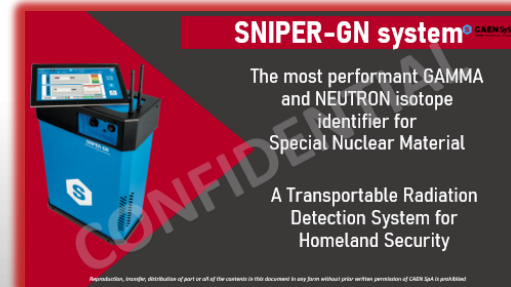# SNIPER-GN system

Transportable GAMMA and NEUTRON isotopes identifier
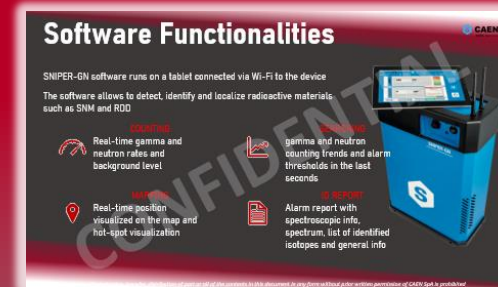

USE CASES

In what scenarios may I use SNIPER-GN?
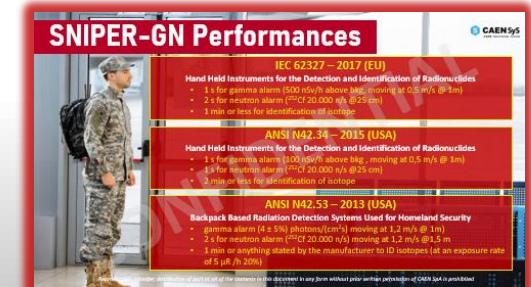
DEVICES OVERVIEW
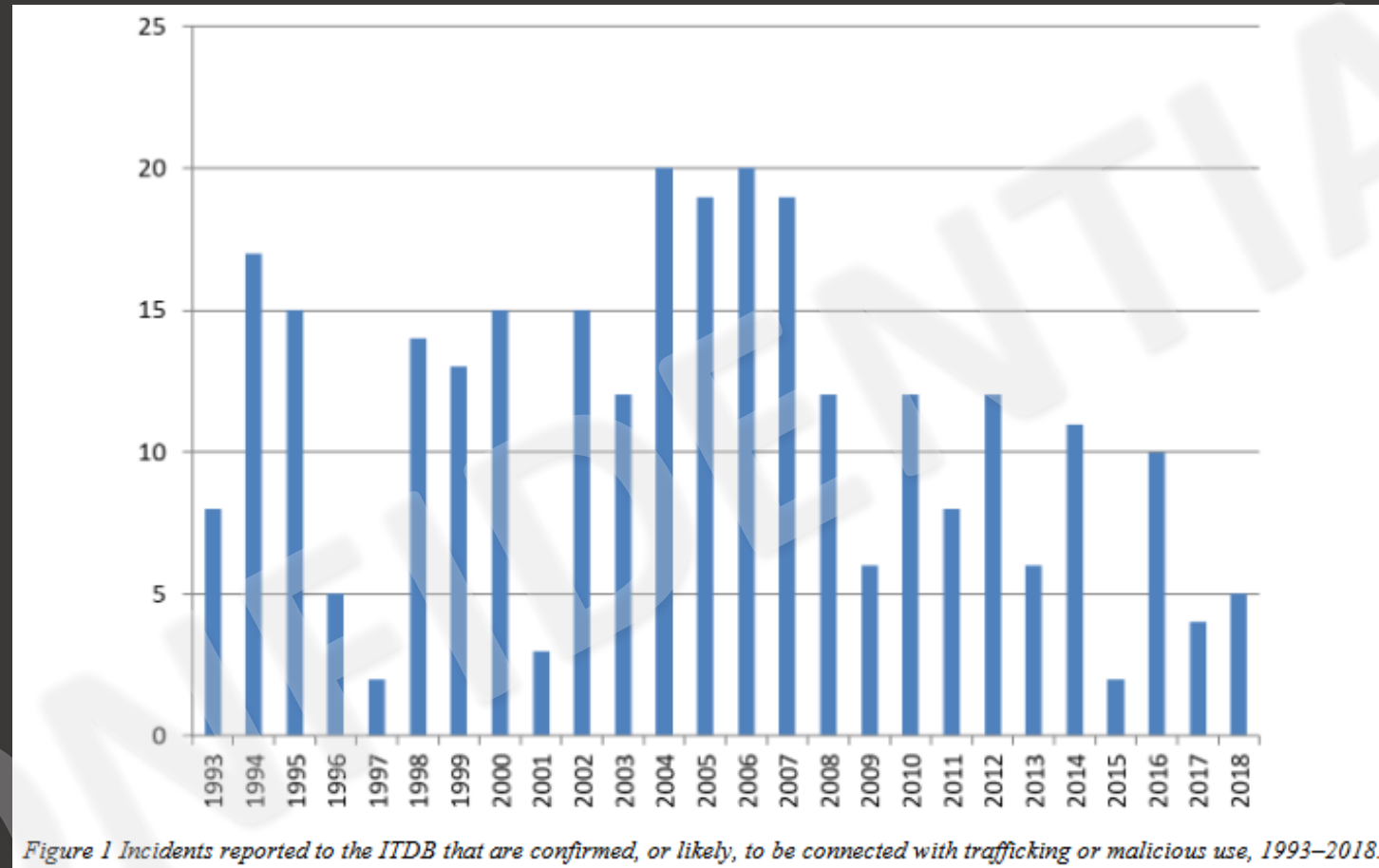
what are the SNIPER-GN characteristics?

