Australian Government
Australian Radiation Protection and Nuclear Safety Agency

arpansa

Regulatory Guide

Human imaging for security screening purposes using ionising radiation -

Justification and optimisation of practices

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1. Introduction

Whenever a human activity causes an individual to be exposed to ionising radiation, the activity needs to be justified and optimised.

Radiation protection in Australia follows the principles of justification, optimisation and limitation as recommended by the International Commission on Radiological Protection (ICRP). The ICRP advises that when it is planned in advance to introduce a new activity requiring radiation protection and where actions can be taken on the source of the radiation to control exposure then the principle of justification applies.

The justification principle requires that no situation involving planned exposure should be introduced unless it can be demonstrated that sufficient net benefit is produced to the exposed individuals or to society to offset the radiation detriment it causes.

The overarching principles of justification and optimisation in relation to human imaging for security screening are contained in Annex I.

2. Scope

This guidance is applicable to the controlled use of ionising radiation in the security screening of humans for counter-terrorism and national security, by appropriate law enforcement, security or border protection authorities (applicants). It is intended for use by applicants seeking to justify the implementation of any proposed use of ionising radiation for human imaging for security screening and by Australian radiation regulators to determine whether the use of such imaging is justified for authorised use.

In addition to seeking advice from a radiation protection adviser, the applicant should seek advice from other professionals such as those involved in aviation security and matters of privacy.

The scope of this guide does not extend to the use of ionising radiation in screening humans for theft detection or anti-smuggling purposes.

3. Background

3.1. Screening technologies

Currently, there are two types of x-ray scanning systems available for security screening of humans, one type using radiation scattered back from an individual, the other type using radiation transmitted through an individual.

Backscatter x-ray systems use low energy x-rays that deposit most of their energy in the skin and underlying tissue, so they are useful for imaging objects hidden under clothing. These systems use a narrow beam of ionising radiation that scans the person at a high scanning speed where the source of ionising radiation and detectors are located in the same plane. The image is formed from the x-rays backscattered from within the body surface or other material present. The effective dose from such systems typically ranges from between 0.02 µSv and 0.1 µSv per scan.

Backscatter x-ray systems are sensitive to low atomic number elements, therefore they are particularly useful in the detection of light organic materials such as explosives and drugs. These systems cannot detect ingested objects, surgically concealed objects, or objects hidden in body cavities.

Transmission x-ray systems, similar to medical x-ray equipment, create an image by passing x-rays through the body to a detector on the other side of the body away from the x-ray source. This technique is used so that objects within the body may be visible. The effective dose from such systems is variable, and typically ranges from between 2 µSv and 5 µSv per scan.

Information about screening technologies which do not use ionising radiation can be found in Radiation and Health Fact Sheet *Airport Passenger Screening Technologies*, which is available from the ARPANSA website.

4. Policies and guidance

This guide reflects the current principles of radiation protection and recommendations in:

- The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Annals of the ICRP, 37 (2-4), 2007.

The following publications provide additional guidance on the specific considerations for the justification, optimisation and regulation of the use of ionising radiation for the screening of humans for security purposes:

- Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. IAEA, GSR Part 3, 2014
- ICRP Publication 125, Radiological Protection in Security Screening, 2014
- IAEA Safety Guide, Justification of Practices, Including Non-Medical Human Imaging. IAEA, GSG-5, 2014
- IAEA Safety Guide, Radiation Safety of X-Ray Generators and Other Radiation Sources Used for Inspection Purposes and Non-Medical Human Imaging, IAEA DS471 (Draft)
- NCRP Commentary No.16, Screening of Humans for Security Purposes Using Ionizing Radiation Scanning Systems, 2003
- ISCORS Technical Report 2008-1, Guidance for Security Screening of Humans Utilizing Ionizing Radiation, Interagency Steering Committee on Radiation Standards, 2008

Applicants and Australian radiation regulators may consider the guidance provided in the above publications during the justification, optimisation and authorisation process.

Until such time as an Australian standard or equivalent is published, the most relevant standard to be applied in the manufacture and operation of human security screening systems utilising ionising radiation is American National Standard ANSI/HPS N43.17-2009 Radiation Safety for Personnel Security Screening Using X-ray or Gamma Radiation.

5. Justification of practices and optimisation process

This section is intended to assist applicants in identifying matters to be included in a justification submission and Australian radiation regulators involved in assessing such submissions.

It is a fundamental principle of radiation protection that any new practice involving ionising radiation has to be evaluated to determine if the expected benefit of the practice offsets the potential risk of the radiation. In addition, the balance between benefit and risk should be optimised so that individuals are subjected to the lowest dose necessary to ensure an effective outcome.

It is important that any decision on the justification of a new practice and the need for subsequent optimisation of the radiation dose be made at an early stage in the process. In the context of justification of a specific form of ionising radiation screening technology it is important to understand these concepts and their implications before committing to a technology.

