SNIPER-GN System

The most performant gamma and neutron isotope identifier for Special Nuclear Material

CAEN SyS

Systems & Spectroscopy Division

The Challenge

Nuclear security is one of the most urgent policy issues of the 21st century, but it poses serious technical obstacles.

Engineering has been charged with a crucial set of challenges: discover all the dangerous nuclear material in the world, track and secure it and detect its diversion or transport for terrorist use.

Improving our ability to secure and to detect material more quickly and from a greater distance is crucial to meeting these challenges. Perhaps the most critical issue involves the detection of (SNM) Special Nuclear Materials which has been concealed for terrorist activities.

Unfortunately, theft or diversion of Plutonium, while difficult, is not impossible, and today represents a major nuclear material threat.

Many solutions for the detection of hidden nuclear material have been proposed or tested, but none have combined the elements of accuracy, speed, portability, and affordability in a single system; until now!

The SNIPER-GN is ideal for nuclear & homeland security applications because it can detect and identify Plutonium, SNM, and spent fuel in just a few seconds and at distances ten times greater than current detection standards (ISO and ANSI).

Dr. Massimo Morichi

*International Qualified Radioprotection
and Nuclear Measurements Expert*

U.S. Patented Device

The Solution

The SNIPER-GN is a radiation detection system designed to be quickly deployed by the nuclear security community for homeland security and/or for emergency response purposes.

The SNIPER-GN can "detect and identify" Plutonium, SNM, and spent fuel in just a few seconds and at distances ten times greater than current detection standards (ISO and ANSI) enabling security personnel to immediately recognize and resolve hidden threats without the need to introduce costly secondary detection measures or highly specialized personnel. A patented algorithm allows to identify the SNM through neutron measurements, very difficult to shield and detectable at high distance (this feature is not yet included in any ISO and ANSI standard).

This new compact and portable instrument can be easily hidden in a backpack or a trolley to be used in multiple scenarios ranging from rapid implementation in public events to perimeter monitoring of critical infrastructure. SNIPER-GN can also be employed for radiation monitoring of harbors or airports cargo areas, for customed borders inspection and for first responder.

The SNIPER-GN is equipped with CAEN patented, cutting-edge PSD technology that combines a highly sophisticated blend of spectroscopy, counting, and neutron multiplicity algorithms to create a truly innovative detection system. This PSD technology has been tested, qualified, and implemented at the most respected nuclear research laboratories and has been adopted by the IAEA Safeguards Division for nuclear fuel verification.

COMPACT AND TRASPORTABLE

Web Interface functionalities

Data are shown in real-time on a tablet or any other mobile device via a web interface connected through Wi-Fi or a USB cable

- **DASHBOARD**: start, pause and shutdown buttons. Real-time counting rate of gamma and neutrons

- **SEARCH**: Counting rate trend of gamma and neutrons in the last minute. Alarm thresholds of gamma and neutrons are plotted

- **MAPPING**: real-time position plot and route of the device on the map. The position where an alarm is triggered is also highlighted on the map

- **REPORT**: the report of the last identification measurement is reported: spectra, list of identified isotopes and their category and the confidence level.

