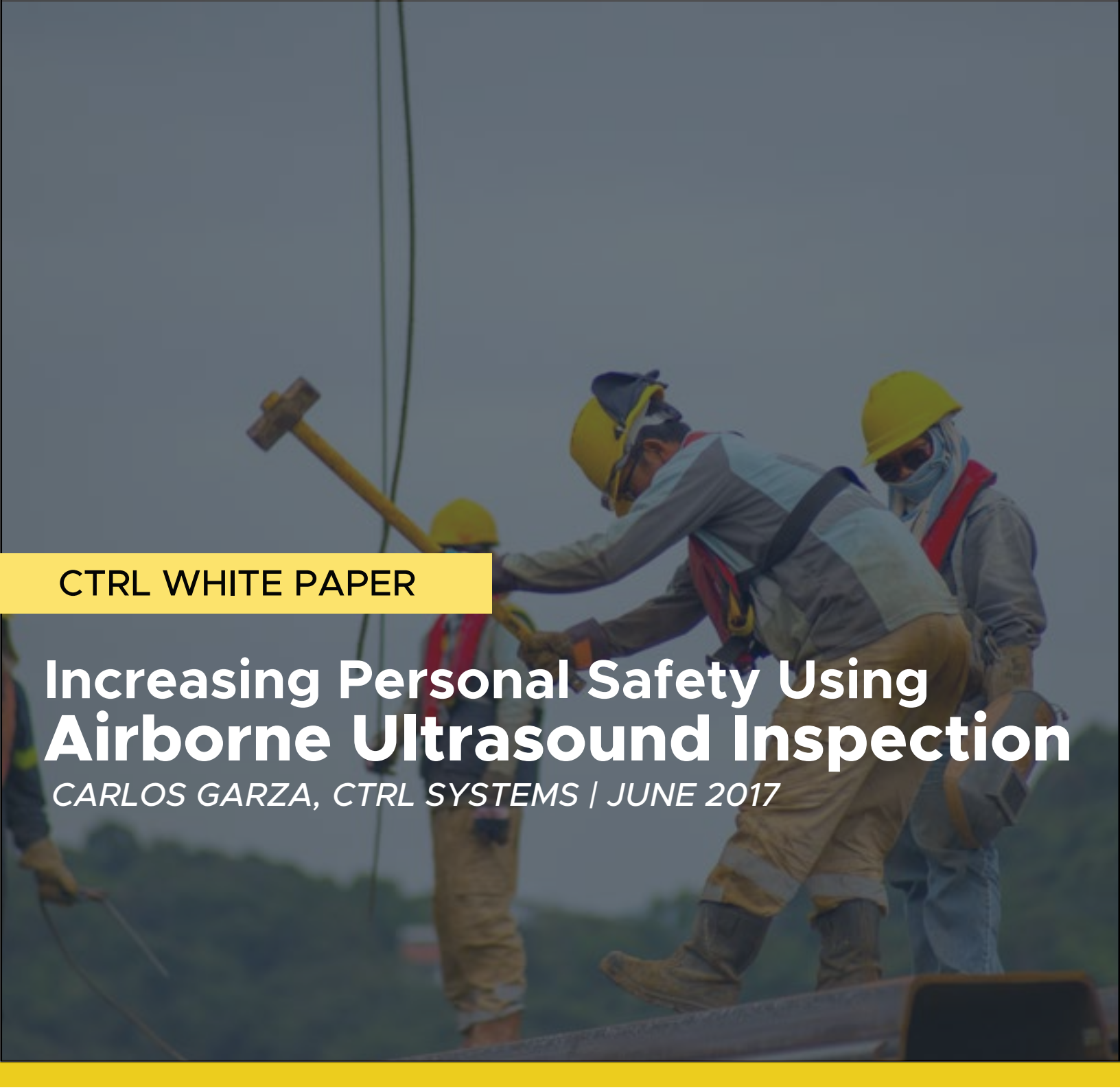

CTRL WHITE PAPER

Increasing Personal Safety Using Airborne Ultrasound Inspection

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The safe performance of Condition-Based Monitoring (CBM) tasks is essential and is quickly becoming a top priority for the industry. This paper will educate on how airborne ultrasoud technology can be utilized to detect gas leaks of pressurized flamable or toxic fluids, to inspect electrical cabinets or energized transformers without opening them, and to inspect machinery in movement with touching it.