SOFTWARE

what features does SNIPER-GN software have?

PERFORMANCES

what tests have been performed?

Homeland Security

Figure 1 Incidents reported to the ITDB that are confirmed, or likely, to be connected with trafficking or malicious use, 1993–2018.

"Information reported so far to the ITDB (International and Trafficking Database – IAEA) demonstrates that unsecured nuclear and other radioactive material continues to be available and individuals and groups are prepared to engage in trafficking this material."

Homeland Security

The potential use of
smuggled radioactive materials by
terrorist has raised serious concern,
thus increasing the demand for a
more capillary survey system.

Security systems designed to work
against threats like:

Figure 1 Incidents reported to the ITDB that are confirmed, or likely, to be connected with trafficking or malicious use, 1993–2018.

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The potential use of **smuggled radioactive materials** by terrorist has raised serious concern, thus increasing the demand for a more capillary survey system.

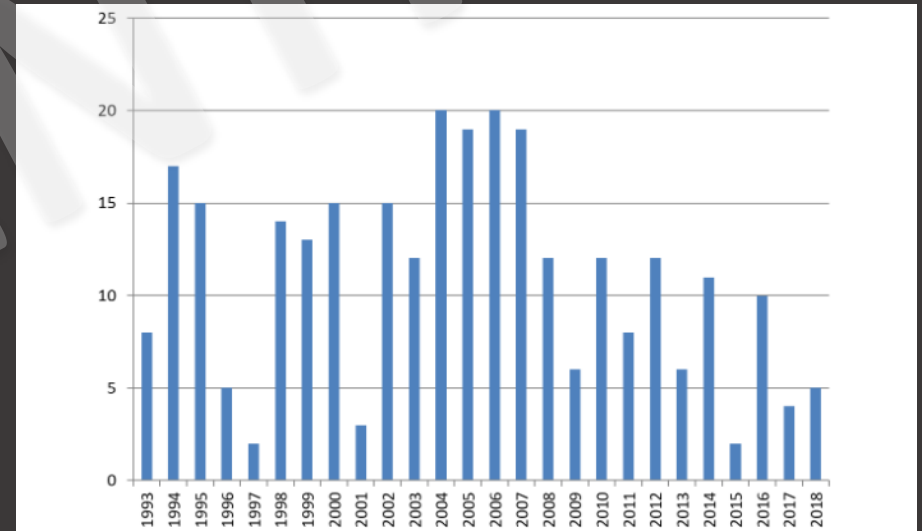Security systems designed to work against threats like:

- DIRTY BOMBS

radioactive material dispersed using a conventional explosive

Homeland Security

The potential use of
smuggled radioactive materials by
terrorist has raised serious concern,
thus increasing the demand for a
more capillary survey system.

Security systems designed to work
against threats like:

- DIRTY BOMBS

- ORPHAN SOURCES

source in an uncontrolled condition that
requires removal to protect public health

Homeland Security

The potential use of **smuggled radioactive materials** by terrorist has raised serious concern, thus increasing the demand for a more capillary survey system.

Security systems designed to work against threats like:

- DIRTY BOMBS

- ORPHAN SOURCES

- RADIOLOGICAL DISPERSAL DEVICES (RDD)

device that causes the purposeful dissemination of radioactive material without a nuclear detonation
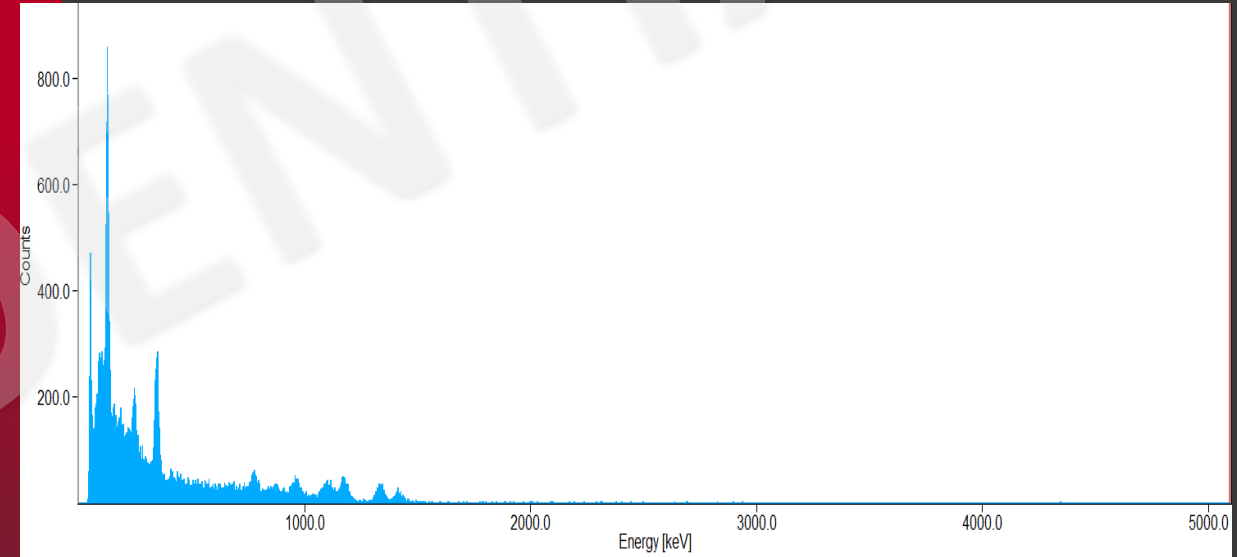
Security requirements

GAMMA source detection and identification:

- Wide energy range
- Different sources Identification (Medical, NORM, Industrial)
- Shielded and masked sources

NEUTRON source detection is a plus

Why Neutron Detection?

