

**BY ORDER OF THE  
SECRETARY OF THE AIR FORCE**

**AIR FORCE INSTRUCTION 32-1064**

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**Civil Engineering**

**ELECTRICAL SAFE PRACTICES**



**COMPLIANCE WITH THIS PUBLICATION IS MANDATORY**

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This instruction implements Air Force policy directive (AFPD) 32-10, *Installations and Facilities*. It assigns responsibilities to personnel who maintain and operate electrical systems, including airfield lighting, and facilities. Unified Facilities Criteria (UFC) 3-560-01, *Electrical Safety, O&M*, provides additional safety requirements. This publication applies to all Air Force, Air Force Reserve Command (AFRC), and Air National Guard (ANG) units and personnel. This publication may be supplemented at any level, but all direct Supplements must be routed to the Office of Primary Responsibility (OPR) of this publication for coordination prior to certification approval. The authorities to waive wing/unit level requirement in this publication are identified with a Tier (“T-0, T-1, T-2, T-3”) number following the compliance statement. See AFI 33-360, *Publications and Forms Management*, for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the Publication OPR for non-tiered compliance items. Refer recommended changes and questions about this publication to the OPR using the AF Form 847, Recommendation for Change of Publication; route AF Forms 847 from the field through the appropriate functional chain of command. Ensure all records created as a result of processes prescribed in this publication are maintained in accordance with Air Force Manual (AFMAN) 33-363, Management of Records, and disposed of in accordance with the Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS). The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

***SUMMARY OF CHANGES***

This revision updates AFI 32-1064 by (1) changing application and scope for contract work to apply when incorporated into the contract documents; (2) adding an OSHA reference for confined space requirements to include new rule 29 CFR 1926 subpart AA; and (3) removing reference to AFI 32-1063, *Electric Power Systems*, and ETL 11-9, *Electrical Manhole Entry and Work Procedures* from the Glossary of References and Supporting Information. Finally, the AF Form 1213, Civil Engineer Energized Electrical Work Permit, is now required for approving energized work meeting the intent of NFPA 70E and the Air Force Risk Management Framework.

## Chapter 1

### APPLICATION AND SCOPE

**1.1. Application and Scope.** Application and Scope. This instruction applies to all electrical work done either in house or by contract when incorporated as a part of the contract documents on infrastructure and facilities that are maintained and operated by the Air Force, assigns supervisor responsibilities and provides necessary guidance to safely build, operate, and maintain electrical distribution systems and equipment. It complies with AFI 91-203, *The Air Force Consolidated Occupational Safety Instruction*, and incorporates National Consensus Standards. Other requirements for worker safety are in UFC 3-560-01.

## Chapter 2

### SUPERVISOR RESPONSIBILITIES

**2.1. Personal Safety.** Supervisors must provide a safe and healthful work environment. **(T-0)**. Supervisors must ensure facilities, work areas, equipment, and work procedures comply with safety, fire, and health policies. **(T-0)**. Each supervisor must be thoroughly familiar with safe working practices, particularly those in UFC 3-560-01 and applicable standards and codes referenced in Attachment 1 of this AFI. **(T-0)**. Supervisors must report and document all injuries, even minor ones, as directed in AFI 91-202, *The US Air Force Mishap Prevention Program* and AFI 91-204, *Safety Investigations and Reports*. **(T-1)**.

**2.2. Planning and Worker Awareness.** Supervisors must plan the work properly and ensure it is performed safely. **(T-0)**. Supervisors must review job requirements with the workers and ensure they understand why and how to do the work, the hazards they may encounter and how to control them, and the proper procedures for working safely. **(T-0)**. When the mission allows, coordinate de-energizing of circuits for safest possible working conditions. Supervisors are required to provide written procedures when working on energized circuits to ensure safe practices. **(T-0)**.

**2.3. Training Assistance.** Supervisors will provide general and specific safety instructions and training to workers, ensure each employee has access to this instruction and UFC 3-560-01, and ensure they demonstrate satisfactory knowledge before performing any task. **(T-0)**. Supervisors must document all training on AF Form 55, *Employee Safety and Health Record* or an alternative as permitted in AFI 91-202. **(T-2)**.

2.3.1. Supervisors will, after initial job safety training, train employees annually on lock out/tag out, safe clearance, confined spaces entry, manhole, pole top and bucket truck rescue, shop operating instructions and review any Air Force mishap reports. **(T-0)**.

2.3.2. Supervisors must instruct employees on identifying abnormal or hazardous existing conditions (e.g., switches left in an abnormal condition or bypassed, broken equipment temporarily fixed, changes to the one-line distribution map or schematic diagram, lock out or safe clearance tags left on unfinished jobs). **(T-1)**.

**2.4. Safety Meetings.** Supervisors will conduct weekly safety meetings. **(T-2)**. As a minimum, safety meetings should cover the following topics annually:

2.4.1. Hazardous Energy Control (lockout/tagout).

2.4.2. Selected safety rules (two or three).

2.4.3. Methods and hazards of jobs in progress.

2.4.4. Unsafe practices and common causes of mishaps.

2.4.5. Recent accidents.

2.4.6. Potential personal injuries.

2.4.7. Personal Protective Equipment (PPE).

2.4.8. Electrical tools.

- 2.4.9. Materials handling.
- 2.4.10. Good housekeeping.
- 2.4.11. Adequate illumination.
- 2.4.12. Working on or near machinery.
- 2.4.13. Ladders.
- 2.4.14. Working in elevated positions.
- 2.4.15. Lifting and hoisting equipment, including aerial lifts.
- 2.4.16. Grounding systems.
- 2.4.17. Working in underground facilities (confined spaces).
- 2.4.18. Overhead lines.
- 2.4.19. First aid.
- 2.4.20. Rescue and resuscitation.
- 2.4.21. Arc Flash Hazards.
- 2.4.22. Hazards associated with working on or near energized lines or equipment.
- 2.4.23. Abnormal or hazardous existing conditions.
- 2.4.24. Equipment ratings (i.e. amp rating, interrupt rating, short circuit current rating (SCCR) and available interrupting current ratings (AIC)).
- 2.4.25. Energized work and the Air Force Form 1213.