Background

According to the last report by the Occupational Security of Health Administration (OSHA), in 2015 there were approximately 2.9 million injuries and non-fatal illnesses in work places, of which just over 50% caused disabilities resulting in time off work. In addition to this, there were 4,836 registered fatalities in the same calendar year.[1]

Without any doubt, the conscious and unconscious exposure to different safety risks should be a priority to the different industrial operations and their workforce. The condition-based monitoring practices are not exempt from fulfilling the regulations, nor from the exposure to the risks. Condition monitoring technicians should be informed, specifically trained, and prepared to face these circumstances in the best possible way, protecting not only themselves, but also their environment and assets.

Airborne ultrasound technology, in addition to being a condition-based monitoring (CBM) instrument is also a safety tool: through its implementation it is possible to detect flammable gas and toxic leaks. CBM tools can inspect electrical equipment of both medium and high voltage without having to open panels, thereby avoiding direct exposure to the energized parts of the equipment under test. Further, CBM equipment can facilitate the inspection of mechanical elements in potential entrapment zones.

This document will analyze some of the potentially risky situations that can be directly addressed using airborne ultrasound technology.

[1] https://www.bls.gov/iif/

Figure 1: Airborne ultrasound detection technology is a versatile and reliable safety tool.

Airborne Ultrasound

Airborne (or acoustic) ultrasound technology allows the user to detect frequencies that are above the normal threshold of human hearing (40 kHz). At this specific frequency, it is possible to obtain the greatest sensitivity capacity of the piezoelectric crystals that are used in the detection instrument. Further, at this frequency it is also possible to detect the turbulence generated by pressurized gases as they escape into atmosphere and the ionization of the atmosphere that is electron-fed by electric deficient circuits or the friction that rotating elements generate.

The CTRL UL101 ultrasound detector is easy to use, sturdy, and light-weight; it is the ideal tool for technicians to use in their daily routines through the industrial plants. Weighing only 12 oz. and with intrinsically safe certification, the UL101 is a fundamental tool for the safety inspectors.

Figure 2: The UL101 and InCTRL platform potentiate safety by locating multiple ultrasound sources within industrial plants.

Safety Applications for Airborne Ultrasound Technology: Detection and Location of Pressurized Gas Leaks

Within industrial operations a number of different pressurized gases and their respective risks can be found. For example, highly flammable or explosive gases like methane, propane, oxygen, hydrogen, acetylene, and many others exist. Also of rist are gases that can cause suffocation: gases such as CO2 and nitrogen, besides toxic gases like ammonia and chlorine gas.

Due to this situation, most safety departments require that the industrial plant personnel possess and utilize portable gas detectors as part of their PPE (Personal Protection Equipment). In this manner, they achieve control of the risk by allowing the detector to promptly warn the technician of the presence of either toxic or flammable gas, in addition to continuously checking the oxygen levels in the working area.

The opportunity arises when the detector does its job and gives a warning of the presence of gas or of low oxygen level. In other words, the presence of a leak causes a potentially dangerous situation as the gas is accumulating or displacing the oxygen from the area. In these situations, portable gas detectors are not capable of pinpointing the leak. This hinders the efforts of maintenance and safety personnel to alleviate the risk by repairing or eliminating the source of the problem.

Figure 3: The portable gas detectors provide the users with a prompt warning of a specific gas or of a low oxygen level, but they are not able to locate the exact source of the leak.

By contrast, airborne ultrasound detectors are able to detect leaks of any type of pressurized gas at the exact moment the gas escapes into the atmosphere. This is accomplished by detecting the turbulence generated by the acceleration of the gas as it travels through the escape orifice, which can be as small as the diameter of a human hair. Since it is not linked to a pre-determined type of gas the same detector is capable of detecting leaks of all gases in the industry.

