Status and Perspectives on Standards for RN Detection

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List of Topics

• List of standards being revised

• Changes in requirements and test methods:
  • IEC and ANSI standards
  • Changes made due to ITRAP+10 recommendations

• Future IEC activities
Rad/Nuc Detector Standards for Homeland Security

http://standards.ieee.org/getN42/

- **PRDs - ANSI N42.32** out for ballot - IEC 62401 under revision
  - Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security

- **GSDs - ANSI N42.33** under revision - IEC 62533

- **RIDs - ANSI N42.34** final publication - IEC 62327 under revision
  - Performance Criteria for Hand-held Instruments for the Detection and Identification of Radionuclides

- **RPMs - ANSI N42.35** out for ballot - IEC 62244
  - Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security

IEC standards are developed for detection of illicit trafficking of radioactive materials
Rad/Nuc Detector Standards for Homeland Security

- **Training - ANSI N42.37  under revision**
  - Training Requirements for Homeland Security Purposes
    Using Radiation Detection Instrumentation for Interdiction and Prevention

- **SRPMs - ANSI N42.38 final publication - IEC 62484**
  - Performance Criteria for Spectroscopy-Based Portal Monitors used for Homeland Security

- **NSDs - IEC 62534**
  - Radiation protection instrumentation - Highly sensitive hand-held instruments for neutron detection of radioactive material

- **ANSI N42.42 (IEC 62755) applicable to all instrument standards**
  - Data format standard for radiation detectors used for Homeland Security

Information on ANSI N42.42: [http://www.nist.gov/pml/div682/grp04/n42.cfm](http://www.nist.gov/pml/div682/grp04/n42.cfm)
Validation tools: [https://secwww.jhuapl.edu/n42/Account/LogOn](https://secwww.jhuapl.edu/n42/Account/LogOn)
Rad/Nuc Detector Standards for Homeland Security

- **Mobile - ANSI N42.43 out for ballot - IEC plans for a vehicle mounted**
  - Standard for Mobile and Transportable Systems used for Homeland Security

- **SPRDs - ANSI N42.48 - IEC 62618**
  - Performance Requirements for Spectroscopic Personal Radiation Detectors (SPRDs) for Homeland Security

- **PERDs - ANSI N42.49 A &B (no IEC)**
  - Performance Criteria for Personal Emergency Radiation Detectors (PERDs) for Exposure Control

- **BRDs - ANSI N42.53 - IEC 62694**
  - Performance Criteria for Backpack Based Radiation Detector Systems Used for Homeland Security
Main changes to IEC 62401 that addresses comments from ITRAP+10:

- Air Kerma was changed to ambient dose equivalent rate.
- Tests are performed at a single background level.
- It is **not** specified what testing mode was used for the tests is going to be the one requested by the manufacturer.
- A section was added to describe the PRD setup during testing.
- Radiological tests require the presence of a phantom (for both gammas and neutrons).
- Personal protection alarm has an example of a 10 μSv/h, the suggested value of 20 μSv/h was **not** used.
- The time to alarm test is now performed with the sources passing by the PRD instead of popping up – as operationally sources will approach a detector they will not just pop-up.
- **No** quantitative method was added to verify that the PRD is working properly after the over-range exposure.
- Relative intrinsic error test is changed to 1 μSv/h, 10 μSv/h and 50% of the maximum.
- For the time to alarm test the number of trials was increased to 20 trials (allows for 1 failure).
- The time to alarm for neutrons allows for changing the emission rate and testing distance – scaled to give the same field.
Main Observations for PRD IEC 62401 Standard

• No detailed test methods for the environmental, mechanical and EMC tests compared to the revised versions of the ANSI standards – references the IEC 62706 standards

• Test methods are not added for requirements that require the review of a manual or observation of the instrument (i.e., general test requirements)

• Allows for a variation of ±30 % in the instrument indication instead of ±15 % specified in the ANSI standards for EMC, environmental and mechanical tests

• There is no requirement for explosive atmospheres as in the SPRDs

• The false alarm rate is 1 in 1 hour compared to the published version of the ANSI standard that is 1 in 10 hour and the revised version that is 2 in 8 hours (uses a work shift for the specification)
Main Observations for PRD IEC 62401 Standard

• The gamma response test is changed to have the source moving pass-by the instrument and alarming in 2 s – same as ANSI

• The neutron response is with the source moving and stopping in front of PRD and alarming within 5 s distance and emission rate is allowed to change – ANSI has a fixed distance and neutron emission rate

• Over-range test is 1.5 times the maximum value – ANSI is 2 times the maximum

• Gradually increase radiation tested at 0.1 m/h – there was no consensus in ANSI to changed from the 2006 published value of 0.5 m/s

• Neutron indication in the presence of photons does not check for the neutron response when exposed to the gamma source – it was to be added in the CD3 version
Validation Testing - Comments for ANSI N42.32

• Validation testing was performed at SRNL and PNNL

• Issues addressed from the validation comments
  • Clarification on the pre-test and post-test measurements
  • Clarification on the examples in the Annex D
  • Allow the PRD to alarm when dropped
  • Clarified that measurements without sources do not require the determination of the COV
  • Allow during the environmental and battery-life tests to have the PRDs connected to a power supply instead of being powered by a battery (if applicable)
ITRAP+10 Comments Addressed in PRD ANSI N42.32 Standard

• Comments from the ITRAP+10 testing effort were considered during the revision of the standards

