

Instruction Sheet

MS-28

Maintenance of Electrical Switchgear

TL-4:

MAY 10, 2011

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**Maintenance Series Handbook MS-28
Maintenance of Electrical Switchgear**

**Transmittal Letter 4
May 10, 2011**

A. Explanation

This Maintenance Series (MS) handbook supports the Maintenance of Electrical Switchgear and will be updated as future needs demand.

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A handwritten signature in black ink, appearing to read "Robert E. Albert".

Robert E. Albert
Manager



***Maintenance Series Handbook
MS-28***

Maintenance of Electrical Switchgear

TL-4: May 10, 2011

FRONT MATTER

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**CHAPTER 1
INTRODUCTION**

110 PURPOSE

111 Scope

This handbook contains information on safety practices and environmental considerations when working on switchgear, descriptions of typical classes of switchgear, and preventive and corrective maintenance guidelines for switchgear. Also, information is presented to assist local Postal Service personnel in establishing an effective preventive maintenance program for their facility. Since many facilities are not able to perform all required maintenance with local personnel, information is given in Statement of Work templates on what provisions should be considered in contracting for these services. The facility manager has ultimate responsibility for switchgear maintenance.

The information in this handbook will be used only by USPS personnel for ongoing training and performance of maintenance by career maintenance bargaining unit employees. Changes are not intended to remove any electrical work from the bargaining unit e.g. decrease staffing levels, nor to encourage or mandate subcontracting. A subcontracting decision must be made in accordance with Article 32 of the Collective Bargaining Agreement (CBA) and Section 530 of the Administrative Support Manual (ASM).

112 Types of Switchgear

This Handbook provides general guidelines for the proper maintenance of electrical switchgear used in postal facilities. Specific models of switchgear apparatus are not described in detail because of the large variety of models available. Rather, maintenance information is presented for five classes of switchgear equipment:

- a. Transformers
- b. Circuit Breakers
- c. Relays
- d. Connection Equipment
- e. Motor Starters 200 H.P. and above

113 Use

Postal Service installations range from the small facility with residential-type single-phase power to the very large facility with incoming service voltages at 13.8 kV (kilovolts) or higher and capabilities of over 1000 kVA (Kilovolt Amps). In any installation, the switchgear equipment is designed to trip or otherwise open the electrical circuits in the event of malfunction of connected equipment. This automatic disconnect function is required to protect the personnel, the postal facility, equipment, and the utility providing the electrical service. Naturally, larger facilities have the more elaborate and costly switchgear. However, to function properly when needed, all switchgear requires maintenance.

120 MAINTENANCE

121 Need for Maintenance

The Postal Service will ensure that electrical switchgear functions properly. Unreliable or inoperable protective devices are not suitable for use. These devices may result in damage to other equipment, fire, death, or injury to personnel. The increasing reliance of the Postal Service on automatic, electrically powered and controlled mail processing equipment requires a reliable electrical distribution system. Any serious power system failure in a Postal Service facility will significantly reduce the facility's ability to process mail.

122 Benefits of Maintenance

Only a program of electrical apparatus testing under simulated or actual operating conditions combined with regularly scheduled preventive maintenance will ensure the reliability of electrical switchgear. Conclusive electrical tests, properly applied, will determine if equipment is operating properly, if it needs repair, or if it should be replaced with newer apparatus.

Regularly scheduled preventive, predictive, and reliability centered maintenance has many benefits. It permits more than a routine inspection of equipment and allows time for more thorough maintenance to be performed. Equipment can be cleaned, inspected, lubricated, mechanically checked, and operated. Thorough maintenance results in improved system performance, higher reliability, and a reduction in the number of unexpected problems that can occur on poorly maintained equipment.

Properly planned component testing in coordination with scheduled maintenance ensures electrical protective devices operate as designed when a power anomaly occurs. Device testing should be completed using up-to-date industry processes and testing equipment.

123 Elements of an Effective Maintenance Program

A number of elements are required to establish and operate an effective maintenance program for electrical switchgear. These elements are:

- a. A thorough knowledge of the facility switchgear and distribution equipment and its characteristics, including one-line and control diagrams and assorted other documentation.
- b. Adequate familiarization training for employees operating electrical switchgear.
- c. Sufficient properly trained personnel to perform authorized maintenance tasks.
- d. Coordination between all functional areas within a facility, particularly in regard to scheduling of equipment down time.
- e. Proper equipment to perform all required tests, inspections, adjustments, cleaning, and repair associated with preventive, predictive, and reliability centered maintenance.
- f. Appropriate spare parts to accomplish repairs.
- g. A tracking system to schedule, report on, and control all switchgear maintenance activities.

124 Contract Maintenance

124.1 Need for Contract Maintenance

Many postal facilities, due to postal policy (above 600 volts), – may obtain switchgear maintenance service from outside contractors. If the facility cannot inspect, test, and maintain its vital switchgear electrical components, local management should contract this service to someone who can in accordance with Article 32 of the CBA and Section 530 of the ASM.

124.2 Contract Maintenance Requirements

Contract maintenance must be tailored to a particular facility. Some facilities may need a pre-site contract to validate or assemble up-to-date electrical switchgear inventories, one-line drawings, and short circuit, device evaluation, and coordination studies.

The contractor and qualified staff personnel should perform a preliminary survey of facility equipment to identify equipment inventory, interconnection wiring, and equipment needing maintenance or repair. The survey should list hazardous conditions and recommend preventive maintenance schedules.

Local management must determine what corrective, preventive, predictive, and reliability centered maintenance may be performed by the facility staff.

If needed, a maintenance contract should be initiated for scheduled testing, inspection, cleaning, and minor repair.

If needed, a contract should be initiated for assistance in repairing major failures and any problems identified during the preliminary survey or scheduled maintenance.

130 REFERENCE LIBRARY

The senior maintenance official of each postal facility should maintain an up-to-date electrical maintenance library to include but not be limited to the following:

- a. National Electrical Code (NEC) or National Fire Protection Agency (NFPA) 70 Handbook
- b. International Fire Protection Association (NFPA) standard 70B, Recommended Practice for Electrical Equipment Maintenance (available on USPS internal web server)
- c. Occupational Safety and Health Act of 1970 (OSHA)

The following reference materials are optional in the local electrical maintenance library:

- a. National Electrical Safety Code (American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE)
- b. International Electrical Testing Association of 2001 (or latest edition)
- c. Electrical Power Equipment Maintenance and Testing of 1998 by A. S. Gill (Marcel Dekker Inc. NY, NY)
- d. Standard for Electrical Safety in the Workplace (NFPA) 70E

In addition, the senior maintenance official shall provide each employee engaged in building electrical work access to a current copy of the NEC (available on USPS internal web server).

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**CHAPTER 2
SAFETY**

210 GENERAL

Because of the extremely dangerous voltages and currents present in electrical switchgear, precise attention must be paid to safety rules and proper working conditions, to protect both personnel and equipment. Normally, all maintenance work is performed only on completely deenergized equipment. However, under very special conditions, some work may be performed on energized equipment (see 232.1).

Prior to the commencement of any electrical switchgear activities, the use of USPS lockout procedures, Individual Personal Protective Equipment (PPE), Occupational Safety Health Act (OSHA) requirements, and other applicable safety procedures should be understood and in place. A walk-through procedure of switchgear activities must be established and reviewed.

220 QUALIFIED PERSONNEL

221 Maintenance

The senior maintenance official or designee will ensure personnel are qualified by reviewing documented education, training and expertise, both postal and private. Only currently qualified personnel may perform corrective, preventive, predictive, or reliability centered maintenance on electrical switchgear.

222 High Voltage Maintenance (600 Volts or Higher)

High voltage electrical maintenance is done by contract and not by USPS personnel unless an exception has been specifically approved by Headquarters Maintenance Policies and Programs. The requirements in HBK MS-1, Operation and Maintenance of Real Property, must be followed by USPS staff.

230 SAFETY RULES

231 Deenergized Equipment

231.1 Deenergized Procedures

Prior to commencing work on deenergized electrical switchgear, a qualified person, other than the person who deenergized the equipment, must verify the equipment is deenergized. The use of a lockout device is mandatory. This device will accommodate up to six padlocks, one for each person working on the apparatus. Form 4707, Out of Order Tag, along with the lockout device, must be placed on the apparatus when it will be out of service for an extended period of time. Use of the local deenergized procedures (plans) is critical during this process.

231.2 Reenergizing Procedures

All persons must be clear before circuit can be reenergized. Use of the local reenergizing procedures (plans) is critical during this process.

NOTE

Safeguards to protect other personnel, e.g., danger signs, roped-off space, barriers, notification procedures etc., must be used if the nature or location of the work creates a hazard.

231.3 Work Procedures

The supervisor must ensure that each member of the work crew is familiar with the work to be done and that each person is aware of all specific safety procedures to be followed. Cleaning of switchgear equipment must be performed with insulated High Efficiency Particulate Air filter (HEPA) vacuum or other non-conductive cleaning equipment. High voltage (600 volts or higher) power circuits must have all work procedures completed by a qualified contractor. (See Appendix E for safety procedures to be followed by contracted personnel.)

NOTE

“Dead circuits” must always be treated the same as “live” circuits until they are verified to be deenergized. This practice develops a caution that may prevent an accident. A circuit may be energized through the error of some other person, back feed, or an automatic feed from another source. Two or more experienced maintenance bargaining unit employees shall be present at all times when work is in progress if the voltage of the systems or equipment being worked on exceeds 600V.

232 Energized Equipment

232.1 Policy

When it is necessary to have switchgear testing performed on energized switchgear equipment, and when the work practices stated below are in effect, qualified personnel are authorized to perform these duties. Repair of energized switchgear will be accomplished in accordance with OSHA, applicable USPS Maintenance Management Orders (MMOs) and Management Instructions (MIs).

232.2 Procedures

- a. The senior maintenance official or designee for the facility must individually authorize each job.
- b. All work must be performed by qualified personnel who are familiar with the National Electrical Code, NFPA 70 and other applicable codes and standards.
- c. USPS personnel are not authorized to work on electrical circuits or devices operating at or above 600 volt AC (alternating current)
- d. Only qualified personnel will be allowed to work on energized equipment to replace components etc.
- e. All energized parts and working personnel must be effectively guarded by the use of protective equipment such as rubber gloves, rubber blankets and floor mats, hot-line tools, switch sticks, testing and grounding devices, and other appropriate safety equipment to protect persons or objects from harmful contact.
- f. All protective equipment used on energized lines or circuits must be approved, periodically examined, tested (by a certified test facility), and kept in a safe condition in accordance with established criteria (i.e., OSHA guidelines, USPS MMOs, etc.). Ensure all testing records are properly maintained.
- g. When working on energized equipment, approved long face shields and other appropriate PPE must be worn by all personnel at all times.
- h. When cleaning energized equipment, care must be taken to prevent short circuits caused by disturbing heavy accumulations of dirt onto exposed electrical contacts.
- i. Maintenance employees performing maintenance tasks on energized circuits, devices, equipment, etc. must be provided personal protective equipment (PPE) in accordance with OSHA Regulation 1910, Subpart S.

**CHAPTER 3
ENVIRONMENT**

310 BACKGROUND

The USPS is committed to providing employees and customers with a safe and healthy environment. In 1993 the USPS launched an effort to integrate environmental decision making into daily operations. The Seven Guiding Principles were published and an Environmental Strategic Plan was drafted to carry out the principles. Electrical switchgear maintenance does have environmental impacts that need to be considered when making decisions.

320 DISPOSAL OF ASBESTOS

The regulations and laws concerning asbestos and other hazardous waste may change, and thus it is best to check with the appropriate USPS officials at District offices, Area Offices or Headquarters, and check the state and local laws. Additionally, current federal information may be found on the Environmental Protection Agency (EPA) web site.

330 USE AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBs)

331 Federal

The EPA, under authority granted in the Toxic Substances Control Act, has issued revised regulations concerning the manufacture, use, and disposal of the chemical substance known as PolyChlorinated Biphenyls (PCBs). The most common occurrence of PCBs in Postal Service facilities is the dielectric/coolant oil used in transformers. The most recognizable PCB dielectric oil by trade name is "Askarel", manufactured by Monsanto Corporation. Other representative trade names are: Aroclor, Pydraul, Therminol, Pyroclor, Santotherm, Peralene, Inerteen, Asbestol, Chlorextol, Diachior, Dykanol, Elemex, Hyvol, No-flamol, Saf-T-Kuhl, Ardor B, Clorinol, Clorphen, and Eucarel. PCBs may also be present in capacitors and fluorescent ballasts manufactured before 1978, and in dielectric mineral oil not bearing one of the above trade names.

332 USPS Responsibilities

The USPS is responsible for the proper use, storage, and disposition of any PCBs used in its electrical equipment. This responsibility cannot be contracted out. Therefore, local management must ensure that contractors who service PCB equipment comply with the EPA regulations. Postal employees must not service equipment containing PCBs if they might come in direct contact with PCBs. The EPA allows, under certain conditions, PCBs to be disposed of by burning in large boilers. It is Postal Service policy that PCBs will not be disposed of in its boilers. The facility manager or designee must have a thorough understanding of USPS prohibited and permitted activities and uses, marking requirements and required records on PCB materials.

333 References

All applicable maintenance management orders (MMOs) can be found on the Maintenance Technical Support Center's web site for reference.

333.1 Sources

If you have unique problems or extensive quantities of PCBs in use or stored, you may wish to have copies of the regulations on site.

Additional current regulations and amendments can be found on the EPA web site.

For additional background information, you may search the Federal Register for applicable rules and regulations.

333.2 Supply

Copies of the Federal Register are available from the Corporate Library (USPS Headquarters, Washington D.C., 20260), Regional EPA Offices, or local university and metropolitan libraries. The above material is very time consuming to read; therefore, specific questions can be answered most efficiently by calling your Regional EPA Office.

CHAPTER 4
EQUIPMENT DESCRIPTION

410 BACKGROUND

Because of the wide variety of different models and designs of electrical switchgear equipment in use today, this handbook cannot present complete equipment descriptions. Detailed descriptions of switchgear equipment are available from a number of sources including manufacturer's catalogs and industrial electrical handbooks. Three useful reference documents containing extensive equipment descriptions and application information are:

Recommended Practice for Electrical Equipment Maintenance NFPA 70B

(also available on USPS internal web server)

National Fire Protection Association

Battery March Park

Quincy, MA 02269-9101

National Electrical Safety Code, IEEE

Institute of Electrical and Electronics Engineers Inc.

345 East 117th St.

New York, NY 10017-23911

National Electrical Manufacturers Association (NEMA)

300 North 17th Street, Suite 1847

Arlington, VA 22209-3801

420 SWITCHGEAR EQUIPMENT CLASSES

This handbook covers electrical equipment grouped into the following five classes. Each piece of the electrical equipment noted within the classifications below is defined in Appendix C.

a. Transformers

This equipment class includes both power and distribution type transformers whether dry or liquid (oil) filled. Generally these devices transform the high voltage of the utilities power input down to the appropriate voltages needed to operate building equipment. This class also includes current and potential transformers used to provide metering signals for the power circuits and voltages for the control circuitry.

b. Circuit Breakers

This class includes a wide variety of devices designed to break a circuit under certain conditions. The devices use thermal or magnetic elements, including relays, to respond to over- or under-current, or voltage conditions and mechanically interrupt the circuit path. Since these devices are designed to interrupt current-carrying circuits, an arc is formed when the circuit is broken. Several different methods are used, including the use of insulating oil, to quench the arc rapidly. Many circuit breakers have both an instantaneous trip rating and an adjustable time delay rating.

c. Relays

This class also includes a wide variety of designs used in power circuits in many ways. Some relays operate when an abnormal circuit condition causes the relay to open or close an auxiliary electric circuit, in turn tripping the switch or circuit breaker mechanism. Relays operate on thermal, magnetic, or induction principles and may be instantaneous or time delayed. Switchgear relays are normally used to sense under- or over-voltage or current, power factor, reverse current, phase unbalance, or other important circuit conditions.

d. Connection Equipment

This class of switchgear includes the apparatus used to interconnect utility power lines, transformers, power wiring, and protective devices. Connection equipment includes switchboards, disconnect switches, lightning protectors, power cables and insulation, and switchgear equipment vaults.

e. Motor Starters (200 H.P. and above)

Motor Starters 200 horsepower and above typically include NEMA (National Electrical Manufacturers Association) size five (5) or larger motor starters, or the equivalent IEC (International Electrotechnical Commission) rating for providing power to a 200 horsepower motor or greater. These may include reduced voltage starters including delta-wye starters and in some cases starters that contain solid state soft-start or VFD (variable frequency drives). In addition, it also includes medium voltage starters (1,000 to 15,000 Volt starters) that power motors 200 horsepower or greater.

430 SWITCHGEAR APPARATUS

The switchgear apparatus covered by this handbook is differentiated and organized in the following sequence.

NOTE

When used in this handbook, the designation high voltage refers to voltages of 600 volts or more and low voltage refers to voltages below 600 volts.

431 Transformers

- a. Liquid filled, High voltage, substation type, 500 kVA and up
- b. Dry type, High voltage, 500 kVA and up
- c. Liquid filled, Distribution type, 500 kVA and below
- d. Dry type, Distribution type, 500 kVA and below
- e. Dry type, Current and potential types
- f. Transformer oil or air cooling equipment

432 Circuit Breakers

- a. High/Medium voltage, oil filled
- b. High/Medium voltage, air
- c. Medium voltage, vacuum
- d. Low voltage, 3-phase power
- e. Low voltage, molded-case
- f. Low voltage, air

433 Relays

- a. Induction disk overcurrent
- b. Induction disk directional overcurrent
- c. Thermal overcurrent
- d. Over- and under-voltage
- e. Power factor, reverse current, or watt type
- f. Transformer and bus differential; current balance

434 Connection Equipment

- a. Switchboards
- b. Disconnect switches
- c. Transfer switches
- d. Lightning and network protectors
- e. Power cables
- f. Insulators
- g. Power vaults
- h. Bus ducts
- i. Current/Potential Transformers
- j. Battery/Charging systems
- k. Instrument meter
- l. Protection devices
- m. Power factor correction devices

435 Motor Starters, 200 H. P. and above

- a. Across the line starters
- b. Delta-Wye starters
- c. Resistive starters
- d. Reactive starters
- e. Solid state components (soft-start and VFD)
- f. Medium voltage (1,000 Volt to 15,000 Volts)

EQUIPMENT DESCRIPTION

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**CHAPTER 5
PREVENTIVE MAINTENANCE**

510 PREVENTIVE MAINTENANCE PROGRAM

510.1 General

Although a well planned and thorough preventive maintenance program reduces the chance of a power outage or switchgear failure there are times when equipment does fail. Such failures can seriously damage mail processing operations, and therefore must be corrected. The capabilities of the facility's maintenance department determine if the services of outside experts are needed. However, some troubleshooting and repair work may be within the capabilities of the facility maintenance staff. Procedures and requirements for performing corrective maintenance are presented below

511 Responsibility

It is the responsibility of the senior maintenance official or designee to initiate and continue a preventive maintenance (PM) program in accordance with this handbook.

512 Required Records

512.1 General

Initial set-up requires the completion of a Switchgear Documentation Checklist (See 512.2). The documentation needed may require contracted services as referenced in Chapter 8 using Appendix B as a guide. Documentation on the checklist deemed necessary should be on file and accurate before moving forward with a preventive maintenance program.

The survey must be conducted by a company that specializes in such work. The survey will show the adequacy of the wiring diagrams and schematics, and may discover deficiencies in original design or designs that have been developed since installation. The survey must contain a report of findings and recommended solutions. A fault current and coordination study may be necessary if modifications have been made that impact the overall load by 25% or greater of total electrical load since last study was conducted.

A record of the equipment installed in the facility must include: the name of the equipment, manufacturer, part number and series if applicable, and rating or descriptive performance characteristics. The inventory must be updated as required (see Appendix C).

512.2 Switchgear Documentation Checklist

The Switchgear Documentation Checklist is described in Appendix B. Reference this guide when completing the checklist. See Appendix F for form templates.

513 Required Tools and Equipment

Specialized tools and test equipment are required to perform preventive maintenance. Refer to Chapter 2 for additional information on safety requirements.

514 Required Lead Time

All work should be scheduled at least four weeks in advance and coordinated with operation personnel so that the deenergized circuits have the least impact on facility operations. Check with local utility suppliers to ensure adequate lead time is given. When possible, additional lead time (up to two months) should be allowed for planning. Since the reliability of the building electrical power equipment is vital to mail processing operations, it is the responsibility of the senior maintenance official to see that the preventive maintenance program is not ignored or postponed without serious cause.

520 MAINTENANCE GUIDELINES

Utilizing the equipment inventory, establish schedules to accomplish preventive maintenance activities in accordance with postal criteria as set forth in postal policy. Refer to postal policy for a list of activities that may be accomplished by USPS maintenance employees.

When utilizing contracted services to complete required preventive maintenance activities, Appendix E is used as a guide to ensure necessary PM activities are accomplished at appropriate schedules.

**CHAPTER 6
CORRECTIVE MAINTENANCE**

610 GENERAL

Although a well planned and thorough preventive maintenance program reduces the chance of a power outage or switchgear failure there are times when equipment does fail. Such failures can seriously impede facility operations, and therefore must be corrected. The capabilities of the local maintenance staff determines if the services of outside experts are needed. However, some troubleshooting and repair work is generally within the capabilities of the local maintenance staff.

620 REQUIRED PERSONNEL

Electrical workers must have sufficient electrical background, either from formal study or practical training, to evaluate electrical operating problems and to troubleshoot efficiently. A considerable knowledge of electrical theory is necessary, and the ability to read and interpret electrical drawings is mandatory. Local maintenance personnel can gain valuable training and experience by working with contractor personnel while the contractor personnel are performing test, evaluation, preventive, and corrective maintenance on the facility switchgear.

630 REQUIRED DOCUMENTS

Effective troubleshooting is extremely difficult without access to a well prepared documentation file that describes the equipment in use and contains complete and up to date wiring and schematic diagrams of the switchgear and distribution installation. Records of previous failures and repairs along with preventive maintenance records are of great benefit in analyzing troubles. Therefore, a paramount requirement for a facility maintenance operation is ensuring that a documentation file is established and kept up to date. The file should contain information as required on switchgear documentation checklist. Records of repairs and modifications information are required as part of the facility documentation package. Adequately documented safety procedures should be maintained and available for use.

640 REQUIRED SPARE PARTS

An analysis of the equipment inventory and personnel capabilities must be performed to determine what equipment spare parts are needed in order to repair equipment with a minimum of downtime. One source for a recommended list of spare parts might be the outside contractor who performed an installation survey. Also, manufacturer's data should give some indication as to what spares must be stocked for repairs. These spares must be procured, properly stored, and inventoried. Spare parts usage must be recorded.

650 REQUIRED TOOLS AND EQUIPMENT

Troubleshooting and repair of switchgear apparatus requires the use of specialized tools and test equipment. Generally, test equipment required for such actions as circuit breaker trip current tests, cable and insulation breakdown strength tests, and similar tests is too expensive and complex to justify its procurement by a facility.

The appropriate lockout device and lock is recommended for coordinating the work of mechanics and electricians on electrical equipment. One device and lock should be provided to each mechanic and electrician who will have the responsibility for disconnecting power on equipment during maintenance.

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**CHAPTER 7
ELECTRICAL SWITCHGEAR TESTING AND PREVENTIVE MAINTENANCE**

710 GENERAL

711 Scope

Tests ensure that all electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications. The tests and inspections determine the suitability of continued use. In many facilities, technical support to test and complete Preventive Maintenance (PM) requirements is not adequate or available. These tests must be conducted every five years. Appendix E offers support in contracting these requirements.

712 Applicable Codes, Standards and References

712.1 Codes and Standards

All inspections and tests must be completed in accordance with applicable codes, standards and ordinances contained in Appendix C, Paragraph 112.

712.2 References

All inspections and tests must use the following reference materials:

- a. Existing Coordination Study — Set Points (if available)
- b. One-Line Drawings and Switchgear Control Drawing
- c. Manufacturer's instruction manuals applicable to each particular apparatus
- d. Up-to-date switchgear documentation. (See Appendix B for additional information.)

720 CONTRACTOR TESTING

Appendix E contains general specifications in soliciting contract support of electrical switchgear testing and maintenance.

730 INSPECTION AND TEST PROCEDURES

Inspections and test procedures noted in Appendix E are guidelines to utilize when inspections and testing tasks are to be completed.

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**CHAPTER 8
INITIAL SURVEY AND INVENTORY CONTRACT**

810 GENERAL

If this work is beyond the capabilities of a local post office, it may be contracted out. This document, including any pertinent MMOs, national electrical switchgear standards, and USPS purchasing manual may be used as a guide. In addition the contractor must be able to perform all specified work. Care must be taken to ensure that any contract is made in accordance with Article 32 of the CBA and Section 530 of the ASM.

820 GUIDELINE FOR CONTRACTING SERVICES

821 Switchgear Documentation Checklist

The first necessary contract activity of a new maintenance program is a comprehensive survey, Utilizing Switchgear Testing/PM/Inventory (reference Appendix C). To obtain the services of a professional services contractor, submit the following information to the responsible purchasing organization.

- a. Switchgear Documentation Checklist (form in Appendix F)
- b. Statement of Work for USPS Electrical Switchgear Professional Services-Inventory Documentation Studies
- c. Switchgear Testing/PM/Inventory sheet to be completed by contractor (form in Appendix F)
- d. Appropriate request/funding documents (e.g., Form 7437, eBuy, etc.)
- e. Any locally required switchgear requirements

830 PREVENTIVE MAINTENANCE CONTRACTS

831 Contract Requirements

PM contracts must specify the equipment to be tested, cleaned, and serviced under the specifications in Appendix D. The scheduled power outages must be specified and previously agreed to by all responsible parties of the Postal Service.

To obtain the services of a maintenance and testing contractor, submit the following information to the responsible purchasing organization.

- a. Switchgear Testing/PM/Inventory definitions (Appendix C)
- b. Completed Switchgear Testing/PM/Inventory sheet
- c. Applicable completed forms for Testing/PM/Inventory requirements (Appendix F)
- d. Appropriate Electrical Switchgear PM Guidelines (Appendix D)
- e. Statement of Work for USPS Electrical Switchgear Testing and Maintenance (Appendix E)
- f. Appropriate request/funding documents (e.g., Form 7437, eBuy, etc.)
- g. Any locally required switchgear maintenance requirements

832 Contractor Responsibilities

See Appendices C, D and E for list of contractor responsibilities.

833 USPS Responsibilities

See Appendix E for list of USPS responsibilities.

APPENDIX A
GLOSSARY

NOTE

The following definitions are for use with the National Electrical Code. For other use and for definitions not contained herein, see ANSI/IEEE Std 100-1977, IEEE Standard Dictionary of Electrical and Electronics Terms (Chapter 3).

Apparatus: Classified as devices attached to electrical switchgear/switchboard enclosures such as circuit breakers, disconnects, ground fault systems, and battery charging systems for control systems. This apparatus is designed to carry the electrical energy or protect the system from abnormal conditions.

Ampacity: The current in amperes that a device is designed to carry under normal conditions.

Approved: Acceptable to the authority having jurisdiction.

Automatic: Self acting, operating by its own mechanism when actuated by some impersonal influence, for example, a change in current strength; not manual; without personnel intervention. Remote control that requires personal intervention is not automatic, but manual.

Bonding: The electrical interconnecting of conductive parts, designed to maintain a common electrical potential.

Branch circuit: The circuit conductors between the final overcurrent device protecting the circuit and the outlets.

