Property risk solutions

Inside this issue

Welcome to this edition of the Property risk solutions newsletter. This quarterly publication focuses on fixed fire protection and human element safety solutions for property and boiler/ machinery exposures.

In this edition we will be discussing:

- What industry standards should be used
- Which standard is correct
- What to look for in a good preventative electrical maintenance program
- Electrical system – Additional tests
- Spare parts and contingency plans
- Common equipment and procedures

Electrical maintenance and testing guidelines

In industry today, it is common practice for management to overlook electrical equipment, particularly non-rotating machinery, in setting up the facility's preventive maintenance program. Insurance companies routinely pay claims resulting from unplanned electrical outages. While many of these outages are the result of a problem with the electrical utility company, problems that are more serious result when the failure originates within plant owned equipment. The purpose of this article is to summarize some of the most common electrical maintenance and testing procedures.

Which industry standards should be used?

When testing electrical equipment, it is critical to follow these national standards:

IEEE (Institute of Electrical & Electronic Engineers)
OEM required testing and standards of electrical equipment

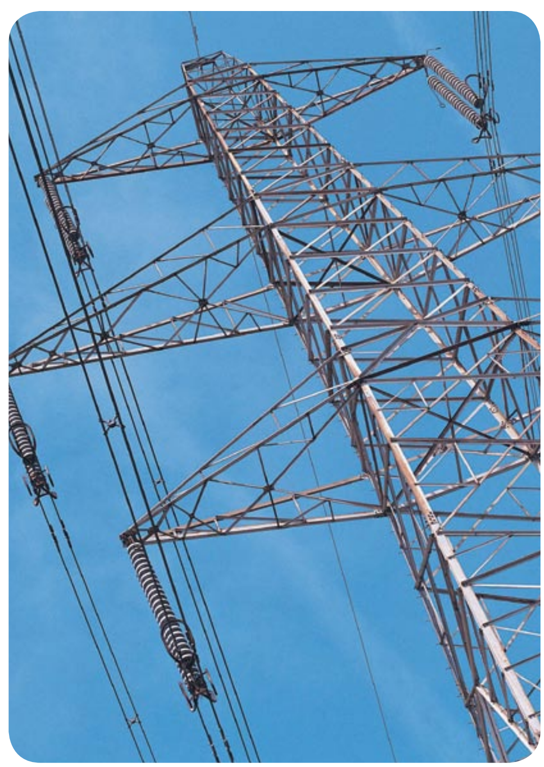
NEC (National Electric Code) / NFPA (National Fire Protection Association)
Building code

UL (Underwriters Laboratory)
Component testing for reliability

NETA (National Electric Testing Association)
NICET (National Institute for Certification in Engineering Technologies
In Service testing requirements for repair and service companies as well as training requirements of individuals doing the work

ANSI (American National Standards Institute)
ASTM (American Society for Testing and Materials)
Standards relating to governance of requirements

With the exception of the infrared survey, emergency generators and motors, all testing listed in this article should be performed by a NETA (National Electrical Testing Association) or NICET (National Institute for Certification in Engineering Technologies) certified electrical testing firm.



Which standard is correct?

All of the organizations mentioned say something similar to the following from NETA:

"It is necessary to make an informed judgment for each particular system regarding how extensive a procedure is justified... The guidance of an experienced testing professional should be sought when making decisions such as how extensive testing should be. In smaller systems, some of the tests can be deleted. In other cases, a number of the tests indicated as optional should be performed.

As a further note, it is important to follow the recommendations contained in the manufacturer's instruction manuals. Many of the details of a complete and effective maintenance testing procedure can only be obtained from that source."

In short, it is important to use qualified organizations or personnel to perform the work on electrical systems. For basic operation, keep it cool, clean, tight and dry.

NETA says:

1.1 Maintenance Testing Specifications

1. These specifications cover the suggested field tests and inspections that are available to assess the suitability for continued service and reliability of electrical power distribution equipment and systems.

2. The purpose of these specifications is to assure that tested electrical equipment and systems are operational and within applicable standards and manufacturer's tolerances and that the equipment and systems are suitable for continued service.

3. The work specified in these specifications may involve hazardous voltages, materials, operations, and equipment. These specifications do not purport to address all of the safety problems associated with their use. It is the responsibility of the user to review all applicable regulatory limitations prior to the use of these specifications.

