United States

Interagency Steering Committee on Radiation Standards

Guidance for Security Screening of Humans Utilizing Ionizing Radiation

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FOREWORD

The Interagency Steering Committee on Radiation Standards (ISCORS) developed this technical report to assist Federal agencies in determining when the use of ionizing radiation for security screening of humans is warranted. This guidance anticipates that the decision to perform security screening of humans will be made by an authority at the appropriate organizational level.

Federal agencies with an anticipated need for security screening of humans were invited to discuss this topic at a March 2005 ISCORS meeting. It was evident that:

- The agencies that attended the meeting:
    - had a wide range of security needs;
    - had a wide range of expertise in radiation safety; and
    - had many limited-use applications.

- Guidance for the selection and implementation of ionizing radiation security screening technology did not exist.

- The use of security screening systems was not adequately addressed in Federal regulations.

- Larger agencies were developing their own criteria while smaller agencies were acting unilaterally based on limited information.

Development of this document, *Guidance for Security Screening of Humans Utilizing Ionizing Radiation*, was undertaken as a result.

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EXECUTIVE SUMMARY

The Interagency Steering Committee on Radiation Standards (ISCORS) developed this guidance document to assist Federal agencies in determining when the use of ionizing radiation for security screening of humans is warranted. This guidance was needed to complement existing standards[1] and guidance that primarily address radiation risks.

First, the document outlines the process of selection of a security screening technology and justification for its use. Second, the document provides guidelines and information for establishing a radiation safety program necessary for a safe and successful security screening operation. The recommendations presented in this document are based on the three basic principles of radiation safety[2]: (1) justification of the use of ionizing radiation, (2) optimization of radiation exposure, and (3) limitation of the radiation dose.

The security screening technologies covered in this document include systems designed specifically for security screening of humans and systems designed for security screening of vehicles or cargo containers when used for security screening of humans. There are two main imaging technologies in use today for security screening using ionizing radiation: backscatter and transmission. Backscatter technology is used mainly to image objects hidden under clothing while transmission systems are also used to image objects that have been ingested, hidden in body cavities, or implanted under the skin. Generally, the radiation dose to the scanned individual from a backscatter system is much lower than the dose from a transmission system. Backscatter systems raise concerns about privacy because of the ability of these systems to "see" through clothing. Transmission systems raise concerns about radiation exposure that may be deemed unnecessary.

In addition, existing recommendations categorize these security screening systems based on the radiation dose to the screened individual[3]:

- "*General-use systems* should adhere to an effective dose of 0.1 µSv [10 µrem] or less per scan, and can be used mostly without regard to the number of individuals scanned or the number of scans per individual in a year."
- "*Limited-use systems* include all other ionizing radiation scanning systems that require effective doses per scan greater than 0.1 µSv [10 µrem] and less than or equal to 10 µSv [1 mrem]. These

[1] ANSI/HPS N43.17 and NCRP Commentary No. 16

[2] ICRP 60

[3] NCRP Commentary No. 16

> systems should be used with discretion in terms of the number of individuals scanned and the number of scans per individual in a year."

This guidance anticipates that the decision to perform security screening of humans will be made by an authority at the appropriate organizational level. The decision involves many factors in addition to radiation protection. The overall benefit must outweigh the risks associated with the chosen security screening method. Prior to conducting security screening of humans, the responsible executive should obtain legal advice and consider the operation, the current threat assessment, physical security, and cultural/social issues, to determine when security screening of humans is justified. An institution should gather sufficient information and data to properly carry out each of the following assessments:

1) Define the need
2) Evaluate options
3) Evaluate privacy concerns
4) Assess radiation risks from the technology and the net benefit of implementation
5) Evaluate agency's ability to implement the practice

After due consideration of the findings from the five steps listed above, the agency should document its decision process.

If a Federal agency decides to implement a security screening practice that uses ionizing radiation, it should establish and maintain an effective radiation safety program. The scope of any radiation safety program should be commensurate with the potential risks associated with the security screening practice. In particular, the adoption of limited-use systems requires a significantly higher level of control and documentation than general-use systems. Therefore, each agency (or organization within an agency) will need to tailor their radiation safety program to their specific needs.

The purpose of an agency's radiation safety program is to ensure the safety of individuals who could be exposed to radiation. These individuals may be employees who operate the security screening system(s), employees who happen to work nearby, screened individuals, and members of the general public. This document provides guidance on establishing a radiation safety program and a sample Radiation Safety Program Standard Operating Procedure.

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1. INTRODUCTION

1.1. SCOPE

This document applies to activities associated with the use of ionizing radiation for security screening of humans. It is intended for use by Federal Agencies. The controlled, security screening of humans discussed in this document is for the detection of contraband or threat objects. Higher dose systems (doses greater than 10 μSv (1 mrem) per scan), such as medical diagnostic x-ray systems should not be used for security screening and their use is beyond the scope of this document.

1.2. BACKGROUND

The concept of using x-ray systems for security screening of humans is almost as old as the discovery of x-rays. In the past, the use of ionizing radiation for security was considered only for rare situations and was deemed unsuitable for security screening of the general public. Two factors have significantly increased the interest in security screening of humans with ionizing radiation: (1) the development of systems capable of producing images with extremely low doses of radiation and (2) the need for increased security in response to current threats.

In 2002, the Health Physics Society (HPS) published a radiation safety consensus standard, American National Standards Institute (ANSI) N43.17, "*Radiation Safety for Personnel Screening Systems Using X-rays*." ANSI N43.17-2002 established a limit for the effective dose from one scan of 0.1 microsieverts (μSv) (10 microrem (μrem)). This standard also established a limit of no more than 0.25 millisieverts (mSv) (25 millirem (mrem)) annual effective dose to an individual from any one security screening venue[4].

The following year, in a position statement, HPS recommended limiting the use of ionizing radiation to security screening applications resulting in a net benefit to society. The position statement stated that appropriate organizations should develop criteria to determine the net benefit.

In 2003, the National Council on Radiation Protection and Measurement (NCRP) published its Commentary 16, "*Screening of Humans for Security Purposes Using Ionizing Radiation Scanning Systems*." This document examined the potential radiation risks associated with security screening and outlined the application of radiation protection principles to this source of radiation exposure. Regarding the overall benefit to society, NCRP Commentary 16 stated that

[4] See NCRP Commentary No. 16 for more information.

"the overall justification for use of such devices for specific security applications and what constitutes a net benefit to society are broader questions that are outside the NCRP scope." NCRP Commentary 16 provided recommendations for two distinct categories: general-use and limited-use. The commentary explained these terms as follows:

- "*General-use systems* should adhere to an effective dose of 0.1 μSv [10 μrem] or less per scan, and can be used mostly without regard to the number of individuals scanned or the number of scans per individual in a year."

- "*Limited-use systems* include all other ionizing radiation scanning systems that require effective doses per scan greater than 0.1 μSv [10 μrem] and less than or equal to 10 μSv [1 mrem]. These systems should be used with discretion in terms of the number of individuals scanned and the number of scans per individual in a year."

