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Detector Field Guide

A reference guide and overview of radiation detection devices deployed globally in port facilities
This field guide is intended to familiarize personnel working in international ports with commonly seen types of radiation detection equipment.

Radiation detectors serve both a safety and a security purpose. Some nations and port authorities install them in order to prevent the introduction of radioactively contaminated scrap metal or lost radioactive sources into their countries, where they could pose a public health hazard. There have been numerous incidents of undeclared radioactive scrap steel contaminating the product in steel foundries, and less frequent cases of radiation injuries caused by unshielded radioactive sources that were misplaced from hospitals or industry.

More frequently, radiation detectors are installed as a security measure to prevent nuclear smuggling. UN Security Council Resolution 1540 urges all countries to develop effective border detection measures to prevent the proliferation of chemical, biological, radiological, or nuclear weapons. US law also requires that foreign ports have a means to perform radiation detection for all high-risk shipping containers bound for the United States. Many countries have acquired their own equipment. Others have worked with the United States, the European Union, or the International Atomic Energy Agency to build their capacity via joint projects.

When a radiation detector alarms for the presence of gamma rays or neutrons, the reason for the alarm must be determined. Many materials contain non-harmful levels of naturally occurring radioactivity. The process of collecting and analyzing the gamma ray spectrum to determine whether the shipment poses a threat – a process known as an alarm adjudication – may be performed by local personnel or by a dedicated team, and may or may not include review by national or regional experts. Countries may decide to protect details of their radiation detection programs for operational security reasons.
Over the last decade, the NNSA Nuclear Smuggling Detection and Deterrence program has significantly increased the number countries with which it partners to strengthen and expand the ability to deter, detect and interdict illicit trafficking of special nuclear and other radioactive materials at controlled land and maritime borders. Radiation portal monitors, mobile detection systems, and handheld equipment continues to be installed at international crossings and larger container megaports around the world. This detector infrastructure encompasses a wide variety of instruments; from portal monitors used to survey large containers to smaller handheld devices used for search and identification during secondary inspection operations. This guide provides an overview of instruments commonly deployed to border crossings, airports, seaports, and other points of entry and their capabilities. Equipment from Russian and Chinese based manufacturers, typically analogous to the devices deployed by the IAEA and NSDD, is also included in this guide.
Handheld, portable radioisotope detector and identifier. Provides operator with gamma ray count rate and dose rate information. Some variants include neutron count rate capabilities. Detector is capable of determining whether source is threat material using on-board isotope identification algorithm.

**Manufacturer:** Smiths Detection

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, CL and CS models

**Isotopic identification:** Yes

**Common uses:** Gamma ray detection and identification of radioactive material

**Dimensions:** 18 x 30 x 12 cm (7 x 12 x 5 in.)

**Weight:** Approximately 2 kg (4.5 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports

**Similar detectors:** Aspect MKC-A03 (Russia), NuTech RM0100NA/NH (China)
identiFINDER

Handheld, portable radioisotope detector and identifier. Widely deployed in ports overseen by the IAEA. Provides operator with gamma ray count rate and dose rate information. The blue cap indicates the instrument includes neutron detection capabilities while the red cap denotes a gamma only model. Attachments available to extend reach of operator. Waterproof models available.

**Manufacturer:** FLIR Systems (formerly known as Target, ICx Technologies, Thermo Scientific)

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, optional

**Isotopic identification:** Yes

**Common uses:** Gamma ray detection and identification of radioactive material

**Dimensions:** 10 x 27 x 8 cm (4 x 10 x 3 in.)

**Weight:** Approximately 1.5 kg (3.2 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports, IAEA partnered ports
Handheld, portable radioisotope detector and identifier produced by the Russian company SPC Aspect. Provides operator with gamma ray count rate and dose rate information. Instrument includes neutron detection capabilities. Deployed to Russian supported port locations.

