High Voltage Service
A Subsidiary Company Of DYMAX Holdings, Inc.

ELECTRICAL EQUIPMENT CONDITION ASSESSMENT

ARE YOU MAINTAINING YOUR EQUIPMENT?

High Voltage Service can perform a condition assessment of your facility's electrical distribution system. The assessment consists of the following major items:

Preventive Maintenance

NFPA 70B 2006 – Maintenance and Testing "Recommended Practice for Electrical Equipment Maintenance." This standard is intended to be used to help establish Electrical Preventive Maintenance Programs (EMP). "The purpose of this recommended practice is to reduce hazards to life and property that can result from failure or malfunction of industrial-type electrical systems and equipment." NFPA 70B also references the NEC and NFPA 70E.

Switchgear

1. When working within the Limited-Approach Boundary on de-energized equipment, verify that all applicable breakers and switches are locked and tagged out. Check for possible sources of backfeed such as an automatic transfer switch and emergency generators. Take appropriate action to provide adequate protection.
2. Verify that all voltage transformers are disconnected and grounded.
3. Verify that all control power transformers are disconnected and grounded.
4. Verify that there is no possibility of other backfeed.
5. Verify that all equipment to be worked on is tested to determine it is de-energized at the point of contact. Confirm operation of voltage detection device before and after the test to ensure correct operation. Use temporary ASTM F-855 rated protective grounds in accordance with OSHA 29 CFR 1910.269(n).
6. Verify that appropriate persons have been notified that personnel are working on switchgear.
7. Discharge stored energy devices such as springs, capacitors, hydraulic lines and tanks, and compressed air lines and tanks.
8. Use protective equipment as determined by hazard analysis including insulating gloves, mats, barriers, insulating sticks, fire-retardant clothing, flash suits, and flash hoods. Observe flash boundary and shock hazard boundary distances in accordance with NFPA 70E.

Transformers

1. Test to assure that no voltage is present at the transformer terminals. Visually assure that the transformer is isolated using visible air gaps switches or disconnects.
2. Apply grounds as required. Remove grounds when work is completed. Leave grounds connected for adequate discharge time.
3. When filtering or filling transformers, wear appropriate protective equipment for the type of fluid being handled to prevent contact from spillage or accidental discharge, e.g., face shields and work gloves.

4. Prior to working on the inside of transformer tanks, provide adequate fresh air supply and assure that all toxic fumes have been removed. Manholes and other confined spaces should be tested for oxygen level, percent combustible gases, and parts per million of carbon monoxide before entry and while occupied. Use gas detection to warn of hazardous environment and continuously monitor for percent of oxygen, percent of combustible gas, and parts per million of carbon monoxide.
5. Perform a visual inspection prior to replacing covers.
6. When testing is complete, remove all tools and grounds.
7. When oil testing or using chemicals, wear appropriate protective equipment for eyes and exposed skin areas even when using safety solvents. The term safety solvent only means it has a flash point above 140°C, not that it is safe to breathe.
8. Inspect for EPA-mandated labeling on transformers. Beware of units containing PCBs or other hazardous fluids. When working on such units, follow appropriate state and federal standards in fluid handling and disposal.

Disconnects (Air Switches)

1. Test to determine that all circuits have been de-energized.
2. Use grounding cables on both line and load sides of the open loadbreak disconnect. Use ASTM F-855 rated grounds and apply in accordance with OSHA 29 CFR 1910.269(n).
3. Verify that no one is working on any portion of the circuits which are to be tested.
4. Use lockout/tagout procedures to assure that no one can energize the circuit. Discharge stored energy mechanisms which may present a mechanical hazard.

Current Transformers

1. Take precautions to assure that the secondary or secondaries of an energized current transformer are not open-circuited.
2. When monitoring current transformer circuits, assure the test equipment is of the nonfused type.
3. Follow safe work guidelines outlined in IEEE C57.13.1.