Federal agencies with an anticipated need for security screening of humans were invited to discuss this topic at a March 2005 Interagency Steering Committee on Radiation Standards (ISCORS) meeting. It was evident that:

- The agencies that attended the meeting:
  - had a wide range of security needs;
  - had a wide disparity of expertise in radiation safety; and,
  - had many limited-use applications.

- Guidance for the selection and implementation of ionizing radiation security screening technology did not exist.

- The use of security screening systems was not adequately addressed in Federal regulations.

- Larger agencies were developing their own criteria while smaller agencies were acting unilaterally based on limited information.

Development of this document, *Guidance for Security Screening of Humans Utilizing Ionizing Radiation,* was undertaken as a result.

1.3. SECURITY SCREENING SYSTEMS OVERVIEW

A variety of systems employing x-rays or gamma radiation are currently available for screening individuals at a security checkpoint. The systems use either backscatter or transmission technology to form an image. Systems are categorized as general-use or limited-use based on the radiation dose required to obtain the image. Additionally, systems designed for screening vehicles or cargo containers may sometimes be used for security screening of humans with appropriate controls.

1.3.1. Backscatter Technology

Backscatter systems designed for security screening of humans are used mainly to image objects hidden under clothing. It may be necessary to scan a person multiple times, from the front, from the back, and from the sides. The effective dose from such systems is typically about 0.05 μSv (5 μrem) per scan of the front of the body; scans of the back or sides produce lower effective doses. Concerns have been raised about privacy because of the ability of these systems to "see" through clothing.

These systems use a narrow beam of ionizing radiation that scans the subject in a raster pattern at high speed. They use large detectors on the same side of the subject as the x-ray source that detect radiation scattered back from the body of the individual being scanned.

These systems have been used successfully in the United States by Customs and Border Protection and by the prisons for interdiction of drugs, weapons, and contraband. Additionally, backscatter systems are being evaluated for screening airline passengers.

1.3.2. Transmission Technology

Transmission systems are used to image objects that have been ingested, hidden in body cavities, or implanted under the skin. The effective dose from this type of system, when designed for security screening of humans, is variable and ranges roughly between 2 and 5 μSv (200 and 500 μrem). However, transmission images show objects and body parts superimposed. For this reason, image interpretation is more complex than for a backscatter image.

These systems create an image by passing ionizing radiation through the subject to a detector. The detector is placed on the opposite side of the subject from the ionizing radiation source. The radiation may be machine-generated x-rays or gamma-emitting radioactive isotopes.

Transmission systems designed for screening humans are used in other countries, such as South Africa, to screen workers in diamond mines to prevent theft. Larger, higher dose transmission systems are also used successfully in the United States by Customs and Border Protection to screen cargo and unoccupied vehicles for interdiction of drugs, weapons, and contraband.

1.3.3. System Categories

NCRP Commentary No. 16 classifies scanning systems that utilize ionizing radiation for security screening of humans into two categories: general-use systems and limited-use systems. General-use systems comply with the dose per scan limit in ANSI N43.17-2002 of less than or equal to 0.1 μSv (10 μrem). From a radiation protection standpoint, these systems can be used "mostly without regard to the number of individuals scanned or the number of scans per individual in a year[5]." *Note: For a system to be general-use it must incorporate adequate engineering controls to assure the dose limit is never exceeded.*

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[5] NCRP Commentary No. 16

The NCRP has classified a system as a limited-use system if the effective dose per scan can be greater than 0.1 μSv (10 μrem) but less than or equal to 10 μSv (1 mrem). A greater degree of control is necessary at a location where limited-use systems are used due to the higher potential for an individual to receive an effective dose greater than 0.25 mSv (25 mrem) per year. From a radiation protection standpoint, these systems should be used "with discretion in terms of the number of individuals scanned and the number of scans per individual in a year[6]."

1.3.4. Cargo Screening Systems

Besides systems designed specifically for security screening of humans, systems designed for security screening of vehicles or cargo containers may also be used for security screening of humans with appropriate controls. These systems are available in a wide variety of configurations which include: stationary, re-locatable, and mobile. In some systems both the subject and the system are stationary, in some the subject moves through the system, and in some the system moves past the subject. The ionizing radiation used by these systems comes from a radioactive source or is produced by a machine (e.g., x-ray tube or linear accelerator). The screening image is created utilizing backscatter, transmission, or a combination of backscatter and transmission technologies. Cargo screening systems may sometimes be used as limited-use systems for screening humans provided that the dose to any individual can be limited to 0.25 mSv (25 mrem) per year. This may be accomplished with a combination of engineering controls and administrative controls.

Engineering controls might be used to monitor the relative motion between the individual being scanned and the radiation beam so that the scan speed never drops below a minimum allowed speed. Administrative controls might be documented operational procedures that limit the maximum allowed dose per scan and recordkeeping procedures that keep track of the number of passes by individuals screened.

1.4. RADIATION SAFETY PHILOSOPHY

A sound radiation safety framework is based on three fundamental principles outlined by the International Commission on Radiological Protection (ICRP) – justification, optimization, and limitation[7].

Justification is the concept that practices involving exposure to ionizing radiation should only be adopted when it produces a sufficient benefit to the exposed individual or society to offset the radiation detriment it may cause. The decision to perform security screening of humans should be made by an authority at the appropriate organizational level and involves many factors other than radiation protection. Prior to conducting security screening of humans, the responsible

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[6] NCRP Commentary No. 16

[7] ICRP 60

executive should obtain legal advice and consider the operation, the current threat assessment, physical security, and cultural/social issues, to determine when security screening of humans is justified.

Optimization means that once a practice has been justified and adopted, procedures should be developed to ensure that the magnitude of doses received, the number of people exposed, and the likelihood of unnecessary exposures are kept *as low as reasonably achievable* (ALARA), taking into account economic and social factors.

Limitation involves the establishment of specific dose limits to control the exposures to individuals. Both the ICRP and NCRP recommend an annual dose limit of 1 mSv (100 mrem) for exposure to members of the general public. Since each member of the public may be exposed to ionizing radiation from more than one source, the NCRP further recommends that the dose from any single venue (defined as a single source or group of sources under one control) not exceed 0.25 mSv (25 mrem) per year. This rationale is based on the assumption that if each user of radiation sources limits the most exposed member of the general public to 0.25 mSv (25 mrem) per year, it is unlikely that any single individual will exceed the 1 mSv (100 mrem) per year dose limit.