A formal justification process should be undertaken when considering the use of specific screening systems based on any ionising radiation imaging technology. The decision to authorise the use of each type of ionising radiation technology to security screen humans should be made by an appropriate authority.

The depth of detail and resources devoted to answering the questions in the following sections should be commensurate with the risks from the proposed screening technology.

5.1. Define the need

The process of justifying the use of ionising radiation begins in the initial stages of considering screening methodologies, even before ionising radiation has been identified as the preferred technology. Careful consideration of the specific security need will facilitate the quantification of the desired benefit of a security screening practice for the risk-benefit analysis.

There should be an attempt to assign some numerical descriptors to the expected consequences of not screening. When a threat is not readily quantifiable, a relative scale for the probability and severity of an event or threat may be adequate and may be all that is practicable. In this case, categories like Certain, Very Likely, Possible, Not Likely, or Never might be the appropriate level of detail and analysis. Following are some key questions to be answered:

- What are the threats?
- Who is the population affected by the threat? How are they affected?
- What is the probability that the threat will occur?
- What can happen, how likely is it, and what are the probable consequences?

Data should be provided in support of any estimation although not all threats may be easily quantifiable.

After quantifying the probability and consequences of a threat, the desired effect of the proposed security screening practice(s) should be considered. Some key questions are:

- What is driving the need for the screening?
- What are you attempting to detect?
- How can screening affect the probability of a threat?
- How can screening affect the consequences of a threat?

- How do false-positives affect the screening process? (For example, incorrectly identifying harmless items as threat objects may result in unwarranted delays or repeat screening)
- What is the acceptable false-positive rate?
- What is the acceptable success rate needed for each class of threat material or weapon in order for the screening to be worthwhile?
- What are the expected benefits and who benefits?

5.2 Evaluate Options

There are usually several options, each with its own advantages and disadvantages, that may meet the security need(s). The following questions will assist in narrowing down and categorising available options:

- Does the system do what you need it to do?
- Are there non-radiation or non-ionising radiation options? (For example, physical searches.) Are they practicable? If a non-ionising technology option exists that achieves equivalent screening outcomes to the ionising radiation technology under consideration then this non-ionising radiation option should be preferred.
- How well does the technology fulfil the defined need(s)?
- Other than radiation safety issues, are there undesirable consequences of the technology?
- Are there environmental factors?
    - Will the technology work in the intended environment? (For example, extreme heat, cold, humidity, etc.)
    - Will the technology impact the environment? (For example, hazardous materials, electromagnetic interference, noise, etc.)
- Does the option increase some risks while reducing others? (Consider other hazards such as electrical shock, moving parts, sharp edges, etc.)
- What guidelines, consensus standards, etc. exist to support this security screening technology? What are legal concerns/issues?
    - Liability
    - Perceived risks
    - Defence of justification
    - Impact of outsourcing on the Applicant's regulatory responsibilities.
- Are the available resources adequate for addressing associated legal, policy, statutory, and technology limitations?
- What information technology system(s) will be used for this technology and how will they be integrated?
- How will the technology be secured against unauthorised use?
- Is any other applicant successfully utilising the technology? Is their use similar or different? How? Why?

5.3 Privacy Concerns

The justification should consider privacy concerns of employing the security screening technology. Advice should be sought from the Office of the Privacy Commissioner or equivalent authority.

5.4 Radiation risks from the technology and the net benefit of implementation

After arriving at a list of possible options, the next step is to consider the radiation risks associated with each proposed technology. It is not the purpose of this document to provide a universal formula for deciding whether the benefits outweigh the risks. Each applicant should decide the method used for such analysis based on the particular situation. What is important is that the analysis is performed. There should be a review of the analysis by a suitably qualified independent external radiation protection adviser.
Some key questions to be answered in assessing the radiation risks are:

- What is the individual dose per scan to the person screened? To the operator?
- How many scans is an individual likely to receive in a given time period (for example, in one year)?
- What could be the total dose to an individual in one year?
- What are the potential acute and chronic risks to individuals undergoing screening with the selected technology?
- What are the risks to employees and bystanders?
- Who is affected by the technology? How are they affected?
- Do the benefits outweigh the risks?
- How do you effectively communicate the benefits and risks to the scanned population?
- What is the impact of communicating the benefits and risks to the scanned population? Exposure to radiation may cause fear and stress. Can adequate and easily understandable information be provided to alleviate concerns?

5.5 The applicant's ability to implement the practice

The costs and consequences of implementation should be considered. The applicant should be prepared to provide the necessary safeguards to guarantee a safe and effective screening operation. The justification should consider the implementation of a radiation protection program. The extent of the program will depend on the nature of the equipment and the scope of the screening operation(s).