Motor Control Centers (MCCs)

1. Before beginning any testing, verify that all equipment and cables to be tested have been de-energized and locked and tagged. Discharge or mechanically restrain stored energy systems.
2. When inserting starters, verify that contact fingers have made connection with the bus. This is best accomplished on de-energized MCCs. If the starter must be installed when the MCC is energized, wear appropriate arc- flash protective equipment in accordance with the current edition of the NFPA 70E.
3. Before placing a starter back in the motor control center, verify that its disconnecting means is in the open position.
4. Never open a motor isolation switch when the motor starter is engaged. Ensure the load is interrupted by the starter contacts or with an upstream circuit breaker or load-break device.

Automatic Transfer Equipment

1. Obtain written approval from the customer prior to performing maintenance procedures on equipment that will compromise life safety.
2. Before beginning testing or maintenance on any portion of this type of equipment, verify that both normal and emergency sources have been de- energized and locked and tagged out-of-service.
3. Before making any functional operational check, verify that no one is present in elevators or on vital equipment supplied by the transfer equipment.

Batteries

1. Verify that areas containing storage batteries are adequately ventilated.
2. Smoking, open flames, and spark-producing equipment are prohibited.
3. Face shields, gloves, and aprons shall be worn when working in the battery vicinity and/or when handling electrolyte or batteries. Determine that an eye wash station is present and operational before starting job.
4. Do not handle energized parts of batteries unless necessary precautions have been taken to avoid shock and short circuits.
5. Extreme caution should be used when moving batteries. Do not drag, push, or rock cells into position. Improper handling can result in personal injury.

Engineering Documentation

Article 120 – Establishing an Electrically Safe Work Condition

120.1.1 Process of Achieving an Electrically Safe Work Condition. An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:
Determine all possible sources of electrical supply to the specific equipment. Check applicable *up-to-date* drawings, diagrams, and identification tags.

120.2(B)(3) Plan. A plan shall be developed on the basis of the existing electrical equipment and system and shall utilize *up-to-date* diagrammatic drawing representation(s).

6.6.2 Diagrams and Data. The availability of up-to-date, accurate, and complete diagrams is the foundation of a successful Electrical Preventative Maintenance (EPM) program. No EPM program can operate without them, and their importance cannot be overemphasized.

Arc Flash Hazard Analysis and Warning Labels

NFPA 70E, Article 110.8 (B)(1)(b) – states that "A flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash. The analysis shall determine the Flash Protection Boundary and the personal protective equipment that people within the Flash Protection Boundary shall use".

The safe and reliable performance of a facility's electrical distribution system is due in a large part to the quality and capability of the maintenance and operation of the system. Optimizing the maintenance and operation of the system can often be the most cost-effective means in improving the overall system reliability and safety.

2005 NEC® Section 110.16 Flash Protection – requires warning labels to be installed on electrical equipment where workers are likely to be exposed to a potential arc-flash or shock hazard. The electrical equipment includes switchboards, panelboards, industrial controls, meter sockets enclosures and MCC's that are likely to require maintenance, inspections and examinations while energized.

Personal Protective Equipment (PPE)

OSHA 29 CFR 19110.132(d) – requires employers to assess the workplace to determine if hazards are present or likely to be present and select and have each employee use the types of Personal Protective Equipment (PPE) that will protect them.

Safety Training

Arc flash hazard training is regulated under OSHA 29 Code (CFR) Part 1910 Subpart S.
Included in the code is (1) a facility must provide, and be able to demonstrate, a safety program with defined responsibilities, and (2) workers must be trained on the hazards of arc flash.

1910.332(a) Scope. The training requirements contained in this section apply to employees who face a risk of electric shock that is not reduced to a safe level by the electrical installation requirements of 1910.303 through 1910.308.

1910.332(b) Content of training. 1910.332(b)(1) Practices addressed in this standard. Employees shall be trained in and familiar with the safety-related work practices required by 1910.331 through 1910.335 that pertain to their respective job assignments.

