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Infrared NDT Activities and Electrical Inspections in the USA

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In 1995, infrared thermography was in its technological infancy. This photograph of a very young John Snell, shows him a carrying a then-modern portable cryogenically cooled infrared camera system which cost about $60,000. All infrared cameras were cooled devices at that time. The late 1990's saw a technological breakthrough with the development of the uncooled microbolometer. This achievement led to systems that were much easier to use and lower in cost.

By 2005, the typical cost for a high performance uncooled infrared camera system had fallen to $20,000 to $30,000, and a new generation of lower cost infrared cameras were being introduced in the $10,000 and under price range. The low cost cameras sacrificed a nominal level of performance and placed infrared cameras into the hands of many more users. With the cameras being easy to use came the misconception that no real training was needed. This led to many users being untrained in the proper use of the technology. In the USA, this problem was recognized by the National Fire Protection Association (NFPA).

In the USA, the NFPA writes the National Electric Code which provides guidance on installing electrical systems. The NFPA also writes a document called 70E: The Standard for Electrical Safety in the Workplace. In the USA, NFPA 70E is LAW. In 2015, NFPA 70E introduced many major changes to the law for electrical safety. Most of the changes are directed towards the companies, but several are directed specifically at the personnel, and in today's setting I am referring to those people who are not electricians but who are performing inspections of electrical equipment.

Safety is essential. Arc flash can occur spontaneously even when you do everything right.

Arc flash is much worse than deadly. These images illustrate classic minor injuries from arc flash. In most instances, the injuries are actually much worse. And in many cases, death may be preferred to surviving a serious arc flash accident.

Quantitative InfraRed Thermography requires more than understanding how the infrared camera quantifies thermal radiation. The thermographer is also required to understand the quantification of energy which could result from an arc flash. The NFPA established very specific rules in this regard and has established arc

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flash protection boundaries that we must follow. When inspecting energized electrical equipment, the closer you are to the energized equipment, the greater the risk if an arc flash occurs.

The company is mandated to have a formal electrical safety program, conduct job briefings before each job, issue an energized electrical work permit and for all to wear the proper protective equipment. As part of this safety program, each electrical panel is required to be labeled to identify the level of arc flash hazard and provide information regarding what PPE is required to inspect the equipment.

Today's infrared cameras have changed the definition of what a high performance infrared camera is. Typical high performance cameras are still in the $15 - $30,000 price range.

But the technology is in the midst of another major change. Only 20 years ago, we saw the development of the uncooled microbolometer completely change the way infrared thermography is done, with lower cost high performance equipment. Today, we are seeing a combination of lowering costs AND miniaturization of the infrared cameras while still providing exceptionally high performance.

There are new families of infrared cameras today that interface directly with our smartphones. I attended a conference last year where I received a promotional thumb drive packaged as a high performance camera. Today's real infrared camera is smaller!

This combination of small size and low cost is driving the development of new products and markets. Here we see electrical power transmission lines, and the small dot, barely visible, is an unmanned aerial vehicle (UAV or drone) with an infrared camera inspecting the electrical connections.

Here's a closer look, with the drone mounted infrared camera system inspecting the pole mounted transformers and connections.

Inspections using UAV technology require a pilot and a camera operator. When piloting a UAV, you are constantly adjusting for wind and obstacles, while the camera operator focuses on performing the inspection and collecting the data. The pilot has views of the visible camera from the UAV and the infrared scene from the UAV.

UAV inspections can greatly reduce risk. Imagine using a UAV for indoor electrical inspections in a large manufacturing facility.

Many manufacturing processes are also hazardous locations with respect to explosive environments, so there are now intrinsically safe infrared cameras available.

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And there is new technology for optical gas imaging. Optical gas cameras are thermal cameras that are spectrally tuned to the wavelengths where specific gases absorb infrared radiation. For example, in a sub station, sulfur hexafluoride can leak from circuit breakers. By using the proper spectral filter, the an optical gas imaging camera can SEE the leak, making dangerous leak detection much easier and safer.

The optical gas cameras are available in a wide range of models and you must know which specific gases you need to detect, and choose the right camera for the right gas in order to be able to detect it.

Where is our technology going? Some of the newest infrared imaging instruments are going beyond simple thermal analysis and into spectral analysis. Here we see an example of the Telops Hyper-cam imaging spectrometer, showing the simultaneous release of SF6 and NH3 at a distance of 1.5 km.

And a soon to be released smart phone, the H2, has a built-in spectrometer. Imagine having this instrument in your pocket, that enables you to simply place the smartphone’s camera over something (a strawberry or a pill or a piece of plastic) and have it identify the chemical composition.

Imagine the blending of thermal infrared cameras with an imaging spectrometer and spectrophotometer, all using the same infrared portion of the electromagnetic spectrum. Instead of needing many different infrared cameras, we would have one that detects all of these gases and even tells you which gas you are seeing.

I believe we will see a day in the near future where we change QIRT from Quantitative InfraRed Thermography to Quantitative InfraRed Testing.