NISTIR 7548

# Selected Impacts of Documentary Standards Supported by NIST 2008 Edition

National Institute of Standards and Technology
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**NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY**
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## List of Acronyms

| | |
|---|---|
| ACI | American Concrete Institute |
| ANSI | American National Standards Institute |
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| ASME | American Society for Mechanical Engineers |
| ASTM | ASTM International, formerly American Society for Testing & Materials |
| CIE | International Commission on Illumination |
| CIPM | International Committee for Weights and Measures |
| CISPR | The International Special Committee on Radio Interference |
| CLSI | The Clinical and Laboratory Standards Institute |
| DHS | Department of Homeland Security |
| DNDO | Domestic Nuclear Detection Office |
| DOE | Department of Energy |
| FIPS | Federal Information Processing Standard |
| GRaDER | Graduated Rad/Nuc Detector Evaluation and Reporting Program |
| HITSP | Health Information Technology Standards Panel |
| HL7 | Health Level 7 |
| HIS | Homeland Security Instrumentation |
| IEC | International Electrotechnical Commission |
| IEEE | Institute of Electronic and Electrical and Electronics Engineers |
| IESNA | Illuminating Engineering Society of North America |
| IETF | Internet Engineering Task Force |
| IFSTA | International Fire Service Training Association |
| ILO | International Labour Organization |
| INCITS | International Committee for Information Technology Standards |
| iNEMI | The International Electronics Manufacturing Initiative |
| IPC | formerly Institute of Interconnecting and Packaging Electronic Circuits |
| IT | Information Technology |
| ISO | International Organization for Standardization |

| | |
|---|---|
| ITU | International Telecommunication Union |
| JTC1 | ISO Joint Technical Committee 1 (Information Technology Standards) |
| NEMA | National Electronics Manufacturers Association |
| NFPA | National Fire Protection Association |
| NIJ | National Institute of Justice |
| NIST | National Institute of Standards and Technology |
| NVLAP | National Voluntary Laboratory Accreditation Program |
| OAG | Open Applications Group |
| OASIS | Organization for the Advancement of Structured Information Standards. |
| OIML | International Organization for Legal Metrology |
| OMG | Object Management Group |
| RM | Radioactivity Measurements |
| SAE | SAE International, formerly Society of Automotive Engineers |
| SCP | Standards Committee Participation Database |
| SI | International System of Units |
| SSL | Solid State Lighting |
| STEP | Standard for the Exchange of Product Model Data |
| TIA | Telecommunications Industry Association |
| UL | Underwriters Laboratories Inc. |
| VESA | Video Electronics Standards Association |
| W3C | World Wide Web Consortium |

# IX. Development of Radiation Detector Standards for Homeland Security Applications

## Executive Summary

Since 9/11, one of the most frightening threats that has disrupted many a night's sleep were "dirty bombs," explosives salted with radiological materials and smuggled through an American port. It was feared that a single dirty bomb attack could cost billions, kill hundreds, and take years of recovery.

The chaos of 9/11 quickly turned into widespread resolve to better protect U.S. citizens. The challenge faced was simple and profoundly daunting: create and deploy rugged detector equipment that could be used easily by non-specialists and first responders to scan massive amounts of cargo for nuclear-radiological threats.

Speed and precision were driving factors for the diverse group that coalesced to confront this challenge. DHS pressed hard on the group, urging them to "fast-track" detection equipment and training standards. Leadership quickly fell to NIST, with its wide and deep experience in creating, testing, and validating standards. NIST chaired the "N42 Committee" that coordinated and integrated the work of several diverse groups, addressing radioactivity measurements, homeland security, and protection instrumentation.

NIST guided the dedicated and highly proficient groups to create the technical foundation for a suite of standards that reflected the complexities of the challenges presented by equipment from small, hand-held detectors to massive, port-screening monitors, including standard data formats to easily process readouts. These groups also designed the training essential to move the standards from the working groups to effective field protection practices. The initial effort took two years of intense work during 2002-2004.

