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International
Electrical
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Technology Trends & the Impact on Electrical Inspection

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International Federation
for the Safety of Electricity Users

Agenda

- Seven Electrical Construction Technology Trends to Follow
- New Technologies used in Electrical Inspection
 - Infrared Electrical Inspections
 - Ultrasound Electrical Inspections
 - Examples of Inspection using Ultrasound and infrared
- Using Technology trends to serve Electrical Inspection
- Conclusion

1. Seven Electrical Construction Technology Trends to Follow

- 1- Automated Technology
- 2- Internet of Things and 5G Network
- 3- Wearables
- 4- Augmented and Virtual Reality
- 5- Software
- 6- Prefabrication and Modular Construction
- 7- Artificial Intelligence and Machine Learning



1.1 Automated Technology: Robotics and Drones

Automated technology is the future of construction technology because it uses AI to computerize functions that can be performed by humans, therefore reducing human error. With less human error, electrical work will be safer because of smart technology.

6 Ways Drones Are Affecting the Construction Industry:

- Surveying Land
- Improvements to Infrastructure
- Communication and Management
- Improved Overall Security
- Accurate Surveillance
- Transportation and Inspection



Electrical Pole Climbing Robot



Wireless underground cable cutter and then control it remotely

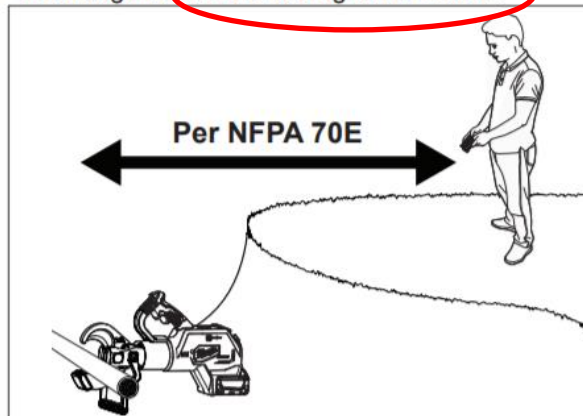
Wireless remote communicates with the tool via a mutually exclusive Bluetooth connection, removing and physical connection to the tool and allowing linesman to make remote cuts WIRELESSLY



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Remote Cutting

- Before cutting, ensure blades are properly installed.
- To set the tool on the ground, rotate the cutting head 180° to use the front handle as a "foot" and set the tool in position on the ground.
- To hang the tool, use the front handle and tool hanger to set the tool in a hanging position.
- Insert the workpiece squarely between the blades. Do not attempt to make angled cuts as it will damage the workpiece and blades.
- The range for remote cutting is 10 meters.



1.2 Internet of Things (IoT) and 5G Network



The Internet of Things (IOT)

Smart machinery can perform repetitive tasks and maintain itself, **boosting efficiency** and **productivity** and **reducing carbon footprint**.

Smart applications track footfall, perform inductions and check workers in and out **saving time**. Geo-location technology can identify hazards **increasing safety**.



5G and Wi-Fi 6

Mobile broadband is proving a competitive alternative to the traditional fixed lines.

This technology enables **quicker installation times** and **greater flexibility**, whilst still receiving the required level of service.

IoT allows electrical workers to use internet-connected tools and software to connect themselves



5G will increase productivity by more than

27x

It will reduce man hour work

20%

7

Cloud Services and Data Storage

- Cloud computing is similar, but it delivers and stores data over the IoT centers for quick and easy access whereas IoT refers to the connection of devices via the internet.
- Electrical contractors & inspectors can benefit from these technologies to stay organized and efficient.



IoT Connected Devices

The Internet of Things (IoT) is bringing connectivity to all types of devices; in the case of construction, this includes equipment, tools and even the gear worn by construction personnel. This generates abundant data that can be used for many purposes:

- **Live monitoring**, which allows construction activities to be programmed more efficiently, while **preventing accidents**.
- **Tracking the performance** of specific tools and equipment, revealing potential ways to **improve their efficiency**.

1.3 Wearables

Smartwatches have made an impact on the electrical industry. Smartwatches, Fitbit, and other wearables are produced to ensure and promote safety.

Many of the wearable devices used by electrical contractors & inspectors can help enhance safety.