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).

Cable Jacket: A protective covering over the insulation, core, or sheath of a cable.

Cable Sheath: A conductive protective covering applied to cables. A cable sheath may consist of multiple layers, one or more of which is conductive.

Cable Terminal: A device that provides insulated egress for the conductors. Also termination.

Circuit: A conductor or system of conductors through which an electric current is intended to flow.

Circuit Breaker: A switching device capable of making, carrying, and breaking currents under normal circuit conditions and also making, carrying for a specified time, and breaking currents under specified abnormal conditions such as those of short circuit.

Conductor: A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current.

Conductor, Insulated: A conductor encased within material of composition and thickness that is recognized by the NEC as electrical insulation.

Continuous Load: A load where the maximum current is expected to continue for 3 hours or more.

Conduit System: Any combination of duct, conduit, conduits, manholes and vaults joined to form an integrated whole.

Covered Conductor: A conductor covered with a dielectric having no rated insulating strength or having a rated insulating strength less than the voltage of the circuit in which the conductor is used.

Current-Carrying Part: A conducting part intended to be connected in an electric circuit to a source of voltage.

Deenergized: Free from any electrical connection to a source of potential difference and from electric charge; not having a potential different from that of the earth. The term is used only with reference to current-carrying parts that are sometimes energized (alive). Also dead.

Designated Person: A qualified person designated to perform specific duties under the conditions existing.

Disconnecting or Isolating Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a source of power. It is required to carry normal load current continuously, and also abnormal or short-circuit current for short intervals as specified. It is also required to open or close circuits either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the switch poles occurs. Also disconnector, isolator.

Duct: A single enclosed raceway for conductors or cable.

Effectively Grounded: Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the build up of voltages that may result in undue hazard to connected equipment or to persons.

Electric Supply Equipment: Equipment that produces, modifies, regulates, controls, or safeguards a supply of electric energy. Also supply equipment.

Electric Supply Station: Any building, room, or separate space within which electric supply equipment is located and the interior of which is accessible, as a rule, only to qualified personnel. This includes generating stations and substations, including their associated generator, storage battery, transformer, and switchgear rooms, or enclosures, but does not include facilities such as pad mounted equipment and installations in manholes and vaults.

Enclosed: Surrounded by case, cage, or fence and designed to protect the contained equipment and minimize the possibility, under normal conditions, of dangerous approach or accidental contact by persons or objects.

Energized: Electrically connected to a source of potential difference, or electrically charged so as to have a potential significantly different from that of earth in the vicinity. Also alive or live.

Equipment: A general term including fittings, devices, appliances, fixtures, apparatus, and similar terms used as part of or in connection with an electric supply or communication system.

Explosion-proof Apparatus: Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

Exposed: Not isolated or guarded.

Grounded: Connected to earth or some conducting body that serves in place of the earth.

Grounded Conductor: A system or circuit conductor that is intentionally grounded.

Grounded System: A system of conductors in which at least one conductor or point is intentionally grounded, either solidly or through a non-interrupting current-limiting device.

Grounding Conductor: A conductor that is used to connect the equipment or the grounded circuit of wiring system to a grounding electrode or electrodes.

Grounding Conductor, Equipment: The conductor used to connect the non-current-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor, the grounding electrode conductor, or both, at the service equipment or at the source of a separately derived system.

Grounding Electrode Conductor: The conductor used to connect the grounding electrode to the equipment grounding conductor, or to both, at the service, at each building or structure where supplied from a common service, or at the source of a separately derived system.

Guarded: Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, or mats or platforms, designed to minimize the possibility, under normal conditions, of dangerous approach or accidental contact by persons or objects.

Insulated Conductor: A conductor covered with a dielectric (other than air) having a rated insulating strength equal to or greater than the voltage of the circuit in which it is used.

Insulation: (as applied to cable): That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground.

Insulation Shielding: An envelope that encloses the insulation of a cable and provides an equipotential surface in contact with the cable insulation.

Insulator: Insulating material in a form designed to support a conductor physically and electrically separate it from another conductor or object.

Isolated: Not readily accessible to persons unless special means for access are used.

Isolator: See: Disconnecting or Isolating Switch.

Jacket: A protective covering over the insulation, core, or sheath of a cable.

Low Voltage Protection: The effect of a device operative on the reduction or failure of voltage so as to cause and maintain the interruption of power supply to the equipment protected.

Manhole: A subsurface enclosure that personnel may enter to install, operate, and maintain submersible equipment and cable.

Manhole Cover: A removable lid that closes the opening to a manhole or similar subsurface enclosure.

Manhole Grating: A grid providing ventilation and a protective cover for a manhole opening.

Manual: Capable of being operated by human intervention.

Network Protectors: An air circuit breaker equipped with specialized relays that sense network circuit conditions and command the circuit breaker to either open or close. There is no separate power source for control. All control power is taken from the system.

Non-current-carrying parts are those not intended to be so connected.

Open Conductor: A type of electric supply or communication. Also open wire.

Outlet: The point where the wiring system ends and current is taken to supply the connected equipment.

Overcurrent: Current that is in excess of the rated current or ampacity of a conductor or apparatus.

Pad-mounted Equipment: A general term describing enclosed equipment, the exterior of which enclosure is at ground potential, positioned on a surface-mounted pad.

Qualified: Having adequate knowledge and thorough training of the installation, construction, or operation of apparatus and the hazards involved.

Raceway: Any channel designed expressly and used solely for holding conductors.

Switch: A device for opening and closing or for changing the connection of a circuit. In these rules, a switch is understood to be manually operable, unless otherwise stated.

Switchboard: A type of switchgear assembly consisting of one or more panels with electric devices mounted thereon, and associated framework.

Tag: Accident prevention tag (DANGER, PEOPLE AT WORK, etc.) of a distinctive appearance used for the purpose of personnel protection to indicate that the operation of the device to which it is attached is restricted.

Transformer Vault: An isolated enclosure either above or below ground with fire-resistant walls, ceiling, and floor, in which transformers and related equipment are installed, and that is not continuously attended during operation. See also: vault.

Utility: An organization responsible for the installation, operation or maintenance of electric supply or communication systems.

Utilization Equipment: Equipment, devices, and connected wiring utilizing electric energy for mechanical, chemical, heating, lighting, testing or similar purposes and not a part of supply equipment, supply lines, or communication lines.

Vault: An enclosure above or below ground that personnel may enter to install, operate, or maintain equipment or cable.

Voltage: The effective root mean square (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. The nominal voltage of a system or circuit is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. The operating voltage of the system may vary above or below this value.

Voltage of Circuit Not Effectively Grounded: The highest nominal voltage available between any two conductors of the circuit.

NOTE

If one circuit is directly connected to and supplied from another circuit of higher voltage (as in the case of an autotransformer), both are considered as of the higher voltage, unless the circuit of the lower voltage is effectively grounded, in which case its voltage is not determined by the circuit of higher voltage. Direct connection implies electric connection as distinguished from connection merely through electromagnetic or electrostatic induction.

Voltage of a Constant Current Circuit: The highest normal full load voltage of the current.

Voltage of an Effectively Grounded Circuit: The highest nominal voltage available between any conductor of the circuit and ground unless otherwise indicated.

Voltage To Ground of:

- a. **A Ground Circuit:** The highest nominal voltage available between any conductor of the circuit and that point or conductor of the circuit that is grounded.
- b. **An Undergrounded Circuit:** The highest nominal voltage available between any two conductors of the circuit concerned.

Voltage To Ground of a Conductor of:

- a. **A Grounded Circuit:** The nominal voltage between such conductor and that point or conductor of the circuit that is grounded.
- b. **An Ungrounded Circuit:** The highest nominal voltage between such conductor and any other conductor of the circuit concerned.

Wire Gauges: Throughout these rules the American Wire Gauge (AWG), formerly known as Brown & Sharpe (B&S), is the standard gauge for copper, aluminum, and other conductors; however the Steel Wire Gauge (SWG) is used for steel conductors.

**APPENDIX B
ELECTRICAL SWITCHGEAR EQUIPMENT
REQUIRED DATA AND DOCUMENTATION SPECIFICATIONS**

GENERAL

USPS installations range from the small facility with residential type single-phase power to the very large facility with incoming service voltages to 138 KV (kilovolts) and capabilities of over 20,000 kVA (Kilovolt Amps). Naturally, larger facilities have the more elaborate, complex, and costly electrical switchgear equipment and require more documentation.

It is the responsibility of each USPS installation containing electrical switchgear equipment, to participate in a routine preventive maintenance and testing program to ensure that all equipment and related apparatus functions properly and operates at peak performance. Further, it is the responsibility of each USPS installation to ensure that all required data and documentation are available, complete and current.

It is important that all of the existing data available, as well as any significant changes made to the electrical distribution system that are not reflected in the drawings and/or inventory records, is appropriately collected and recorded. The availability, quality and integrity of the data can substantially reduce overall service costs.

DOCUMENTATION INVENTORY SURVEY

The Electrical Switchgear Equipment-Documentation Inventory Survey is used to identify and validate the availability, accuracy and integrity of any data (i.e., equipment inventory and specifications, drawings and schematics, plans and equipment availability scheduling, and professional study) that is required prior to initiating an electrical switchgear preventive maintenance and testing program.

Each USPS installation requiring electrical switchgear testing must utilize the Electrical Switchgear Equipment–Documentation Inventory Survey to verify the availability and accuracy of required data and documentation. Using the survey also helps the installation identify and determine what data and documentation is not available, and what assistance is required from a professional services provider to collect and prepare required data and documentation, and/or perform required studies prior to initiating an electrical switchgear equipment preventive maintenance and testing program.

Site personnel should collect as much data as possible. Some of this required data may be obtained from the Area Maintenance Support unit, the Facility Service Office, the Facility Service Center, the architectural firm that designed the building, or the contractor that installed and adjusted the equipment initially.

APPENDIX B

To complete the Electrical Switchgear Equipment-Documentation Inventory Survey, the following guidelines must be adhered to:

- a. Identify the USPS installation in the "Site" block. Be sure to use a separate survey for each individual installation.
- b. Annotate the date the survey was completed in the "Date" block.
- c. For each separate item on the survey form, place an "X" in the appropriate block to indicate whether the required data, documentation and/or professional study requirements have been satisfied; or if outside professional services are required to satisfy a specific requirement. In addition, indicate the install date and last revision date for each line item.
- d. Annotate in the "Comments" block any information that you feel would be pertinent to local personnel, the purchasing office, or an outside supplier.

If it is determined that a USPS installation "has all" of the required data and documentation available (current, complete, and accurate) you can proceed to obtain electrical switchgear preventive maintenance and testing services from a pre-qualified service provider. Each USPS installation requiring electrical switchgear equipment preventive maintenance and testing services (by an outside contractor) must forward a funded requisition and a copy of the completed Electrical Switchgear Equipment-Documentation Inventory Survey to the Category Management Center (CMC), for coordination of requirements.

REQUEST FOR PROFESSIONAL SERVICES (DATA, DOCUMENTATION AND STUDIES)

If it is determined that a USPS installation "does not have all" of the required data and documentation available (current, complete and accurate), and/or requires professional studies to be performed prior to initiating an electrical switchgear preventive maintenance and testing program, you must forward a funded requisition. A completed Electrical Switchgear Equipment-Documentation Inventory Survey (indicating what specific services are required) must accompany the survey to the Category Management Center (CMC). A contract will then be initiated to obtain these services from an outside, pre-qualified service provider. Refer to Appendix C.

REQUIRED DATA AND SPECIFICATIONS

The following data, documentation and specifications are information that should be available at the USPS installation prior to initiating an electrical switchgear preventive maintenance and testing program. However, the detail and extent of the documentation/specifications will vary with the size of the facility and complexity of the electrical distribution system.

MAINTENANCE OF ELECTRICAL SWITCHGEAR

(SAMPLE)

SWITCHGEAR DOCUMENTATION CHECKLIST

SITE: _____ DATE: _____

#	ITEM	ON FILE		FILE COMPLETE		STATUS UPDATE		INSTALL DATE	LAST REVISION	COMMENTS
		YES	NO	YES	NO	YES	NO			
1	Complete Inventory available of: a. Drawings									
	b. Schematics									
2	Plans available for: a. Shutdown									
	b. Power transfer									
	c. Start up procedures									
3	A. Short circuit, device evaluation, and coordination study (See Note 1)									
	B. Coordination settings available for: (See Note 1)									
	a. Protective relays									
	b. Circuit breakers									
	c. Ground fault protection									
4	A reproducible one-line drawing that includes distribution diagrams, control wiring and coordination settings									
5	Inventory of cables showing the manufacturer's voltage class, type and length									
6	Inventory of breakers listing type, manufacturer's model, serial numbers, and time current characteristic curves									
7	Inventory of all PT & CT transformers listing manufacturer's model and serial number including voltages and ratios									
8	Inventory of switchgear listing manufacturer, model, serial number, voltage and amperage									
9	Inventory of relays, induction disc overcurrent, directional overcurrent, thermal overcurrent, over and under voltage, power factor, reverse current and watt type with coordination set points indicated									
10	Drawings indicating lightning and network protectors showing all down conductors & tie points, with wire sizes									
11	Inventory of all distribution power transformers									
12	Inventory of Distribution bus ducts									

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#	ITEM	ON FILE		FILE COMPLETE		STATUS UPDATE		INSTALL DATE	LAST REVISION	COMMENTS
		YES	NO	YES	NO	YES	NO			
13	Inventory of switchboards or power distribution panels									
14	Inventory of reduced voltage motor starters for chillers									
15	Inventory of ground fault relays listing coordination set points									
16	Drawings that show all grounding connection points, type of connection grounding, electrode size, number of electrodes and the wire size									
17	Complete inventory list documenting all the electrical power distribution equipment that requires testing as required per Switchgear Testing/PM/Inventory Form									

Note 1: The short circuit and coordination study is generally performed when the facility is built or major modifications occur to the electrical distribution system. These are design exercises and may or may not be available at the site. Generally these are not required for a switchgear maintenance contract, but if major modifications occurred (greater than 25% of the design electrical load) or a major change in the electrical service capacity occurred, a new study should be conducted. The device evaluation study is also a design exercise to ensure the devices can withstand the loads that may be imposed. The device evaluation is generally also performed when the facility is built or major modifications are performed that require design work. Coordination settings are supplied from the coordination study, typically for large devices with adjustable settings, relays, and ground fault protection. Generally the existing setting(s) on the device(s) was obtained from the coordination study, but the actual study may not be available at the site. If coordination settings are not available, the current setting should be used unless the original settings have been altered. Many older molded case breakers, virtually all fuses, and some older ground fault detectors are non-adjustable and thus do not have coordination settings.

Item B1 Inventory of Drawings and Schematics

This is a document that you can establish that is a listing of all the available electrical drawings and schematics by title and drawing number. The drawings should be up to date and accurately reflect any additions or modifications made to the system throughout the years.

Item B2 Plans available for shutdown, power transfer, and startup

These are detailed instructions comprised of:

- A one-line drawing of the switchgear, with each device identified that is associated with the shutdown, power transfer, and start-up procedures.
- The sequence of operations needed to accomplish the shutdown, power transfer, and startup procedures.
- Each disconnect or circuit breaker that is to be opened or closed in the above procedures must be identified exactly the same for both the drawing and sequence of operation.
- The physical location of these devices must also have this same identification.

NOTE

These instructions are to be posted (laminated or framed) in a conspicuous location within each switchgear room, vault or in area of electrical service panel.

Shutdown

This is the plan for the shutdown of the total system, which can also be used for partial shutdowns. This would contain the sequence by which electrical loads should be shed to power down various parts of the system.

Power Transfer

If the facility electrical service or switchgear is powered by multiple power sources, this would contain the information and procedures regarding the transfer between them safely.

Start Up Procedures

This would contain the procedures and sequencing necessary for the closure of devices when restoring electrical loads.

Item B3 Up-To-Date Short Circuit, Device Evaluation, and Coordination Study - (Or exemption statement)

Settings (where applicable) for relays, breakers, and ground fault protection are to be provided.

NOTE

This study must be reviewed every five (5) years prior to the issuance of an Electrical Switchgear Testing and Maintenance Contract. If additional large electrical loads have been added to the facility that lead to increased levels of available short circuit currents, or if the electrical utility company enlarged its own system and increased the available fault capacity, then a new study is required before an Electrical Switchgear Testing and Maintenance contract can be performed. If no significant changes have been made, then a dated exemption statement at the required 5-year interval to that effect is required. It is to be signed by the senior maintenance official responsible for the facility. It is to then be maintained on file with all required electrical switchgear documentation.

This information is to be found in the coordination survey that was performed when the building was constructed, or possibly provided later through an engineering contract when a major modification or upgrade of the original system was made.

Item B4 One-line Drawings

These are drawings that graphically represent the electrical system in the facility. They contain information about the type, size, and capacity of all the electrical safety devices in the facility. Other drawings will contain information on the control wiring and may also display the coordination settings. Maintain relative geographic relations and, as far as practical, approximate relative positions of components. All devices in switching equipment are to be referred to by IEEE/ANSI numbers according to the function they perform.

The information required for one-line drawings is, but may not be limited to, the following:

- a. Manufacturers' type designations and ratings of apparatus
- b. Ratios of current and potential transformers, taps to be used on multi-ratio transformers, and connection of double-ratio current transformers
- c. All control transformers, protective and control relays, and metering devices shown
- d. Connections of power transformer windings
- e. All fuses shown with their size and rating
- f. All circuit breakers shown with their ratings in volts and amperes, their interrupting rating, settings, type, frame size, and number of trip coils
- g. Functions of relays
- h. Ratings of large motors
- i. Size and type of conductors
- j. Voltage, phase, and frequency of all incoming circuits. Indicate wye or delta systems, grounded or ungrounded
- k. Incoming feeder and distribution transformer kVA and impedance ratings

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- l. Transformer input/output voltages, and taps
- m. All disconnects or load interrupters shown with their size and ratings
- n. All busses shown with their size and ratings
- o. All power, lighting, and receptacle panels shown with their ratings and actual or calculated loads

NOTE

The drawings must be complete and up to date prior to the use of the Electrical Switchgear Testing and Maintenance Contract.

Item B5 Cables

Cable information may be displayed on the drawings, in the coordination survey, or in separately provided cable charts. This information is generally found in the drawings or data provided when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. The information required for cables is, but may not be limited to, the following:

- a. Cable sizes (AWG)
- b. Voltage class
- c. Voltage ratings
- d. Ampacity
- e. Types
 - 1. Insulation types
 - A) Laminated
 - B) Solid dielectric
 - 2. Insulation shields
 - A) Non-metallic
 - B) Metallic
 - 3. Cable jackets
 - A) Non-metallic
 - B) Metallic
 - 4. Cable terminations
 - A) Non-shielded
 - B) Shielded
 - 5. Cable lengths

Item B6 Breakers

This information is generally found in the drawings or data provided when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made.

Some information may be found on nameplates or within manufacturer's supplied or available data. The information required for circuit breakers is, but is not limited to, the following:

- a. Breaker types
 - 1) Molded case
 - 2) Low voltage air breakers
 - 3) Medium voltage air-magnetic breakers
 - 4) Medium voltage vacuum breakers
 - 5) Low voltage oil breakers
 - 6) High voltage oil breakers
- b. Voltage ratings
- c. Interrupt ratings
- d. Interrupting capacities
- e. Ambient temperature ratings
- f. Manufacturers
- g. Quantity
- h. Locations
- i. Models
- j. Types
- k. Serial numbers
- l. Time current characteristic curves (if available)
- m. Trip settings

Item B7 **PT (Potential Transformers) and CT (Current Transformers)**

These are transformers associated with electrical meters, instruments, and safety devices. They are generally found located within the interior of switchgear equipment.

This information is generally found in the drawings or data provided when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. Some information may be found on nameplates or within manufacturer's supplied or available data. The information required for PTs and CTs is, but is not limited to, the following:

- a. Manufacturers
- b. Quantity
- c. Location
- d. Models
- e. Serial numbers
- f. Current ratios
- g. Voltage insulation ratings
- h. Types
- i. Ambient temperature ratings
- j. Insulation class
- k. Rated primary voltage and ratios

Item B8 Switchgear

This information may be found on equipment name plates, or contained in the original data information supplied with the equipment. (An exception to this may be the serial numbers, which may only be obtainable from the nameplate). The information required for switchgear is, but is not limited to, the following:

- a. Manufacturers
- b. Location
- c. Models
- d. Serial numbers
- e. System voltage
- f. Maximum design voltage
- g. Momentary short circuit rating
- h. Main bus rating
- i. Classification
 - 1) Metal-Enclosed - Low Voltage Switchgear Up to 600 V
 - 2) Metal-Clad - Medium Voltage Switchgear 600 V - 15 kV
 - 3) Metal-Enclosed - High Voltage Switchgear 15 kV - 34.5 kV
- j. Interrupter switches
 - 1) Amperes continuous
 - 2) Amperes interrupting
 - 3) Momentary (switch closed, 10 cycle) amps asymmetrical
 - 4) Fault close amps asymmetrical

Item B9

Relays

This information is generally found in the drawings or coordination data provided when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. The information required for relays is, but is not limited to, the following:

- a. Manufacturers
- b. Quantity
- c. Location
- d. Models
- e. Serial numbers
- f. Types
 - 1) Alarm
 - 2) Differential
 - 3) Distance
 - 4) Directional power
 - 5) Timing
 - 6) Voltage
- g. Kinds
 - 1) Differential protection
 - 2) Directional over current protection
 - 3) Ground protection
 - 4) Under voltage protection
 - 5) Reverse current protection
 - 6) Over-current protection
 - 7) Thermal over-current protection

Item B10 Lightning Protection Systems

Lightning protection for this area consists of drawings of the equipment that is designed to protect the electrical system and building from the effects of a lightning strike.

This information is generally found in the drawings or data provided when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. Maintain relative geographic relations and, as far as practical, approximate relative positions of components. The information required for lightning protection is, but is not limited to, showing the following:

- a. Air terminals
- b. Conductors
- c. Ground terminals
- d. Interconnecting conductors with all tie points shown
- e. Arresters
- f. Grounding rod sizes

Item B11 Distribution and Power Transformers – Inventory

This could be developed from the nameplate data or from the drawings or data that was provided with the equipment when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. Power transformers are defined as those larger than 500 kVA, while distribution transformers are those 500 kVA or smaller. The information required for distribution and power transformers is, but is not limited to, the following:

- a. Manufacturer
- b. Quantity
- c. Location
- d. Model
- e. Serial number
- f. Primary and secondary voltage ratings
- g. kVA capacity
- h. Cooling method
- i. Temperature rise
- j. Insulation class
- k. Phase
- l. Indicate wye or delta windings and placement

Item B12 Metal Enclosed Busways – Inventory

These are rectangular or square ducts that carry electrical conductors whether inside or outside. (Do not confuse with rectangular wire raceways)

These could be developed from the drawings or data that was provided when the facility was constructed, or possibly provided later through an engineering contract when major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. The information required for metal enclosed busways is, but is not limited to, the following:

- a. Manufacturer
- b. Quantity
- c. Location
- d. Operating voltage
- e. Continuous current rating
- f. Momentary current rating
- g. Bus types
 - 1) Non-segregated
 - 2) Segregated
 - 3) Isolated
- h. Enclosure type
 - 1) Enclosed
 - 2) Ventilated
- i. Ambient temperature rating
- j. Conductor material
 - 1) Copper
 - 2) Aluminum

Item B13 Switchboards/ Power Distribution Panels – Inventory

This could be developed from the drawings or data that was provided when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. The information required for switchboards/distribution panels is, but is not limited to, the following:

- a. Manufacturer
- b. Type
- c. Quantity
- d. Location
- e. Serial and/or catalog number
- f. Maximum voltage rating
- g. Maximum amperage rating
- h. Continuous amperes rating
- i. Interrupting capacity, amperes symmetrical

Item B14 Motor Starters for Chillers – Inventory

Motor starters for chillers in excess of 200 HP may be found incorporating other features such as reduced voltage starters.

This could be developed from the drawings or data that was provided with the equipment when the building was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. The information required for motor starters is, but is not limited to, the following:

- a. Manufacturers
- b. Quantity
- c. Location
- d. Horsepower
- e. Voltage rating
- f. Class
- g. Type
 - 1) Full voltage starters
 - 2) Reduced voltage starters
- h. Contactor amp rating
- i. Starter interrupting rating (kVA)

Item B15 Ground Fault Protection System – Inventory

The ground fault protection system is designed to shut down the system if a ground fault is detected. This system includes ground fault current sensing devices (GFS), relaying equipment (GFR), combinations of the two, or other equivalent protection equipment that opens all ungrounded conductors at predetermined values of ground fault current.

These procedures are not applicable to equipment that contains electronic sensing devices integral to the breaker.

The inventory could be developed by reviewing the prints, devices and manufacturer data. The information required for ground fault protection system is, but may not be limited to, the following:

- a. Manufacturers
- b. Quantity
- c. Locations
- d. Models
- e. Serial numbers
- f. Disconnect device
 - 1) Molded case circuit breaker
 - 2) Power circuit breaker
 - 3) Bolted pressure switch or other fusible disconnect device, suitable for ground fault sensing and relaying equipment.
 - 4) Zone interlock
 - 5) Neutral disconnect
- g. Coordination set points

Item B16 Grounding System Drawings

These drawings show electrical-grounding conductors and equipment-grounding conductors.

Grounding conductor is a conductor used to connect equipment or a grounded circuit of a wiring system to a grounding electrode(s).

Grounding conductor-equipment is the conductor used to connect the non-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor, the grounding electrode conductor, or both, at the service equipment or at the source of a separately arrived system.

Grounding electrode conductor is the conductor used to connect the grounding electrodes to the equipment grounding conductor, to the grounded conductor, or both, at the service, at each building or structure where supply from a common service, or at the source of separately derived system.

This information is generally found in the drawings or data that was provided with the equipment when the building was constructed, or provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made. Maintain relative geographic relations and, as far as practical, approximate relative positions of components. The information required for grounding system drawings is, but is not limited to, showing the following:

- a. Size and type of all conductors
- b. Grounding terminals
- c. Ground rod sizes and locations
- d. Interconnecting conductors and/or conducting paths shown, including all tie points
- e. All other connector or fittings required to complete the grounding system.

Item B17 Power Factor Correction Devices

This information is generally found in the drawings or data provided when the facility was constructed, or possibly provided later through an engineering contract when a major modification or upgrade was performed, or when an electrical equipment and documentation survey was made.

Some information may be found on nameplates or within manufacturer's supplied or available data. The information required for power factor correction devices is, but not limited to, the following:

- a. Power factor correction types
 - 1) Liquid filled
 - 2) Dry
- b. Voltage ratings
- c. KVAR
- d. Manufacturer
- e. Quantity
- f. Locations
- g. Models
- h. Serial numbers

Item B18 Completed Testing Inventory

This is a complete inventory of all equipment requiring testing. The Switchgear Testing/PM Inventory lists all of the equipment that should be included in this master inventory. This will include all the inventory sheets created for the previous items.

If after collecting the data identified in the switchgear documentation inventory you find that major items are missing (ignoring any section that does not apply to your equipment), you will not be able to proceed any further until all the documentation is obtained.

If your data is complete and up-to-date, you can proceed to assemble the Electrical Switchgear Testing and PM Contract.

APPENDIX C

STATEMENT OF WORK (SOW) USPS ELECTRICAL SWITCHGEAR
PROFESSIONAL SERVICES DOCUMENTATION AND STUDIES

NOTE

This statement of work (SOW) is authorized only for use by the Category Management Center (CMC), for inclusion in solicitations and formal contracts, and solely for the purpose of obtaining contracted services through professional firms.