- Low energy gamma rays may be easy to shield and hard to detect
- Materials such as <u>nuclear fuels</u> and weapons grade material are low gamma ray emitters, but <u>emit neutrons</u>
- <u>Neutrons are harder to shield</u>
- The neutron detector increases the chance of detecting radioactive materials with lower energy gamma ray
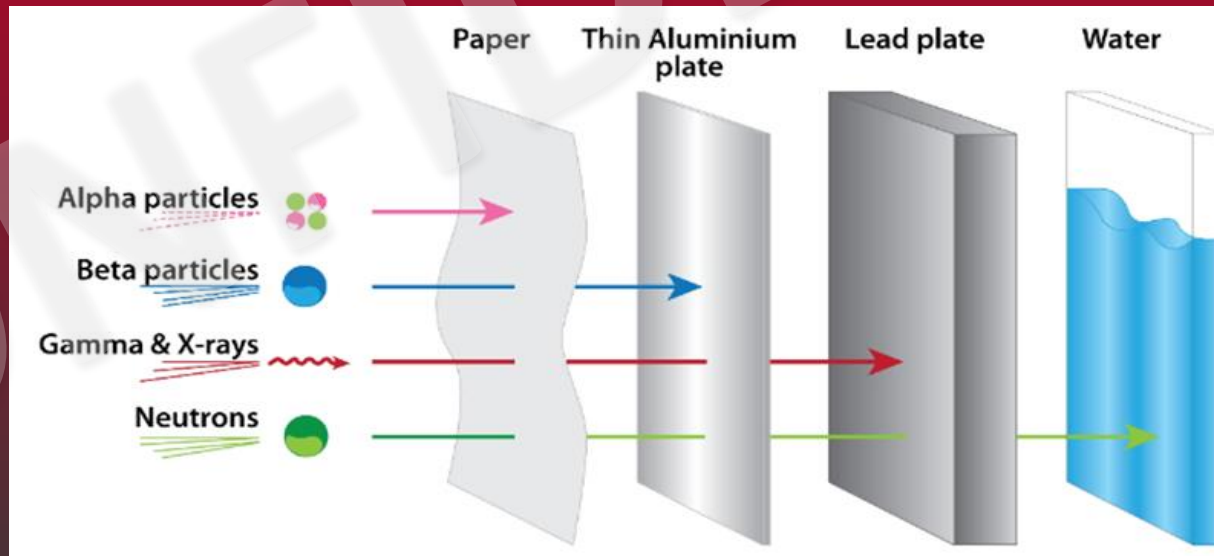
SNIPER-GN use cases

CBRN

Industrial

Civil

CBRN

- security control in airports

- Radiological Dispersal Device detection and identification

- First responder prompt intervention

- Custom border inspection

- Dirty bomb and smuggled material

INDUSTRIAL

- Critical infrastructure's perimeter monitoring

- Enrichment plant survey and verification

- Spent fuel safeguards

- UF6 cylinder characterization

- Fast waste screening

CAEN SyS
CAEN Spectroscopy Division

CIVL

- Public events fast deployment

- Parcel scanning

- Harbor's container or airport's cargo areas

- Preventive radiation survey in crowded areas

SNIPER-GN system

CAEN SyS
CAEN Spectroscopy Division

The most performant GAMMA and NEUTRON isotope identifier for Special Nuclear Material

A Transportable Radiation Detection System for Homeland Security

SNIPER-GN overview

GAMMA SPECTROSCOPY

It's equipped with mid-high resolution (<3,5% @662 keV) gamma detector

It allows the peaks search in the spectrum to identify gamma nuclides

Extended gamma library (with NORM, Industrial, medical and SNM)