1.5. SENSITIVE GROUPS

Various subgroups of the general population may be more susceptible to radiation-induced health effects than others. Some of these sensitive groups include pregnant women and children. For this reason the NCRP recommends lower limits of exposure for these special groups. For example, the NCRP recommends a maximum equivalent dose of 0.5 mSv/month (50 mrem/month) to the embryo or fetus of an occupationally exposed woman while the occupational limit is 50 mSv (5 rem) per year[8]. The dose constraint of 0.25 mSv (25 mrem) effective dose per year recommended by the NCRP for security screening is based on the general public limit and is much lower than the special limit for the embryo or fetus of occupationally exposed pregnant women. Therefore, there is no need to set different limits for the more sensitive members of the population being scanned by the systems. However, the NCRP recommends that alternative security screening methods be considered when there is a need to screen a pregnant woman with a limited-use system[9].

[8] NCRP Report 116

[9] NCRP Commentary No. 16

2. JUSTIFICATION AND OPTIMIZATION PROCESS

Justification is an essential element of national and international radiation safety standards[10]. Whenever a human activity causes an individual to be exposed to ionizing radiation, the activity needs to be justified. Any (agency's) new practice involving 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 optimized so that individuals are subjected to the lowest dose necessary. It is important that early decisions be made in the context of justification of a new practice and the need for subsequent optimization of the radiation dose. Understanding these concepts and what they entail for the security screening operation is crucial before committing to a technology.

A government agency should undertake a formal justification process (described below) when considering the use of security screening systems based on x-ray or gamma imaging technology. The decision to perform security screening of humans must be made by an authority at the appropriate organizational level. Prior to conducting security screening of humans, the responsible executive should obtain legal advice and consider the operation, the current threat assessment, physical security, and cultural/social issues, to determine when security screening of humans is justified. The purpose of this chapter is to guide the agency through the steps that are necessary to ensure an adequate justification for the use of ionizing radiation.

While considering the elements below during the justification process, the decisions made about those elements may require reassessments of the preceding elements and analyses. There is also a need for periodic reassessment of the justification and optimization processes for the practice.

The depth of detail and resources devoted to answering the questions in the following sections should be commensurate with the risks from the proposed practice. A practice using a general-use system may not require as much effort as one using a limited-use system.

2.1. DEFINE THE NEED

Note: The following steps are intended to assist with the decision process and are not necessarily in order of importance.

The process of justifying the use of ionizing radiation begins in the initial stages of considering security screening methodologies, even before ionizing 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 benefit-risk analysis. This process should result in the development of a requirements document, which can be used to

[10] ICRP 60, IAEA BSS No. 115, and NCRP 116

develop specifications for a security screening practice and assist in assessing the various options.

First, the agency should 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?

The agency should research and compile available data to support its best estimates. For example, the agency may identify the amount of contraband found and an estimate of missed contraband to help identify the need. All threats may not be as easily quantifiable.

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

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

2.2. EVALUATE OPTIONS

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

- Does the system do what you need it to do?
- Are there non-radiation or non-ionizing radiation options? (For example, physical searches.) Are they practicable?
- How well does the technology fulfill the agency's security screening needs?
- 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
  - Defense of justification
  - Impact of outsourcing on the agency'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 unauthorized use?
- Is any other agency successfully utilizing the technology? Is their use similar or different? How? Why?

2.3. EVALUATE PRIVACY CONCERNS

The agency should consider privacy concerns of employing a security screening technology and how much such concerns may affect the desirability of security screening. Negative public reaction may be so severe that the detriment to society out weighs the potential benefit of the activity. Significant litigation costs could make more traditional security methods much more cost effective. Also, any unintended release of the privacy information gathered could have a negative societal impact. All of these factors can result not only in a practice being abandoned after substantial monetary investment but also in discouraging other agencies from utilizing practices that don't have the same privacy issues.

- What information will be collected and used for this security screening process?
- Why is the information being collected and how are people affected?
- What notice or opportunities for consent can be provided to the individuals regarding the information collected, and how that information is shared?
- Who will see the images?
- Will the images or other information be shared? If so, with whom.
- Will the images and other information be retained and if so, for what period?
- Does this technology create a new system of records under the Privacy Act?
- Are there civil rights issues or other privacy concerns? For example, pregnant women or people with a disability or medical device implant.

2.4. ASSESS 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 specific technology. It is not the purpose of this document to provide a universal formula for deciding whether the benefits outweigh the risks. Each agency 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 qualified independent offices within the agency or, when possible, by qualified independent external agencies or institutions. The basis for the analysis should be documented and agreed upon by multiple officials who are in a position to understand the technical principles.

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 over a specified period of time?
- What are the potential acute and chronic risks to individuals undergoing security screenings with the selected technology?
- What are the risks to employees and by-standers?
- 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?

2.5. EVALUATE AGENCY’S ABILITY TO IMPLEMENT THE PRACTICE

When it has been determined that there is a net benefit to be derived from implementation of a security screening practice utilizing ionizing radiation, the costs and consequences of implementation should be considered. The agency should be prepared to provide the necessary safeguards to guarantee a safe and effective security screening operation. The agency should identify an official responsible for radiation safety and implement a radiation safety program. The extent of the program will depend on the nature of the equipment and the scope of the security screening operation(s).

The following questions will assist in evaluating the agency’s ability to implement the practice.

- REGULATORY
  - What are the applicable laws and regulations for the practice? (Federal, State, Local, Foreign)
  - 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 and NCRP Commentary No. 16?

- 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 outsourced, has training been appropriately addressed? (For example: How is appropriate training and expertise ensured?)
  - Does the training adequately address risk communication and image control for operators and management?

2.6. CONCLUDING DECISION

An agency's final decision on which security screening technology best meets their needs will be based on several competing factors. No matter what the factors, the overall benefit must outweigh the risks associated with the chosen security screening method. After due consideration of the justification process outlined above, the agency should document its decision. The following elements of the decision process should have been appropriately considered and documented:

1) The security need should be defined including the magnitude of the threat and the risk of not implementing the chosen security practice.

2) The various options should have been considered, including their effectiveness and their limitations.

3) Technologies should have been evaluated based on the expected reduction of the security 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).

4) The agency should have confirmed the availability of sufficient resources and its ability to implement the chosen security screening method. The decision should include an initial plan for instituting the necessary programs and allocating resources.

5) 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.

3. ESTABLISHING A RADIATION SAFETY PROGRAM

If a Federal agency decides to use security screening practice that uses ionizing radiation, they should establish and maintain an effective radiation safety program.

The general elements of a radiation safety program are discussed below. A sample radiation safety program is provided in Appendix A. The scope of any radiation safety program should be commensurate with the potential risks associated with the security screening practice. Therefore, each agency (or organization within an agency) will need to tailor their radiation safety program to their specific needs. Some of the radiation safety program elements discussed below will not be necessary in all programs.

Systems should be operated in conformance with the applicable sections of ANSI N43.17 and NCRP Commentary No. 16.

Mobile systems require a more complex program than similar stationary systems.

3.1. RADIATION SAFETY PROGRAMS

The purpose of an agency's radiation safety program is to ensure the safety of individuals who could be exposed to radiation. These individuals may be employees who operate the security screening system(s), employees who happen to work nearby, screened individuals, and members of the general public. This is accomplished through engineering controls (proper equipment and facility designs) and administrative controls (training as well as policies and procedures consistent with applicable regulations and industry standards).

