Department of Veterans Affairs **VHA DIRECTIVE 1028**
Veterans Health Administration **Transmittal Sheet**
Washington, DC 20420 **July 25, 2014**

ELECTRICAL POWER DISTRIBUTION SYSTEMS

1. REASON FOR ISSUE: This Veterans Health Administration (VHA) Directive establishes policy regarding the installation, operation, testing, and maintenance of Electrical Power Distribution Systems at VA medical facilities.

2. SUMMARY OF MAJOR CHANGES References and responsibilities have been updated.

3. RELATED ISSUES: VHA Handbook 7701.01.

4. RESPONSIBLE OFFICE: The Office of Capital Asset Management, Engineering and Support (OCAMES) (10NA5), Senior Electrical Engineer, is responsible for the content of this Directive. Questions may be referred to 402-599-2104.

5. RESCISSIONS: VHA Directive 2006-056, Electrical Power Distribution System, dated October 16, 2006, is rescinded.

6. RECERTIFICATION: This VHA Directive is scheduled for recertification on or before the last working day of July 2019.

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DISTRIBUTION: Emailed to the VHA Publications Distribution List 07/28/2014**.**

ELECTRICAL POWER DISTRIBUTION SYSTEMS

1. PURPOSE: This Veterans Health Administration (VHA) Directive provides policy regarding the installation, operation, testing, and maintenance of Electrical Power Distribution Systems at VA medical facilities. **AUTHORITY:** 29 U.S.C. 655.

2. BACKGROUND:

a. VHA and The Joint Commission have adopted the National Fire Protection Association (NFPA) codes and standards including the National Electrical Code (NFPA 70), Recommended Practice for Electrical Equipment Maintenance (NFPA 70B), Standard for Electrical Safety in the Workplace (NFPA 70E), Health Care Facilities Code (NFPA 99), Life Safety Code (NFPA 101) and Standard for Emergency and Standby Power Systems (NFPA 110) as the basis for the requirements of the design, installation, operation, testing, and maintenance of the Electrical Power Distribution System at VHA facilities.

b. The Joint Commission's Environment of Care (EC) standards require written Utility Management Plans. The Utility Management Plan must ensure reliability, control risks, reduce failures, and train users and operators of the Electrical Power Distribution System.

c. Occupational Safety and Health Requirements (OSHA) Part 1910 Subpart J, The control of hazardous energy (lockout/tagout) (1910.147); Occupational Safety and Health Requirements Part 1910 Subpart S , Electrical (1910.301-1910.399); and Safety and Health Regulations for Construction Part 1926 Subpart K, Electrical (1926.400-1926.449) apply.

d. Working on energized electrical equipment is inherently dangerous to patients, staff, visitors, and VHA property. Such actions, if unplanned or poorly executed, can result in disruption of operations, injuries, loss of life and/or loss of property.

3. POLICY: It is VHA policy that the Electrical Power Distribution System must operate in a safe, reliable, and efficient manner, recognizing its importance and potential danger; and in compliance with The Joint Commission, OSHA, and NFPA electrical standards.

4. RESPONSIBILITIES:

a. **Veterans Integrated Service Network Director.** The Veteran Integrated Service Network (VISN) Director is responsible for ensuring that:

(1) The installation, operation, testing, and maintenance of Electrical Power Distribution Systems meet or exceed The Joint Commission, NFPA, and other applicable requirements;

(2) That all work on this system complies with OSHA and NFPA standards; and

(3) Appropriate resources are provided to each medical facility in order to ensure compliance. To ensure each subordinate VA medical facility is in compliance with this Directive, the VISN Director must:

(a) Delegate review and interpretation of electrical power system documentation, including

tracking of status reports regarding the installation, operation, testing, and maintenance of Electrical Power Distribution Systems within the Network to a qualified member of the VISN staff.

(b) Conduct a status verification survey annually on or before May 1st using the survey tool found on the VHA Center for Engineering and Occupational Safety and Health (CEOSH) website at: (http://vaww.ceosh.med.va.gov/OnlineSurveys/Scripts/ezs.exe?DATABASE=ElectDirComp&ACTION=START). *NOTE: This is an internal Web site and is not available to the public.*

b. **Medical Facility Director.**

(1) The medical facility Director is accountable to the VISN Director for ensuring that the installation, operation, testing, and maintenance of Electrical Power Distribution Systems meets or exceeds The Joint Commission, NFPA, and other applicable requirements; and that all work on this system complies with OSHA and NFPA standards.