The operational experiences that followed pointed to even more effective protocols, and NIST engaged in another two more years of concentrated proceedings refining the standards. Today, users and vendors have access to a set of nine specific standards for radiation detection, which cover instrumentation, alarms, and fixed and mobile systems, easing the burdens on industry and defenders

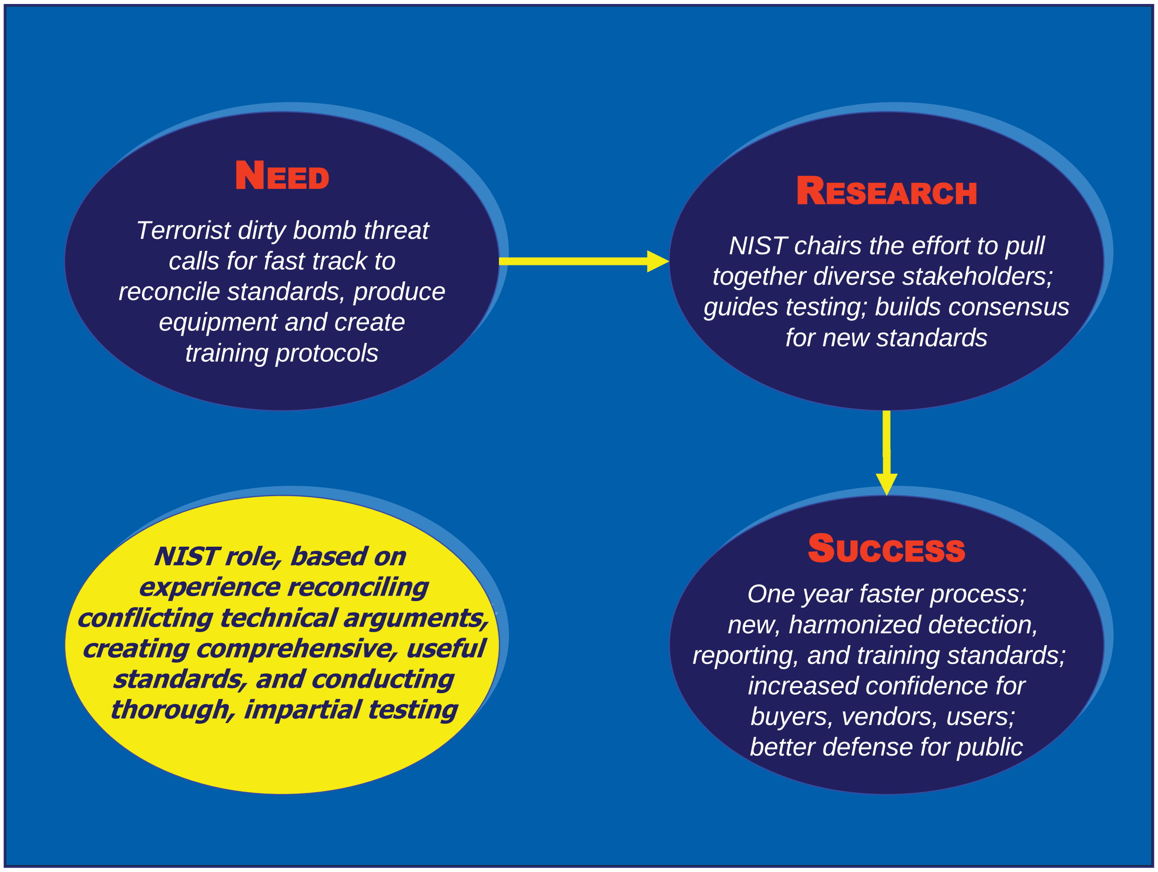


**Figure 1R: NIST technical leadership contributes to protection of U.S. citizens and property**

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**Introduction**

In collaboration with the U.S. Department of Homeland Security (DHS), industry, and other national laboratories, the National Institute of Standards and Technology (NIST) responded to the nation's needs for increased port security in the post-9/11 environment. On DHS's behalf, NIST radiation experts took part in and led an effort to fast-track a suite of radiation detection standards through the voluntary consensus standard process. These standards set performance requirements for radiation detection equipment based on homeland security needs, and will increase the effectiveness and efficiency of cargo, vehicle, and other screening processes and reduce the risks of dramatic terrorist attacks on U.S. soil.

