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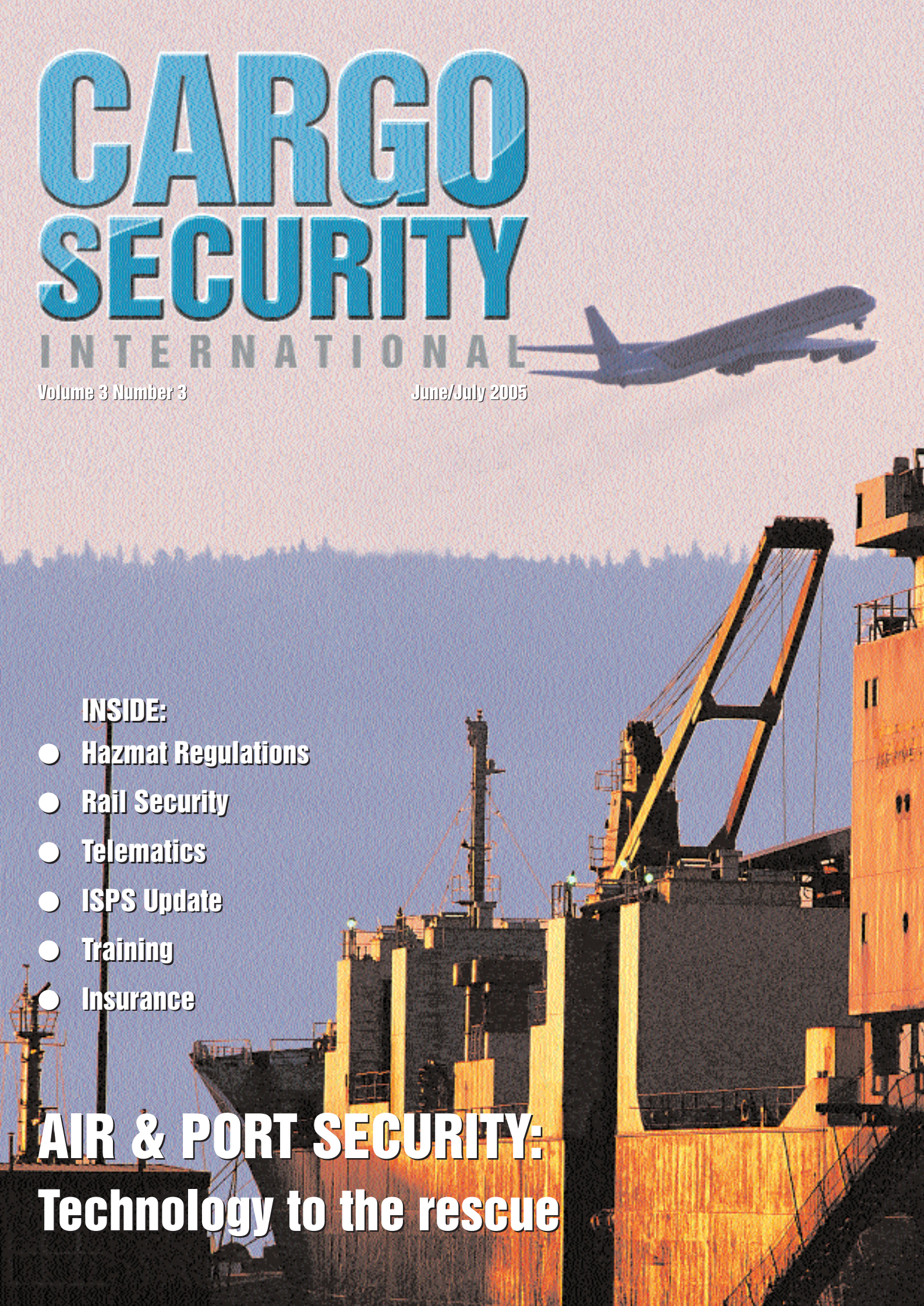

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AIR & PORT SECURITY:
Technology to the rescue

What's in the box?

Robert Ledoux of Passport Systems presents a new solution for cargo security

Do you remember the classic shell game where a magician hides a pea under a shell and then moves the shell around rapidly with two empty shells trying to confuse the on-looker from finding the pea?

At the world's borders, a far more dangerous shell game is being played every day. Thousands of sea, air and land-based cargo containers arrive daily in Europe, the US and the Far East. How do we detect which ones may be used by terrorists to conceal and deliver weapons of mass destruction? It needs to be more than a guessing game. We are faced with the urgent need to devise a technology that can look inside those containers and identify the threats before they can cause harm.

Have you ever passed your luggage through an airport security x-ray machine and watched the operator struggle to guess what is inside your suitcase? A conveyor belt moves the luggage through the x-ray machine; the operator peers into a monitor, then backs up the conveyor belt and runs it through again. Often, he cannot tell whether that hair dryer is a weapon, or if that powdery substance is an explosive, so you are asked to open your bag. Even when they open it, security personnel cannot readily identify most substances except obvious weapons or contraband. Can you imagine a more stressful and thankless job than trying to determine if one of the thousands of images passing across your display might provide the means to overpower a crew or blow up a commercial jetliner?

Multiply the complexity of that task a hundred times by passing a forty-foot cargo container jammed with electronic devices, frozen fish, engine blocks or toy guns through an x-ray's path. How can a human being or an artificially intelligent computer see through inches of steel and clutter to distinguish harmless shapes from lethal ones, particularly if the sender wants to camouflage the contents? The answer is, it can't be done very well using current scanning technology.

