

ANSI and IEC Standards for Radiation Detection Instrumentation

Agenda

- **Report on status of American National Standards – ANSI**
 - Published standards
 - Standards in development
 - Testing and evaluation protocol process
- **Report on status of International Electrotechnical Commission Standards – IEC**
 - Radionuclide identifiers
 - Portal monitors
- **Issues**

Published ANSI Standards

- **ANSI N42.32 - Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security**
 - Describes design and performance criteria along with testing methods for evaluating the performance of instruments for homeland security that are pocket sized and carried on the body for the purpose of detecting the presence and magnitude of radiation
 - Specifies the performance criteria for radiation detection and measurement instruments that may be used in a variety of environmental conditions
 - Provides a means for verifying the capability of these instruments to reliably detect significant changes above background levels of radiation and alert the user to these changes
- **ANSI N42.33 - Performance Criteria for Hand-held Instruments for the Detection and Identification of Radionuclides**
 - Specifies technical performance requirements and performance testing requirements for those purchasing and using portable radiation survey meters and portable radiation detectors for Homeland Security applications
 - Establishes design and performance criteria, test and calibration requirements, and operating instruction requirements for portable radiation detection instruments

Published ANSI Standards

- **ANSI N42.34 - Performance Criteria for Hand-held Instruments for the Detection and Identification of Radionuclides**
 - Addresses instruments that can be used for homeland security applications to detect and identify radionuclides, for gamma dose rate measurement, and for indication of neutron radiation
 - Specifies general requirements and test procedures, radiation response requirements, and electrical, mechanical, and environmental requirements
 - Successful completion of the tests described in this standard should not be construed as an ability to successfully identify all isotopes in all environments.
- **ANSI N42.35 - Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security**
 - Describes the performance requirements for portal monitor instruments
 - Requirements stated are based on instruments used in support of efforts associated with the United States Department of Homeland Security.

ANSI Standards Being Developed

- **N42.37 – Training Requirements for Homeland Security Responders using Radiation Detection Instruments**
 - Chair: Morgan Cox/Alex Boerner
 - Provides reach back to training organizations on DHS needs for training of emergency responders
 - Does not provide instrument-specific training
 - Does provide criteria for homeland security specific training

- **N42.38 – Performance Criteria for Spectroscopy-Based Portal Monitors Used for Homeland Security**
 - Chair: Peter Chiaro
 - Will establish the performance requirements for spectroscopy based portal monitors to include radiological response and environmental conditions
 - Will soon perform testing as a means to establish a baseline for the requirements
 - Will also develop test and evaluation protocols for equipment testing

ANSI Standards Being Developed

- **N42.39 – Standard for Performance Criteria for Neutron Instruments**
 - Chair: Alan Thompson
 - Testing of commercially available neutron detectors
 - Develop test and evaluation protocols for equipment testing

- **N42.40 - Standard for Evaluation and Performance of High-Energy, X- and Gamma- Ray Interrogation Systems for Detection of Contraband of Concern in Homeland Security**
 - Chair: David Gilliam
 - Broad spectrum of systems (small packages, carry-on luggage, checked luggage, large packages, trucks and cargo-container inspection)
 - Requires user input due to broad applications
 - Looking at currently deployed systems
 - Will include safety standards for users

ANSI Standards Being Developed

- **N42.41 - Standard for Evaluation and Performance of Neutron Interrogation Systems for Detection of Contraband of Concern in Homeland Security**
 - Chair: David Gilliam
 - Report of existing active interrogation devices (existing and under-development technologies)
 - Safety standard for use of neutron interrogation devices (combine with existing standards)
 - Use of existing standards for new standard development for DHS applications

- **N42.42 – Data format standard for radiation detectors used for Homeland Security**
 - Chair: Ed Groeber
 - Develop test and evaluation protocols for equipment testing
 - Provide data format information on commercially available equipment

ANSI Standards Being Developed

- **ANSI N42.xx - Standard for Mobile and Transportable Systems Including Cranes used for Homeland Security Applications**
 - Chair: Peter Chiaro
 - Create working group
 - Provide draft version of the standard
 - Provide test and evaluation protocol for equipment testing

Testing and Evaluation Status

- **US DHS is currently testing commercially available equipment**
 - **Number of Companies = 28**
 - **Number of Models Received for N42.32 = 20**
 - **Number of Models Received for N42.33 = 25**
 - **Number of Models Received for N42.34 = 8**
 - **Number of Models Received for N42.35 = 15**
- **Total number of instruments to test = 192**

Equipment Testing – Who is doing what

- **LANL**
 - Portal monitors testing
- **ORNL**
 - Radionuclide identifiers coordination and testing and portal monitor testing
- **PNNL**
 - Radiation pagers and hand held detectors
- **LLNL**
 - Testing hand held detectors and portal monitors
- **NIST**
 - Coordinates all 4 labs and portal monitor testing.
 - Reports results to DHS

Status of Applicable IEC Standards

- **IEC 62401 - Alarming Personal Radiation Detectors (PRDs) for Border Radiation Monitoring**
- **IEC 62327 – Hand-held instruments for the Detection and Identification of Radionuclides and Additionally for the Indication of Ambient Dose-Equivalent Rate from Photon Radiation**
- **IEC 62244 - Installed Radiation Monitors for the Detection of Radioactive and Special Nuclear Materials at National Borders**

IEC 62401 - Alarming Personal Radiation Detectors (PRDs) for Border Radiation Monitoring

- **Chaired by Dr. Geneviève Bicheron, France**
- **Status**
 - **First Committee Draft issued late 2003**
 - **Comments received and being addressed by author**
 - **Discussion expected at next IEC meeting in April 2005**

IEC 62327 – Hand-held instruments for the Detection and Identification of Radionuclides ...