Ultrasound is also directional: therefore, it is also easy to locate, which allows the instruments to pinpoint the exact location where the leak is occuring. By locating the source, both the brigades and the maintenance department will be able to immediatelyfocus their efforts in eliminating the problem. If the gas in question is flammable or explosive, it is mandatory to use an intrinsically safe equipment which guarantees that during the repair it will not generate a spark that can lead to a fire or explosion.

Figure 4: The Intrinsically Safe UL101 detector is an extremely versatile tool in the technician's pocket: it is able to detect leaks of flammable gases such as methane or suffocating gases such as CO2.

Inspection of Electrical Cabinets and Transformers

The Electric Safety International Foundation (ESFI) has reported that between 2003 and 2015 in the United States, 2,498 fatalities were caused by electrical accidents. The ESFI further reports that in 2015 the exposure to electrical current was the seventh leading cause for exposure-related fatalities. In the same time frame, the ESFI reports that 30,820 non-fatal electrical accidents were documented, caused by discharges or burns.[2]

Figure 5: Whether caused by and electrical discharge or an arc flash, injuries caused by eleictral failures can result in fatality.

Due to the criticality and fatal effects often generated by this type of failure, the industry has focused on both improving their procedures and on re-engineering of the electrical components themselves. There is a very clear effort to minimize the amount of accidents caused by electricity. However, the statistics show that there are still many other measures that must be taken. Every day, thousands of energized electrical cabinets are opened, exposing the personnel of the plants to countless dangerous safety hazards.

[2] https://www.esfi.org

One of the simplest and most effective ways to eliminate this risk is to perform inspections of contained electrical components (such as electric cabinets or transformers) without openingthe containers themselves. Because most electrical cabinets are not hermetically sealed, and because high ultrasonic frequencies are not able to penetrate solid objects, the presence ofultrasound can pinpoint electrical failures such as Corona, Tracking, or Arc Flashing. The ultrasound waves are able to travel through the air towards the exterior of the panel eliminating the technician's exposure to the energized components.

Standards such as NFPA70B and its Canadian equivalent CSA Z463 recommend establishing inspection programs for condition-based maintenance with the objective of minimizing the exposure for plant personnel. Airborne ultrasound not only lines up with the recommended standards, but is can also be used to record and analyze the collected samples, thereby assisting in the diagnosis of the type of failure detected.

Figure 6: Airborne ultrasound technology is able to detect, record, and diagnose failures of elecrical components without requiring the technician's direct exposure to the energized components.

Inspection of Mechanical Components in Limited Access Areas

Sometimes it is necessary to perform inspection tasks of rotating mechanical elements in areas which are inaccessible to entrapment or risk of mutilation. In these conditions, the directionality of airborne ultrasound with accessories that will allow an extremely reduced angle, will allow the inspector to collect the information from a safe distance.

Figure 7. The UI101, together with the PowerBeam 300, is capable of collecting information with a precision of 1˚ from up to 300 feet away. This opens up a world of possibility for inspection.

Conclusion

Without doubt, industrial safety is the focus of greatest strength within industrial operations. We must take care of our most valued assets: our personnel. At the same time, we can guarantee the functionality of our physical assets in an effort that will impact our operation's bottom line.

Airborne ultrasound technology, used in a correct manner and in conjunction with international approved standards, will allow the companies that use it to minimize the risks of exposure to their personnel without sacrificing the quality of their collected information.

Figure 8. The UL101 and the PowerBeam 300 will allow inspectors to collect information about the health of their machinery without exposure to safety risks.

CTRL Systems has more than 25 years providing civilian, government, and military industries the lightest, most sensitive, sturdiest, and easiest-to-use tools for acoustic ultrasound detection. If you wish to receive more information about ultrasound condition-based monitoring (CBM) or if you would like to know more about our products and solutions, please contact us.

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