- **Full Gamma and Neutron identification of Nuclear threats in only 60 seconds**
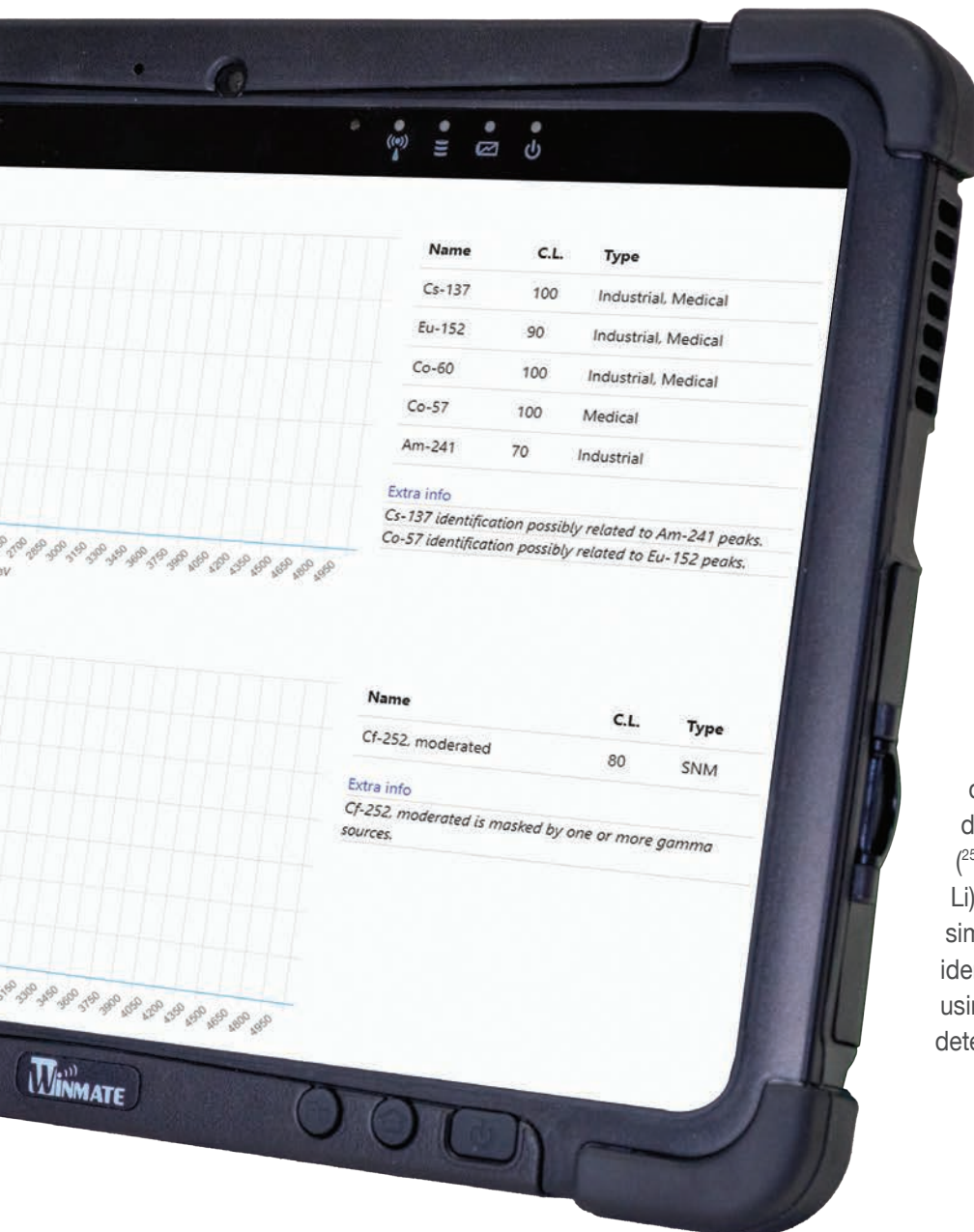- **Alarming in 1 seconds**