- **Chaired by Peter Chiaro, United States**
 - Formerly led by Klaus Duffs Schmidt
- **Status**
 - **Committee Draft for Vote (CDV) issued July 2004**
 - **The due date for the comments is early January 2005**
 - **FDIS level document will follow very quickly**

IEC 62244 - Installed Radiation Monitors for the Detection of...

- **Chaired by Peter Chiaro (US) and Alexander Komissarov (RU)**
- **Status**
 - **Third CD issued late 2003**
 - **Major revision due to comments received prior to meeting in Beijing**
 - **Comments received on CD with CDV prepared and issued to Working Group members for quick review**
 - **CDV version to be provided for release by November 2004**
 - **CDV review results scheduled for discussion at next IEC meeting in April 2005**

Problem Areas

- **List of Radionuclides**
 - Spectroscopic based instrumentation
- **Radioactivity Levels**
 - Spectroscopic based instrumentation
 - Portal Monitors
- **Establishment of “Bookends”**

List of Radionuclides - Portals

- **Devices shall be able to identify the following radionuclides at the reference speed (portals) or collection interval (fixed) as required**
 - **Unshielded:** ^{57}Co , ^{60}Co , ^{67}Ga , $^{99\text{m}}\text{Tc}$, ^{131}I , ^{133}Ba , ^{137}Cs , ^{192}Ir , ^{201}Tl , ^{233}U , ^{235}U , ^{238}U , plutonium*, ^{241}Am , ^{237}Np .
 - **Natural materials:** Natural sources (such as potash, granite and ceramic tile) will be used to test monitors for the ability to identify the isotopes ^{40}K , ^{226}Ra and ^{232}Th .
 - **Shielded by materials that are typical of inspected containers:** ^{60}Co , ^{131}I , ^{133}Ba , ^{137}Cs , ^{192}Ir , ^{238}U , plutonium*, ^{237}Np
 - * Monitors shall identify either weapons grade plutonium or reactor grade plutonium (> 12% ^{240}Pu)

List of Radionuclides - Handhelds

- **Radionuclide Categorization**

- The radionuclides of greatest interest and those most likely to be encountered are listed below in four different categories:

- Nuclear Materials: ^{233}U , ^{235}U , ^{237}Np , Pu^* ,
- Medical radionuclides: ^{18}F (PET), ^{67}Ga , $^{99\text{m}}\text{Tc}$, ^{111}In , ^{123}I , ^{125}I , ^{131}I , ^{133}Xe , ^{201}Tl ,
- Industrial radionuclides: ^{57}Co , ^{60}Co , ^{133}Ba , ^{137}Cs , ^{192}Ir , ^{241}Am ,
- Naturally occurring radioactive materials (NORM): ^{40}K , ^{226}Ra (in equilibrium with daughters), ^{232}Th and decay products, ^{238}U and decay products.

- **Identification of single radionuclides**

- The instrument shall be able to identify the following radionuclides within the times indicated after exposure to the radionuclide.

- Unshielded, in 1 min: ^{111}In , ^{133}Xe , $^{99\text{m}}\text{Tc}$, ^{201}Tl , ^{67}Ga , ^{125}I , ^{123}I , ^{131}I , ^{18}F (PET),
- Behind 3 mm steel shielding, in 2 min: ^{235}U , ^{238}U , ^{57}Co , ^{241}Am , ^{237}Np ,
- Behind 5 mm steel shielding, in 2 min: Pu^* , ^{233}U , ^{133}Ba , ^{40}K , ^{226}Ra , ^{232}Th , ^{137}Cs , ^{60}Co , ^{192}Ir .

- * > 6% ^{240}Pu

Radioactivity Levels - Non-Spectroscopic Portals

- **Current**
 - **IEC**
 - ^{241}Am – 17 MBq
 - ^{137}Cs – 0,6 MBq
 - ^{60}Co – 0,15 MBq
 - **ANSI**
 - ^{57}Co – 3,5 MBq
 - ^{133}Ba – 0,85 MBq
 - ^{137}Cs – 0,6 MBq
 - ^{60}Co – 0,15 MBq
 - ^{228}Th – 0,26 MBq
 - ^{241}Am - 17 MBq
 - Neutron (^{252}Cf) 20 000 n/s
- **Proposed from comments**
 - **IEC**
 - **Pedestrian/ conveyor monitor**
 - ^{241}Am - 60 kBq
 - ^{137}Cs - 80 kBq
 - ^{60}Co - 50 kBq
 - **Road and rail vehicle monitors**
 - ^{241}Am - 800 kBq
 - ^{137}Cs - 1400 kBq
 - ^{60}Co - 700 kBq

Establishment of “Bookends”

- **Could the establishment of very detailed requirements cause identification limitations?**
 - Development of instrumentation that is designed to “meet the specification”
- **Is there an end to the list and activity requirements?**
 - Does it, or can it ever end?