

A Brief Overview of Radiation Safety Guidance for Airport X-Ray Security Screening

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Abstract: With the significant increase in security concerns worldwide, security screening for individuals and objects at airports has increased rapidly. Various technologies are being used to meet the desired security aspects, among which is the use of ionizing radiation, which is the most common. However, with the deliberate exposure of individuals to ionizing radiation in non-medical settings like security screening, the question of justification of these practices becomes a vital issue. The states are responsible for making careful decisions on justifying security screening before employing the technology. Even if a decision is made that its use is justified, the framework for radiation protection and safety needs to be utilized to minimize the harmful effects of ionizing radiation on the people and the environment. To minimize the harmful hazards, organizations like the International Commission on Radiological Protection (ICRP) and the International Atomic Energy Agency (IAEA) publish international standards and guidelines for the safe use of ionizing radiation for security screening by inspection devices. These standards are in place to be followed by the states in the justification process and to set proper radiation protection frameworks according to their country's context. This article aims to provide a brief overview of the radiation safety aspects for airport security screening of humans in light of guidelines provided in the IAEA Safety Standards Series No. SSG-55 regarding radiation safety of non-medical human imaging in inspection purposes.

Keywords: Airport Security, X-ray Screening, Inspection devices, Non-medical, Human imaging, Radiation Protection, Safety, International standards

1. Introduction

Security Screening is defined as an activity undertaken to detect unintended, unwanted, or deliberately introduced objects or materials that could pose a security threat or be used for malicious purposes [1]. In the past few decades, terrorist threats have evolved from cases like passengers hiding a gun or knife to passengers hiding explosive liquid, powder, and non-metallic explosive devices and weapons. To cope with the required circumstances, advanced imaging technology like the whole-body imaging technique has become popular worldwide as the primary passenger screening method.

Airport security screening devices involve both ionizing and non-ionizing radiation technologies. Full-body scanners using ionizing radiation like X-rays can detect non-metal objects, swallowed items, or items hidden in a person's body cavity. According to the "Global X-Ray Security Scanner Market" study report, the X-Ray Security Scanner Market is projected to reach growth at a CAGR of 7.89% from 2024 to 2031 [2]. The following figure illustrates the trend in the market as shown in the report:



Figure 1: X-Ray Security Scanner Market Size and Forecast [2]

For X-ray full-body scanning devices, direct exposure to individuals raises the potential for further increases in radiation risk. The system of radiation protection for those situations in which humans are deliberately exposed for medical purposes is well established at present. In contrast, using ionizing radiation to screen individuals for security purposes in non-medical settings is an exceptional circumstance, and hence, it requires careful justification [1]. The responsibility lies on the States to make decisions for justification for this type of non-medical human imaging practice. Even if the practice is decided to be justified, the proper framework for radiation protection and safety must be in place following the national and international standards.

The IAEA's Basic Safety Standards are used as benchmarks in developing national regulations. The IAEA Safety Standards Series No. GSR Part 3, "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards," included requirements for non-medical human imaging [3]. Guidance on the procedures to be followed in deciding whether or not a particular practice is justified can be found in the IAEA Safety Guide, GSG-5: Justification of Practices, Including Non-Medical Human Imaging [4]. To further support Member States in the implementation of non-medical human imaging, the IAEA has developed a Safety Guide, "Radiation Safety of X-ray Generators and Other Radiation Sources Used for Inspection Purposes and Non-Medical Human Imaging (SSG-55)," in 2020 [5]. This Safety Guide focuses on ensuring the safety of non-medical human imaging and inspection devices. This article is intended to provide a concise summary of radiation safety aspects specific to non-medical human imaging at airport security screening in light of the guidelines provided in SSG. This work could be helpful to those who are in the process of establishing requirements for the Radiation Protection Program (RPP), applying for a license, and establishing an RPP framework in this field.

