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Department of Homeland Security
(DHS) Science and Technology (S&T)

Energized Wire Sensor

Homeland Security

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TECHNOLOGY SCOUTING RESEARCH SUMMARY

Date: August 2019

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Research Summary

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Overview: Subject matter experts, proprietary commercial datasets, and open-source research were utilized to compile a preliminary list of Solution Options. A summary is outlined below, and the **top 9 Solutions** identified thus far are displayed on the following pages. Upon the initial scan, there were **zero solutions** found that meet all requirements specified, but the 9 solutions listed partially meet the specified requirements.

Problem Description:

This report is seeking technology solution options to detect if a downed power line is energized during emergency response operations. An "energized" or "live" wire is one that still has an electric current running through it. Downed power lines are often found at emergency scenes, particularly in the cases of car accidents and natural disasters, such as severe weather with high winds. An energized downed wire can carry a current strong enough to cause serious injury or death. First responders risk electric shock through "step potential," when a person is exposed to a difference in ground voltage while walking, or "touch potential," when a person is exposed to an object with a voltage difference. Currently, first responders must wait for the local utility company to test the downed wire three times before entering the scene to ensure safety. The process for utility company testing starts when a central control center receives notification of an electrical disruption, either through a local electrical substation or via calls from people who have lost power. The outage is then confirmed by a utility crew who inspects the wire, isolates the downed line, installs grounds to prevent energization, and then tests to ensure the downed line is no longer live. In large incidents with many downed wires, this process can take hours to days which significantly delays first responders in reaching victims. Further, downed wires are often covered by debris, so first responders and victims may not be able to know if there is a wire or where it is located. Thus, first responders need a sensor that is either handheld or integrated into existing gear that detects energized wires at a stand-off distance; this would provide situational awareness of hazards so they can safely navigate an emergency scene.

This report will examine solutions that provide stand-off detection of energized wires. The sensor could be used by first responders across the law enforcement, fire, and emergency medical services (EMS) communities in a variety of environments. Ideally, the sensor would have a graphical user interface (GUI) where first responders could access voltage information. This solution would be government-off-the-shelf (GOTS) or commercial-off-the-shelf (COTS) and available for purchase in the next 8-12 months.

Desired Use Case:

Upon arrival at an incident scene, a first responder would be able to quickly ascertain whether visible downed wires are energized and if there are any energized wires in the area that are not immediately visible. In the case of a car that has hit a utility pole and detached wires, the difference in voltage between the victims in the car and current running through soil could create a highly dangerous situation for both first responders and victims. A first responder would be able to carry the energized wire sensor in their hand or as part of their personal protective equipment (PPE) or other gear. The form factor and use would be similar to a thermal imaging camera. The sensor would scan the area for energized wires or objects that may be energized and indicate on a GUI the voltage and location. The first responder would understand in a matter of minutes where there were energized wires on the scene. The first response teams would not need to wait for the downed wires to be isolated and tested three times by utility companies. Once the first responder determined the area was safe, emergency teams could immediately start attending to victims.

Technology Requirements:

The solutions identified were assessed against the following technology requirements. The considerations when evaluating energized wire sensors include being able to provide:

Distance	Detects energized wires from a minimum distance of 25 feet
Battery	Contains a rechargeable battery or single use battery that can be easily replaced

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Form Factor	Able to be handheld or integrated with other commonly used first responder gear
AC/DC Currents	Detects both alternating (AC) and direct (DC) electric currents
Voltage	Detects at least 110 volts and above

Solution Categories:

Through the initial research, three dominant categories of energized wires were found. For these categories, low voltage is defined as below 600 VAC, medium voltage is defined as 600 to 69k VAC, and high voltage is defined as above 69k VAC per ANSI C84.1 standards.

1. **Handheld:** There are many commercially available handheld voltage detectors. These detectors have a form factor similar to a flashlight based on their shape and weight and often can be used to detect low and medium range voltages. These are most often sold for personal use in the home to understand the voltages of switchboards and outlets through light or sound alerts. Handheld voltage detectors generally need to be close to or in-contact with the energized object for testing, may lack a graphical user interface, and may run on replaceable AA or AAA batteries. Handheld detectors are likely the best solution for low voltage detection, but are unable to do so at a stand-off distance.

