USE OF X-RAY BODY SCANNER EQUIPMENT IN THE UK AND MATTERS TO CONSIDER TO KEEP DOSES ALARA

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Introduction

X-rays have been used for many years to screen baggage and postal items for illicit materials. In the last 15 years larger versions of this type of technology have been developed to screen vehicles. However within the last 10 years, there has been the introduction in the UK of x-ray transmission and backscatter devices to screen people, in particular those travelling through airports.

There has been significant interest in this technology by security agencies for use in penal establishments, police raids on suspected drug suppliers, customs examination of suspected smugglers and to enhance airport pre-flight security.

In parallel to this there has been much interest by the press in the use of this technology. On balance the privacy issue of “strip searching” a passenger, thereby exposing matters of a personal nature, appears to be of more public concern than the radiological hazard.

Use of X-Ray Body Scanners at Airports

Exposed Persons

At an airport, there are two categories of passengers who may be selected for x-ray examination;

A Passengers about to fly and transiting through security who, through profiling, may pose a greater risk (to the flight), and

B Passengers who have landed and leaving the airport through customs control who, through intelligence or profiling, may be carrying illicit materials (narcotics, gemstones or similar) concealed on them, ie smugglers.

Examination of category A passengers is concerned with items that may be used for terrorist or criminal activity on the flight (fire arms, explosives, knives and similar) and many passengers may be requested to undergo such screening using backscattered x-rays. This differs from Category B passengers since the examinations, using transmission x-ray systems, (carried out by custom officers) are concerned with narcotics and other illicit materials that may be brought into the country and involve fewer persons than the previous category.

The use of transmission x-ray systems gives rise to greater dose (up to 5 μSv/ examination) than backscatter x-ray systems (typically up to 100 nSv/

complete examination). There is some further justification for the screening of suspected smugglers, since the item(s) swallowed might give rise to significant health effects in the event containment is breached, eg drugs overdose.

Regulations and Standards

The European Union Council Directive 96/29/Euratom (known as the Basic Safety Standards Directive) laid down the basic safety standards for the protection of the health of workers and the public against the risks arising from ionising radiation. The justification of practices utilising sources of ionising radiations was included within this Directive and implemented within the UK by the Justification of Practices Involving Ionising Radiation Regulations 2004[1]. The guidance to these regulations lists a number of existing practices prior to 13 May 2000 which do not explicitly require to be justified. X-ray backscatter security equipment was in use prior to May 2000 and hence accepted as an existing practice. Dose to screened passengers is much less than those screened by transmission systems but more people could be selected for this type of screening.

The first radiological review of an x-ray backscatter device by HPA's Radiation Protection Division (then the National Radiological Protection Board [NRPB]) was made in 1999. Further assessments have since been made of similar equipment. The principal legislation covering the use of this equipment is the Ionising Radiations Regulations 1999[2]. This covers occupational exposure in the workplace but does not provide much guidance for public exposure. Consideration of dose constraints for comforters and carers is raised in the regulations as is the NRPB recommendation on a public dose constraint from a single practice (see next paragraph) but there is no guidance covering the deliberate exposure of the public for non-medical purposes.

NRPB[3], in its response to ICRP publication 60, made the recommendation that there should be a public dose constraint of 0.3 mSv/y from a controlled source, with advice on further optimisation below this figure if this was readily achievable. It was felt appropriate to use this figure to determine if foreseeable annual doses were optimised from backscatter x-ray equipment, ie up to 5000 examinations per year would be required to give rise to 0.3 mSv. Even frequent flyers were unlikely to be scanned this often. However it was also noted that passengers were unlikely to be examined two hundred times a year hence the annual effective dose would be less than 20 μSv, the value below which further optimisation may not be appropriate.

Based on the low dose received from the examination (comprising of three scans), no recommendations were made to restrict passengers who may be scanned, eg children, pregnant women etc. A dose of 100 nSv per examination was comparable to the background dose rate of 30 - 60 nSv/h for the area and significantly less than the 5000 nSv/h exposure during the flight.

Since 1999 when HPA first reviewed the radiological safety of x-ray backscatter equipment, a relevant USA standard (ANSI N43.17[4]) was

published in 2002 and a draft IEC standard has been produced for comment (draft IEC 62463[5]) concerned with the specification of x-ray systems for the screening of persons for security.

In recent years, a number of organisations have indicated a desire to use transmission x-ray systems for scanning persons entering airport, prison or other secure facilities, extending the use beyond the examination of suspected smugglers on entry to the country. Since this is considered a new practice, anyone wishing to introduce this practice in the UK would need to submit a justification[1] case through the relevant authority. The dose per scan from transmission x-rays is higher than backscatter equipment. If used frequently then this could give rise to exposures greater than 0.3 mSv (approximately 60 scans), the constraint used up to this point.

Restriction of Exposure

Restriction of exposure from this practice focuses on three areas

1 Optimisation of operating parameters to provide an acceptable image with minimum dose,

2 Criteria to select those scanned, and

3 The use of other non-ionising technologies to avoid ionising radiation exposures.

1 Optimisation of operating parameters

Improvements in imaging technology and a reduction in the kV and particularly mA can have a significant impact on dose reduction. The security criteria will determine what image quality is acceptable but the radiation protection professional can still seek optimisation of the operating parameters so that the minimum dose is received for an acceptable image to be produced.

One point worth taking into account is the setting up of these systems. Without an adequate test tool, there is a risk that the engineer will use himself/herself to test the system. Suppliers of this type of equipment should provide a suitable test tool to avoid this temptation!

2 Criteria for selection of persons to be scanned

Profiling of persons who may be selected to be scanned would hopefully minimise the numbers selected for this examination. However profiling is still likely to encompass large groups, eg prisoners entering a prison, passengers flying on high risk flights, persons arrested during police narcotics raids (to check for hidden needles) and so on. As a note on the potential wide scale use of this technology, one police force offered the use of an x-ray backscatter unit to a school which had had problems with its pupils carrying knives.

3 Use of non-ionising radiation to scan persons

There have been recent developments in the use of non-ionising technologies to replace backscatter x-ray systems and their use may be promulgated providing the relevant authorities are satisfied with their performance. However it is unlikely that transmission systems could be so easily replaced.

Whilst the radiation protection professional may have some influence over (1), the decision on who to scan and with what technology ultimately rests with the security professionals.

References

1 The Justification of Practices Involving Ionising Radiation Regulations 2004, Statutory Instrument 2004 No.1769, ISBN 0 11 049500 4

2 The Ionising Radiations Regulations 1999, Statutory Instrument 1999 No. 3232, ISBN 0 11 085614 7

3 Statement by the National Radiological Protection Board: 1990 Recommendations of the International Commission on Radiological Protection. Documents of the NRPB, Volume 4, No 1 1993 ISBN 0-85951-360-2

4 American National Standard ANSI 43.17-2002, “Radiation Safety for Personnel Security Screening Systems Using X-Rays”

5 Draft IEC 62463 Radiation protection instrumentation – X-ray systems for the screening of persons for security and the carrying of illicit items