GAMMA AND NEUTRON DETECTORS

UNATTENDED MODE ID FAST BLINKING LED

USB CONNECTION

GAMMA SPECTOMETER

SMEAR/AIR FILTER AND CARTRIDGE HOLDER SUPPORT FOR RADIOACTIVE CONTAMINATION TEST

TWO HOT SWAP BATTERIES

INTEGRATED WIFI AND GPS ANTENNAS

IP 67 PROTECTION CLASS ENCLOSURE

Highlights

- Detection and localization of radioactive materials such as Special Nuclear Material (SNM) and Radiological Dispersal Devices (RDD)
- High-resolution spectroscopy detector for identification of gamma emitters and a high efficiency gamma/neutron detector for neutron source identification with discrimination between fissile material, alpha-n source, Plutonium and Uranium
- Real-time gamma/neutron discrimination is performed and based upon the same Pulse Shape Discrimination (PSD) algorithms implemented by CAEN for the IAEA Safeguards Fast Neutron Collar Monitor.
- Identification of gamma ray emitters and NORM sources
- Highly secure Wi-Fi connectivity supports quick setup and simple functionality and data visualization
- Software functionalities including Search, Mapping and Identification
- Highly portable (i.e., backpack or trolley) and adaptable system (<7.8kg)
- Optional battery power with runtime 8+ hours

Operative Applications

▶ CBRN
▶ INDUSTRIAL
▶ CIVIL

Name	C.L.	Type
Cs-137	100	Industrial, Medical
Eu-152	90	Industrial, Medical
Co-60	100	Industrial, Medical
Co-57	100	Medical
Am-241	70	Industrial

Extra info

Cs-137 identification possibly related to Am-241 peaks.
Co-57 identification possibly related to Eu-152 peaks.

Name	C.L.	Type
Cf-252, moderated	80	SNM

Extra info

Cf-252, moderated is masked by one or more gamma sources.

Automatic isotope identification (also for neutron emitters) and report generation

SNIPER-GN performs automatic isotope identification, but in the event of an alarm condition, the operator can initiate an identification measurement. **A unique feature of the SNIPER-GN system is the neutron source identification algorithm.** SNIPER-GN can automatically detect and identify neutron sources, discriminating between fissile material (^{252}Cf), alpha-n sources (Am/Be, Am/Li), Plutonium and Uranium. The system simultaneously performs gamma isotope identification, through peak detection using the integrated high resolution CeBr$_3$ detector.

CBRN Applications

The SNIPER-GN has been specifically designed for CBRN defense applications

▶ **Operative Application**

Search and secure operations

Airport security checkpoints

Nuclear facilities and radiation-sensitive areas

Radiological Dispersal Device (RDD) detection and identification

First responder prompt intervention

Customs border inspections

NATO Stock Numbers

SNIPER-GN

CBRN

HOMELAND SECURITY

TERRORIST ATTACKS

INFRASTRUCTURE PROTECTION

Separated gamma and neutron counting

SNIPER-GN can detect small deviation from the measured natural background thanks to the high efficiency detector. Gamma and neutron counting rates are displayed separately and alarm thresholds are calculated independently for both types of particles.

Industrial Applications

SNIPER-GN can be a critical tool for securing and monitoring sensitive facilities and infrastructure, as well as in other stages of the nuclear fuel cycle

▶ **Operative Application**

Enrichment plant survey and verifications

Spent fuel safeguards

UF_6 cylinders characterization

Fast waste screening

Urban waste controls

Facility remote unattended monitoring

SNIPER-GN

WASTE DISPOSAL

TERRORIST ATTACKS

INFRASTRUCTURE PROTECTION

Gamma: 1,265.3 cps   Neutron: 0.0 cps   Status: SEARCH STABILIZED

IDENTIFY   STABILIZE   START MISSION

Gamma ALARM   Neutron

1,265.3 cps   0.0 cps

ALARM
Auto ID starts in 2
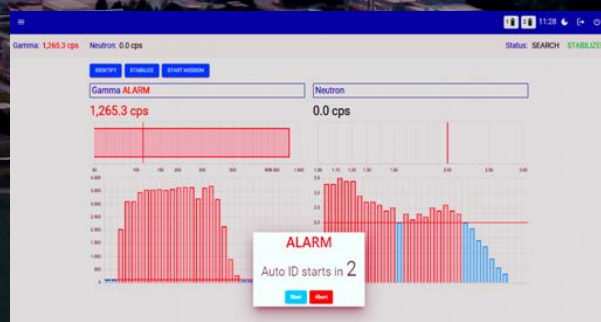
Continous background updating and automatic thresholds calculation

The background is continuously updated as the operator moves around an area. The neutron and gamma alarm thresholds are automatically calculated based on the background moving average. Alarms for gamma, neutron, or both are triggered when the detection rate exceeds the alarm threshold.