2. **Hot Stick:** There are a number of commercially available hot stick voltage detectors. These detectors have a form factor of a wand, generally around 1 foot in length. Hot sticks are most often used by ultiliy works and electricians for medium and high range voltages, though some hot sticks can detect low voltages. Hot sticks can often detect lower voltages at longer distances than handhelds (ranging from 3ft-15ft) but not very long distances. These detectors may not contain a graphical user interface and may run on replaceable 9 volt or rechargeable batteries.

3. **Stationary Sensor:** There are a few commercially available stationary voltage sensors and sensor systems. Voltage stationary sensors can be placed on vehicles, buildings, or attached to hot sticks. Many have graphical user interfaces on the sensor or may transmit voltage data to an internet connected device. Generally, stationary voltage sensors are ideal for measuring high voltages and may contain replaceable or rechargeable batteries. These vary in distance of detection.

End Users:

Technologies identified through this Technology Scouting Report could be used by law enforcement officials, firefighters, and emergency medical personnel at emergency scenes, particularly in natural disaster scenarios or vehicle accidents involving electric vehicles.

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Legend:		
Key Performance Parameter Criteria:		
✓ Solution Meets Criteria	? Additional Information Required from Vendor to Determine if the Solution Meets Criteria	✗ Solution Does Not Meet Criteria

Technology Solutions

While there are many voltage detectors readily available on the commercial market, **zero Solutions** were found that meet all of the requirements. Specifically, there are no solutions listed below that meet both the AC/DC current detection and distance (25 ft.) requirements. Listed below are 9 Solutions that meet many, but not all, of the stated requirements.

#	Solution	Description	Distance	Battery	Form Factor	AC/DC Currents	Voltage
1	trACer by FireCraft 	FireCraft's trACer does not detect DC current but is a great solution to detect medium and high voltages at longer distances. It is specifically designed for firefighters to detect voltage in downed power lines at a safe distance and pinpoint where covered down lines may be. It has a visual (flashing light) and audible (beeping) alerting mechanisms. The trACer runs on a replaceable 9 volt battery and has a ruggedized case for rough use. This solution does not have a GUI. **Category:** Handheld **Weight:** 0.6 lbs **TRL:** 9 **Country of Origin:** United States Additional Information	✓ Up to 125 ft for 12kVAC	✓	✓	✗ Only AC detection	✓ Vendor outreach needed for exact voltage range
2	AC HotStick by Hotstick USA 	While the AC HotStick does not detect DC current, it is a great solution to detect lower voltages at longer distances (about 15ft). However, it can detect higher voltages at even greater distances (200+ ft). The AC HotStick is designed for professional rescuers, providing warning of exposed high voltage AC from a safe distance. The AC HotStick will give early audible (beeping) and visual (flashing LED) warning of the presence of dangerous voltages without the need to contact the surface carrying the current. This solution does not have a GUI. **Category:** Hot stick **Weight:** 1 lb 4 oz **TRL:** 9 **Country of Origin:** United States Additional Information	✓ 15+ ft, depending on voltage	✓	✓	✗ Only AC detection	✓ 120 VAC to 46 kV

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#	Solution	Description	Distance	Battery	Form Factor	AC/DC Currents	Voltage
3	Lookout by HD Electic Company 	The Lookout detection sensor system is ideal for electric utility workers to affix to various equipment (such as bucket truck arms) but it does not scan an area like a thermal camera. The sensors could be affixed to first responder vehicles to detect energy around the vehicle, but only at high voltage levels. The system comprises a series of sensors that detect the presence of an electric field caused by a nearby energy conductor. If an electric field is detected, there are audible and visual alerts to warn the team in the area. Sensors can transmit to each other up to 100 ft. The Lookout system connects to an app that can be viewed on a tablet or other internet enabled device to display voltage information. Lookout sensors can be charged up to five at a time on a charging station and have up to 8 hours of battery life in "alert" mode. **Category:** Stationary sensor **Weight:** 1 lb each **TRL:** 9 **Country of Origin:** United States **Additional Information**	3 ft	✓	✓	✓	4kVAC to 500kVAC
4	Amprobe TIC 300 Pro High Voltage Detector 	The TIC-300 PRO is a hot stick voltage detector that is specifically designed for checking downed power lines, transmission lines, power distribution equipment, and load break connectors. It does not require direct contact with wires, but the tool must be within a short distance to detect. The device alerts when voltage is detected by flashing bright lights and loud beeps. The hot stick can be adapted with an extender, which can increase the voltage detector length by 57" (~4.75 ft) and is ruggedized to survive a drop of 6ft. The TIC-300 PRO does not have a GUI. **Category:** Hot stick **Weight:** 0.5 lbs **TRL:** 9 **Country of Origin:** United States **Additional Information**	Close detection needed	✓	✓	Only AC Detection	30 VAC to 122,000 VAC
5	H286 SVD Personal Safety Voltage Proximity Detector by Hoyt 	The H286 SVD is a sensor for detecting high AC voltage. It is specifically designed for electric engineering personnel, power engineering personnel, firefighting personnel, and instrument equipment workers with prominent warning when approaching high voltage and for taking necessary safety action. It can be attached to personal protective equipment (PPE), including helmet mounted, or worn round the upper arm. When approaching an electric field the sensor will give buzzer and LED flash light alerts. It is ruggedized for outdoor environments and is waterproof. This solution does not have a GUI. **Category:** Stationary sensor **Weight:** ~1.2 oz **TRL:** 9 **Country of Origin:** United States **Additional Information**	~2.6 ft	✓	Worn with PPE	Only AC Detection	110VACto 11.4 kVAC

