

Why test your generator?

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Why should you test your generator? After all, the operation of the machine is monitored in the control room, right? Well, yes but.... The fact is that control room instrumentation is focused on machine performance, with voltage, current, power factor, winding temperatures, bearing temperatures and vibration being the typical types of measured parameters. For normal day-to-day service, those performance measurements are appropriate.

For long term maintenance purposes, however, additional tests should be periodically performed in order to provide a view of the condition of your machine. Just as you receive an annual physical examination from a doctor to determine the status of your health, it is smart to periodically collect additional, detailed information about the condition of your generator.

This type of testing can be performed during scheduled minor and major outages and the results can be compiled to help provide trends about the long term condition of the generator. If particular deficiencies are identified, then the appropriate remedial measures can be applied on a scheduled basis. This approach helps to maintain the availability, as well as the capability, of the generator – and on your schedule and terms.

Minor Inspection Test Program

What tests and inspections should be performed and when? Usually, a combination of visual inspections and mechanical and electrical tests are specified. During minor inspections, a fairly simple schedule of tests is usually performed, since the rotor is probably not removed from the stator. In that case, limited visual inspections can be performed and fundamental electrical test results can be collected for a sort of interim “view” of the machine.

The visual inspection might include a survey of the stator and rotor end windings, circuit rings, main leads and bushings to identify looseness, dusting or greasing, visual evidence of corona, excessive oil coating the interior of the machine and evidence of cracking or other deterioration to the stator frame and lead box structure. Also checked are looseness or fretting at any visually accessible fit or interface surfaces and wear patterns evident on the shaft journals and collector rings. In some cases, a borescope might be the only viable way to see certain



regions of the machine. But even without a borescope, an experienced inspector can determine quite a lot simply by the looking at the interior of the generator.

The electrical tests performed during a minor inspection could include d.c. resistance measurements of the stator and rotor windings, insulation resistance measurements of the windings and a.c. impedance and pole balance measurements of the rotor winding.

The mechanical measurements or tests could include journal measurements to determine taper and lobes, brush measurements and brush holder spring pressure measurement, hydrogen seal leakage tests, stator cooling water system hydraulic integrity tests and axial core clamping tests.

Major Inspections

Since major inspections normally allow the rotor to be removed from the stator, more extensive testing is possible. Now, the condition of the stator core can be closely examined. In addition to a detailed visual inspection, these tests can include testing for the tightness of the laminations and slot wedges. The core insulation integrity may be tested using EL CID and ring flux loop tests.

The stator end winding support system can be examined and “bump testing” can be employed to determine if the structure is resonant near the operating frequency. If there are deficiencies, they can be corrected during this type of testing.



More extensive electrical tests are also now possible. Specifically, d.c. leakage tests and high potential tests can be performed on each phase of the stator. These tests can help determine the long term condition of the ground wall system by trying to identify incipient faults during an inspection outage, and before a catastrophic failure occurs when the machine is in service. This approach

might be considered analogous to the stress tests administered to determine cardiovascular health during a physical exam.

For older machines, a boresonic inspection might be appropriate for the rotor during a major inspection. This test can be extremely important since it will help establish the mechanical integrity of the rotor forging. Unless such testing is performed at some time in the life of the rotor, a buried flaw in the forging could be present and grow to critical size, resulting in a catastrophic rotor burst with no advanced warning.

NDE for the retaining rings and other shaft components can also be performed during the major inspection program.

In some cases, high speed balance testing is appropriate for a generator rotor. Testing to synchronous speed and overspeed in a balance facility might be looked upon as a luxury by some, but it should be considered seriously for those rotors that have exhibited vibration issues. This testing can help to greatly improve the running characteristics of the machine. This approach is usually much more efficient and timely than trying to install balance weights in the end planes of the machine when the rotor is in the stator. In fact, high speed balance testing in a bunker allows the weights to be placed in the body section of the rotor, leaving the end planes available whenever subsequent trim balancing might be required at the plant.

Testing Intervals

How do you determine the intervals between minor and major inspections? Many operators have established major inspection intervals in the 7 to 10 year range. Of course, those intervals depend heavily on a large number of variables, including machine operating regime, age, unit history and frequency of operation. Also to be considered is the importance or priority of the generator in the company's fleet based on fiscal or system considerations, environmental issues and other factors.

Minor inspections are usually evenly spaced between majors. Depending on the plant, that may be adjusted based on whether the major intervals are relatively long or short. Also, certain operating trends or data may point to the need for a minor inspection to check whether some component or system is actually deteriorating at a rate that will lead to failure before a scheduled major outage.

Finally, two key issues are important to consider when examining a generator. One, regardless the extent or context of testing, the inspection program should be conducted by experienced generator personnel using inspections and test methodologies that are consistent from outage to outage. Two, the test results should be used to help establish trends in the condition of the machine. These trends will help to drive a maintenance program that is appropriate for the long term viability of the unit.