Electrical Safety solution through wearing a specific wearable band

- Radically reduce electrical injuries across your company.
- Protect your workers with real-time alerts when they are in the proximity of a dangerous electrical current.



Real-Time Hazard Alerts

Multi-sensory alerts warn users of danger in any voltage environment from 110V - 500kV



Always On Protection

Voltage is always on so workers can perform daily tasks with lowered risk of electrical contact injuries



Detailed Reporting

Reports provide insights in order to improve safety procedures and training



Customizable Settings

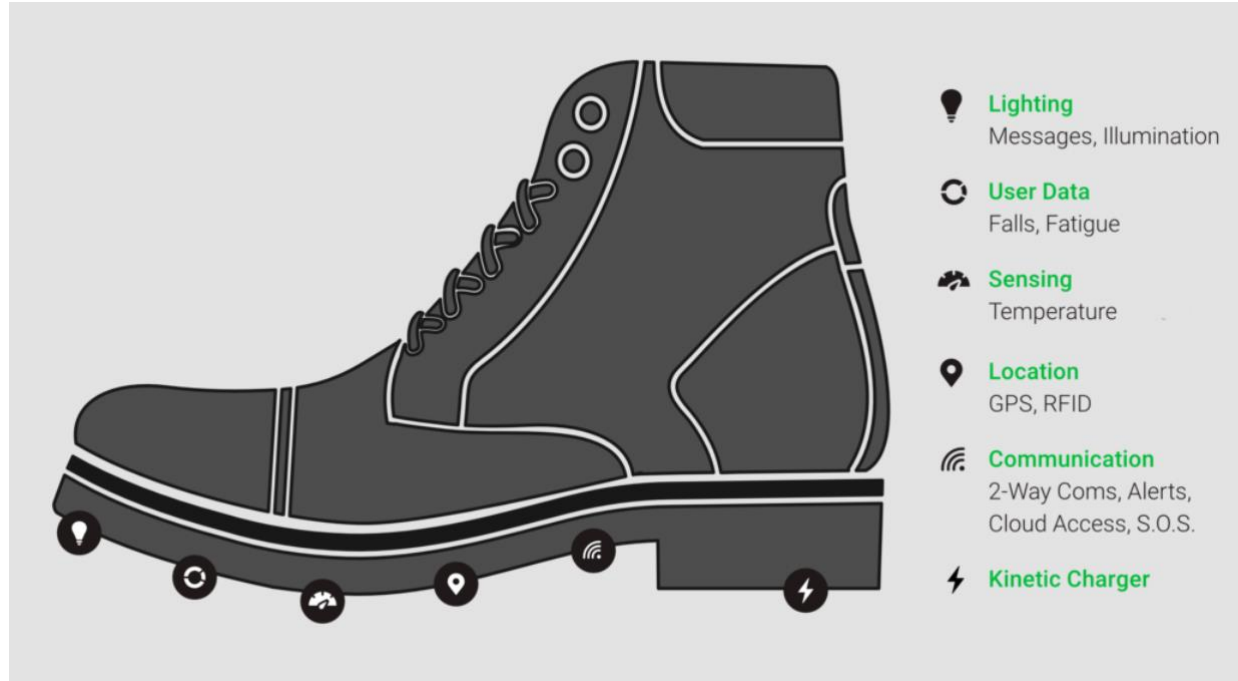
Set a variety of parameters depending on each worker, team, location and date



Proxxi wearable

SMARTBOOTS

Remote management
platform for improving
safety and
productivity on high
risk worksites



SolePower smart boots

1.4 Augmented and Virtual Reality



Augmented Reality (AR) / Virtual Reality (VR) Technologies

AR/VR technology support fast and precise simulation of architectural or structural changes, automatic measurements and **enables design improvements**.

Risk assessments reinforced with hazard simulations and clash detections **improving collaboration** between designers regardless of physical location.

AR systems can display key information about equipment as the user looks at components, or they can display warnings when there are risks nearby. For example, AR lens can signal surfaces that are at high temperature or electrically charged.