• Main changes to ANSI N42.32 that addresses comments from ITRAP+10
  • Tests are performed at a single background level
  • It was clarified that the testing mode used for the tests is going to be the one requested by the manufacturer
  • A section was added to describe the PRD setup during testing
  • Radiological tests require the presence of a phantom (for both gammas and neutrons)
  • ANSI does not require a personal protection alarm
  • The time to alarm test is now performed with the sources passing by the PRD instead of popping up – as operationally sources will approach a detector they will not just pop-up
  • A quantitative method was added to verify that the PRD is working properly after the over-range exposure
  • The fields for the accuracy test were changed to 0.4 mR/h, 1 mR/h, 1.6 mR/h and 70 % of the maximum
  • For the time to alarm test the number of trials was increased to 20 trials (allows for 1 failure)
  • The time to alarm for neutrons was changed to 5 s to match the IEC requirement
  • The reference point marking requirements were expanded – 2 markings plus orientation
Main changes to ANSI N42.35 that addresses comments from ITRAP+10

- An annex was added to provide guidance on the alarm indication
- Tolerances were added for the distance between panel and testing speeds
- A section was added to address PRM with energy analysis capabilities – it was not possible to reach consensus on the tests so a Technical Capability Standard will be developed under DNDO to address this need
- The neutron test was changed to be performed with moderated and unmoderated neutrons, the neutron emission remained unchanged at $2 \times 10^4 \text{n/s}$
- The over-range test was modified to better describe the test to be performed to very that the PRM recovered after exposure and it is not possible to reset the RPM when a high radiation field without an indication
- Details were added to test methods for the environmental, mechanical and EMC tests
Validation Testing - Comments for ANSI N42.35

• Validation testing was performed at ORNL and PNNL

• Issues addressed from the validation comments
  • Clarification on the occupancy time specified only for the false alarm test
  • Neutron indication in the presence of photons test – needed the revision of the test method in order to be able to conduct the test
  • Allow for out door testing by adding a statement about the environmental conditions during testing
  • False alarm test – number of trials and requirement are not statically compatible
  • Changes in the test methods for the RF tests – allows for different technique
  • Changes in the moisture test method – to ensure that entire portal is exposed to water
Revision of ANSI N42.43 – Mobile and Transportable Systems

- The BRDs and Crane mounted monitors were removed from the standard – BRDs are addressed in N42.53
- Additional details were added to the requirements for the data file
- The number of sources were reduced – RGPu, $^{40}$K, $^{57}$Co, $^{233}$Np, and $^{192}$Ir were removed and $^{241}$Am was added
- Guidance was added for the test preparation, the setup and the controls before and during testing
- For the gamma response test, the number of sources were reduced to $^{241}$Am, $^{137}$Cs and $^{60}$Co ($^{57}$Co, $^{133}$Ba, and $^{232}$Th were removed)
- The testing heights were reduced from 3 to 2
Revision of ANSI N42.43 – Mobile and Transportable Systems

• The area monitor test was completely changed – new version verifies the alarm response 360° around the monitor

• The neutron response is only tested with moderated neutrons using 4 cm HDPE – before it was tested with unmoderated neutrons and moderated by an equivalent of 1.22 m of pine

• The over-range test was changed from a field of 10 mR/h (~100 μGy/h) to 50% greater than the manufacturer’s stated maximum

• Slowly approaching source – a speed of 0.12 m/s was added for pedestrian monitors

• The background change test was modified – the new version will be very hard to execute as 60 trials need to be performed during the background transition while the value of the background is changing in a time period of 30 s. The increase in background is a factor of 3 from ambient conditions
Revision of ANSI N42.43 – Mobile and Transportable Systems

- For monitors with ID capabilities – the required radionuclides in the library were changed
- Single radionuclide ID – medical sources are only tested inside the PMMA container to mimic in-vivo measurements, bare sources were removed
- Shielded sources ID – shielding was changed from 3 cm steel to 1 cm steel plus 8 cm HDPE, $^{133}$Ba was removed from the source list
- The source combinations for simultaneous radionuclide ID were changed – new combinations $^{137}$Cs + DU, $^{99m}$Tc + HEU, $^{131}$I + WGPu, NORM + HEU
- The following tests were deleted – overload for ID, efficiency, FWHM, pile-up effects
- Radionuclide not in library test was added
Revision of ANSI N42.43 – Mobile and Transportable Systems

• The functionality ID test for the environmental, mechanical and EMC tests are now performed with $^{60}$Co and $^{133}$Ba instead of $^{137}$Cs for

• The test methods for the environmental, mechanical and EMC tests are now referring to corresponding IEC standards

• The RF requirements were changed from frequency range from 80 MHz to 2500 MHz at field intensities of 10 V/m to 10 V/m from 80 to 1000 MHz and 3 V/m from 1000 to 2500 MHz

• Conducted disturbance by burst and radio frequencies test was removed

• Surges and oscillatory waves test was removed

• Mechanical shock test was removed
IEC Activities

TC 45 WG B15 had an interim meeting from June 23 to 26 at the IAEA

Standards revised during the meeting

- PRD IEC 62401 standard
  - Comments were addressed for committee draft 2 (CD2) version
  - A CD3 will be circulated for discussion in the next meeting

- RID IEC 62327 standard
  - Comments were addressed for committee draft 2 (CD2) version
  - A CD3 will be circulated for discussion in the next meeting
IEC WG B15 Future Activities

Next TC 45 WG B15 meeting will be in South Korea from March 7 to 8, 2016

Plans for standards development and revision:
- Development of a standard for vehicle mounted mobile system
- Revision of RPM standard
Thank you for your attention

Questions?