Gamma peak search is used also in neutron source identification algorithm
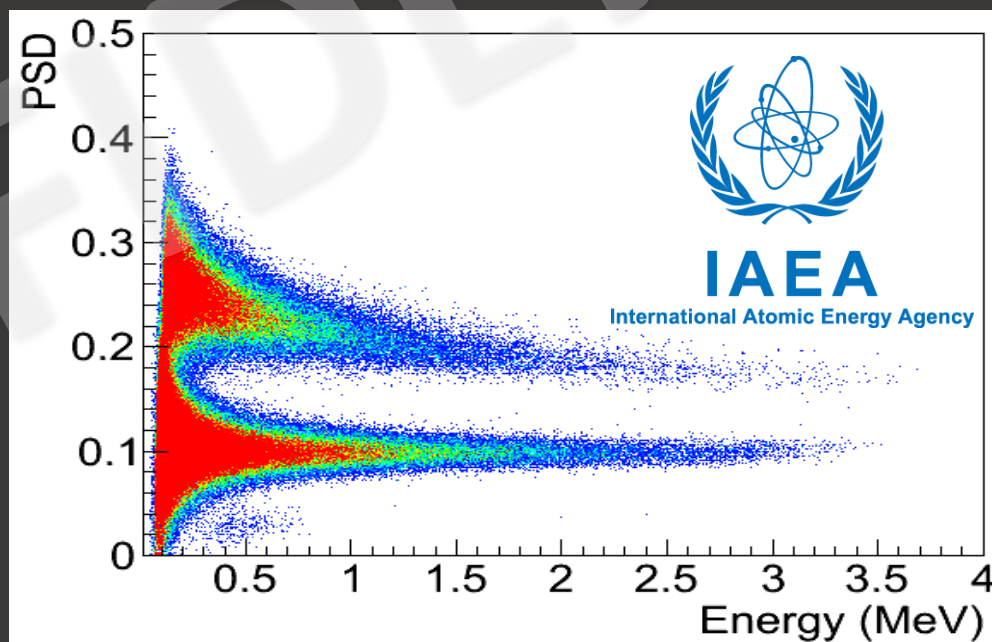→ enhances the SNM identification
→ Allows enrichment level estimation

GAMMA/NEUTRON COUNTING

High-efficiency gamma/neutron detector enhances the detection distance

Real time gamma/neutron discrimination**

** based on the same Pulse Shape Discrimination (PSD) algorithm tested and implemented by CAEN for the IAEA Fast Neutron Collar Monitor (fresh fuel verification)
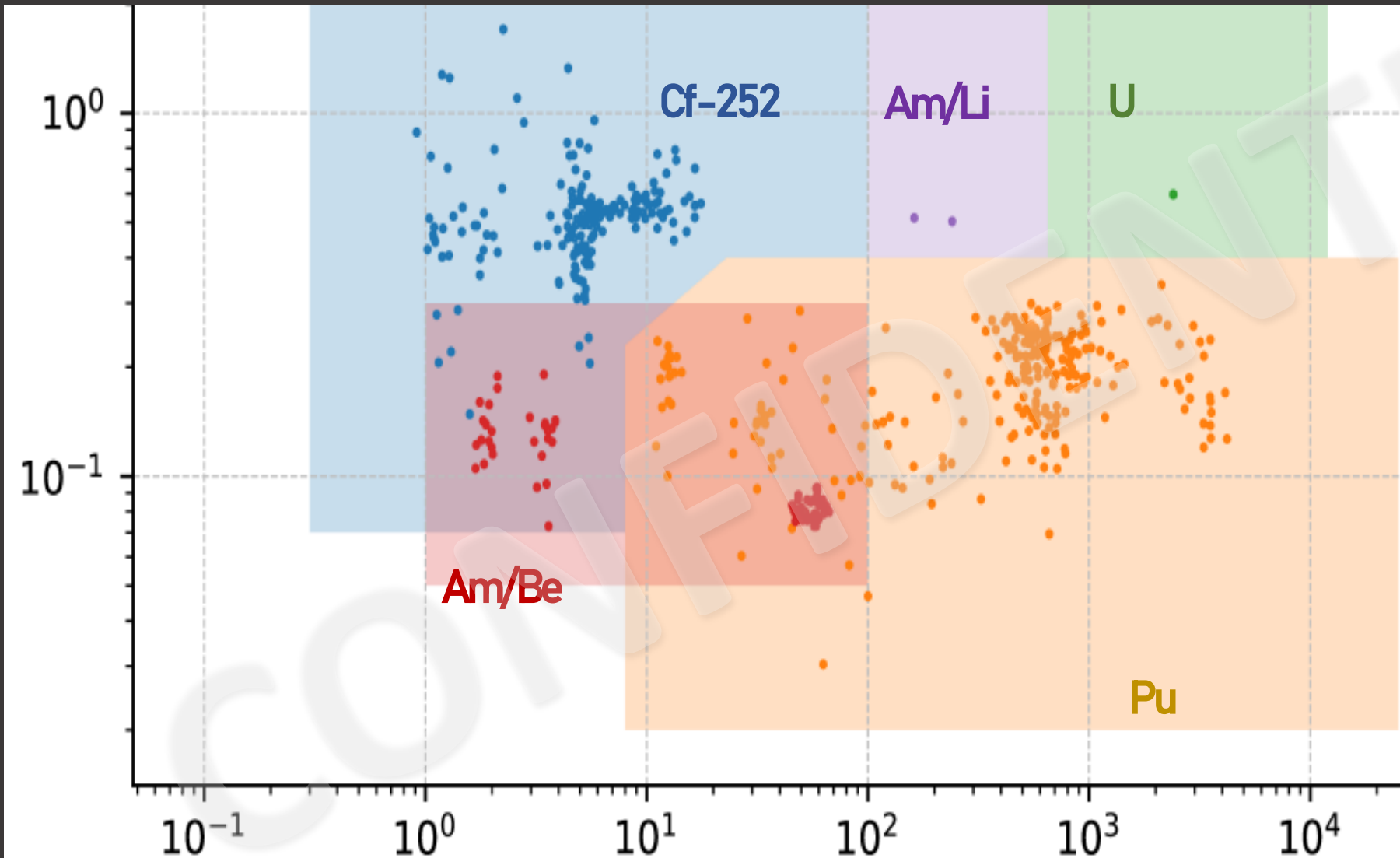
GAMMA/NEUTRON COUNTING