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2. Brief History of X-ray Full-body Scanners in Airport Security

Before discussing the radiation safety of Airport X-ray full-body scanners, some background on the plot that drives the implementation of this technology needs to be drawn. After World War II, air travel gained substantial traction in the 1960s, and security checks of persons and their luggage were carried out manually during this period [6]. Over time, hijackings used to occur, especially in the late 1960s and early 1970s; hijacking happened globally once every five days on average, and these events eventually laid the foundation for today's airport security protocols [7]. Examining timelines of attacks on commercial aviation, there are distinct tactical phases, both pre-9/11 and post-9/11, and security tactics have also evolved to address specific techniques used during attacks [8]. The two phases are illustrated in the following figures [8]:

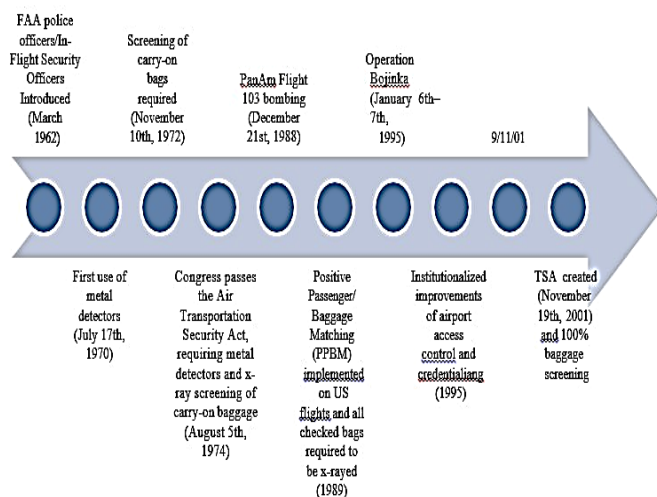


Figure 2: Pre-9/11 Security Reactive Measures Timeline [8].

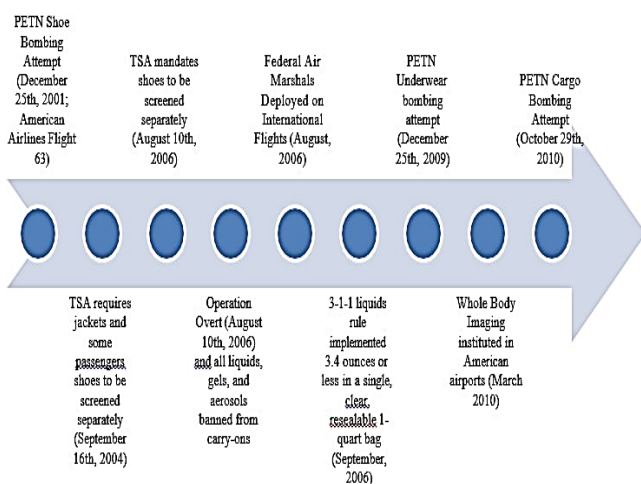


Figure 3: Post 9/11 Attacks (Rise in Aircraft Bombing Attempts with Person-Borne Explosives) Timeline [8].

As for passenger checks, the attacks showed how easily people could smuggle dangerous items onboard a plane and hide non-metal objects beneath their clothes. As a result, full-body scanners started to appear at airports, with Amsterdam Schiphol Airport leading the way in 2007 [7]. However, body scanners did not become the norm around the world until 2010, when a new attack was attempted at Detroit Airport in 2009. The fear that the Christmas Day Bomber of 2009 led to the Transportation Security Administration (TSA)- a department of the US Department of Homeland Security, introducing whole-body imaging to security screening procedures [9]. Concerning the screening of passengers beyond metal detection processes, the security industry has developed two major types of body security scanners: one that relies upon ionizing radiation (x-rays) or non-ionizing radiation [9]. It is to be mentioned that the first full-body scanner to use backscatter radiation technology was produced by Steven W. Smith in 1992. Since then, Smith has sold the technology and rights to Rapiscan Systems and continues to develop new generations of backscatter scanners, among other weapon detection systems [10].

3. Types of Equipment in security screening

The X-ray-based security screening relies on two techniques: backscatter and transmission. As per the Glossary of ICRP Publication 125, the definitions are [1]:

3.1 Backscatter technology

A security screening device using ionizing radiation by measuring the radiation scattered from an object to create an image [1].

