ICRP 125?

Radiological Protection in Security Screening

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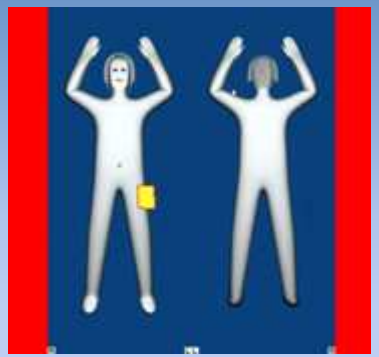
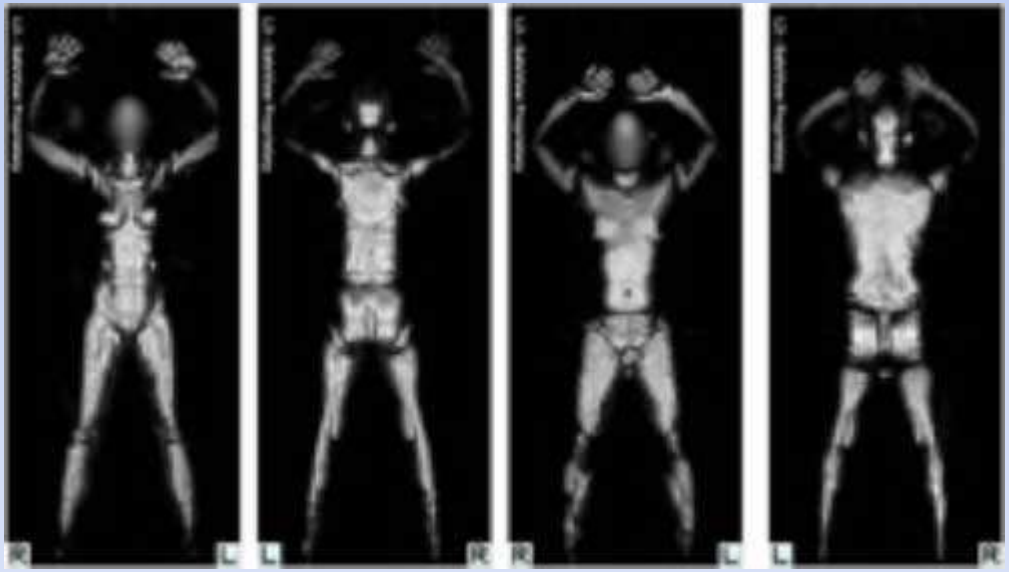
Security Scans





Two Types of Scanners

- Backscatter technology
  - These systems use a narrow beam that scans the subject in a high speed raster pattern, with large detectors on the same side of the subject as the x-ray source
  - 0.1 μSv per image of the front of the body
  - the exposure distribution with depth in tissue may be predominately to the skin
- Transmission technology
  - These systems pass ionizing radiation through the subject to a detector on the opposite side of the subject.
  - The radiation may be machine-generated x-rays or gamma-emitting radioactive isotopes
  - 2 to 5 μSv or more, depending upon the equipment
  - Transmission systems are also used to screen cargo and unoccupied vehicles

Operational Quantities

The Commission continues to recommend that the appropriate operational quantities, including the use of ambient dose equivalent H*(10) for area monitoring and Hp(10) for individual monitoring, be utilized in the development, assessment, and operation of such systems (ICRP 2007). For backscatter security systems, the exposure may be predominately to the skin, because the degree of penetration will be dependent upon the specifications of the equipment being considered. Transmission systems, which utilize higher energies, will more significantly contribute to effective dose, and the equivalent dose in various organs and tissues. Individual occupational monitoring of individuals operating the security systems should not be necessary, other than as part of the on-going quality control program to ensure the systems are functioning as designed.

