White Paper

Best Practices for Load Bank Testing

ASCO Power Technologies®

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Load bank testing is essential to commission, verify and maintain power systems. Maintaining a safe workplace and understanding load test fundamentals promotes safe and efficient testing. This document describes best practices for ensuring the safety and usefulness of load tests.

PROTECTING PERSONNEL

Using qualified personnel is necessary for successful testing. A qualified operator/technician must fully understand the application to ensure correct load bank set-up and operation. Testers should have the skills needed to safely administer a load test, operate a load bank in varied conditions, and test pre-set capabilities using a remote laptop or a handheld controller. In addition, each member of the load test team should understand how a load bank will respond to an unexpected hot shut-down or potential errors. Consult applicable industry standards as well as national, state, and local regulations to verify that personnel are qualified for load testing work.

Figure 1: Typical personal protective equipment.

To mitigate load bank hazards, appropriate precautions must be undertaken to protect test personnel. Operators must fully understand the test procedures and equip themselves with correct personal protective equipment (PPE). Minimum recommended PPE includes goggles, gloves, steel toe cap boots, and a high visibility vest. For high voltage testing, arc flash protection equipment may also be required. Consult industry standards, governmental regulation, and site safety policies to evaluate PPE needs.

Most load bank manufacturers offer technical training about load testing and operational procedures. Contact the manufacturer to learn about load bank specifications, load testing regulations and practices, and training for operating specific load banks.

SCHEDULING LOAD TESTS

Deciding the frequency and time when to conduct a load test often depends on the requirements of the facility as well as the standards and regulations that apply to the application. Mission critical facilities such as hospitals, data center's and financial institutes back up power supplies require precision load testing more often than non-mission critical

applications. Governing bodies that recommend or require load tests for emergency power systems include the National Fire Protection Association, the American Society for Hospital Engineers, and the Joint Commission on Accreditation of Healthcare Organizations. Before initiating a load test, be sure to review the test procedures and regulations from these organizations.

Non-mission critical diesel generators are typically exercised at 30% to 50% of their maximum load once per month for 30 minutes (critical diesel generators may be much more frequently depending on regulations). This run time maintains lubrication of mechanical components, prevents oxidation of electrical components, and consumes fuel before it deteriorates. Typically, an annual test is also required. This test usually requires running a generator at 100% of its rated load for one to four hours. This ensures that the engine exhaust reaches and maintains optimal temperature, and helps prevent the accumulation of products of incomplete combustion in the exhaust system.

CALIBRATION

Many load bank manufacturers use integrated electronics to control and monitor load banks. Users should check the operation and accuracy of load banks by calibrating them annually or in accordance with the manufacturer's specifications. Calibration ensures that electronic controls are correctly sensing and communicating within a load bank, and are displaying the reliable information. Leading manufacturers offer proprietary software that verifies operation and documents calibration.

LOCATING LOAD BANKS

Load banks should only be located only where environmental conditions will not exceed the conditions of their IP or NEMA classifications as well as limitations for lengths of cable runs. Environments that may negate the specifications include off shore rigs, arctic climes, and dusty regions such as deserts. When load banks are equipped with a cable entry slot or a plate with grommets, their protection from environmental conditions is reduced.

Load banks are typically designed to operate at ambient temperatures between -10°C and +50°C, in non-condensing environments at relative humilities up to 90%, and at altitudes up to 1000 meters above sea level. Operation in conditions beyond these ranges may be feasible if additional or modified components are used. Consult load bank manufacturers to learn about options for specific applications.

Load banks must be protected from exposure to direct solar radiation, particularly to control and switchgear compartments. For outdoor installations in the northern hemisphere, this is most easily achieved by arranging the unit so that its controls face north. Control cabinets should face south for applications located in the southern hemisphere. Where high ambient temperatures (above +50°C) are common, shade should be provided for the entire unit.

Load banks exhaust very hot air, which integral fans dissipate vertically or horizontally. Users must provide sufficient free space for the exhaust stream for two reasons. First, the hot air may crack glass, melt plastics, trigger overhead sprinkler operation, and overheat cameras and wiring busways. Second, without sufficient space, hot air could recirculate through a load bank, causing internal components to overheat. Discuss the location and positioning of load banks with suppliers to ensure adequate heat dissipation for correct operation.

MANAGING CABLES

One of the most significant factors in load testing is specifying the correct cable for the load test. There are numerous points to consider including the length and thickness of the cable, the ambient temperature and the magnetic fields produced in operation. Cables should be sized in accordance with applicable codes and regulations before a load test is initiated. Minimize additional costs by reducing excess cable runs and connection points. Ensure your cable run is placed in a secure location, away from people, to reduce the risks of theft and loss of connectivity.

Figure 2: Bus Bar Connection Point.

Figure 3: Quick Connect Receptacles.

Load banks may be fitted with bus bars (figure 2) to provide convenient bolt-on connections for crimped terminal lugs. Alternatively, they may be fitted with single-pole power connectors designed for quick cable connection and disconnection (figure 3). These terminal bars or connectors can accept adequately sized copper or aluminium cables.

It is good practice to route phase conductors in a close trefoil arrangement, held together with cable ties. This arrangement minimizes stray magnetic fields from the cable array, and reduces inductive losses in the cables. If a high-current fault occurs, a trefoil arrangement will reduce the risk of sudden and violent cable movements.

If more than one conductor is used for each phase, all cables serving the same phase should have the exact same length and follow the same route. Ensuring that equal quantities of conductors for each phase pass through multiple cable entry openings will minimize eddy current losses.

For permanent load bank installations, ladder racks are the preferred solution for concealing cables to promote safety and avoid damage. Ladder racks also enable cables to be installed vertically to reach equipment located on rooftops, in basements, or on other floors.

POWERING FANS AND CONTROLS

Load bank fan and control systems can be powered from either an external supply or from the supply that is under test i.e. the gen-set. An external supply is preferred for the following reasons:

1. External supplies do not require any load from the test supply, increasing accuracy of control instrumentation.

2. If the test supply fails, fans and controls remain energized, preventing overheating and loss of load test data.

3. If a load bank will be used in more than one country, its controls and supply will be unusable outside of certain voltage and frequency parameters.

A test supply power source can be used in specific situations, such as in remote areas where an external supply is unavailable, or where publicly available voltage and frequency do not match load bank requirements.

SUMMARY

Following best practices and applicable codes and regulations facilitates safe and efficient load testing. Before starting any type of electrical testing, applicable codes, regulations, and policies must be reviewed. Load tests should not commence without assurance of compliance with applicable standards.

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