There are millions of cargo containers in circulation in the world at any given moment. The enormous assortment of goods contained in these containers forms an essential component of global trade. The livelihoods of a significant fraction of the world's population depend on the containers' free and efficient movement. Yet, up to now, no reliable means to non-intrusively determine the contents of these containers without impeding the flow of commerce has existed. It is sobering to consider that 17,000 containers enter US ports alone each day, but only a few hundred are actually inspected.

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The US 9/11 Commission Report had this ominous warning, 'While commercial aviation remains a possible target, terrorists may turn their attention to other modes. Opportunities to do harm are as great or perhaps greater, in maritime or surface transportation. Initiatives to secure shipping containers have just begun.'

In the absence of a comprehensive solution, international container security programmes, such as the **US Customs and Border Protection Agency's (CBP)** Container Security Initiative (CSI), have attempted to ensure security through a layered approach. The method relies on intelligence, certification of shippers, improved container and manifest tracking, and non-intrusive and intrusive inspection using existing generation cargo screening equipment. This inspection equipment includes portable and portal radiation monitors, x-ray scanners and chemical sniffers, to name a few. However, layered

Dr Robert Ledoux serves as CEO and Director of Passport Systems, which he co-founded in December 2002 to commercialise nuclear resonance fluorescence imaging technology (NRFI) for use in cargo security. Dr Ledoux was Associate Professor of Physics at the Massachusetts Institute of Technology (MIT) until 1990. He subsequently founded RSA (medical instruments), where he managed the company from start-up to profitability, developing and bringing to market high technology products, including the XKnife therapeutic radiation therapy system. Most recently, as Vice President of Pyramid Technical Consultants, he developed control algorithms and hardware used in semiconductor manufacturing equipment.

inspection has serious detection limitations: long scan times, multiple inspection locations and unacceptably high-rates of false threat alerts. For these reasons only a small percentage of cargo containers are scanned.

Fortunately, there is a solution to this problem on the horizon. A scanning technology based on nuclear resonance fluoresce imaging (NRFI), is currently being developed by **Passport Systems, Inc.** along with the **US Department of Homeland Security** (**DHS**). NRFI technology, patented by the **Massachusetts Institute of Technology** (**MIT**), can detect a wide range of weapons and contraband including fissile material, high-energy explosives, chemical agents and radioactive materials. By using deeply penetrating photons and detectors, it can determine the elemental content of the cargo – literally, what the cargo is made of. Because it relies on elemental information to determine the contents of the cargo, if dangerous materials are present, it can recognise them automatically by comparing their chemical characteristics against a known database. There is no need for an operator to try to interpret images. It is difficult to disguise or hide contraband material because detection using NRFI is based not on how the object 'looks' as in a standard x-ray, but rather on what it is made of.

The scanner is expected to have high detection probability for contraband while maintaining low false alarm rates. Both of these capabilities are essential since high detection probability with high false alarm rates necessitates opening an unacceptable number of containers, significantly increasing the cost of inspection and backing up the flow of goods.

This new technology has been proven in large-scale laboratory experiments. A full-scale prototype using commercial off-the-shelf components is presently being designed to test multiple container freight scenarios in a contract funded by the US DHS's **Agency Advanced Projects Research**. Its design allows an average density 40-foot cargo container to be scanned in approximately 30 seconds with the result of the scan being immediately available. It is anticipated that the prototype will be ready for field tests in less than two years. Important engineering challenges remain to be worked out to make this new technology robust and reliable in a wide range of operating conditions, but the prospects for a significant breakthrough in scanner technology are real. The scanner does not produce any residual radiation, but just as with existing high-energy x-ray scanners, there are special regulations that govern the use of ionizing radiation.

'NRFI can even distinguish between uranium isotopes commonly used for various medical purposes and weapons grade uranium – without opening the box'

The impact of this technology on container security will be dramatic. It offers the possibility of screening a much larger proportion of containers than is being done at present, for a wide range of threats and all in one scanner.

The international freight transfer system has made enormous strides since World War II. The ability to pick up, carry, track and deliver goods, rapidly, almost anywhere in the world, is unparalleled in human history. Some pundits have even suggested it would be far more efficient and dramatically less costly for a rogue state to deliver a nuclear device to Chicago by merely calling a freight forwarder rather than launching a missile.

To date, the airline industry, freight forwarders and commercial freight carriers have resisted efforts to mandate 100% inspection of air, land and sea cargo. They have resisted, not because they are obstructionists, but because they know that the means to do so in an accurate and timely manner has not existed. It may sound appealing, but 100% inspection using only today's x-ray technology would bring the system to its knees. Yet, in the circumstance of a catastrophic event introduced through the freight system, their industry would suffer disproportionately. A nuclear or chemical device detonated in the supply chain would cause an immediate shutdown of the system and would have hugely negative economic consequences to their business. Now, with a technology that permits rapid, automatic (no human operator required), non-intrusive inspection with very high accuracy, approaching 100% inspection will be possible and the shipping industry is rethinking its position.

NRFI technology may not be able to tell whether the running shoes stored in a container are **Adidas** or **Nike**, but it will be able to tell if the soles are lined with high-energy explosives. It can even distinguish between uranium isotopes commonly used for various medical purposes and weapons grade uranium that has only one purpose – all this without opening the box.

At present, with the x-ray scanning systems deployed at airports and seaports throughout the world, there is not a reliable means to answer the question, 'What's in the box?' However, NRFI technology may facilitate the transformation of the international freight inspection business. Rather than impeding the flow of commerce, elemental detection increases the security and reliability of inspections. A relatively obscure branch of nuclear physics may soon enable customs authorities and security officials to protect us from potential threats hiding within the 'Trojan Horse' of modern international commerce, the ubiquitous steel cargo container.

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