Augmented and Virtual Reality: Smart Helmet

- DAQRI created **a smart helmet** and **augmented reality glasses** that allows engineers, architects, and contractors to see their surroundings in an optimized way.
- Equipped with sensors, cameras, and high-tech electronics to know the location of ductwork and electrical cabling that is in the walls.
- Alert with visual or audible alarms when detecting dangerous proximities



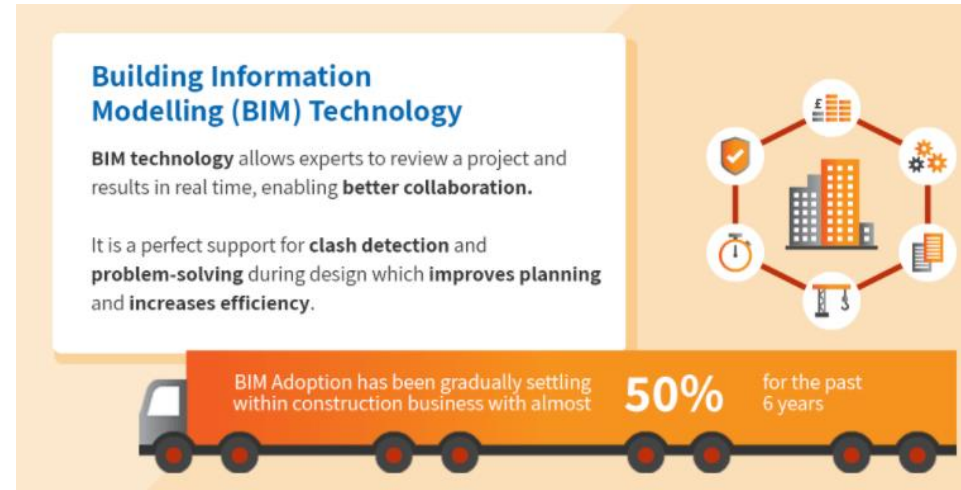
1.5 Software

- CAD

- **CAD** is a Computer-Aided Design software for drafting or image creation.
- Can be used to create two and three-dimensional models of parts and assemblies from their desired materials.
- Design engineers use CAD files for projects that require numerous parts and components to fit together for a large assembly.

- BIM

- **BIM** stands for building information modeling.
- It is an **intelligent 3D model-based** process for generating and managing digital representations as well as the digital and physical functions of places.
- **BIM is different from CAD** because it's more than just a 3D model. It's an intelligent version of CAD as it can reduce change orders, increase field communication, and collaboration.



1.6 Prefabricated products

- Modular construction is growing in popularity because of its increase in production with residential and commercial projects.
- In terms of electrical construction, the prefabrication methods are used for in-floor/in-wall products and switches.
- Using premade solutions helps reduce the amount of repetitive work electrical workers need to do on-site, and some products come with fittings already attached.
- Prefabrication helps make electrical work safer and more efficient. This efficiency could help compensate for the labor shortage the construction industry is currently experiencing. In the future, prewired walls may arrive on-site, significantly increasing the speed of projects.