The following questions will assist in evaluating the Applicant's ability to implement the practice.

Regulatory

- What are the applicable laws and regulations for the practice? (Commonwealth, State or Territory)
- Can the regulatory requirements be fulfilled on a continuing basis? (For example, licensing, registration, training requirements, maintenance, monitoring, routine tests, continuity of responsible individual, adequate and appropriate personnel resources.)

Operational

- What engineering safeguards are in place? (For example, are there safety interlocks? Are the operating parameters subject to operator error?)
- Are adequate resources available to implement the applicable provisions outlined in ANSI standard N43.17-2009?
- If operations are outsourced, are adequate resources available for oversight of the contractor?
- Is a procedure in place that assures an operating environment appropriate for safe use of the equipment?
- Are detailed responsibilities clearly identified and assigned for all aspects of the security screening practice (For example: operations, maintenance, training, budgeting, etc.).

- Are there adequate resources available to provide controls over stored images for the purpose of privacy or evidence collection?
- How will screened individuals be informed of the radiation dose and associated risks?
- Is consent necessary? What kind of consent will be obtained? Will consent be sought or implied?
- Are there adequate resources available to address any privacy issues? (For example: Who will see the images? How will the images be controlled?)

Training

- What expertise is required to ensure all operational requirements are met? (For example: system operation, safety, image interpretation, etc.) What training is needed to attain and maintain that expertise? *Note: This includes training of management and operational personnel*.
- Are there adequate resources available to ensure that the required training is provided?
- If the security screening is to be outsourced, how will training be appropriately addressed? (For example: How will appropriate training and expertise be ensured?)
- Does the training adequately address risk communication and image control for operators and management?

5.6 Concluding statement

The overall benefit must outweigh the risks associated with the proposed screening method. The following elements should be appropriately considered and documented:

1. The security need should be defined including the magnitude of the threat and the risk of not implementing the proposed security screening technology.
2. The various options should be considered, including their effectiveness and their limitations.
3. If a non-ionising technology option exists that achieves equivalent screening outcomes to the ionising radiation technology under consideration then this non-ionising radiation option should be preferred.
4. The technologies should have been evaluated based on the expected reduction of the threat as weighed against the risks associated with the screening technology and social or legal implications. (Risks evaluated should include electrical shock, physical hazards, radiation exposures, environmental factors and any other associated risks).
5. The availability of sufficient resources and the ability to implement the proposed screening method, including an initial plan for instituting the necessary programs and allocating resources.
6. There should be a documented commitment for periodic reassessment of the justification and optimization processes for the practice chosen and for ongoing conformity assessment of the systems adopted.

Annex 1
Justification and optimisation principles
Human imaging for security screening purposes using ionising radiation

Background

Screening to reveal objects concealed under clothing or in body cavities falls under the category 'non-medical imaging'. The use of ionising radiation for this purpose by a Commonwealth entity or Commonwealth contractor is subject to the requirements of the *Australian Radiation Protection and Nuclear Safety Act 1998* (the Act) and will be subject to mandatory licensing by ARPANSA. The use of ionising radiation for human imaging for security screening by any other entity is subject to the laws of the State or Territory in which the use is proposed.

Principles

Justification

Any use of ionising radiation for human imaging for the detection of concealed objects which can be used for terrorism or pose a national security threat requires that the use be justified. This would include use of ionising radiation in security screening of airline passengers for the purpose of revealing objects concealed under clothing.

Under these circumstances, the use of ionising radiation for the above purposes may be considered justified, provided the use of ionising radiation demonstrably does more good than harm. The justification process shall consider, *inter alia*

- benefits and detriments of implementing the type of imaging procedure
- benefits and detriments of not implementing the type of imaging procedure
- any legal or ethical issues associated with the introduction of the type of imaging procedure
- effectiveness and suitability of the proposed type of imaging procedure including the appropriateness of the radiation equipment for the proposed use
- availability of sufficient resources to safely conduct the imaging procedure throughout the intended period of the practice

The use of ionising radiation for the purpose of imaging humans for the detection of concealed objects for theft detection purposes is not justified.

Optimisation

If use of ionising radiation for human imaging for security screening is deemed justified, exposures shall be maintained as low as reasonably achievable, according to the protocols applicable to planned exposure situations.

The optimisation shall consider, *inter alia*

- measures to reduce exposure of those individuals subjected to screening, as well as to reduce the number of screened individuals,
- measures to reduce and monitor exposure of staff,

- analysis of the possibility or need to exclude certain individuals, e.g. pregnant women, children, or individuals with contraindications of any sort,
- the training and competence of staff operating the screening technology,
- the establishment of procedures and maintenance of relevant documentation, and
- safety of the operations including analysis of the ways in which the operation of the screening technology may fail leading to potential exposures, and the consequence of such failures.