## **2.5. Specific Job-Related Safety Training.**

- 2.5.1. Supervisors must instruct employees who handle hazardous materials to include personal hygiene and protective measures in their safe handling of potential hazards. **(T-0)**. Supervisors must ensure Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all hazardous chemicals according to AFI 90-821 **(T-1)**.
- 2.5.2. Supervisors must provide Hazard Communication training to employees who work on job sites where harmful plants or animals are present regarding potential hazards, and train how to avoid injury, and relevant first aid. **(T-0)**.
- 2.5.3. Supervisors must instruct employees who enter confined or enclosed spaces on hazards and necessary precautions. **(T-0)**. Specific instructions and procedures to enter and work in hazardous or potentially hazardous confined spaces are consistent with the requirements in AFI 91-203, **Chapter 23**, and 29 CFR 1910.146, *Code of Federal Regulations Occupational Safety and Health Standards*, "Permit Required Confined Spaces." Employees engaged in construction activities having one or more confined spaces must also comply with the requirements in 29 CFR 1926, *Safety and Health Regulations for Construction*, subpart AA. Technical orders or other procedures that incorporate the requirements established in the standard are valid and may be used. This training should also include egress even if the space is not confined.

2.5.4. Supervisors must ensure that employees are able to describe the work assignment and methods immediately before doing the work.

2.5.5. Arc Flash Safety Awareness Computer Based Training is required annually for 3E0X1, 3E0X2, 3E1X1, 3E4X1 Air Force Specialty Codes from the AFCEC Virtual Learning Center. **(T-3)**. This can be taken as a group and annotated in training records through your unit training manager.

**2.6. Assigning Tasks.** Assign employees to jobs they are capable of doing safely. Permit only qualified personnel to operate equipment and machinery. Supervisors must ensure a minimum of two qualified employees work together when high-voltage circuits or energized circuits are present. **(T-0)**.

**2.7. Job Site Inspection.** Frequently, but not less than daily, inspect active job sites, materials, and equipment and ensure unsafe items are tagged, rendered inoperative, or removed from the work site. Ensure safe working conditions and practices. Take action to correct any observed or reported violation of safety rules in this instruction. Pay particular attention to safe clearance procedures and practices when working on energized lines and equipment. Present safety briefings to workers at the job site.

**2.8. Mishap Reports.** Investigate every mishap involving an injury, property damage, or “near misses.” Determine the cause and implement corrective action to prevent recurrence. Notify the wing or installation safety staff of all mishaps involving injuries or property damage. Investigate and report certain mishaps through safety channels according to AFI 91204, *Safety Investigation and Reports*. Either the supervisor or base safety personnel will perform the initial investigation. **(T-1)**.

**2.9. Standards and Codes.** Supervisors must train employees to comply with safety standards and the following codes: National Fire Protection Agency (NFPA) 70, *National Electrical Code (NEC)*®; NFPA 70E, *Standard for Electrical Safety in the Workplace*®; *National Electrical Safety Code* (NESC or American National Standards Institute (ANSI)®; state, local, and host nation codes (see Attachment 1). **(T0)**.

**2.10. Protective Equipment.** Supervisors must properly equip and train workers to properly use and maintain tools and PPE. **(T-0)**. Supervisors must ensure PPE is properly worn in accordance with additional guidance provided (see Attachment 2). Pay particular attention to rubber insulating protective equipment (rubber gloves, sleeves, line hoses, hoods, and covers) and hotline tools. Supervisors must make sure equipment receives periodic documented electrical tests in accordance with applicable ANSI and American Society for Testing and Materials (ASTM) specifications (see Attachment 1). **(T-0)**.

**2.11. Scheduling Routine Maintenance.** When routine maintenance requires disrupting power, schedule the outage for the least inconvenience to all users possible without jeopardizing the safety of workers or equipment. Arrange electrical circuits and equipment of the prime power source to allow safe and efficient performance of routine maintenance tasks with minimum mission impact as a result of the outage.

**2.12. First Aid Training.** Supervisors must ensure all electrical personnel (military and civilian) receive training in cardiopulmonary resuscitation (CPR), controlling bleeding, shock management, emergency care of a person having open wounds or burns, and using automated external defibrillators. **(T-0)**.

2.12.1. Host base medical personnel usually train unit CPR instructors. If the host base cannot provide medical personnel, they can arrange for certification of unit personnel through the American Red Cross or American Heart Association.

2.12.2. Personnel's certification shall be current according to American Red Cross or American Heart Association guidelines. **(T-0)**. Supervisors must maintain written documentation of current certification. **(T-1)**.

2.12.3. Supervisors must ensure relevant emergency phone numbers are readily available to all personnel. **(T-2)**.

**2.13. Rescue Training.** Supervisors must train individuals designated for rescuing workers from confined spaces according to Occupational Safety and Health Administration (OSHA) and Air Force occupational safety and health requirements to include blood borne pathogen training; this includes initial and annual refresher training. **(T-0)**.

**2.14. Noise Hazards.** Ensure all potentially hazardous noise sources are identified to bioenvironmental engineering services for evaluation. Ensure all personnel that may be exposed to noise hazards are made aware of them and use the controls required by AFI 48-127. Supervisors will post noise hazard warning signs at noise hazard area entry points, to warn workers. **(T-0)**. Refer to AFI 91-203, [Chapter 23](#) and 29 CFR 1910.146 for additional information.