100 OVERVIEW

101 Introduction

101.1 The United States Postal Service (USPS) intends to award multiple strategic contracts for electrical switchgear services relative to collecting and preparing critical information and data, and conducting professional studies. The basis for this requirement is to apply the principles of Supply Chain Management (SCM) to develop and deploy a nationwide universal business strategy, comprised of multiple strategic contracts, for electrical switchgear equipment professional services. The USPS intends to form partnerships with the most highly qualified professional electrical service providers to implement an effective switchgear information and documentation management program and employ cost reduction processes throughout the supply stream. This strategy will provide the highest level of client and service value, and result in significant captured cost savings for the USPS through volume leverage buying, process standardization and continuous improvement.

101.2 This Statement of Work (SOW) provides general guidelines for the proper collection and preparation of critical information and documentation and required processes associated with conducting professional studies relative to electrical switchgear equipment used in USPS installations. It is the purpose of these guidelines to assure that all required electrical switchgear equipment information and documentation is properly prepared and maintained and to ensure that professional studies are properly conducted according to industry and manufacturer's specifications.

102 Background

102.1 USPS installations range from the small facility with residential type single-phase power to the very large facility with incoming service voltages to 138 KV (kilovolts) and capabilities of over 20,000 kVA (Kilovolt Amps). Naturally, larger facilities have the more elaborate, complex, and costly electrical switchgear equipment. It is imperative that all USPS installations containing electrical switchgear equipment properly maintain the required data and documentation and ensure the appropriate professional studies be performed to accurately assess the condition and performance of electrical switchgear equipment and related apparatus.

102.2 The term “USPS Installations” includes both owned and leased facilities where the USPS has maintenance responsibility for electrical switchgear equipment and apparatus.

102.3 The USPS currently obtains electrical switchgear equipment professional services relative to collecting and preparing data and documentation, and conducting studies from a wide array of local, geographical and national contractors. Acquisition of these services is primarily coordinated and accomplished through the respective purchasing office, facilities office and/or as authorized through local buying activities. As a result of this decentralized acquisition approach, volume leveraging is usually not realized, because price determinations are based on low demand volume and/or fragmented requirements.

103 Justification for Service

103.1 Specific guidelines for collecting and preparing electrical switchgear equipment information and documentation, and conducting professional studies at USPS facilities are contained in the USPS Operation and Maintenance Series Handbook MS-28, “Maintenance of Electrical Switchgear”. Policies and procedures contained in handbook MS-28 mandate that it is the responsibility of each USPS installation to ensure that all required data is available, complete and current, and that all required professional studies are conducted prior to initiating an electric switchgear preventive maintenance and testing program.

103.2 Because of a lack of internal technical capability and qualified expertise to perform data collection and documentation requirements, or perform professional studies on electrical switchgear equipment and apparatus, most USPS installations must obtain required services from outside qualified contractors.

103.3 A majority of USPS installations have not properly collected and maintained the required data or documentation (available, complete, current and accurate), or performed the required studies to effectively initiate an electric switchgear preventive maintenance and testing program.

103.4 There are no viable options other than adhering to the guidelines for required electrical switchgear equipment data and documentation, and professional studies performed at USPS facilities that are contained in the USPS Operation and Maintenance Series Handbook MS-28. Failure to properly gather and maintain required information and documentation, as well as appropriately conduct studies, could result in higher total service costs.

104 Scope

104.1 In accordance with the guidelines in the USPS Maintenance Series Handbook MS-28, "Maintenance of Electrical Switchgear," the contractor will perform services relative to collecting and preparing electrical switchgear equipment information and documentation, and conducting studies at USPS facilities as required.

104.2 This statement of work (SOW) encompasses all USPS installations, where there are no qualified USPS employees, and it has been identified that professional services are required to collect and prepare required data and documentation, or perform required studies relative to electrical switchgear equipment and related apparatus.

104.3 The USPS shall not be held liable for and the contractor agrees to indemnity and will hold the USPS harmless in respect to injuries or dangers, whether direct or consequential, to persons or property that may arise through the performance and intent of this contracting requirement.

105 Definitions

105.1 The term "Electrical Switchgear Equipment" is generally applied to the material, fittings, devices, fixtures, and apparatus that are part of, or are used in connection with, an electrical installation. This includes the electrical power-generating system, substations, distribution systems, utilization equipment, and associated control, protective, and monitoring activities.

105.2 The term "Contractor Qualifications" is intended to be the minimum standards for a prospective offer or to be considered as qualified to provide services under this proposed contract.

105.3 Additional terms and definitions can be found in the USPS Operation and Maintenance Series Handbook MS-28, "Maintenance of Electrical Switchgear", Glossary of Terms.

106 Contract Type and Duration

106.1 Contract type will be a Firm-Fixed Price Service Contract. The duration of the contract base period will be two (2) years, with three (2)-year options.

107 Contract Exceptions

107.1 The only exception to purchasing from this contract is if the requirement is extremely urgent and the contractor cannot meet the required service date.

108 This Section Reserved for Future Use

109 Description of Switchgear Equipment

109.1 In USPS installations, the electrical switchgear equipment is designed to trip or otherwise open the electrical circuits in the event of overloading, short-circuiting, ground faults, and malfunction of connected equipment. This automatic disconnect function is required to protect the postal facility, personnel, equipment, and the utility providing the electrical service.

109.2 In general, there are a wide variety of switchgear apparatus makes and models. However, electrical switchgear equipment can be grouped into the following four classes:

109.21 Transformers - This equipment class includes both power and distribution type transformers whether dry or liquid (oil) filled. Generally these devices transform the high voltage of the utilities power input down to the appropriate voltage needed to operate building equipment. This class also includes current and potential transformers used to provide metering signals for the power circuits and voltages for the control circuitry. The following apparatus differentiates the types of transformers:

- a. High voltage, liquid-filled, substation type, 500 kVA and up
- b. High voltage, dry, 500 kVA and up
- c. Distribution type, liquid filled, 500 kVA and below
- d. Distribution type, dry, 500 kVA below
- e. Current and potential types, dry
- f. Transformer oil or air cooling equipment

109.22 Circuit Breakers - This class includes a wide variety of devices designed to break a circuit under certain conditions. The devices use thermal or magnetic elements, including relays to respond to over-current or under-current, or voltage conditions and mechanically interrupt the circuit path. Since these devices are designed to interrupt current-carrying circuits, an arc is formed when the circuit is broken. Several different methods are used, including the use of insulating oil, to quench the arc rapidly. Many circuit breakers have both an instantaneous trip rating and an adjustable time delay rating. The following apparatus differentiates the type of circuit breakers:

- a. High/Medium voltage, oil filled
- b. High/Medium voltage, air
- c. Medium voltage -vacuum
- d. Low voltage, 3-phase power
- e. Low voltage, molded-case
- f. Low voltage air

109.23 Relays - This class also includes a wide variety of designs used in power circuits. Some relays operate when an abnormal circuit condition causes the relay to open or close an auxiliary electric circuit, in turn tripping the switch or circuit breaker mechanism. Relays operate on thermal, magnetic, or induction principles and may be instantaneous or time delayed. Switchgear relays are normally used to sense under- or over-voltage or current, power factor, reverse current, phase unbalance, or other important circuit conditions. The following apparatus differentiates the type of relays:

- a. Induction disc over-current
- b. Induction disc directional over-current
- c. Thermal over-current
- d. Over- and under-voltage
- e. Power factor, reverse current, or watt type
- f. Transformer and buss differential; current balance

109.24 Connection Equipment - This class of switchgear includes the apparatus used to interconnect utility power lines, transformers, power wiring, and protective devices. The following apparatus differentiates the type of connection equipment:

- a. Switchboards and Panel Boards
- b. Switches (Disconnect, Air and Transfer)
- c. Lightning and network protectors
- d. Power cables
- e. Meters
- f. Insulators
- g. Bus Ducts and Structures
- h. Ground Fault Systems and Grounding Systems
- i. Battery Systems
- j. Surge Arrestors
- k. Motor Control Centers and Motor Starters
- l. Engine Generators
- m. Passive Devices and Correction Devices
- n. Power vaults

109.3 Detailed descriptions of electrical switchgear equipment are available from a number of sources including manufacturer's catalogs and industrial handbooks.

110 GENERAL REQUIREMENTS

111 Work Requirements

111.1 The contractor shall perform all professional services relative to collecting, gathering, and preparing required electrical switchgear information and documentation, as well as performing required studies.

111.2 Specific professional services are outlined in the solicitation, Attachment 6, Detailed Item Work Specifications. These requirements are quite extensive in an attempt to cover required electrical switchgear professional services at all USPS installations. The contractor must use only those portions of the detailed item work specifications that pertain to the specific professional services being requested at a USPS installation.

111.3 It is the responsibility of the Contractor Officer Representative (COR) to monitor the contract and ensure the contractor's responsibilities are complied with. The COR must immediately notify the Contracting Officer of any discrepancies, defaults, or deviations from requirements, as it is Contracting Officer's responsibility to enforce the contract. Only the Contracting Officer is authorized to approve deviations to contract requirements, and/or request the contractor to perform additional or alternate requirements; therefore, the Contracting Officer must be notified prior to any changes or deviations

111.4 The contractor warrants, for the period specified in section 506, that upon completion of work performed, all services performed will be competent; all services furnished by the contractor shall be free of defects in workmanship and material; and that all recommendations shall reflect their best judgment. The contractor's responsibility, response, and resolution regarding warranty requirements must be consistent with all requirements of Clause 2-8, *Warranty*.

111.5 The contractor guarantees that all work requirements will be performed within established service schedules as jointly established between the contractor and the USPS Installation Manager, Maintenance or their designee. Failure to adhere to established service schedules would result in interruption of mail processing operations, lost productivity, customer dissatisfaction, and additional costs to USPS. Therefore, if contractor fails to perform work requirements within established service schedules, the contractor shall be liable to provide USPS adequate compensation as recovery for losses and/or damages. In such instances, the Contractor Officer reserves the right to make the final decision concerning adequate compensation for nonconformance in satisfying work requirements.

112 Codes, Standards and Ordinances

112.1 All contracted professional services must be in accordance with the latest edition of the following applicable codes and standards (as of the date of the contract) except as may be provided otherwise herein:

- a. National Electrical Code (NEC).
- b. National Electrical Manufacturer's Association (NEMA)
- c. Institute of Electrical and Electronic Engineers (IEEE)
- d. American National Standards Institute (ANSI)
- e. National Fire Protection Association (NFPA) 70B
- f. National Electrical Testing Association (NETA)
- g. MS-28, Maintenance of Electrical Switchgear, Maintenance Handbook Publication (USPS)
- h. Federal, State and local ordinances
- i. Standard for Electrical Safety in the Workplace (NFPA 70E)

113 Safety and Precautions

113.1 Because of the extremely dangerous voltages and currents present in electrical switchgear, precise attention must be paid to safety rules and proper working conditions, to protect both personnel and equipment.

113.2 Safety practices must include, but are not limited to, the following applicable references:

- a. Occupational Safety and Health Act of 1970 - OSHA and current revisions as of the date of this contract
- b. Applicable state and local safety operating procedures as of the date of this contract
- c. ANSI/NFPA 70E, Electrical Safety Requirements for Employee Workplaces
- d. OSHA 29 CFR 1910.147 – Control of Hazardous Energy Sources (Lockout/Tagout)
- e. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4
- f. National Electrical Safety Code, IEEE
- g. National Safety Council, Industrial Data Sheets:
 - 1) Methods of Locking Out Electric Switches, No. 237
 - 2) Flexible Insulated Protective Equipment, No. 598

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113.3 The contractor must provide a designated safety representative for the project to determine when it is safe to proceed with work, and to supervise all the safety aspects.

113.4 The contractor must provide sufficient protective barriers and warning signs to conduct specified tests safely. Safeguards to protect other personnel, i.e., danger signs, roped-off space, barriers, etc., must be used if the nature or location of the work creates a hazard.

113.5 All equipment and working personnel must be effectively guarded by the use of protective equipment (i.e., rubber gloves, approved long face shields, rubber blankets, and floor mats) to protect persons or objects from harmful contact. The contractor is responsible for providing this protective equipment and pre-testing prior to its use.

113.6 All protective equipment, materials and garments must be approved, periodically examined, tested (by a certified test facility), and kept in a safe condition. Any defective equipment, materials and garments must be properly destroyed and replaced.

113.7 Approved leather protection gloves must be worn over rubber gloves to protect the rubber gloves from damage. The gloves must not be used as work gloves, and must be properly disposed of and replaced if they become oil soaked, have faulty or torn stitching, holes, or cuts, or if for any other reason they cannot protect the rubber gloves.

113.8 Prior to commencing work on electrical switchgear equipment that is energized or functioning in an operational state, the equipment must be de-energized. It is imperative that all service work must be performed with equipment and apparatus de-energized unless power is specifically required for the procedure.

MAINTENANCE OF ELECTRICAL SWITCHGEAR

113.81 It is the responsibility of the contractor to verify that all equipment and apparatus being worked on are de-energized. USPS Form 4811 Equipment Lockout Tag, or a Keep Out Tag USPS Form 4812 High Voltage Equipment Lockout Tag, must be attached to the circuit disconnect switch. Whenever possible, a lock (or lockout device) must be placed on the switch to prevent accidental closing of the switch. This device will accommodate up to six padlocks, one for each person working on the circuit. Only the person who "tagged" the equipment and has ensured that all persons are clear of the circuit should remove USPS Forms 4811 and 4812 and switch locks when the job is complete

113.82 All persons must be clear before circuit can be deenergized. The contractor's qualified designee is required to test the circuit at the point of work to positively determine that the circuit is dead, and the downstream load is de-energized before energizing the main circuit breaker.

113.9 "Dead Circuits" must always be treated the same as "live" circuits until they are proven to be dead. This practice develops a caution that may prevent an accident. A circuit may be energized through the error of some other person, back feed, or an automatic feed from another source.

114 Contractor in Attendance

114.1 The contractor shall, upon entering the premises and again when he/she leaves, report time in and out and personnel used to the Manager, Maintenance or his/her designee.

114.2 The contractor is not to perform any work requiring a shutdown of equipment without informing the USPS Installation Manager or designee, in writing and receiving a positive response of when to commence in writing.

115 Division of Responsibilities

115.1 The USPS will have certain responsibilities to the contractor to assist in the performance of the contractor's work. When a contractor performs electrical switchgear data and documentation professional services, the USPS is responsible for:

- a. Providing the contractor with on-site access to the facility on a reasonable continuous schedule.
- b. Providing the contractor with on-site access to available copies of short-circuit, device evaluation, and coordination studies (including change orders) as well as any other pertinent data and documentation.
- c. If required, providing the contractor with copies of plans available that reflect shutdown, power transfer, and start-up procedures.

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- d. Providing the contractor with an equipment availability schedule. All planned service requirements must be performed within the time frames identified in this schedule. The service requirements may cause selective power shutdowns; therefore, the equipment availability schedule must be utilized to coordinate and expedite work requirements to ensure that mail processing operations experience as little interruption as possible.
- e. If available, providing the contractor with available switchgear equipment inventory records for all items located within a specific USPS installation.
- f. Providing the contractor with on-site access to manufacturer's instruction manuals applicable to each particular apparatus and any available switchgear manufacturer's data.
- g. If required, coordinating with the utility company the scheduling of requirements to pull fuses for incoming power to the facility, and reapplying power after work has been completed.
- h. Supplying the facility with necessary emergency lighting for security purposes only.
- i. Coordinating with the contractor all power switching functions. However, it is the contractor's responsibility to verify that circuits being worked on are de-energized.

115.2 The contracting firm will have certain responsibilities in the performance of the required work. When a contractor performs electrical switchgear data and documentation professional services, the Contractor is responsible for:

- a. Performing a pre-site visit at each requesting USPS Installation prior to commencing work. The purpose of this visit is to assess the conditions, environment, configuration and requirements of the individual facility; perform any site preparation requirements; and construct a tailored cost estimate for services to be performed at each specific USPS installation. The pre-site visit date and time will be coordinated and arranged between the contractor and the Manager, Maintenance or designee at the requesting facility. Approval of cost estimates must be submitted to the Contracting Officer's Representative (COR) at each facility for review and approval prior to the commencement of any work. Failure to perform this pre-site visit and/or satisfy pre-approval requirements will not relieve the contractor from having to furnish any material or perform any labor that may be required to complete the work in strict accordance with the intent and meaning of specifications without additional cost to the USPS.
- b. Coordinating with and notifying the USPS prior to performing any services at a USPS installation. The contractor must coordinate the scheduling and performance of work, especially any work that may require electrical outages, with the USPS Installation Manager, Maintenance or designee.
- c. Providing a designated safety representative for the project to determine when it is safe to proceed with work, and to supervise all the safety aspects.
- d. Incurring transportation, travel and administrative costs associated with performing all requirements as contained herein.
- e. Supplying all labor, parts, material, equipment, transportation, technical support, manufacturers' data and all other items necessary to perform required services.
- f. Supplying required protective barriers and warning signs to conduct specified service requirements in a safe manner; and supplying protective equipment (i.e., rubber gloves, approved long face shields, rubber blankets, and floor mats) to protect persons or objects from harmful contact.

- g. Supplying a portable power source (the installation of which must meet USPS safety requirements) where conditions are such that portable power is needed.
- h. Providing immediate notice to the USPS Installation Manager, Maintenance or designee of any apparent damage and/or defects to the electrical switchgear equipment and apparatus. The contractor must notify the Manager, Maintenance or designee in writing on the day of discovery, of the existence of discovered damage or defects in, or required repairs to electrical switchgear equipment.

116 Information and Documentation Guidelines

116.1 Specific information and documentation (gathering and preparing data, and conducting studies) are outlined in the solicitation, Attachment 6, Detailed Item Work Specification. The contractor must perform only those service requirements that have been requested and pre-approved at a specific USPS installation.

117 Submittals

117.1 All submittals (documentation and studies) shall be forwarded through the Contracting Officer's Representative to the USPS Contracting Officer.

117.2 If the submittal is being made for more than one facility, then the submittal shall be divided and made complete, as a stand-alone section, for each individual facility containing all requested material.

117.3 As a minimum, all submittals shall contain the following:

- a. The date of submission
- b. The facility title and contract identification
- c. Name of contractor, with business address
- d. Listing of all applicable standards, such as IEEE, ASTM, ANSI, or Federal Specification numbers
- e. A complete documentation inventory listing of all equipment, with any required submissions, applicable to the study/studies being performed
- f. If applicable, a clear legible copy of manufacturer's time current characteristic curves for each applicable overcurrent protective device
- g. Identification of deviations from Contract Documents
- h. An 8" X 3" blank space for Contractor's and Professional Engineer's stamp
- i. Contractor's and Professional Engineer's stamp, initialed or signed, certifying to review of submittal, verification of procedures, field measurements and field performance criteria, and coordination of the information within the submittal with requirements of the Work and the Contract Documents
- j. Completed study/studies as requested herein
- k. Completed Switchgear Documentation Inventory Form for each facility

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117.41 The submittal manual must be of the following format:

- a. Size: 8-1/2" X 11"
- b. Paper: White bond, at least 20 lb. weight
- c. Text: Neatly typed with a table of contents arranged in a systematic order
- d. Inserts: 11" in height preferable; bind in with appropriate text; foldout acceptable but fold to fit in the Manual within a containment pocket. (This includes any drawings or schematics.)
- e. Flysheets: Separate each portion of the Manual with neatly prepared flysheets briefly describing contents of the ensuing portion; flysheets may be in color.
- f. Binding: Use heavy-duty plastic or fiberboard covers with binding mechanism concealed inside the Manual; 3-ring binders will be acceptable.

117.42 Provide durable front and back covers for each manual and clearly identify on or through the cover the contractor's firm name, address and telephone number in a format similar to the following:

UNITED STATES POSTAL SERVICE
ELECTRICAL SWITCHGEAR MAINTENANCE PROGRAM
TECHNICAL SUBMITTAL MANUAL FOR
(State Facility(s) name and address)

Submitted by:
(Contractor's Company Name)
(Name of responsible principal)
(Company Address)
(Company Phone Number)

118 Study Report

118.1 Two sets of final draft review will be provided to the facility for their review and comments for a period not to exceed fourteen (14) days from date of submittal. Comments will be submitted to the vendor in writing.

118.2 The results of the studies shall be summarized in a final report to be furnished, as required in submittal section, to the USPS Contracting Officer no later than thirty (30) days after the completion of the study.

118.3 Three (3) bound copies of the report, and (if applicable) a single-line diagram of the portion of the power system that is included within the scope of the studies shall be provided. Contractor is to ensure that any required submittals for this report that are necessary because of conclusions or recommendations made, are included in this final report. Specific comments regarding findings and recommendations, along with cost estimates, shall be furnished as a part of this report as appropriate.

In addition one electronic copy (Microsoft Excel or Word) of the completed study must be furnished with the hard copy document. All drawings must be in electronic copy using most recent CAD software.

118.4 The study report shall include the following:

- a. A neatly typed report with a table of contents arranged in a systematic order.
- b. Contractor's firm name, the name of the responsible principle, business address and telephone number.
- c. Clearly identify the data applicable to each individual facility.
- d. (If applicable) Coordinate data with drawing numbers to assure correct illustration is provided for all completed requirements.
- e. Provide a logical sequence of data for each procedure performed.
- f. (If applicable) Ground fault relays; if not already done, provide documentation establishing recommended set points for these relays.
- g. A detailed discussion on the overall existing conditions found with notations provided regarding any instances of code noncompliance, poor workmanship, or other deficiencies. Include recommended solutions and cost estimates where applicable.
- h. A/E professional evaluation or opinion of electrical switchgear components and system.

119 Quality Reviews

119.1 The USPS and the contractor will hold annual reviews at a site designated by USPS to discuss contract performance, and address concerns, issues and opportunities for improvement. The contractor will offer suggestions for improvements to enhance the effectiveness of the contract and to reduce costs throughout the entire supply chain.

119.2 During the annual review session, the contractor must be capable of reporting to the USPS Installation local finance number level with intermediate District Cluster and Area roll-up capabilities. Information contained in these reports must be current, accurate and accessible to the Postal Service. A summary of the minimum required reports follows.

- a. Cost Improvement Targets (SCM processes such as standardization and resource optimization)
- b. Cost Savings to the USPS and Contractor
- c. Year-to-date Invoicing and Billing Summary Report for each USPS Installation finance number
- d. Supplier Diversity Report - breakdown by small, minority, woman-owned businesses (Clause 3-2, *Quarterly Submission of Supplier Diversity/Subcontracting Reports*)
- e. Customer Satisfaction Indices
- f. Quality Assurance Measurements (a documented reporting system that includes mechanisms to monitor and measure the processes being used to perform the contract, systematic approaches for corrective action, where needed, continuous improvement measurement of key indicators, regular quality reviews, and periodic customer reviews.

120 CONTRACTOR QUALIFICATIONS

121 Company Requirements

121.1 The contractor is required, and must show proof that a Professional Electrical Engineer (PEE), licensed within the State where the work is being performed, has validated all information and documentation service requirements and results. Validation may be through actual witnessing of each service requirement performed, or a signed statement indicating that the PEE has reviewed and approved all service requirements performed. Only contractors that utilize a PEE to verify the work and procedures required herein will be considered. The contractor must submit proof of this qualification with bid documents.

121.2 The contractor must have three or more years experience related to the electrical switchgear information and documentation requirements contained herein, and must be currently engaged in performing these professional services. The contractor must submit proof of this qualification with bid documents.

121.3 The contractor must be covered by Workman's Compensation Insurance and Public Liability Insurance, and indemnify and save harmless the USPS from any liability for damages arising out of the activity of the contractor because of injury to or death of any person or damage to any property. The contractor must submit proof of this qualification with bid documents.

122 Operational Requirements

122.1 Management and Infrastructure - The contractor must possess the structural, organizational and managerial support mechanisms necessary to perform a contract of this size and scope. As a minimum, the following management and infrastructure factors must be addressed:

- a. The contractor must describe the composition and organization of the company's service network, and list the locations of all technical service/customer support centers and the areas they service.
- b. The contractor must explain how the company's service network will provide the operational capacity necessary to fully satisfy contract requirements.
- c. The contractor must describe qualifications and competencies of personnel, as evidenced by:
 - 1) Key Personnel
 - 2) Job Description and Responsibilities
 - 3) Years of Experience (with the contractor's company and previous companies)
 - 4) Educational and Professional Qualifications

122.11 The contractor must explain plans, if any, to outsource or establish alliances to meet service requirements.

122.2 Implementation Plan - The contractor must submit with their bid proposal, a clear and comprehensive Implementation Plan that, as a minimum addresses how the contractor will coordinate schedules and resources, track performance and comply with the overall requirement to perform services at various USPS Installations. The plan must also address the following key elements:

- Names, titles and experience of key personnel working on implementation plans
- Specific plan for full state-wide implementation
- Detailed milestone schedule
- Commitment to customer service (technical, operational, problem resolution)

122.21 The implementation plan should include an explanation that the contractor has a thorough understanding of the Statement of Work, technical expertise and adequate resources (financial, personnel, facilities, equipment, etc.) to adequately perform the contract service requirements.

122.22 Within fourteen (14) days after contract award, the contractor will submit a final, updated Implementation Plan to the Contracting Officer for approval.

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122.3 Past Performance - The Postal Service is looking for service providers with a past performance record of maintaining quality standards and high levels of customer satisfaction. Therefore, the contractor must show a history of being reasonable and cooperative with the customer, while demonstrating a commitment to quality workmanship, customer satisfaction, integrity, and ethics. It is preferred that the contractor address past performance in terms of activities that are similar in size, scope, and magnitude of the USPS service requirements contained herein. As a minimum, the following information must also be provided:

- a. The contractor must provide a minimum of three (3) references.
- b. The contractor must provide verifiable data that supports their claim of past experience.
- c. The contractor must provide a list of all contracts with the USPS during the past 5 years.

122.4 SCM - The contractor must manage the contract using Supply Chain Management (SCM) principles that include a commitment to continuous improvement, and cost reduction over the term of the contract in such areas as transaction and process costs, and quality enhancements. After contract award, service history will be collected and used to establish mutually agreed upon baselines and criteria for accomplishing quality improvements, and reductions in transaction and process costs within the entire supply chain. The contractor will be responsible for submitting at least three cost savings processes before the end of the base term period of the contract.

122.5 Quality Assurance - The contractor must employ a documented quality assurance system to monitor and measure its performance against contract requirements as required in Clause 2-49, Quality Assurances Services. The USPS has the right to evaluate the acceptability and effectiveness of the contractor's quality system prior to award, and to periodically verify that it is in use and effective during contract performance. The contractor must submit proof of this qualification with bid documents.

122.51 As a minimum the contractors Quality Assurance System must include:

- a. Comprehensive measurement of contract performance
- b. Comprehensive means of assessing customer satisfaction that includes, at a minimum, periodic customer survey
- c. Contractor/customer focus groups, and/or other means of securing regular customer feedback

122.6 Sub-Contracting - All contractors, except small businesses, must submit an established sub-contracting plan that is specific to this contract, and separately addresses sub-contracting with small, minority, and woman-owned businesses. The sub-contracting plan must indicate how commitments and results will be obtained to comply with Clause 3-1, *Small, Minority, and Women-owned Business Subcontracting Requirements*, and contain clear goals and objectives as to what the contractor will do to increase sub-contractors in the realm of small, minority and woman-owned businesses. Further, the sub-contracting plan must address the requirements of Clause 3-2, *Quarterly Submission of Supplier Diversity/Subcontracting Reports*. (See *Instructions for Suppliers Submission of Sub-Contracting Reports*, Attachment 4). This sub-contracting plan must be approved by the USPS and will be made a part of the contract.

