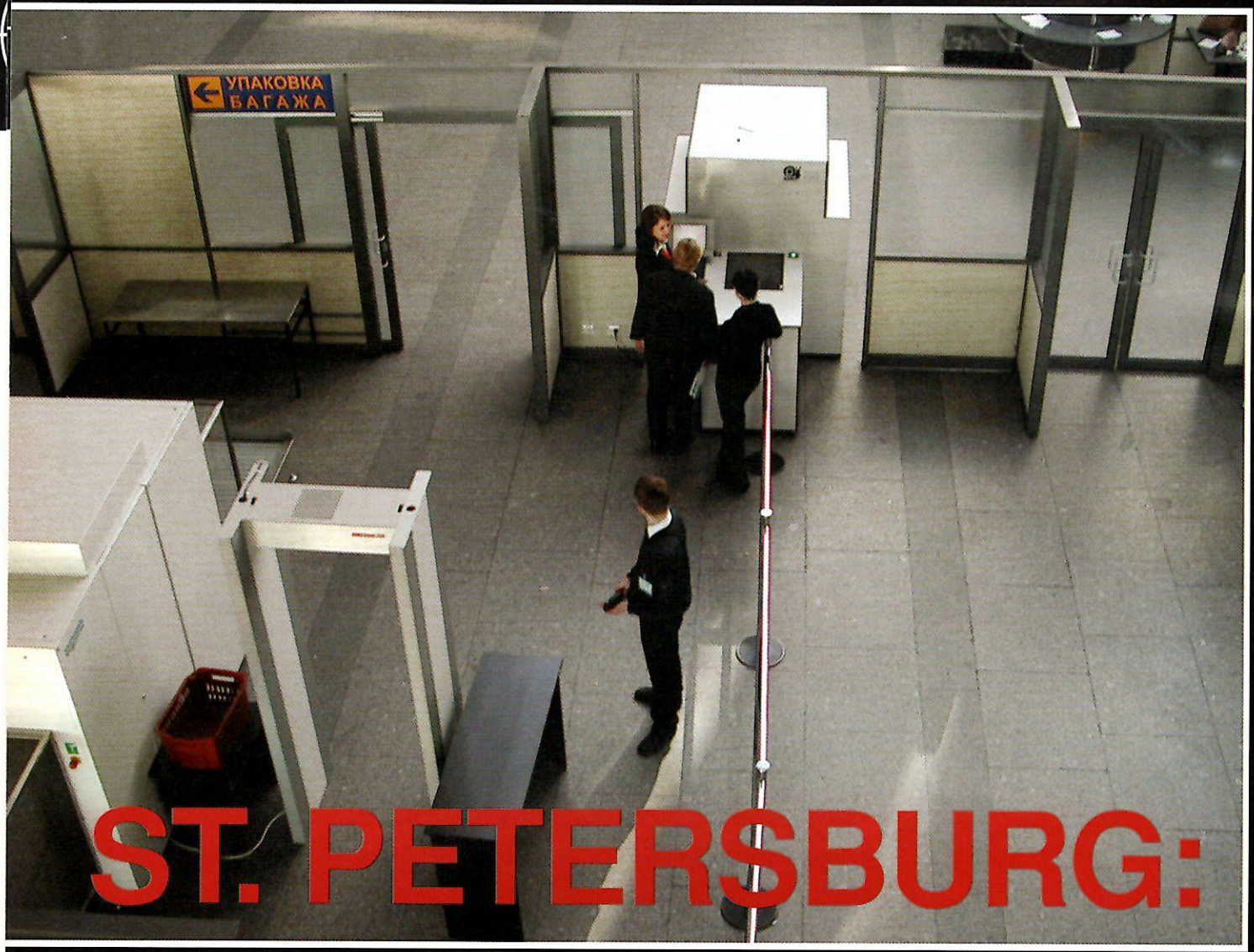

ST. PETERSBURG:

LEADING THE WAY IN THERMAL NEUTRON ANALYSIS

Russia may not be where one first turns ones attention to when considering emerging security technologies, yet as **Philip Baum** discovers, perhaps we have had blinkered vision. For, in St. Petersburg's Pulkovo Airport, together with 100% inspection of check-in and carry-on baggage, Thermal Neutron Analysis (TNA) explosive detection systems are now part and parcel of the security infrastructure.