**2.15. System Maintenance.** Supervisors must ensure electrical systems are maintained so they continue to operate in a safe and effective manner in accordance with UFC 3-550-01, Exterior Electrical Power Distribution and UFC 3-520-01, Interior Electric System. **(T-0)**. Supervisors must not authorize or permit alterations or modifications to equipment or protective device settings without adequate engineering guidance and study. **(T-1)**. Supervisors must remove all obstacles and vegetation that restrict unimpeded egress from the work area or ready access to equipment. **(T-2)**.

**2.16. Technical Data.** Supervisors will ensure current maintenance and operations procedures, diagrams, schematics, device settings, fuse sizes, and manuals are available and properly used. **(T-0)**. Supervisors will develop them if manufacturers' data are not available; obtain engineering guidance if necessary. **(T-2)**. Accurate, current (typically five (5) years or less) electrical short circuit and coordination studies on the primary distribution system that includes facility transformers are necessary in order to further calculate and determine arc flash potentials, equipment ratings, and settings on downstream equipment within the facility."

**2.17. Supervisory Control and Data Acquisition (SCADA) Systems.** Comply with ETL 11-1, *Civil Engineering Industrial Control System Information Assurance Compliance*. All operators of SCADA systems that remotely control electrical distribution systems must have full knowledge of the base distribution system and thorough understanding of switching procedures. **(T-1)**. Operators must keep each display screen (schematic or map) within the SCADA system up-to-date and all switching points on the remote terminal unit accurately identified. **(T-1)**. Supervisors will develop local written and posted procedures for remote operation of circuit breakers and switches to ensure safety of personnel and equipment. **(T-0)**.

**2.18. Safe Clearance.** Make sure all workers are thoroughly familiar with and comply with the most stringent safe clearance procedures found in NFPA 70E; AFI 91-203, [Chapter 21](#); or those

posted at the job location before starting work. See paragraph 4 of this AFI. Supervisors must not permit work unless workers follow these procedures. **(T-0)**.

**2.19. Work on Energized Equipment.** Work on energized electrical equipment is prohibited except in circumstances justified and approved by the Base Civil Engineer (BCE), or equivalent, in accordance with paragraph 5. **(T-1)**.

**2.20. Routine Maintenance Outages.** Before de-energizing circuits or equipment for routine maintenance or repair, the BCE must:

2.20.1. Provide a minimum three-day notice to all users who may be affected by the electrical utility outage. **(T-3)**. Facility manager approval is not required, but as a courtesy, an effort should be made to coordinate the outage.

2.20.2. Coordinate substation, switch station, or major feeder outages with the utility provider, giving as much advance notification as possible. **(T-3)**.

2.20.3. Assist users with authorized backup power, either through equipment authorization inventory data or real property installed equipment generators; prepare to run a backup generator during the outage if necessary. **(T-3)**.



## Chapter 3

### POLYCHLORINATED BIPHENYLS (PCB)

**3.1. Purpose and Limitations.** PCB is a class of nonflammable liquid insulation formerly used as a transformer liquid dielectric. PCB is a suspected carcinogen and no longer manufactured. Several manufacturers distributed PCB under various trade names, such as Askarel, Inerteen, Pyranol, and Chlorextol.

**3.2. Personal Contact Precautions.** Workers should avoid contact with PCBs. If PCB contacts the skin, remove it with waterless hand cleaner, wipe with towels, and dispose of towels with other contaminated material. Flush eye thoroughly with water if eye contact occurs and seek further medical attention.

**3.3. Cleaning Spills.** PCB spills shall be cleaned up immediately in accordance with 40 CFR 761.125. **(T-0).** Prevent PCB from reaching storm drains, sewers, drainage ditches, or any other place where water is flowing. Handle a PCB spill and report it according to base and Environmental Protection Agency (EPA) requirements. Report a spill through the base environmental coordinator.

**3.4. Controlling Equipment Containing PCB.** Mark, handle, store, dispose of, and account for equipment containing PCB according to the latest EPA standards and in accordance with 40 CFR 761 Subpart B and D. **(T-0).** See AFI 32-7042, Waste Management, for on base PCB waste management and recordkeeping requirements and contact the base CE environmental coordinator for additional information and the latest EPA rulings.

## Chapter 4

### SAFE CLEARANCE REQUIREMENT

**4.1. Safe Clearance Requirement.** Supervisors must require safe clearance procedures for personnel opening and closing switches while working on transmission or distribution lines and equipment. **(T-0)**. Safe clearance procedures are necessary to clear lines and equipment for work in the de-energized condition. Safe clearance includes locking out switches, breakers, or other controlling devices when necessary. Mishap prevention tags, completing and posting energized work permits, and grounding provide additional warning and safety if lockout is not possible because of equipment design; however, if a circuit cannot be locked out, a qualified worker must remain at the controlling device while work is being conducted. **(T-0)**. Supervisors must ensure no individual works on lines or equipment until all safety requirements are satisfied. **(T-0)**.

#### 4.1.1. Safe Clearance Responsibilities.

4.1.1.1. The Safe Clearance Manager, who is designated by the BCE, will issue a written safe clearance as required and documented on AF Form 269, *Electrical Facilities Safe Clearance*. **(T-1)**. The Safe Clearance Manager will arrange for interruption of service, must have knowledge of the base distribution system, and notify the utility company supplying power to the installation before performing any operation that may affect the utility company's system. **(T-1)**. An on-site supervisor may also perform the duty of Safe Clearance Manager or Switching Supervisor (person receiving safe clearance), but never both. The Safe Clearance Manager and person receiving the safe clearance (Switching Supervisor) must never be one and the same (person receiving safe clearance, see paragraph 4.2). **(T-1)**.