Item 1: Inventory of Drawings and Schematics

The Inventory of Drawings and Schematics is a document that lists all of the available electrical drawings and schematics by title and drawing number. This information may be available from the electrical prints (usually the “E” drawings), information supplied with the switchgear and associated equipment or other “as built” information supplied with the facility. The detail and extent of information will vary with the complexity of the distribution system and size of the facility. In general, the following drawings are available from onsite technical data files or with the facility drawing package:

1. One line diagram depicting overview of the plant electrical distribution system, identifying the equipment to be tested and the electrical parameters (kVA, volts, amps, HZ, power factor, impedance, phasor diagram, etc.)
2. One line diagram and three line diagram (schematic) showing incoming power lines, high voltage circuit breakers, power and distribution transformers, Current Transformer (CT) and Potential Transformer (PT) connections, circuit breakers, relays, control switches, auxiliary devices, substations, load centers, motor control centers, auto-transfer switches, onsite emergency power sources, Power, Lighting and Receptacles Panels, etc.
3. DC power and control schematic displaying DC distribution including batteries, charging devices, distribution panels, etc.
4. One line displaying Main uninterruptible (UPS) power sources for the plant vital equipment and systems.
5. Interface drawings showing Safety Related systems, Heating Ventilating and Air Conditioning (HVAC), Fire Protections, Security systems that may impact temporary power shutdowns while performing maintenance on power equipment. It is important to consider the consequences and impact of partial or total outage during testing for these systems.

NOTE

Alternate sources should be available to power such critical and vital plant equipment or systems.

6. If available or optionally such other data including Power Quality parameters, THDs, tolerable voltage and amperes imbalances, power factors, recent drawings showing grounding and bonding improvements, etc.
7. Historical Testing Reports, Studies or Reference Documents including the thermographic Infra-Red (IR) surveys, detailing deficiencies and remedies completed in previous years.

Item 2: Plans Available (Shutdown, Power Transfer, and Start-Up)

NOTE

The following plans will vary in detail depending on complexity of the system and the specific site needs based on past history of problems.

These are detailed instructions comprised of a one-line drawing of the switchgear, with each device associated with the shutdown, power transfer, and start-up procedures identified, along with a listing of the sequence of operation to be performed to accomplish any of these procedures. Each disconnect or circuit breaker that is to be opened or closed in these procedures must be identified exactly the same for both the drawing and sequence of operation. In addition, the physical location of these devices must also have this same identification. These instructions are to be provided in a suitable frame that is to be mounted in a conspicuous location within each switchgear room and vault.

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Plans for Shutdown - This plan provides the necessary detailed instructions to perform partial branch shutdowns or a shutdown of the total system. The details provided must contain the sequence by which electrical loads should be shed to power down various parts of the system. The plan must consider that the loads shed are loads that would have an impact on the ability to restore power as rapidly as possible upon restoration of service. In addition, consideration should be given to leaving the main disconnect or breaker "closed", along with a complete "closed" circuit to a designated lighting circuit that is to be monitored. This would provide an immediate indication of restoration of power to the facility, with little impact regarding a surge load.

Power Transfer - If the facility is powered by multiple power sources, this plan provides the necessary detailed instructions and procedures to perform the transfer of power safely between multiple power sources. It must indicate whether the transfer is automatic or non-automatic and the sequence of operation that is (if automatic) or has to be performed (if non-automatic).

Automatic Transfer Switch - Provide details of the sequence of operations performed that automatically transfers electrical loads from the normal power source to another standby source, whenever the normal source fails or changes beyond any preset operating limits. In addition, provide the details of the sequence of operation that is to be performed, in accordance with an established procedure, of transferring the load back to the normal source once the normal source is restored.

Non-automatic Transfer Switch - Provide details of the sequence of operations performed to operate by direct input, by manual input, or by electric signals received from remotely located control devices that transfer electrical loads from the normal power source to another standby source when the normal source fails or when conditions warrant a transfer need. Bypass isolation switches should be indicated where used in conjunction with an automatic transfer switch.

Start-Up Procedures - This plan provides the necessary detailed instructions regarding the procedures and sequencing necessary for the closure of devices when re-application of electrical loads is planned.

Required Documentation - Three drawings, minimum of "C" size, shall be provided, one of which shall be a reproducible mylar. A copy of the drawing shall also be provided on computer disk when generated by a Computer Assisted Design (CAD) system.

Drawings shall be presented in a clear and thorough manner using ASA symbols. Maintain relative geographic relations and, as far as practical, approximate relative positions of components. These plans shall be comprised of a one-line drawing of the switchgear with each device associated with the shutdown, power transfer, and start-up procedures identified. Detailed instructions shall be provided on the drawings that list the sequence of operation to be performed to accomplish any of these procedures. Each disconnect, relay, or circuit breaker that is to be opened or closed in these procedures must be identified exactly the same for both the drawing and sequence of operation. In addition, the physical location of these devices must also have this same identification. These drawings/instructions are to be provided in a suitable frame that is to be mounted in a conspicuous location within each switchgear room and vault.

Item 3: Short Circuit, Device Evaluation, and Coordination Study

The basis of these studies is the major consideration that the electrical distribution system provides the required quality of service to all its various loads. This includes serving each load under normal and abnormal conditions, and providing the desired protection to system equipment and/or devices so that interruptions of service are minimized consistent with good economic and mechanical/electrical design. As a result of these studies, settings are established (where applicable) for relays, breakers, and ground fault protection settings.

These studies should be reviewed whenever additional large electrical loads are added to the facility that lead to increased levels of available short circuit currents or if the electrical utility company enlarged its own system and increased the available fault capacity. Completed studies must be maintained on file with all required electrical switchgear documentation.

If a Short Circuit, Device Evaluation, and Coordination Study is needed, the following should be performed:

- A power and protective device coordination study that will provide feeder loading calculations
- A complete short circuit and equipment evaluation study indicating equipment withstand and interrupting values
- A protective device coordination study of the facility(s) electrical distribution system.

The studies shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low voltage distribution system. Normal system operating method, alternate operation, and operations that could result in maximum fault conditions shall be thoroughly covered in the studies.

Before performing the Short Circuit, Device Evaluation, and Coordination Study, the following data must be collected and made a part of the finished report:

1. A single-line interconnection diagram.
2. The short circuit contribution from the power company source and the X/R ratio of this contribution.
3. The impedance, voltage ratios MVA rating, and method of neutral grounding for all transformers.
4. The type, size, number of conductors and the lengths of all interconnecting cables. For overhead conductors, include spacing configurations.
5. Motor horsepower including nameplate data for full-load amperes, locked-rotor amperes, acceleration time to attain 99% synchronous speed and service factor.
6. An indication as to which tie breakers or switches are normally closed or cannot be closed for certain reasons.

Short Circuit Study

The study shall be performed in accordance with ANSI C37.5 and IEEE Standard 241, 242, 399, and 602.

The study input data must include the utility company's short circuit single and three phase contribution, with the X/R ratio for each resistance and reactance component of the branch impedances, motor and generator contributions, transformers, and all conductive components (bus, bus ducts, cables, reactors, and capacitors), base quantities selected and all other applicable circuit parameters.

A determination of the maximum short-circuit current capacity at each nodal point in the power system is to be performed to develop the short-circuit duty. The contents of the short-circuit study shall also discuss the effects on the system after the removal of any lines due to protective device operation or scheduled line outages.

Equipment Evaluation Study

Once the short-circuit duty has been determined, it is to be compared to the equipment ratings to see if the rating exceeds the calculated duty. The ratings that must be compared include the mechanical bracing of transformers and buses and withstand and interrupting ratings of over-current protective devices, switches, disconnects, controllers, surge arrests, busways, and fuses.

Protective Device Coordination Study

A protective device coordination study shall be performed to check the selection of fuses, circuit breakers, switches, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, low voltage breaker trip characteristics and settings, and size and settings of all other applicable equipment.

Many components of the electrical system have adjustments that are made to electrical protective devices to be sure that they will operate properly, without hesitation, when needed. The information for the proper settings is to be obtained from the coordination study. This information is to be found in the coordination survey that was performed when the building was constructed, or possibly provided later through an engineering contract when a major modification or upgrade of the original system was made. If this information is not available, or major changes to the electrical distribution system have occurred that would affect settings, without an updated coordination survey being performed, then electrical switchgear and preventive maintenance should not be performed at a facility.

The coordination study must include all voltage classes of equipment from the utility's incoming line protective devices down to and including each motor control center and/or panel board, and determination of operating-current characteristics (normal, peak and starting) of each utilization circuit. The phase and ground over-current protection shall be included as well as settings for all other adjustable protective devices. The time-current characteristics of the specified protective devices shall be plotted on the appropriate log-log paper. [In addition, a time-trip characteristic of all devices in series should be plotted on a single sheet of standard log-log paper. Devices of different-voltage systems are to be plotted on the same sheet by converting their scales, using the voltage ratios, to the same voltage basis.] The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuse curves.

The coordination plots shall indicate the types of protective devices, relay taps, time dial and instantaneous trip settings, ANSI transformer magnetizing inrush and withstand curve per ANSI C37.91, cable damage curves, and symmetrical and asymmetrical fault currents. Reasonable coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. Separate curves shall be used for each utility main breaker, primary feeder breaker, unit substation primary protective device, main and tie secondary breakers, substation feeder breakers, and main load protective devices rated 100 amps or more. There shall be a maximum of six (6) protective devices per plot.

The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system. Discrepancies, problem areas or inadequacies shall be promptly brought to the Contracting Officers attention.

Item 4: One-Line Drawings and Schematics

Consists of reproducible one-line (single line) drawings and schematics, which includes distribution diagrams, control wiring and coordination settings. Existing (new or updated) one-line drawings and schematics must be available at each USPS installation that possesses electrical switchgear equipment. The need to update drawings will be dependent upon whether or not existing drawings reflect the true extent of the current electrical distribution system, as of the date of the contract award. This will also include the identification of any planned additions as of this same date. If drawings and schematics do not reflect the true extent of the current system, they should be updated. All drawings and schematics are required to bear the seal of a Professional Engineer licensed in the state where the facility(s) is located.

One-Line Power Distribution Drawings

One-line power distribution drawings graphically represent the electrical system in the facility. They must contain information about the type, size, and capacity of all the electrical safety devices in the facility, as well as include incoming feeder and distribution transformer kVA ratings, input/output voltages, and transformer taps. Switchgear shall be identified by IEEE device and function numbers. Additional requirements for one-line drawings are, but may not be limited to, the following:

1. Manufacturers' type designations and ratings of apparatus.
2. Ratios of current and potential transformers, taps to be used on multi-ratio transformers and connection of double-ratio current transformers.
3. All control transformers, protective and control relays, and metering devices are to be shown.
4. Connections of power transformer windings.
5. All circuit breakers shown with their ratings in volt and amperes, their interrupting rating, settings, type, frame size and number of trip coils.
6. Function of relays.
7. Ratings of large motors.
8. Size and type of conductors.
9. Voltage, phase, and frequency of all incoming circuits. Indicate wye or delta systems, grounded or ungrounded.
10. Incoming feeder and distribution transformer kVA and impedance ratings.
11. Transformer input/output voltages, and taps.
12. All disconnects or load interrupters shown with their size and ratings.
13. All busses shown with their size and ratings.
14. All power, lighting, and receptacle panels shown with their ratings, and actual or calculated loads.

It is not required to document the loads beyond the lighting or receptacle panels. Power panels, rated 200 Amps or above, and secondary loads will be identified on the drawings.

Required Documentation

Drawings shall be presented in a clear and thorough manner using ANSI/IEEE symbols. Maintain relative geographic relations and, as far as practical, approximate relative positions of components.

Switchgear Control Schematics

Switchgear control schematics must show all the control, protective and metering devices. All devices shall be identified on the Bill of Material (part of drawing) by IEEE device and function number, with the manufacturer's catalog and serial numbers. Brief operation instructions for the controls will be included with the schematics.

Required Documentation

Three drawings, minimum of "C" size, shall be provided; one of which shall be a reproducible mylar. A copy of the drawing shall also be provided on computer disk when generated by a CAD system.

Drawings shall be presented in a clear and thorough manner using ANSI/IEEE symbols. Maintain relative geographic relations and, as far as practical, approximate relative positions of components. The drawings presented are to consist of a schematic and wiring diagram combined. The schematic portion of the drawing depicts how the circuit functions with regard to the electrical sequence of events, while the wiring diagram shows where the various components are physically located.

Item 5: Inventory of Cables

The inventory of cables consists of all documented information as indicated below, which includes the wiring that feeds each distribution panel board and any sub-distribution panel boards. Information must also identify the manufacturer's voltage class, type and length. It is not required to document the loads beyond the lighting or receptacle panels.

Cable information displayed on the drawings or presented in the coordination survey does not meet the requirements of this section. The cable information that is required in this section must be provided in separately provided cable charts.

The information required is, but may not be limited to, the following:

1. Cable sizes (AWG)
2. Voltage class
3. Voltage ratings
4. Ampacity
5. Types
6. Insulation types
 - a. Laminated
 - b. Solid dielectric
7. Insulation shields
 - a. Non-metallic
 - b. Metallic
8. Cable terminations
 - a. Non-shielded
 - b. Shielded
9. Cable lengths

Item 6: Inventory of Breakers

The Inventory of breakers consists of all documented information as indicated below, which includes the breakers serving the distribution panel boards. Information must also identify the breaker type, manufacturer's model, serial numbers, and time current characteristic curves (if available). All panel boards, including any sub-panel boards, are to be listed as a requirement of this section, with an indication of whether or not it has a main breaker. If a distribution panel board has a main breaker, it is also to be listed as a requirement of this section.

The information required is, but may not be limited to the following:

1. Circuit Breaker types
 - a. Molded case
 - b. Low voltage air
 - c. Medium voltage air
 - d. Medium voltage vacuum
2. Voltage ratings
3. Interrupt ratings
4. Interrupting capacities
5. Ambient temperature ratings
6. Manufacturers
7. Quantity
8. Locations
9. Models
10. Types
11. Serial numbers
12. Time current characteristic curves
13. Compatibility - are breakers installed correctly and compatible with panel board original manufacturer's specifications.
14. Service - are breakers able to be repaired, replaced with new or rebuilt equipment. Include direct replacement alternatives.

Item 7: Inventory of PT & CT Transformers

The inventory of potential transformers (PT) and current transformers (CT) consists of all documented information as indicated below, which includes manufacturer's model and serial number, and voltages and ratios.

The information is, but is not limited to, the following:

1. Manufacturers
2. Quantity
3. Location
4. Models
5. Serial numbers
6. Current ratios
7. Voltage insulation ratings
8. Types
9. Ambient temperature ratings
10. Insulation class
11. Rated primary voltage and ratios
12. Compatibility with system
13. Projected life cycle
14. Replacement alternatives (optional)

Item 8: Inventory of Switchgear

The inventory of switchgear consists of all documented information as indicated below, which includes name of manufacturer, model, serial number, and voltage and amperage.

The information is, but is not limited to, the following:

1. Manufacturers
2. Location
3. Models
4. Serial numbers
5. System voltage
6. Maximum design voltage
7. Momentary short circuit rating
8. Main bus rating
9. Classification
 - a. Metal-Enclosed - Low Voltage Switchgear - Up to 600 V
 - b. Metal-Clad - Medium Voltage Switchgear – 600 V – 15 kV
 - c. Metal-Enclosed - High Voltage Switchgear – 15 kV – 34.5 kV
10. Interrupter switches
 - a. Ampères continuous
 - b. Ampères interrupting
 - c. Momentary (switch closed, 10 cycle) amps asymmetrical
 - d. Fault close amps asymmetrical
11. Projected life cycle
12. Replacement alternatives

Item 9: Inventory of Relays

The inventory of relays consists of all documented information as indicated below, including a complete inventory of relays, induction disc overcurrent, directional overcurrent, thermal overcurrent, over and under voltage, power factor, reverse current and watt type with coordination set points indicated.

The information is, but is not limited to, the following:

1. Manufacturers
2. Quantity
3. Location
4. Models
5. Serial numbers
6. Types
 - a. Alarm
 - b. Differential
 - c. Distance
 - d. Directional power
 - e. Timing
 - f. Voltage
7. Kinds
 - a. Differential protection
 - b. Directional overcurrent protection
 - c. Ground protection
 - d. Under voltage protection
 - e. Reverse current protection
 - f. Overcurrent protection
 - g. Thermal overcurrent protection
8. Projected life cycle
9. Replacement alternatives

Item 10: Lightning Protection Drawings

Lightning protection drawings reflect the devices used to protect the electrical system and building from the effects of a lightning strike. These drawings should clearly identify all down conductors and tie points, with wire sizes.

The information required to be presented in the drawings is, but is not limited to, the following:

1. Air terminals
2. Conductors
3. Ground terminals
4. Interconnecting conductors with all tie points shown
5. Arresters
6. Grounding rod sizes
7. All other connectors or fittings required to complete a lightning protection system

Drawings shall be presented in a clear and thorough manner using ANSI/IEEE symbols. Maintain relative geographic relations and, as far as practical, approximate relative positions of components.

Item 11: Inventory of Distribution and Power Transformers

The inventory of distribution and power transformers consists of all documented information as indicated below, including all transformers divided into the categories of either distribution or power transformers. Power transformers are defined as those larger than 500 kVA, while distribution transformers are those 500 kVA or smaller.

The information required is, but is not limited to, the following:

1. Manufacturer
2. Quantity
3. Location
4. Model
5. Serial number
6. Primary and secondary voltage ratings
7. kVA capacity
8. Impedance rating
9. Cooling method
10. Ambient temperature rating
11. Insulation class
12. Input/output voltages, and taps
13. Phase and frequency
14. Indicate wye or delta windings and placement
15. Sound level rating

Item 12: Inventory of Distribution Bus Ducts

The inventory of distribution bus ducts consists of all documented information as indicated below, including all bus ducts contained within each facility that are rectangular or square and carry electrical conductors.

The information required is, but is not limited to, the following:

1. Manufacturer
2. Quantity
3. Location
4. Operating voltage
5. Continuous current rating
6. Momentary current rating
7. Bus types
 - a. Non-segregated
 - b. Segregated
 - c. Isolated
8. Bus duct types
 - a. Feeder
 - b. Plug-in
 - c. Short-run
 - d. Weatherproofed
 - e. Trolley
9. Enclosure type
 - a. Enclosed
 - b. Ventilated
10. Ambient temperature rating
11. Conductor material
 - a. Copper
 - b. Aluminum
 - c. Copper-clad aluminum

Item 13: Inventory of Switchboards or Power Distribution Panels

The inventory of switchboards or power distribution panels consists of all documented information as indicated below, including all switchboards and power distribution panels contained within each facility. This information must also be provided for the main panels in smaller facilities, and sub and secondary panels in other facilities.

The information required is, but is not limited to, the following:

1. Manufacturer
2. Type
3. Quantity
4. Location
5. Serial and /or catalog number
6. Maximum voltage rating
7. Maximum amperes rating
8. Continuous amperes rating
9. Interrupting capacity, amperes symmetrical

Item 14: Inventory of Motor Starters for Chillers

The inventory of motor starters for chillers consists of all documented information as indicated below, including all motor starters over 200 HP contained within each facility. Some motor starters for equipment in excess of 200 HP may be found incorporating other features such as reduced voltage starters for A/C chillers.

The information required is, but is not limited to, the following:

1. Manufacturer
2. Quantity
3. Location
4. Horsepower
5. Voltage rating
6. Class
7. Type
 - a. Full voltage starters
 - i. Non-reversing
 - ii. Reversing
 - b. Wound rotor starters
 - c. Synchronous motor starters
 - d. Reduced voltage starters
 - i. Reactor starter
 1. Non-reversing
 2. Reversing
 - ii. Autotransformer starter
 1. Non-reversing
 2. Reversing
8. Contactor amp rating
9. Starter interrupting rating (kVA)

Item 15: Inventory of Ground Fault Relays

The inventory of ground fault relays consists of all documented information as indicated below, clearly identifying the ground fault relay for each facility, and listing the coordination set points.

The information required is, but is not limited to, the following:

1. Manufacturer
2. Quantity
3. Locations
4. Models
5. Serial numbers
6. Disconnect device
 - a. Molded case circuit breaker
 - b. Power circuit breaker
 - c. Bolted pressure switch or other fusible disconnect device, suitable for ground fault sensing and relaying equipment
7. Replacement alternatives

Item 16: Grounding System Drawings

Grounding system drawings identify all grounding connection points, type of connection grounding, electrode size, number of electrodes and the wire size. Drawings shall be presented in a clear and thorough manner using ANSI/IEEE symbols. Maintain relative geographic relations and, as far as practical, approximate relative positions of components.

The information required to be presented in the drawings is, but is not limited to, the following:

1. Size and type of all conductors
2. Grounding terminals
3. Ground rod sizes and locations
4. Interconnecting conductors and/or conducting paths shown, including all tie points
5. All other connector or fittings required to complete the grounding system

Item 17: Inventory of Electrical Switchgear Equipment Requiring PM/Testing

Refer to the Electrical Switchgear Testing/PM/Inventory form in Appendix F. This form provides a complete listing of all electrical switchgear and power distribution equipment that should be included in the master inventory, requiring routine preventive maintenance and testing. To complete the Electrical Switchgear Testing/PM/Inventory form, the following guidelines must be adhered to:

1. Identify the name of the USPS installation in the "Site" block. Be sure you complete a separate form for each individual USPS installation.
2. The "Item #" column provides a cross-reference to the equipment line items contained in the Maintenance Series Handbook MS-28, Appendix C.
3. The "Item Description" column provides a cross-reference to the equipment descriptions as listed in the Maintenance Series Handbook MS-28, Appendix B.
4. The "Size" column indicates the size of equipment to which the PM or testing applies.
5. Indicate in the "Estimated Test Time" column, a reasonable estimation of the time required to perform tests on the specific equipment (by per unit and total time).
6. The "Freq-Year Interval" column indicates the frequency by which the maintenance and testing should be performed for each equipment line item.
7. In the "Number in Inventory" column, identify all of the quantities that you may have for a particular line item.

**APPENDIX D
SWITCHGEAR - TESTING/PM/INVENTORY**

**ELECTRICAL SWITCHGEAR EQUIPMENT
REQUIRED INVENTORY SPECIFICATIONS**

GENERAL

USPS installations range from the small facility with residential type single-phase power to the very large facility with incoming service voltages to 138 KV (kilovolts) and capabilities of over 20,000 kVA (Kilovolt Amps). Naturally, larger facilities have the more elaborate, complex, and costly electrical switchgear equipment and require more documentation.

It is the responsibility of each USPS installation containing electrical switchgear equipment to participate in a routine preventive maintenance and testing program to ensure that all equipment and related apparatus function properly and operate at peak performance. Further, it is the responsibility of each USPS installation to ensure that all required inventory documentation is available, complete and current.

It is important that all of the existing inventory data available, as well as any significant changes made to the electrical distribution system that are not reflected in the drawings and/or inventory records, is appropriately collected and recorded. The availability, quality and integrity of the data can substantially reduce overall service costs.

INVENTORY SURVEY

The Electrical Switchgear Equipment-Inventory Survey is used to identify and validate the amount and type of electrical equipment that is required for electrical switchgear preventive maintenance and testing.

Site personnel should collect as much data as possible. Some of this required data may be obtained from prior surveys, site drawings, and the architectural firm that designed the building, or the contractor that installed and adjusted the equipment initially.

To complete the Electrical Switchgear Equipment-Documentation Inventory Survey, the following guidelines must be adhered to:

1. Identify the USPS installation in the "Site" block. Be sure to use a separate survey for each individual installation.
2. Annotate the date the survey was completed in the "Date" block.
3. For each separate item on the survey form, place an "X" in the appropriate block to indicate whether the required data, documentation and/or professional study requirements have been satisfied; or if outside professional services are required to satisfy a specific requirement. In addition, indicate the install date and last revision date for each line item.
4. Annotate in the "Comments" block any information that you feel would be pertinent to local personnel, the purchasing office or an outside supplier.

If it is determined that a USPS installation has all of the required data and documentation available (current, complete and accurate), you can proceed to obtain electrical switchgear preventive maintenance and testing services from pre-qualified service providers. Each USPS installation requiring electrical switchgear equipment preventive maintenance and testing services (by an outside contractor) must forward a funded requisition and a copy of the completed Electrical Switchgear Equipment-Documentation Inventory Survey to the Category Management Center (CMC), for coordination of requirements.

REQUEST FOR MAINTENANCE AND TESTING SERVICES

If it is determined that a USPS installation requires a preventive maintenance testing contract, the required data and documentation must be available (current, complete and accurate) prior to initiating an electrical switchgear preventive maintenance and testing program. You must forward a funded requisition, along with the completed Electrical Switchgear Equipment-Testing and PM/ Inventory Sheet, to the Category Management Center (CMC). A contract will then be initiated to obtain these services from an outside, pre-qualified service provider. Refer to Appendix E.

REQUIRED DATA AND SPECIFICATIONS

The following data, documentation and specifications are information that should be available at the USPS installation prior to initiating an electrical switchgear preventive maintenance and testing program. However, the detail and extent of the documentation/specifications will vary with the size of the facility and complexity of the electrical distribution system.

Your first step (if not done previously) is to review your inventories and fill in the quantities on the Switchgear Testing/PM Inventory form in Appendix F. The quantities should be put in the NUMBER IN INVENTORY column, on the appropriate equipment line.

The ITEM & GUIDE # column indicates the ITEM DESCRIPTION number that corresponds to the item definitions in this appendix.

The SIZE column indicates the size of equipment to which the maintenance or PM applies.

The ESTIMATED TEST TIME should be filled out by the contractor at time of solicitation. (See form in Appendix F.)

The REF GUIDE NO., TEST, and PM columns indicate sections in the MS-28, or additional addenda developed, that describe the necessary maintenance and testing. This package contains all of the individual specifications applicable to the items identified in the TEST column.

The FREQUENCY, TEST, and PM columns list the recommended frequency (1 for annually and 5 for every five years) at which the maintenance and testing should be performed.

The NUMBER IN INVENTORY column will be filled out prior to solicitation using the data compiled from the Switchgear Documentation Checklist Item 17. (See form in Appendix F.)

MAINTENANCE OF ELECTRICAL SWITCHGEAR

(Sample)
SWITCHGEAR-TESTING/PM INVENTORY
FACILITY GUIDE

ITEM AND GUIDE #	ITEM DESCRIPTION	SIZE	FREQ-YEAR INTERVAL	
			TEST	PM
D1	Switchboard Assembly	= > 1000 A	5	2.5
D2	Liquid Filled Transformer	All	5	2.5
D3	Dry Transformer	>112.5 kVA	5	2.5
D4	Medium Voltage (Vacuum) Circuit Breaker	=>2000V	5	
D5	Indoor Main Distribution Busway	All	5	5
D6	Outdoor Busway	All	5	2.5
D7	Medium Voltage Air Switch	= > 2000 V	5	2.5
D8	Low Voltage Air Switch	< 2000 V => 400 A	5	2.5
D9	Automatic Transfer Switch	= > 2000 V or =>400 A	5	2.5
D10	Medium Voltage (Air) Circuit Breaker	= > 2000 V	5	5
D11	(OIL) Circuit Breaker	All	5	2.5
D12	Low Voltage (Air) Circuit Breaker	< 2000 V	5	
D13	Molded Case - Circuit Breaker	= > 400 A or >65K AIC	5	
D14	Protective Relay	All	5	
D15	Instrument Meter	All	5	
D16	Ground Fault System	All	5	
D17	Ground System	All	5	
D18	Battery System	Back up & Control Volt	2.5	
D19	Surge Arrestor	= > 400 A	5	
D20	Lightning Protection System	= > 400 A	5	1
D21	Motor Starters	= >200 HP	5	
D22	Power Factors Correction Devices: Passive Devices Automatic Devices	= > 50 KVAR => 50 KVAR		1 1
D23	Power Vaults	All	5	1
D24	Infrared Thermal Scanning	All of the Above		1

Switchgear Equipment Inventory
(Refer to IEEE/ANSI-C37.84.1)

Item D1 Switchboard Assemblies

Application: Switchboards of 1,000 Amps or more.

