



Scanners for Security Screening and for Theft and Contraband Detection

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Personal Scanners

Figure 1 Backscatter Systems and
Sample Images
(NCRP Commentary No. 16)

Rapiscan's Secure 1000™



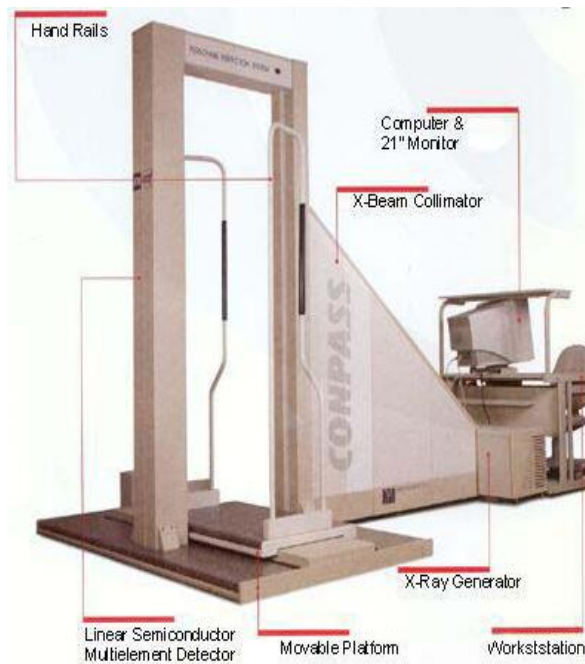
A S & E BodySearch™





Personal Scanners

Transmission System and Sample Images





Scanner Types



Cargo Scanners





Cargo Scanners

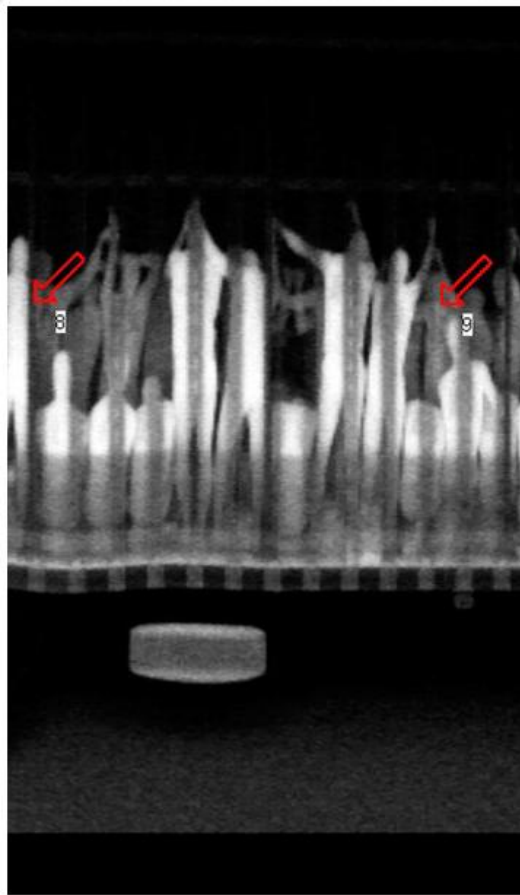
6 MeV Mobile Linear Accelerator for Cargo Scanning