Pulkovo is the main airport of the second largest city in Russia – St. Petersburg, known as Leningrad in Soviet times. It is considered by many to be the cultural capital of Russia to this day.

In 1932 the "Izvestija" newspaper announced that, "On June 24, the first two planes with passengers and mail from Moscow landed on the landing ground of Leningrad airport. The planes took off from Moscow aerodrome at 2 a.m. and landed in Leningrad – one at 5:31 a.m. and the other one 10 minutes later". The air bridge had opened between Russia's old and the new capital.

Construction actually began in 1931, yet before the airport had even been completed, two airlines were operating to Leningrad (as it was then). Now, some 70 years on, the airport, a Pulkovo Aviation Enterprise, is not only one of the most modern airports in Russia but is also one of the biggest commercial entities in the country too.

Pulkovo has two terminals: Pulkovo-1 used mainly for domestic flights, in particular to the North Caucasus region, and Pulkovo-2 is used exclusively for international flights.

Pulkovo Aviation Enterprise includes the airport and the home-based airline. Pulkovo air routes stretch from the Atlantic to the Pacific Ocean and service over 80 cities around the globe. During the last five years, the St. Petersburg carrier has been one of the leaders of "Wings of Russia" competition. Due to the results of its operation in 2001, Pulkovo Aviation Enterprise was voted "Best Aviation Company of the Year: Passenger Carrier of International Lines". In August 2001, Pulkovo made one more important step in its development and became a full member of IATA.

Security Concerns

In recent years, terrorism has reared its ugly head in Russia's main cities and public transport has been targeted. Whilst the rest of the world may focus on the fall-out of 11 September attacks, Russia has been fighting its own war against Chechen suicidal terrorism.

October 2002: Chechen rebels seize a Moscow theatre and held about 800 people hostage in a three-day siege. Most of the rebels and around 120 hostages were killed when Russian forces used gas to storm the building.

27 December 2002:
A suicide attack destroys the Grozny headquarters of Chechnya's Moscow-backed government, killing 72 people.

12 May 2003:
A truck loaded with explosives kills more than 50 in a suicide attack on a government building in northern Chechnya.

14 May 2003:
An attack at a Muslim religious ceremony in Chechnya, in which two female suicide bombers apparently tried to assassinate Chechnya's pro-Moscow leader Akhmad Kadyrov, killing 18.

5 June 2003:
A female suicide attacker detonates a bomb near a bus carrying soldiers and civilians to a military airfield in Mozdok, a major staging point for Russian troops in Chechnya, killing at least 16 people.

5 July 2003:
Two female suicide bombers kill 14 people at an open-air rock festival near Moscow. 60 people are injured, and a 15th victim dies later.

1 August 2003:
50 people, including Russian soldiers wounded in Chechnya, are killed in a truck-bomb attack on a military hospital in Mozdok, North Ossetia.

3 September 2003:
Two bombs explode under a commuter train in southern Russia, killing at least five people and wounding 30 others. The bomb was planted on the railway between Kislovodsk and Mineralnye Vodi.

5 December 2003:
A suicide bomber kills 44 in an attack on a train during the rush-hour near Yessentuky (on the same route as above). More than 150 are injured.

9 December 2003:
A female suicide bomber blows herself up outside the National Hotel near Red Square and the Kremlin in Moscow, killing at least five people and injuring 22.

Left to Right:
Dr. Yury I. Olshansky (Director, RATEC), Evgeny A. Stepanov (Deputy Director, Aviation Security, Aviation Enterprise Pulkovo), and Andrey B. Vishnevkin (Deputy Director Development, RATEC).

6 February 2004:
A suicide attack during the rush-hour on a busy underground train in Moscow kills 39 and injures more than 100 people.

Russian Avsec

Whilst aviation has not to date been the target, the authorities are taking no chances. Russian Federation laws prescribe rigid security requirements to the pre-flight inspection of passengers, aircrew, ground-handling personnel, carry-on and checked baggage, mail, cargo and catering. According to these requirements each airport has to effect 100% pre-flight inspection of passenger baggage for the purpose of detection of forbidden objects and substances. This has led, as elsewhere in the world, to significant changes in the processing of bags for inspection; many airports of the former Soviet Union had been built long before the need for such requirements had been contemplated.