Clean, cool, tight and dry

The advantage of a good preventative electrical maintenance program is that it will improve the service life of equipment in respect to its life, dependability and reliability.

What to look for:

- Heavy accumulation of dust, dirt or debris on motors, cabinets and controllers
- Clogged ventilation filters which could restrict flow into a room, control cabinet or Motor Control Center (MCC)
- Air flow paths blocked by equipment or other Items which could reduce the airflow through a room or around motors and cabinets
- Grease or oil leaking from motors, gearboxes and hydraulics. This is an indication of improper lubrication. The fluids will act as an insulating layer, attract dust/dirt, and could chemically attack insulation, wiring and printed circuit boards.
- Airborne spray or concentration of vapors may coat equipment creating an insulating layer, create an explosive atmosphere and may damage wiring and insulating materials
- High ambient heat load and humidity will raise the operating temperature of equipment, and can reduce the amount of heat removed from equipment.
- Condensation is not very obvious. This can occur when there is a large temperature difference between ambient air and a control cabinet. Look for signs of dripping or running fluid on vertical surfaces, and pooling or rivulets on horizontal surfaces.
- Use of high pressure compressed air during preventive maintenance will clean one area, but redistribute the dust and dirt to other areas. High pressure air may also have high moisture content.

Electrical system – Additional tests

It is essential for facilities to have a current, up to date one-line diagram of the electrical system. Additional testing that can be conducted to assure reliability in the electrical system includes:

Arc Flash Hazard Analysis – This analysis determines the incident energy and arc flash boundary of various equipment and systems. Arc Flashes have a potential to be highly dangerous to personnel and equipment.

Once the energy and boundaries are known, the required PPE (personal protective equipment) is determined and the appropriate arc flash warning labels are generated to warn personnel. This analysis should be performed on all systems 208/220 volt and higher.

Electrical system – Additional tests *(continued)*

Protective Device Coordination Study – This study ensures the continuity of power in the event of a fault. Anytime a protective device is changed (size or type) or the branch circuits are added too, the coordination of the devices should be checked. This is not applicable for low voltage, molded case circuit breakers supplying lighting and non-essential service. An example of what can happen occurred in 1989 at a 23 million square foot facility in SC when a 650 MW power generation plant went "black plant" by a 5 hp water pump motor.

Short Circuit Study – This study is done to analyze the fault duties of each circuit interrupting device, transformer and conductor in case of a line-to-line or a line-to-ground fault. This is conducted to determine if system upgrades are needed or current limiting devises are needed within the current system. As a rule of thumb, this study should be done every 5 years.

Insulation Coordination Study – This Study is used to determine whether vital plant equipment has adequate protection against damage by transient voltages, which are a leading cause of equipment insulation breakdown resulting in failure.

Load Flow Study – This study is a steady-state analysis of a systems capability to adequately supply its connected load. Knowledge of each branch line, bus voltage and the power factors are known from the real and reactive power flows from this study. This is a useful study at the design phase of the system when additional load is being installed

Motor Starting Study – This study is generally preformed on large motor systems to determine the starting load and the effect on the system. This helps reduce nuisance trips, light flickering conditions and excessive starting currents into the motor system. This study is best completed on a limited capacity distribution system from the utility.

Spare parts and contingency plans

Spare parts and equipment should be stored in a controlled atmosphere. Motors need to be equal in size both physically and electrically. Breakers must be rated the same to assure functionality. Plant should have phone numbers available for repair and maintenance facilities and the utility for quick replacement or service calls.

Recap

- Consider the electrical system as a whole and start at the plant meter through the lighting system breaker panels (110 V service)
- Visual, mechanical and electrical testing needs to be employed on all types of electrical equipment
- Clean, Cool, Tight & Dry is the key to electrical equipment operating as designed. Housekeeping and control of the environment increase reliability and life expectancy of the equipment
- Motors and rotating equipment need to be free of combustible dust; their failure can lead to a source of ignition
- Transformers are reliable devices but may contain the fuel that makes a small fire a large fire
- Infrared Thermography is a cost benefit means of preventative maintenance and increases reliability of electrical devices

Common equipment and procedures

Some of the more common electrical maintenance and testing procedures that need to be performed on key equipment include:

Thermo-graphic (Infrared) Survey – performed annually

1. Inspect physical, electrical, and mechanical condition.
2. Remove all necessary covers prior to thermo-graphic inspection.
3. Equipment inspected should include all current-carrying devices.
4. Provide report including the following: a) Discrepancies, b) Temperature difference between the area of concern and the reference area, c) Cause of temperature difference, d) Areas inspected – Identify inaccessible and/or unobservable areas and/or equipment, e) Identify load conditions at time of inspection, f) Provide photographs and/or thermograms of the deficient area.
5. Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 degrees C at 30 degrees C.
6. Equipment should detect emitted radiation and convert detected radiation to visual signal.
7. Thermo-graphic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected.

Common equipment and procedures *(continued)*

Liquid-filled Transformers – performed annually

1. Inspect physical and mechanical condition.
2. Verify that cooling fans and/or pumps operate correctly.
3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter.
4. Verify correct liquid level in all tanks and bushings.
5. Verify that positive pressure is maintained on nitrogen-blanketed transformers.
6. Verify correct equipment grounding.
7. Test load tap changer, if applicable.
8. Verify the presence of transformer surge arresters.
9. Remove a sample of insulating liquid in accordance with ASTM D923. The sample should be tested for dielectric breakdown voltage, acid neutralization number, interfacial tension, color, and visual condition.
10. Remove a sample of insulating liquid in accordance with ASTM D3613 and perform dissolved gas analysis.
11. The frequency of insulating liquid sampling should be increased to once per quarter for transformers exposed to severe loading (i.e. arc furnace).

Dry Type Transformers (> 500 KVA or critical to production) – performed every 2-3 years

1. Inspect physical, electrical, and mechanical condition including evidence of moisture, corona, or brittleness.
2. Verify that cooling fans operate.
3. Inspect all bolted electrical connections for high resistance by use of low-resistance ohmmeter.
4. Verify that resilient mounts are free and that any shipping brackets have been removed.
5. Verify that the core, frame, and enclosure are grounded.
6. Verify the presence of transformer surge arresters.
7. Thoroughly clean unit prior to testing unless as-found and as-left tests are required.
8. Verify that as-left tap connections are as specified.
9. Perform insulation-resistance tests with winding-to-winding and each winding-to-ground. Calculate polarization index.
10. Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable.
11. Perform power-factor or dissipation-factor tests in accordance with the test equipment manufacturer’s published data.
12. Perform turns-ratio tests at the designated tap position.
13. Measure core insulation-resistance at 500 volts dc if core is insulated and if the core ground strap is removable.
14. Verify correct secondary voltage phase-to-phase and phase-to-neutral after energizing and prior to loading.

Common equipment and procedures *(continued)*

For maintenance and testing on the following equipment, please contact Zurich:

- AC motors – visual and mechanical inspection – perform every 1-3 years
- AC induction motors – electrical tests – perform every 1-3 years
- AC synchronous motors – electrical tests – perform every 1-3 years
- Air switches – low voltage – perform every 2-3 years
- Automatic transfer switches – perform every 2-3 years
- Batteries – perform annually
- Cables – Low voltage (600 volt maximum) – perform as needed
- Capacitors – perform every 1-3 years
- Chargers – perform annually
- Emergency generators – perform annually
- Ground fault protection systems – perform every 2-5 years
- Grounding systems – perform every 2-3 years
- Insulated case/molded case circuit breakers – perform every 2-3 years
- Low-voltage surge protection devices – perform annually
- Metal-enclosed busways – perform every 2-3 years
- Metering – perform every 1-2 years
- Motor starters – low voltage – perform every 1-3 years
- Network protectors – 600 volt class – perform every 2-3 years
- Oil circuit breakers – perform every 2-3 years
- Power circuit breakers – perform every 2-3 years
- Protective device coordination study – usually done as part of modernization/expansion projects
- Protective relays – perform every 2-3 years
- Short-circuit (fault) study – usually done as part of modernization/expansion projects
- Switchgear and switchboard assemblies – perform every 2-3 years
- Transformers over 10,000 KVA - Liquid-filled or those exposed to severe loading (i.e. arc furnace) – perform every 2-3 years

References

1. International Electrical Testing Association (NETA) Maintenance Testing Specifications.

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