3.1.1. Administrative Organization

One of the most important elements of any radiation safety program is the administrative organization.

Executive management has the ultimate responsibility for the safe use of security screening system that use ionizing radiation. The agency or organization management should be committed to the safe use of ionizing radiation and this commitment should be clearly communicated to all employees (and, in some cases, the public). This commitment also involves ensuring that sufficient resources are provided to establish and maintain an effective radiation safety program.

In some cases, a radiation safety committee (RSC) will need to be established. Generally, an RSC is only required for complex radiation safety programs. Less complex programs may not require an RSC. The organizations could consider using an existing safety committee to provide oversight of radiation safety issues.

The agency's executive management should designate an individual responsible for radiation safety. This individual is often called a radiation safety officer (RSO) or a radiation safety manager. Whatever the title, this individual is responsible for the day-to-day operation of the radiation safety program. This individual should have appropriate qualifications (for example, training and experience) commensurate with the scope of the program. This individual should be granted sufficient authority, resources, and organizational freedom to effectively manage the program and stop unsafe activities.

3.1.2. Written Policies and Procedures

Any organization that uses ionizing radiation for security screening needs to have a written radiation safety program. The form of this document may vary for different agencies. The radiation safety program should be acknowledged as a management policy applicable to the whole organization. At a minimum, the written procedures should address the following topics:

- Assignment of responsibilities
- Licensing/registration requirements
- Training
- Life cycle management of ionizing radiation systems
- Procedures for safe use
- Preventive maintenance
- Site selection
- Security/Access
- Emergencies
- Record keeping
- Risk Communication Plan
- Periodic Reviews
- Leak checking/surveys

3.1.2.1. Assignment of responsibilities

This section of the written program documents the administrative organization discussed in paragraph 3.1.1 above. It also documents the responsibilities and authority of each group or individual within that organization, in regards to radiation safety. The membership of the RSC, if required, is documented in this section.

3.1.2.2. *Licensing, registration, and other regulatory requirements*

The type of ionizing radiation source (x-ray or radioactive material) and the location of use determine the appropriate regulatory authority. For Federal agencies[11] (with the exception of DOE), the U.S. Nuclear Regulatory Commission (NRC) is the regulatory authority for most radioactive materials. For occupational exposure to non-Atomic Energy Act (AEA) materials,

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[11] For other than Federal agencies, the regulatory authority for radioactive material is either NRC or a State Radiation Control Program

OSHA has regulatory authority. For machine generated radiation, the regulatory authorities are FDA and OSHA.

3.1.2.3. *Training*

All personnel managing, operating, and servicing security screening systems should have appropriate training and experience. The minimum level of training needed to operate the system should be specified. Prior to using the system, personnel should receive both operator training and radiation safety training. It is also highly recommended that operators receive training in risk communication since they may need to provide information to members of the public. Annual refresher training should also be provided.

Another category of individuals who may need training are ancillary personnel who work nearby such as security guards, administrative staff, and housekeeping staff. Providing these individuals with basic radiation safety awareness training may prevent misunderstandings and allay some of the fears they may have about working in the area.

3.1.2.4. *Life cycle management of security screening systems*

The written radiation safety program should also address the procedures for acquisition of security screening systems once their use has been justified. The procedures should specify the individual whose approval is required prior to obtaining these systems.

All security screening systems should be installed and maintained according to the manufacturer's specifications for safe operation. Preventive maintenance schedules should be developed and followed. Procedures should also be established for unscheduled maintenance or repairs.

Procedures should be established to maintain a current inventory of all ionizing radiation systems.

The program should include policies and procedures for the movement or transfer of security screening systems. The procedures should ensure that the individual responsible for radiation safety is involved in the movement or transfer process. This includes movement within the facility and between facilities as well as transfer to another agency or location. The individual responsible for radiation safety should ensure that all appropriate regulations are followed.

Finally, procedures for the ultimate disposition of the system should be included. These procedures should ensure that the individual responsible for radiation safety is involved in all disposition actions. There are specific federal and/or state regulations that should be followed for the disposal of hazardous materials.

3.1.2.5. *Procedures for safe use*

Although security screening systems are generally designed to produce low radiation exposures, the decision to monitor personnel exposures needs to be evaluated on a case-by-case basis. Documenting zero or near zero doses may be desirable, especially with the implementation of new security screening practices.

An alternative to individual monitoring may be area monitoring. The results of area monitoring may be used to ensure that there are no failures of the shielding and individual doses are maintained as low as reasonably achievable (ALARA).

Policies and procedures should be established for conducting radiation safety surveys of each security screening system. Some of these security screening systems may present technical challenges to accurately measure their emissions. Appropriate meters should be used correctly to accurately measure the radiation emitted. For example, Geiger-Mueller (GM) meters are inadequate for making quantitative exposure measurements for x-ray systems, yet GM meters are useful for finding the locations with the highest emissions. At a minimum, each system should be surveyed prior to the first use and then annually. In addition, a re-survey is needed when repairs have been performed that may affect the radiation producing or shielding components of the system.

Procedures should be developed and implemented to determine if a site is appropriate for security screening (including relocation of existing sites). Primary factors to be considered include occupancy of adjacent areas, system orientation, and traffic flow.

3.1.2.6. Security/Access

Procedures should be established to prevent unauthorized access or use of the systems. Only trained and qualified personnel should operate the systems.

3.1.2.7. System damage and/or malfunction

Procedures should be established to ensure that damaged or malfunctioning security screening systems are not used. Clear procedures for reporting damage or malfunction should be included in the operator's instructions.

3.1.2.8. Record keeping

The record keeping requirements should be documented in the written radiation safety program. These records should include surveys of the system(s). See ANSI N43.17 and NCRP Commentary 16 for specific record keeping requirements.

3.1.2.9. Risk Communication Plan

When appropriate, each organization should establish a procedure for communicating basic information about the security screening practice to the appropriate individuals. This communication can take almost any form. For example, fact sheets that can be distributed or posters placed in conspicuous areas, etc. A sample fact sheet that can be adapted to an organization's specific needs is provided in Appendix B.

In addition, some individuals may have more detailed concerns or questions that the operators are unable to answer. To avoid spreading inaccurate information, an appropriate individual should be designated to handle these types of inquiries. This individual should have additional knowledge and training in both radiation safety and risk communication and, if properly trained or briefed, may be someone from the agency's public affairs office.

3.1.2.10. Periodic program reviews

An important feature of any radiation safety program is a periodic comprehensive program review. This review is typically conducted annually. The review should confirm that the written program meets all regulatory requirements, is adequate to ensure safety, and that the program is being followed. It may be either an internal review or an external review. It is highly recommended that an external radiation safety expert conduct the review at least once every three years.