Civil Applications

SNIPER-GN is light, flexible, and portable, allowing quick and easy deployment at large public events and other non-traditional sites and activities

▶ **Operative Application**

Parcel scanning in shipping facilities

Entry-points for concerts, sporting events, and other large public gatherings

Discrete scanning for advanced detection in crowded public areas

Screening assessment of contamination sites

RDD search & detection in airport and harbor cargo container

Preventative radiation survey for event protection

SNIPER-GN

CBRN

TERRORIST ATTACKS

TRANSPORTATION DISASTER

Gamma: 34.7 cps   Neutron: 0.0 cps   Status: SEARCH STABILIZED
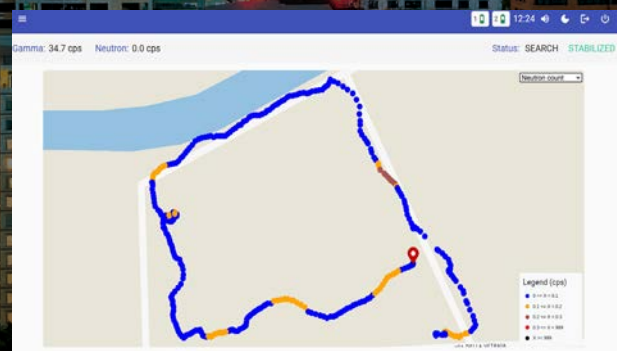
Integrated GPS for mapping

The location of the system can be easily monitored in real time thanks to the integrated GPS functionality.

This position can be superimposed on a GPS map for visualization and monitoring; measurements and alarm conditions are integrated into the map position according to the movement of the system. A secure file, which records the location and movement of the system is saved locally.

SNIPER-GN Performances

Neutron sources identification

- IEC 62327 requirements: neutron alarm triggered in 2 seconds for a ^{252}Cf source with 20.000 neutrons/s @ 25 cm

- 1 second for gamma alarm - 2 second for neutron alarm

- up to 1 minute to identify the gamma source

Alarming

- Alarm for neutron and gamma are calculated with 95% detection probability at 95% confidence level for a dose rate on the front face of the scintillator of at least 50 nSv/h

- neutron alarm detection has been tested also in high gamma ray fields up to 0.1 mSv/h

- 1 second for gamma alarm - 2 second for neutron alarm

- < 1 minute for isotope identification (also for neutron emitters)

INTERNATIONAL STANDARD

ANSI N42.34-2015 (USA)

- 1 s for gamma alarm due to an activity of 100 nSv/h above background

- 1 s for neutron alarm due to a ^{252}Cf source emitting 20.000 n/s @ 25 cm

- 2 min or less for identification of isotopes

IEC 62327-2017 (EU)

- 1 s for gamma alarm due to an activity of 500 nSv/h above bkg

- 2 s for neutron alarm due to a ^{252}Cf source emitting 20.000 n/s @ 25 cm

- 1 min or less for isotope identification

SNIPER-GN exceeds International Standard

Minimum detectable activity to trigger a gamma alarm

International Reference (IEC62327)	500 nSv/h
SNIPER-GN	1/10 Standard ➠ 50 nSv/h

252Cf

Minimum distance to detect the neutron source

International Reference (IEC62327)	☢ ➠ ☐ = 25 cm
SNIPER-GN	☢ ➠ ☐☐☐☐☐ = 125 cm (Standard X5)

Minimum shielding to detect the neutron source

International Reference (IEC62327)	☢ ➠ = 5 cm polyethylene
SNIPER-GN	☢ ➠ = Standard + 5 cm polyethylene + 5 cm Lead