Switchboards are assemblies that consist of one or more panels with a framework on which electrical devices are mounted. They are considered a type of switchgear assembly. Switchboards are described as follows:

1. Power switchboard; has primary power circuit breakers and associated electrical devices.
2. Dead-front switchboard; has no exposed live parts on the front of panel.
3. Control switchboard; an assembly that includes instrumentation, metering, protective relays, and control for controlling remote equipment.
4. Vertical switchboards; consists of only vertical panels and no rear enclosure is included.
5. Dual switchboard; has both front and rear panels on which electrical devices are mounted. Both the ends and top are enclosed. A hinged access panel is provided on at least one side for wire access means.
6. Duplex switchboard; has both front and rear panels made up to form a common aisle that is enclosed at the end and top.

Item D2 Liquid Filled Transformers

Application: All sizes of liquid filled transformers.

Transformers that have their core and coils immersed in a high grade petroleum product, commonly called transformer oil, encased in a liquid-tight tank. This oil serves the dual purpose of conducting the coil heat to the tank surface for dissipation to the air by the cooling fins, tank surface, or radiator, and also serves as an excellent insulating medium. The various cooling methods are:

1. Self-cooled - heat is dissipated by the tank surface and cooling fins or tubes.
2. Forced-air-cooled - fans force air over the cooling surfaces to supplement the self-cooling.
3. Forced-air cooled/forced-oil-cooled - an oil pump circulates oil through a fan blown oil-to-air-heat exchanger.

Item D3 Dry Transformers

Application: Sizes greater than 112.5 kVA

Transformers that operate in air or gas rather than being liquid filled. They are usually self-cooled with a much higher temperature rise than liquid-filled units. There are two general types of construction associated with dry transformers as follows:

1. Open or ventilated type. The windings generally are simply surrounded by air at atmospheric pressure. Heat is removed by natural convection of the surrounding air and by radiation from the different parts of the transformer structure.
2. Sealed or closed type. The windings are cooled and insulated by an inert-high-dielectric gas such as nitrogen, sulphur hexafluoride, or perfluoropropane.

Item D4 Medium Voltage (Vacuum) Circuit Breaker

Application: Vacuum circuit breakers (VCB) that are rated at 2,000 volts or more.

Vacuum circuit breakers (VCBs) are essentially an assembly of parts on a welded steel frame. The spacing of parts tends to be greater than in a molded-case breaker, and the components are somewhat larger and heavier. Vacuum circuit breakers only have main current-carrying contacts. Because of the vacuum design there is no arcing between contacts.

VCBs are usually of drawout construction, for use in metal-enclosed drawout switchgear. These breakers operate through stored-energy spring mechanisms. Closing springs can be manually or electrically charged, and closing the breaker simultaneously charges the opening springs.

Item D5 Indoor Main Distribution Busway

Application: All indoor main distribution busways.

There are three different kinds of metal-enclosed bus structures:

1. The first is a non-segregated-phase bus where the 3-phase conductors are enclosed in a single housing.
2. The second is a segregated-phase bus where a metal barrier is interposed between the individual phase conductors.
3. The third is an isolated-phase bus where each of the phase conductors is totally enclosed in its own grounded metal enclosure.

Item D6 Outdoor Busway

Application: All outdoor busways .

Includes all of the above types of bus structures, listed in Item D5, where utilized outdoors.

Item D7 Medium Voltage Air Switch

Application: Air switches that are rated at 2,000 volts or more.

Air switches are usually stored-energy, spring-operated. The operating handle compresses the spring during most of its motion and then drives the mechanism at the end of its motion, which causes the spring to close (or open) the switch. For safety reasons, the speed of contact opening or closing is independent of the speed of handle operation.

Switches may be unfused, used as disconnecting means only - usually as the primary disconnect on a unit substation. More frequently, these switches are fused and provide both disconnecting means and overcurrent and short-circuit protection. Switches may be individual metal-enclosed units, separate or as part of a unit substation, or assembled into metal-enclosed distribution switchgear with bare bus and minimal compartmentalization.

Air switches are generally rated for either 600, 1200 or 2,000 amps continuous current. (They are load-break only). That is, the switch is able to interrupt its rated full-load current, but not much more. The switch must not open fault currents.

Item D8 Low Voltage Air Switch

Application: Air switches that are rated at less than 2,000 volts at equal to or greater than 400 amps.

Description is same as indicated for high voltage air switch except for application difference.

Item D9 Automatic Transfer Switch

Application: All automatic transfer switches equal to or greater than 2000 volts or equal to or greater than 400 amps.

An automatic transfer switch moves an electrical load from the normal (or preferred) source to an emergency (or alternate) source when normal source voltage fails or is substantially reduced. Automatic transfer switches are provided to reduce downtime by reestablishing electric service via an alternate source after a momentary service outage, or to an uninterruptible power supply (UPS) for equipment that cannot tolerate even this small period of loss of power.

In operation the transfer switch monitors the normal electric power source. When the normal voltage fails or is reduced, the load is switched to the alternate source. The switch may require manual operation to return to the normal source or it may automatically reconnect the load back to the normal source when it has been restored.

Generally automatic transfer switches are mechanically and/or electrically interlocked so that only one source can be closed at a time. The speed of operation generally is so fast that the transfer cannot be detected from the light flicker and in some cases magnetically held motor starters will not drop out.

One kind of automatic transfer switch is a single-coil device with a double-throw switch. This type is mechanically or magnetically held with single-coil or dual-coil operators. Dual-coil solenoids will have interlocking protection to prevent simultaneous opening or closing. The majority of automatic transfer switches are of the electrically-operated, mechanically-held type.

A second type consists of two contactors that are mechanically or electrically interlocked. Each contactor is mechanically and electrically held in either the open or closed position while the other is interlocked in the opposite position. It is made up of two circuit breakers that are mechanically and electrically interlocked. The breakers can have a common operator or individual motor operators. In large sizes, the circuit-breaker transfer switches have motor-driven breaker handles. In this case, either a single motor or two motors are used for transferring.

Item D10 Medium Voltage (Air) Circuit Breakers

Application: Air circuit breakers that are rated at equal to or greater than 2,000 volts.

Air circuit breakers (ACBs) are essentially an assembly of parts on a welded steel frame. The spacing of parts tends to be greater than in a molded-case breaker, the components are larger and heavier and the arc-chutes are somewhat larger. Air circuit breakers usually have separate arcing and main current-carrying contacts. These are designed mechanically so that on closing, the arcing contacts make before the main contacts, and on opening the main contacts part before the arcing contacts.

ACBs are usually of drawout construction, for use in metal-enclosed drawout switchgear. These breakers operate through stored-energy spring mechanisms. Closing springs can be manually or electrically charged, and closing the breaker simultaneously charges the opening springs.

Item D11 Oil Circuit Breaker

Application: All oil circuit breakers.

Oil circuit breakers (OCBs) generally use mineral oil as their insulating medium. Oil-filled equipment may not be used indoors, except in a fireproof vault, if it contains more than 10 gallons of flammable oil. Therefore, tank-type OCBs are used primarily in outdoor applications. All oil circuit breakers require protective relaying to provide system protection.

Item D12 Low Voltage (Air) Circuit Breakers

Application: Air circuit breakers that are rated at less than 2,000 volts.

Description is same as for high voltage air circuit breakers, except for application difference.

Item D13 Molded Case Circuit Breakers

Application: Molded case circuit breakers that are equal to or greater than 400 amps or greater than 65 kilo amps interrupting capacity (KAIC).

A molded case circuit breaker is assembled as an integral unit in a supporting and enclosing housing of insulating materials that is designed to open and close a circuit by non-automatic means and, to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.

All molded case breakers have the same main components: a molded case, the operating mechanism, arc extinguishers and contacts, trip elements and terminal connectors. The function of the molded case is to provide an insulated housing to mount and enclose the circuit breaker components. The cases are molded from moldarta or glass polyester material that combines ruggedness and high dielectric strength in a compact design.

Each different type and size of molded case is assigned a frame designation to facilitate identification. Frames may be identified by letters such as EB, JA, LB, etc. This frame identification refers to a number of important characteristics of the breaker, i.e., maximum allowable voltage and current, interrupting capacity, and the physical dimensions of the molded case. Unfortunately, all manufacturers have a different identification system because the breaker's characteristics are different. For example, a 225-ampere, 600-volt breaker, supplied from two different manufacturers may have different physical dimensions and interrupting capacity.

Item D14 Protective Relays

Application: All protective relays.

Protective relays are devices that are designed to sense abnormal conditions of a system. These relays either isolate or deenergize the troubled circuit through the operation of one or more power circuit breakers. Relays can be divided into two fundamental groups - electromechanical relays and solid-state or static relays.

Practically all electromechanical protective relays operate because of the application of either one or a combination of two basic principles:

 Electro-magnetic attraction

 Electro-magnetic induction

Solid-state relays perform the same function but have no moving parts.

The status, performance, and condition of the system are monitored by sensors whose output is measured by these relays. When the relay setting is reached, indicating an abnormal or undesired condition, the relay contacts complete a control circuit, causing the breaker to open or another desired action to take place.

Sensors can be current transformers (CTs), potential transformers (PTs), temperature or pressure instruments, float switches, tachometers, or any device or combination of devices that can respond to the desired conditions or events. In switchgear application, the most common sensors are CTs to measure current and PTs to measure voltage.

Most switchgear-type relays are mounted in a semi-flush draw-out-type case, which is usually installed on the door of the switchgear cubicle. The relay has sliding contacts and can be withdrawn from the case without disturbing the wiring.

Item D15 Instrument Meters

Application: All instrument meters.

Ammeters, voltmeters, wattmeters, power factor meters and similar devices are the types of meters or metering that play significant roles in monitoring the status and values of electrical systems. Such meters usually are the panel-mounted type located on the front or door of switchgear panels. Ammeters and voltmeters can be relatively simple single-function, solid-state types with digital readouts or electromechanical types with pointers.

Item D16 Ground Fault Systems

Application: Ground fault protection is provided for all solidly grounded wye electrical services of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase for each service disconnecting means rated 1,000 amperes or more.

Ground fault systems are intended to provide protection of equipment from damaging line-to-ground fault currents, or what is called phase-to-ground fault by operating a disconnect means to open all ungrounded conductors of the faulted circuit for faults having a current value less than the rating of the overcurrent device.

Ground fault protective devices include ground-fault current sensing devices (GFS), relaying equipment (GFR), combinations of the two, or other equivalent protection equipment that opens all ungrounded conductors at predetermined values of ground-fault current.

There are two basic types of ground-fault equipment protectors. The first is where the ground fault sensor is installed around all the circuit conductors, and a stray current on a line-to-ground fault will set up an unbalance of the currents flowing in individual conductors installed through the ground-fault sensor. When this current exceeds the setting of the ground-fault sensor, the shunt trip will operate and open the circuit breakers. The second is where the ground-fault sensor is installed around the bonding jumper only, and when an unbalanced current from a line-to-ground fault occurs, the current will flow through the bonding jumper and the shunt trip will cause the circuit breaker to open.

Item D17 Ground System

Application: The facility wiring system ground.

The grounding of one of the wires limits the maximum voltage to ground under normal operating conditions. This intentional conductor grounding will provide for automatic opening of the circuit if an accidental or fault ground occurs on one of its ungrounded conductors. This conductor grounding requires that a connection to a suitable grounding electrode must be made at the service entrance. The grounding electrode conductor (which runs to building steel and/or water pipe or driven ground rod) must be connected to the system neutral. A grounded service to a building must have the neutral point of the supplying transformer connected to a grounding electrode at the utility transformer outside the building, as well as having the neutral grounded to a water pipe and/or other suitable electrode at the building.

Item D18 Battery System

Application: Battery systems used for standby service in substation switching, UPS (Uninterruptible Power Supply) and communication system service.

UPS and communication system utilizes stationary batteries that must supply power instantaneously if an AC power fails or other emergency occurs.

Stationary batteries for sub-station are normally a wet cell design and are designed for repeated discharging and recharging, or "cycling," without appreciable decrease in capacity per cycle. Thus a stationary battery is normally in full-float operation and is always at, or near, full charge. Often these batteries may never be fully discharged during their service life.

Stationary batteries come in various sizes, with various alloys, plate types, and electrolyte specific gravities. Lead acid types may be pure lead, lead-antimony alloy, lead-calcium alloy, or lead-antimony-selenium alloy; with lead, modified lead, pasted, or tubular plates. NiCd types may have pocket or sintered-plates.

The capacity of the battery is basically its ability to supply a given amperage for a given period of time at a given initial cell temperature while maintaining voltage above a given minimum level. They are rated in ampere-hours at a given discharge rate. Stationary batteries are commonly rated for 8-h, 3-h, 1-h, or 1-min discharges but may be rated for any desired time interval, including minutes or seconds.

Item D19 Surge Arrestors

Application: Arrestors installed on circuits of equal to or greater than 400 amps.

Surge arrestors are protective devices that limit surge voltages by discharging or bypassing surge current. Their role is to protect components of the electrical system from high-energy disturbances on the line caused by lightning strikes, lightning surges, and switching surges.

Item D20 Lightning Protection Systems

Application: Where installed with services equal to or greater than 400 amps.

A lightning protection system consists of three components:

1. Properly arranged air terminals (rods) on the roof or top of the structure.
2. Suitable ground terminals; often buried in the earth.
3. A conductive path connecting both the air and ground terminals.

A lightning protection system will typically be comprised of the following elements.

Air terminals. Commonly referred to as lightning rods, these components are made of copper, aluminum, monel, or stainless steel, and are sometimes lead-coated or nickel-dipped. Air terminals are solid or hollow rods, usually 1 to 2 ft. long. They must extend 10 in. or more above the protected area or object, and must be braced if more than 24 in. high. Maximum spacing is 20 ft. on high points of the roof and all projections, and a terminal must be located within 2 ft. of a corner, roof edge or gable end. Sizing, positioning, and anchoring should be in accordance with National Fire Protection Association Lightning Code NFPA-78, or Lightning Protection Institute Standard Practice LPI-175.

Conductors and bonding plates. Conductors are heavy, multi-strand aluminum or copper cables. Primary conductors are used to:

- Interconnect all air terminals, forming a closed loop on a flat or low-slope roof.
- Bond into the system all primary metal bodies (grounded metal bodies on the roof or above the eave line).
- Connect the roof system to steel columns, or alternatively serve as low-resistance down-conductors to ground electrodes.
- Bond the base of each column to the grounding system in steel column construction.

Smaller secondary conductors. Smaller secondary conductors are used to bond secondary metal objects (metal bodies located below the roof line) into the lightning conductor system.

Surge arrestors. Surge arrestors are often installed independent of direct-strike lightning protection systems to protect against surges that can damage sensitive electronic systems. Such protection may be considered as part of a lightning protection system. There are four general classes of arrestors: station, intermediate, distribution, and secondary. Station arrestors are heavy-duty units normally used on critical or expensive equipment. The other classes follow in order of descending capacity and costs. Surge protection should be provided at the building's electrical service entrance where required.

Item D21 Motor Starters

Application: All motor starters rated at or greater than 200 horsepower (HP).

Motors that are started on full voltage will draw from two to six times their normal running current.

Item D22 Power Factor Correction Devices

Application: All power factor correction devices rated at equal to or greater than 50 KVAR

These are capacitor installations that are installed to correct lagging power factor (PF) of an installed electrical system.

Capacitors are rated in kilovars (KVAR) which stands for reactive kilovolt-amperes. The KVAR rating indicates how many KVAR the capacitor will supply in order to cancel out the reactive kilovolt-amperes caused by inductance. For example, a 50-KVAR capacitor will cancel out 50 kVA of inductive kilovolt-amperes.

Capacitors contain a fluid such as specially treated castor oil or a liquid such as a phthalate ester, which is free of PCBs and compatible with the environment. Individual capacitor cases should contain less than three gallons of fluid to be certain that they comply with Sec. 460-2(a) of the NEC, unless they are enclosed in vaults or outdoor fenced enclosures.

Automatic power factor correction control consists of sophisticated controls that allow switching capacitance on and off to match the needs of the system.

Item D23 Power Vaults

Application: All power vault locations.

The construction of vaults is intended primarily as passive fire protection. The need for a vault is dictated by the combustibility of the dielectric media and size of any transformers placed within. The walls and roofs of vaults are constructed of materials that provide a minimum fire resistance of 3 hours. Floors of vaults in contact with the earth are constructed of concrete that is not less than 4 in. thick. When a vault is located with a space below it has to be constructed of adequate strength for the load(s) imposed and a minimum fire resistance of 3 hours. An exception to the 3-hour requirement is permitted to be reduced to a 1 hour rating, where vaults are protected with automatic sprinkler, water spray, carbon dioxide, or halon.

Item D24 Infrared Thermal Scanning

Application: All facilities where the USPS is responsible for Electrical Switchgear Maintenance.

The accomplishment of infrared (IR) thermal scanning is to performed with portable IR thermal scanning instruments. Thermal scanning should be accomplished with non-contact IR thermometers, thermal imagers or a combination of both instruments.

IR thermometers - are non-imaging devices used for simple temperature measurements. When pointed at an object, the instruments sample and measure a small area. Temperature readings are presented in degrees (either Fahrenheit or Celsius) on a digital or analog meter readout.

Thermal imagers - scan the entire surface of a target. They produce an IR image by converting the radiation to a visual display of contrasting intensities of light. The image is usually seen in tones of dark to light; the brighter tone represents the higher intensities of thermal radiation.

**APPENDIX E
STATEMENT OF WORK
USPS ELECTRICAL SWITCHGEAR TESTING AND MAINTENANCE**

NOTE

This statement of work (SOW) is authorized only for use by the Category Management Center (CMC), for inclusion in solicitations and formal contracts, and solely for the purpose of obtaining electrical switchgear maintenance and testing.

500 OVERVIEW

501 Introduction

501.1 The United States Postal Service (USPS) intends to award a nationwide contract (or contracts) for routine electrical switchgear equipment testing, preventive maintenance, and corrective maintenance. The basis for this requirement is to apply the principles of Supply Chain Management (SCM) to develop and deploy a nationwide universal business strategy for electrical switchgear equipment services. The USPS intends to form an alliance with the most highly qualified service provider(s) to design and implement an effective switchgear management program and employ cost reduction processes throughout the supply stream. This strategy will provide the highest level of client and service value, and result in significant captured cost savings for the USPS through volume leverage buying, process standardization and continuous improvement.

501.2 This Statement of Work (SOW) provides general guidelines for the proper testing, preventive maintenance, and corrective maintenance of electrical switchgear equipment used in USPS installations. It is the purpose of these guidelines to assure that all electrical switchgear equipment and apparatus are properly tested and operational, within industry and manufacturer's tolerances, and installed in accordance with design specifications for application.

502 Background

502.1 USPS installations range from the small facility with residential type single-phase power to the very large facility with incoming service voltages to 138 KV (kilovolts) and capabilities of over 1000 kVA (Kilovolt Amps). Naturally, larger facilities have the more elaborate, complex, and costly electrical switchgear equipment. However, to function properly, all electrical switchgear equipment requires testing, preventive maintenance, and corrective maintenance to be performed on a routine basis.

502.2 The term “USPS Installations” includes both owned and leased facilities where the USPS has maintenance responsibility for electrical switchgear equipment and apparatus.

502.3 The increased reliance of USPS on automatic, electrically powered and controlled mail processing equipment means that any serious power failure in a USPS facility will significantly reduce the facility's ability to process mail.

503 Justification for Service

503.1 Specific guidelines for electrical switchgear equipment testing, preventive maintenance, and corrective maintenance at USPS facilities are contained in the USPS Maintenance Series Handbook MS-28, “Maintenance of Electrical Switchgear.” Policies and procedures contained in Handbook MS-28 recommend that all postal owned or leased facilities have electrical switchgear testing and maintenance performed every five (5) years, and routine preventive and corrective maintenance performed every year (annually) or as stipulated.

503.2 The senior maintenance official or designee will verify bargaining unit personnel are qualified by reviewing and/or providing documented education, training and expertise, both postal and private. Only currently qualified personnel may perform corrective, preventive, predictive, or reliability centered maintenance on electrical switchgear. If there is a lack of internal capability and qualified expertise to perform testing, preventive maintenance, and corrective maintenance on vital electrical switchgear equipment and apparatus, USPS installations must obtain required services from outside qualified contractors in accordance with Article 32 of the CBA and Section 535 of the ASM.

503.3 A majority of USPS installations contain electrical switchgear equipment that is more than 5 years old and may not have had routine maintenance performed. In many cases, regular maintenance of this equipment has not gone beyond superficial requirements. The condition of this equipment is unknown in some situations and without proper testing, preventive maintenance, and corrective maintenance it may not function as designed or potentially be damaged.

503.4 Unreliable or inoperable electrical switchgear equipment and protective devices are not suitable for use, and may result in damage to other equipment, property or personnel. Therefore, to protect USPS investments, to prevent potential catastrophe or injury, and to meet the reliability requirements for mail processing, the USPS must ensure that electrical switchgear equipment function properly and is appropriately maintained.

503.5 Only a program of testing under simulated or actual operating conditions combined with regularly scheduled preventive maintenance will ensure reliability of electrical switchgear equipment. Conclusive electrical tests, appropriately applied, will determine if equipment is operating properly, the suitability of continued use, if it needs repair, or if it should be replaced with modern apparatus. Regularly scheduled preventive maintenance ensures more than a routine inspection of equipment, and allows time for more thorough corrective maintenance to be performed. Equipment must be cleaned, inspected, lubricated, mechanically checked, and operated. Routinely scheduled testing, preventive maintenance, and corrective maintenance result in improved apparatus performance, higher reliability, and a reduction in the number of unexpected problems, which can occur on poorly maintained equipment.

503.6 There are no viable options other than adhering to the guidelines for electrical switchgear equipment testing, preventive maintenance, and corrective maintenance at USPS facilities that are contained in the USPS Maintenance Series Handbook MS-28. Failure to perform required tests, preventive maintenance, and corrective maintenance could result in lost processing time, potential injury, and unplanned expenses associated with repair of equipment and rental of emergency power equipment to bring the facility back on line.

504 Scope

504.1 The client base for this SOW encompasses approximately 300 major USPS installations located throughout the country. All parties understand that additional USPS installations may be included over the duration of the contract.

504.2 This statement of work (SOW) encompasses USPS installations located throughout the nation, where there are no qualified USPS maintenance personnel to perform electrical switchgear testing and maintenance.

504.3 In accordance with the guidelines in the USPS Operation and Maintenance Series Handbook MS-28, "Maintenance of Electrical Switchgear", the contractor will perform required testing and maintenance every (5) years, and required preventive maintenance and corrective maintenance every year (annually) or stipulated frequency for electrical switchgear equipment located at the USPS installations.

504.4 The USPS shall not be held liable for and the contractor agrees to indemnify and will hold the USPS harmless in respect to injuries or dangers, whether direct or consequential, to persons or property that may arise through the performance and intent of this contracting requirement.

505 Definitions

505.1 The term “Electrical Switchgear Equipment” is generally applied to the material, fittings, devices, fixtures, and apparatus that are part of, or are used in connection with, an electrical switchgear installation. This includes the electrical power-generating system, substations, distribution systems, utilization equipment, and associated control, protective, and monitoring activities.

505.2 The term “Testing” refers to any electrical inspections and analytical tests performed to measure and assess the performance or condition of electrical switchgear equipment and apparatus to insure peak operating efficiency, and validate conformance to appropriate settings.

505.3 The term “Preventive Maintenance” refers to a proactive managed program of inspecting, analyzing, and servicing electrical systems and equipment. Its purpose is to maintain safe operations and production by proactively identifying potential problems, and reducing or eliminating system interruptions and equipment breakdowns.

505.4 The term “Corrective Maintenance” refers to minor repairs, replacement and the corrective servicing of electrical switchgear equipment and apparatus. Corrective maintenance costs (repairs, replacement and corrective service) up to \$1,000 are covered within the scope of this service contract. All corrective maintenance requirements must be approved prior to the commencement of work. The USPS Contracting Officer Representative (COR) is authorized to approve additional costs for corrective maintenance up to the dollar threshold identified above. The USPS Contracting Officer reserves the right to make the final decision concerning the responsibility for such corrections or repairs. Failure to agree with the final determination of the Contracting Officer is a dispute within the meaning of the clause of this contract entitled "Claims and Disputes". In those instances where the Contracting Officer determines that the Postal Service is responsible for such corrections or repairs, and these requirements are outside the scope of this contract, the Contracting Officer reserves the right to solicit offers from, and have the corrections or repairs made by other sources.

505.5 The term “Contractor Qualifications” is intended to be a minimum standard for a prospective offer or to be considered as qualified to provide services under this proposed contract.

505.6 The term “Destructive Testing” refers to certain types of electrical testing procedures that tend to “test over the load” or “over stress” equipment and/or apparatus, and can potentially cause damage to the equipment just through the testing process.

505.7 Additional terms and definitions can be found in the solicitation Attachment #8, Glossary of Terms.

506 Contract Type and Duration

506.1 Contract type will be a modified indefinite delivery/indefinite quantity IDIQ Contract.

507 Contract Exceptions

507.1 The only exception to purchasing from this contract is if the requirement is extremely urgent and the contractor cannot meet the required service date.

508 Price and Cost Factors

508.1 Initial price and cost evaluations will be based on the contractor's response to a "market basket" inventory model, which consists of specific electrical switchgear equipment inventory items contained in the solicitation, Attachment #11, USPS Market Basket Cost Worksheet. This market basket inventory is presented as a "sample bundle" of switchgear equipment inventory that may be found at a fairly large USPS Installation (approximately 650,000 square feet). The contractor is required to develop and submit with their bid package a clear and concise cost methodology utilizing the Market Basket Cost Worksheet. The instructions for developing the cost module are contained in the solicitation, Attachment #10, Competitive Bidding Event (CBE) Overview.

508.2 The USPS expects that, in consideration of potentially high volume business commitments over the duration of this contract, the contractor will designate the USPS as a "most preferred customer" regarding volume leveraging and total cost savings.

508.3 The contractor must use the general cost methodology, reflected in the USPS Market Basket Cost Worksheet and submitted with their bid package, as a baseline for developing cost formats for all USPS Installations covered under the scope of this contract. Further, the USPS will incorporate into the contract, the leveraged percentage discount offered in the USPS Market Basket Cost Worksheet as the baseline percentage discount to be applied to fair market value cost proposals for USPS Installations covered within the scope of this contract.

508.4 The contractor is required to schedule and conduct a pre-site visit at each requesting USPS Installation prior to commencing any work. The purpose of this visit is to assess the conditions, environment, configuration and unique requirements of the individual facility. In compiling critical information, the contractor must develop a project cost for services to be performed at each specific USPS installation, and submit in writing to the Manager, Maintenance or designee (i.e., COR). The Contracting Officer must review and approve all actual cost proposals prior to the commencement of any work.