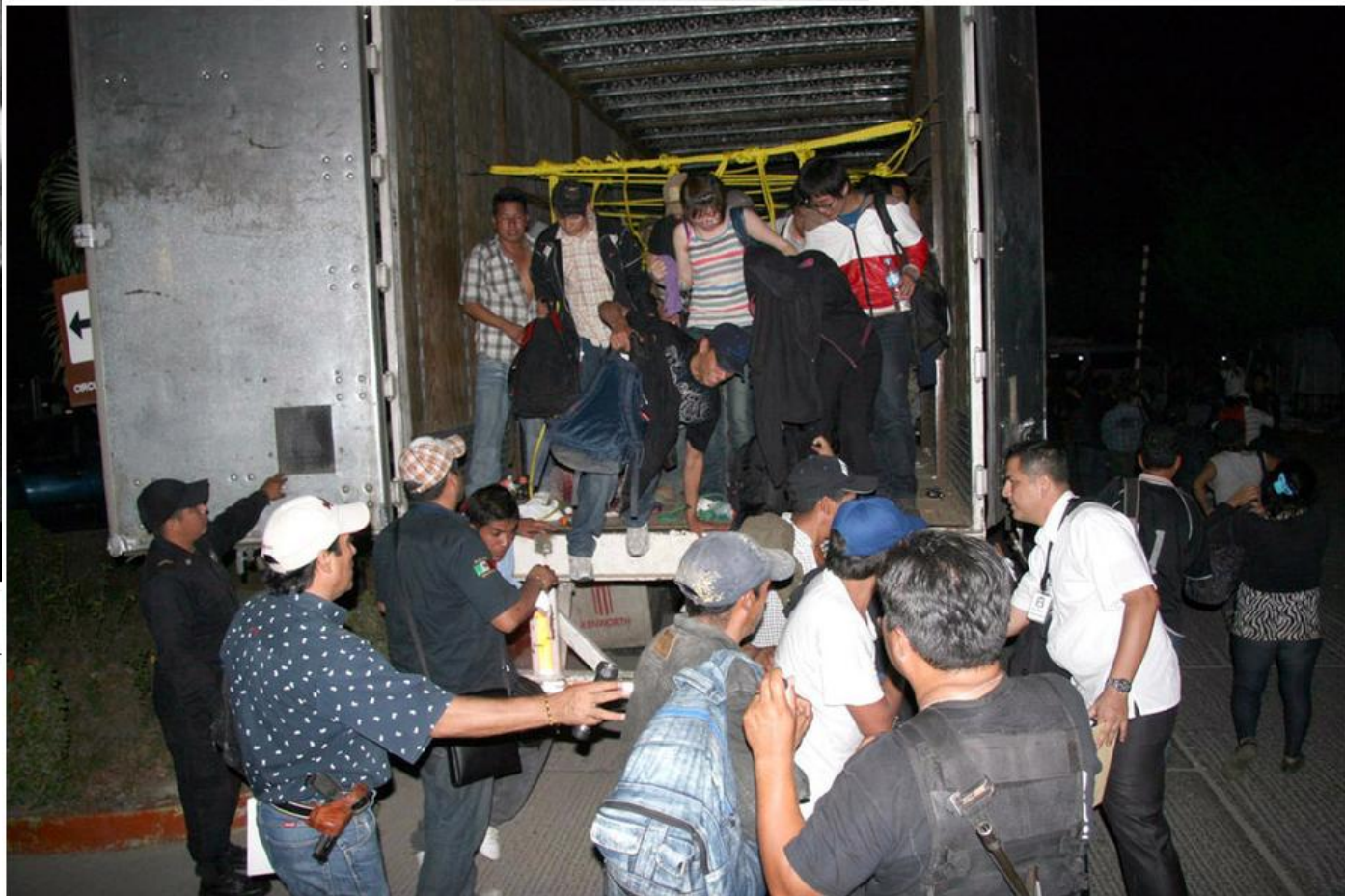


Mobile unit of the type allegedly used for security purposes in Tampa, Florida, USA, to image the inside of cars and trucks accessing the 2009 Super Bowl venue





