Electrical Maintenance Tests and Inspections for Distribution Equipment

A Proactive Approach

In any major facility, no matter whether industrial, commercial, or institutional, a significant investment exists in the electrical system. These assets are in the form of transformers, cables, circuit breakers, contactors, switchgear, motors, and instrumentation and protection. Depending on the process, many specialized electrical components can exist, although this article is the most basic review. The complexity and variance of the distribution equipment is as wide and varied as the facilities themselves.

A common rule-of-thumb for equipment longevity is 25 years. Practical experience shows this life cycle can be well exceeded with nominal maintenance. More extensive maintenance plans, combined with a focused repair and upgrade program, can easily result in a doubling of the rule-of-thumb expectations.

The following provides some rationale for performing due diligence maintenance and inspections tests on the electrical distribution system. It also reviews some of the more basic test procedures and processes utilized by the testing industry.

Why Is Testing Done?

The critical importance of the electrical system to many facilities is evident to all when failure occurs. In addition to the obvious disruption of service and resultant productivity loss, further repercussions are usually involved. Depending on weather, operator response, process considerations, etc., peripheral mechanical or structural damage can occur. Insurance companies are well aware of the potential losses due to electrical system failure or misoperation. In many cases it is a requirement of the underwriters’ policy that testing of major and critical distribution equipment be performed on a routine basis.
When Should Testing Be Done?

Depending on the age, critical nature, and complexity of the system, this criterion certainly varies. In most cases annual shutdown testing is standard practice. The next most prominent maintenance period is every two years. To utilize a period in excess of three years is not recommended, since the potential for problems increases as time from last maintenance increases.

Restrictions for testing of equipment are not limited to preference of the owner. Budgetary and operational requirements are also key determining factors. Work is typically scheduled at nonregular hours to accommodate this and can add significant cost to the maintenance program. The NETA MTS specification, appendix B provides useful matrix for determining when periodic tests and inspections should be performed.

What Should Be Done?

Usually the most cost-effective approach is taken. An evaluation of potential loss is weighed against the cost of preventative maintenance. Usually the major distribution components such as high-voltage equipment, large distribution transformers, switchgear, and larger-horsepower motors are easily justified under this evaluation. In order to be cost-effective, the scope of work must be matched to the equipment, based on critical importance and replacement cost, including procurement time and operating conditions. In some cases a full and complete maintenance-testing program is initiated, since the cost is easily justified under the preceding criteria.

How Is Testing Done?

Maintenance testing is performed via inspection, function testing, and simulation of operation. Also, specific testing equipment has been developed to allow for evaluation of equipment condition. The results of these tests are sometimes quantitative, sometimes comparative, and usually combine both aspects.

Nondestructive testing allows for evaluation of equipment condition and can, in many cases, allow for remedial action to prevent unscheduled loss of service and equipment. As part of a testing company’s assistance package, it is usually standard practice to include cleaning and lubrication as applicable. This normally goes a long way towards providing safe and reliable service.

The basic types of shutdown testing are as follows:

Insulation Tests: Normally carried out at some multiple of actual operating voltage to stress insulation. A dc high potential test is the usual test instrument. This test is especially critical for high-voltage equipment. Recently, low frequency ac testing has been added as a new diagnostic tool.

Conductivity Tests: Normally carried out at 100 Adc. This indicates the condition of joints, contacts, etc. It is of special concern where high currents are encountered such as air circuit breakers and bus ducts. This is an alternative to infrared without some of the drawbacks.
Relay Calibration: A simulation of fault conditions to confirm operation of protective devices. This testing insures that the electrical system operates in accordance with the coordination in the event of a fault. A well-coordinated system will minimize the effect to power distribution in the event of upset. Metering equipment and SCADA are normally tested at the same time.

Function Test/Inspection: Function tests include manual and electrical operation, including trip test by simulated fault. This confirmation of operation is also useful in ensuring mechanical performance and lubrication.

Who Should Do The Work?
The maintenance company should have the following experience and capabilities:

- Has provided successful assistance to numerous clients for many years to ensure experience
- Promotes and requires safety to be the cornerstone of all electrical work
- Has sufficient test equipment and has developed procedures which allows for testing of equipment at identical or nearly identical conditions to operating
- Specializes in the field of electrical power and qualifies that expertise through the highest credentials such as membership in NETA, APPEGA, and ASET.

Contact Resistance Testing

Relay Testing

Outdoor Fused Loadbreak Switch 13,800 Volts
This quality of testing ability and knowledge will provide the client with a high level of confidence on the integrity of the distribution system.

The value of experienced personnel will become readily evident when reviewing engineering reports and recommendations. These observations based on site work and test results will itemize concerns, indicate priority, and provide constructive solutions, usually with budgetary costs included. A good report will include suggestions for systems improvement relating to performance, energy efficiency, and potential upgrade.

John Hodson is an Engineering Technologist in both electronics and electricity as well as a journeyman electrician. He started his career in electronics but since 1980 has concentrated on the electrical field and in building the Magna Group of Companies. He has been instrumental in the start up of several new offices, including Calgary where he now resides as Manager. Mr. Hodson is a director of Magna Group and is the NETA representative for Magna Group of Companies. John has recently added the role of safety manager in Calgary to his general manager duties.