(2) The medical facility Director is responsible for ensuring:

(a) Appropriate resources (funds, equipment and qualified personnel) are allocated in order to achieve compliance;

(b) Only qualified senior staff at the facility and/or qualified electrical contract professionals are authorized to execute any design, installation, operation, testing, and maintenance of the Electrical Power Distribution System in accordance with The Joint Commission and NFPA requirements and that all work on these systems is compliant with OSHA standards;

(c) Appropriate actions are taken to correct deficiencies found in the Electrical Power Distribution System;

(d) All electrical work is executed with all proximate energized circuits de-energized. The Process of Achieving an Electrically Safe Work Condition as prescribed in NFPA 70E shall be followed to ensure electrical equipment is de-energized. It is the intent of this directive to make planned electrical system shutdowns for maintenance/repair the standard operating procedure, not the exception;

(e) If work on energized electrical system components cannot be avoided, a management system is developed and implemented so that work on energized equipment does not take place without the medical facility Director's prior knowledge and approval; and

(f) Written procedures are established to prepare the medical center for a planned electrical outage. The procedures must take into account the worst case of risk to patients, staff, visitors, and VHA property. When a planned electrical outage cannot be accomplished, the following requirements are mandatory for working on energized circuit:

1. Full and proper personal protective equipment (PPE) is available and worn by the qualified persons performing the work. PPE shall include, but not be limited to, appropriate clothing, eye protection, face protection, hearing protection, gloves, certified and tested

insulating material to cover exposed energized electrical components, and certified and tested insulated tools. ***NOTE:*** *Refer to the NFPA 70E, and General Safety Guidebook for guidance on the appropriate PPE.*

2. Qualified persons (e.g. electricians) are provided with the appropriate PPE, including arc-rated (AR) clothing. The appropriate PPE is to be determined in accordance with requirements of NFPA 70E which include assessment of the voltage, incident energy and hazard risk category.

3. Before initiating work, a specific work plan is developed and a peer review of the plan documented.

a. The work plan must include: procedures to be used on and near the energized electrical equipment, barriers to be installed, safety equipment to be provided, and exit paths to be accessed.

b. Energized work is only to be accomplished by Qualified Persons as defined in NFPA 70E. As noted therein, qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present. The employer is required to document that each qualified person has received such training.

c. An Energized Electrical Work Permit must be obtained from the appropriate Office (typically within Engineering or Safety service). The Energized Electrical Work Permit shall include *Elements of Work Permit* identified in NFPA 70E.

d. Any energized electrical work plan must have the prior knowledge and approval of the medical facility Director. However, the Chief of Engineering Service may approve energized electrical work plan for Branch Circuits (i.e., those circuits and components thereof from the final overcurrent protecting devices to the outlets) that do not serve the critical patient care areas, such as Surgery Rooms, Critical Care, Intensive Care, Dialysis Units, Isolation Rooms, Catheterization Laboratories, Emergency Rooms, or Sterile Processing Areas.

(3) A Utility Systems Management Plan is developed which meets, or exceeds The Joint Commission, OSHA, and NFPA requirements and is approved by the Department of Veterans Affairs (VA) medical facility EC committee and/or medical facility Director.

(4) Arc flash and shock hazards are analyzed, to include the following:

(a) A shock hazard analysis must be performed to determine the voltage(s) to which personnel will be exposed, boundary requirements, and the PPE necessary to minimize the possibility of electrical shock to personnel.

(b) An arc flash hazard analysis determines the arc flash protection boundary and the PPE required for employee protection with within the arc flash protection boundary.

(c) The shock hazard and arc flash hazard analyses, along with any subsequent system labeling or output reports, must comply with the requirements outlined in NFPA 70E and

Institute of Electrical and Electronics Engineers (IEEE) Standard 1584. The preceding analyses, labeling and reports must be updated regularly to ensure accuracy and reflect current facility conditions, including additions, upgrades and other changes that occurred following completion of the previous analyses.

(5) The Electrical Power Distribution System is supplied by a source of power from the Utility Power Company (UPC). A second independent source from the UPC, referred to as utility redundant feed, should be considered only when utility power reliability is proven to be questionable or it can be justified as cost effective.