Justification for Screening Individuals

- Decision taken at government level (multi-dimensional)
- Site-specific considerations
- Number of scans needed
- Reliable operation, no extra scans
- System performance
- Average dose per scan to assess detriment
- Consensus standards
- Frequency of scans
- Collective dose

Justification for Screening Cargo

- Similar to justification of the use of radioactive material when the exposure of individuals is not intended
- However, concealed individuals must be considered

Alternative Techniques

The Commission states, in Pub 103:

(205) The Commission recommends that, when activities involving an increased or decreased level of radiation exposure, or a risk of potential exposure, are being considered, the expected change in radiation detriment should be explicitly included in the decision-making process. The consequences to be considered are not confined to those associated with the radiation – they include other risks and the costs and benefits of the activity. Sometimes, the radiation detriment will be a small part of the total. Justification thus goes far beyond the scope of radiological protection. It is for these reasons that the Commission only recommends that justification require that the net benefit be positive. To search for the best of all the available alternatives is a task beyond the responsibility of radiological protection authorities.

Alternatives for Medical Exposures

The Commission States in Pub 103:

(333) Justification of individual exposures should include checking that the required information is not already available and that the proposed examination is the most suitable method of providing the clinical information required. For high-dose examinations, such as complex diagnostic and interventional procedures, individual justification is particularly important and should take account of all available information. This includes the details of the proposed procedure and of alternative procedures, the characteristics of the individual patient, the expected dose to the patient, and the availability of information on previous or expected examinations or treatment. It will often be possible to speed up the justification process by defining referral criteria and patient categories in advance.

Alternative Considerations for Security Scanning

However, in Publication 125, the Commission alternatives:

(45) Justification decisions regarding the use of ionizing radiation in screening will, of necessity, also include consideration of alternative techniques that may be available for accomplishing the specific goals of screening. This may include alternative technologies to the use of ionizing radiation, as well as various procedural alternatives and options. Again, it is not the role of the ICRP to state whether non-radiological alternatives should take precedence to use of ionizing radiation for a particular activity. Factors other than the radiological criteria, such as the efficiency of detection of target objects, the time necessary to conduct scans, reliability, etc. may influence the overall benefit delivered by the systems using ionizing radiation. Furthermore, non-radiological systems may also present risks or inconveniences to the individuals being scanned, which must be also taken into account. The Commission does not wish that its recommendations be construed as implying any preference for or against the various available alternatives to using ionizing radiation. Systems must obviously be judged on the basis of their effectiveness in accomplishing the intended purpose for security screening for a particular context.

Optimisation of Protection

- Optimisation is needed during the design and equipment specification phase, the installation and setup of the screening environment, and during the operation and maintenance of the screening systems
- Acceptance testing during installation, periodic measurements during operation, and other quality control measures are important to ensure that the assumptions used in the optimization of protection are valid, and maintained during operations.

Public Optimisation

- For security screening utilizing ionizing radiation, since it is not possible to eliminate exposures, the optimized situation will be the one which essentially is the lowest exposure consistent with obtaining the necessary information.
- Optimization includes planning the installation of the equipment, to provide for appropriate distance, shielding, access controls, and other measures to prevent individuals from coming into contact with radiation that is not part of the expected operations.
- The optimization of protection for screened individuals is largely determined by considerations of design, and installation. Once the scanning system is installed and becomes operational, there may be limited opportunities to further improve radiological protection, on an individual exposure basis. Selection of the most appropriate equipment, and verification of the design meeting the appropriate standards for performance, is an important component of this process.

Occupational Optimisation

- Optimization during the operations of the screening system will primarily rely on ensuring that the equipment is functioning as intended, including periodic verification of various operational parameters, surveys, and other measures.
- The information needed for the optimization of on-going operations will most often be based on periodic surveys and reviews conducted by the operating management to ensure that the systems are operating as designed, reviews of the radiological conditions and physical arrangements in the vicinity of the scanning systems to determine if there have been changes in any exposure of any individuals (occupational or public), and adherence to a maintenance schedule to ensure that equipment is functioning properly.
- The Commission emphasizes that it is a fallacy to assume that categorization of an exposure as occupational automatically means that it is acceptable for the exposure to be greater than that allowed for public exposure.

Dose Constraints

Nominally, ICRP has described dose constraints in terms of an annual exposure from the source. However, because of the unique and episodic nature of security screening, specifications on a "per screening event" are appropriate as starting points, particularly since they are established in reference to a clearly identifiable circumstance.

