GenCo Alliance
CRITICAL POWER CONSULTING

WHITE PAPER · STANDBY POWER RELIABILITY

Why Generators Fail When You Need Them Most

Standby power reliability from the manufacturing and repair bench: a guide for data center owners, developers, and investors.

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PUBLISHED
November 2026

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A standby generator is the most expensive machine on a data center site that is designed to do nothing most of the time. It sits, often for months, waiting for the one moment that matters: a utility outage with the building at full load. When it fails at that moment, the cause is rarely bad luck. It is usually something that built up quietly while the unit sat.

We have spent our careers in motor and generator repair shops and around large rotating apparatus and critical switchgear at nuclear power plants. This paper is written from that bench: what these machines are made of, how they actually fail, and what it takes to keep them ready.

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01 How idle units fail

Standby equipment does not wear out the way running equipment does. It deteriorates from sitting.

Moisture in the windings

A cool machine in humid air collects condensation on and inside its windings. Insulation absorbs it and resistance to ground drops. Energize a wet winding and it can fail on the first start. Space heaters help only if they work and someone checks them. However, these machines are not made to sit idle without specialized care.

Insulation breakdown

Heat cycles, vibration, contamination, and moisture age insulation. Dirt plus moisture creates tracking paths to ground. The decline is gradual and measurable, if anyone is measuring.

Corrosion
Terminals, lugs, rectifier components, and control contacts corrode in damp air. A high-resistance connection can pass a no-load run and overheat under real load.

Wet stacking
A diesel run at light load never gets hot enough to burn its fuel completely. Unburned fuel and carbon collect in the cylinders and exhaust. A unit exercised unloaded every month can be building this problem.

Fuel degradation
Stored diesel oxidizes, picks up water, and can grow microbes. The sludge plugs filters right when the engine needs full fuel flow for hours.

Batteries and starting
Weak batteries, failed chargers, and corroded cables are widely recognized as a leading reason standby units fail to start.

Bearings and lubrication
Oil drains off surfaces while a machine sits. Bearings can corrode or mark in place, and seals dry out. The first moments after a cold start are when a bearing is least protected.

Controls and transfer
Relays, settings, sensing circuits, and ATS mechanisms that rarely operate are the parts least often proven under real conditions. A generator that runs perfectly is no help if the switch never transfers.

02 “Tested monthly” is not the same as “ready”

Most sites exercise their generators on a schedule, and they should. But a typical exercise (start, run unloaded or lightly loaded for a short time, shut down) proves that the engine starts. It does not prove that the set will carry the building for hours, that the governor and AVR will hold frequency and voltage through a large block load, that the fuel system will deliver at full flow, or that the transfer scheme works end to end. Light-load runs can even make wet stacking worse. A green check on the monthly log is a record of a start, not a measure of readiness.

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03 What the repair shop sees

When standby machines come into a repair shop, the story is rarely one dramatic defect. We see windings that read low to ground because they were left damp, insulation that tested fine at installation and was never tested again, connections discolored by heat, exciter and rectifier parts that let go on a hard start, bearings marked from sitting, and engines fouled from years of light-load running.

Almost every one of those failures was visible in advance to someone measuring the right things. That is the lesson of the bench: generators tell you they are going to fail, if you are listening.

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04 Readiness practices that work

Controlled atmosphere for long idle periods

For units idle for extended periods, such as during construction delays, before commissioning, or held in reserve, sealing the machine and purging it with dry nitrogen keeps moisture and oxygen away from windings and metal surfaces. We developed and applied a nitrogen-cocoon preservation approach for a standby emergency diesel generator at a nuclear power plant, where readiness is not optional.

Trend insulation, don't just test it

Insulation resistance and polarization index readings, taken the same way each time, corrected for temperature, and trended, show whether insulation is drying, contaminated, or aging. One reading is a snapshot. A trend is a diagnosis.

Fuel management

Sample and test stored fuel, polish or replace it as needed, keep water out of tanks, and change filters on schedule.

Commissioning discipline

Test the generator, switchgear, and ATS as one integrated system, and record baselines (insulation readings, vibration, thermal scans, settings) that every later test is measured against.

Real load bank testing

Periodically run each unit at meaningful load, using a load bank where building load isn't available, long enough to reach full operating temperature. This proves capacity, burns off light-load deposits, and works the cooling and fuel systems.

Batteries and controls

Load-test batteries, verify chargers, inspect cables, and confirm protective settings and ATS operation in real transfers.

☑ Questions to ask about your standby power

- ☐ When were the windings last tested for insulation resistance and polarization index, and can we see the trend?
- ☐ How is stored fuel sampled, tested, and maintained, and when was it last done?
- ☐ Has the full sequence (utility loss, start, transfer, retransfer) been tested end to end under real load?
- ☐ What commissioning baselines exist, and who compares new readings against them?
- ☐ When was each unit last run at meaningful load, long enough to reach full operating temperature?
- ☐ What is the condition and test history of the starting batteries and chargers?
- ☐ How are idle or pre-commissioning units protected from moisture, and are the space heaters verified?
- ☐ Who reviews the data, and do they know what the machine is telling them?

Let's make sure yours is ready.

We bring the manufacturing and repair bench to your site. GenCo Alliance assesses standby generation and switchgear for data center owners, developers, and investors: readiness reviews, preservation plans for idle units, commissioning oversight, and independent due diligence before you buy, build, or energize.

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