Examples of prefab electrical components



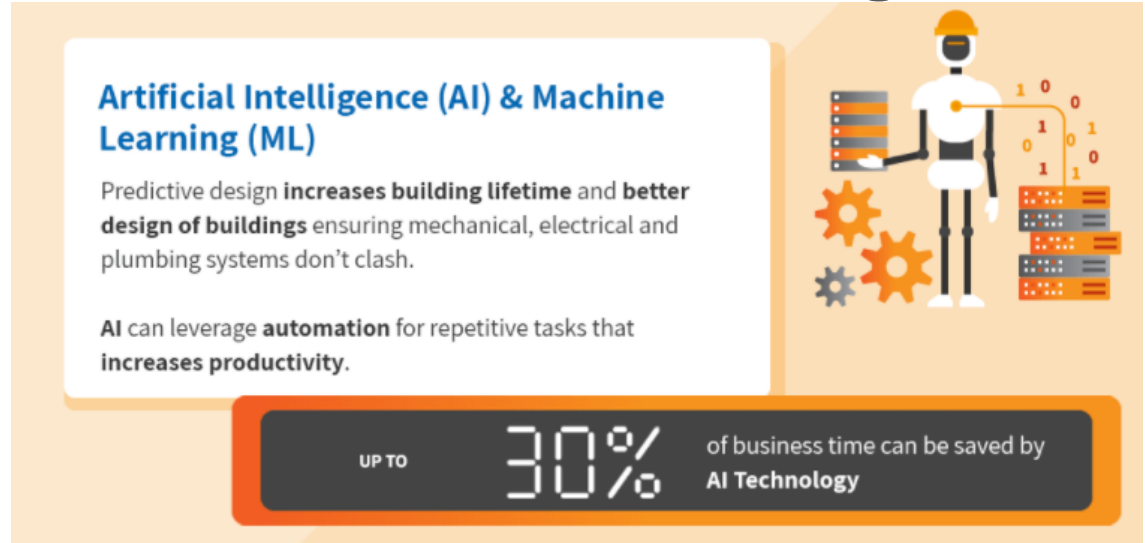
Prefab ELECTRICAL PANEL ROOM CABIN-PUF



Prefab ELECTRICAL Boxes

1.7 Artificial Intelligence and Machine Learning

- The data volume produced by multiple connected devices is often too large for human analysts, requiring artificial intelligence (AI) to be processed effectively.



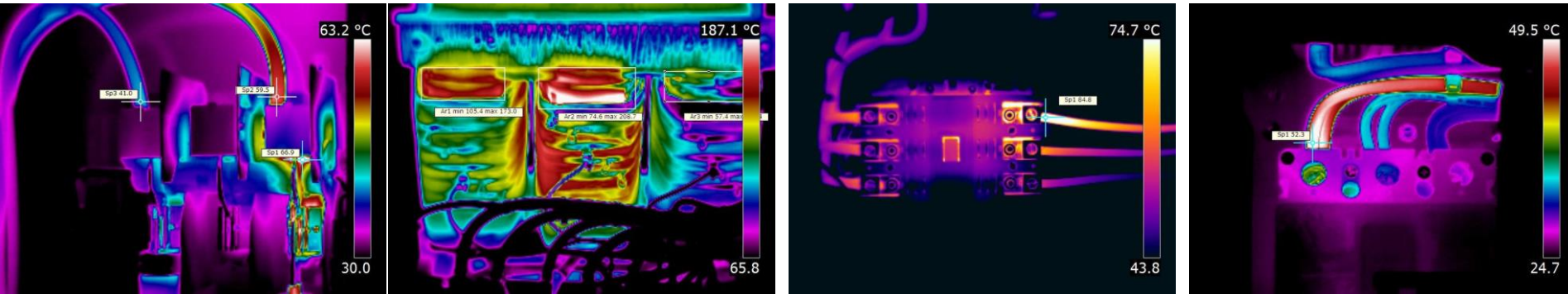
- The construction industry is characterized by its high exposure to risk and uncertainty, but this can start to change with AI services.
- Data analysis also has applications in procurement, where it can be used to program material purchases based on price trends, achieving better deals and ensuring a timely delivery.

2. Electrical Inspection

Inspection Test	Description
Insulation test	To ensure that the insulation is acceptable using 250 V, 500 V or 1000 V
Earth Loop Impedance	To measure the earth resistance for TN systems
Earth Fault Current	Prospective current at a specific point of the circuit in case of earth fault at that point. (for TN systems).
Short Circuit current	Prospective current at a specific point in case of short circuit at that point
Testing of the Residual Current Device	It should not trip if the current is 0.5 times the RCD tripping current. The tester measure the tripping speed which should be below certain limit (200mA); normally it is in the vicinity of 40 mA
Earth Resistance	For TT systems, the resistance shall be less than $50V / I_{\Delta N}$
Polarity of the socket outlet	To check that the phase, neutral and earth are properly arranged. Especially for BS socket outlets where a switch is provided for every socket; it shall disconnect the phase

2.1 Infrared Electrical Inspections

- Low and Medium Voltages (24VDC - 1000VAC)



Infrared thermography is used to find areas of excess heat (caused by increased resistance) so that problems can be corrected before a component fails, causing damage to the component, creating safety hazards and productivity loss.

2.2 Ultrasound Electrical Inspections

Typical electrical components that can be inspected with ultrasound and infrared include:

- Switchgears
- Load interrupter switches
- Breakers
- Transformers
- Motor control centers
- 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.

AIRBORNE ULTRASOUND HIGH VOLTAGE ELECTRICAL INSPECTIONS

- In electrical applications, airborne ultrasound can detect corona which exists above 1 kV and does not generate any heat. Infrared, therefore, can not find the existence of corona which if left unattended will further develop into tracking and arcing situations.



