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Case Study

Tracking Radiation in the Lion City; Preventing 'Dirty Bombs' Elsewhere

Millions of people and millions of goods pass through the island city-state of Singapore, off southern Malaysia. Singapore, known by many names including the 'Lion City', is truly a major world hub, home to more than 5 million people and a global financial center with a tropical climate and multicultural population. With countless parcels and packages of all sizes and shapes funneling through the sprawling Singapore Post Centre in Paya Lebar, the Immigration and Checkpoints Authority (ICA) is charged with a truly Herculean task; it is responsible for checking millions of parcels for drugs and other contraband. ICA does so using the most advanced and efficient technologies available. In the parcel post section, for example, ICA officers screen up to 20,000 postal articles for dangerous and prohibited items every day, according to a recent article in *Channel News Asia*.[1] According to the article, ICA figures the "total number of articles cleared at the parcel post section each year has gone up from 5.2 million in 2016 to 6.1 million in 2018. In the same period, contraband cases detected annually increased from about 14,000 to almost 17,000."

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Every day of every year, everything contraband from drugs to weapons to drug paraphernalia are detected by alert screeners and sophisticated analyzers and sensors. Parcels are scanned, screened, and opened if suspicious items are detected, quite often through X-ray technology integrated into constantly-moving conveyor systems. The accuracy and comprehensiveness of the effort depend largely upon the skilled and trained X-ray system operators who know what to look for in the ghostly images. When drugs or drug paraphernalia are suspected and detected, they are referred to the Central Narcotics Bureau (CNB), which makes a determination as to the nature and disposition of the materials and may conduct further investigations.

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While a great deal of attention is justifiably focused on illegal drug interdiction, another type of substance, radioactive materials and sources of radiation, i.e. radioactive isotopes, are also a focus of detection. While the first thought that may come to mind might be that of weapons-smuggling and the stuff of high television drama, most radioactive products passing through customs are benign medical or industrial products. Because the laws and regulations classifying them and governing their transport are somewhat complicated, especially internationally, they are invariably flagged and inspected typically for reasons of protocol.[1] However, products and substances intended for innocent purposes can also

1. https://www.channelnewsasia.com/news/singapore/how-ica-weeds-out-illegal-mail-singpost-11962616

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be used for purposes that are not innocent. With radioactive isotopes, the types of radionuclides and their quantity or concentration become the issue that requires detection and identification of all of them that may be passing through a major international postal facility. A terrorist's dirty bomb isn't made from one small packet of an isotope intended for medical diagnostic instruments, but from a collection and concentration of certain classes of isotopes collected together in one place.

Dirty Bomb?

The US Nuclear Regulatory Commission defines a dirty bomb as a "type of Radiological Dispersal Device (RDD) that combines conventional explosives, such as dynamite, with radioactive material." Although most do not produce enough radiation to kill many people, an RDD explosion could engender a number of prolonged and unpredictable consequences, including mass hysteria, significant health risks – both physical and psychological – due to radiation exposure, property damage and economic repercussions, such as major cleanup costs.[2]

For this reason, everything radioactive passing through the Post Centre has to be checked out by ICA. This is accomplished using a hand-held portable analyzer, the Thermo Scientific™ RIIDEye™ X Handheld Radiation Isotope Identifier (RIID). It facilitates the scanning and checking of large bundles, pallets of products, or rooms full of goods for signs of unseen radioactive elements, using patented Quadratic Compression Conversion (QCC) technology. RIIDEyeX provides the industry's fastest, most accurate real-time gamma source and isotopic identifications, all presented in an easy-to-read, full-spectrum color-coded format.

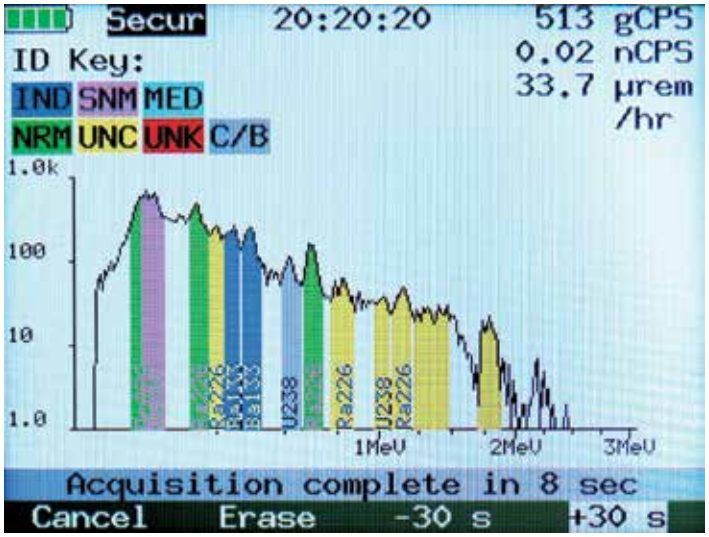
Special Nuclear Material (SNM)