墨西哥两辆货车查获513名偷渡客



墨西哥两辆货车查获513名偷渡客

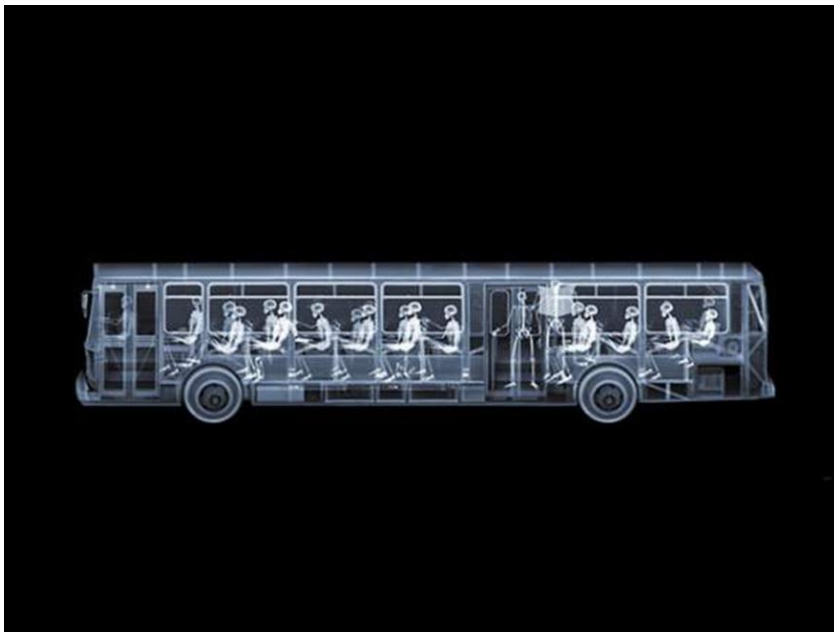
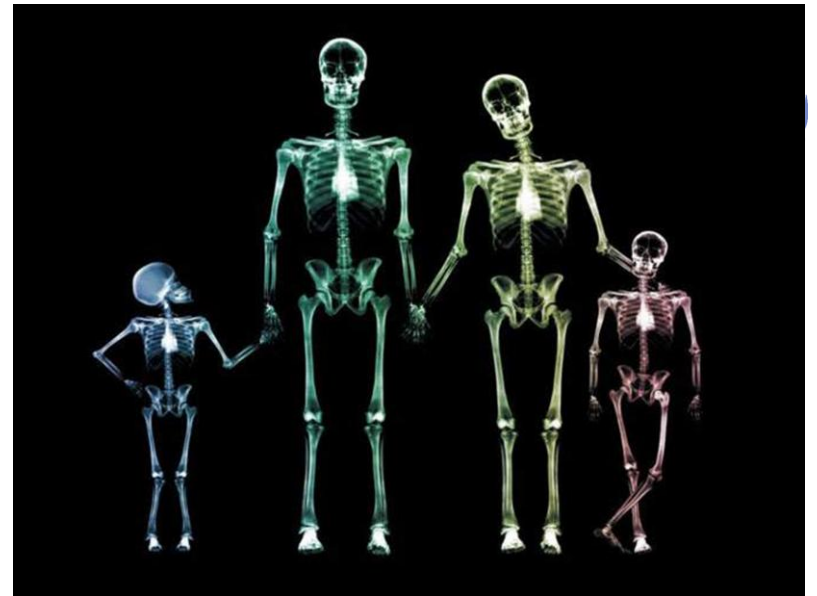
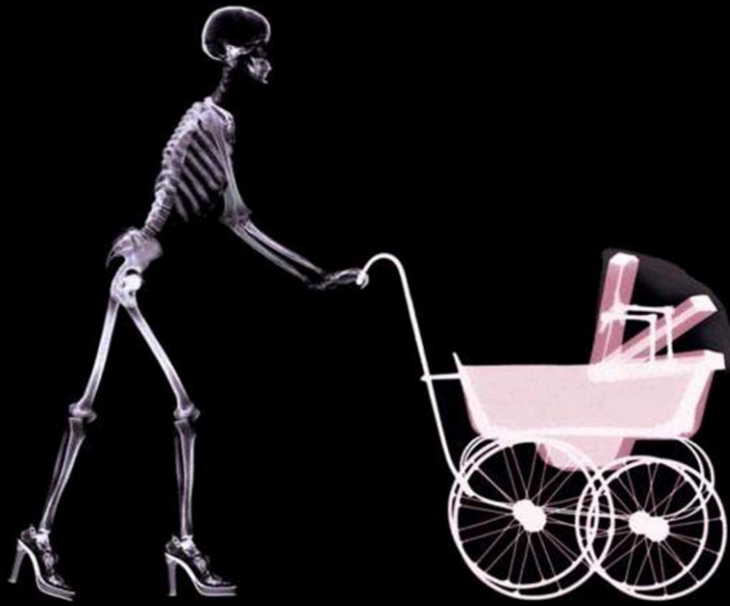
一处警方检查站的x光机显示了一张惊人的透视照片
240个人，另一辆装了273人。

墨西哥两辆货车查获513名偷渡客

偷渡客挤在货柜车厢里像沙丁鱼罐头一样，一个紧挨着一个，没有一丁点移动的空间，他们大多来自拉美和亚洲国家。

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Draft 2 - Review Paper

“Use of Radiation in Human Imaging to Prevent Illegal Activities - Radiation Safety of Scanners for Security Screening and for Theft and Contraband Detection”.