3.2. WHERE TO GO FOR HELP

3.2.1. Department of Defense (DOD)

Each DOD component establishes and maintains their radiation protection program as specified in Department of Defense Instruction (DODI) 6055.8, Occupational Radiation Protection Program. Each DOD component has specific policies for addressing radiation safety; however, the scope of the programs and the procedures employed vary from one component to another. Any DOD organization that wants to acquire radiation sources needs to follow their service specific procedures.

3.2.2. Department of Energy (DOE)

Under the Atomic Energy Act, DOE is generally responsible for radiation protection of the public, environment, and workers at its facilities and operations. Field and Program Offices are directly responsible for radiation protection at their facilities and the Office of Health, Safety, and Security provides oversight. The DOE web site, www.doe.gov, provides information on responsibilities within DOE. Information on the requirements in DOE directives is available at www.directives.doe.gov.

3.2.3. Environmental Protection Agency (EPA)

Through its Federal Guidance authority, inherited from the Federal Radiation Council in 1970, EPA issues recommendations to Federal Agencies, signed by the President, for protecting workers and the general public from radiation. EPA also issues Federal Guidance technical reports that promote standard methods for performing dose and risk assessments (see section 3.3).

3.2.4. Food and Drug Administration (FDA)

FDA regulates the manufacturers of electronic products that emit radiation. FDA's regulatory authority includes non-medical security products that use x-ray tubes, linear accelerators, or any other electronic source of radiation. FDA can take regulatory action if a regulated product has a radiation safety defect. FDA can answer questions on regulated products' radiation emission; regulatory requirements for the manufacturers of these products; and on the compliance of manufacturers to FDA's regulations. FDA’s Radiological Health Program web site’s address is: http://www.fda.gov/cdrh/radhealth/.

3.2.5. National Institute for Occupational Safety and Health (NIOSH)

NIOSH was established to help assure safe and healthful working conditions for working men and women by providing research, information, education, and training in the field of occupational safety and health. The Institute is authorized to (1) develop recommendations for occupational safety and health standards, (2) conduct research on worker safety and health, (3) conduct training and employee education, (4) develop information on safe levels of exposure to toxic materials and harmful physical agents and substances; (5) conduct research on new safety and health problems; (6) conduct on-site investigations to determine the toxicity of materials used in workplaces, and (7) fund research by other agencies or private organizations through grants, contracts, and other arrangements.

3.2.6. Nuclear Regulatory Commission (NRC)

NRC is responsible for licensing and inspection of commercial uses of byproduct materials as defined in the Atomic Energy Act. Information on licensing can be obtained from NRC's Regional Offices. The NRC web site, http://www.nrc.gov/, provides information on the areas covered by each Regional Office. Information can also be obtained from the Office of Federal and State Materials and Environmental Management Programs. Guidance on the information that would need to be submitted in support of a license is also available on the NRC web site.

3.2.7. Occupational Safety and Health Administration (OSHA)

As it relates to ionizing radiation, OSHA is the regulatory agency with jurisdiction over occupational exposures related to non-AEA radiation sources. This includes occupational exposures during the use of x-ray systems, accelerators, and non-AEA radioactive materials.

3.2.8. State Agencies

Almost every state has a radiation control program. The program's location within the government structure varies. It can be in the Labor, Health, Emergency Services, and/or Environmental Protection Department. A contact list of state radiation control programs can be located at http://www.crcpd.org.

Most state radiation control programs regulate, to some degree, radioactive materials and radiation generating devices (RGDs). If a state is an NRC Agreement State, all radioactive material licensing, with the exception of federal facilities, occurs through the state program. For states that are not Agreement States, the NRC has authority to regulate all radioactive materials covered by the Atomic Energy Act of 1954 (AEA) except for materials and RGDs regulated by the Department of Energy under their AEA authorities and responsibilities.

The Conference of Radiation Control Program Directors (CRCPD) publishes model regulations for control of RGDs, see http://www.crcpd.org/WGs/SRC/Suggested_State_Regs_Council.html. RGDs include dental and medical x-ray units (e.g., radiography, CT, fluoroscopy, etc.) as well as non-medical x-ray products (e.g., x-ray fluorescent analyzers, baggage security cabinet x-ray systems, non-destructive testing radiography systems, etc.). RGDs also include high energy medical and non-medical accelerators.

Any private sector entity or state agency that plans to perform security screening of humans using ionizing radiation should contact their state's radiation control program for guidance on applicable regulations. Federal agencies that plan to use security screening equipment or other RGD within a given state's borders might consider setting up a mechanism with the state's radiation control program for technical assistance with equipment testing, public, personnel monitoring and personnel protection. Appropriate mechanisms include contracts, memorandum of agreement (MoA) or understanding (MoU). For example, the FDA has many contracts with states for the testing of mammography x-ray equipment.

3.3. REFERENCES FOR FURTHER INFORMATION

[*Note: The documents below provide relevant guidance. (It may be beneficial to contact other federal users who have gone through the process.)*]

Resources:

EPA Federal Guidance Report No. 13: Cancer Risk Coefficients for Environmental Exposure to Radionuclides [EPA 402-R-99-001] http://epa.gov/radiation/docs/federal/402-r-99-001.pdf

21 CFR 1000-1005 FDA Regulations and FDA's Radiological Health Program (http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPartFrom=1000&CFRPartTo=1005) and http://www.fda.gov/cdrh/radhealth/

29 CFR 1910.1096, Occupational Exposure to Ionizing Radiation http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10098

NUREG-1556 Vol. 1 Rev. 1 Program Specific Guidance about Portable Gauge Licenses

10 CFR 835, Occupational Radiation Protection

DOE P 441.1 DOE Radiological Health and Safety Policy

DOE G 441.1-12 Radiation Safety Training Guide

DOE G 441.1-1A Management and Administration of Radiation Protection Programs Guide

DOE G 441.1-2 Occupational ALARA Program Guide

DOE G 441.1-4A External Dosimetry Program Guide

DOE G 441.1-5 Radiation-Generating Devices Guide

DOE G 441.1-6 Evaluation and Control of Radiation Dose to the Embryo/Fetus Guide

ANSI/HPS N43.17-2002 Radiation Safety For Personnel Security Screening Systems Using X-Rays (http://hps.org/hpssc/N43_17_2002.html)

NCRP Commentary No. 16, Screening of Humans for Security Purposes Using Ionizing Radiation Scanning Systems (2003) (http://www.ncrppublications.org/index.cfm?fm=Product.AddToCart&pid=8182473315)

NCRP Report No. 93, Ionizing Radiation Exposure of the Population of the United States (1987) (http://www.ncrppublications.org/index.cfm?fm=Product.AddToCart&pid=9832704096)

NCRP Report No. 116, Limitation of Exposure to Ionizing Radiation (1993) (http://www.ncrppublications.org/index.cfm?fm=Product.AddToCart&pid=9143114606)

ICRP Publication 60, 1990 Recommendations of the International Commission on Radiological Protection (1990) (A summary is available at: http://www.icrp.org/downloadDoc.asp?document=docs/Summary_B-scan_ICRP_60_Ann_ICRP_1990_Recs.pdf)