1910.332(b)(2) Additional requirements for unqualified persons. Employees who are covered by paragraph (a) of this section but who are not qualified persons shall also be trained in and familiar with any electrically related safety practices not specifically addressed by 1910.331 through 1910.335 but which are necessary for their safety.

1910.332(b)(3)Additional requirements for qualified persons. Qualified persons (i.e. those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:

1910.332(b)(3)(i) The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.

1910.332(b)(3)(ii) The skills and techniques necessary to determine the nominal voltage of exposed live parts, and

Note 1: For the purposes of 1910.331 through 1910.335, a person must have the training required by paragraph (b)(3) of this section in order to be considered a qualified person.

Note 2: Qualified persons whose work on energized equipment involves either direct contact or contact by means of tools or materials must also have the training needed to meet 1910.333(C)(2).

1910.332(c) Type of training. The training required by this section shall be of the classroom or on-the-job type. The degree of training provided shall be determined by the risk to the employee.

The Electrical Distribution System Compliance Assessment will audit the following areas as follows:

Preventive Maintenance

- Review of current electrical maintenance practices and procedures
- Condition of electrical distribution equipment
- Condition of Electrical Equipment Room(s)
- Preventive maintenance performed as per manufactures/NETA recommendations
- Ground System is Tested Periodically
- Electrical Equipment is Free from Corrosion
- Capacitor Integrity Verified
- Emergency Generator(s) Condition is inspected and operational testing done monthly and recorded
- Uninterruptible Power Supply/Battery Inspection
- Automatic Transfer Switch and Operation Inspection
- Proper Maintenance Practices are Followed, Especially for Fault- Protection Equipment
- Equipment Grounding is verified

Engineering Documentation

- Review of existing engineering documentation
    - Arc flash hazard analysis
    - Update one line drawings
    - One-lines are posted in substations
    - De-energized & energized procedures exist
    - Energized work procedures exist
    - Written switching plans are used

Arc Flash Hazard Analysis and Warning Labels

- Short Circuit/Protective Device Coordination/Arc Flash/Shock Hazard
- Studies have been done on a five year cycle or as additions and expansions are completed and relays are calibrated to the setting(s) recommended
- Arc Flash/Shock Hazard labels installed on all electrical equipment

Personal Protective Equipment (PPE)

- Has appropriate uniform materiel type
- Has appropriate PPE for switching
- Has appropriate ground sets
- Has appropriate voltage detectors

Safety Training

- Level of safety training for maintenance personnel
- Persons Who Operate/Maintain Electrical Equipment are Trained for the Voltage-Class Equipment they Operate/Maintain

Based on the findings of the Electrical Equipment Condition Assessment, High Voltage Service will provide recommendations regarding:

- Maintenance Schedules
- Changes to current electrical maintenance practices and procedures
- Corrections to existing problems or deficiencies of the electrical distribution equipment.
- Corrections to existing problems or deficiencies found in electrical equipment room(s).
- Arc flash hazard analysis
- Arc flash and shock hazard labeling
- Proper Personal Protective equipment (PPE)
- Level of safety training for maintenance personnel
- Corrections and/or updates to engineering documentation

The condition assessment and recommendations are based on the following industry- wide consensus standards:

ANSI C2/2002 – National Electrical Safety code
IEEE Std 1584(TM)-2002 Guide for Performing Arc-Flash Hazard Calculations
ANSI/NETA MTS-2007– Maintenance Testing Specifications
NFPA 70-2005 – National Electrical Code
NFPA 70B-2006 – Recommended Practice for Electrical Equipment Maintenance
NFPA 70E-2004 – Standard for Electrical Safety in the Workplace
OSHA 29 CFR 1910.147: Subpart "J" – The control of hazardous energy
OSHA 29 CFR 1910.303: Subpart "S" – General Requirements
OSHA 29 CFR 1910.331-335: Subpart "S" – Covered work for both qualified and unqualified persons