Life Cycle Management of Power Distribution Equipment
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Maximizing equipment life cycles and improving reliability with preventive and predictive maintenance of power distribution equipment

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- Infrared Surveys
- Circuit Breakers
- Equipment Modernization
- NFPA70E Compliance
- Power System Studies
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Overview

Electrical switchgear is composed of passive and active components.

Passive components:
• Horizontal and vertical bus structures.

Active components:
• Power Circuit Breakers
• Fusible Switches
• Protective Relays
• Motor Control

Their role is to protect the electrical assets downstream, disconnect the circuit, and protect personnel in case of an arc flash event.
Preventative Maintenance

• Once installed, all electrical equipment begins deteriorating due to normal wear and tear

• Maintenance ensures equipment integrity and proper mechanical and electrical functionality, as well as optimizes the equipment’s useful life.

• A regularly scheduled electrical system preventive maintenance program is intended to detect, repair, or replace affected electrical equipment
Published failure rates do not account for the varying degrees of maintenance between installations.

• Industry groups set Electrical PM Standards
  • NFPA70B
  • ANSI/NETA
  • Manufacturers Recommendations

• Even the best maintained equipment ultimately degrades and reaches the end of its useful life, albeit a longer life than if not maintained.
• Average useful life for well maintained equipment is 35 years vs 17 years left unmaintained.
Perform Preventive Maintenance

Switchgear should be cleaned, inspected, tightened, lubricated, and exercised on a regular basis.

Maintenance frequency depends on the environment, the condition of the equipment, and its criticality.

• Environmental and equipment conditions should be considered when determining preventive maintenance schedule.
• An expert in switchgear maintenance should help prepare this plan.

Thorough on-site maintenance of electrical switchgear includes a comprehensive scope of work.
Key EPM Elements

• Responsible and qualified technicians

• Regularly scheduled inspection, testing and servicing of equipment

• Survey and analysis of equipment to determine PM requirements and priorities

• Comprehensive and accurate test and inspections reports

• Accurate analysis of reporting so that corrective action can be recommended and implemented

• Comprehensive electrical safety plan
Infrared Surveys

Infrared inspections can prevent equipment outages.

- Excess heat in electrical equipment
  - Indicates poor connection or excess load
  - Can dramatically reduce the useful lifecycle
- Can also indicate impending equipment failure (consider downtime costs)
- Poses a potential safety risk to maintenance staff

- Does not require outage time
- Creates a baseline and trending data
- Useful prior to PM to identify areas of concern
Circuit Breaker Recondition and Refurbishment

In-shop reconditioning offers a more complete maintenance option.

- The circuit breaker is initially tested against industry standards.
- The circuit breaker is disassembled, cleaned, and inspected.
- Damaged parts are refurbished or replaced.
- Mechanisms are lubricated before the circuit breaker is reassembled.
- The reconditioned circuit breaker including retested.
In-shop reconditioning offers a more intensive maintenance option.

- Reconditioning should be performed when the on-site maintenance work scope cannot bring the circuit breaker within tolerances defined in current industry standards.
- The use of new or refurbished parts or subassemblies may be required to return a circuit breaker to a reliable operating condition.

► Applicable for LV and MV Circuit Breakers.
Equipment Modernization

- Choice between maintaining and replacing aging/obsolete equipment.
- Even with annual maintenance, equipment may need additional upkeep or upgrades.

Account for initial capital cost, business disruption, and workflow when considering equipment maintenance or replacement.

- ETU upgrades
- Protective relay upgrades,
- Inclusion of EPMS
- Replacing fusible switches
- MCC bucket retrofits
NFPA 70E Compliance

**Arc Flash Consultation**
- Outcomes & KPIs
- Training paths to secure tenant safety & system efficiency

**Arc Flash Study**
- Power systems study
- Resource gap analysis
- Arc Flash recommendations

**Arc Flash Mitigation**
- Program setup
- Arc Flash Mitigation Solutions & Service
- Modernizations
- Upgrades
- NFPA 70E compliant
- One-time services

**Preventative Maintenance**
- Arc Flash Protection Based Maintenance Agreement

**Measure results**
- Performance & execution reporting
- Quality assurance meetings

**Define service program and KPIs**
- Continuous Safety Training

**Plan**
- Deliver KPI driven services

**Implement**
- Demonstrate results

**Evaluate**
- Measure

**Service**
- Preventative Maintenance
Predictive Maintenance Techniques

- Power System Assessments
- Infrared Inspections
- Remote Monitoring
- Intelligent Protective Devices
- Partial Discharge Monitoring Systems
- EPMS Systems

Diagnose potential problems and safety concerns while minimizing equipment and facility downtime.
Power System Studies

- Short Circuit
- Protective Device Coordination
- Arch Risk Assessment
- Harmonics Analysis
- Power Quality Assessment
- Voltage Inbalance
- Load Flow
- Transient Stability
- Grounding

PSS provide multiple benefits including: retention of protective device settings, proper sizing of electrical equipment, protecting employees and equipment and compliance with industry standards and codes.
Electrical equipment and power distribution systems have never been designed to be or intended to remain perpetually energized without interaction by the owner.
Your #1 team for all Switchgear Solutions

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Surge Protection - Overview

• UL1449 E4 Revised in 2014

• Standardization - influencing the surge protection industry.

• Stronger, consistent, and more stringent testing and certification

• RESULT – Safer & Better Products!
A voltage surge (transient) is a voltage level that is short in duration and can be several times greater than the system’s normal operating AC RMS or DC voltage level.
UL1449 Main Points of Interest / How To Select A Device?

✓ **Type** 1, 2, 3, 4 and Category Ratings

✓ **In** rating (Nominal Discharge Current)
  Limited to 10 or 20KA

✓ **VPR** – a Cat B 6kV/3kA “Residual” Voltage Test

✓ **Surge Capacity (Imax) & (SSCR)** Short-Circuit Current Ratings

✓ **UL1449 E4** addresses testing on Recognized Components
Type 1: Permanently connected, intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device (service equipment). Their main purpose is to protect insulation levels of the electrical system against external surges caused by lightning or utility capacitor bank switching.

Type 2: Permanently connected, intended for installation on the load side of the service disconnect overcurrent device (service equipment), including branch panel locations. Their main purpose is to protect the sensitive electronics and microprocessor based loads against residual lightning energy, motor generated surges and other internally generated surge events.

Type 3: Point-of-utilization SPDs installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point-of-utilization. Examples include cord connected, direct plug-in and receptacle type SPDs

Category C: outside overhead lines and service entrance (outdoor)
- Service drops from pole to building
- Runs between meter and panel
- Overhead lines to detached building
- Underground lines to well pump

Category B: feeders, short branch circuits and service panels (indoor)
- Distribution panel devices
- Bus and feeder distribution
- Heavy appliance outlets with “short” connections to service entrance
- Lighting systems in large buildings

Category A: outlets/receptacles and long branch circuits (indoor) (least severe)
- All outlets at more than 10m (30 ft) from Category B
- All outlets at more than 20m (60 ft) from Category C
SPD Type Designations & Location Categories
Applying SPD’s - Multistage Protection!

- Power Protection at the Point of Entry, (1\textsuperscript{st} Level of Defense.) \textit{There will be a Let Through Voltage, amplified by inductance of the wires!}
- Secondary Protection on the Branch Circuits that feed more sensitive equipment should be utilized. This should be installed as close to the equipment as possible.
- 80\% of damaging transients occur inside your facility

Figure 1. Poor protection layout

Figure 2. Preferred protection layout