IAEA BSS No. 115, International Basic Safety Standards for Protection Against Ionizing Radiation (1996) (http://www-pub.iaea.org/MTCD/publications/PDF/SS-115-Web/Start.pdf)

Health Physics Society Position Statement, Use of Ionizing Radiation for Security Screening Individuals (2003) (http://hps.org/documents/IonRadPS.pdf)

CRCPD Resolution Relating to Public Being Irradiated with Ionizing Radiation for non-medical purposes (5/99) [HA19] (http://www.crcpd.org/Positions_Resolutions/Healing_Arts/medicine_19990599.htm)

Airline Passenger Security Screening: New Technologies and Implementation Issues. Publication NMAB-482-1. National Academy Press. Washington, D.C (1996) (http://books.nap.edu/catalog/5116.html)

APPENDIX A:
Sample Radiation Safety Program SOP for Limited Use Systems

The sample SOP presented in this appendix is intended to provide a starting point for developing an agency or organization specific SOP. It is written for a program using limited-use x-ray based security screening systems. Some items may not be applicable to programs that have only general-use system and additional items will be needed for radionuclide-based systems.

Every agency has its own guidelines for style, format, and in some cases content. Therefore, this sample SOP will need to be modified to meet the needs of each agency (or organization within an agency). Several notes are included to indicate places where agency specific information may need to be inserted. These notes are not all inclusive, and each agency should carefully consider all aspects of their program and ensure that their SOP includes all necessary policies and procedures for their specific need.

<Document Control No.>

<date>

<Agency>

<Activity>

<Address>

Radiation Safety Program for Security Screening of Humans with Limited-Use Systems

1. **Purpose**. This procedure outlines responsibilities and describes the requirements and implementation of the radiation safety program for the use of limited-use personnel security screening systems.

2. **Scope**.

3. **References**.

   a. ANSI N43.17-2002

   b. NCRP Commentary No. 16

   c. *<<Insert NRC regulations and NRC license or for other than federal agencies, Agreement State equivalent regulations and license" for radionuclide systems>>*

   d. *<<Insert other references used (e.g. the system users manual)>>*

4. **Definitions**.

a. Effective Dose – Sum of the tissue-weighted equivalent doses in all the tissues and organs of the body.

b. Inspection Zone – A well defined (demarcated by tape, paint, rope barrier, etc) area around the personnel security screening system where no one but the individual being scanned is authorized during the operation of the device. Purpose of the zone is radiation exposure control.

c. *<<Note: Include other relevant definitions – when possible use definitions from a standard such as ANSI/HPS N43.17>>*

5. **Responsibilities**.

a. *<<Agency/organization head>>* will—

(1) Make the ultimate decision to use security screening systems and be ultimately responsible for radiation safety.

(2) Designate an individual responsible for radiation safety. This individual must have training and experience commensurate with the scope of the radiation safety program.

(3) Designate authority to approve and manage the day-to-day use of the system .

b. The individual responsible for radiation safety will—

(1) Formulate, implement, and exercise staff supervision over the radiation safety program.

(2) Formulate, implement and supervise an active, documented program to keep ionizing radiation doses to levels that are ALARA.

(3) Advise and assist the agency management and personnel in all matters regarding radiation safety.

(4) Review current and proposed uses of the system for compliance with applicable regulatory requirements and guidance.

(5) Ensure radiation safety considerations are incorporated into system operating procedures.

(6) Review and approve the location/relocation of security screening systems to ensure compliance with radiation safety criteria and manufacturer's recommendations/specifications. Other individuals may need to review and approve the location/relocation of security screening systems to ensure compliance with other safety/engineering requirements (e.g., floor loading, electrical, and/or operational process).

(7) Ensure that radiation safety surveys are performed in areas around security screening systems at least annually. Ensure surveys are performed with appropriately calibrated equipment and documented accordingly. See paragraph 10.b for recommended survey records.

(8) Ensure that dosimeters, if issued, are used, collected and processed properly.

(9) Maintain an inventory of radiation producing devices.

(10) Maintain radiation safety records in accordance with applicable federal regulations and agency policies.

(11) Ensure initial and annual (refresher) radiation safety training is provided to system operators and other personnel.

(12) Coordinate investigations of radiation safety related system defects, damage, malfunctions, and violations of radiation safety procedures.

(13) Immediately terminate any unsafe activity involving personnel security screening systems.

(14) Ensure that the radiation safety program is reviewed at least annually. This review will ensure that the program is adequate to ensure the safety of personnel and that the program is being followed. At least once every three years, an external qualified expert will perform this review.

c. Operators.

(1) Follow all applicable SOPs and regulations.

(2) Immediately report any unsafe situation, damage to or malfunction of the security screening system, violation of regulations or radiation safety procedures to their supervisor and/or the individual responsible for radiation safety.

(3) Ensure only trained and authorized personnel operate the security screening systems.

(4) Maintain system use and maintenance log(s) as described in section 10 and update as appropriate.

d. Other Workers.

(1) Follow all applicable SOPs and regulations.

(2) Immediately report any unsafe situation, damage to or malfunction of the security screening system, violation of regulations or radiation safety procedures to their supervisor and/or the individual responsible for radiation safety.

6. **Equipment Life Cycle Management**.

a. Licensing/Registrations.

<<Note: Insert information here about agency specific requirements. For radionuclide sources, this will involve NRC license issues. For x-ray systems, it may involve state registration (if applicable) or internal agency permits or property control procedures. See paragraph 3.1.2.2 for further discussion.>>

b. System Acquisition/Replacement. Any acquisition of a limited-use security screening system will be approved by <<insert appropriate approval authority>> prior to purchase or replacement and after justification of such system.

c. Installation.

(1) Security screening systems shall be installed in accordance with the manufacturer's installation instructions. Only properly trained individuals will install security screening systems.

(2) From a radiation safety standpoint, security screening systems must be installed in locations that are as far as reasonably possible from routinely occupied areas, subject to the operational requirements. Consideration must also be given to the direction of the x-ray beam relative to occupied areas, traffic flow, the number of scans per day, the effective dose per scan, and locations of existing walls or structures that can provide shielding.

(3) During installation the area for the Inspection Zone for the system shall be determined, documented and clearly delineated.

<<Note: Consider inserting the specific technique that will be used at your facility to clearly delineate the inspection zone, e.g., tape, paint, rope barrier, etc.>>

d. Maintenance. Qualified personnel will perform all maintenance. Maintenance records will be maintained in accordance with section 10.

(1) Routine Preventive Maintenance. Preventive maintenance will be performed in accordance with the manufacturer's recommended maintenance schedule.

(2) Non-Routine Maintenance. Provisions must be made when purchasing a system for the possibility of repairs outside of the recommended preventive maintenance schedule.

e. Relocation/Transfer.

