Backup UPS System Maintenance Matters

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The failure of a backup power system in an institutional or commercial facility could cause the loss of productivity, revenue and even human life. As a result of these high stakes, maintenance and engineering managers must ensure they provide a reliable flow of power to support critical systems and equipment, especially in emergencies.

In many facilities, a standby generator system supports crucial life-safety systems, such as egress lighting and fire alarm, that enable occupants to safely evacuate a building. In health care facilities, these systems also support essential life-support and other equipment.

In facilities with critical computer and technology loads, uninterruptible power supplies (UPS) are part of the standby power-distribution system. These systems include auxiliary equipment, such as transfer switches and fuel tanks.

But even modern facilities that are designed according to codes to provide backup power systems with appropriate levels of redundancy will have a high probability of failure if technicians do not properly test and maintain these essential systems.

TROUBLESHOOTING TIPS

Prior to the testing and maintenance of backup power systems, technicians need to investigate potential locations and environmental causes of failure. Is key equipment located below flood level? Is it located below seismically unsafe objects or in an area with insufficient air flow? Assuming the system's designers and installers resolved any location and environmental issues prior to installation, managers can focus on testing and maintenance.

Just as a chain is only as strong as its weakest link, a standby power-distribution system is only as strong as its weakest link. A 5 megawatt (mW) generator distribution system can fail because of an incorrect fuse, a loose wire connection, or a lack of fuel.

It is important that technicians address all system components both individually and as a system. Standby power systems typically contain cooling, fuel, battery/charging, engine, and distribution subsystems, which all have their own unique testing and maintenance requirements.

FOCUS ON SYSTEM FAILURE

Among the most common causes of failure in generator and UPS distribution systems are these:

- incomplete system commissioning that fails to identify installation or control-logic errors
- equipment not returned to proper operational state after testing, maintenance or alarms
- generator failure to start, due to old, discharged or poorly maintained batteries

Proper maintenance of a facility's backup power system helps insure that crucial life-safety systems, such as egress lighting, are working when needed in an emergency.

- battery charger breaker turned off
- low fluid levels or fluid leaks
- exhaust system failure due to wet stacking, or running generators under low load that causes the accumulation of carbon particles, unburned fuel, oil and condensed water in the exhaust system
- insufficient reserve of fuel or deteriorating fuel quality
- operational failure of ventilation louvers

TESTING, PROPER PM PROGRAM ESSENTIAL TO POWER SYSTEM RELIABILITY

The first step to having a reliable power system is proper factory testing of the equipment, followed by acceptance testing and commissioning of the complete system on site. Once installed, it is then critical that managers develop a comprehensive preventive maintenance (PM) program and that technicians follow it. Managers can use the following criteria to develop the program:

- manufacturer recommendations
- ANSI/NETA MTS-2011, Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
- NFPA 70B, Recommended Practice for Electrical Equipment Maintenance
- NFPA 110, Emergency and Standby Power Systems
- Other codes and standards as applicable to facility type, such as NFPA 75, Protection of Information Technology Equipment, and NFPA 99, Health Care Facilities
- other codes and standards as required by local and industry authorities having jurisdiction

These references give managers detailed recommended and required PM tasks that are too numerous to list. Also, maintenance and testing requirements vary depending on facility type and the critical nature of the supported loads.

PM PROGRAM COMPONENTS

A typical PM program for standby power systems and equipment can include the following steps:

Weekly

- Check the coolant heater, coolant level, oil level, and charge-air piping.
- Visually inspect exterior of equipment for obvious damage or leaks.
- Check gauges and instruments.

Monthly

- Load test generators and transfer switch operation. For hospitals, the testing frequency must be 12 times per year with intervals of not less than 20 days and not more than 40 days as required by the Joint Commission.
- Visually examine fuel samples.
- Check coolant concentration.
- Visually examine belt tension.
- Check air filters and battery chargers.
- Drain fuel filter and drain water from fuel tank. Fix if this is a recurring issue.
- Drain exhaust concentrate.
- Check battery electrolyte levels.
- Check connections for corrosion.

Quarterly

- Visually inspect for loose connections, burned insulation and signs of wear.
- Visually inspect fuses for discoloration caused by heat from poor contact or corrosion.
- For hospitals, perform tests of stored emergency-power-supply systems.
- Semiannually
- Clean crankcase breathers.
- Check radiator hoses.
- Visually check for liquid contamination from batteries and capacitors.
- Clean equipment enclosure.
- Inspect environment HVAC equipment and performance to check temperature and humidity.
- Conduct thermal scans of electrical connections to ensure all are tight and not generating heat, which is the first and sometimes only indication of a problem. Using this non-evasive diagnostic tool helps identify hot spots not visible to the human eye. Re-torque if the thermal scan provides evidence of a loose connection.
- Test entire transfer switching sequence.
- Exercise main and feeder circuit breakers over 600 volts (V).

Annually

- Provide a complete operational test of the system, including a monitored battery rundown test to determine if battery strings or cells are nearing the ends of their useful lives.
- Flush and refill the cooling system.
- Change the oil and filter, as well as the coolant filter
- Change the air and fuel filters.
- Inspect the main and feeder circuit breakers less than or equal to 600V, and periodically exercise the components per manufacturer recommendations and test them under simulated overload trip conditions.

- Test the UPS transfer switch, circuit breakers and maintenance bypasses.

Biannually

- Test the main and feeder circuit breakers greater than 600V under load conditions.
- Every three years
- Run a four-hour generator load test.

As needed

- Test components suspected of being defective or that have been subjected to unusual adverse conditions.
- Only qualified personnel who have been adequately trained and adhere to requirements of the NFPA 70E, Electrical Safety in the Workplace, and other applicable safety requirements should perform PM work.

CONSIDER EMERGENCY RESPONSE FACTORS IN BACKUP POWER SYSTEMS ISSUES

In addition to a PM program for backup power systems, managers also should consider additional recommendations designed to maximize system reliability and emergency-response efforts.

For example, managers can consider the use of remote monitoring systems. These systems monitor and provide audible and visual notification of trouble and alarm events before the facility actually needs the system to operate in an emergency. These monitoring systems also can provide notification when PM is required. Examples of available remote-monitoring features that address common causes of failure include:

- Alarms when not set in automatic, when the emergency stop engages, or when the output breaker is open
- Battery condition, backup time and test schedule, and charge levels. This is particularly valuable because more than 90 percent of generator failure-to-start issues are related to the batteries.
- Block-temperature and coolant-level monitoring and alarms.
- Fuel level and load measurements
- Lube oil pressure
- Water temperature
- Notifying qualified personnel and the backup staff of emergency, alarm and trouble events. Many generator control panels now have web interfaces with automatic dialing,
- Securing equipment from access by unqualified personnel
- Maintaining code-required working clearances around equipment
- Providing adequate battery-powered illumination of critical-equipment locations
- Posting the PM schedule with automated PM reminders. Technicians should not delay PM efforts just because it is difficult to arrange an outage.
- Providing simulations of various potential emergencies to determine effective responses, identify points of failure, and train technicians
- Storing necessary spare parts on site
- Storing system record drawings at a readily accessible location.
- Storing equipment and system operation and maintenance manuals at a readily accessible location.
- Documenting and organizing all testing and maintenance events

Finally, it is imperative that technicians perform regular system testing and maintenance in order for managers to sleep well at night and be confident their power systems have the highest probability of operating when needed.

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