(6) Where there are two sources of power supplies (Primary and Redundant Feeds) coming from the UPC, a test is coordinated with the UPC to maintain the tie-circuit breaker, or transfer switch for such system every 36-months.

(7) Where required by NFPA 70, NFPA 99, or NFPA 101, an Essential Electrical System (EES) is provided for each building; it must include the following:

(a) EES must consist of an alternate source of power, all connected electrical power distribution systems, and ancillary equipment

(b) The EES must have a minimum of two independent sources of power: a normal source generally supplying electrical power to the entire Electrical Power Distribution System, and one or more alternate sources for use when the normal source of power is interrupted. The alternate source must be one or more emergency generator(s) located on the facility property. ***NOTE:*** *When the alternate source requirements are sufficiently small, a stored energy (battery) supplied source may be considered.*

(8) The EES, including all related components, such as Automatic Transfer Switches and emergency generators, must be inspected weekly.

(9) The EES, including all related components, is exercised under load at least monthly, for a minimum of 30 minutes, in accordance with the requirements of NFPA 99 and NFPA 110.

(10) All risks to the patients, staff, visitors, and VHA property is mitigated with proper planning prior to any test of the EES and with safe execution during the test period. Individual medical facilities with a significant rate of key staff turnover, absence of key staff during the most recent test, significant incidents during the most recent test, significant modifications to the Electrical Power Distribution System, significant modifications or seasonal variation to the electrical loads, may consider more frequent testing of the EES.

(11) A test of the EES that lasts for 4 hours continuously should be planned and executed every 36 months, in accordance with the requirements of NFPA 99 and NFPA 110. This test must meet The Joint Commission requirements to be under load (dynamic or static) of at least 30 percent of the nameplate load. Locations at high altitude where generator capacity is to be derated, 30 percent of the derated generator capacity should be used (versus 30 percent of the nameplate value). ***NOTE:*** *The Joint Commission now requires a 4-hour generator test under load (dynamic or static) that is at least 30 percent of the nameplate rating of the generator once every 36 months. If a facility's generator requires an annual load bank to comply with*

EC.02.05.07 EP 5, it will also require a load bank every 36 months for 4 hours to comply with EC.02.05.07 EP 8. It is important to note the annual load bank only exceeds 30 percent for 1.5 hours.

(a)This test must meet two objectives:

1. EES Response a thorough test of the EES initiated by a loss of utility normal power.

2. Facility Staff Response a thorough test of the medical center staff's ability to operate while restricted only to the EES.

(b) This test requires coordination with the local UPC. The main electrical switch, owned by the local UPC that serves the medical facility, must be opened to simulate a total electrical power outage. This switch is to remain opened for a minimum of 4 hours continuously. During this time, the facility's staff must test, inspect, and record the operation of the EES, including all related components.

(c) Deficiencies found in the EES must be recorded promptly, and corrected in a timely manner.

(d) This test may be incorporated into the facility-wide disaster drills required by The Joint Commission. Moreover, an unscheduled facility power outage of at least 4 hours continuous duration may be documented and considered the equivalent of the EES test, providing that all requirements listed in subparagraph 4b(11)(b) are met.

(e) Testing, maintenance, and exercising of the EES, including all related components, must be executed to meet the requirements of NFPA 99 and NFPA 110, whichever is more stringent.

(12) Transformers, including all related components, are inspected, tested, and maintained every 36 months. The following is a minimum list of items to be inspected, tested, and maintained:

(a) Transformers of 500 Kilovolt-Amps (kVA) or larger must be cleaned exteriorly, inspected for signs of overheating with infra-red thermal detecting equipment, and inspected for any damage to the housing, connection points, or insulation.

(b) Liquid cooled transformers must have the cooling liquid tested and replaced, when tests indicate that the liquid no longer meets manufacturer's specification. The liquid must be re-filled to meet the manufacturer's specification.

(c) Dry type transformers must be thoroughly cleaned exteriorly, and inspected for overheating with infra-red thermal detecting equipment.

(13) Electrical equipment (including, but not limited to switchgears, switchboards, distribution panels, motor control centers, and all related components) is inspected, tested, maintained, and/or calibrated every 36 months, and all work must be documented. ***NOTE:*** *The National Electrical Testing Association (NETA) provides guidance which is considered best practice for the maintenance of electrical equipment; these practices should be followed to the extent possible.*

(a) Use lint-free rags to clean conductors, contact points between the circuit breakers and main buss bars, buss bars and interior of the electrical equipment. Use a vacuum cleaner to remove large debris; compressed air is not to be used for this purpose. Visually inspect for signs of overheating, misaligned contacts, damaged insulation, or lose lugs.

