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# Australian Developers and Distributors of Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) Sensors

Edition 1

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RNSA Convener: A/Prof Priyan Mendis

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**Australian Government**

The RNSA is an Australian Government initiative.

The Research Network for a Secure Australia (RNSA) is a multidisciplinary collaboration established to strengthen Australia's research capacity for protecting critical infrastructure (CIP) from natural or human caused disasters including terrorist acts. The RNSA facilitates a knowledge-sharing network for research organisations, government and the private sector to develop research tools and methods to mitigate emerging safety and security issues relating to critical infrastructure. World-leaders with extensive national and international linkages in relevant scientific, engineering and technological research will lead this collaboration. The RNSA also organises various activities to foster research collaboration and nurture young investigators.

Participants are encouraged to join the RNSA. Membership of the RNSA is open to Australian and international researchers, industry, government and others professionally involved in CIP Research. Information on joining is at [www.secureaustralia.org](http://www.secureaustralia.org).

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#### Changes

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## Overview

This publication identifies Australian researchers, manufacturers and distributors of CBRNE sensors. The aim of this publication is to aid individuals and organisations in the identification of potential partners for collaboration or systems for procurement.

While there are only a few research and development organisations in Australia specialising in CBRNE sensors, those that are have the potential to be world leaders or are already have this reputation.

## Classifying CBRNE threats

There is a wide range of sensors designed to detect the presence of a CBRNE threat, and measure the extent of an outbreak/attack so as to take the appropriate mitigation strategy.

Below is a classification of CBRNE threats.

### ***Chemical weapons***

These weapons can be gases, liquids or solids. They have a direct toxic effect on people. These are divided into the following categories:

1. Nerve agents, eg sarin and VX, which poison the nervous system and disrupt bodily functions
2. Blood agents, eg hydrogen cyanide and chlorine, which prevent the normal use of oxygen by the body issues so that vital organs cease to function within minutes.
3. Vesicants, eg mustard gas, which cause burning or stinging of the eyes and skin.
4. Pulmonary agents, eg phosgene, which damage and flood the respirator system causing suffocation.

### ***Biological weapons***

These weapons can be distributed through the air, through consumed food and liquid, or directly into the bloodstream. These are divided into the following categories:

1. disease-causing organisms, principally bacteria and viruses.
2. toxins produced by living organisms, to incapacitate or kill human beings and animals or to destroy crops.

### ***Radiological Weapons***

These weapons are designed to disperse radioactive material over an area typically via a conventional explosive attached to the radioactive material. Radiological weapons are also known as *dirty bombs*.

Any type of radioactive material could be used in a radiological weapon, including relatively common isotopes such as cesium-137 and spent nuclear fuel.

### ***Nuclear Weapons***

These weapons are designed to release enormous quantities of energy through a chain reaction of splitting plutonium or highly enriched uranium atoms (fission) or combining hydrogen atoms (fusion).

All fission weapons contain:

1. plutonium
2. highly enriched uranium

## ***Explosives***

These weapons are designed to release enormous quantities of energy by expanding suddenly, producing heat and large changes in pressure.

There are a wide of explosive classifications and one is:

1. high explosive
2. low explosive

## **CBRNE sensors developers**

### ***BioSenZ***

BioSenZ is an enterprise targeted at developing a bio-diagnostic system for the rapid detection of pathogens. The system provide users with the ability to perform fast (<1hr) diagnostic tests onsite. It has patented BioSAW technology (PCT\_AU2005\_000244, PCT\_AU2005\_001098) for chemical and biological sensing and microfluidic delivery of samples to BioSAW chips in field portable electronic read detectors. The technology builds a BioSAW using a Love mode Surface Acoustic Wave device as an extremely sensitive mass balance. A selective coating is applied to the BioSAW device which is then exposed to the environment (either air or liquid). Substances of interest attach to the selective surface and the BioSAW detects the change in attached mass as a change in frequency.

Selective coatings currently exist for toxic industrial gasses (H<sub>2</sub>, CO, NO<sub>2</sub>), microorganisms (LPsg1 Legionella, Salmonella and E.coli), and some organic molecules (pesticide residues).