(1) Security screening systems will not be relocated without appropriate approval. Many factors, such as radiation safety, electrical safety, traffic flow, floor loading, etc., need to be considered when relocating a security screening system.

(2) Security screening systems will not be transferred to another organization without appropriate approval.

<<Note: Radionuclide systems can only be transferred to organizations with an appropriate NRC license.>>

f. Disposal. The disposal of x-ray systems will be coordinated with the hazardous materials coordinator to ensure proper disposal of all hazardous materials, such as cooling oil and lead shielding.

<<Note: For radionuclide systems disposal must be performed in accordance with NRC regulations and license conditions. Insert the specific procedures that need to be followed.>>

7. **Training**.

a. Each operator will be provided with training on the operation and use of the security screening system(s). At a minimum, this training will include pre-operational checks, operation of the system, subject positioning, interpretation of images, procedures to be followed if the system is damaged or malfunctions, and practical operational experience. Periodic updates will be provided as the security screening systems or relevant threats change.

b. Each individual associated with the operation of the security screening system will be provided Radiation Safety Training prior to performing security screening operations. At a minimum, this training will include the following:

(1) The types of radiation

(2) Sources and magnitudes of typical exposures

(3) Radiation units

(4) Concept of time, distance, and shielding

(5) Concept of ALARA

(6) Biological effects

(7) Radiation risk

(8) Basic risk communication concepts

c. Other individuals who work near the security screening system, but are not directly associated with its operation will be provided with basic radiation awareness training. This will be a simplified version of the radiation safety training discussed in paragraph B above and include information pertinent to the system around which they will be working.

8. **Surveys**.

a. A formal radiation survey by a qualified expert is required upon installation and at least once every twelve months.

b. A formal radiation survey is also required whenever the system is relocated or non-routine service involving the x-ray source, any x-ray collimating device, or x-ray shielding in performed.

c. These surveys will verify the effective dose per scan, radiation leakage, the adequacy of the inspection zone, and other parameters specified by the manufacturer.

d. Records of surveys will be maintained as specified in paragraph 10.b.

9. **Procedures for Use**.

a. Preoperational Checks. <<Insert the preoperational checks needed for the specific security screening system(s) being used. This should include what checks are performed, how they are performed, and where/how they are recorded. See the manufacturer’s literature for recommended checks and other information>>

b. Notification and Communication Plan. Each individual screened will be provided with information regarding the security screening process. At a minimum, this information will include the following:

(1) The system emits radiation.

(2) The dose per scan from the system and the number of scans that would result in an effective dose of 25 mrem.

(3) Comparisons of the dose to other common exposures (such as natural background radiation).

<<Note: Insert the specific method(s) that will be used to convey this information to the subject. Possible methods include fact sheets, Q&As, posters, signs, video clips, briefings, website, etc. The best method will depend on the audience and the situation. For example, briefings may be appropriate for situations where there are a limited number of individuals being routinely screened. A brochure or poster may be more effective where there are large numbers of individuals. If the screened population includes non-English speaking individuals, consideration should be given providing the information in other languages.>>

<<Note: Insert the local procedures that will be followed when individuals have additional questions or concerns beyond the information typically provided. Consider designating a qualified individual to handle these additional questions. This individual may in the public affairs office.>>

c. Security/Access. *<<Insert the procedures that will be used to control access to and operation of the security screening system. This may include keys control and/or user names and passwords.>>*

d. System damage or malfunction. In the event of damage to the system or a system malfunction, the system will be removed from service until appropriate maintenance or repair personnel have corrected the problem. In no case will damaged or malfunctioning equipment be used for security screening.

<<Note: Insert specific procedures for notifying the appropriate individual(s) of damage or malfunction. Consider specifying an alternate security screening process that will be used until the system is returned to normal operation.>>

<<Note: Insert additional procedures that will be needed for radionuclide based systems.>>

e. Sensitive Groups. *<<Note: Insert the local policies for security screening of pregnant women and children. Will it be performed? Under what conditions? Alternate security screening method is not performed?>>*

10. **Recordkeeping**.

a. Use and Maintenance Logs. Records of upgrades, modifications, maintenance and repair will be maintained for the life of the system.

b. Survey Records. Records of radiation surveys will be maintained for the life of the systems. Survey records will include the following:

(1) System make, model, serial number, and location

(2) Surveyor

(3) Survey date

(4) Instrumentation make, model, serial number, and calibration dates.

(5) Results of visual inspection of system safety features

(6) Background measurements

(7) Survey measurements

(8) Survey diagram

(9) System parameters at which measurements were made

c. Training Records. Records of training will be maintained that contain the date of training, an outline of the training, and the names of those in attendance.

d. Scanned individuals. For individuals who could receive radiation doses approaching 0.25 mSv (25 mrem) in a year, such as employees or frequent visitors, records will be maintained to demonstrate that the administrative control of 0.25 mSv (25 mrem) in a year is not exceeded. These records will include the following:

(1) The maximum estimated effective dose per scan or the actual effective dose per scan, if known.

(2) The number of times and dates when the individual was scanned.

(3) The cumulative effective dose to the individual over the past 12 months.

APPENDIX B:
Sample Information Sheet on Security Screening

The sample information sheet presented in this appendix is intended only to provide a starting point for developing an agency or organization specific information sheet. The sample information sheet contains blanks where data specific to the agency's security operation can be inserted. Any text contained within angle brackets (< >) is inserted as a placeholder. This text will need to be modified based on the specific security screening system and/or procedures.

Every agency has its own guidelines for style, format, and in some cases content. No single information sheet can meet the needs of every agency for all types of security screening operations. Therefore, this sample information sheet will need to be modified to meet the needs of each agency (or organization within an agency).

One method of communicating information to the screened individual is by distribution of an information or fact sheet. The following sample information sheet provides general information on ionizing radiation and the security screening process. If an organization intends to communicate information through an information or fact sheet, the following sample should be tailored to the organization's specific needs. Information pertaining to the specific security screening system(s) will need to be added.

For purposes of comparing the radiation dose from a security screening system to other sources of radiation exposure, the following data, extrapolated from NCRP Report No. 93, can be used:

- The dose rate at 39,000 feet is approximately 5 μSv (500 μrem) per hour. For example, a dose per scan of 0.1 μSv (10 μrem) would be equivalent to

$$\frac{0.1\,\mu Sv}{5\,\mu Sv/h}\left(60\text{ min}/h\right)=1.2\text{ min}$$

- The average annual radiation dose to a member of the U.S. population from natural background radiation is 3 mSv (300 mrem), or 5.7×10^{-3} μSv/min (0.57 μrem/min). For example, a dose per scan of 0.1 μSv (10 μrem) would be equivalent to

$$0.1\ \mu Sv/5.7 \times 10^{-3}\ \mu Sv/\text{min} = 18\text{ min}$$

- The weighted average of the diagnostic medical x-ray examination doses from NCRP Report No. 93 is approximately 500 μSv (50 mrem) per examination. For example, a dose per scan of 0.1 μSv (10 μrem) would be equivalent to

(0.1 μSv/500 μSv) x 100 = 0.02% of a typical diagnostic medical x-ray examination

- The weighted average of the diagnostic nuclear medicine test doses from NCRP Report No. 93 is approximately 4300 μSv (430 mrem) per examination. For example, a dose per scan of 0.1 μSv (10 μrem) would be equivalent to

(0.1 μSv/4300 μSv)*100 = 0.0023% of a typical diagnostic nuclear medicine tests

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Information Sheet on Security Screening

Summary of Key Messages

- People are exposed to ionizing radiation every day.
- The ionizing radiation dose from the security screening process is much less than the average member of the public receives in one day from natural sources of radiation.
- Exposure to ionizing radiation may increase an individual's risk of developing cancer later in life; however, at these very low doses the potential increase in risk is extremely small.