4.1.1.2. The Safe Clearance Manager will develop written and posted local procedures for proper switching, blocking, tagging, and lockout when switching by remote control, such as the SCADA system. **(T-0)**. Depending on the type of SCADA system, each software manufacturer has different protocols to identify and issue tag orders for equipment or switchgear being worked on. The Safe Clearance Manager will ensure written procedures are available to an electrician and the SCADA operator in the event of a switching failure by SCADA requiring the technician to manually clear the switching failure. **(T-0)**. Each worker and system operator must fully understand local procedures; local procedures must be accessible or available in the work area. Physically verify all SCADA-issued commands for opening and physically apply lockout before beginning work. **(T-0)**. When working on equipment with local control capability, the technician must take control from the SCADA operator and notify the operator when the equipment is returned to normal operation. **(T-0)**. The operator must issue blocking orders and attach messages stating the reason for the condition and estimated restoration time. **(T-0)**.

**4.2. Switching and Blocking Procedures.** The Switching Supervisor (person receiving AF Form 269 from the Safe Clearance Manager) ensures workers accomplish switching, blocking, and tagging operations in the sequence specified on AF Form 269. Operations may begin only when authorized by the Safe Clearance Manager. When work is completed the system will be restored to normal operation in reverse order. For instance, if a detail of switching, blocking, and tagging reads, "Open Switch No. 501 and Attach Danger Tag," the opposite operation is

"Remove Danger Tag and Close Switch No. 501." Annotate the form with the date and time. Do not operate switches bearing AF Form 979, *Danger Tag*, or AF Form 982, *Danger Tag: Do Not Start*, under any circumstances without specific authorization from the operations flight chief. Notify the SCADA systems operator before operating remotely operated or monitored circuit-opening devices. The "local-remote" switch must be blocked in the position which disables remote operation. The Switching Supervisor will notify the SCADA systems operator when work is complete and remote operation is safe. **(T-1)**. These switching and blocking procedures are only used only when following an approved AF Form 269 for primary distribution.

**4.3. Tagging Procedures.** "Tagging" is placing an appropriate tag directly on the circuit opening device. Apply tags and lock out the energy control device to ensure safety and prevent unauthorized personnel from altering device positions. A qualified technician will place danger tags in a conspicuous place upon opening a switch, disconnects, cutouts, primary jumpers, or breakers, before beginning work on a line or equipment. **(T-0)**.

**4.4. Underground Distribution Systems.** A qualified technician will block the switch mechanically and lock and tag the handle on underground distribution systems when it is not practical to provide a visible line break. **(T-1)**. A qualified technician will always use AF Form 979; AF Form 980, *Caution Tag*; and AF Form 982 under a safe clearance (AF Form 269), except when working on secondary lines or equipment. **(T-1)**. A qualified technician will not use AF Form 269 when applying AF Forms 979, 980, and 982 on secondary lines or equipment. **(T-1)**.

**4.5. Grounding Lines and Equipment.** Before touching for work, always check all de-energized transmission and distribution lines and equipment by testing for voltage. Confirm lines are grounded. Treat all lines which are not grounded as energized. For definitions of transmission and distribution voltages, see Attachment 1.

## Chapter 5

### ENERGIZED CIRCUITS

**5.1. Energized Circuits.** When energized work is deemed absolutely necessary, and approved by the BCE or equivalent, supervisors must ensure it is accomplished with extreme caution and only when the basic energized work procedures listed in the following paragraphs are followed and reviewed with all personnel immediately before starting. **(T-1)**. Furthermore, if any potential environmental, safety and health, operational, fiscal, or mission risks are associated with working on energized circuits, the BCE must notify and consult with the base/wing Staff Judge Advocate. **(T-1)**. Such risks may also create potential legal liabilities for the Air Force and Air Force personnel.

**5.2. Electrical Hand Holes.** Work on or near energized electrical lines in hand hole enclosures sized to allow personnel to reach into, but not enter, for the purpose of installing, operating, or maintaining equipment or wiring or both is prohibited because the available working space is too small for safe work practices. Supervisors must ensure all hand hole electrical circuits are completely de-energized before starting any troubleshooting, maintenance, or repair action within the hand hole. **(T-1)**.

**5.3. Low Voltage Electrical Panels.** Conventional circuit de-energizing/re-energizing methods (i.e., turning off/on a switch, opening and closing switches, or operating circuit breakers/disconnects) for the purpose of controlling an entire circuit is not considered performing "energized work" however, supervisors must ensure the PPE requirements of UFC 3-560-01. **(T-0)**. On a case-by-case basis, the BCE can grant written approval to waive the usage of the 8 Cal/cm<sup>2</sup> overall requirement if a qualified electrical engineer has verified that the panel meets the parameters of Table 4-2 to include all notes, and panel maintenance per NFPA 70E, Article 225, has been performed and documented.

**5.4. Electrical Manholes Containing Low-Voltage Circuits.** Electrical manholes containing low voltage are considered Permit Required. Work on or near energized electrical equipment in manholes containing low-voltage circuits is prohibited because of high arc flash currents for secondary circuits downstream of distribution transformers. Supervisors must ensure manholes that contain distribution voltage but also share space for low-voltage electrical circuits are also completely de-energized before starting any troubleshooting, maintenance, or repair actions. **(T1)**.

**5.5. Electrical Work Not In Manholes or Hand holes.** Work on or near energized electrical equipment is prohibited except in rare circumstances and then only when approved by the BCE or equivalent in accordance with the procedures outlined in the following paragraphs. Authorization is not required for tasks such as voltage measurement on circuits operating less than 600V as long as maintenance or repair is not performed, and safe practices and appropriate PPE are used. Safe practices and appropriate PPE are determined by the qualified site supervisor who must follow applicable UFC, and NFPA 70E, Article 130 guidance. **(T-0)**.

