Electrical Preventive Maintenance and Inspection

Statistics indicate that more fires start from electrical system failure than from any other cause. Electrical equipment is usually well designed and properly installed. However, the principal reason for electrical system breakdown is the failure to maintain the installation in its designed state.

As soon as electrical equipment is installed, normal deterioration begins. If left unchecked, the deterioration process can cause malfunction or complete failure. Performance and life expectancy are decreased by environmental conditions, system overload or excessive duty cycles on equipment. These factors, when combined with neglect, can result in a premature breakdown of your stationary and rotating electrical equipment.

Instituting a preventive maintenance program that consists of routine inspections, tests and service of electrical equipment can significantly reduce the potential for breakdown. Without an electrical preventive maintenance program, your facility assumes a risk of serious electrical failure and the heightened potential consequences of fire and/or production interruption.

Advantages of an Electrical Preventive Maintenance Program

An effective electrical preventive maintenance program:

- Provides maximum freedom from breakdown during normal operation. If a breakdown occurs, downtime is significantly reduced.
- Controls the cost of maintenance repairs and equipment replacement. Maintenance costs can be effectively budgeted against large, intermittent expenditures.
- Maintains equipment at peak operating efficiency. This is often seen in reduced operating costs resulting from improved efficiency of electrical consumption.
- Reduces accidents and increases personnel safety.

While the advantages resulting from improved safety are difficult to measure directly, the economic statistics can be tracked by reduced repair costs and equipment downtime. The investment in preventive maintenance is small compared to the cost of repairing equipment damage.

Instituting a Preventive Maintenance Program

Starting an electrical preventive maintenance program requires the support of top management.

Basic planning should consider "what if" scenarios such as:

- Personnel safety – Should a failure of the electrical system or major electrical apparatus occur, will the safety of personnel be endangered? Have precautions been taken to protect the worker from electrical injury?
- Equipment breakdown – Is the electrical equipment complex and so unique that should a breakdown occur repairs would be expensive?
- Production interruption – Should equipment become inoperable, will repair or replacement require extensive downtime? Consideration must be given to availability of spare parts. What effect would the loss of a vital piece of equipment have on overall production?

The scope of an electrical maintenance program may be influenced by factors including:

- Location size – 2,000 square feet versus 250,000 square feet
- Business operation – Mercantile versus industrial
- Type of plant equipment in use – Lighting fixtures versus large, rotating electrical apparatus
- Consequences of electrical failure – Relatively minor inconvenience versus substantial downtime or economic loss

Consideration should include the types of programs or combinations of programs that can be implemented, such as:

- Preventive Maintenance (PM) – Regularly scheduled inspections and periodic dismantling of equipment to check every detail likely to cause trouble.
- Predictive Maintenance (PdM) – Activities that monitor the performance and condition of equipment during normal operation to reduce the likelihood of failures.

Due to high demand for continuous electrical power, implementing an electrical preventive maintenance program may not seem like an easy task. However, the benefits almost always outweigh the challenges. There may be production scheduling considerations, budget requirements and the need to have electrical systems inspected, tested and maintained by personnel specifically trained in electrical maintenance.

Lack of maintenance and system inspections can increase the potential for unnecessary interruptions or critical breakdowns during peak operation, which can result in lost production and profits. An effective electrical maintenance program will satisfy an important part of management's responsibility: keeping costs down and production up.

Value of an Effective Electrical Preventive Maintenance Program

The cost of an electrical preventive maintenance program is small compared to the cost of repairing extensive damage. Expensive time-consuming repairs are often the result of unexpected electrical trouble. It can be easier to address major electrical repairs or replacements when found necessary through periodic inspections. Equipment can be shut down when its effect on output is minimal. However, unscheduled maintenance can seriously affect operations.

That's why a regularly scheduled, effective electrical preventive maintenance program is critical to correcting electrical defects, reducing equipment failure and the resulting breakdown costs, and protecting personnel against injury.

Components of an Electrical Preventive Maintenance Program

An electrical preventive maintenance program often includes the following components:

Assign qualified personnel. Where appropriate, provide maintenance personnel with formal training, preferably by the equipment manufacturer or authorized service provider. Certain tasks may require hiring a qualified third-party service provider.

Establish necessary maintenance requirements and priorities. This should align with Original Equipment Manufacturer (OEM) recommendations for maintenance and inspection. At a minimum, electrical equipment such as switchgear, circuit breakers, protective relays, rectifiers, transformers, motors, busways, controllers and other electrical protective devices should receive a thorough inspection and evaluation. Electrical preventive maintenance such as Infrared (IR) thermography should be completed on all critical electrical equipment on an annual basis.