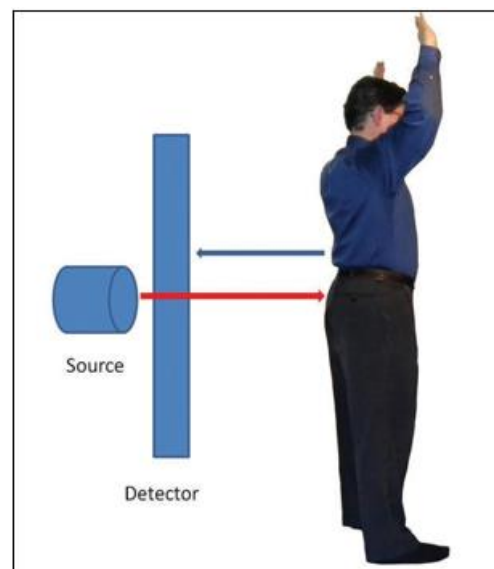


Figure 4: Backscatter X-ray method of operation [1].

3.2 Transmission detection system

A security screening device using ionizing radiation to create an image by measuring radiation transmitted through an object [1].

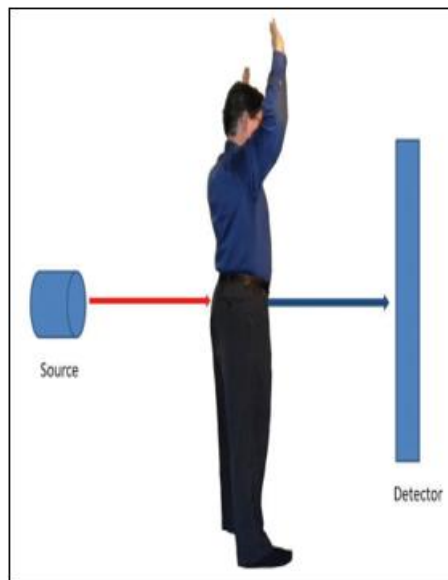


Figure 5: Transmission X-ray method of operation [1].

The key features of these two technologies are drawn in the following table:

Table 1: Technologies available for X-ray Inspection Devices.

Technology	Radiation source and detector location	The effective dose per scan*
Backscatter	The radiation source and the detector are located on the same side of the object.	The effective dose from such systems is of the order of 0.1 μSv per image of the front of the body; images of the back or sides of the body may produce lower effective doses.
Transmission	The radiation source and the detector are located on opposite sides of the object.	The effective dose per scan ranges from approximately 2 to 5 μSv or more, depending upon the equipment.

*For Backscatter technology, the exposure may be predominately to the skin, whereas Transmission systems, which use higher energies, will contribute more significantly to effective dose and equivalent dose in various organs and tissues [1].

In addition to the type of technology, inspection imaging devices can also be categorized in terms of how they could be deployed. There are two categories of use, often referred to as 'general use' and 'limited use' [5], which are defined as follows:

Table 2: Categories of inspection devices according to uses.

Use	Condition for exposure
General use	A very low dose per exposure, typically an effective dose of less than 0.1 μSv per scan. Such systems would be based on backscatter technology.
Limited use*	A higher dose per exposure, typically greater than 0.1 μSv effective dose per scan and up to 10 μSv per scan.

* Limited-use systems should be used with discretion in terms of the selection of individuals to be scanned and the number of scans per individual per year.

3.3 Technology for Airport Security Screening

Backscatter systems are designed for the security screening of humans. This system is mainly used to image objects hidden under clothing. Thus, this system has been placed into service at national borders and in prisons for interdiction of drugs, weapons, and contraband. Following the attempted aircraft terrorism event in December 2009, there has been considerably increased pressure to implement the use of imaging systems for screening airline passengers [1]. In contrast, screening activities for materials and cargo generally employ transmission techniques and such systems are not intended to screen individuals [1].

this [11]. It is a tool for the management of measures to protect people and the environment from the risk generated by ionizing radiation. RP aims to prevent the deterministic effects and reduce the stochastic effect of ionizing radiation.

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application [12]. The IAEA standards are issued in publications in the form of the IAEA Safety Standards Series. These are considered as a global reference for radiation protection and harmonized high levels of safety worldwide.