In response to the needs of the counter terrorism community, BioSenZ is partnering with government public health and chemical labs to develop new selective coatings targeting ricin, sarin, anthrax and a range of toxic industrial chemicals.

BioSenZ is seeking direct investment to further develop its technology.

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### ***ContainerScan Limited***

ContainerScan is developing an integrated solution to deliver improved shipping container biosecurity.

The volume of shipping container traffic around the world is increasing along with the threat of biosecurity incursions. The flow of goods through ports is increasing and trade demands for rapid throughput and clearance at ports are strong. Rapidly identifying biosecurity threats from such volume and flow of containers is a problem.

ContainerScan's system detects minute quantities of risk volatile organic compounds present in shipping containers and allows immediate notification to relevant parties.

The system is based on a combination of technologies: a small cassette with trapping surface which samples the air in shipping containers; a high speed mass spectrometer which analyses the samples; and a rapid reporting and communications software system.

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### **CSIRO ICT Centre**

The CSIRO ICT Centre is conducting research into terahertz sensors. It is known that a range of chemical, biological and explosive materials have unique spectroscopic signatures in the terahertz region of the electromagnetic spectrum. Terahertz also penetrates a range of common packaging and clothing materials. Terahertz sensors offer the potential for the stand-off identification of concealed materials.

The ICT Centre has developed their first generation of terahertz sensor based on high temperature superconductors and is now working on improving system sensitivity and developing arrays of THz imaging sensors

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### **CSIRO Manufacturing & Materials Technology**

CSIRO has formed a Micro Analysis Systems Team which is focusing on technologies for detecting molecules and biologically-related molecules in particular

It aims to combine physical and chemical methods with micro fabrication techniques to develop hand-held low cost sensors and systems. Such a sensor system would include:

- Micro fluidic device for pre-processing the sample
- A sensor device that detects the chemicals of interest
- A system for controlling the micro fluidic device and reading out the sensor

This research is undertaken in partnership with the Defence Science and Technology Organisation, and one project has been funded by the National Security Science and Technology Unit, Department of Prime Minister and Cabinet.

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### ***CSIRO Marine and Atmospheric Research***

The Proton Transfer Reaction - Mass Spectrometers (PTR-MS) allow for real-time quantification of trace components with concentrations as low as a few pptv. This online mass spectrometry method works with most of the common volatile organic compounds (VOCs).

The CSIRO PTR-MS has applications in applications in air toxics and hazards. Its services include

- Integration of meteorology, plumes and sensors
- Assimilation of data for prediction (real time) and interpretation (design)
- Signal recognition software
- Calibration of alternative (simpler) electronic noses
- Perimeter monitoring systems
- Adaptation to urban canopies, building emissions, tunnel emissions
- Integration with numerical modelling

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### ***CSIRO Minerals***

The CSIRO Air Cargo Scanner is based on a novel fast neutron/gamma-ray radiography technique that is particularly sensitive to concealed organic materials such as illicit drugs and explosives.

Existing high-energy X-ray scanners show the shape and density of scanned objects and are well-suited to the detection of metal items such as weapons. As they provide no composition information, however, the detection of ill-defined, organic materials such as drugs and explosives is more difficult and requires the attention of highly skilled operators.

CSIRO's scanner combines X-ray images with images obtained using highly penetrating neutrons, thereby simplifying the detection of contraband materials hidden in air freight containers.

Neutron and gamma-ray sources, and custom-designed detector systems are arranged to collect images of cargos as they pass through a tunnel. Because different materials attenuate, or block, fast-neutrons and gamma rays differently, the scanner can generate a composite image showing shape, density and composition.

The neutron technology is non-intrusive to minimise the impact of security measures on rapid freight movement. It is estimated that scanning an air freight container will take less than two minutes.

CSIRO has installed a full-scale commercial prototype scanner in an Australian Customs Service purpose built facility at Brisbane International Airport.