In one of the DHS planning scenarios, high explosives, radioactive sources, and other "dirty bomb" components are smuggled into the country in sea-land containers shipped to U.S. ports under assumed business names. The containers are picked up and transferred to safe houses near three target cities. After detonation, thirty-six blocks are contaminated by the initial explosion and the spread of radioactive contamination by mild winds. The scenario estimates several hundred fatalities and injuries, extensive environmental contamination, and the evacuation of thousands of individuals in each city. Bus, rail, and air transport routes are altered, and highway checkpoints are established to monitor incoming traffic for contamination. Hospitals in each region, already at maximum capacity with injuries from the blasts, are inundated with up to 50,000 “worried well.” Sewage treatment plants are quickly contaminated; businesses are closed for an extended duration while radioactive contamination is remediated; and local tax revenues plummet. The entire contaminated area is economically depressed for years. The total economic impact is in the billions of dollars.7

With scenarios like this in mind after 9-11, efforts to screen the vast amount of cargo that floods into U.S. ports increased dramatically. While some of the equipment needed to monitor cargo arriving by vehicles and vessels had been available previously, it was not available in the ruggedized form required to handle greatly expanded throughput or use in diverse settings, nor was the available equipment designed for use by non-specialists or first-responders. Extraordinary effort was needed to alter the situation. NIST was called upon to provide its technical expertise and leadership.

[7] U.S. Department of Homeland Security*, National Planning Scenarios*, March, 2005, “Scenario 11: Radiological Attack – Radiological Dispersal Devices,” pp. 11-1 – 11-8.

**Figure 2R. Cargo screening equipment installed at an airport facility.**

### Origin of the Effort

To address the looming problem described above, DHS called on experts from NIST, the private sector, and other government organizations to “fast-track” a number of critical radiation detection equipment and equipment training standards through the Institute of Electrical and Electronics Engineers (IEEE), Radiation Detection Standards Program. The primary N42 Committee, chaired by NIST experts, oversaw and coordinated the work of subcommittees N42.RM (Radioactivity Measurements), N42.RPI (Radiation Protection Instrumentation), N42.HSI (Homeland Security Instrumentation), and working groups.

Through the efforts of a diverse group of stakeholders, IEEE’s ANSI-accredited National Committee on Radiation Instrumentation developed a suite of consensus standards for personal radiation detectors, portable radiation detection instrumentation, hand-held instruments for detection and identification of radioactive materials, radiation detecting portal monitors, mobile and transportable radiation monitors, training for radiation detection instrumentation, performance criteria for spectroscopy-based portal monitors, performance criteria for active detection systems, and standard data formats for instrument read-outs.

The initial stage in the development of the standards covered the period from 2002-2004. After development and use of testing and evaluation protocols based on these standards, they were revised from 2004-2006. Table 1R lists the suite of radiation detection standard currently available to users and vendors of radiation detection equipment.

**Table 1R. IEEE's Radiation Detection Standards**

- 42.32 American National Standard Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security
- 42.33 American National Standard for Portable Radiation Detection Instrumentation for Homeland Security
- 42.34 American National Standard Performance Criteria for Hand-Held
- Instruments for the Detection and Identification of Radionuclides
- 42.35 American National Standard for Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security42.37 American National Standard for Training Requirements for Homeland Security Purposes Using Radiation Detection Instrumentation for Interdiction and Prevention
- 42.38 American National Standard Performance Criteria for Spectroscopy-Based Portal Monitors Used for Homeland Security
- 42.41 American National Standard Minimum Performance Criteria for Active Interrogation Systems Used for Homeland Security
- 42.42 American National Standard Data Format Standard for Radiation Detectors Used for Homeland Security
- 42.43 American National Standard Performance Criteria for Mobile and Transportable Radiation Monitors Used for Homeland Security

