OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY
FACT SHEET

Remote Monitoring of Building Operations

Using Electrical Signature Analysis

Opportunity

If you are looking for a means of monitor the operation of electro-mechanical equipment in a building from an external location, a technology known as Electrical Signature Analysis (ESA) offers a powerful set of diagnostic capabilities well suited to the task. The technique is non-intrusive and has no detectable impact on the equipment operation. This technology has been proven to work with high reliability in identifying proper operation of a variety of machinery tested at the Oak Ridge National Laboratory (ORNL).

Technology

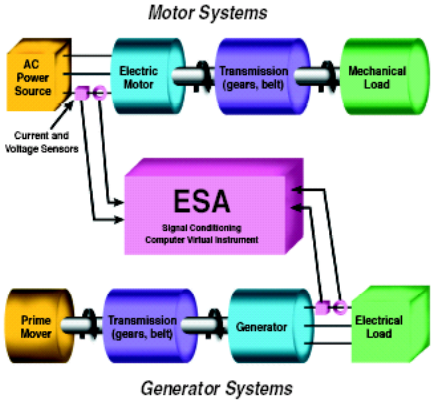
ESA is a versatile and powerful, yet non-intrusive, technology pioneered at ORNL that can be readily applied to most electro-mechanical equipment for condition diagnostics and prognostics purposes. ESA provides diagnostic and prognostic information comparable to conventional vibration analysis, but requires only access to electrical lines carrying input or output power rather than to the equipment itself. Thus, either onboard or remote analysis is possible—even continuous monitoring, if desired

Load and speed variations in electro-mechanical systems generally produce correlated variations in current and voltage. ESA analyzes these small perturbations and matches them to their source. The resulting time and frequency signatures reflect loads, stresses, and wear throughout the system and allow an extensive range of mechanical diagnostic information to be obtained from a single sensor attached to an electrical line.

Few available technologies can be so seamlessly applied to condition monitoring programs. With the addition of a few sensors, ESA diagnostics can pinpoint the equipment in use and its operational condition.

How It Works

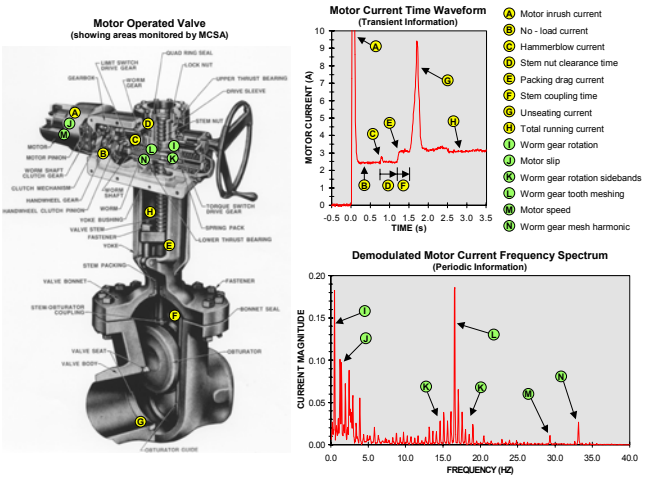
ESA provides a breakthrough in the ability to detect and quantify mechanical defects and degradations in electromechanical equipment and unwanted changes in process conditions. ESA is truly non-intrusive and does not interfere with the operation of the equipment being monitored



As a result of continued R&D at ORNL, ESA has matured as a diagnostic/prognostic technology. ORNL has developed several signal conditioning and signature analysis methods to capitalize on the intrinsic abilities of conventional electric motors and generators to act as transducers. Time-dependent load and speed variations occurring throughout an electro-mechanical system will generally induce small variations in the motor's and/or generator's electrical response. These variations are observed as a change in current (for a motor) or a change in voltage (for a generator). ORNL researchers have developed the signal conditioning techniques for extracting these small electrical perturbations and relating them to their source, thus opening a whole new field for diagnostic innovations.

Sample Application

The motor-operated valve shown in the figure is a good example for illustrating the kind of electrical signatures that can be obtained from the power line connected to the valve motor. The Motor Current Time Waveform shows transient information on the total current being drawn by the motor. The shape of this waveform is indicative of the electro-mechanical design of the valve. The Demodulated Motor Current Frequency Spectrum shows periodic information related to rotational phenomena associated with movement of the valve's internal parts. The shape of this spectrum is also indicative of the valve design. Changes in the heights of the peaks in these curves are indicative of changes of the valve's operational condition. Monitoring of the peaks can be used to determine need for repairs.



Motor current time waveforms and frequency spectrum for a motor-operated valve (MOV) showing multiple locations where degradation can be detected.

Other Applications of ESA Demonstrated by ORNL include:

- Air Force Power Generator Sets
- Army Ammunition Delivery Systems
- Army Portable Power Generator Sets
- Navy Fire and Seawater Pumps
- NASA Propellant Control Valve
- Fuel Injectors and Solenoid Valves
- Helicopter (Rotor and Gear Train)
- Diesel Engine Starter Motors
- Automobile Alternators
- Electric Vehicle Motors
- Large Compressors (Rotating Stall)
- HVAC Equipment
- Large Blowers and Fans
- Vacuum Pumps
- Variable Speed Motors

How To Contact Us

If you would like additional information on ESA and would like to find out how ESA can help you minimize unexpected failures, increase equipment reliability, and reduce unscheduled downtime, please contact:

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