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### **DSTO**

The Human Protection and Performance Division (HPPD) was created from the Chemical Biological Radiological and Nuclear (CBRN) Defence Centre in October 2005. HPPD's mission is the application of innovative science for protection and performance of personnel in chemical, biological, radiological (CBR) and other physically challenging environments, for Australian national security.

Human Protection and Performance Division (HPPD) is one of 13 divisions in DSTO. HPPD applies innovative science for protection and performance of personnel in Chemical Biological and Radiological (CBR) and other physically challenging environments.

HPPD's research is administered in five areas:

1. The biomedical defence program which contributes to the capability of the Australian Defence Force (ADF) and national security agencies to maintain operational effectiveness when threatened with the use of chemical and biological weapons.
2. The Combatant Protection, Performance and Nutrition research program which focuses on providing a capability edge in human performance and protection.
3. The CBR hazard management program which contributes to the capability of the ADF and national security agencies to operate safely and effectively in environments contaminated with toxic chemical, pathogenic biological or radiological materials.
4. The Chemical Warfare Agent Synthesis and analysis program which involves the application of synthesis and structural characterisation techniques to meet Defence's needs and to support the national requirement for identification and forensic analysis of CB materials and enhanced understanding of the properties of CW agents. (aim of increasing the efficacy of our defensive measures.)
5. The CBR Arms Control / Knowledge Integration Area is responsible for: The Application of the principles of arms control to meet Defence's needs and support the national requirement, and Defence's regional engagement objectives relating to countering NBC proliferation and CBR terrorism.

HPPD is responsible for liaison and input into CBR counter terrorism for and provision of S&T advice on CT issues to Australian Intelligence Community. Also HPPD liaises with the National Security Science & Technology (NSST) Unit within the Department of Prime Minister and Cabinet (PM&C) and Commonwealth, State emergency services, forensic laboratories, the public health laboratory

network and other agencies involved in the crisis and consequence management of CBR incidents and protection of national infrastructure.

The key areas for research for HPPD in the areas of CBR sensors are:

1. Providing situational awareness including sensing, understanding, and communicating the CBR environment
2. Improving detection reliability through data integration and sensor fusion
3. Modelling and simulation to guide use, refine required performance characteristics, assess operational effectiveness and inform acquisition

DSTO Maritime Platforms Division is working on the development of chemical sensors. This work is being performed in collaboration with DSTO Human Protection and Performance Division. Maritime Platforms Division main area of expertise is in the development of transduction mechanisms so that the presence of target chemical species results in an electrical response. Test sensors are then fabricated to prove the sensing principles. Human Protection and Performance Division is involved in the development of the primary part of the sensors that is sensitive to the target chemicals and the testing of the complete sensors. The work is in the research stage.

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### ***Gammasonics Institute for Medical Research***

Beside research and development of new technology, Gammasonics support their research with the state of the art medical and scientific calibration facility for training of medical and scientific personnel not only in Australia but also from overseas for gamma, X-ray and mammography.

Gammasonics has also set up the most comprehensive data base of medical and scientific radiation given apparatus making a total of 28,000 certifications across Australia, making it by far the largest in the southern hemisphere. The number of technologies developed by Gammasonics is numerous covering a broad spectrum from medicine, industrial or aeronautical and national security applications.

They are also setting up a new facility for training and education and the setting up of a new optical stimulated lab (OSL) which will attract interest across the world.

Some of the technology developed through the years include:

- Radiation Detection Warning Device
- Personal Monitoring Device

- Mobile Radiation Response and Inspection Vehicle
- Multi-purpose Area monitor, Survey meter and Contamination meter
- Automatic Radioactive Detection and Measurement System
- Universal Multi Channel Analyzer - Photomultiplier Tube Base + PC
- Automatic Radioactive Detection and Measurement System, plus a MCA for the identification of Radiosotopes

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### ***Gas Alarm Systems***

The company design, engineer, develop safe-T-sentry for monitoring of host of toxic, flammable and oxygen deficient atmospheres for application in buildings, conference venues, shopping centres, railway stations, hospitals, airports and defence. Safe-T-sentry hosts various sensors for continuous monitoring of CWA (Chemical Warfare Vapours), and TIC (Toxic Industrial Vapour). The system is being developed for the identification for biological agents and testing for radio/nuclides is under development.

