Using Ultrasound and Infrared for Electrical Inspections: Examples

Ultrasound and infrared technologies are a perfect match when conducting inspections of electrical equipment. At any voltage, thermal anomalies and sources of ultrasound such as tracking and arcing can occur. Corona can also occur at 1000 volts and greater. Any of these conditions threaten the reliability of the equipment being inspected.

ADRIAN MESSER, CMRP
adrianm@uesystems.com

TYPICAL ELECTRICAL components that can be inspected with ultrasound and infrared include:

- Switchgears
- Load interrupter switches
- Breakers
- Transformers
- Motor control centres
- Terminal transition cabinets.

As a further complement to infrared inspections and to aid in the proper diagnosis of the condition, recorded ultrasounds can be seen in both FFT and Time Wave Form from spectrum-analysis software - this will show how to properly diagnose electrical anomalies. This form of analysis is referred to as ultrasound imaging.

Ultrasound technology and electrical inspections

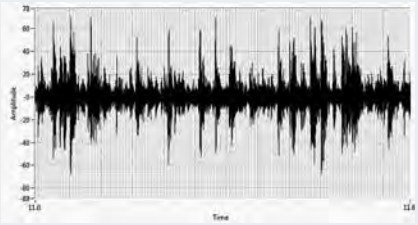
Ultrasound is probably the most versatile of any PdM technology. Typical applications for ultrasound include compressed air & gas leak detection, bearings, motors, gearboxes, valves, steam traps, hydraulic applications, and for condition-based lubrication of bearings and rotating equipment.

When it comes to electrical inspection, ultrasound instrumentation can

Ultrasound and infrared: Examples

1. 2000-AMP MAIN BREAKER (FIGURE 1)

- **Figure 1** represents a 2000-amp main breaker. Arcing was detected on the B Phase line side. The arcing heard was worse when the load increased. The arcing has severely deteriorated the internal contacts, and eventually will become so deteriorated that the voltage and waveform will be unable to reach the load. At this particular facility, the replacement cost for this item is approximately $20,000 USD.



- **Figure 2** The Time Waveform from the recorded ultrasound shows characteristic patterns of arcing – changes in amplitude and a loss of well-defined 60Hz harmonics

2. 2000 KVA 11KV-415V CAST RESIN TRANSFORMER

- **Figures 3 and 4** show an example of a 2000 KVA 11KV-415v cast resin transformer. An inspection on this equipment was requested after audible noise in the area increased, so the operators knew something has changed for the area to become louder. The inspection was done during the winter months, and for this facility, this transformer typically sees a reduction in load as it supplies chillers and associated other plant equipment that normally does not work as hard during the winter months. During the inspection it was noted that the load was around 420 Amps per phase.

Figure 3 and 4 – Images of the 2000KVA transformer

Figure 5 Time Waveform of recorded ultrasound from this transformer showing characteristics of arcing

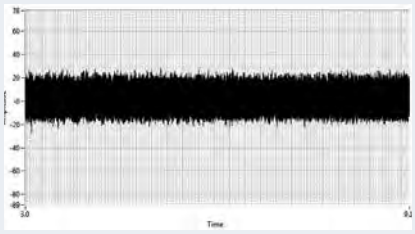
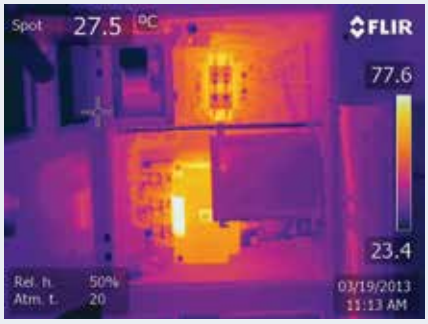


Figure 6 Time Waveform of another 2000KVA transformer in the same facility showing normal ultrasonic noise for this type of transformer

3. CONTACTOR

- **Figures 7 and 8** show an example of a contactor on a piece of equipment called an orbit motor. A routine airborne ultrasound inspection was done, and distinct sounds of tracking were heard. A follow up inspection with infrared was performed, and the diagnosis was severe tracking.



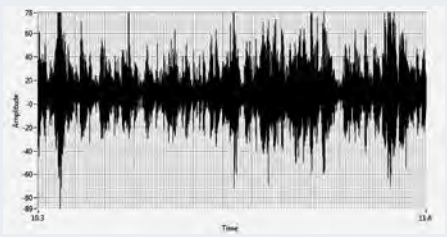


Figure 9 Time Waveform view of the recorded ultrasound of this contactor show distinct signs of severe tracking and early stages of arcing

be used on almost any energized electrical equipment including metal-clad switchgear, transformers, substations, relays, and motor control centres just to name a few. Ultrasound instruments can be used to inspect energized electrical components that are on low, medium, and high voltage systems.

ULTRASOUND AND INFRARED TECHNOLOGIES ARE A PERFECT MATCH WHEN CONDUCTING INSPECTIONS OF ELECTRICAL EQUIPMENT.

Traditional inspection of energized electrical equipment has been performed by noncontact infrared cameras. However, in recent years, ultrasound instruments have been added to these inspections for various reasons. One of the main reasons has been safety. An ultrasound inspection of electrical equipment can be performed without opening the cabinet or enclosure.

Ultrasound is quite effective in detecting certain failures like corona, tracking and arcing.

Conclusion

Ultrasound instruments are versatile and easy to use and can greatly enhance inspections on almost any electrical equipment. In the end, it is all about safety. Ultrasound inspections can be done prior to opening the energized gear to scan with infrared. If an ultrasonic emission is heard, then the proper precautions can be taken before opening the energized cabinet. Also, for those that rely on the services of an outside contractor to perform infrared scans, an ultrasound scan can be done in between the annual infrared scan to see if any emissions are heard.

When ultrasound and infrared are used together, an inspector is given a greater chance of detecting anomalies that could potentially be missed when relying on just one single technology. For best results, analyzing recorded ultrasounds in either the FFT, or time waveform view is the recommended method of diagnosing electrical anomalies heard with ultrasound. ■