5.5.1. The BCE must approve energized work in advance. **(T-0)**. Prepare an AF Form 1213, Civil Engineer Energized Electrical Work Permit in accordance with UFC 3-560-01 and also include an emergency egress plan in the event of an emergency. The AF Form 1213 helps to ensure a qualified site supervisor has the information to ensure all work performed on or near

energized lines greater than 600V is based upon a risk management (RM) analysis in accordance with AFPAM 90-803, *Risk Management (RM) Guidelines and Tools* and has been coordinated through the operations flight chief. A qualified site supervisor must deliver the final signed AF Form 1213 to the foreman/acting foreman or NCOIC of the electric shop to retain for a period of one year following completion of work. **(T-0)**.

5.5.2. Per UFC 3-560-01, energized work performed must be under the direct supervision of a qualified work leader devoting full time and attention to the workers and the safety of their work. **(T-0)**. A qualified site supervisor must ensure two-person teams are used to perform the work. **(T-0)**. The Safety observer must be trained in CPR. **(T-0)**.

5.5.3. A qualified supervisor must be consulted and approve any plan to work on energized equipment and ensure proper use of PPE. **(T-0)**.

5.5.4. Place special emphasis on PPE and appropriate supervision. Proper supervision, training, and planning are paramount to ensure safety.

5.5.5. For work on or near energized distribution voltage greater than 600V while the job is in progress, an on-site supervisor must closely supervise the workers, checking them constantly to make sure they are in safe working positions, handling tools safely, and complying with the energized work permit. **(T-0)**.

**5.6. Electrical Work in Manholes Containing Distribution Voltage.** Electrical manholes containing distribution voltage are considered Permit Required. Work on or near energized electrical equipment in manholes is extremely dangerous and prohibited except when justified and approved in accordance with the following paragraphs. Before entering a manhole containing distribution-voltage energized circuits, first visually confirm the manhole's installed configuration allows entry without disturbing any installed conductors or equipment. If it is not possible to enter the manhole without disturbing conductors, or if it is not possible to move around inside the manhole without disturbing conductors (adequate working space), then all circuits inside the manhole are de-energized before entry. The foreman/acting foreman or NCOIC of the electric shop must make the assessment regarding safe entry. **(T1)**.

**5.6.1. Inspection-Only Access in Manholes Containing Energized Circuits with No Known Problems.** Inspection-type work can be authorized in accordance with the following paragraphs and is limited to allow a qualified employee to enter a manhole where energized cables or equipment are in service for the purpose of inspection, housekeeping, taking readings, or similar work, if such work can be performed safely. Safely entering a manhole for this purpose requires wear of minimum Arc Flash PPE Category 2 arc flash PPE (NFPA 70E) and compliance with other confined space requirements in AFI 91-203, **Chapter 23**. "Inspection-only access" must be approved by the foreman/acting foreman or NCOIC of the electric shop. **(T-1)**. Up to one-half (0.5) inch of standing water is permitted for inspection activities so long as no conductors are present in the standing water. Qualified technicians must ensure measurements are taken with a non-conductive instrument from outside the manhole/hand hole. **(T-0)**. The energized work permit for "inspection-only access" can be discarded after the activity is complete.

5.6.1.1. Entering a manhole safely for the purpose of examining insulated cable, equipment, or accomplishing other inspections not requiring touching or disturbing the energized conductors or equipment is permitted, but requires wear of minimum Arc Flash

PPE Category 2 arc flash PPE (NFPA 70E) and compliance with other confined space requirements AFI 91-203, [Chapter 23](#).

5.6.1.2. A minimum of three qualified persons is necessary for this activity. Qualification requirements are specified in UFC 3-560-01.

5.6.1.3. Supervisors will prepare an energized work permit in advance in accordance with UFC 3560-01, and also include an emergency egress plan in the event of an emergency. **(T-0)**.

**5.6.2. Work Inside Manholes Containing Energized Circuits.** Electrical manholes containing energized circuits are considered Permit Required. Work other than inspection-only can be authorized in manholes that have a minimum of four (4) feet of working clearance in accordance with the following paragraphs, but is limited to: removing conduit plugs; spare conduit inspection using fish tape; boroscope or other devices; splicing de-energized conductors; pulling new conductors in spare conduits; removing abandoned (de-energized) circuits, including load break or dead break elbows if nearby energized circuits are not disturbed. Re-racking energized conductors is not permitted. The circuits are de-energized before the conductors can be disturbed. Accomplishing this work when standing water is in the manhole is not permitted.

5.6.2.1. The BCE must approve energized work in advance. **(T-0)**. Prepare an energized work permit in accordance with UFC 3-560-01 and also include an emergency egress plan in the event of an emergency. The operations flight chief must ensure “Work performed inside a manhole containing energized circuits” is accomplished based upon a risk management (RM) analysis in accordance with AFPAM 90-803, *Risk Management (RM) Guidelines and Tools* and coordinated through the operations flight chief. **(T-1)**. The RM analysis must be kept with the energized work permit and retained by the chief of the electrical shop retains for a period of one year following completion of work. **(T-1)**.

5.6.2.2. A minimum of three qualified persons is necessary for this activity. Qualification requirements are specified in UFC 3-560-01.

5.6.2.3. Supervisors will prepare an energized work permit in advance in accordance with UFC 3560-01, and also include an emergency egress plan in the event of an emergency. **(T-0)**.

**5.6.3. All Other Work Inside Manholes Containing Energized Circuits.** Accomplishing this work where there is standing water in the manhole is not permitted. All other work in manholes containing energized circuits is considered Permit Required.

5.6.3.1. The BCE must approve energized work in advance. **(T-0)**. Prepare an energized work permit in accordance with UFC 3-560-01 and also include an emergency egress plan in the event of an emergency. **(T-0)**. The operations flight chief must ensure “All other work performed inside a manhole containing energized circuits” is accomplished based upon a risk management (RM) analysis in accordance with AFPAM 90-803, *Risk Management (RM) Guidelines and Tools* and coordinated through the operations flight chief. **(T-1)**. The RM analysis must be kept with the energized work permit and retained by the chief of the electrical shop retains for a period of one year following completion of work. **(T-1)**.

