Maintaining Your Switchgear

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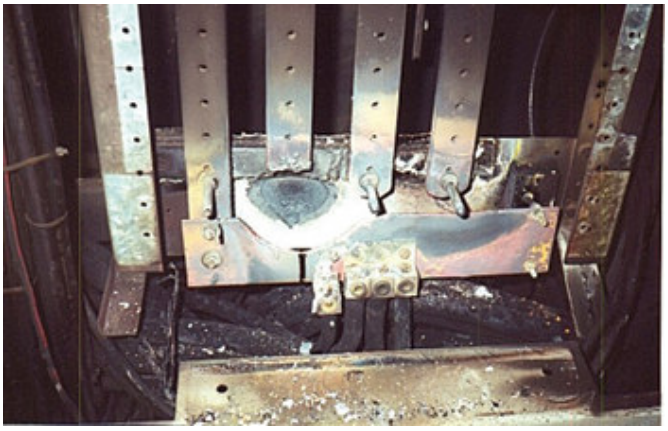
You can prevent switchgear failure with proper maintenance.

When switchgear malfunctions, the consequences are often catastrophic. Damage to the switchgear itself can be extremely expensive, but that pales in comparison to corollary damage and the potential hazards to people. Thus, implementing an effective switchgear testing, inspection, and maintenance program is essential. Even switchgear labeled “maintenance free” requires periodic testing and maintenance.

Develop a maintenance program. The many approaches to switchgear maintenance range from continuous online monitoring to “do nothing” (also called “run-to-failure”). Predictive and preventive maintenance programs—including most of the National Fire Protection Association (NFPA) and InterNational Electrical Testing Association (NETA) recommendations—fall in the middle of this range. Most real-world maintenance programs are a combination of these approaches. For instance, replacing indication lights only when they’ve failed is an example of run-to-failure maintenance. On the other hand, maintaining disconnect switches on a periodic basis—cleaning, lubricating, and exercising them—is an example of preventive maintenance. Annual visual and thermographic inspections on bus connections and breakers are examples of predictive maintenance.



Developed by the airline industry and later adopted by other industries, reliability centered maintenance (RCM) is another approach. RCM is a systematic and comprehensive method appropriate where equipment reliability is critical. It involves analyzing system criticality and component failure modes, evaluating those failure modes and the appropriate maintenance activities for each component and then determining what is the most appropriate and effective preventive maintenance activity for each component. RCM programs improve electrical system reliability, and experts credit RCM programs with improving safety and management of spare parts, decreasing repair costs, shortening outages, and reducing overhaul frequency.

Manufacturer maintenance recommendations may or may not suggest maintenance frequency. The 2001 NETA standard provides a maintenance frequency matrix that gives recommendations based on the level of reliability required and the condition of the equipment.

The NFPA standard also includes suggested maintenance frequencies. They vary (typically from three months to six years) depending on system criticality and the environment in which the equipment is located. Because no manufacturer or standards-making body can presume to know how these conditions differ in your installation, it’s impossible for them to come up with a meaningful maintenance frequency. On one hand, you want to minimize the number of maintenance outages; on the other, you don’t want a switchgear failure to occur.

Part of maintaining switchgear is ensuring your protective devices operate in the right sequence. But how often must you verify that the settings and sizes are correct? Any time you have a change on the utility system or to your own system, you must confirm the short circuit withstand and interrupting ratings of your equipment are still adequate. A short-circuit study determines the magnitudes of available short-circuit current at each of your switchgear locations. A proper study will identify any switchgear that available short-circuit current would overstress.

Have your breakers tripped or fuses blown without a fault occurrence? Did the wrong device operate when a fault occur? A coordination study provides device settings so breakers and fuses in your facility can coordinate and operate selectively. That is, a fault near the end of your circuit will cause the nearest upstream breaker or fuse to operate—not your main breaker. If you don't know whether your system coordination is correct, do a coordination study long before the next maintenance outage.

Plan for the maintenance outage. The following steps will help you formulate a comprehensive maintenance action plan and in turn an effective switchgear maintenance program. Prior to the outage:

- Review your equipment history. What failures have occurred? Are you aware of any repair or refurbishment needs?
- Review the drawings and other documentation. Are the relevant drawings current? Do you have the correct instruction manuals?
- Perform visual inspections, thermal scanning, partial discharge testing, and other testing before the outage so you can take corrective action when it happens.
- Identify and order all materials required for the outage. Take lead times into account.
- Develop a specific work plan and schedule. Communicate this information to all involved personnel, and keep your end-users updated on the big picture.
- Conduct the tailgate safety meeting to be sure each person understands any dangers, special circumstances, and related work assignments. During the outage:
- Shutdown the switchgear and apply protective grounds. Follow lockout/tagout procedure. Barricade and put up warning signs as appropriate.
- Check and correct any drawing inconsistencies or connection questions.
- Perform inspections and cleanings.
- Disconnect as necessary for tests.
- Make any planned repairs, changes, or upgrades.
- Perform measurements and tests.
- Based on test results, make additional repairs. Concluding the outage:
- Re-connect and torque connections.
- Account for all tools and personnel.
- Make a visual check of all work.
- Remove grounds and then test to ensure you have no unintentional grounds.
- Energize switchgear and verify normal operation.
- Remove barricades and signs, and follow appropriate procedures to clear the lockout/tagout condition. After the outage:
- Interview crews about problems they may have encountered. Ask them for recommendations for improving response efforts during the next outage or preventing problems that occurred in this one.
- Prepare a report of maintenance outage and test results. Include trending and analysis of results and recommendations for future maintenance as appropriate.

Making maintenance happen. Switchgear maintenance is usually considered a low priority by most management teams, who defer or ignore it until a failure occurs. At many facilities, the maintenance crews take only some of the easier steps. However, experience shows this is an economic dance with the devil. When you fail to conduct the proper maintenance, the risk of loss is high. But a solid maintenance program is much less costly than the impact of switchgear failure, which can include injury or death, lost product and production, as well as clean-up and switchgear replacement costs. When you give maintenance the thought and effort it deserves, you improve safety, reliability, uptime, and profitability.

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