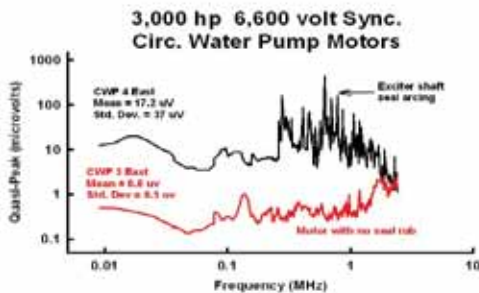


Generator, Transformer & Motor Tests



Global Power Services
Doble's Expert Consulting Division

Electromagnetic Interference (EMI) DiagnosticsSM



These two identical synchronous motors have very different EMI signatures. The 4 East motor has a shaft seal rub at the exciter, the 3 East motor does not.

EMI analysis techniques can provide critical information useful for developing targeted maintenance strategies for power systems, and can also identify equipment that does not require attention or repair. This is a passive, non-intrusive, non-invasive measurement technique, with no applied signal. Data is collected without affecting operations, and the process is inherently safe.

EMI Diagnostics can save money and time by identifying specific areas that require maintenance, repair, or replacement allowing strategic, proactive, planned decisions to be made well in advance of an upcoming scheduled outage.

EMI Diagnostics can provide valuable specific maintenance recommendations on the very first test. The test equipment is very sensitive and measurement accuracy is traceable to NIST standards. EMI Diagnostics presents an opportunity for companies to dramatically improve their condition assessment and optimize their preventative maintenance programs.

Doble Global Power Services, a division of Doble Engineering, is proud to offer an innovative approach to testing generators, exciters, isophase bus, transformers, motors, switchgear and power cables - Electromagnetic Interference (EMI) Diagnostics. This is a time tested technology that allows Doble to perform an online diagnosis in a non-intrusive, non-invasive manner while the equipment remains in service unaffected.

EMI enables Doble to identify and locate many defects that other technologies are unable to detect. Doble Global Power Services utilizes EMI Diagnostics as a tool to focus on supporting condition based maintenance programs for many applications including fossil, nuclear and hydro power plants, as well as industrial and petro-chemical industries.



EMI Diagnostics has the ability to detect and classify a variety of EMI signals generated by electrical and mechanical systems defects. System component defects are found in addition to motor or generator stator problems—including numerous types of mechanical abnormalities such as mis-alignment and bearing problems.

EMI data is collected from the temporary placement of a single-split core radio frequency current transformer (RFCT) around the power conduit, safety ground or neutral lead of the component being tested. No hot connection is required to any energized conductor and no hardware installation modifications are required. The resulting radio frequency spectrum (EMI signature) acquired is unique for each physical location and type of defect present within the electrical system.

Contact us at 1-617-926-4900 or DobleGPS@doble.com.

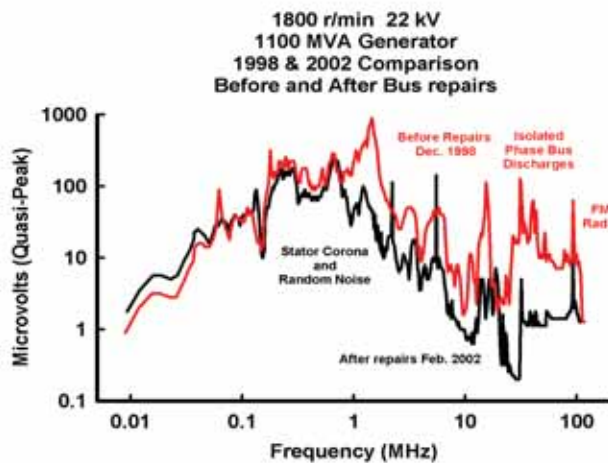
One setup location permits a global survey of the motor or generator system being tested. Data collection requires about 1/2 hour while equipment remains in operation unaffected by the EMI Diagnostic test equipment.



Experience shows that 80% of the equipment tested does not require maintenance during the next outage. However, 15% are in the process of developing a problem, and 5% need immediate attention to prevent equipment failure. Identifying the 80% is extremely important since it releases maintenance resources to the 5% that require immediate attention. Additional inspections or tests can then be scheduled to confirm the existence of these conditions and condition-based maintenance can be scheduled before a failure occurs.

Unique Features of EMI Diagnostics

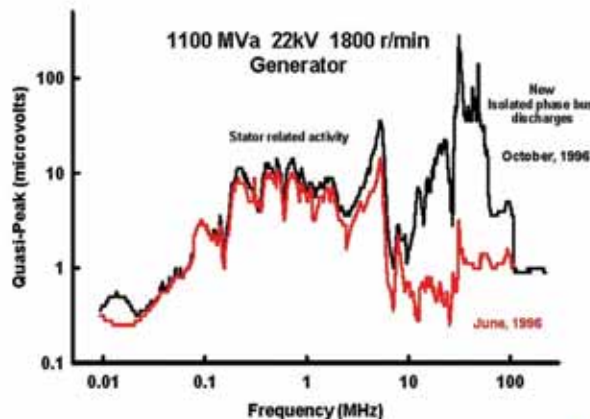
- Test on-line
- Find problems before they become issues
- Test prior to and post maintenance activities



The figure to the left shows two EMI signatures Pre and Post Maintenance for a generator. The Dec 2008 (post main- red) signature shows that the maintenance performed based on the recommendations from the Jan 2008 EMI test results corrected the isophase bus discharge issues.

EMI testing is a tried and tested technology developed over 25 years ago. It has been proven with over 7,000 successful field tests on more than 500 different designs with over 65 types of defects and conditions that have been identified, catalogued and verified.

The figure to the right is an example where bus maintenance was scheduled. An EMI test was requested pre and post work activity to ensure repairs were successful. The Oct 1996 (post maint - black) signature shows that the bus maintenance activity was performed incorrectly and introduced isophase bus discharge problems. EMI Diagnostics then recommended additional corrective actions to resolve the issue.



Here is a brief selection of EMI Diagnostic conditions that can be detected:

Generators

- Stator bar slot discharges from conductive coating erosion
- Stator slot side-packing erosion
- Stator bar stress grading system deterioration
- Loose stator wedging (loose stator bars)
- Loose end winding ties
- Blocking and circuit rings
- Loose/broken stator sub conductors
- Dirt on stator end windings and much more...

Motors

- Stator coil partial discharge
- Deterioration in slots and on ends
- Winding contamination, oil, dirt, carbon black, coal dust
- Defective bolted/crimped stator lead connections
- Broken induction motor rotor bars
- Bearing problems
- Misalignment
- Shaft oil seal rub, plus more...

Bus & Cable

- Contaminated, loose or cracked bus support insulators
- Loose bolted joint hardware
- Deteriorated enclosure insulation
- Foreign objects in the isolated phase bus enclosures
- Defective potential transformer (PT) fuses and connections among many other items...

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