4. Framework for Radiation Protection and Safety

Radiation protection (also radiological protection) is defined as the protection of people from the harmful effects of exposure to ionizing radiation and the means for achieving

5. Radiation Safety guidelines provided by IAEA Specific Safety Guide: SSG-55 [5]

Recommendations and guidance on protection and safety for X-ray generators and other types of radiation sources used for inspection purposes and non-medical human imaging are provided in IAEA Safety Standard: SSG-55. This Specific Safety Guide categorizes non-medical human imaging into two types, Category-1 & Category-2. In short, Category 1 is the imaging done in a medical set-up with medical diagnosis equipment through the radiological procedure. In Category 2, an inspection device does human imaging in a non-medical setup. The main topic of this article is airport security screening, which falls under category 2, non-medical human imaging, according to this guide. So, recommendations that are implicated for category 2 type non-medical human imaging are the main ones to focus on. Also, airport security screening is under the general use of inspection devices, which

we discussed in the earlier section. The guidelines of radiation safety provided by SSG-55 for category 2 non-medical human imaging, which is applicable to airport security screening, will be discussed briefly in the further sections of this article. However, it was challenging to rewrite them without losing their fundamentals.

5.1 Responsibilities of Different Parties for Radiation Protection and Safety

Governments should ensure that the uses of radiation for non-medical human imaging that are deemed justified are subject to a thorough system of protection and safety. In the following table, a summary has been tried to draw up so that it could be easy to have an idea at a glance about the responsible parties for radiation protection along with their key responsibilities in the field of non-medical human imaging, including security screening as described in the IAEA Specific Safety Guide SSG-55:

Table 3: Parties with responsibilities for protection and safety.

Responsible Parties	Relevant IAEA Standards	Key responsibilities
The government	GSR Part 1 & Requirement 2 and paras 2.13–2.28 of GSR Part 3	Establishing an effective legal and regulatory framework, legislation, independent regulatory body, requirements for Education and training, ensuring arrangements for technical services and Education and training
The government or regulatory body	GSG-5 & Requirement 18 of GSR Part 3	Establishing or approving dose constraints for public exposure
The regulatory body	GSR Part 1, GSR Part 3, GSG-13, GSG-7, GSG-8	Verify all operational aspects of radiation protection through the authorization process. Inspection of facilities, Providing specific guidance for practices that have been justified by the State on the Assessment of occupational exposure, and dissemination of information to relevant parties.
The registrant or licensee	Principle 1 of SF-1, Requirement 5 of GSR Part 3	The prime responsibility for safety. Effective management of protection and safety, developing, documenting, and implementing a radiation protection and safety program, and arranging for the supplier to provide training to relevant staff on the operation and maintenance of the inspection imaging device and the associated inspection system and software.
Suppliers	GSR Part 3 (para. 3.49)	Suppliers of inspection imaging devices and systems and developers of associated software have responsibilities with respect to protection and safety in terms of the design and performance of the devices.

For non-medical human imaging procedures in security screening, some States have recommended a dose constraint of 0.25 mSv per year in terms of the cumulative dose to any individual at a given security screening facility [5, 13].

5.2 Application of Radiation Protection Principles

The principles of radiation protection and safety upon which the IAEA safety standards are based are developed by the ICRP publication 103 [14]. The detailed formulations of those principles are often found in ICRP publications.

The three general principles of radiation protection, justification, optimization of protection and safety, and the application of dose limits are expressed in Principles 4–6 of IAEA Safety Fundamentals SF-1 [15]. Requirement 1 of GSR Part 3 states, "Parties with responsibilities for protection and safety shall ensure that the principles of radiation protection are applied [3]."

5.2.1 Justification

Justification is a multi-attribute process that must examine all of the possible benefits and impacts of a particular proposal, taking into account the various alternatives that may be available, to determine if there is a net benefit to the conduct of the activity [1].

In the case of the security screening of airline passengers, the government should carefully consider the need for extensive public consultation; the government should also consider liaising with counterparts in other States in view of the international dimension of air travel. The benefits from some of these types of practice could be substantial. Nevertheless, the government should carefully scrutinize proposals to introduce them into a State.

The person or organization applying for a Category 2 practice to be justified should undertake a radiological assessment that determines the individual dose per inspection or scan as well as the cumulative dose to persons who are likely to be exposed frequently, for example, frequent air travelers, flight crew and ground crew. Issues relating to privacy, provision of information to individuals to be screened, selection criteria for individuals to be screened, and informed consent should be considered in the justification process while noting that alternative methods not involving the use of radiation can also involve many of the same issues.