**Manufacturer:** SPC Aspect

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes

**Isotopic identification:** Yes

**Common uses:** Gamma ray detection and identification of radioactive material

**Dimensions:** 28 x 13 x 18 cm (11 x 5 x 7 in.)

**Weight:** Approximately 3 kg (6.5 lbs)

**Locations deployed:** Russian supported port facilities

**Similar detectors:** Smiths RadSeeker (US), NuTech RM0100NA/NH (China)
Handheld, portable radioisotope detector and identifier produced by the Chinese company NucTech. Provides operator with gamma ray count rate and dose rate information. The RM0100NH model includes neutron count rate capabilities. Deployed to Chinese supported port locations.

**Manufacturer:** NucTech

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, RM0100NH model

**Isotopic identification:** Yes

**Common uses:** Gamma ray detection and identification of radioactive material

**Dimensions:** 29 x 14 x 17 cm (11 x 5 x 6 in.)

**Weight:** Approximately 2.5 kg (5.5 lbs)

**Locations deployed:** Chinese supported port facilities

**Similar detectors:** Smiths RadSeeker (US), Aspect MKS-A03 (Russian)
Handheld, lightweight, portable radiation monitor produced by the US privately held company Rapiscan Systems. Provides operator with gamma ray and neutron count rate and dose rate information that can be used to conduct material searches or monitor background radiation levels.

**Common uses:** Gamma ray and neutron detection, contamination and background monitoring, material searches

**Dimensions:** 20 x 12 x 9 cm (7 x 5 x 3.5 in.)

**Weight:** Approximately 1 kg (2.2 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports

**Manufacturer:** Rapiscan Systems, formerly TSA Systems

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, CGN models

**Isotopic identification:** No

**Manufacturer:** Mirion Technologies (formerly MGP Instruments)

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, HDS-101GN model

**Isotopic identification:** Yes

**Common uses:** Search, localize, and characterize materials during radiological surveys

**Dimensions:** 28 x 8 cm (11 x 3 in.)

**Weight:** Approximately 1.5 kg (3 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports
Handheld radioisotope detector and identifier. Detector is a precision instrument capable of identifying complex radioactive materials. Provides operator with gamma ray count rate and dose rate information. Instrument models vary in detector crystal size which effects the size of the end cap on the front of the detector.

**Manufacturer:** ORTEC  

**Sensitive to radiation:** gamma  

**Neutron detection:** No  

**Isotopic identification:** Yes

**Common uses:** Gamma ray detection and identification of radioactive material  

**Dimensions:** Approximately 42 x 24 x 38 cm (17 x 10 x 15 in.) – model dependent  

**Weight:** 12 - 21 kg (26 - 47 lbs)  

**Locations deployed:** Domestic and U.S. partnered international ports  

**Similar detectors:** ORTEC Detective EX (US), ORTEC Micro-Detective (US)
Handheld radioisotope detector and identifier. Detector is a precision instrument capable of identifying complex radioactive materials. The compartment below the end cap on the front of the detector contains the neutron detection capabilities. Instrument models vary in detector crystal size which effects the size of the end cap on the front of the detector.

**Manufacturer:** ORTEC

**Sensitive to radiation:** gamma

**Neutron detection:** Yes

**Isotopic identification:** Yes

**Common uses:** Gamma ray and neutron detection and identification of radioactive material

**Dimensions:** 39 x 18 x 35 cm (16 x 7 x 14 in.)

**Weight:** Approximately 12 kg (26 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports

**Similar detectors:** ORTEC Detective (US), ORTEC Micro-Detective (US)
Handheld radioisotope detector and identifier. This instrument is a lightweight version of the ORTEC Detective with an approximate 50% reduction in weight. Instrument utilizes a mechanically cooled HPGe crystal to obtain high resolution gamma ray data for the identification of complex radioactive materials. Contains a single $^3$He tube for neutron detection.

**Manufacturer:** ORTEC

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes

**Isotopic identification:** Yes

**Common uses:** Gamma ray and neutron detection and identification of radioactive material

**Dimensions:** 38 x 15 x 28 cm (15 x 6 x 11 in.)

**Weight:** Approximately 7 kg (15 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports

**Similar detectors:** ORTEC Detective (US), ORTEC Detective EX (US)
Backpack form factor radioisotope detector. Relatively large, high efficiency detector used to survey areas and localize radioactive material. Provides operator with gamma ray and neutron count rate and dose rate information. Optional PDA available for remote monitoring.