508.5 Prices will be negotiated on a yearly basis. The date will be determined and agreed to by both parties upon determination of the initial award date of the contract.

508.6 Voluntary Price Decreases - The contractor, through monitoring the market and utilizing demand-based management, is expected to be aggressive in reducing costs and passing on those savings to the USPS in the form of price reductions. Agreed upon price reductions can be applied by the contractor at any time during the term of the contract.

509 Description of Equipment

509.1 In USPS installations, the electrical switchgear equipment is designed to trip or otherwise open the electrical circuits in the event of malfunction of connected equipment. This automatic disconnect function is required to protect the postal facility, personnel, equipment, and the utility providing the electrical service.

509.2 The designation "high voltage" refers to voltages in excess of 600 volts and low voltage refers to voltage below 600 volts.

509.3 In general, there is a wide variety of switchgear apparatus makes and models. However, electrical switchgear equipment can be grouped into the following four classes:

509.31 Transformers - This equipment class includes both power and distribution type transformers whether dry or liquid (oil) filled. Generally these devices transform the high voltage of the utilities power input down to the appropriate voltage needed to operate building equipment. This class also includes current and potential transformers used to provide current and voltage to relays, meters, and control circuitry. The following apparatus differentiates the types of transformers:

- a. High voltage, liquid-filled, substation type, 500 kVA and up
- b. High voltage, dry, 500 kVA and up
- c. Distribution type, liquid filled, 500 kVA and below
- d. Distribution type, dry, 500 kVA below
- e. Current and potential types, dry
- f. Transformer oil or air cooling equipment

509.32 Circuit Breakers - This class includes a wide variety of devices designed to break a circuit under certain conditions. The devices use thermal or magnetic elements, including relays, to respond to over-current or under-current, or voltage conditions and mechanically interrupt the circuit path. Since these devices are designed to interrupt current-carrying circuits, an arc is formed when the circuit is broken. Several different methods are used, including the use of insulating oil, to quench the arc rapidly. Many circuit breakers have both an instantaneous trip rating and an adjustable time delay rating. The following apparatus differentiates the type of circuit breakers:

- a. High voltage, oil filled
- b. High voltage, air
- c. Low voltage, 3-phase power (including vacuum)
- d. Low voltage, molded-case

509.33 Relays - This class also includes a wide variety of designs used in power circuits. Some relays operate when an abnormal circuit condition causes the relay to open or close an auxiliary electric circuit, in turn tripping the switch or circuit breaker mechanism. Relays operate on thermal, magnetic, or induction principles and may be instantaneous or time delayed. Switchgear relays are normally used to sense under- or over-voltage or current, power factor, reverse current, phase unbalance, or other important circuit conditions. The following apparatus differentiates the type of relays:

- a. Induction disc over-current
- b. Induction disc directional over-current
- c. Thermal over-current
- d. Over- and under-voltage
- e. Power factor, reverse current, or watt type
- f. Transformer and buss differential; current balance

509.34 Connection Equipment - This class of switchgear includes the apparatus used to interconnect utility power lines, transformers, power wiring, and protective devices. The following apparatus differentiates the type of connection equipment:

- a. Switchboards and Panel Boards
- b. Switches (Disconnect, Air and Transfer)
- c. Lightning and network protectors
- d. Power cables
- e. Meters
- f. Insulators
- g. Bus Ducts and Structures
- h. Ground Fault Systems and Grounding Systems
- i. Battery Systems
- j. Surge Arrestors
- k. Motor Control Centers and Motor Starters
- l. Engine Generators
- m. Passive Devices and Correction Devices
- n. Power vaults

509.4 Detailed descriptions of electrical switchgear equipment are available from a number of sources including manufacturer's catalogs and industrial handbooks. Additional reference materials that contain extensive electrical switchgear equipment descriptions and application information include, but are not limited to:

Switchgear and Control Handbook

Editor Robert W. Smeaton.

Recommended Practice for Electrical Equipment Maintenance NFPA 70B

National Fire Protection Association

Battery March Park

Quincy, MA 02269-9101

Westinghouse Electrical Maintenance Hints

Westinghouse Electrical Corporation

National Electrical Safety Code, IEEE

Institute of Electrical and Electronics Engineers Inc.

345 East 47th St

New York, NY 10017-2394

Attachment 7, Switchgear Equipment Inventory Description

Statement of Work (SOW), USPS Electrical Switchgear Equipment

Solicitation #2CMROS-04-A-XXXX

510 GENERAL REQUIREMENTS

511 Work Requirements

511.1 The contractor shall perform all required testing, preventive maintenance, and corrective maintenance during the first year of the contract. The contractor shall perform routine preventive maintenance and corrective maintenance on an annual basis, over the remaining years of the contract base period.

511.2 Specific testing, preventive maintenance, and corrective maintenance requirements are outlined in the solicitation, Appendix D, Switchgear – Testing/PM Inventory Facility Guide. These requirements are quite extensive in an attempt to cover required electrical switchgear equipment services at all USPS installations. The contractor must use only those portions of the detailed item work specifications that pertain to the specific electrical switchgear equipment and apparatus located at a USPS installation, as identified on the individual facility's Switchgear Inventory Records.

511.3 It is the responsibility of the Contracting Officer's Representative (COR) to monitor the contract and ensure the contractor's responsibilities are complied with. The COR must immediately notify the Contracting Officer of any discrepancies, defaults, or deviations from requirements, as it is Contracting Officer's responsibility to enforce the contract. Only the Contracting Officer is authorized to approve deviations to contract requirements, and/or request the contractor to perform additional or alternate requirements; therefore, the Contracting Officer must be notified prior to any changes or deviations

511.4 The contractor warrants, for the period specified in section 506, that upon completion of work performed, all services performed will be competent; all services, replacement or other parts furnished by the contractor shall be free of defects in workmanship and material; and that all recommendations shall reflect their best judgment and industrial standards. The contractor's responsibility, response, and resolution regarding warranty requirements must be consistent with all requirements of Clause 2-8, *Warranty*.

511.5 The contractor guarantees that all testing, preventive maintenance, and corrective maintenance work requirements will be performed within established service schedules (i.e., equipment availability and/or facility shut-down plans) as jointly established between the contractor and the USPS Installation Manager, Maintenance or their designee. Failure to adhere to established service schedules would result in interruption of mail processing operations, lost productivity, customer dissatisfaction, and additional costs to USPS. Therefore, if contractor fails to perform work requirements within established service schedules, the contractor shall be liable to provide USPS adequate compensation as recovery for losses and/or damages. In such instances, the Contracting Officer reserves the right to make the final decision concerning adequate compensation for nonconformance in satisfying work requirements.

512 Codes, Standards and Ordinances

512.1 All inspections and tests must be in accordance with the latest edition of the following applicable codes and standards (as of the date of the contract) except as may be provided otherwise herein:

- a. National Electrical Code (NEC)
- b. National Electrical Manufacturer's, Association (NEMA)
- c. American Society for Testing and Materials (ASTM)
- d. Institute of Electrical and Electronic Engineers (IEEE)
- e. American National Standards Institute (ANSI)
- f. Insulated Power Cable Engineers Association (IPCEA)
- g. National Fire Protection Association (NFPA), 70B
- h. OSHA Part 1910; Subpart S. 1910.308
- i. National Electrical Testing Association (NETA)
- j. Association of Edison Illuminating Companies (AEIC)
- k. MS-28, Maintenance of Electrical Switchgear, Maintenance Handbook Publication (USPS)
- l. Standard for Electrical Safety in the Workplace (NFPA 70E)

512.2 All inspections and tests must be in accordance with state and local ordinances.

513 Reference Materials

513.1 As a minimum, all inspections and tests must use the following reference materials:

- a. Current USPS Short Circuit, Device Evaluation, and Coordination Studies (where available)
- b. Current USPS Switchgear Equipment Drawings and Schematics
- c. USPS Plans Available (Shut-down, Power Transfer, and Start-up Procedures)
- d. USPS Equipment Availability Schedule
- e. USPS Installation Switchgear Equipment Inventory Records
- f. Switchgear Equipment Testing and Maintenance forms
- g. Manufacturer's instruction manuals applicable to each particular apparatus.
- h. Switchgear Manufacturers' Data
- i. Switchgear-Testing/PM Inventory Facility Guide, Appendix D

514 Safety and Precautions

514.1 Because of the extremely dangerous voltages and currents present in electrical switchgear, precise attention must be paid to safety rules and proper working conditions, to protect both personnel and equipment.

514.2 Safety practices must include, but are not limited to, the following applicable references:

- a. Occupational Safety and Health Act of 1970 - OSHA and current revisions as of the date of this contract.
- b. Applicable state and local safety operating procedures as of the date of this contract.
- c. ANSI/NFPA 70E, Electrical Safety Requirements for Employee Workplaces
- d. OSHA 29 CFR 1910.147 – Control of Hazardous Energy Sources (Lockout / Tagout)
- e. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
- f. National Electrical Safety Code, IEEE
- g. National Safety Council, Industrial Data Sheets:
 - (I) Methods of Locking Out Electric Switches, No. 237
 - (II) Flexible Insulated Protective Equipment, No. 598

514.3 The contractor must provide a designated safety representative for the project to determine when it is safe to proceed with work, and to supervise all the safety aspects.

514.4 The contractor must provide sufficient protective barriers and warning signs to conduct specified tests safely. Safeguards to protect other personnel; danger signs, roped-off space, barriers, etc, must be used if the nature or location of the work creates a hazard.

514.5 All equipment and working personnel must be effectively guarded by the use of protective equipment, such as rubber gloves and approved long face shields (worn by personal at all times), rubber blankets, floor mats, hot-line tools, switchsticks, and testing and grounding devices, to protect persons or objects from harmful contact. The contractor is responsible for providing this protective equipment.

514.6 All protective equipment must be approved, periodically examined, tested (by a certified test facility), and kept in a safe condition.

514.61 Rubber gloves must be thoroughly examined and air tested prior to use each time they are used. Before insulating rubber gloves are used, a visual inspection and air test must be done. Stretch a small area of the glove and check for embedded metal or foreign material, deep cuts or scratches, pinholes or punctures, or any other sign of deterioration. Inspect the entire glove including the gauntlet. Any suspect or defective gloves must be destroyed, properly disposed of, and replaced. After the visual inspection the rubber glove must be air tested. Inflate the glove by gripping the gauntlet and squeezing the palm, fingers, and thumb. Inspect the glove for defects. Then hold the glove near the face to detect air leakage. An independent testing contractor must test rubber gloves every six months to assure that the gloves comply with ANSI/ASTM requirements. The shelf life of rubber gloves must be recorded and monitored. Sealed gloves in the original container do not require testing, providing they do not exceed their rated shelf life.

514.62 Approved leather protector gloves must be worn over rubber gloves to protect the rubber glove from damage. The gloves must not be used as work gloves, and must be properly disposed of, and replaced if they become oil soaked, have faulty or torn stitching, holes, or cuts, or if for any other reason they cannot protect the rubber gloves.

514.63 Insulating mats required for high voltage switchgear maintenance must be visually inspected before use. Place the mat on a table and visually inspect each side for embedded metal or foreign material, cuts, cracks, abrasions, or any other abnormal condition. Insulating mats must be tested every 12 months in accordance with ANSI/ASTM. The shelf life of mats must be recorded and monitored. Sealed mats in the original container do not require testing, provided they do not exceed their rated shelf life. Defective mats must be properly destroyed and replaced. Insulating mats must be kept in a protective bag or other protective container to prevent damage or contamination. Under no circumstance may high voltage insulating mats be left on the floor or on equipment when maintenance is not being performed on the equipment.

514.7 Prior to commencing work on electrical switchgear equipment that is energized or functioning in an operational state, the equipment must be deenergized. It is imperative that all tests and inspections must be performed with equipment and apparatus deenergized unless specifically required for the procedure. Attempting to check equipment when energized or operating is a USPS recognized unsafe practice.

514.71 It is the responsibility of the contractor to verify that all equipment and apparatus being worked on are deenergized. A lock (or lockout device) must be placed on the switch to prevent accidental closing of the switch. This device will accommodate up to six padlocks, one for each person working on the circuit. Only the person(s) who locked out the equipment and has ensured that all persons are clear of the circuit, should remove lock(s) when the job is complete.

514.72 All persons must be clear before circuit can be deenergized. The contractor's qualified designee is required to test the circuit at the point of work to positively determine that the circuit is dead, and the downstream load is deenergized before energizing the main circuit breaker.

514.8 Cleaning of switchgear equipment must be performed with insulated HEPA vacuum cleaning equipment. After deenergization, circuits operating in excess of 600 volts between conductors must have conductors shorted to ground by a hot-line grounding device, approved for this purpose. Solvents used for cleaning of electrical equipment should be carefully selected to ensure compatibility with materials being cleaned. Liquid cleaners, including spray cleaners, are not recommended unless specified by the equipment manufacturers because of the risk of residues causing damage or interfering with electrical or mechanical functions or introducing conducting contaminants into critical areas to produce short circuits and ground faults.

514.9 "Dead Circuits" must always be treated the same as "live" circuits until they are proven to be dead. This practice develops a caution that may prevent an accident. A circuit may be energized through the error of some other person, back feed, or an automatic feed from another source.

515 Contractor in Attendance

515.1 The contractor shall, upon entering the premises and again when he/she leaves, report time in and out and personnel used to the Manager, Maintenance or his/her designee.

515.2 The contractor is not to perform any work requiring a shutdown of equipment without informing the USPS Installation Manager or designee, in writing and receiving a positive response of when to commence in writing.

516 Division of Responsibilities

516.1 The USPS will have certain responsibilities to the contractor to assist in the performance of the contractor's work. When a contractor performs a facility's testing and maintenance, the USPS is responsible for:

- a. Providing the contractor with on-site access to a complete set of current electrical switchgear drawings, schematics, distribution diagrams and control wiring, as well as pertinent change orders.
- b. Providing the contractor with on-site access to any available current copies of short-circuit, device evaluation, and coordination studies, as well as pertinent change orders.
- c. Providing the contractor with copies of plans available that reflect shutdown, power transfer, and start-up procedures.
- d. Providing the contractor with an equipment availability schedule. All testing and maintenance shall be done within the time frames identified in this schedule. The testing and maintenance activities will cause selective power shutdowns; therefore, the equipment availability schedule must be utilized to coordinate and expedite work requirements to ensure that mail processing operations experience as little interruption as possible.
- e. Providing access to USPS installations on a reasonably continuous schedule.
- f. Providing the contractor with switchgear equipment inventory records for all items requiring service at a specific USPS installation.
- g. Providing the contractor with on-site access to manufacturer's instruction manuals applicable to each particular apparatus and any available switchgear manufacturer's data.
- h. Coordinating with the utility company the scheduling of requirements to pull fuses for incoming power to the facility, and reapplying power after work has been completed.
- i. Supplying the facility with necessary emergency lighting for security purposes only.
- j. Supplying the contractor with a suitable and stable source of test power consisting of in-house power, to the test at each test site. The USPS must allow use of its power for testing, inspection and maintenance. However, if complete outage is required, the contractor is responsible for supplying the electrical power necessary for testing and maintenance activities.
- k. Coordinating with the contractor all power switching functions. However, it is the contractor's responsibility to verify that circuits being worked on are deenergized.

516.2 The contracting firm will have certain responsibilities in the performance of the required work. When a contractor performs a facility's testing and maintenance, the Contractor is responsible for:

- a. Performing a pre-site visit at each requesting USPS Installation prior to commencing work. The purpose of this visit is to assess the conditions, environment, configuration and requirements of the individual facility; perform any site preparation requirements; and construct a tailored cost estimate for services to be performed at each specific USPS installation. The pre-site visit date and time will be coordinated and arranged between the contractor and the Manager, Maintenance or designee at the requesting facility. Approval of cost estimates must be submitted to the Contracting Officer's Representative (COR), at each facility for review and approval prior to the commencement of any work. Failure to perform this pre-site visit and/or satisfy pre-approval requirements will not relieve the contractor from having to furnish any material or perform any labor that may be required to complete the work in strict accordance with the intent and meaning of specifications without additional cost to the USPS.
- b. Coordinating with, and notifying the USPS prior to any testing and maintenance of equipment located at a USPS installation. The contractor must coordinate the scheduling and performance of work, especially any that may require electrical outages, with the USPS Installation Manager, Maintenance or designee.
- c. Providing a designated safety representative for the project to determine when it is safe to proceed with work, and to supervise all the safety aspects.
- d. Incurring transportation, travel and administrative costs associated with performing all requirements as contained herein.
- e. Supplying all labor, parts, material, equipment, testing instruments, transportation, technical support, manufacturers' data and all other items necessary to perform tests, maintenance, inspections, adjustments, cleaning and minor repairs on all electrical switchgear equipment.
- f. Supplying all testing and maintenance forms. Testing and maintenance forms must be reviewed and approved by USPS before use. All field observations and data shall be written, during the work, directly onto the testing and maintenance forms (supplement the form with additional pages if required). In addition, results of as-found/as-left observations and tests should be documented on these forms.
- g. Supplying required protective barriers and warning signs to conduct specified tests safely.
- h. Supplying protective equipment, such as rubber gloves and safety glasses, rubber blankets, floor mats, hot-line tools, switchsticks, and testing and grounding devices, to protect persons or objects from harmful contact.
- i. Supplying a portable power source (the installation of which must meet USPS safety requirements) where conditions are such that portable power is needed.
- j. Verifying that all circuits being worked on are deenergized.
- k. Removing switchgear and switchboard covers, panel board trims and the like, to obtain access to the equipment or devices.
- l. Performing all required testing, preventive maintenance, and corrective maintenance requirements in accordance with procedures outlined in sections 511.1 and 511.2. Only perform testing and maintenance requirements for specific electrical switchgear present at the USPS installation requiring service.

MAINTENANCE OF ELECTRICAL SWITCHGEAR

- m. Performing testing, preventive maintenance, and corrective maintenance to include equipment items and similar components that may have been overlooked.
- n. Providing immediate notice to the USPS installation Manager, Maintenance or designee of any apparent damage to the equipment covered by the contract, and any system material or workmanship that is found defective on the basis of tests performed. The contractor must notify the Manager, Maintenance or designee, in writing on the day of discovery, of the existence of discovered damage or defects in, or required repairs to, equipment that the contractor does not consider to be its responsibility under the terms of the contract. Failure to do so will render the contractor responsible for these repairs at no additional cost to the Postal Service.
- o. Providing the USPS installation Manager, Maintenance or designee (i.e., COR) with a written estimate of the cost to perform corrective maintenance (minor repairs, replacement and corrective service) to correct any defects or repair requirements. If approved by authorized USPS personnel, the contractor shall perform corrective maintenance work requirements. All replacement parts or expendable materials will be billed at cost. An itemized list of all parts and materials expended during the performance of service, including the cost, must be submitted to the authorized USPS representative in a timely manner.
- p. Comparing protective device settings and tap changes to the information contained on the coordination study (if available). Under no circumstances should the contractor change settings. Any deviation between found settings and the coordination study must be reported to the USPS installation Manager, Maintenance or designee.
- q. Remaining on site for at **least (1) hour after the work has been completed** and the system is returned to operational status. The purpose of this requirement is to ensure the contractor is available to immediately address and respond to any problems.
- r. Completing switchgear testing and maintenance forms, and maintaining a written record of all tests performed.
- s. Attaching a label to all serviced equipment indicating the contractor's company name and the date of service.
- t. Assembling and preparing a final report that guarantees, in writing, that the equipment has been properly tested, inspected and maintained; that the equipment is adequate for the service intended; that the equipment is properly installed; that it is in good operating condition; and that it is coordinated with other equipment. Final test report must be certified by the contractor's Professional Electrical Engineer (PEE).

517 Testing and Maintenance Guidelines

517.1 Specific testing, preventive maintenance, and corrective maintenance requirements are outlined in the solicitation, Appendix D, Switchgear - Testing/PM Inventory Facility Guide. The contractor must use only those portions of the detailed item work specifications that pertain to the specific electrical switchgear equipment and apparatus located at a USPS installation, as identified on the facility's Switchgear Inventory Records.

517.11 No testing procedures that can be determined or classified as "destructive testing" shall be performed on USPS electrical switchgear equipment and/or apparatus.

517.2 All test equipment and instruments must have updated certified calibration labels traceable to National Institute of Standards and Technology (NIST) standards and be in good mechanical and electrical condition.

517.3 Split-core current transformers and clamp-on or tong-type ammeters require careful consideration of the following in regard to accuracy:

- a. Position of the conductor within the core
- b. Clean, tight fit of the core pole faces
- c. Presence of external fields
- d. Accuracy of the current transformer ratio in addition to the accuracy of the secondary meter

517.4 Selection of metering equipment must be based on knowledge of the waveform of the variable being measured. Digital multimeters may be average or RMS sensing and may include or exclude the dc component. When the variable contains harmonics or dc offset and, in general, any deviation from a pure sine wave, average sensing RMS scaled meters may be misleading.

517.5 Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked.

517.6 Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of two percent of the scale used.

517.7 Wave shape, sampling rates and frequency of test equipment output waveforms should be appropriate for the test and the tested equipment.

517.8 Upon completion of the testing, preventive maintenance, and corrective maintenance requirements as outlined in the solicitation, Appendix D, Switchgear – Testing/PM Inventory Facility Guide for specific electrical switchgear equipment and apparatus located at a USPS installation, system functional tests must be performed. A system functional test involves all or part of the switchgear equipment being tested while working together to ensure total system operation. System functional tests verify the proper interaction of all sensing, processing, and actuary devices.

517.81 During the system functional test, all interlocks, safety devices, and failsafe functions must be tested to insure compliance with the design function.

517.82 The contractor must develop test parameters for evaluating the performance of all integrated components as a complete unit within design requirements, and must propose methods to initiate the sensing devices.

517.9 The testing contractor must use a calibration program that maintains all applicable test instrumentation within rated accuracy that can be traced to the National Bureau of Standards in an unbroken chain. Any instrument that does not meet the calibration requirements must not be used; and any tests performed with testing equipment that is out of calibration would not be valid.

MAINTENANCE OF ELECTRICAL SWITCHGEAR

517.91 Testing instruments must be calibrated in accordance with the following criteria:

- a. Dated calibration labels must be visible on all test equipment.
- b. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
- c. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
- d. Testing instruments must be calibrated in accordance with the following frequency schedule.
 - (I) Field instruments – Analog = 6 months maximum; Digital = 12 months maximum.
 - (II) Laboratory instruments - 12 months maximum.
 - (III) Leased specialty equipment - 12 months and the lessor guarantees accuracy.

518 Test Forms and Test Report Submittals

518.1 It is the contractor's responsibility to furnish standard test forms required for documenting electrical switchgear equipment inspections, tests and/or maintenance activities performed at all USPS installations. All test forms must be reviewed and approved by USPS prior to utilization. If the USPS determines the contractor's recommended test forms are not appropriate for use, it is the responsibility of the contractor to develop and furnish an acceptable standard form prior to implementation.

518.2 Contractor shall complete a separate test form for each piece of equipment and/or device which was subjected to inspection, test, and/or maintenance. Each test form must clearly identify the equipment or device being serviced, as well as the specific test performed and the test results.

518.3 The contractor must prepare and submit a report to USPS that covers all equipment and systems inspected and tested. The document must be bound in 8-1/2" x 11" written format.

518.4 Three copies of the completed report must be furnished to the USPS no later than thirty (30) days after completion of project unless directed otherwise. In addition, one electronic copy (Microsoft EXCEL or WORD) of the completed report must be furnished with the hard copy documents.

518.5 The test report must be bound and its contents certified by a licensed professional engineer.

518.6 The test report must include the following:

- a. Summary of project(s) prioritizing and highlighting safety related issues, corrective measures implemented to safely operate or lockout such devices and listing of malfunctioning items.
- b. Description of equipment tested. (Also include, if available, the nameplate information, date of last testing, and name of testing contractor.)
- c. A list of all equipment inspected and tested, with information on the procedures used, test results, and recommendations.
- d. A list of the test equipment utilized. Provide information on the calibration and calibration date of all test equipment used.
- e. Verification that the equipment is operational within industry and manufacturer's recommendations.
- f. Conclusions and recommendations. This should include recommendations for actions, corrections, or modifications beyond the scope of this contract.
- g. Cost estimates for maintenance, repair, or replacement of equipment as identified in the recommendations, which are beyond the scope of this contract.
- h. A listing of any code violations discovered during the maintenance and inspections.
- i. An appendix, including appropriate completed test forms.
- j. Original Infrared Thermographic pictures with a high-quality visible light photo and digital format that clearly identifies the equipment contained in each thermographic picture and displaying hot-spot areas as compared to surrounding ambient temperatures presented.

519 Quality Reviews

519.1 The USPS and the contractor will hold quarterly reviews at a site designated by USPS to discuss contract performance, and address concerns, issues and opportunities for improvement. The contractor will offer suggestions for improvements to enhance the effectiveness of the contract and to reduce costs throughout the entire supply chain.

519.2 During the quarterly review session, the contractor must be capable of reporting to the USPS Installation local finance number level with intermediate District Cluster and Area roll-up capabilities. Information contained in these reports must be current, accurate and accessible to the Postal Service. A summary of the minimum required reports follows.

- a. Cost Improvement Targets (SCM processes such as standardization and resource optimization)
- b. Cost Savings to the USPS and Contractor
- c. Year-to-date Invoicing and Billing Summary Report for each USPS Installation finance number
- d. Supplier Diversity Report - breakdown by small, minority, and woman-owned businesses (Clause 3-2, *Quarterly Submission of Supplier Diversity/Subcontracting Reports*)
- e. Customer Satisfaction Indices

- f. Quality Assurance Measurements - a documented reporting system that includes mechanisms to monitor and measure the processes being used to perform the contract, systematic approaches for corrective action, where needed, continuous improvement measurement of key indicators, regular quality reviews, and periodic customer reviews

519.3 During the quarterly business reviews, the supplier's performance will be evaluated and assessed in accordance with established performance-based service measurements. The following performance-based measurements have been established as the criteria for measuring supplier performance:

- Ebuy Order Acknowledgement – within 1 business day
- Requirement Fulfillment – within established baseline timeframes for each service requirement
- Supply Chain Management – implementation of 3 impact activities during base-term of contract
- Quality Assurance – 0% defect and deficiency in workmanship
- Customer Service – customer service rating of 4.5% or greater
- Reporting Capability – 100% compliance with established reporting schedules
- Sub-Contracting Plan – 100% compliance with established sub-contracting plans

520 CONTRACTOR QUALIFICATIONS

521 Company Requirements

521.1 National Capability - The supplier must demonstrate they have the service network to satisfy all Postal Service requirements for electrical switchgear maintenance and testing on a national level. Service must be to all locations within the forty-eight contiguous United States (CONUS) as well as Alaska, Hawaii and its related islands, Puerto Rico, and the U.S. Virgin Islands.

521.2 Technical Background/Experience - The contractor must have three or more years experience related to the appraisal, testing, and maintenance of apparatus designated herein, and must be currently engaged in power engineering switchgear testing and maintenance. The contractor must submit proof of this qualification with bid documents.

521.21 The contractor must be able to identify qualified engineering and technical resources to complete work under approved schedules. At least one of the contractor's technical representatives, on-hand at each test performed, must have a minimum of 4,000 hours of actual testing experience for the individual test being performed. The contractor must submit proof of this qualification and a list of prior jobs that have been completed with bid documents.