C. Borrás, IACRS Task Group Chair

Background

The use of ionizing radiation in human imaging to prevent illegal activities is not new. X-ray screening of individuals was considered by the International Commission on Radiological Protection (ICRP) already in 1969, which stated that: “The irradiation of persons for non-medical purposes, such as “anti-crime” fluoroscopy and in customs examinations, is generally deprecated. If in exceptional circumstances that are permitted by the competent authority, such examinations are decided to be essential, they shall be carried out under the supervision of a qualified medical radiologist” (1). In 1971, the ICRP extended this recommendation to the use of radiography as part of “a system for security screening of airline passengers” “to be used only when other methods have indicated the presence of unexplained objects on the passenger” and assuming that “such passengers would be given the choice between x ray examination and a body search” (2).

In the early 1990’s, the Inter-Agency Committee on Radiation Safety (IACRS) was asked for advice regarding mass screening for theft detection. The practice was used in diamond mines, where conventional x-ray units were used to radiograph workers as they exited the mines in order to prevent them from stealing diamonds and concealing them in their body cavities. Because diamonds are very dense and very easy to see with x-rays, the doses received by the workers being radiographed were relatively low. Whether the practice was justified, though, could not be agreed upon internationally. In 1994, the *International Basic Safety Standards for Protection against Ionization Radiation and for the Safety of Radiation Sources* (BSS) simply stated that: “Radiological examinations for theft detection purposes should be limited to those cases where other methods have failed to detect the presence of contraband.”

Personal & Cargo Scanners



- There are a number of cargo systems in use for the inspection of trucks, sea containers and rail cars.
- They consist of radionuclide devices or radiation generators. The radionuclide type use either Cs-137 or Co-60 sources.
- X-ray generators, operating at the 100's kVp range (up to 450 kVp), have been replaced by high-energy linear accelerators (from 6 to 15 MeV), that can penetrate several inches of steel and image the contents within any cargo container.
- CT scanners for cargo screening are under development.
- Neutron generators are also used for cargo scanning.
- Neutrons have the required penetration, they interact with matter in a manner complementary to X-rays and they can be used to determine elemental composition.

Dosimetry



Summary of the maximum mean dose values for different types of scanners

Type	MF*	HV (kV)	Current (mA)	Hp(10) (μ Sv)	H*(10) (μ Sv)
Cargo (B,T)	A	450	6.65	0.4 0.2	0.4 slow 0.2 fast
Person (T)	B	160	3.7	5.5 / 5	4 / 4.2
Person (T)	C	140	0.65	5 / 6	4-13 / 5.7
Person (T)	C	140	0.18	2	1.5
Person (T)	C	220	1.0	3 / 3.6	2 / 3.2
Person (B)	D	50	5.0	0.03	0.04 / 0.07

Dosimetry



Effective doses per scan from two backscatter systems (NCRP)

Effective Dose	50 kVp	125 kVp
Anterior View	0.03 μ Sv	0.03 μ Sv
Posterior View	0.01 μ Sv	0.02 μ Sv
Operator dose and Bystander dose (outside primary beam)	Indistinguishable from background	

Standards and Guidelines



- The first NCRP report on human imaging for security purposes, published in 2003 as Commentary 16, clearly stated that transmission scanners were not supposed to be used as a routine screening tool.
- The report recognized that they were being used in countries outside the United States for workers exiting mines and in some “foreign” airports in lieu of body searches.
- Their recommendation was that no member of the public should receive more than 0.25 mSv per year and that scanner operators were to have the same limitation.
- For backscatter systems, “an effective dose of 0.1 μ Sv per scan would allow 2,500 scans of an individual annually”.
- For transmission systems, “at 10 μ Sv per scan, an effective dose of 0.25 mSv would be reached after 25 scans”

Standards and Guidelines



- The report on cargo scanners establishes 5 mSv as the dose limit for individuals within the cargo container, but goes on to say that “acute doses up to 50 mSv are allowable for radiation workers who may need to receive this dose as part of a specific work assignment and the small increase in cancer risk is not considered particularly hazardous”, de facto allowing that value as the occupational dose limit.
- Cargo scanners have been installed in airports and seaports. In the United States, all cargo that is loaded aboard passenger planes will have to be screened (by 2010).

Standards and Guidelines



- The International Electrotechnical Commission (IEC) is currently in the process of developing two international standards, one on personal scanners and another one on cargo scanners.
- The first one specifies general characteristics, general test procedures, radiation characteristics, electrical characteristics, environmental influences, mechanical characteristics, safety requirements and provides examples of acceptable methods in terms of dose to the whole or part of the body and the time taken for each screening procedure.