Granted the nature of the threat, special attention has been paid to the detection of bulk explosives, irrespective of their type, form and masking. For this purpose it was decided to take a range of administrative and technical measures.

First of all it was decided that all baggage (check-in and carry-on) screening would take place prior to check-in. This allows the inspection of baggage in the passenger's presence; if something suspicious is found in the baggage, the "threat" can be resolved on the spot.

The actual inspection of baggage was split into two phases. In the first phase the operator, using X-ray, conducts a standard inspection of baggage. If suspicious objects, similar in density to explosives, are identified, then this baggage is sent to the second phase of inspection. In the second phase Thermal Neutron Analysis (TNA) is used.

Thermal Neutron Analysis

In both Russia and the United States, over the past 15 years, there have been attempts to develop systems for the detection of explosives in passengers' baggage on the basis of TNA. The aim is that explosives be identified through registration of the gamma radiation of nitrogen nuclei under irradiation by thermal neutrons; explosives, especially plastic explosives, are characterised by high nitrogen content.

To date these attempts have not resulted in the development of a system practical for use in the inspection of passengers' baggage. The problem has been that there are considerable amounts of nitrogen in bags that are not related to explosives and this has led to an unacceptable number of false alarms.

Reliance on X-ray alone, in the Russian view, is also unacceptable. They recognise that X-ray units are aimed at registration of differences in substance density, but that the technology does not enable the detection of camouflaged explosives, especially plastic sheet explosives. Aviation security specialists generally agree that the success in the detection of such explosives can only be achieved only through a combination of different technologies.

In Pulkovo airport this combination is X-ray and TNA. It is important to note that TNA enables penetration into the structure of substances and, with the help of non-invasive analysis, the detection of the presence, or absence, of explosives with a high degree of probability.

The system in use in Pulkovo-1 is the EDS-5101, developed by specialists at the Scientific Technical Centre RATEC Ltd, which also happens to be based in St. Petersburg.

The EDS-5101

The EDS-5101 uses target designation of a suspicious area of a bag, as determined by the X-ray operator. This means that only the area of the bag where explosives were suspected is analysed, thereby resolving the high false alarm rate problem alluded to earlier in respect of TNA technology.

In addition, new improved algorithms, based on the latest developments in physics and mathematical statistics, enable the separation of nitrogen not related to explosives from nitrogen contained within explosives. This further decreases the number of false alarms significantly.

The likelihood of the presence of suspicious objects in check-in and carry-on baggage is estimated at between 20 and 25%, that is every fourth or fifth bag. The time allocated to the inspection of one piece of check-in (or carry-on) baggage in an X-ray unit is about 5 to 7 seconds, whilst the time taken for the inspection of suspicious check-in (or carry-on) baggage with EDS-5101 is about 12 to 17 seconds. Thus, one explosive detection system can serve from two to four usual X-ray units and check carry-on and checked baggage for the presence of explosives without interrupting passenger flow.

The EDS-5101 can be used for checking personal computers, cameras and mobile phones, where explosives can be concealed and it has a function whereby an entire item of carry-on baggage can be inspected; in this case, the EDS-5101 works without target designation, but with special algorithms neutralising the influence of nitrogen not related to explosives so that it does not affect the final result. The results require no operator analysis; the bag or item is either cleared or not.

The previous model of RATEC's explosives detection system was tested in the United States, at the Livermore National Laboratory, by specialists from the Transport Security Administration (USA). It received positive assessment both in respect of operating capability and in respect of safety. As the testing was carried out without X-ray, it was

Above: Pulkovo, the airline.

recommended to conduct repeated trials with an X-ray unit. For comparison, RATEC say that the level of radiation on the surface of the EDS is practically the same as the natural background in the airport owing to the use of special protective material for the casing. The system received a certificate of the Sanitary Inspection (the Russian requirements in respect of radiation safety that conform to international standards). The system can work with two types of neutron sources: a neutron generator or californium isotope Cf-252.