- Dose constraints for occupational exposure of individuals operating security screening systems should normally be set at a very small fraction of the constraints recommended by the Commission for occupational exposure.
- Constraints for public exposure should normally be established at very small fractions of the public dose limits.

Stakeholder Involvement

The Commission recommends that key messages, questions, and answers be developed in advance, and readily available, to improve these interactions. In situations in which screening may be conducted, careful consideration should be given to different means of communication with stakeholders in understandable and plain language.

Exposure of Drivers

- From a radiological protection standpoint, exposure of drivers should not be necessary when screening cargo. The Commission believes that such exposures are generally not justified, unless specific justifications show that there is a positive net benefit to conducting operations in a manner that result in some exposure. Exposure of such individuals should not be a matter of operational convenience, and the Commission recommends that drivers not be allowed to occupy conveyances during screening, except for very unusual circumstances.
- If the very unusual circumstance of exposure of drivers is allowed to occur, these exposures are to be treated as occupational exposure, and subject to the relevant recommendations of the Commission. Specific dose constraints on exposure are to be established. Further, given the very unusual circumstances, the Commission recommends that constraints be selected within the band recommended in Publication 103 for public exposure in planned exposure situations.

Exposure of Concealed Individuals

The Commission recommends that systems be designed and operated such that the dose to a concealed individual would be unlikely to exceed the recommended dose limits for members of the public. In most cases, this would be the 1 mSv per year level, which in the case of a screening of a concealed individual could be considered as equivalent to a per event criterion.

Main Points

- **The use of ionizing radiation to screen individuals for security purposes is an exceptional circumstance which requires careful justification. It should not be presumed that the use of ionizing radiation is generically justified, or acceptable.**
- **Justification decisions should include consideration of all relevant factors, including the definition of the screening objectives (threats, vulnerabilities, and consequences), the degree to which the technology accomplishes the screening objectives, radiological exposure during a screening, and alternatives which may be available to reduce exposures and enable identification of groups of individuals who may incur a significant number of screenings during a year.**

Main Points

- **In most cases, justification decisions to employ a particular security screening technology will involve many factors outside of radiation protection.**
- **Security screening using ionizing radiation, if determined to be justified, is a planned exposure situation, and should be subject to the appropriate regulatory framework for optimization of protection, authorization, and inspection to ensure radiation safety in operation.**
- **The exposure of an individual to be screened for security purposes is considered to be public exposure.**

Main Points

- **Optimization of protection for an individual to be screened should include consideration of the number of exposures necessary to accomplish the screening objective, the dose per exposure, and avoidance of additional (or repeated) exposures.**
- **Optimization of protection is to be applied during the design and operation of a screening system for each category of exposure, including: individuals being screened; members of the public who are not being screened but may be in the vicinity of the screening; and occupational exposure.**
- **Appropriate expectations need to be established for training, retraining, and competence of operators, and the management systems to ensure safety during operations.**

Main Points

- **Dose constraints should be established for each identifiable category of exposure (individuals to be screened, members of the public who are not being screened but may be in the vicinity of the screening, occupational exposure), and used in the optimization of protection.**
- **Appropriate application of the framework of protection, including justification and optimization, will provide adequate protection for more sensitive populations. Thus, if the recommendations in this report are met, it will not be necessary to take separate protection actions for children or pregnant women.**

Main Points

- **Screening of cargo and materials may pose circumstances of exposure, particularly for drivers of conveyances being screened, that should be avoided. Exposure of such individuals should not be a matter of operational convenience. Drivers should not be allowed to occupy conveyances during screening, except for very unusual circumstances.**
- **Screening of cargo and materials may pose the possibility of exposure to individuals concealed in the cargo containers, which must be factored into the analysis and authorization for use. The Commission recommends that even in such circumstances, protection equivalent to that provided by the dose limits for members of the public should be achieved.**

Main Points

- **The use of stakeholder dialogue and provisions of information to meet an individual's right to know, are important tools in the justification, optimization, and implementation of a security screening circumstance. Communications need to be accurate, informative, and responsive to the concerns. The Commission recommends that key messages, questions, and answers be developed and readily available during operations, to facilitate stakeholder interactions.**

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