45B/596/CD\

COMMITTEE DRAFT FOR VOTE (CDV)
PROJET DE COMITÉ POUR VOTE (CDV)

Project number Numéro de projet		IEC 62463 Ed. 1.0	
IEC/TC or SC: CEI/CE ou SC:		Secretariat / Secrétariat	
SC 45B		France	
Date of circulation Date de diffusion		Closing date for voting (Voting mandatory for P-members) Date de clôture du vote (Vote obligatoire pour les membres (P))	
2008-11-21		2009-04-24	
Submitted for parallel voting in CENELEC <input type="checkbox"/>		Supersedes document Remplace le document	
Soumis au vote parallèle au CENELEC		45B/564/CD - 45B/582A/CC	
Also of interest to the following committees Intéresse également les comités suivants		Functions concerned Fonctions concernées	
<input type="checkbox"/>		<input type="checkbox"/> Safety Sécurité	
<input type="checkbox"/>		<input type="checkbox"/> EMC CEM	
<input type="checkbox"/>		<input type="checkbox"/> Environment Environnement	
<input type="checkbox"/>		<input type="checkbox"/> Quality assurance Assurance qualité	

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radioprotection - Systèmes radiographiques aux
rayons X pour le contrôle des individus dans le
cadre de la sécurité et du transport d'objets
illicitesTitre : IEC 62463 Ed.1; Radiation protectio
instrumentation - X-ray systems for th
screening of persons for security and th
carrying of illicit items

Note d'introduction

Introductory note



45B/595/CD

COMMITTEE DRAFT (CD)

IEC/TC or SC: SC 45B	Project number IEC 62523 Ed. 1.0	
Title of TC/SC: Radiation protection instrumentation	Date of circulation 2008-11-14	Closing date for comments 2009-02-20
Also of interest to the following committees	Supersedes document 45B/562/CD - 45B/580A/CC	
Functions concerned: <input type="checkbox"/> Safety	<input type="checkbox"/> EMC	<input type="checkbox"/> Environment
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Title:

Radiation protection instrumentation – Cargo/Vehicle radiographic inspection systems

(Titre) :

Instrumentation pour la radioprotection – Systèmes radiographiques d'inspection de cargaison/véhicule

Introductory note

This is 2nd CD.

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Regulatory Control Concerns



Who has the authority in each country to enforce the ionizing radiation safety aspects?

- Radiation Protection
- Public Health
- Home security
- Custom
- Others

Regulatory Control Concerns



- The UK has also justified the use of X/gamma radiation scanners by the Immigration Services for detecting people seeking to enter the UK illegally in vehicles and/or freight, by clandestine means.
- The United States has not established any formal mechanism for the manufacture and use of these devices, but, in July 2008, the Interagency Steering Committee on Radiation Standards published “Guidance for Security Screening of Humans Utilizing Ionization Radiation”, a document intended to assist US federal agencies to elaborate technical criteria for the justification of the screening practice and establish a radiation safety program.
- For the justification process, the following steps should be taken: “Define the need, evaluate options, evaluate privacy concerns, assess radiation risks from the technology and the net benefit of implementation, evaluate agency’s ability to implement the practice and reach a concluding decision”.

Regulatory Control Concerns



For the justification process, “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.

Regulatory Control Concerns



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”.

Current use of personal and cargo scanners



- Personal scanners have been mainly installed at airports. Some examples are: Heathrow in the UK; Schiphol in The Netherlands, and in the US: Phoenix, Arizona; JFK, New York; Los Angeles, California, and Dallas Fort Worth, Texas. Anecdotal evidence by travelers who have undergone the procedure suggest that the operators are either unfamiliar with or cannot convey to the public the operation of the system or its radiation risks.
- Cargo scanners have been installed in airports and seaports. In the United States, all cargo that is loaded aboard passenger planes will have to be screened by 2010. Vehicle scanners have been deployed at public places. A mobile gamma ray inspection system has been designed to “non-intrusively inspect the contents of trucks, containers and cargo for purposes of manifest verification, contraband interception, and explosives, weapons or threat identification” .