Initiate routine inspections and tests. At a minimum, OEM recommendations should be followed, with frequency increased for critical components or severe service conditions. Some testing may have to be performed during operational shutdowns. Generally, for continued reliable operation, switchgear components should be cleaned, inspected and checked for tightness of electrical connections on an annual basis. Electrical testing of insulation for indications of deterioration or faults should also be performed annually. At the same time, protective relays and controllers can be tested for proper operation and recalibrated, if necessary, by a qualified contract service.

Analyze inspection test reports such as IR reports so that proper corrective measures can be implemented. Evaluate the data to determine equipment condition and if repair work is needed. This helps establish the frequency of required inspections and tests as well as cost estimates.

Perform the required work. Follow through with appropriate corrective action after the inspections are completed and the test reports are analyzed. Performing necessary repair work, replacement and adjustment is the result of an effective electrical preventive maintenance program. Keep a sufficient supply of replacement parts recommended by the OEM to avoid downtime and extended lead time.

Maintain complete and accurate records. Maintaining records is invaluable when planning, budgeting and evaluating the overall effectiveness of the program. At a minimum, it is suggested that nameplate data, purchase information, test and/or startup (acceptance) specifications and any applicable information from the manufacturer be kept for comparison purposes. Also, document emergency contacts and phone numbers of repair companies and equipment suppliers as well as lead times for replacement parts.

Periodically re-evaluate the electrical preventive maintenance program. Annually review the inspection and test reports as well as the replacements and failures to determine if the program is meeting its objectives.

Inspection Frequency

Pieces of equipment identified as critical to business operations should require the most frequent inspection and testing to ensure continued reliability.

Most electrical equipment manufacturers provide a recommended frequency of inspection in their service manuals. The frequency is normally based on standard or common operating conditions and environments. The manufacturers cannot provide accurate frequencies for equipment exposed to unusual combinations of environmental and operating conditions. However, OEM specifications, combined with information by InterNational Electrical Testing Association (NETA) and NFPA 70B, provide the best guidance on inspection and testing frequency.

Fundamentals of Electrical Preventive Maintenance

Effective electrical preventive maintenance programs focus on reducing the potential for a serious electrical interruption. A basic rule applying to all electrical apparatus is to keep it clean, dry and tight, and to prevent friction.

Clean

Dirt is a common cause of electrical failure. Dirt is the day-to-day accumulation of particulate matter from the surrounding environment, consisting of dust, lint, chemicals, metallic particles, oil mists, spray residues, etc. If allowed to accumulate, dirt can contaminate electrical equipment, causing increased electrical resistance and overheating. In some applications, heavy contamination cannot be avoided. This is typical of foundries, mills, quarries, cement plants and grain elevators. In these applications, special apparatus designs are appropriate. Every effort, however, should be made to keep equipment free of particulate matter. This includes activities such as weekly cleaning of motor casings and keeping electrical cabinets free of dust by vacuuming. Every maintenance opportunity should include a thorough cleaning of the apparatus.

Dry

Electrical equipment operates best in dry and corrosive-free atmospheres. Humidity accelerates the oxidation of metals used in electrical switchgear. Oxide buildup increases resistance, reducing effective electrical contact and causing arcing and resultant heat that can lead to failure. High moisture levels can lead to direct short circuiting and immediate failure. Humidity should be controlled if possible and guarded against by using equipment designed for damp or wet conditions. Some typical examples of high moisture areas or where there is an exposure to moisture or corrosion include dairies, laundries, canneries, tanneries, meat-packing plants, locations near seashores, swimming pools, metal plating, and areas where acids and alkali chemicals are used, handled or stored.

Tight

Many electrical components operate with high-speed movement while other electrical equipment may not appear to move at all. While electrical switchgear is stationary equipment, mechanical connections may work loose from expansion and contraction during continuous energize and de-energize cycles. Rotating electrical equipment may eventually cause wear and imbalance, creating vibrations in equipment and loosening vital connecting parts. Routine maintenance is necessary to detect wear and loosening of parts and connections. This should include a check for tightness of accessible hardware and bolted parts. IR is an invaluable tool in locating electrical "hot spots" while the equipment is energized. Tightening identified loose connections will greatly decrease the possibility of unexpected electrical faults such as an arc flash or arc blast event that can cause extensive equipment damage and harm to personnel in the area.

Friction Free

Rotating electrical equipment such as motors normally operate with little to no friction when bearings are properly lubricated. However, friction can result from numerous causes, including misalignment of equipment and excessive wear. Some electrical apparatus does not require lubrication nor should it be performed unless specified by the manufacturer. Over-lubrication of motor bearings can allow excessive oil to collect dust and abrasive materials, causing friction and wear. Lack of required lubrication will significantly add to overheating of the unit and may eventually lead to failure. Machinery must be properly lubricated at recommended frequencies. Squeaking machinery may be the first indication that friction is developing. Equipment operators should be instructed to be alert for signs of faulty operation or unusual equipment sounds. Maintenance is key for effective, reliable operation of your electrical equipment.

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