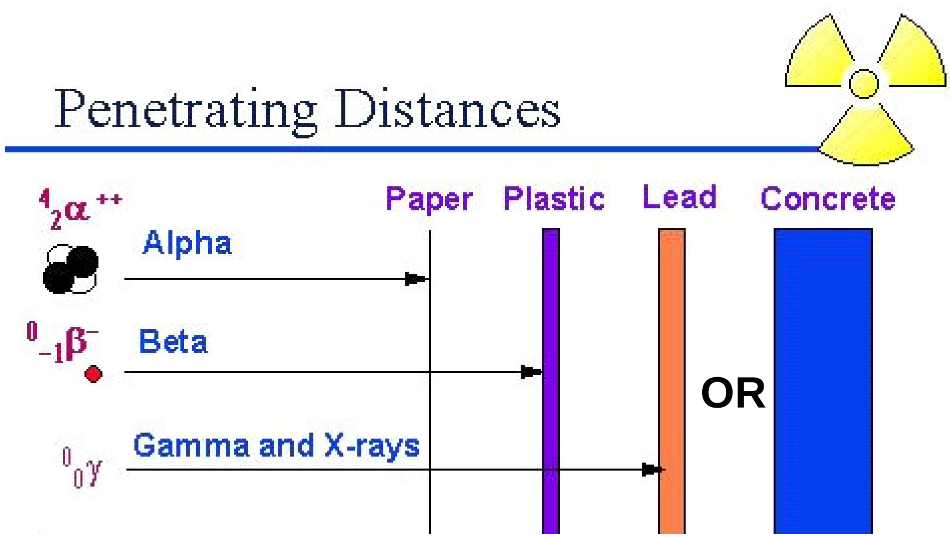
What is ionizing radiation?

Radiation is a form of energy. If radiation has sufficient energy to eject electrons from neighboring atoms, it is called *ionizing radiation*. This energy may be in the form of particles or electromagnetic waves.

What are the types of ionizing radiation?

The main forms of ionizing radiation are alpha particles, beta particles, gamma rays, and x-rays. This screening system uses <x-rays/gamma rays>.

Gamma and X-rays are electromagnetic waves (like radio waves and visible light, but more energetic). They are more penetrating than alpha and beta particles.

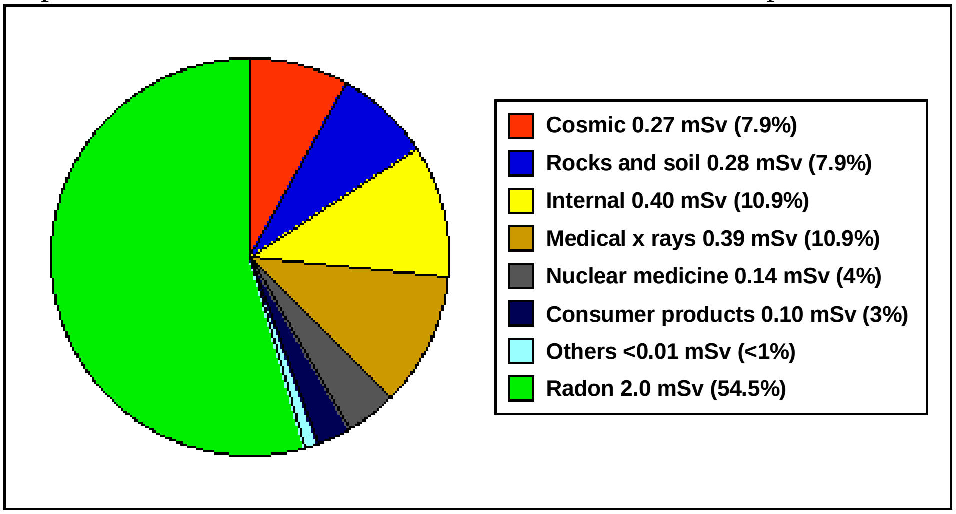


How may I be exposed to ionizing radiation?

Ionizing radiation is an everyday part of our environment. Low levels of radiation strike the earth in the form of cosmic rays and solar emissions. All soils contain naturally occurring uranium and thorium, which are radioactive. Uranium and thorium decay to produce radon, a radioactive gas that seeps from the soil into the air we breathe. Additionally, small amounts of radioactive material are found in our food supply and in many consumer products such as tobacco and smoke detectors. All of these sources of *background radiation* can vary widely depending on geographic location.

How much radiation do we typically receive?

Everyone receives some radiation dose every day. Most of this exposure comes from natural sources, but a portion comes from man-made sources, such as medical procedures.



Sources of Radiation Exposure for U.S. Public (NCRP 93, 1987)

How much radiation will I receive from this screening?

The dose from one scan with this security screening system is approximately: _____ millisieverts (a unit of radiation dose). This radiation dose is the same as that received from the following: _____ minutes of air travel at 39,000 ft (from cosmic radiation) _____ minutes of exposure to naturally occurring background radiation _____ % of typical chest x-ray examination _____ % of a diagnostic nuclear medicine test	OR _____ scans are equivalent to 1 hour of air travel at 39,000 ft _____ scans are equivalent to1 year of exposure to natural background radiation _____ scans are equivalent to a typical chest x-ray examination _____ scans are equivalent to a typical nuclear medicine test

Will this exposure to radiation make me radioactive?

No. Exposure to gamma rays or x-rays deposits energy in the body, but will not cause you to become radioactive.

Where can I get more information?

Environmental Protection Agency, Understanding Radiation
http://www.epa.gov/radiation/understand/index.html

World Health Organization Ionizing Radiation Page
http://www.who.int/ionizing_radiation/en/

NCRP Report No. 93, Ionizing Radiation Exposure of the Population of the United States http://www.ncrppublications.org/

Centers for Disease Control and Prevention Radiation Emergencies Page http://www.bt.cdc.gov/radiation/emergencyfaq.asp

Health Physics Society fact sheets
http://hps.org/publicinformation/radterms/

Food and Drug Administration, Radiological Health Program
http://www.fda.gov/cdrh/radhealth/