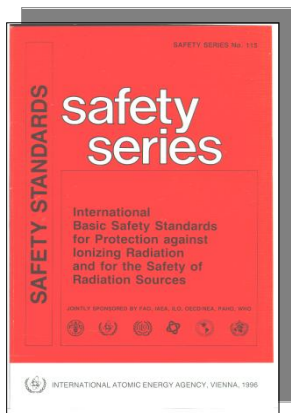


Main concerns

Justification of the use of scanners.

proper maintenance and calibration.

Impact of world-wide use, especially if for personal screening, transmission rather than backscatter scanners are used as the dose per scan is 100 times higher.



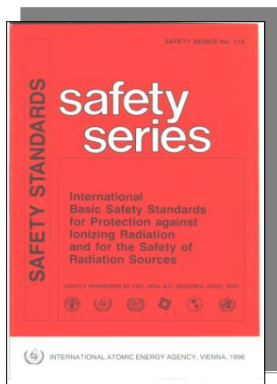
Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

<http://www-ns.iaea.org/committees/files/CSScomments/1038/DS379-Draft5.0-21Mar2011.doc>

Requirement 10: Justification of practices

The government or the regulatory body shall ensure that only justified practices are authorized.

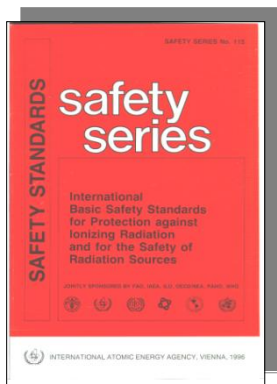
3.16 The government or the regulatory body, as appropriate, shall ensure that provision is made for the justification of any type of practice and for review of the justification, as necessary, and shall ensure that only justified practices are authorized.



Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

3.17 The following practices are deemed to be not justified:

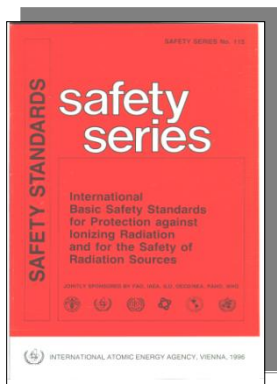
- (a) Practices, except for justified practices involving medical exposure, that result in an increase in activity, by the deliberate addition of radioactive substances or by activation, in food, feed, beverages, cosmetics or any other commodity or product intended for ingestion, inhalation or percutaneous intake by, or application to, a person;*
- (b) Practices involving the frivolous use of radiation or radioactive substances in commodities or in products such as toys and personal jewellery or adornments, which result in an increase in activity, by the deliberate addition of radioactive substances or by activation;*
- (c) Human imaging using radiation used as a form of art or for publicity purposes.*



Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

3.18 Human imaging using radiation that is performed for occupational, legal or health insurance purposes, and is undertaken without reference to clinical indication, shall normally be deemed to be not justified. If, in exceptional circumstances, the government or the regulatory body decides that the justification of such human imaging for specific practices is to be considered, the requirements of paras 3.61–3.64 and 3.66 shall apply.

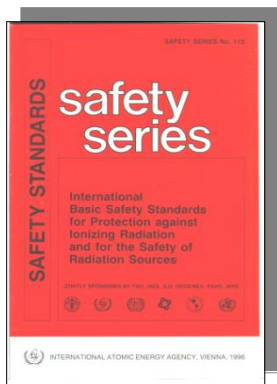
3.19 Human imaging using radiation for theft detection purposes shall be deemed to be not justified.



Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

3.20 Human imaging using radiation for the detection of concealed objects for anti-smuggling purposes shall normally be deemed to be not justified. If, in exceptional circumstances, the government or the regulatory body decides that the justification of such human imaging is to be considered, the requirements of paras 3.61–3.67 shall apply.

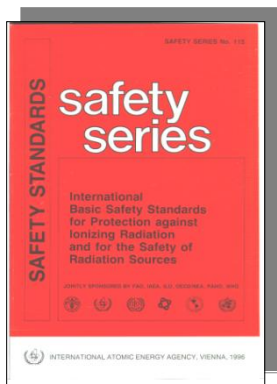
3.21 Human imaging using radiation for the detection of concealed objects that can be used for terrorism or to pose a national security threat shall be justified only by the government. If the government decides that the justification of such human imaging is to be considered, the requirements of paras. 3.61–3.67 shall apply.



Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

Requirement 18: Human imaging using radiation for purposes other than medical diagnosis, medical treatment or biomedical research

The government shall ensure that the use of ionizing radiation for human imaging for purposes other than medical diagnosis, medical treatment or biomedical research is subject to the system of protection and safety.



Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

3.61 The government, if so decided in accordance with paras 3.18, 3.20 and 3.21, shall ensure that the requirements of para. 3.16 for the justification of practices are applied to any type of human imaging procedure in which radiation is used for purposes other than for medical diagnosis or medical treatment or as part of a programme of biomedical research. The justification process shall include the consideration of;

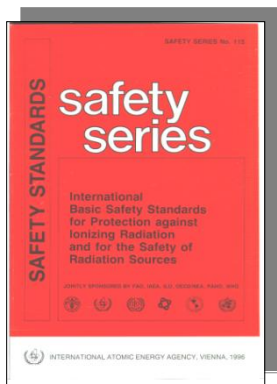
(a) The benefits and detriments of implementing the type of human imaging procedure;

(b) The benefits and detriments of not implementing the type of human imaging procedure;

(c) Any legal or ethical issues associated with the introduction of the type of human imaging procedure;

(d) The effectiveness and suitability of the type of human imaging procedure, including the appropriateness of the radiation equipment for the intended use;

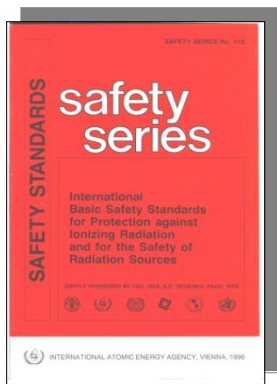
(e) The availability of sufficient resources to conduct the human imaging procedure safely throughout the intended period of the practice.



Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

3.62 If it has been determined through the process specified in para. 3.61 that a particular practice of human imaging using radiation is justified, then, such a practice shall be subject to regulatory control.

3.63 The regulatory body, in cooperation with other relevant authorities, agencies and professional bodies, as appropriate, shall establish the requirements for regulatory control of the practice, and for review of the justification.

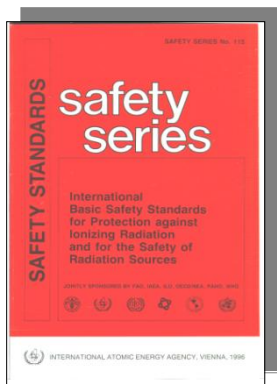


Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

3.64 For human imaging using radiation conducted by medical personnel using medical radiological equipment, which exposes humans to radiation for employment related, legal or health insurance purposes without reference to clinical indications:

- (a) The government shall ensure, on the basis of consultation between relevant authorities, professional bodies and the regulatory body, that dose constraints are established for such human imaging;*
- (b) The registrant or licensee shall ensure that the appropriate optimization requirements for medical exposure in paras 3.161–3.176 are applied, with dose constraints as required in (a) above used instead of diagnostic reference levels.*

Such purposes include assessment of fitness for employment (prior to employment or periodically during employment), assessment of physiological suitability for a career or a sport, assessment of athletes before a selection or transfer, determination of age for legal purposes, obtaining of evidence for legal purposes, detection of drugs concealed within the body, immigration or emigration requirements, pre-insurance checks and obtaining evidence for the purposes of a compensation claim.



Revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

3.65 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. Registrants and licensees shall apply the requirements for public exposure in planned exposure situations. In particular, registrants and licensees shall ensure that optimization of protection and safety is subject to any dose constraints for public exposure set by the government or the regulatory body.

3.66 Registrants and licensees shall ensure that all persons who are to undergo procedures with inspection imaging devices in which ionizing radiation is used are informed of the possibility of requesting the use of an alternative inspection technique that does not use ionizing radiation, where available.

3.67 The registrant or licensee shall ensure that any inspection imaging device used for the detection of concealed objects on or within the body, whether it is manufactured in or imported into the State in which it is used, conforms to applicable standards of the International Electrotechnical Commission or the International Organization for Standardization or to equivalent national standards.

DS401

Date 4 May 2010

IAEA SAFETY STANDARDS

for protecting people and the environment

Status: In initial review by RASSC in April 2007. Work on DS401 ceased pending revision of BSS. This new draft has been developed to take account of comments from RASSC, to bring DS401 into align with the revised BSS. See cover note for further details.

Justification of Practices

DRAFT SAFETY GUIDE

DS401

New Safety Guide

IAEA

International Atomic Energy Agency



Thank You