**Manufacturer:** Thermo Scientific

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, GN-2 model

**Isotopic identification:** No

**Common uses:** Gamma ray and neutron detector to survey areas and localize radioactive material

**Dimensions:** 42 x 24 x 38 cm (17 x 10 x 15 in.)

**Weight:** 5 kg (11 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports
Pager form factor radioisotope detector. Small, easily portable detector used to survey areas and localize radioactive material. Provides operator with gamma ray dose rate and neutron count rate information.

**Manufacturer**: Polimaster

**Sensitive to radiation**: gamma, neutron

**Neutron detection**: Yes, GNA model

**Isotopic identification**: No

**Common uses**: Gamma ray and neutron detector to survey areas and localize radioactive material

**Dimensions**: 7 x 3 x 9 cm (3 x 1 x 3 in.)

**Weight**: 230 g (0.5 lbs)

**Locations deployed**: Domestic and U.S. partnered international ports

**Similar detectors**: PDS-100G/GN (US)
PDS-100G/GN

Pager form factor radioisotope detector. Small, rugged, and easily portable detector used to survey areas and localize radioactive material. Provides operator with gamma ray count and dose rate and neutron count rate information.

Manufacturer: Mirion Technologies (formerly MGP Instruments)

Sensitive to radiation: gamma, neutron

Neutron detection: Yes, PDS-100GN model

Isotopic identification: No

Common uses: Gamma ray and neutron detector to survey areas and localize radioactive material

Dimensions: 12 x 7 x 4 cm (5 x 3 x 2 in.)

Weight: 300 g (0.6 lbs)

Locations deployed: Domestic and U.S. partnered international ports

Similar detectors: PM1703 GN/GNA (US)
Pager form factor radioisotope detector. Small, rugged, and easily portable detector used to survey areas and localize radioactive material. Provides operator with a readout proportional to gamma ray count rate. The Pager and Pager-S models are identical in size though the the Pager-S includes a button on the top of the device to update the background level.

**Manufacturer:** Sensor Technology Engineering, Inc

**Sensitive to radiation:** gamma

**Neutron detection:** No

**Isotopic identification:** No

**Common uses:** Gamma detector to survey areas and localize radioactive material

**Dimensions:** 10 x 6 x 2 cm (4 x 2 x 1 in.)

**Weight:** 170 g (0.4 lbs)

**Locations deployed:** Domestic and U.S. partnered international ports
A two pillar portal system typically separated by less than 5 m. The pillars contain gamma ray and neutron detectors for the continuous monitoring of automobiles and small trucks. Device operation can be overseen from remote facility.

**Manufacturer:** Rapiscan Systems, formerly TSA Systems

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, optional

**Isotopic identification:** No

**Common uses:** Continuous gamma ray and neutron rate monitoring of automobiles and small lightly loaded trucks

**Dimensions:** 305 x 65 x 20 cm (120 x 26 x 8 in.)

**Pillar spacing:** Typically 5 m or less

**Locations deployed:** Domestic and U.S. partnered international ports, IAEA partnered ports

**Similar detectors:** SPC Aspect Yantar-1A (Russian), RM2000 (China)
A two pillar portal system typically separated by more than 5 m. The pillars contain gamma ray and neutron detectors for the continuous monitoring of large vehicle and train freight material. Device operation can be overseen from a remote facility.

**Manufacturer:** Rapiscan Systems, formerly TSA Systems

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, optional

**Isotopic identification:** No

**Common uses:** Continuous gamma ray and neutron rate monitoring of large freight vehicles

**Dimensions:** 400 x 120 x 25 cm (160 x 48 x 10 in.)

**Pillar spacing:** Typically 6 m

**Locations deployed:** Domestic and U.S. partnered international ports, IAEA partnered ports

**Similar detectors:** SPC Aspect Yantar-1ZH (Russian), RM3000 (China)
A pillar portal system produced by the Russian based company SPC Aspect. System is available in either a 2-pillar (1A) or single pillar configuration (2A). The pillars contain gamma ray and neutron detectors for the continuous monitoring of automobiles and small trucks.