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### ***Macquarie University***

The Centre for Lasers and Applications designs, develops and builds compact, robust diode-pumped solid-state lasers which operate in the ultraviolet and/or visible (yellow-orange) regions at wavelengths where there are few, if any, commercial lasers available.

These versatile and adaptable lasers may be suitable optical sources for CBRNE sensing techniques.

Fixed wavelength UV output can be provided at over 20 single discrete wavelengths between 266 and 400nm. Wavelength-selectable output can also be provided, switchable between around 2-4 closely-spaced wavelengths say between 275 and 285nm (eg. for detecting tryptophan).

The lasers can be designed as stand-alone sources or as a simple “add-on” to commercially-available 532nm lasers. Average output powers for an “add-on” model are 10mW to 200mW, and for a “stand-alone” model are 100-500mW

Laser output up to several Watts (pulsed or continuous) can also be provided at visible (green-yellow-orange) and a range of infrared wavelengths (1.1-1.5 $\mu$ m).

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***OptoTech / Swinburne University of Technology / Victorian  
Department of Primary Industries***

A collaboration of OptoTech, Swinburne University of Technology and the Victorian Department of Primary Industries is developing a portable instrument capable of detection and identification of chemical and biological contaminants in water. The device uses Surface Enhanced Raman Scattering (SERS).

The three parties have the following expertise:

- OptoTech Pty Ltd: system integration, engineering design, laser technology, optical systems
- Swinburne University of Technology: SERS technology, Raman spectroscopy
- DPI: Trace chemical analysis, supporting laboratory for water incidents, ongoing collaboration with emergency responders\

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## **QRSciences**

QRSciences a leading research and development company specialising in the commercialisation of Quadrupole Resonance (QR) as a scanning technology. QR utilises non-invasive radio waves to detect and identify a wide range of chemical compounds found in materials including plastic explosives and narcotics. The technology is automatic with high detection rates and low false alarm rates. It is also safe.

- Technology: Advanced Metal Detection (AMDS) is an array based, multi-frequency inductive metal detection technology. It is capable of detecting metal shapes and metal characteristics in scanned objects. The technology has immediate applications in weapons and improvised explosive device (IED) detection for baggage, cargo, personnel and shoe screening.
- Technology: SentryScope Ultra high resolution surveillance system is a 21 megapixel video camera focused on partially manned or unmanned video surveillance operations. It provides unprecedented resolution over large viewing areas.

Founded in 1996, QRSciences is a publicly listed company based in Perth, Western Australia with a wholly owned subsidiary QRSciences Corporation based in San Diego, California.

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## **System Two**

System Two Pty Ltd is a research and development company specialising in test kits for first line detection against possible explosive, chemical and biological agents. The organisation produces the Frontline Explosive Test Kit.

The Frontline Explosive Test Kit is an affordable, compact, robust, and comprehensive explosive test device and detects a range of explosive categories at trace levels. The Kit contains no hazardous or corrosive liquids, does not require operators to sequentially apply via dropper bottles or spray cans, the reagents or break ampoules or liquid carriers in specific sequence in order to achieve detection.

The system utilises the oldest and most established form of forensic identification methods - colorimetric chemistry. This tool is used throughout the world every day for in-field detection and screening of most crime scene residues. The system does not require supplementary equipment such as heaters, battery operated electronic tooling or gas burners. The Frontline Explosive Test Kit simply contains one pre-wetted swab stick and one plastic device which contains three miniature tests. The tests corresponds to all classes of explosives;

TEST 1 – Chlorates and Peroxides.

TEST 2 – Nitrates, Nitramines, Nitroesters.

TEST 3 – Nitroaromatics.

The swab is rubbed through suspect residues or over surfaces and then rubbed onto the three test pads. Indications occur within seconds. The Frontline Explosive Test Kit is also capable of detecting precursors of clandestine explosive manufacture such as materials used in improvised liquid explosive mixtures and will detect Triacetone Triperoxide (TATP) and Hexamethylenetriperoxidodiamine

(HMTD). The Frontline Explosive Detection Kit is a dry pack application test kit for the detection of explosive residues. System Two is also researching both biological and chemical detection systems.