## NIST Gets Involved

Representatives of the Ionizing Radiation Division of NIST's Physics Laboratory have been involved with ANSI and IEEE in the development of numerous consensus standards over the years. N42, the ANSI-IEEE committee for the development of radiation instrumentation standards, was chosen as the lead for this effort because of its ability to rapidly produce the desired standards. As part of its ongoing support for voluntary standards development, NIST personnel chaired the committee at the time of the DHS initiative At the time the fast track effort was initiated, a number of ANSI and ASTM standards were in place for similar applications in the health physics arena, but none of them covered the requirements needed for their use either by non-highly trained individuals nor for the additional environmental and mechanical ruggedness requirements inherent in homeland security applictions.

The standards that emerged in 2004 were subjected to two rounds of DHS-funded testing. The testing results were used by testing labs to evaluate instruments, by manufacturers to improve their product to be able to meet the requirements set by the standards that apply to homeland security applications, and by users for instrument procurement purposes. After the initial development, validation and implementation of these standards, and the failure of any of the equipment to meet them, the manufacturers began developing new equipment and, through an iterative process with industry, the standards were further refined.

This resulted in the establishment of the Graduated Rad/Nuc Detector Evaluation and Reporting (GRaDER) program, which establishes the current American National Standards Institute (ANSI) N42 consensus standards as the initial acceptable performance baseline for radiation detectors and lays the groundwork for more detailed instruction to enter the program. The GRaDER program is managed by DHS's Domestic Nuclear Detection Office (DNDO) together with NIST and NIST's National Voluntary Laboratory Accreditation Program (NVLAP) under which laboratories perform independent and consistent testing of the commercial-off-the-shelf radiation detectors.[8] Results of the GRaDER program testing will be made available to law enforcement and first responder agencies to inform their procurement and grant awards processes.


**Figure 3R. Handheld radiation detectors.**

**What would have been done, absent NIST?**

Without NIST in the lead, these radiation equipment standards would have taken longer to develop. The fact that NIST is viewed as an impartial participant greatly helped in resolving differences among the various groups involved in the writing of these standards. For all the standards, NIST personnel led the harmonization of the sometimes unrealistic differences between user requirements and the manufacturers' concerns of what present technology can achieve. In addition, NIST provided the means for collaborators to access the information necessary to apply the standards to different types of instruments.

Through its voluntary public-private collaboration, the IEEE's suite of radiation detection standards was developed in under 2 years, at least a year earlier than for a typical documentary standard, and, as a result, problems could be addressed by port personnel in a much more effective manner than they would have been without the standards; industry could develop the new ruggedized and user-friendly detection equipment needed quickly and effectively; and the value added from the sales of new equipment would accrue to industry sooner than it otherwise would have.

From an economic perspective, NIST helped to lower the high transaction costs associated with organizing and harmonizing technical and quality assurance issues among diverse equipment users, designers, and manufacturers.

**Conclusion**

A joint effort between industry and government agencies to meet the critical DHS objective of increased port security led to the fast-track development of a suite of ANSI accredited documentary standards for radiation detection equipment performance and equipment training. These achievements would not have been achievable in the time accomplished had it not been for NIST's contribution. The economic impacts of these efforts would be measured in terms of shifting a stream of public and private benefits forward in time by

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[8] The Domestic Nuclear Detection Office (DNDO) was established in 2005 to improve the Nation's capability to detect and report unauthorized attempts to import, possess, store, develop, or transport nuclear or radiological material for use against the Nation, and to further enhance this capability over time.

a minimum of 1 year and in the dramatic reduction in transaction costs that would have been required to harmonize technical differences among the users and designers of new radiation detection equipment. This should result in a system of certified radiation detection equipment that reduces the ability of terrorists to smuggle radioactive material into the United States lowers the risk of the dire consequences depicted in DHS planning scenarios, and increases our sense of security.