**Manufacturer:** SPC Aspect

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes

**Isotopic identification:** No

**Common uses:** Continuous gamma ray and neutron rate monitoring of automobiles and small lightly loaded trucks

**Dimensions:** 80 x 300 x 37 cm (31 x 120 x 15 in.)

**Pillar spacing:** Approximately 4 m for the two pillar configuration

**Locations deployed:** Russian supported port locations

**Similar detectors:** TSA VM-250 (US), NucTech RM2000 (China)
A pillar portal system produced by the Russian based company SPC Aspect. The pillars contain gamma ray and neutron detectors for the continuous monitoring of large truck and train freight material. Commonly used at railway checkpoints in a two pillar configuration with 6 m spacing.

**Manufacturer:** SPC Aspect

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes

**Isotopic identification:** No

**Common uses:** Continuous gamma ray and neutron rate monitoring of large freight vehicles

**Dimensions:** 113 x 275 x 40 cm (45 x 110 x 16 in.)

**Pillar spacing:** Approximately 6 m

**Locations deployed:** Russian supported port locations

**Similar detectors:** TSA TM-850 (US), NucTech RM3000 (China)
A two pillar portal system. The pillars contain gamma ray and neutron detectors for the continuous monitoring of vehicle (RM2000) and train (RM3000) freight material. System has the ability to characterize radioactive material. Device operation can been overseen from remote facility.

**Manufacturer:** NucTech

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, optional

**Isotopic identification:** Yes

**Common uses:** Continuous gamma ray and neutron rate monitoring of large freight vehicles

**Dimensions:** 180 x 60 x 500 cm (70 x 24 x 195 in.)

**Locations deployed:** Chinese supported port locations

**Similar detectors:** SPC Aspect Yantar-1A/1ZH (Russian), TSA VM-250 (US), TSA TM-850 (US)
A radiation detection system mounted in a van for mobile screening. The system is available in gamma, neutron, and a combination of gamma and neutron detector configurations. System monitors current gamma and/or neutron counts rates. Audio and visual alarms are triggered if these values exceed values above recent background data.

**Manufacturer:** Rapiscan Systems, formerly TSA Systems

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, optional

**Isotopic identification:** No

**Common uses:** Stationary or mobile inspection of vehicles or containers via monitoring of gamma and/or neutron radiation.

**Dimensions:** 340 x 320 cm (130 x 125 in.)

**Locations deployed:** Domestic and U.S. partnered international ports, IAEA partnered ports

**Similar detectors:** SPC Aspect Yantar-MA-01 (Russian), NuTech RM0600NA/NH (China)
A radiation detection system mounted in a van for mobile screening. The system consists of a combined detector module MDK-01 that contains a plastic scintillator pillar for gamma detection and an optional neutron detector. Multiple detector pillars can be added for increased detection sensitivity. One power supply module can power up to eight MDK-01 detector modules.

**Manufacturer:** SPC Aspect

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, optional

**Isotopic identification:** No

**Common uses:** Stationary or mobile inspection of vehicles or containers via monitoring of gamma and/or neutron radiation.

**Dimensions:** 45 x 126 x 24 cm (18 x 50 x 9 in.)

**Locations deployed:** Russian supported port locations

**Similar detectors:** TSA MD134 (US), NuTech RM0600NA/NH (China)
A radiation detection system mounted in a cargo container on the roof of a vehicle for mobile screening. The system contains large NaI crystals for gamma ray detection and isotope identification. The RM0600NA is a gamma only system while the RM0600NH adds neutron detection capability.

**Manufacturer:** NucTech

**Sensitive to radiation:** gamma, neutron

**Neutron detection:** Yes, optional

**Isotopic identification:** Yes

**Common uses:** Stationary or mobile inspection of vehicles or containers via monitoring of gamma and/or neutron radiation.

**Dimensions:** 175 x 80 x 45 cm (70 x 30 x 18 in.)

**Locations deployed:** Chinese supported port locations

**Similar detectors:** TSA MD134 (US), SPC Aspect Yantar-MA-01 (Russian),