521.3 Electronic Data Interchange (EDI) Capability - The USPS purchasing system, eBuy facilitates and controls the USPS purchasing process. All requirements for electrical switchgear equipment maintenance and testing will be processed through eBuy. This will allow the Postal Service to take full advantage of the electronic processing capabilities, including order information and status as well as payment information. The supplier must demonstrate they have the ability to conduct business utilizing EDI technology. Acceptable electronic data formats include ANSI (ASC) X12, Open Buying on the Internet (OBI), EDI, Flat File Exchange or XML as stated in the attached *Supplier Interface Guide for Electronic Orders*, Attachment #9. This attachment also covers the methods of communication, acceptable data formats, data elements of each data set, and levels of validation and business rule detail.

521.31 The supplier's EDI processes must be implemented, operational and usable in the U.S. Postal Service Electronic Data Interchange environment within the later of 90 calendar days following contract award, or within 90 calendar days following notification from the Contracting Officer. Supplier will assume all costs related to inbound and outbound van charges.

521.4 Financial Capability - The contractor must demonstrate that it possesses the necessary financial capacity and working capital to perform a contract of this size and scope. To document this capacity, the contractor must provide a financial plan for undertaking the statement of work and a copy of its most current financial statement together with an interim report to as near the submission date as possible. Financial statements must be for the entity making this submittal. For the purpose of this requirement, the term "current financial statement" is defined as the data (including both the balance sheet and income statement) covering the contractor's immediate past fiscal year, normally the most recent annual report. The following guidelines are to be observed:

- a. Statement must be prepared in accordance with Generally Acceptable Accounting Principles.
- b. Statement must include all required notes to the Financial Statement.
- c. Statement must be certified by either a company executive as to the accuracy and veracity of the statement, or by an opinion statement on the fairness of the presentation after review by independent auditors.

521.5 Insurance Certification - The contractor must be covered by Workman's Compensation Insurance and Public Liability Insurance, and indemnify and save harmless the USPS from any liability for damages arising out of the activity of the contractor because of injury to or death of any person or damage to any property. The contractor must submit proof of this qualification with bid documents.

522 Operational Requirements

522.1 Past Performance - The Postal Service is looking for service providers with a past performance record of maintaining quality standards and high levels of customer satisfaction. Therefore, the contractor must show a history of being reasonable and cooperative with the customer, while demonstrating a commitment to quality workmanship, customer satisfaction, integrity, and ethics. It is preferred that the contractor address past performance in terms of activities that are similar in size, scope, and magnitude of the USPS service requirements contained herein. As a minimum, the following information must also be provided:

- a. The contractor must provide a minimum of three (3) references.
- b. The contractor must provide verifiable data that supports their claim of past experience.
- c. The contractor must provide a list of all contracts with the USPS during the past 5 years.

522.2 Management and Infrastructure - This nationwide contract for electrical switchgear testing, PM and corrective maintenance is anticipated to be large and complex. Therefore, the contractor must possess the structural, organizational and managerial support mechanisms necessary to perform a contract of this size and scope. As a minimum, the following management and infrastructure factors must be addressed:

- a. The contractor must describe the composition and organization of the company's service network, and list the locations of all technical service/customer support centers and the areas they service.
- b. The contractor must explain how the company's service network will provide the operational capacity necessary to fully satisfy contract requirements.
- c. The contractor must describe qualifications and competencies of personnel, as evidenced by:
 - 1) Key Personnel
 - 2) Job Description and Responsibilities
 - 3) Years of Experience (with the contractor's company and previous companies)
 - 4) Educational and Professional Qualifications

522.21 The contractor must explain plans, if any, to out-source or establish alliances to meet nationwide service requirements.

522.3 Implementation Plan - The contractor must submit with their bid proposal a clear and comprehensive Implementation Plan that, as a minimum, addresses how the contractor will coordinate schedules and resources, track performance and comply with the overall requirement to perform services at various USPS Installations. The plan must also address the following key elements:

- Names, titles and experience of key personnel working on implementation plans
- Specific plan for full nation-wide implementation
- Detailed milestone schedule
- Commitment to customer service (technical, operational, problem resolution)

522.31 The implementation plan should include an explanation that the contractor has a thorough understanding of the Statement of Work, technical expertise and adequate resources (financial, personnel, facilities, equipment, etc.) to adequately perform the contract service requirements.

522.32 Within fourteen (14) days after contract award, the contractor will submit a final, updated Implementation Plan to the Contracting Officer for approval.

522.4 Supply Chain Management (SCM) - The contractor must manage the contract using Supply Chain Management (SCM) principles that include a commitment to continuous improvement, and cost reduction over the term of the contract in such areas as transaction and process costs, and quality enhancements. After contract award, service history will be collected and used to establish mutually agreed upon baselines and criteria for accomplishing quality improvements, and reductions in transaction and process costs within the entire supply chain.

522.41 As part of the Supply Chain Management process the supplier must provide and use a demand-based plan to manage the contract.

522.42 The contractor will be responsible for submitting at least three cost savings processes before the end of the base term period of the contract.

522.5 PEE Licensing - The contractor is required, and must show proof that a Professional Electrical Engineer (PEE) validated all tests or procedures utilized, testing methodology, and test results. Test validation may be through actual witnessing of each test performed, or a signed statement indicating that the PEE has reviewed and approved all test procedures utilized.

MAINTENANCE OF ELECTRICAL SWITCHGEAR

522.6 Quality Assurance - The contractor must employ a documented quality assurance system to monitor and measure its performance against contract requirements as required in Clause 2-49, Quality Assurances Services. The USPS has the right to evaluate the acceptability and effectiveness of the contractor's quality system prior to award, and to periodically verify that it is in use and effective during contract performance. The contractor must submit proof of this qualification with bid documents.

522.61 As a minimum the contractor's Quality Assurance System must include:

- a. Comprehensive measurement of contract performance.
- b. Comprehensive means of assessing customer satisfaction that includes, at a minimum, periodic customer surveys, contractor/customer focus groups, and/or other means of securing regular customer feedback.

522.7 Customer Service - The supplier is responsible for establishing customer service processes to support the contract. As a result, the supplier must design and implement customer assistance to guide Postal clients through these processes. Suppliers must address all elements of customer service, including, but not limited to the following:

- Client Profiles
- Service Requirements
- Client orders and follow-up
- Order status
- Special order requirements
- Discrepancies, Refunds and Complaints

522.71 The supplier must have dedicated customer service access (Toll free phone & Fax numbers, Internet address) for Postal clients, supported by an appropriate number of personnel.

522.8 Reporting - The supplier must submit quarterly summary reports of key business indicators in a clear graphic form, containing information that is current, accurate and in an appropriate electronic format.

522.81 Supplier must be capable of reporting to the local finance number and FEDSTRIP number level with intermediate District, Area and National roll-up capabilities. A summary of the minimum required reports follows:

- Dollar value of service requirements (line item and total) by FEDSTRIP
- Average days to response or fulfillment of requirements
- Cost improvement targets
- Supplier Diversity report - breakdown by small, minority, and woman-owned businesses (Clause 3-2, Quarterly Submission of Supplier Diversity/Subcontracting Reports)
- Cost savings to the Postal Service and Supplier
 - Customer Satisfaction Indices

522.9 Sub-Contracting - All contractors, except small businesses, must submit an established sub-contracting plan that is specific to this contract, and separately addresses sub-contracting with small, minority, and woman-owned businesses. The sub-contracting plan must indicate how commitments and results will be obtained to comply with Clause 3-1, *Small, Minority, and Women-owned Business Subcontracting Requirements*, and contain clear goals and objectives as to what the contractor will do to increase sub-contractors in the realm of small, minority and woman-owned businesses. Further, the sub-contracting plan must address the requirements of Clause 3-2, *Quarterly Submission of Supplier Diversity/Subcontracting Reports*. (See *Instructions for Suppliers Submission of Sub-Contracting Reports*, Attachment 4. This sub-contracting plan must be approved by the USPS and will be made a part of the contract.

Review inventories and fill in the quantities on the Switchgear Testing/PM Inventory form. Insert total quantities in the NUMBER IN INVENTORY column, on the appropriate equipment line.

The ITEM & GUIDE # column indicates the ITEM DESCRIPTION number that corresponds to the item definitions in this appendix.

The SIZE column indicates the size of equipment to which the maintenance or PM applies.

The ESTIMATED TEST TIME should be filled out by the contractor at time of solicitation.

The REF GUIDE NO., TEST, and PM columns indicate sections in the MS-28, or additional addenda developed, that describe the necessary maintenance and testing. This package contains all of the individual specifications applicable to the items identified in the TEST column. NETA Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems should be used for items not included on this inventory form.

The FREQUENCY, TEST, and PM columns list the recommended frequency (1 for annually and 5 for every five years) by which the maintenance and testing should be performed.

The NUMBER IN INVENTORY column will be filled out prior to solicitation using the data compiled from the Switchgear Documentation Checklist Item 17.

NETA standards may be used for items not included on the inventory sheet below. Forms are located in Appendix F.

MAINTENANCE OF ELECTRICAL SWITCHGEAR

**(SAMPLE)
SWITCHGEAR – TESTING/PM/INVENTORY SHEET
CONTRACTING GUIDE**

ITEM #	ITEM DESCRIPTION	SIZE	ESTIMATED TEST TIME		FREQ-YEAR INTERVAL		NUMBER IN INVENTORY
			PER UNIT	TOTAL	TEST	PM	
E1	Switchboard Assembly	= > 1000 A			5	2.5	
E2	Liquid Filled Transformer	All			5	2.5	
E3	Dry Transformer	>112.5 kVA			5	2.5	
E4	Medium Voltage (Vacuum) Circuit Breaker	=>2000V			5		
E5	Indoor Main Distribution Busway	All			5	5	
E6	Outdoor Busway	All			5	2.5	
E7	Medium Voltage Air Switch	= > 2000 V			5	2.5	
E8	Low Voltage Air Switch	< 2000 V => 400 A			5	2.5	
E9	Automatic Transfer Switch	= > 2000 V or =>400 A			5	2.5	
E10	Medium Voltage (Air) Circuit Breaker	= > 2000 V			5	5	
E11	(OIL) Circuit Breaker	All			5	2.51	
E12	Low Voltage (Air) Circuit Breaker	< 2000 V			5		
E13	Molded Case - Circuit Breaker	= > 400 A or >65K AIC			5		
E14	Protective Relay	All			5		
E15	Instrument Meter	All			5		
E16	Ground Fault System	All			5		
E17	Ground System	All			5		
E18	Battery System	Back up & Control Volt			2.5		
E19	Surge Arrestor	= > 400 A			5		
E20	Lightning Protection System	= > 400 A			5	1	
E21	Motor Starters	= >200 HP			5		
E22	Power Factors Correction Devices: Passive Devices Automatic Devices	= > 50 KVAR => 50 KVAR				1 1	
E23	Power Vaults	All			5	1	
E24	Infrared Thermal Scanning	All of the Above				1	N/A

* NOTE: All breakers in a primary distribution panel or those deemed critical should be considered for testing if the breaker size requirements are met.

SWITCHBOARD ASSEMBLY (Item E1)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following visual inspections and tests including evidence of moisture. Also visually inspect all doors, panels and sections for paint, dents, scratches and fit.

- a. Inspect for physical, electrical and mechanical condition.
- b. Compare equipment nameplate information, including CT and PT ratio, fuse sizes and communication links with the latest one-line diagram and report discrepancies. If nameplate is damaged/missing, install properly labeled engraved plastic nameplate, using rivets or screws.
- c. Inspect for proper alignment, anchorage, grounding and required area clearance.
- d. Key interlock systems must be physically tested to ensure proper function. Closure attempt must be made on locked open devices. Opening attempt must be made on locked closed devices.

NOTE

When working on key interlock systems, the key exchange procedures must be observed at both the beginning and end of the job, to ensure that the system cannot be energized without the knowledge of all individuals involved.

- e. Inspect for cleanliness and need of lubrication.
- f. Exercise all active components (providing plant operation is not jeopardized).
- g. Inspect all indicating devices for proper operation.
- h. Enter switchboard and perform complete inspection looking for:
 - 1) Proper anchoring
 - 2) Grounds or shorts
 - 3) Evidence of overheating or arcing
 - 4) Cable arrangements and supports, cracked or damaged insulator
- i. Inspect fuse clips for tightness and alignment.
- j. Inspect operation of shutters.
- k. Inspect all internal heaters.
- l. Inspect and align all disconnects.
- m. Thoroughly vacuum and clean interior (especially the insulating supports for the bus).
- n. Examine assembly for evidence of leakage from an outside source, such as roof or wall seams, and report any deficiencies found.
- o. Examine vents and verify filters are clean (i.e., equipped with filters).

SWITCHBOARD ASSEMBLY (Item E1)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

The test results for each of the following is to be provided in the report section

- a. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for one (1) minute. Test voltage and minimum acceptable resistance values must be in accordance with NETA Maintenance Test Specifications Electrical Power Distribution Equipment and Systems, if no other criteria are available. (If additional criteria are utilized they must be documented as to their source. The criteria used are to be identified in the report section).
- b. Perform a DC over potential test on each bus section phase-ground. Voltage application must be for one (1) minute. Test voltage must be in accordance with manufacturer's recommendations. The criteria used are to be identified in the report section.
- c. Measure insulation of control wiring to ground.
- d. Where applicable, use the elementary diagrams of the metal clad switchgear to identify each remote control and protective device. Conduct tests as required to verify satisfactory performance of each of the control features.
- e. Determine available fault current from utility or primary source and compare with main circuit breaker interrupting capability.
- f. If heat is evident with IR scanning/testing, then a high resistance test is required using a resistance ohmmeter and check tightness by using a calibrated torque wrench.

NOTE

Refer to manufacturer's instruction for proper torque levels. If connections are not accessible, an infrared survey should be made with system in operation to identify high resistance connections.

- g. Bolt torque levels must be in accordance with manufacturer's recommendations.
- h. Perform insulation-resistance tests on Control and Power Transformers. Perform measurements from winding-to-winding and each winding-to-ground.
- i. Verify correct function of control transfer relays located in switchgear with multiple power sources.
- j. Perform insulation-resistance tests on Voltage Transformers. Perform measurements from winding-to-winding and each winding-to-ground. Verify secondary voltages.

LIQUID FILLED TRANSFORMER (Item E2)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage. Closely examine for all damage that may have occurred as the result of rodents, birds, environmental, or any other causes.
- b. Compare equipment nameplate information with latest one-line diagram and report all discrepancies.
- c. Verify proper auxiliary device operation by examining fans, pumps, sudden pressure devices, indicators, tap changers, and gas pressurization systems.
- d. If heat is evident with IR scanning/testing, check tightness of bolted electrical joints by using a calibrated torque wrench.
- e. Check for grounding, alignment, support beam corrosion, etc.
- f. Check liquid in tanks and bushings for proper level and inspect for oil leaks. (Verify NO PCB labels.)
- g. Perform all specific inspections and mechanical tests as recommended by manufacturer.
- h. Clean bushing, fans, insulators, etc.
- i. Verify operation of alarm, temperature controls, oil level indicators, vacuum gauge, pressure gauges and relief valves.
- j. Verify positive pressure is maintained on the gas blanketed transformer.
- k. Verify condition and connection of surge arrestor.

LIQUID FILLED TRANSFORMER (Item E2)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Insulation resistance tests must be performed winding-to-winding and winding-to-ground. Appropriate guard circuits must be used over all bushings.
- b. A turns ratio test must be performed between windings for all tap positions. The equipment owner determines the final tap settings, which is set by the test contractor.
- c. Measure secondary voltage phase-to-phase and phase-to-ground after final energizing and prior to loading.
- d. Insulating oil must be sampled in accordance with the American Society for Testing Material (ASTM) D-923. Sample must be laboratory tested for:
 - (I) Dielectric strength
 - (II) Acid neutralization number
 - (III) Interfacial tension
 - (IV) Color
 - (V) Power factor
 - (VI) Parts Per Million (PPM) water (only required on units above 69 kVA)
 - (VII) Furan analysis
- e. Measure dew point and/or oxygen content of top gas when applicable.
- f. A complete dissolved combustible gas analysis shall be performed on all transformers over 50 kVA. Analysis must include interpretation by Roger's Ratio and Dorenberg Method.
- g. Perform special tests and adjustments as suggested by manufacturer on tap changer, fan(s), and pump control and alarm functions.

Test Values

- a. Insulation resistance and absorption test. Test voltages to be in accordance with NETA Maintenance Test Specifications Electrical Power Distribution Equipment and Systems. Resistance values to be temperature corrected in accordance with NETA Maintenance Test Specifications Electrical Power Distribution Equipment and Systems.
- b. The absorption test polarization index should be above 2.0 unless an extremely high value is obtained at the end of one (1) minute that when doubled will not yield a meaningful value with the available test equipment.

DRY TRANSFORMER (Item E3)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage, moisture, and mechanical and electrical conditions.
- b. Compare equipment nameplate information with latest one-line diagram and report all discrepancies.
- c. Verify that proper auxiliary device operation such as fans and indicators is in accordance with manufacturer's recommendations.
- d. If heat is evident with IR scanning/testing, check tightness of bolted electrical joints by using a calibrated torque wrench.
- e. Check for grounding, alignment, support beam corrosion, etc.
- f. Inspect terminals for alignment, burns, and corrosion.
- g. Perform specific inspections and mechanical tests recommended by manufacturer.
- h. Inspect insulated joints for signs of localized heating or corona (medium voltage transformers).
- i. Closely examine for shipping brackets or fixtures that may not have been removed during original installation. Ensure that resilient mounts are free.
- j. Closely examine for the collection of dirt or other forms of material that may have collected in the windings during normal operation. Any foreign material that may interfere with cooling, or reduce clearances to ground, must be removed using accepted methods.
- k. Clean bushing, fans, insulators, etc.
- l. Verify operation of alarm, temperature controls

DRY TRANSFORMER (Item E3)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Insulation resistance tests must be performed winding to winding and winding to ground.
- b. A dielectric absorption test must be made winding to winding and winding to ground for ten (10) minutes. The polarization index must be computed.
- c. Insulation power factor tests must be made from winding to winding and from each winding to ground.
- d. A turns ratio test must be performed between windings.
- e. Over-potential tests must be made on all high and low voltage windings to ground.
- f. Perform special tests and adjustments as suggested by manufacturer for fan(s), tap changers, controls, and alarm functions.
- g. Measure secondary voltage phase to phase and phase to ground after final energizing and prior to loading.

Test Values

- a. Insulation resistance and absorption test voltage must be in accordance with manufacturer's recommendations. All results are temperature corrected in accordance with manufacturer's recommendations.
- b. The absorption test polarization index must be above 2.0 unless an extremely high value is obtained at the end of one (1) minute that when doubled must not yield a meaningful value with the available test equipment.
- c. Power factor test values in excess of three percent (3%) must be investigated.

MEDIUM VOLTAGE (VACUUM) CIRCUIT BREAKER (Item E4)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage, cleanliness, and adequate lubrication. Clean and lubricate as necessary.
- b. Inspect anchorage, alignment, and grounding.
- c. Perform all mechanical operational tests.
- d. Check tightness of bolted bus joints with a calibrated torque wrench. Refer to manufacturer's instruction for proper foot pound levels.
- e. Check the cell fit and element alignment.
- f. Ensure that all maintenance devices required to service and operate the equipment are available.

MEDIUM VOLTAGE (VACUUM) CIRCUIT BREAKER (Item E4)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure contact resistance.
- b. Perform minimum pickup voltage tests on trip and close coils.
- c. Perform insulation resistance tests, pole to ground, pole to pole, and across open pole.
- d. Perform insulation resistance test at 1000 volts DC on all control wiring. (Do not perform the test on wiring connected to solid state relays.)
- e. If charging motors are used, check condition of brushes and limit switches.
- f. Perform vacuum bottle integrity (overpotential) test across each vacuum bottle with the breaker in the open position in strict accordance with manufacturer's published data. Do not exceed maximum voltage stipulated for this test. Provide adequate barriers and protection against x-radiation during this test. Do not perform this test unless the contact displacement of each interrupter is within manufacturer's tolerance. (Be aware that some dc high-potential test sets are half-wave rectified and may produce peak voltages in excess of the breaker manufacturer's recommended maximum.)

Test Values

- a. Contact resistance must be determined in micro-ohms. Resistance values must not exceed 500 micro-ohms. Consult the manufacturer for acceptable range.
- b. Power factor and arc chute watts loss must be no greater than the manufacturer's allowable value.

INDOOR MAIN DISTRIBUTION BUSWAY (Item E5)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect the bus for physical damage, cleanliness, and proper connection in accordance with one-line diagram.
- b. Inspect for proper bracing, suspension alignment, and enclosure ground.
- c. If thermographic scan indicates heat, the tightness of bolted joints should be checked with a calibrated torque wrench.
- d. In some cases a thermographic survey can be made to evaluate the connections of the bus duct. This must be made with the unit operating under maximum load conditions.
- e. Closely inspect the bus enclosure for any indication of environmental influence or the presence of any foreign material that might affect the insulation resistance by reducing clearance phase-to-phase or phase-to-ground.

INDOOR MAIN DISTRIBUTION BUSWAY (Item E5)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure the insulation resistance of each bus run, phase-to-phase and phase-to-ground, for one (1) minute.
- b. Perform over-potential tests on each bus run, phase-to-phase and phase-to-ground.

Test Values

- a. Bus bolt torque values must be in accordance with U. S. Standard bolt torques for bus connection for heat treated steel unless otherwise specified by manufacturer's recommendations.
- b. Insulation resistance test voltage must be in accordance with manufacturer's recommendations. Resistance values must be in accordance with manufacturer's values.

OUTDOOR BUSWAY (Item E6)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Examine bus and supports for defects, such as cracked welds, chipped porcelain, etc.
- b. If thermographic scan indicates heat the tightness of bolted bus joints should be checked with a calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels.
- c. Inspect for evidence of foreign material such as bird nests, dust, and for missing or damaged rain guards.
- d. Inspect for cleanliness and clean if necessary.
- e. Examine outdoor busway for removal of "weep-hole" plugs, if applicable, and the correct installation of joint shield.
- f. Verify the operation of heaters.

OUTDOOR BUSWAY (Item E6)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground, for one (1) minute.
- b. Perform over potential test on each bus section, phase-to-phase and phase-to-ground. Voltage application must be for one (1) minute.
- c. Measure resistance of bus section joints with micro-ohmmeter, or "ductor," preferably at a high current.

Test Values

- a. Bolt torque levels must be in accordance with manufacturer's recommendations.
- b. Insulation resistance test values must be in accordance with manufacturer's recommendations.
- c. Measured bus joint resistance must be compared to calculated resistance of bus. Investigate resistances above one hundred fifteen percent (115%) of calculated value.

MEDIUM VOLTAGE AIR SWITCH (Item E7)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Document equipment nameplate data.
- b. Inspect for physical damage.
- c. Perform mechanical operation tests in accordance with manufacturer's instructions.
- d. Check blade alignment and arc interrupter operation.
- e. Check fuse linkage and element for proper holder and current rating.
- f. Check each fuse holder for adequate mechanical support of each fuse.
- g. Check key interlocks for safe operation and proper key distribution.
- h. Inspect interphase linkages and operating rods to make sure that they are not bent or distorted, and that all fastenings are secure.
- i. Observe operation of the switch and check for approximately simultaneous closing of all blocks and for complete closing.
- j. Inspect contacts for alignment, pressure, burns, or corrosion.
- k. Inspect arcing horns for signs of excessive burning.
- l. Inspect flexible braids or slip ring contacts commonly used for grounding the operating handle. Replace braids showing signs of corrosion, wear, or broken strands.
- m. Lubricate and clean as necessary.

MEDIUM VOLTAGE AIR SWITCH (Item E7)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Perform insulation resistance test on each phase-to-ground and from phase-to-phase for one (1) minute.
- b. Perform over-potential test on each pole-to-ground and pole-to-pole for one (1) minute.
- c. Perform contact resistance test across each switch blade and fuse holder.

Test Values

Contact resistance must be determined in micro-ohms. Any value exceeding 100 micro-ohms or any value that deviates from adjacent poles or similar switches by more than fifty percent (50%) must be investigated.

LOW VOLTAGE AIR SWITCH (Item E8)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Document equipment nameplate data.
- b. Inspect for physical damage.
- c. Perform mechanical operation tests in accordance with manufacturer's instructions.
- d. Check blade alignment and arc interrupter operation.
- e. Check fuse linkage and element for proper holder and current rating.
- f. Check each fuse holder for adequate mechanical support of each fuse.
- g. Check key interlocks for safe operation and proper key distribution.
- h. Inspect interphase linkages and operating rods to make sure that they are not bent or distorted, and that all fastenings are secure.
- i. Observe operation of the switch and check for approximately simultaneous closing of all blocks and for complete closing.
- j. Inspect contacts for alignment, pressure, burns, or corrosion.
- k. Lubricate and clean as necessary.

LOW VOLTAGE AIR SWITCH (Item E8)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS Installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS Installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Perform insulation resistance test on each phase-to-ground and from phase-to-phase for one (1) minute.
- b. Perform over-potential test on each pole-to-ground and pole-to-pole for one (1) minute.
- c. Perform contact resistance test across each switch blade and fuse holder.

Test Values

Contact resistance must be determined in micro-ohms. Any value exceeding 100 micro-ohms or any value that deviates from adjacent poles or similar switches by more than fifty percent (50%) must be investigated.

AUTOMATIC TRANSFER SWITCH (Item E9)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage.
- b. Check switch to ensure positive interlock between normal and alternate sources (mechanical and electrical).
- c. Check tightness of all control and power connections.
- d. Perform a manual transfer operation.
- e. Ensure mechanical breaker reset function.
- f. Clean and lubricate as necessary.

AUTOMATIC TRANSFER SWITCH (Item E9)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

Perform insulation resistance tests, phase-to-phase and phase-to-ground, with switch in both source positions.

Check calibration of following:

- a. Voltage sensing relays
- b. Transfer time delay relay
- c. Engine shutdown relay

Perform an automatic transfer by:

- a. Simulating loss of normal power
- b. Returning to normal power
- c. Activating the transferring time delay relay
- d. Activating the engine shutdown relay

Monitor and verify correct operation and timing by:

- a. Normal voltage sensing relays
- b. Engine start sequence
- c. Time delay upon transfer
- d. Alternate voltage-sensing relays
- e. Automatic transfer operation
- f. Interlocks and limit switch function
- g. Timing delay and retransfer upon normal power restoration
- h. Engine shutdown feature

Test Values

Insulation resistance test voltages and minimum values to be in accordance with NETA Maintenance Test Specifications Electrical Power Distribution Equipment and Systems.

MEDIUM VOLTAGE (AIR) CIRCUIT BREAKER (Item E10)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage, cleanliness, and adequate lubrication.
- b. Inspect anchorage, alignment, and grounding.
- c. Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism in accordance with manufacturer's instruction.
- d. Check tightness of bolted bus joints with a calibrated torque wrench. Refer to manufacturer's instruction for proper foot pound levels.
- e. Check the cell fit and element alignment.
- f. Using the manufacturer's instruction book, verify the primary and secondary contact wipe and other dimensions vital to satisfactory operation of the circuit breaker.
- g. Ensure that all maintenance devices required to service and operate the equipment are available.

MEDIUM VOLTAGE (AIR) CIRCUIT BREAKER (Item E10)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure contact resistance.
- b. Perform minimum pickup voltage tests on trip and close coils.
- c. Perform insulation resistance tests, pole-to-ground, pole-to-pole, and across open pole.
- d. Perform insulation resistance test at 1000 volts DC on all control wiring. (Do not perform the test on wiring connected to solid state relays.)
- e. If charging motors are used, check condition of brushes and limit switches.
- f. Perform over-potential tests, or power factor tests with breaker in both the open and closed positions. All arc chutes must be tested for watts loss.