Ultrasound Arcing Emission



Bad Tracking Emission Inside 4160Vac Switchgear Cabinet



Corona Emission Inside 2300Vac Switchgear Cabinet



Tracking Emission inside 115KV Substation on Disconnect Blades



Transformer with Tracking Emission inside Cabinet



Examples of Detecting Partial Discharges and Increase Operational Reliability with Ultrasonic Testing Devices



2.3 Examples of Inspection using Ultrasound and infrared



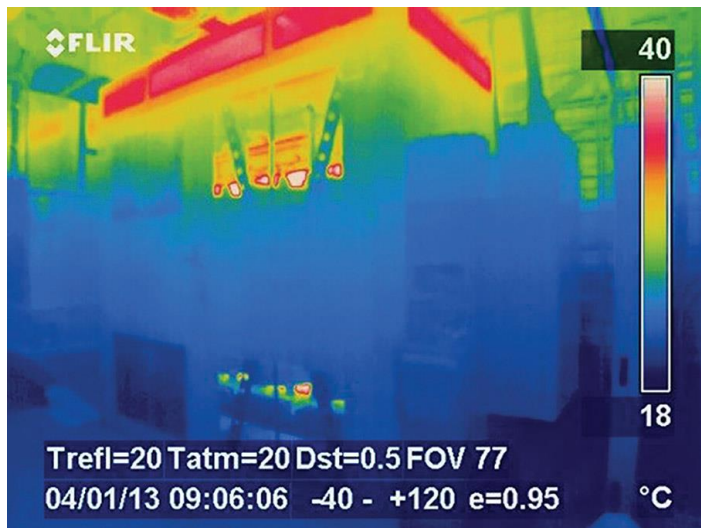
An example of a 2000 KVA 11KV-415v
cast resin transformer

Problem: 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.

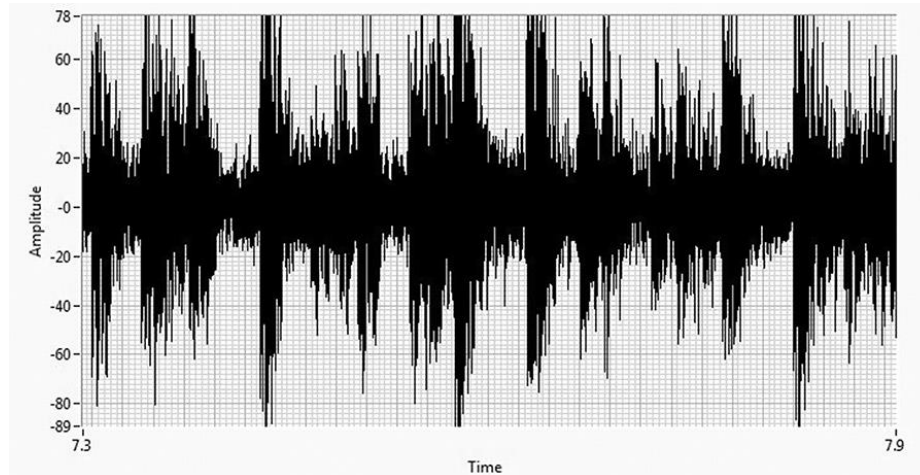
An inspection on this equipment was requested after audible noise in the area increased

During the inspection it was noted that the load was around 420 Amps per phase.