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#	Solution	Description	Distance	Battery	Form Factor	AC/DC Currents	Voltage
6	Monnit Wireless Voltage Detection 	The Monnit wireless voltage sensor is a voltage detector that can be mounted on a person or vehicle. When voltage is detected the sensor displays on a graphical user interface "No Voltage" or "Voltage Detected". Voltage can be detected in an average of 40 milliseconds. It is strictly not for use for detecting 500 VAC or more. The sensor is powered by a CR2032 coin cell battery that is meant to least 1-2 years. Vendor outreach is needed to determine detection distance and applicability use case. **Category:** Stationary sensor **Weight:** 4.0 oz **TRL:** 9 **Country of Origin:** United States **Additional Link**	?	✓	✓	✗ Only AC Detection	✓ 24 VAC to 500 VAC
7	Dual Range Non-Contact Voltage Tester 	The Klein Tools Non-Contact Voltage Tester does not require contact with wires, but tool must be very close to detect low voltage and thus is not ideal for the use case. The tool automatically detects and indicates low voltage (12-48V AC) and standard voltage (48-1000V AC). It is ruggedized for 9.8 ft / 3 m drop protection and is made of lightweight, durable polycarbonate plastic resin construction. This solution does not have a GUI. **Category:** Handheld **Weight:** 0.8 oz **TRL:** 9 **Country of Origin:** United States **Additional Information**	✗ Close detection needed	✓	✓	?	✓ 48VAC to 1000V VAC
8	LV-5 Stray Voltage Detector by HD Electric Company 	The LV-5 Stray Voltage Detector is used to detect stray voltage as low as 5 volts which may be present on any electrically conductive surface, such as street light poles, guide guy wires, wood transmission poles, meter cans, manhole covers, and many other metallic surfaces in and around electrical utilities. While this is a good solution for low-voltage detection, it does not provide stand-off detection at a distance. Low threshold voltage sensing design picks up voltages from 5 VAC to 600 VAC with direct contact and above 600 VAC at a distance. An optional extension handle allows for testing of objects on the ground or hard to reach locations. It is ruggedized for various environments and waterproof. It uses two AA batteries that can be replaced easily. This solution does not have a GUI. **Category:** Handheld **Weight:** Vendor outreach required **TRL:** 9 **Country of Origin:** United States **Additional Information**	✗ Direct contact needed	✓	✓	✗ Only AC Detection	✓ 5 VAC to 600 VAC
9	FLIR T840 by FLIR 	The T840 is an infrared camera that can seek out heat dispersion from electric utilities (e.g. downed powerlines, help prevent power failures at utility companies, and prevent fires from electrical systems). The T480 has a 180° rotating lens platform that helps users quickly diagnose failing components in hard-to-reach areas. It has varying optional camera lenses to focus on nearer or longer distances and displays heat signatures on a GUI. The camera can be used for up to ~4 hours on a fully charged battery. However, this camera does not detect voltage and thus would not alone serve the use case. **Category:** Not a voltage detector **Weight:** 2.9 lbs **TRL:** 9 **Country of Origin:** United States **Additional Information**	✓ Exact distance dependent on lens type	✓	✓	✗	✗