An example of detailed guidance on the justification process

for security screening is given in Guidance for Security Screening of Humans Utilizing Ionizing Radiation, ISCORS Technical Report 2008-1, and includes the following steps [5, 16]

- Defining the need;
- Evaluating the options, including their effectiveness and their limitations;
- Evaluating privacy concerns;
- Assessing the radiation risk from the technologies;
- Assessing the potential net benefit from the implementation of the technologies;
- Assessing the cost and availability of resources (regulatory, operational, and training) and the viability of sustainable implementation.

If the practice is ultimately considered justified, such conditions of use should form part of the authorization conditions.

The justification decision should be reviewed on a regular basis as technologies and threat evaluations constantly change.

5.2.2 Optimization of protection and safety

Optimization of protection and safety is defined as **the process of determining** what level of protection and safety would result in the magnitude of individual doses, the number of individuals (workers and members of the public) subject to exposure, and the likelihood of exposure being as low as reasonably achievable, economic and social factors being taken into account (ALARA) [11].

Optimization is a perspective and iterative process that requires judgments to be made using both qualitative and quantitative techniques. Imaging procedures should be performed in such a way as to optimize the protection and safety of the person being imaged. Much of this optimization will be achieved through the design of the equipment. Each Category 2 non-medical human imaging procedure should be performed in such a way as to optimize the protection and safety of the person being imaged. Much of this optimization will be achieved through the design of the equipment.

Other tools used in the optimization of protection and safety, especially with respect to persons being imaged, include design and operational considerations, calibration, dosimetry, and quality assurance programs.

5.2.3 Dose limits

Security screening using ionizing radiation should be regarded as a planned exposure situation, and the exposure of an individual screened for security purposes should be considered public exposure. The exposure of an individual to be screened for security purposes is considered public exposure that applies irrespective of whether individuals are being screened due to their personal choices or as a consequence of their work duties [1]. Therefore, **the dose limits for public exposure** apply to individuals undergoing security imaging procedures that have been justified within a given State [3, 5]. This means that the dose limit for public exposure is also applicable for airport security screening practices. The dose limit for public exposure is given in the following table:

Table 4: Dose Limits for Public Exposure: Schedule III.3. of GSR Part 3.

Dose Limits
• An effective dose of 1 mSv in a year
• In special circumstances*, a higher value of effective dose in a single year could apply, provided that the average effective dose over five consecutive years does not exceed 1 mSv per year.
• An equivalent dose to the lens of the eye of 15 mSv in a year.
• An equivalent dose to the skin of 50 mSv in a year.

* For example, in authorized, justified, and planned operational conditions that lead to transitory increases in exposures.

5.3 Radiation Protection Program (RPP)

radiation protection measures [11].

A Radiation Protection Program (RPP) is defined as a Systematic arrangement to provide adequate consideration of

The structure and contents of RPP should be documented to an appropriate level of detail. This should include the following contents at a minimum:

Table 4: RPP Structure [5].

Contents of RPP
• Management structure, commitment, and policies
• Assignment of responsibilities for protection and safety
• Education and training
• Designation of controlled areas and supervised areas
• Arrangements for protection of occupationally exposed workers, including local rules and procedures, monitoring of the workplace, assessment of occupational exposure, and workers' health surveillance
• Arrangements for the protection of persons undergoing non-medical human imaging
• Arrangements for the protection of the public, including Assessment of public exposure
• Safety of facilities and equipment used for non-medical human imaging, including safety assessments, accident prevention, design considerations, commissioning and maintenance, and quality assurance programs
• Periodic reviews and audits of the performance of the radiation protection and safety program
• A system for document control and records

Each content is described in SSG-55 in detailed. Some of these are highlighted in the following sections, which are applicable to airport screening.

5.3.1 Management structure and policies

The RPP should include the company policies on protection and safety and should include a commitment by the management to keeping radiation doses as low as reasonably achievable and to promoting a strong safety culture.

5.3.2. Assignment of responsibilities for protection and safety

Responsibilities for radiation safety should be assigned to cover the entire lifetime of inspection imaging devices at the facility, from ordering and receipt, use and storage, to their eventual disposal, sale, or other end-of-life action. The posts for which responsibilities should be allocated include the management of the registrant or licensee, the radiation protection officer, qualified experts, workers operating inspection imaging devices, and other workers as appropriate.