Test Values

- a. Contact resistance must be determined in micro-ohms. Resistance values must not exceed 500 micro-ohms. Consult the manufacturer for acceptable range.
- b. Power factor and arc chute watts loss must be no greater than the manufacturer's allowable value.

OIL CIRCUIT BREAKER (Item E11)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage, cleanliness, and compare nameplate data with plans and specifications. Check all gasketed covers and seals for weather tightness. Clean as necessary.
- b. Inspect anchorage, alignment, and grounding.
- c. Verify correct oil level in tank and bushing (if equipped).
- d. Check tightness of bolted bus joints with a calibrated torque wrench. Refer to manufacturer's instructions for Proper foot pound levels.
- e. Inspect and service hydraulic system and/or air compressor in accordance with manufacturer's published data. Test alarms and pressure-limit switches for pneumatic and/or hydraulic operators as recommended by the manufacturer.
- f. Perform mechanical operation tests on the operating mechanism in accordance with manufacturer's published data.
- g. If performing internal inspection follow h through k:
- h. Remove oil. Lower tanks or remove manhole covers as necessary. Inspect bottom of tank for broken parts and debris and clean carbon residue from tank.
- i. Inspect lift rod and toggle assemblies, contacts, interrupters, bumpers, dashpots, bushing current transformers, tank liners, and gaskets.
- j. Verify that contact sequence is in accordance with manufacturer's published data. In the absence of manufacturer's published data, refer to ANSI C37.04.
- k. Refill tank(s) with filtered oil.

OIL CIRCUIT BREAKER (Item E11)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure contact resistance.
- b. Perform breaker travel time test if unit is properly equipped for it.
- c. Remove a sample of insulating liquid in accordance with ASTM D 923. Sample shall be tested in accordance with the referenced standard.
 - 1) Dielectric breakdown voltage: ASTM D 877
 - 2) Color: ANSI/ASTM D 1500
 - 3) Power factor: ASTM D 924
 - 4) Interfacial tension: ANSI/ASTM D 971 or ANSI/ASTM D 2285
 - 5) Visual condition: ASTM D 1524
 - 6) Verify trip, close, trip-free, and antipump functions.
- d. Perform minimum pickup voltage tests on trip and close coils.
- e. Circuit breaker must be tripped by operation of each protective device. Protective relays must be tested in the housing.
- f. Perform insulation resistance tests on each pole-to-ground and pole-to-pole.
- g. Perform insulation resistance tests on all control wiring at 1000 volts DC. (Do not perform this test on wiring connected to solid state relays.)
- h. Perform power factor tests on each Pole and each bushing equipped with power factor taps.

Test Values

- a. Contact resistance must be determined in micro-ohms. Resistance values must not exceed 500 micro-ohms. Manufacturer must be consulted for acceptable range.
- b. Circuit breaker travel and cycle time values must be compared to manufacturer's acceptable limits.
- c. Insulating liquid tests must comply with manufacturer's recommendations.

LOW VOLTAGE (AIR) CIRCUIT BREAKER (Item E12)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage, cleanliness, and nameplate compliance with one-line diagram. Clean and lubricate as necessary.
- b. Mechanical operational tests must be made in accordance with manufacturer's instruction manual.
- c. Check the cell fit and element alignment.
- d. Check tightness of connections.
- e. Dashpots must be removed, inspected, cleaned, refilled with proper oil, and tested for operation.
- f. Closely inspect the operation of main and arcing contacts of the circuit breaker to ensure that the springs responsible for maintaining primary contact pressure are in good condition.
- g. If circuit breakers are of the draw out type, closely examine the disconnecting devices at the rear of the circuit breaker. Inspect for any deterioration of springs that might result in high contact resistance of primary disconnects.

LOW VOLTAGE (AIR) CIRCUIT BREAKER (Item E12)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Perform a contact resistance test.
- b. Perform an insulation resistance test at 1000 volts DC for one (1) minute from pole-to-pole and from each pole-to-ground and across open contacts of each phase.
- c. Determine the long time delay by primary injection at three hundred percent (300%) pickup current. (See EXCEPTION)
- d. Determine the short time pickup and time delay by primary injection of current. (See EXCEPTION)
- e. Determine the instantaneous pickup current by primary injection. (See EXCEPTION)
- f. Verify the trip unit reset characteristics.
- g. If provided, adjust the final settings in accordance with the engineer's prescribed settings, based on a coordination study.
- h. Activate the auxiliary protective devices, such as ground fault or under-voltage relays, to ensure operation of shunt trip devices.
- i. If the circuit breaker has a charging motor, the springs and other devices associated with this charging motor must be inspected closely. The circuit breaker must be electrically operated to verify the performance of the limit switches responsible for stopping and starting the charging motor.
- j. Test circuit breakers with solid state trips according to manufacturer's instructions.

EXCEPTION

Breakers equipped with solid state trip units may perform secondary injection in lieu of primary injection at every other test interval. (e.g., 10-year intervals for primary injection and 5-year intervals for secondary injection).

NOTE

Primary injection is recommended to evaluate complete trip circuit operation. Secondary injection can be used for evaluating the electronic portion of the trip unit.

Test Values

- a. Determine contact resistance in micro-ohms or voltage drop in millivolts. Values that deviate from adjacent poles or similar breakers by more than fifty percent (50%) must be investigated.
- b. Insulation resistance must not be less than fifty (50) megohms.
- c. Do not use a megohm meter on solid state devices.
- d. Minimum pickup current, trip times and instantaneous pickup values should be adjusted to engineered settings. Test values must fall within manufacturer's published time-current characteristic tolerance band.

MOLDED CASE CIRCUIT BREAKER (Item E13)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Visual and Mechanical Inspections

Perform the following inspections and tests:

- a. Clean and Check the circuit breaker for proper mounting, conductor size, and feed designation.
- b. Operate circuit breaker to ensure smooth operation.
- c. Inspect case for cracks, heat damage, or other defects.
- d. Check tightness of connection with a torque wrench in accordance with manufacturer's recommendations.
- e. Open all unsealed breakers and check internal components for tightness.

MOLDED CASE CIRCUIT BREAKER (Item E13)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure the contact resistance.
- b. Perform a time-current characteristic test by passing three hundred percent (300%) rated current through each pole separately. Trip time must be determined and compared to manufacturer's specifications. (See EXCEPTION).
- c. Determine the instantaneous pickup current by run up or pulse method. Clearing times must be within four (4) cycles or less. (See EXCEPTION).
- d. Determine the insulation resistance pole-to-pole, across pole, and pole-to-ground. Test voltage must be 1000 volts DC. (See EXCEPTION).

EXCEPTION

Breakers equipped with solid state trip units may perform secondary injection in lieu of primary injection at every other test interval. (e.g., 10-year intervals for primary injection and 5-year intervals for secondary injection).

Test Values

- a. Compare contact resistance to adjacent poles and with similar breakers. Deviations of more than fifty percent (50%) must be investigated.
- b. Insulation resistance must not be less than fifty (50) megohms.
- c. All trip times must fall within those given in NETA Maintenance Test Specifications Electrical Power Distribution Equipment and Systems. Circuit breakers exceeding maximum three hundred percent (300%) time must be replaced.
- d. Instantaneous pickup current levels must be within twenty percent (20%) of manufacturer's published values.

PROTECTIVE RELAY (Item E14)

NOTE

There are a variety of relays used in USPS large facilities utilizing medium or high voltage breakers. To include the various detailed and specific test requirements would be cumbersome in this document and thus this is a general guide for electro-mechanical or solid-state relays typically used on medium and high voltage systems. For specific guidelines for the various type of relays refer to NETA Maintenance Testing Specifications section 7.9.

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect relays for physical damage, cleanliness, mechanical and electrical operation.
- b. Inspect cover gasket, cover glass, condition of spiral springs, and disc clearance.
- c. Inspect for presence of foreign material, moisture, and rust on all contacts.
- d. Check mechanism for freedom of movement, proper travel and alignment, and tightness of mounting hardware and tap screws.
- e. All settings should be in accordance with the coordination study.
- f. Inspect all shorting contacts for normal operation.
- g. Examine condition of bearings.
- h. Examine contacts and backstops.
- i. Clean and remove foreign matter from permanent magnet and disc.

PROTECTIVE RELAY (Item E14)

NOTE

There are a variety of relays used in USPS large facilities utilizing medium or high voltage breakers. To include the various detailed and specific test requirements would be cumbersome in this document and thus this is a general guide for electro-mechanical or solid-state relays typically used on medium and high voltage systems. For specific guidelines for the various type of relays refer to NETA Maintenance Testing Specifications section 7.9.

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Perform an insulation resistance test on each circuit to frame. (Do not perform this test on solid state relays.)
- b. Perform the following tests with nominal settings as specified by the manufacturer:
 - 1) Pickup parameters on each operating element.
 - 2) Perform timing at three (3) points on performance curves.
 - 3) Pickup targets and seal in units must operate properly.
 - 4) Perform special tests as required to check operation of resistance, directional and other elements per manufacturer's instruction manual.
- c. Perform phase angle and contribution tests on all phase sensitive relays.
- d. Check all protective relays to ensure they are subjected to the correct electrical signals (amps, volts, watts, etc.).

INSTRUMENT METER (Item E15)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Examine all devices for mechanical or electrical damage and wire connection tightness.
- b. Check condition of meter face and face gaskets.
- c. Clean unit.

INSTRUMENT METER (Item E15)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

Perform the following inspections and tests:

- a. Verify all instrument multipliers.
- b. Meter selector switches must be inspected for proper application and operation.

GROUND FAULT SYSTEM (Item E16)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage.
- b. Inspect the components for damage and errors in polarity or conductor routing.
 - 1) Verify that ground connection is made ahead of the neutral disconnect link and on the line side of any ground fault sensor.
 - 2) Verify that the neutral sensors are connected with correct polarity on both primary and secondary.
 - 3) Verify that all phase conductors and the neutral pass through the sensor in the same direction for zero sequence systems.
 - 4) Verify that grounding conductors do not pass through zero sequence sensors.
 - 5) Verify that the grounded conductor is solidly grounded.
- c. Inspect control current transformer to ensure adequate capacity for system.
- d. Manually operate the following controls on the monitor panels (if present) for:
 - 1) Trip tests.
 - 2) No trip tests.
 - 3) Non-automatic reset; proper operation and test sequence must be recorded.
- e. Inspect zero sequence systems for symmetrical alignment of core balance transformers about all current carrying conductors.
- f. Verify ground fault device circuit nameplate identification by device operation.
- g. Leave pickup and time delay settings as found.

GROUND FAULT SYSTEM (Item E16)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure the system neutral insulation resistance to ensure that no shunt ground paths exist.
- b. Remove the neutral ground disconnect link. Measure the neutral insulation resistance and replace link.
- c. Determine the relay pickup current by performing primary injection at the sensor and operating the circuit interruption device.
- d. Test the relay timing by injecting one hundred fifty percent (150%) and three hundred percent (300%) of pickup current into sensor. Total trip time must be electrically monitored.
- e. Test the system operation at fifty five percent (55%) rated voltage.
- f. If possible, test the zone interlock systems by simultaneously injecting sensor current and monitoring the zone blocking function.

Test Values

- a. System neutral insulation must be a minimum of one hundred (100) ohms preferably one (1) megohm or greater.
- b. Relay pickup current must be within ten percent (10%) of device dial or fixed setting, and in no case greater than twelve hundred (1200) amperes.
- c. Relay timing must be in accordance with manufacturer's published time current characteristic curves.

GROUND SYSTEM (Item E17)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect ground system for adequate termination at all devices.
- b. Inspect ground and connections to water system.
- c. Verify that building steel, water system and ground grid are effectively bonded together.
- d. Make sure that the panels and cabinets are grounded, but that they are not used as part of the grounding system.

GROUND SYSTEM (Item E17)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. On the main grounding electrode or system, perform a fall of potential test per IEEE Standard No. 81, Section 9.04.
- b. Perform the two (2) point method test per IEEE No. 81, Section 9.03, to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
- c. Perform high current (100A DC) resistance test of conductors to ground electrode(s).
- d. Alternate Method: perform a ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. This test must be made by passing a minimum of ten (10) amperes DC current between ground references system and the ground point to be tested. Voltage drop must be measured and resistance calculated by voltage drop method.

Test Values

- a. The main ground electrode system resistance to ground must be no greater than five (5) ohms unless otherwise specified. (Any deviations must be indicated in the certified drawings and report.)

BATTERY SYSTEM (Item E18)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for physical damage, corrosion, sulphation, disconnection, clean support rails, clean cells and cell connectors and ensure connectors are antioxidant coated.
- b. Check intercell bus link integrity.
- c. Inspect lug and intercell connections for integrity.
- d. Inspect ventilators to ensure that they are clean and clear of obstructions.
- e. Examine condition of any mounting support members.
- f. Verify existence and operation of eye wash equipment (except Battery Charging Areas).
- g. Verify grounding of battery system.
- h. Verify electrolyte level. Measure electrolyte specific gravity and temperature levels.

Perform the following inspections and tests of the charger:

- a. Inspect for physical damage.
- b. Remove any dust and dirt from interior.
- c. Check all gauges and indicators for proper operation.

BATTERY SYSTEM (Item E18)

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Measure system charging voltage and each individual cell voltage.
- b. Check to see that the charging rate in amperes does not cause excessive gassing and that the cell temperature does not rise above 110 degrees Fahrenheit (43 degrees Celsius).
- c. Check to see that the correct float charge has been selected according to battery manufacturer's requirements or to the grid type if requirements are unavailable.
- d. Perform a discharge test.

Test Values

- a. Compare measured values with manufacturer's specifications.

SURGE ARRESTOR (Item E19)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

NOTE

There are a variety of surge arrestors used on medium and high voltage systems. To include the various detailed and specific test requirements would be cumbersome in this document and thus this is a general guide. For specific guidelines refer to NETA Maintenance Testing Specifications section 7.19.

Perform the following inspections and tests:

- a. Inspect for physical damage, such as chipped or fractured porcelain.
- b. Inspect ground and discharge connections for integrity.
- c. Inspect for signs of corona and tracking.
- d. Clean all insulators and arrestors.
- e. Apply insulator treating fluid to all insulators and arrestors.
- f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

SURGE ARRESTOR (Item E19)

NOTE

There are a variety of surge arrestors used on medium and high voltage systems. To include the various detailed and specific test requirements would be cumbersome in this document and thus this is a general guide. For specific guidelines refer to NETA Maintenance Testing Specifications section 7.19.

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Perform insulation-resistance tests. Use manufacturer's recommended values.

LIGHTNING PROTECTION SYSTEM (Item E20)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Check that all air terminals (lightning rods) are interconnected, and that at least two (2) down conductors are installed with their own ground connection.
- b. Inspect all air terminals for corrosion and rigid attachment to structure.
- c. Examine conductors for corrosion, strong mechanical joints providing good electrical conductivity and loose or broken fasteners.
- d. Check loops, sharp bends (less than 8" radius), and frayed horizontal and vertical conductors.
- e. Check for damaged guards and down conductors.
- f. Inspect grounding attachments for permanence and corrosion (if practical).

LIGHTNING PROTECTION SYSTEM (Item E20)

TEST REQUIREMENTS

SCOPE OF WORK

Test Values

- a. Measure resistance to ground for each conductor.

MOTOR STARTERS (Item E21)

NOTE

For medium voltage motor starters refer to NETA Maintenance Testing Specification section 7.16.1.

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect for broken parts, contact "arcing", or any evidence of overheating.
- b. Check motor name plate for current rating and controller manufacturer's recommended heater size.

NOTE

Heater size must not be changed without approval from the Appropriate Area Office / Maintenance Technical Service Center.

- c. Check line and load connections and heater mounting screws for tightness.
- d. Clean all areas of equipment as needed.

MOTOR STARTERS (Item E21)

NOTE

For medium voltage motor starters refer to NETA Maintenance Testing Specification section 7.16.1.

TEST REQUIREMENTS

SCOPE OF WORK

Special Condition: If the USPS installation does not provide a current coordination study, under no circumstances should the contractor change any device and/or tap settings. All device and tap settings must be tested at current values and all device and tap settings must remain the same as found. Any deviations from appropriate device or tap settings discovered by the contractor must be reported to the USPS installation Manager, Maintenance or designee for review and corrective action if necessary.

- a. Deenergize and tag circuit.
- b. Obtain and review manufacturer's instruction for starter to be tested (including the time current characteristic curve).
- c. Record data, as found and as left after testing and adjustment.
- d. Remove tags and return circuit to service.

Test Values

- a. All tests must conform to the appropriate ASTM test procedure, and the values used as standards must conform to the manufacturer's and ANSI specifications.

POWER FACTOR CORRECTION DEVICES (Item E22)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

NOTE

For liquid filled capacitors or medium voltage capacitors refer to NETA Maintenance Testing Specification section 7.20

Passive Devices

Perform the following inspections and tests:

- a. Inspect capacitor banks for damage, secure mounting, signs of overheating, corrosion, leaks, and blown fuse indicators.
- b. Examine the conductors for strong mechanical connections, signs of corrosion or overheating.
- c. Record amperage reading on each phase and compare to the rated amperage for the KVAR of the capacitor bank.
- d. Check for grounding.
- e. Clean unit.

Automatic Power Factor Correction Devices

Perform the following inspections and tests:

- a. Inspect the unit for signs of overheating and physical damage.
- b. Check all terminations for clean and tight connections.
- c. Remove all foreign material from the enclosure.
- d. Inspect capacitors for signs of leaking, corrosion, bulging or overheating.
- e. Check all fuses for continuity by observing the blown fuse indicators or checking each fuse.
- f. Using the manufacturer's instructions, verify the accuracy of the set point.
- g. Clean interior of unit.
- h. Check for grounding.

POWER VAULTS (Item E23)

PREVENTIVE MAINTENANCE

SCOPE OF WORK

Perform the following:

Special Instructions

- a. Equipment vaults must be maintained in a clean, dry and ventilated condition at all times.
- b. Doors on enclosures must be kept locked to prevent unauthorized access.
- c. The power vaults may not be used as storage for supplies or equipment.

Checkpoints

- a. Check insulators or insulating supports and bus runs after cleaning them.
- b. Seals on conduit runs entering or leaving the vault must be checked to prevent entry of moisture, rodents and insects.
- c. All switchgear containing transformer sections must be thoroughly cleaned inside and outside.
- d. Inspect and lubricate ventilation fans as required.

INFRARED THERMAL SCANNING (Item E24)

INSPECTION AND TESTING

SCOPE OF WORK

Perform the following inspections and tests:

- a. Inspect the physical, electrical, and mechanical condition.
- b. Remove all covers required to permit scanning prior to the scanning.

Equipment to be Scanned Under Load:

Switches, bus duct, switchgear, transformers, cables, cable connections, circuit breakers, terminations, motor control centers, junction boxes and battery system.

NOTE

The survey should be performed with the equipment to be scanned in an energized state, and loaded to at least forty percent (40%) of load capacity and under load for at least an hour, for beneficial test results.

Scanning Report

Provide Report Indicating the Following:

- a. Problem area with location of "hot spot" to include building name, panel or component number, floor or mezzanine and column coordinate. Provide colored IR images and digital photos of each deficiency identified during the IR testing.
- b. A prioritized listing of the deficiencies listed in the report.
- c. The suspected cause of the abnormal temperature.
- d. Any phase imbalance.
- e. An index of areas scanned.
- f. The report shall be submitted in hard copy and in soft-copy (CD or other as specified). The soft copy shall include all images scanned of major components.

**APPENDIX F
FORMS**

INPUT FORMS

INVENTORY FORMS BY APPARATUS (B8)

- SWITCHGEAR – TESTING/PM/INVENTORY SHEET CONTRACTING GUIDE
- SWITCHGEAR DOCUMENTATION CHECKLIST
- SWITCHGEAR – TESTING/PM/INVENTORY FACILITY GUIDE

TEST RECORD REPORT FORMS WILL BE PROVIDED BY THE CONTRACTOR.

Forms listed below must be provided at minimum.

- (E1) SWITCHBOARD ASSEMBLY REPORT (METAL CLAD)
- (E2) TRANSFORM OIL ANALYSIS REPORT
- (E3) POWER TRANSFORMER TEST REPORT
- (E4) VACUUM BREAKER REPORT
- (E5) INDOOR MAIN DISTRIBUTION BUSWAY TEST REPORT
- (E6) OUTDOOR BUSWAY TEST REPORT
- (E7) MEDIUM VOLTAGE AIR SWITCH TEST REPORT
- (E8) LOW VOLTAGE AIR SWITCH TEST REPORT
- (E9) AUTOMATIC TRANSFER SWITCH TEST REPORT
- (E10) MEDIUM VOLTAGE BREAKER TEST REPORT
- (E11) OIL CIRCUIT BREAKER TEST REPORT
- (E12) LOW VOLTAGE BREAKER TEST REPORT
- (E13) MOLDED CASE CIRCUIT BREAKER TEST REPORT
- (E14) PROTECTIVE RELAY TEST REPORT
- (E15) INSTRUMENT TEST REPORT
- (E16) GROUND FAULT TEST REPORT
- (E17) GROUND SYSTEM TEST REPORT
- (E18) BATTERY TEST REPORT
- (E20) LIGHTNING PROTECTION SYSTEM TEST REPORT
- (E21) MOTOR STARTER TEST REPORT
- (E24) INFRARED INSPECTION REPORT

APPENDIX F

Facility name:
Facility Address: (Street Address, City, Zip Code)
Contact Name:
Contact Phone Number:

**SWITCHGEAR – TESTING/PM/INVENTORY SHEET
 CONTRACTING GUIDE**

ITEM #	ITEM DESCRIPTION	SIZE	ESTIMATED TEST TIME		FREQ-YEAR INTERVAL		NUMBER IN INVENTORY
			PER UNIT	TOTAL	TEST	PM	
E1	Switchboard Assembly	= > 1000 A			5	2.5	
E2	Liquid Filled Transformer	All			5	2.5	
E3	Dry Transformer	>112.5 kVA			5	2.5	
E4	Medium Voltage (Vacuum) Circuit Breaker	=>2000V			5		
E5	Indoor Main Distribution Busway	All			5	5	
E6	Outdoor Busway	All			5	2.5	
E7	Medium Voltage Air Switch	= > 2000 V			5	2.5	
E8	Low Voltage Air Switch	< 2000 V => 400 A			5	2.5	
E9	Automatic Transfer Switch	= > 2000 V or =>400 A			5	2.5	
E10	Medium Voltage (Air) Circuit Breaker	= > 2000 V			5	5	
E11	(OIL) Circuit Breaker	All			5	2.5	
E12	Low Voltage (Air) Circuit Breaker	< 2000 V			5		
E13	Molded Case - Circuit Breaker *	= > 400 A or >65K AIC			5		
E14	Protective Relay	All			5		
E15	Instrument Meter	All			5		
E16	Ground Fault System	All			5		
E17	Ground System	All			5		
E18	Battery System	Back up & Control Volt			2.5		
E19	Surge Arrestor	= > 400 A			5		
E20	Lightning Protection System	= > 400 A			5	1	
E21	Motor Starters	= >200 HP			5		
E22	Power Factors Correction Devices: Passive Devices Automatic Devices	= > 50 KVAR => 50 KVAR				1 1	
E23	Power Vaults	All			5	1	
E24	Infrared Thermal Scanning	All of the Above				1	N/A

* NOTE: All breakers in a primary distribution panel or those deemed critical should be considered for testing if the breaker size requirements are met.

MAINTENANCE OF ELECTRICAL SWITCHGEAR

**APPENDIX F FORMS
SWITCHGEAR DOCUMENTATION CHECKLIST**

SITE: _____ DATE: _____

#	ITEM	ON FILE		FILE COMPLETE		STATUS UPDATE		INSTALL DATE	LAST REVISION	COMMENTS
		YES	NO	YES	NO	YES	NO			
1	Complete Inventory available of: a. Drawings									
	b. Schematics									
2	Plans available for: a. Shutdown									
	b. Power transfer									
	c. Start up procedures									
3	A. Short circuit, device evaluation, and coordination study (See Note 1)									
	B. Coordination settings available for: a. Protective relays									
	b. Circuit breakers									
	c. Ground fault protection									
4	A reproducible one-line drawing that includes distribution diagrams, control wiring and coordination settings									
5	Inventory of cables showing the manufacturer's voltage class, type and length									
6	Inventory of breakers listing type, manufacturer's model, serial numbers, and time current characteristic curves									
7	Inventory of all PT & CT transformers listing manufacturer's model and serial number including voltages and ratios									
8	Inventory of switchgear listing manufacturer, model, serial number, voltage and amperage									
9	Inventory of relays, induction disc overcurrent, directional overcurrent, thermal overcurrent, over and under voltage, power factor, reverse current and watt type with coordination set points indicated									
10	Drawings indicating lightning and network protectors showing all down conductors & tie points, with wire sizes									
11	Inventory of all distribution and power transformers									
12	Inventory of Distribution bus ducts									

APPENDIX F

#	ITEM	ON FILE		FILE COMPLETE		STATUS UPDATE		INSTALL DATE	LAST REVISION	COMMENTS
		YES	NO	YES	NO	YES	NO			
13	Inventory of switchboards or power distribution panels									
14	Inventory of motor starters for chillers									
15	Inventory of ground fault relays listing coordination set points									
16	Drawings that show all grounding connection points, type of connection grounding, electrode size, number of electrodes and the wire size									
17	Complete inventory list documenting all the electrical power distribution equipment that requires testing as required per Switchgear Testing/PM/Inventory Form									

MAINTENANCE OF ELECTRICAL SWITCHGEAR

Facility name:
Facility Address: (Street Address, City, Zip Code)
Contact Name:
Contact Phone Number:

SWITCHGEAR - TESTING/PM/INVENTORY FACILITY GUIDE

ITEM AND GUIDE #	ITEM DESCRIPTION	SIZE	ESTIMATED TEST TIME		FREQ-YEAR INTERVAL		NUMBER IN INVENTORY
			PER UNIT	TOTAL	TEST	PM	
D1	Switchboard Assembly	= > 1000 A			5	2.5	
D2	Liquid Filled Transformer	All			5	2.5	
D3	Dry Transformer	>112.5 kVA			5	2.5	
D4	Medium Voltage (Vacuum) Circuit Breaker	=>2000V			5		
D5	Indoor Main Distribution Busway	All			5	5	
D6	Outdoor Busway	All			5	2.5	
D7	Medium Voltage Air Switch	= > 2000 V			5	2.5	
D8	Low Voltage Air Switch	< 2000 V => 400 A			5	2.5	
D9	Automatic Transfer Switch	= > 2000 V or =>400 A			5	2.5	
D10	Medium Voltage (Air) Circuit Breaker	= > 2000 V			5	5	
D11	(OIL) Circuit Breaker	All			5	2.5	
D12	Low Voltage (Air) Circuit Breaker	< 2000 V			5		
D13	Molded Case - Circuit Breaker	= > 400 A or >65K AIC			5		
D14	Protective Relay	All			5		
D15	Instrument Meter	All			5		
D16	Ground Fault System	All			5		
D17	Ground System	All			5		
D18	Battery System	Back up & Control Volt			2.5		
D19	Surge Arrestor	= > 400 A			5		
D20	Lightning Protection System	= > 400 A			5	1	
D21	Motor Starters	= >200 HP			5		
D22	Power Factors Correction Devices: Passive Devices Automatic Devices	= > 50 KVAR => 50 KVAR				1 1	
D23	Power Vaults	All			5	1	
D24	Infrared Thermal Scanning	All of the Above				1	N/A

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