239Pu

Minimum distance to detect the neutron source

International Reference (IEC62327)	☢ ➠ ☐ = 25 cm
SNIPER-GN	☢ ➠ = 500 cm (Standard X20)

Minimum shielding to detect the neutron source

International Reference (IEC62327)	☢ ➠ = 5 cm polyethylene
SNIPER-GN	☢ ➠ = Standard + 5 cm polyethylene + 5 cm Lead

SNIPER-GN Technical Specifications

Standard procedures
- 3 minutes warm up of the system at power up.
- 3 minutes background measurement.
- Typical scanning times:
   - 1 s for a gamma ray alarm
   - 2 s for a neutron alarm
   - 1 minute for identification of gamma or neutron emitter

Power supply
- Battery powered by LiFePO4 rechargeable batteries
- Removable batteries
   - Nominal voltage: 14.4 V
   - Capacity: 98 Wh
   - Storage Temperature: Best 20±5C for long-time storage
   - Cycle life: >1000 cycles
- Total autonomy 8+ hours
- AC/DC power supply included

Mechanical
- Compact sizes: (L x W x D) = 435 x 295 x147 mm^3
- Easy transportable: weight < 8 kg
- Rugged and shockproof containing case

Tablet
- 10.1" display
- Wi-Fi connection with the SNIPER-GN for data visualization
- Report and data logging saved locally on the tablet SSD
- *Optional: rugged tablet compliant with military standard

Neutron/Gamma PSD detector
- Dimension: 2" x 2"
- Neutron source identification allows discriminating U, Pu, Cf or Am/Be sources
- Flash Point: 144 °C

CeBr$_3$
- Spectroscopy with isotope identification
- Nuclide library compliant with the ANSI N42.34
- Energy Resolution FWHM at 662 keV < 4.2%

Environmental
- IP 67
- Operating temperature: -20 °C to 50 °C (-4 °F to 122 °F) according to ANSI N42.53

Gamma And Neutron Spectroscopy With a Backpack Radiation Device With Special Nuclear Material Identification; *G. Mangiagalli, M. Morichi, A. Pepperosa, I. Bonesso; L. Stevanato;* Proceedings INMM & ESARDA Joint Virtual Annual Meeting, August 23-26 & August 30-September 1, 2021. http://resources.inmm.org/sites/default/files/2021-09/a202.pdf

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A Novel Approach to SNM Analysis and Identification for different application in Homeland Security and Nuclear Fuel Cycle; *M. Morichi, G. Mangiagalli, F. Erica, M. Corbo, L. Stevanato, C. Fontana, I. Bonesso*; IEEE conference 2018

CAEN SyS, the new Systems & Spectroscopy Division of CAEN SpA, is a worldwide leader in development of Radiation Measurements Systems and Spectroscopy Solutions, engaged with high performance operations involving Nuclear Facilities, Measurements Laboratories, Security and Safeguards Applications.

CAEN SyS Systems & Spectroscopy Division is built upon CAEN traditions of teamwork and partnership.

The CAEN Network Companies is a cluster of Companies with excellence know-how. Decades of collaboration and co-development with very large international research projects have maximized CAEN SyS capability to translate customer's needs and expectations into cost-effective and reliable solutions.

CAEN SyS enormously benefits from its foundational relationship with CAEN, a world leader in designing multi-input electronics for a wide range of radiation detectors, and nowadays is involved in several leading-edge R&D collaborative projects, to continue expanding and developing expertise in high-level electronic design, and to extend competence and skills into complementary and relevant applications for the benefit of the community.

CAEN SyS is committed to delivering exceptional nuclear measurement instrumentation, expertise and technical support, offering radiation detection instrumentation and integrated turn-key solutions with added value and operational benefit for customers, enhancing safety and security through nuclear measurements in the SECURITY, SAFETY and SAFEGUARD areas.

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