5.3.3. Education and training

The RPP should describe the training program in protection and safety for all workers directly involved in the management and operation of the Category 2 non-medical human imaging facility. The training should include a radiation 'awareness' program, where appropriate, for other staff, particularly those working near the inspection zone, such as security guards and administrative staff. Such an awareness program should be a simplified version of the training provided to operators of inspection imaging devices. Specific instruction and training should be provided when new inspection imaging devices and associated equipment and software are introduced. Regular refresher training should also be provided as part of the radiation protection and safety program, with additional training when inspection imaging devices, software, or procedures are changed. In addition, workers who operate inspection imaging devices should be given radiation protection and safety training that includes, at a minimum, the following:

- The type and properties of the radiation source and the radiation emitted;
- The typical radiation exposures from the normal use of the inspection imaging device and from incidents;
- The radiation risk for workers and the public, including for persons undergoing non-medical human imaging procedures;
- The use of design features, time, distance, and shielding to reduce exposures;
- Lessons identified from operating experience and from incidents;
- Safe working procedures, including procedures for emergency preparedness and response.

5.3.4. Protection of workers

Workers mean occupationally exposed individuals, including workers operating inspection imaging devices and performing scans, service engineers, radiation protection officers, and qualified experts performing radiation surveys. Facility personnel, such as persons controlling entry to the inspection zone or passport control officials, for whom radiation sources are not required by, or directly related to, their work requires the same level of protection as members of the. Consequently, the recommendations provided for the protection of the public are also applicable in respect of such workers. The following sub-sections are related to the protection of workers.

(a) Local rules and procedures

Local rules and procedures are necessary for the use of all inspection imaging devices. The purpose of these local rules and procedures is to ensure protection and safety for workers and the public. Local rules that describe the procedures for carrying out non-medical human imaging with inspection imaging devices should be developed and written in a language understood by the people who will need to follow them. These local rules should cover all aspects of operating the inspection imaging devices relevant to protection and safety. The operating instructions provided by the manufacturer are an essential resource in this respect, but additional procedures are likely to be needed. The registrant or licensee should approve the final set of operating procedures, and the procedures should be documented and incorporated into the registrant's or licensee's management system.

(b) Monitoring of the workplace

The assessment of occupational exposure on the basis of workplace monitoring will generally be appropriate in Category 2 non-medical human imaging facilities. Workplace monitoring should be carried out in areas around each inspection imaging device while it is in operation.

(c) Assessment of occupational exposure by individual Monitoring

Individual dose monitoring would **not normally be expected** for a worker in a Category 2 non-medical human imaging facility, but there might be circumstances in which it might be considered. For example, a new facility performing Category 2 non-medical human imaging may decide to perform individual Monitoring for an **initial period of time to confirm** that the inspection imaging devices are functioning as designed and to provide reassurance to the operators in their new role. Periodic individual Monitoring may be part of the facility's ongoing **quality assurance** program for the inspection imaging devices. As part of the application for authorization, the registrant or licensee should state whether individual Monitoring for occupational exposure is to be carried out.

(d) Workers' health surveillance

No specific health surveillance related to exposure to ionizing radiation is necessary for workers involved in Category 2 non-medical human imaging procedures. Under normal working conditions, doses incurred in this procedure are very low, and **no specific radiation-related medical examinations are required for workers.**

(e) Arrangements for the protection of female workers

In the case of Category 2 non-medical human imaging, there should be no need for any change in the duties of a pregnant operator of an inspection imaging device. However, it is recognized that a pregnant woman may have concerns about working with radiation, even where exposures are very low, and, in addition to the information required to be provided by the employer on the risks to the embryo or fetus, access to individual advice, for example from a qualified expert, should also be made available.

(f) Persons under 18

The requirements for access to controlled areas and the dose

limits for such persons are more restrictive. A trainee operator aged 16 to 18 years could commence training under supervision to become an operator of an inspection device.

5.4 Protection of persons undergoing non-medical human imaging

Procedures with inspection imaging devices in which radiation is used to expose persons for the purpose of detection of concealed weapons, contraband, or other objects on or within the body shall be considered to give rise to public exposure. Aircrew and airport staff are required to undergo the same security screening as passengers. This is not to be considered occupational exposure; as stated before, such exposure is to be considered public exposure. The operator of the inspection imaging device should ensure that only the person intended to be imaged is within the inspection zone and that the person is positioned correctly before initiating the exposure.