5.6.3.2. Provide an information copy of signed energized work permit and RM analysis to the Air Force Civil Engineer Center, Mechanical/Electrical Engineering Division [AFCEC/COSM].

5.6.3.3. Electrical analysis software packages that perform arc flash calculations do not account for an electrical manhole configuration in which the electrical worker is inside an enclosed area rather than standing adjacent to an enclosure. Increase the arc flash PPE requirements by a minimum of one (1) arc flash PPE category above the arc flash calculation result per UFC 3-560-01.

5.6.3.4. A minimum of three qualified persons is necessary for this activity. Qualification requirements are specified in UFC 3-560-01.

**5.7. Electrical Manholes Containing Transmission-Voltage Circuits.** Work on or near energized electrical equipment in manholes containing transmission-voltage circuits is prohibited. Electrical work in manholes containing transmission voltage circuits using the procedures in the next sentence is considered Permit Required. A qualified technician must ensure all manhole electrical circuits are completely de-energized before starting any troubleshooting, maintenance, or repair action within the manhole. **(T-1)**.

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**Attachment 1****GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

*AFPD 32-10, Installations and Facilities*

*AFPD 33-3, Information Management*

*AFI 32-7042, Waste Management*

*AFI 33-360, Publications and Forms Management*

*AFI 91-202, The US Air Force Mishap Prevention Program*

*AFI 91-203, Air Force Consolidated Occupational Safety Instruction*

*AFI 91-204, Safety Investigation and Reports*

*AFI 90-821, HAZCOM Program*

*AFMAN 33-363, Management of Records*

*AFPAM 90-803, Risk Management (RM) Guidelines and Tools*

*ANSI/ASTM D120, Standard Specification for Rubber Insulating Gloves*

*ANSI/ASTM D178, Standard Specification for Rubber Insulating Matting*

*ANSI/ASTM D1048, Standard Specification for Rubber Insulating Blankets*

*ANSI/ASTM D1049, Standard Specification for Rubber Insulating Covers*

*ANSI/ASTM D1050, Standard Specification for Rubber Insulating Line Hose*

*ANSI/ASTM D1051, Standard Specification for Rubber Insulating Sleeves*

*ANSI/ASTM F478, Standard Specification for Inservice Care of Insulating Line Hose and Covers*

*ANSI/ASTM F496, Standard Specification for Inservice Care of Insulating Gloves and Sleeves*

*ANSI/ISEA Z89.1, American National Standard for Industrial Head Protection*

*29 CFR 1910, Code of Federal Regulations Occupational Safety and Health Standards*

*29 CFR 1926, Safety and Health Regulations for Construction, subpart AA*

*40 CFR 761, Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*

*ETL 11-1, Civil Engineering Industrial Control System Information Assurance Compliance*

*ETL 13-4, Emergency and Standby Generator Maintenance and Testing Criteria*

*NFPA 70, National Electric Code®*

*NFPA 70E, Standard for Electrical Safety in the Workplace®*

*UFC 3-550-01, Exterior Electrical Power Distribution*

*UFC 3-560-01, Electrical Safety, O&M*



***Prescribed Forms***

AF Form 269, *Electrical Facilities Safe Clearance*

AF Form 1213, *Civil Engineer Energized Electrical Work Permit*

***Adopted Forms***

AF Form 55, *Employee Safety and Health Record*

AF Form 979, *Danger Tag*

AF Form 980, *Caution Tag*

AF Form 982, *Danger Tag: Do Not Start*

AF Form 983, *Danger Tag: Equipment Lockout Tag*

***Abbreviations and Acronyms***

**ABU**—Airman Battle Uniform

**AFCEC/CO**—Air Force Civil Engineer Center Operations Directorate

**AFCEC/COSM**—Air Force Civil Engineer Center, Operations Directorate, Engineer Division, Mechanical/Electrical Branch

**AFI**—Air Force Instruction

**AFMAN**—Air Force Manual

**AFPAM**—Air Force Pamphlet

**AFPD**—Air Force Policy Directive

**AFRC**—Air Force Reserve Command

**AFUB**—Air Force Uniform Board

**ANG**—Air National Guard

**ANSI**—American National Standards Institute **BCE**—base civil engineer

**ASTM**—American Society for Testing and Materials

**ATPV**—arc thermal performance value

**BCE**—Base Civil Engineer

**CE**—civil engineer

**cm<sup>2</sup>**—square centimeter

**CPR**—cardiopulmonary resuscitation

**EH**—electrical hazard

**EPA**—Environmental Protection Agency

**ETL**—Engineering Technical Letter

**HQ AFSEC/SEGS**—Headquarters Air Force Safety Center, Engineering and Standards Branch

**ISEA**—Industrial Safety Equipment Association

**J**—joule

**kV**—kilovolt

**LOTO**—Lockout/Tagout

**MAJCOM**—Major Command

**NEC**—National Electric Code

**NESC**—National Electric Safety Code

**NFPA**—National Fire Protection Agency

**O&M**—operation and maintenance

**OCP**—Operational Camouflage Pattern

**OPR**—office of primary responsibility

**RM**—risk management

**OSHA**—Occupational Safety and Health Administration

**PCB**—polychlorinated biphenyls

**PPE**—personal protective equipment

**RDS**—Records Disposition Schedule

**RM**—risk management

**RMS**—root mean square

**SCADA**—Supervisory Control and Data Acquisition

**SDS**—Safety Data Sheets

**UFC**—Unified Facilities Criteria

**V**—volt

### *Terms*

**Approved**—Sanctioned, endorsed, accredited, certified, or accepted as satisfactory by a duly constituted and nationally recognized authority or agency.

**Authorized Person**—A person approved or assigned by a supervisor to perform a specific duty or duties or to be at a specific location or locations at the job site.