One commonly found substance is Cesium-137, a soft, flexible, silvery-white metal that easily bonds with chlorides to create a crystalline powder. Cs-137 is used in small amounts for calibration of radiation-detection equipment, such as Geiger-Mueller counters. In larger amounts, Cs-137 is used in medical radiation therapy devices for treating cancer; in industrial devices to measure the thickness of materials, such as paper and sheet metal, photographs, and other uses. In addition to small quantities of such radioactive isotopes used in medicine and industry, inspectors are also seeking to identify radioactive material that, in consolidation, could be used by terrorists to make a dirty bomb. Isotopes that can pose such a threat are known as Special Nuclear Material (SNM) and include Plutonium, Uranium, and Neptunium (Pu, U, Np). When these isotopes are detected, 'red flags' are raised. That's why it's critical to know the exact isotope of the radioactive material in order to assess the potential threat and quickly initiate a plan of action. Every isotope has its own signature 'spectrum' that is detected and displayed on the RIID. Officers can quickly scan the suspected material with the RIIDEyeX, which analyzes its acquired ID spectrum in real time, and automatically displays the optimum scan time to accurately detect the presence of Special Nuclear Material (SNM).

The U.S. Nuclear Regulatory Commission (NRC) divides SNM into three main categories, according to the risk and potential for its direct use in a clandestine fissile explosive or for its use in the production of nuclear material for use in a fissile explosive. These categories are the following:

1. Strategic SNM (SSNM)
2. SNM of moderate strategic significance
3. SNM of low strategic significance

In each of these categories, SNM is expressed in terms of 'Formula quantity', which is basically a matter of volume of material and combinations thereof. The more of the material you have, the more dangerous the potential outcome. A Formula quantity means Strategic Special nuclear material, in any combination, in a quantity of 5000 grams or more computed by the formula, grams = (grams contained U-235) + 2.5 (grams U-233 + grams plutonium). For example, Category 2 materials are considered by The International Atomic Energy Agency (IAEA) as being able to cause permanent injury or even death in a person who comes in contact with it.



The RIIDEyeX operator can view the real-time spectra build of isotopes present in the environment as the identification scan is in process. Isotopes are color coded to visually alert the operator to the presence of benign, threatening or unknown sources and indicates the moment an accurate identification is made.

The RIIDEyeX isotope identifier enables the officer to view the real-time spectra build of isotopes present in the environment (e.g., warehouse, shipping container, pallet) as the identification scan is in process. Isotopes are color coded to visually alert the operator to the presence of isotopes and indicates the moment an accurate identification is made. To be the most effective, these detectors must be capable of not only determining that radiological material is present, but also what material it is. In this manner, then, an inspector can gauge whether or not the material is of low significance, or if the package needs to be opened and examined.

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As Amanda Vicinanzo writes in *Homeland Security Today*, "Overall, radiation detectors need to become standard protocol in places where radiological material can be easily accessed… (because) The ingredients for a radioactive dirty bomb are in tens of thousands of radiological sources located in more than 100 countries around the world. They are used in medicine and science at hospitals, universities and research centers. They are used in agriculture, in industry and by governments for various purposes. And in all these settings, they are too often poorly secured and vulnerable to theft and sale on the black market."

"US intelligence officials and lawmakers believe it is only a matter of time before a terrorist organization attempts to use chemical, biological, radiological or nuclear weapons. Alarmingly, malicious actors do not need to go abroad to access the radiological material necessary to develop a dirty bomb. There is widespread availability of highly dangerous isotopes, including cesium-137 and cobalt-60, in the United States, and most of the sources of these materials are not secure."

More than ever, the tough, durable, lightweight, portable RIIDEye isotope identifier is needed at such mail and transport hubs around the world because it is a fast and accurate way to not only detect the presence of radionuclide materials hidden or obscured in packaging, but just as importantly, identify what the substance is. That identification goes a long way toward saving time and preventing wasted time and unnecessary alarm, and also of preventing the misdirection of fissionable material to malicious purposes.

2 Vicinanzo, Amanda, 'Radiological Risks Demand Greater Focus and Scrutiny,' August/September 2016 | *Homeland Security Today Magazine*

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Handheld Radiation Isotope Identifier

Find out more at **thermofisher.com/riideyeX**

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