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**Tenix**

Tenix is working with Sandia National Laboratories and CH2M Hill on the development of an Unattended Water Sensor (UWS) for the detection and identification of biotoxins, viruses and bacteria in drinking water. The sensors are placed in critical locations within the water distribution system to provide a warning of contamination in real time. The system uses microfluidics and electrophoresis and fluorescence techniques to separate out and identify the proteins in the sample. The proteins are analysed using Capillary Gel Electrophoresis and Capillary Zone Electrophoresis. A software algorithm then matches the electroferograms to a database for identification. The UWS is based on the existing technology of the hand held uChemlab.

The UWS is part of an on-going Cooperative Research and Development Agreement (CRADA) with Sandia to develop the technology further. Tenix has an Agreement to Licence this technology from Sandia to commercialise the UWS.

The UWS is a sensor which detects and analyses proteins in water. It is specifically designed for deployment in drinking water distribution systems. The proteins targeted for identification include biotoxins such as Ricin, Staphylococcal Enterotoxin B and the Botulinum Toxin. The sensor provides identification within 10 minutes of taking the sample. The UWS is automated for use in remote locations within the distribution system, and would normally be set to take a sample every 30 minutes. Current methods for detection and identification of these toxins require manual sampling, and laboratory testing.

The system also has the capability to detect and identify naturally occurring viruses and bacteria such as E. Coli, Cryptosporidium, and Giardia.

Tenix is currently looking to trial a prototype UWS in an Australian Water Utility as well determining what additional capabilities water utilities would require from the UWS.

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## **University of Newcastle**

The University of Newcastle is developing chemical sensors which will have the ability to sense the presence of characteristic chemical vapours associated with explosives and illicit drugs.

The simplicity and low cost of the chemical listening allows for installation at key locations e.g. transport hubs, shipping containers, airports etc as well as placement within clandestine drug laboratories.

The sensors can be stuck to the inside of cargo containers or coated onto walk-through screening devices, similar to the metal detectors at airports. The technology will allow rapid and specific detection of illicit substances. At the moment each suspicious substance is subjected to multiple presumptive colour tests, where it is placed into small testing bags with a chemical to see if the liquid turns a certain colour. In cases where multiple substances are detected, this process needs to be repeated, making it both time consuming and expensive. A positive match can currently only be made after exhaustive laboratory-based analysis.

The University's technology, will allow the explosive to be correctly identified in a matter of seconds.

The technology could be up to 100 times cheaper than the current methods of detecting explosives and illicit drugs at Australia's borders.

The Centre will receive almost \$400,000 from the Australian Research Council over three years for the project, and could have a prototype electronic device available within 18 months.

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## **CBRNE sensor distributors**

### ***Arnon Rodriguez***

The company distributes the anthrax detection system from US Universal Detection Technology. The product, BSM-2000, is claimed to be the first real time anthrax detection systems. It has a 15 minute response time, can detect levels of 50 spores/litre of air, is automatic and has low cost of operations.

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### ***Counter Terrorism Solutions - Asia Pacific Pty Ltd***

Counter Terrorism Solutions- Asia Pacific Pty Ltd specialises in the sales, service and support of field deployable and hardened Biological capture (Bio Badge, Air Sentinel) and real time 'PCR' Biological agent analysis equipment (RAPID, RAZOR, and freeze dried reagents such as Avian Influenza, Ricin, Anthrax, Small Pox, Plague, Botulism, Salmonella etc).

They are also the sole agent of Residual Skin Decontamination Lotion (RSDL) - a patented, broad spectrum skin decontamination product intended to remove or neutralize chemical warfare (CW) agents or T2 toxin from the skin. Client ranges from military and civilian first responder through to protecting critical infrastructure throughout the Asia Pacific rim.

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### ***Martin International***

Martin International is a long-established product supply and support company based in Canberra and specialising in defence and homeland security equipment and systems.