**Blocking**—Placing a switch in the open or closed position and mechanically ensuring the position of the switch cannot be accidentally changed.

**Cable**—A conductor with insulation or a stranded conductor with or without insulation and other coverings (single conductor cable or a combination of conductors) insulated from one another (multiple conductor cable). NOTE: A cable sheath may consist of multiple layers of which one or more are conductive.

**Cardiopulmonary Resuscitation (CPR)**—An emergency medical procedure that includes opening and maintaining an airway, providing ventilation through rescue breathing, and providing artificial circulation through the use of external cardiac compression.

**Certified or Certification**—The accomplishment of curriculum as specified in this instruction.

**Circuit**—For purposes of this instruction, a conductor or system of conductors through which an electric current is intended to flow.

**Circuit Breaker**—A device to open and close a circuit and to open the circuit automatically at a predetermined overload of current, without injury to itself, when properly applied within its rating.

**Conductor**—Material (typically a wire, cable, or bus bar) for carrying an electric current.

**Note: This term is used only in reference to current**—carrying parts that are sometimes alive (energized).

**Confined Space**—A space large enough and configured so a worker can bodily enter and perform assigned work; has limited or restricted means for entry or exit (for example: tanks, vessels, silos, storage bins, hoppers, vaults, manholes and pits); and is not designed for continuous human occupancy.

**Energized**—Electrically connected to or having a source of voltage.

**Equipment**—General term which includes fittings, devices, appliances, fixtures, apparatus, and like items used as part of, or in connection with, an electrical power transmission and distribution system, or communication systems. Equipment also includes but is not limited to the 4 following ancillary equipment sets:

1. Equipment - Climbing. Includes body belts, safety and climber straps, climbers and ladders.
2. Equipment - Electrical Inspecting and Testing. Electrical and mechanical devices such as voltmeters, ammeters, ohmmeters, phase meters, and similar devices.
3. Mobile and Portable - Large Equipment. Relatively large equipment items easily transported for maintenance, including line trucks, aerial lift trucks, motor-generator sets, pole hole diggers, and similar apparatus.
4. Equipment - Protective. Includes rubber gloves, line hose, matting, blankets, insulator hoods, and sleeves, in addition to barricades and warning devices.

**Limited Approach Boundary**—An approach limit at a distance from an exposed live part within which a shock hazard exists.

**Live (Energized) (Parts)**—Energized conductive components. Electrically connected to a source of potential difference or electrically charged to have a potential significantly difference from the earth in the vicinity. The term "live" is sometimes used in place of the term "current carrying" where the intent is clear to avoid repetition of the longer term.

**Live Line (Hotline) Work**—Maintenance of energized high voltage electrical conductors or equipment using approved hotline tools and rubber protective goods.

**Mishap**—An unplanned or unsought event or series of events that results in death, injury, or occupational illness or damage to or loss of equipment or property.

**Non-Permit Confined Space**—A space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazards capable of causing death or serious physical harm

**Permit-Required Confined Space**—A confined space that has one or more of the following characteristics: contains or has a potential to contain a hazardous atmosphere; contains a material that has the potential for engulfing the entrant; has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; or contains any other recognized serious safety or health hazard.

**Qualified**—A person who has the skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.

**Supervisor**—Refers to the supervisor of "employees or workers" as used in this instruction. Generally includes the supervisor responsible for exterior electrical systems, the zone supervisor or foreman, and the infrastructure support element supervisor. Titles are necessary to assign specific responsibilities to a specific individual.

**Switch**—A device for opening and closing or changing the connection of a circuit. In this instruction, the term is generic for all oil circuit breakers, air switches, network protectors, disconnects (either fusible or plain), hot clamps, and other devices which open an electrical circuit.

**Tag**—A system or method of identifying circuits, systems, or equipment being worked on.

**Tagging**—Placing a safety tag directly on a circuit opening device or equipment for additional safety to ensure it is not used or its position altered.

**Tags**—Temporary signs (usually attached to a piece of equipment or part of a structure) to warn of existing or immediate danger.

**Voltage**—The effective root mean square (RMS) potential difference between any two conductors or between a conductor and ground. Voltages are usually listed as nominal values. The nominal voltage of a system or circuit is the value assigned to a system or circuit of a given voltage class to provide a convenient nomenclature. The operating voltage of the system may vary above or below this value.

1. Low Voltage. Lines and equipment operating at and below 600 V (nominal phase-to-phase).
2. High Voltage. Lines and equipment operating above 600 V (nominal phase-to-phase).
3. Secondary Voltage. Lines and equipment operating at and below 600 V (nominal phase-to-phase).
4. Distribution Voltage. Lines and equipment operating above 600 V (nominal phase-to-phase) up to and including 36 kV (nominal phase-to-phase).

5. Transmission Voltage. Lines and equipment operating above 36 kV (nominal phase-to-phase).

**Working Near (Live Parts)**—Any activity inside a Limited Approach Boundary.

**Working On (Live Parts)**—Coming in contact with live parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the PPE a person is wearing.

## Attachment 2

### REQUIREMENTS FOR WEAR OF MILITARY UNIFORMS WITH ARC THERMAL PERFORMANCE VALUE (ATPV) RATED PERSONAL PROTECTIVE EQUIPMENT (PPE)

**A2.1.** 3E0X1, 3E0X2, 3E1X1 and 3E4X1 personnel must comply with the following PPE and uniform requirements while working on or near energized circuits: **(T-0)**

A2.1.1. Routine Electrical Work not Classified. The following PPE and uniform must be worn when performing Hazard/Risk Category 0 tasks:

A2.1.1.1. Safety glasses (ANSI Z87.1) with side shields or safety goggles (ANSI Z87.1) must be worn over metal frame and non-safety glasses.

A2.1.1.2. 100% cotton or natural fiber underwear (conventional short sleeve t-shirt and briefs/shorts) must be worn next to the body. T-shirts must not have any organizational or other insignias.