(b) Lubricate all moving parts with manufacturer's approved lubricants.

(c)Test and exercise circuit breakers located in switchgears, switchboard, and distribution panels to ensure operation under overload, and short circuit conditions. *NOTE: The following maintenance requirements, although not mandatory, are strongly encouraged: All molded case circuit breakers (frames size 225 amps or less) should be tested annually to determine if contacts open and reclose when breaker is manually tripped and restored. All panels are to be tested including emergency panels. If no failures are encountered and the test is fully documented, the interval between molded case breaker testing may be extended in 6-month increments, up to but not to exceed 36 months between successive tests.*

(d) Test ground fault protection devices for proper function if they are installed in the Electrical Power Distribution System.

(e) Inspect and tighten ground connections. Test ground resistance for the entire facility grounding system.

(f) Identify the hot spots in the electrical equipment by using infra-red thermal detecting equipment. Tighten problem connections to meet equipment manufacturers' specification using a torque wrench or other approved devices.

(g) Calibrate and maintain adjustable protective relays.

(h) Test all control systems equipment for proper operation after maintenance is performed and before placing them back in normal service.

(i) To ensure access is limited to qualified persons, electrical equipment is to be secured. For example, electrical panels located in corridors or other public areas are to be locked or otherwise secured.

NOTE: *Subparagraphs 4b (13) (c) through (h) are typically done by qualified electrical contract professionals who specialize in electrical testing. For the Statement of Work, go to the web site at: http://vaww.ceosh.med.va.gov/sow_ElectPowDistSysTesting.Doc . This is an internal Web site and is not available to the public.*

(14) All work related to the inspection, testing, maintenance, and calibration is documented, and filed appropriately with copies going to the respective VISN upon completion.

(a) As a minimum, a report of status indicating VA medical facilities are in compliance with the required maintenance and testing of the Electrical Power Distribution System (outlined in preceding subparagraph. 4b(1) thru b(16)) is submitted annually on or before the first day of May. This report must utilize the survey tool found on the CEOSH Website at: http://vaww.ceosh.med.va.gov/OnlineSurveys/Scripts/ezs.exe?DATABASE=ElectDirComp&_A

CTION=START ***NOTE:*** *This is an internal Web site and is not available to the public.*

(b) Compliance is assessed annually by each VA medical facility completing the web-based survey referenced in 4b(14)(a) no later than May 1st annually. This survey requires certification by the facility Chief Engineer and the medical facility Director.

5. REFERENCES:

a. NFPA 70, National Electrical Code, Latest Edition.

b. NFPA 70B, Recommended Practice for Electrical Equipment Maintenance, Latest Edition.

c. NFPA 70E, Standard for Electrical Safety in the Workplace, Latest Edition.

d. NFPA 99, Health Care Facilities Code, Latest Edition.

e. NFPA 101, Life Safety Code, Latest Edition.

f. NFPA 110, Standard for Emergency and Standby Power Systems, Latest Edition

g. The Joint Commission Accreditation Manual for Hospitals, Latest Edition.

h. OSHA - Occupational Safety and Health Requirements Part 1910 Subpart J - The control of hazardous energy (lockout/tagout) (1910.147).

i. OSHA - Occupational Safety and Health Requirements Part 1910 Subpart S - Electrical (1910.301 - 1910.399).

j. OSHA - Safety and Health Regulations for Construction Part 1926 Subpart K - Electrical (1926.400 - 1926.449).

k. Statement of Work : Maintenance and Testing of the Electrical Power Distribution System. Contracting Tools on the CEOSH Website at:

http://vaww.ceosh.med.va.gov/01HE/Pages/ST_electrical_distribution.shtml#Contracting.
NOTE: *This is an internal web site and is not available to the public.*

l. CEOSH. The General Safety Guidebook, Latest Edition at:
http://vaww.ceosh.med.va.gov/01HP/pages/guidebooks.shtml . *NOTE: This is an internal Web-site and is not available to the public.*

m. Institute of Electrical and Electronics Engineers (IEEE) Std 1584-2002, Guide for Performing Arc-Flash Hazard Calculations.