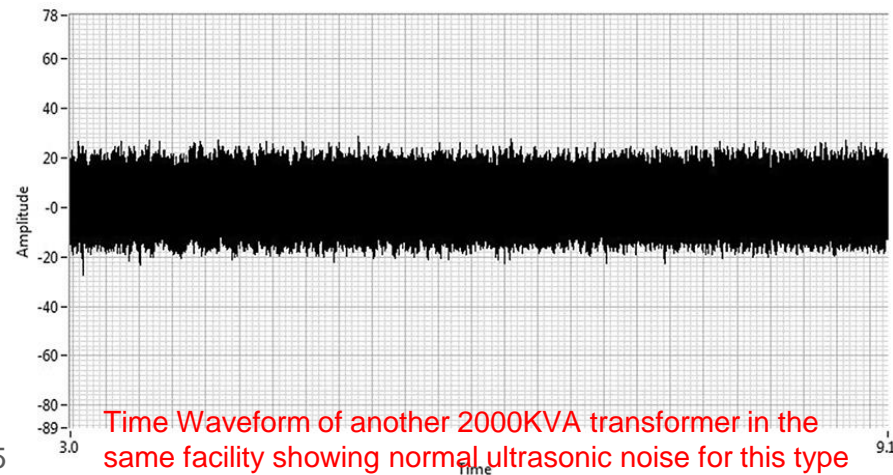
Inspection Results



Infrared thermography of the cast resin transformer



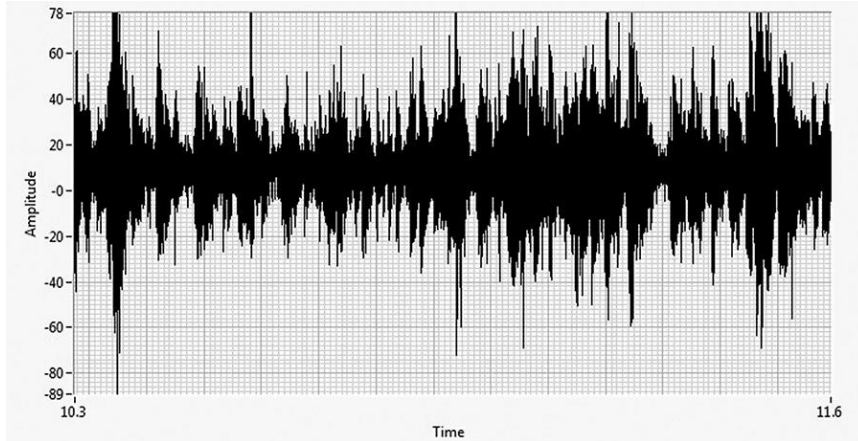
Time Waveform of recorded ultrasound from this transformer showing characteristics of arcing



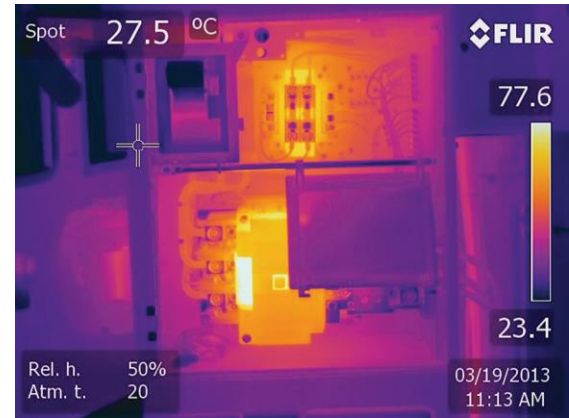
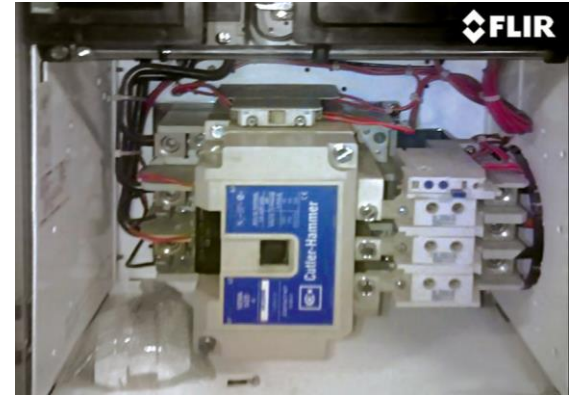
Time Waveform of another 2000KVA transformer in the same facility showing normal ultrasonic noise for this type of transformer

Example of a contactor on a piece of equipment called an orbit motor

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.



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



3. Using Technology trends to serve Electrical Inspection

- For example, a drone carrying an ultrasonic probe and a high-quality camera is used to perform testing. It's able to assess the thickness and condition of materials in locations, such as smokestacks, structural members and chimneys, in a non-destructive manner. It transmits the gathered data live via a digital interface to personnel working at ground level.
- Using drones with laser scanning technology, photogrammetry and thermographic cameras. They undertake inspection tasks that would otherwise be high-risk tasks for human workers.

Conclusion

Technology is evolving, and it's imperative to keep up to date with the current trends to ensure safety and efficiency on job sites. Construction technology is useful in all projects, ranging from residential houses to commercial industries. Be ready to anticipate electrical construction technology trends in software, wearables, IoT and cloud computing, prefabrication and automated technology that will overall increase productivity in the upcoming years.

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Thank you!



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