A2.1.1.3. Personnel must wear one of the following uniforms: **(T-0)**.

A2.1.1.3.1. NFPA-compliant 100% cotton ABU with sleeves rolled down.

**Note:** ATPV-protective clothing is not required when wearing AFUB NFPA-compliant 100% cotton Airman Battle Uniform (ABU) while performing Hazard/Risk Category 0 tasks.

A2.1.1.3.2. 50% nylon/50% cotton ABU or Operational Camouflage Pattern (OCP) uniform and ATPV-rated protective shirt (long-sleeve) and pants (or ATPV-rated protective coveralls) with minimum arc rating of 8 cal/cm<sup>2</sup> (33.47 J/cm<sup>2</sup>)

**Note:** When the 50% nylon/50% cotton ABU or OCP uniform is worn, the blouse must be removed before donning the ATPV protective clothing.

A2.1.1.4. Review NFPA 70E and UFC 3-560-01 for tasks requiring voltage-rated gloves with leather protectors.

A2.1.1.5. Electrical hazard-rated (EH) work shoes/boots.

A2.1.2. Hazard/Risk Categories 1 and 2. Personnel must wear the following PPE and uniform when performing Hazard/Risk Category 1 and Category 2 tasks: **(T-0)**.

A2.1.2.1. Safety glasses (ANSI Z87.1) with side shields, or safety goggles (ANSI Z87.1) worn over metal frame and non-safety glasses.

A2.1.2.2. Hearing protection using ear-canal inserts whenever working within the arc flash boundary.

A2.1.2.3. Balaclava/sock with minimum arc rating of 8 cal/cm<sup>2</sup> (33.47 J/cm<sup>2</sup>)

A2.1.2.4. Hard hat (ISEA Z89.1 Type 1 Class E approved). Long hair must be secured under the hard hat. For cold weather operations, insulated hard hat liner must be arc rated.

A2.1.2.5. Face shield with minimum arc rating of 8 cal/cm<sup>2</sup> (33.47 J/cm<sup>2</sup>) and wrap-around guarding to protect the face, forehead, ears, and neck.

A2.1.2.6. One-hundred percent (100%) cotton or natural fiber underwear (conventional short sleeve t-shirt and briefs/shorts) must be worn next to the body. T-shirts must not have any organizational or other insignias.

A2.1.2.7. NFPA-compliant 100% cotton ABU, 100% cotton coverall, OCP uniform or 50% nylon/50% cotton ABU.

**Note:** If the 50% nylon/50% cotton ABU or OCP uniform is worn, the blouse must be removed before donning the ATPV-protective clothing in paragraph A2.1.2.8.

A2.1.2.8. ATPV-rated protective shirt (long-sleeve) and pants (or ATPV-rated protective coveralls) with minimum arc rating of 8 cal/cm<sup>2</sup> (33.47 J/cm<sup>2</sup>).

A2.1.2.9. Leather work gloves or voltage-rated gloves with leather protectors, used in accordance with NFPA 70E and UFC 3-560-01.

**Note:** Do not use voltage-rated gloves and their leather protectors as work gloves.

A2.1.2.10. EH-rated work shoes/boots.

**A2.2.** The 3E0X1 Air Force specialty is the only authorized civil engineer specialty to work on or near energized Hazard/Risk Category 3-4 circuits. 3E0X1 personnel must comply with the following PPE and uniform requirements while working on or near these circuits: **(T-0)**

A2.2.1. Follow NFPA 70E and UFC 3-560-01.

A2.2.2. NFPA-compliant 100% cotton ABUs or 100% cotton coveralls.

**A2.3.** Base Civil Engineers (BCE) must strictly enforce the wear of ATPV-rated PPE for all civil engineer personnel working on or near energized electrical circuits. BCEs must develop written policy outlining procurement and funding of NFPA-compliant 100% cotton ABUs or 100% cotton coveralls for the 3E0X1 Air Force specialty. NFPA-compliant 100% cotton ABUs are still authorized wear for the 3E0X2, 3E1X1 and 3E4X1 Air Force specialties, but not mandated.

**A2.4.** Civilian personnel will continue to follow requirements outlined in NFPA 70E and UFC 3-560-01. **(T-0)**.

**Table A2.1. Personnel must comply with the below PPE and Uniform Item Requirements (T-0):**

Hazard/Risk Category	Uniform	Hard Hat	Hearing Protection	Safety Glasses or Goggles	Leather Work Gloves	100% Cotton Or Natural Fiber Under Shirt/Wear	EH rated Footwear	Balaclava/Sock	Face Shield	Voltage Rated Gloves	8 cal/cm <sup>2</sup> ppe	25 cal/cm <sup>2</sup> ppe w/Flash Suit Hood	40 cal/cm <sup>2</sup> PPE Multilayer Flash Suit & Flash Suit Hood
Routine Electrical Work not Classified	100% Cotton ABU <sup>1</sup> (Coverall)			X		X	X			3			
	50/50 Blend ABU <sup>2</sup> or OCP Uniform <sup>2</sup>			X		X	X			3	X		
1 & 2	100% Cotton ABU <sup>1</sup> (Coverall) or 50/50 Blend ABU <sup>2</sup> or OCP Uniform <sup>2</sup>	X	X	X	X	X	X	X	X	3	X		
3	100% Cotton ABU <sup>1</sup> (Coverall)	X	X	X	X	X	X			3		X	
4	100% Cotton ABU <sup>1</sup> (Coverall)	X	X	X	X	X	X			3			X

**Notes:**

1. When wearing the 100% cotton ABU (coverall), sleeves must be rolled down.
2. When wearing the 50/50 blend ABU or OCP uniform, the blouse must be removed.
3. Voltage rated gloves with leather protectors must be worn in accordance with NFPA 70E and UFC 3-560-01.