The company is Australian distributor for the Response Biomedical "RAMP" biowarfare field identification system that is both rapid and reliable. "RAMP" is the only system anywhere approved by the AOAC for the field identification of Anthrax. They also distribute the complementary "BioCheck" rapid screening test for use in 'white powder' incidents.

Martin International has a wide CBR product range including personal and collective protection equipment, decontamination and associated support systems.

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## ***Nucletron***

Nucletron specialises in the sales, service and support of the products to detect, identify, quantify and monitor radioactive materials. These instruments, which include detectors, spectrometers and associated software, simple and advanced radiation survey meters, are focused on environmental monitoring, detection of nuclear and chemical weapons, research, personal dosimetry and homeland security.

Our principal suppliers include ORTEC, Saint-Gobain Crystal & Detectors, RADOS Technology (synOdys), BNC and RTI Electronics.

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## ***Nu Scientific***

Nu Scientific is a distributor of radiological sensors and instrumentation from CANBERRA which is a leading manufacturer of radiation detection and analysis instrumentation. CANBERRA provides a full range of services in homeland security and emergency response, including training.

The global terrorist threat exposes first responders to a whole new set of hazards. Today's fire, police and emergency medical technicians need to know what they are up against at every scene. CANBERRA offers a variety of instruments to give your team the critical information they need for smart decisions at every scene.

CANBERRA Industries, a world leader in nuclear safety and security solutions, was awarded a contract for the next generation of portal monitors from the U.S. Department of Homeland Security's (DHS) Domestic Nuclear Detection Office (DNDO). CANBERRA will be providing Advanced Spectroscopic Portals (ASP) which will help to deter and interdict the smuggling of illicit nuclear materials in the more than 69,000 trucks, rail and sea containers that enter the US through its 317 ports of entry every day.

CANBERRA Industries also offers a variety of instruments and systems to help you ensure the radiological safety and security of your buildings and the people that occupy them.

CANBERRA Industries offers a variety of instruments and systems for the transportation industry. These are used to detect illegal or illicit materials, as well as responding to incidents.

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## ***Point Trading***

Point Trading is a distributor of a range of

- Primary and secondary sensors
- Portable, hand held and fixed detectors
- Non-library and library based sensors

### **Contact**

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## ***Warsash Scientific***

Warsash Scientific distributes the FirstDefender, a handheld portable non-contact chemical analyser by Ahura Corporation (US) which was designed to be a fully self-contained Raman spectrometer that can be operated by First Responders.

The First Defender performs all chemical analysis on board allowing the rapid (10's of seconds) identification of an unknown substance (solid, liquid, or powder). The unit can identify a wide range of materials, including:

- Toxic Industrial Chemicals (TICs)
- Explosives
- Narcotics
- White Powders
- Chemical Warfare Agents (CWAs)

Through the selectivity of Raman spectroscopy and Ahura's advanced decision engine, the FirstDefender has an extremely low false positive rate (unlike infrared techniques), allowing it to automatically detect and resolve mixtures of multiple chemical species.

A major benefit of the FirstDefender is that an unidentified and potentially hazardous substance may be analysed without sample preparation, such as through a glass or plastic container; greatly reducing the possibility of evidence corruption, cross contamination, or risk to Response Personnel. Once identified, the included NIOSH, Fire Response and First Aid guides can be employed by the First Responder to take appropriate action.

### **Contact**

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## **XTEK**

XTEK Ltd distributes a wide range of detection systems, including:

- AS&E OmniView Backscatter cargo x-ray systems and the new ZBV Backscatter detection van;
- Nomadics FIDO explosive vapour and trace detection systems, FISCAN multi-energy and EDS conveyor x-ray systems;
- SAIC RTR-4 portable digital x-ray systems;
- Logos Imaging EPIC digital x-ray systems;
- Radiation detection and identification equipment and Chemical Agent Detectors.

The company is also a specialist in a number of Unmanned Systems, including those supplied by iRobot Corporation, Aerovironment Inc and *tele**rob*** GmbH, which lend themselves to a range of remote sensing applications.

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