The ANSI standard on radiation safety for personnel security screening systems provides a measurement methodology and recommends a frequency of at least once every 12 months to establish the reference effective dose per screening for each type of imaging procedure [13, 5]. From this, the annual dose can be estimated by multiplying the reference effective dose per screening by the estimated number of screenings to an individual in a year. The estimated annual dose should be consistent with regulatory requirements and guidance and, in particular, should comply with the dose constraint set by the government or regulatory body. The radiation protection officer or qualified expert should review the reference effective dose per screening to identify those that may be higher than usual and to review whether doses are as low as reasonably achievable.

The dose constraint should be established in terms of the cumulative individual effective dose for the year and should apply to all persons. In a general use practice, where the number of procedures a person could undergo in a year is not controlled and is potentially relatively high, the reference effective dose per image would need to be very low and less than 0.1 μ Sv.

Consideration should be given to providing the information in several languages that are commonly encountered at the facility where the non-medical imaging is being carried out.

5.5 Safety of equipment used for non-medical human imaging

The regulatory body has a responsibility to establish requirements for safety assessment and to review and assess the safety assessment prior to granting authorization. The applicant for authorization, or the registrant or licensee, is responsible for preparing the safety assessment.

5.5.1 Prevention of accidents

For Category 2 non-medical human imaging procedures, possible scenarios for accidental exposure include flaws in the design of inspection imaging devices, failures of engineered controls on such devices while in operation, failures and errors in the software that control or influence the emission of

radiation from the inspection imaging device, and human error.

5.5.2 Installation, commissioning, testing, and maintenance of inspection imaging devices

Inspection imaging devices should be installed in accordance with the manufacturer's instructions, and the Installation should comply with relevant regulatory requirements and authorization conditions. Only properly trained and authorized individuals should be allowed to install inspection imaging devices.

5.5.3 Quality Assurance (QA) Program

The purpose of the quality control tests is to ensure that, at all times, all inspection imaging devices are performing correctly, accurately, reproducibly, and predictably. The regulatory body may have its own specific requirements on the quality control tests that need to be performed and their frequencies. The regulatory body should review the records of the quality assurance program during inspections of facilities and activities using inspection imaging devices.

5.6 Periodic reviews and audits of the performance of the radiation protection and safety program

As an integral part of the registrant's or licensee's management system, the RPP and its implementation should be reviewed on a regular basis. This periodic review should identify any problems that need to be addressed and any modifications that could improve the effectiveness of the radiation protection and safety program.

5.7 Records

Records are an essential part of demonstrating ongoing Compliance with radiation protection requirements. For a Category 2 non-medical human imaging facility, the records kept should include:

- Use and maintenance logs.
- Quality assurance program records.
- Training records.
- Radiation monitoring.
- Records of the reference effective dose per screening for each inspection imaging device in use.
- Events: Records of any events, including corrective actions.

The records should be kept for the period specified by the regulatory body.

5.8 Investigation of Events

All relevant staff should be adequately trained to recognize when an inspection imaging device might not be functioning correctly due to hardware or software problems and, when necessary, immediately terminate an imaging procedure. If an event that is significant for protection and safety occurs, the registrant or licensee should conduct an investigation. For significant accidental exposures, or as otherwise required by the regulatory body, this written record should be submitted to the regulatory body as soon as possible. A copy should be kept by the registrant or licensee.

6. Conclusions

The adoption of X-ray security scanners has to follow stringent regulatory requirements and safety standards. Compliance with international safety norms and standards is critical for all the relevant parties, including the scanner manufacturer and operators, to ensure the safety of workers, the public, and the environment. SSG-55 was developed to assist these relevant parties with implementing the safety standards. The recommendations in this Safety Guide are primarily for organizations that are authorized to use X-ray generators for inspection purposes and non-medical human imaging, as well as for radiation protection experts, radiation protection officers, and staff of regulatory bodies. This may also be of interest to designers and manufacturers of X-ray generators that are used for inspection purposes. For the airport security screening of individuals, these recommendations are to be followed to ensure the safe use of ionizing radiation.

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