Explosives detection system EDS-5101 has successfully passed the tests and received a certificate of the Aviation Security Department of the Transportation Ministry of Russia. Indeed, a special decree of the Transportation Ministry of Russia recommends the use of EDS-5101 in airports.

The Pulkovo Experience

The first system EDS-5101 was installed in the check-in of Pulkovo-1 terminal in spring 2003. The choice of this particular terminal was determined by several factors.

Firstly, Pulkovo-1 serves flights heading in a southerly direction, including the North Caucasus region; given the threat, these flights are considered higher risk.

Secondly, last summer St. Petersburg celebrated its 300th anniversary. An international summit took place with many VIP guests invited, including 45 Heads of State. Pulkovo-1 was the only terminal used for visiting delegations; at its peak, every 40 seconds another governmental flight landed! Perhaps not surprisingly, unprecedented security measures were taken in the airport....including the deployment of the EDS-5101.

According to Alexander Golovin, the Deputy General Director of Aviation Security of Airline "Pulkovo", they plan to install a system in Pulkovo-2 terminal in the near future. Sheremetyevo Airport in Moscow has also demonstrated interest in the Pulkovo experience. Indeed, according to Ruslan Fadeyev, Deputy General Director of Aviation Security at Sheremetyevo, the use of TNA explosives detection systems for additional inspection of suspicious baggage is definitely promising and in 2004 Sheremetyevo plans to launch their first inspection line with the EDS-5101.

RATEC

RATEC is currently negotiating serial production of their EDS systems with western manufacturers of inspection systems. As Director of RATEC Dr. Yury Olshansky said, 'We are ready to ensure the maximum level of security possible in airport security screening. These are not simply words and the results of laboratory research. Our system has been tested by life and it works!'

Furthermore, RATEC plans to develop a fully automatic combined-technology solution, whereby X-ray and TNA solutions are provided in a single system.

RATEC, apart from the development of explosives detection systems, performs research in different areas, such as

Top: St.Petersburg Pulkovo airport Above: RATEC's TNA technology in active use in the terminal building

radiation monitoring and the development of portal monitors for detection of radioactive and fissionable materials. RATEC was the only commercial organisation that participated in the operation of salvaging the "Kursk" nuclear submarine. In that operation RATEC performed full radiation monitoring during the raising and transportation of the submarine.

Pulkovo Security

Security technologies are only as good as those that operate them. In Pulkovo, screeners are employees of the airport, nearly all of whom are trained on the use of TNA technology.

In Soviet times Heimann almost had a monopoly on X-ray installations at the airports of the U.S.S.R., yet now all the major players have a presence in this huge market. St. Petersburg now uses Rapiscan X-ray machines for primary screening. Metorex archway metal detectors are used for the screening of the passengers themselves.

Albeit a responsibility of the Customs authorities, one of the other technologies used to screen all persons entering restricted areas of Russian airports is that of radiation detection. The Scientific Production Center ASPECT, established"in July 1991 is, together with RATEC, a primary supplier of such equipment.

Yantar is ASPECT's system for the detection of fissionable, nuclear and radioactive materials in the course of the continuous automatic monitoring of vehicles, trains, passengers and luggage at numerous installations around the country. Passengers, after baggage reclaim, are screened on arrival and passengers and staff are screened as they enter the customs area on departure, such is the concern as to the potential of nuclear products being transported illegally since the break up of the Soviet Union.

Russia also boasts its own explosive vapour detection manufacturer. The Shelf-DS is one of the company's products and is used in St. Petersburg for the analysis of unattended baggage.

Conclusion

Whilst most readers may contemplate a visit to St. Petersburg in order to see some of the three million treasures housed in The Hermitage's galleries, experience the beauty of the Kirov ballet, wonder at the splendour of the Russian Orthodox churches or taste the Baltic delicacies, all of which I strongly recommend, perhaps the industry should consider its gateway airport to be of equal significance.

TNA is often branded an "emerging technology", yet in Pulkovo it is already a reality. It's not part of a trial. It's not an experiment. It's up and running. And when a country, like Russia, has had so many painful recent experiences of terrorist atrocities, many of which have been suicidal in nature, we would be foolish but to learn from their experience. ■