maximum amount of electric current a conductor or device can carry before sustaining immediate or progressive deterioration).

### **24. Equipment Grounding**

- a) Mig welders, air compressors, electric generators, separators, vessels, etc. must be grounded in accordance with jurisdiction having authority.

### **25. Energized and overhead high voltage power lines and equipment**

- a) Post and maintain signs in plain view of the operator and driver of forklifts, cranes and other similar equipment legible at 12 feet reading: "Unlawful To Operate This Equipment Within 10 Feet Of High-Voltage Lines of 50,000 Volts Or Less."

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- b) Maintain a minimum clearance of 10 feet from high voltage lines when operating vehicular and mechanical equipment such as forklifts, cranes and other similar equipment.
- c) Whenever possible, power lines shall be deenergized and grounded before work is started.
- d) When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact, cannot come close to any unguarded, energized overhead line than the following distances:
  - (1) For voltages to ground 50kV or below – 10 feet (305 cm);
  - (2) For voltages to ground over 50kV – 10 feet (305 cm) plus 4 inches (10 cm) for every 10kV over 50kV.
- e) Qualified employees must adhere to the approach distances in 29 CFR 1910.333 (c) (3) (ii) table S5 when working near overhead lines.

## IV. TRAINING

Employees shall be trained in safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective jobs. Employees shall be trained on an annual basis to identify and understand the relationship between electrical hazards and possible injury. Documentation shall be made when the employee demonstrates proficiency, be maintained for the duration of the employee's employment and contain each employee's name and date of training.

Employees shall be trained in the skills and techniques to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment, to determine the nominal voltage of exposed energized electrical conductors and circuit parts, the approach distances specified in the Table below, and the decision making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.



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<b>Limited Approach Boundary</b>				
<b>Nominal system voltage range, phase to phase</b>	<b>Exposed movable conductor</b>	<b>Exposed fixed-circuit part</b>	<b>Restricted approach boundary (allowing for accidental movement)</b>	<b>Prohibited approach boundary</b>
0 to 50 volts	Not specified	Not specified	Not specified	Not specified
51 to 300 volts	10 ft. 0 in.	3 ft. 6 in.	Avoid contact	Avoid contact
301 to 750 volts	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.	0 ft. 1 in.

### V. RETRAINING

A. An employee is to receive additional training or retraining under any of the following conditions:

1. If the supervision or annual inspections indicate that the employee is not complying with the safety-related work practices.
2. If new technology, new types of equipment, or changes in the procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use.
3. Retraining shall be performed for qualified persons who are allowed to work within the Limited Approach Boundary.
4. If he or she must employ safety-related work practices that are not normally used during their regular job duties.
5. Retraining shall be performed at intervals not to exceed 3 years.
6. Employees shall be trained in the skills and techniques to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical.

### VI. REVISION HISTORY

May 25, 2016 - Complete rewrite.

August 25, 2017 – Section III.1.a) added required text. Section III.3. added c). Section III.8. completely rewritten. Section III. Added 25.



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September 11, 2017 – Section III.1. added e). Section III.3. Added e). Section III.7.a) added (2) and (3). Section III.11. Added a). Section III.25 added d).