High-efficiency gamma/neutron detector enhances the detection distance

Real time gamma/neutron discrimination**

NEUTRON SOURCE IDENTIFICATION WITH DISCRIMINATION BETWEEN FISSILE MATERIAL (CF-252), ALPHA-N (AM/BE AND AM/LI) SOURCES, PLUTONIUM AND URANIUM

NEUTRON source identification patented algorithm results:

Each point is an identification measurement in a different condition:
- Naked sources
- Shieldes sources
- Masked sources

If the color of the point matches with the color of the area, the Identification is correct

Am/Be (red) area has a 3rd parameter to distinguish it from Cf and Pu

CONNECTIVITY

Wi-Fi connection to a tablet for undercover data visualization (see software section)

Wi-Fi allows for higher distance than Bluetooth thus reducing the user exposure

SNIPER-GN overview

GENERAL

Backpack or trolley transportable system (for undercover or military scenarios)

Search and mapping of RDD thanks to the integrated GPS

12 Kg with Extended Life Battery (> 12 h) and military backpack

Software Functionalities

SNIPER-GN software runs on a tablet connected via Wi-Fi to the device

The software allows to detect, identify and localize radioactive materials such as SNM and RDD

COUNTING
Real-time gamma and neutron rates and background level

SEARCHING
gamma and neutron counting trends and alarm thresholds in the last seconds

MAPPING
Real-time position visualized on the map and hot-spot visualization

ID REPORT
Alarm report with spectroscopic info, spectrum, list of identified isotopes and general info

Counting

REAL-TIME COUNTING

Separated real-time gamma and neutron rates (separation based on PSD discrimination)

BACKGROUND and ALARM THRESHOLDS

Automatic separated gamma and neutron alarm thresholds calculation based on the surrounding background

Proximity of the rate to the alarm visualized

ALARMING

When the threshold is exceeded an alarm pop-up is visualized and the identification measurement starts
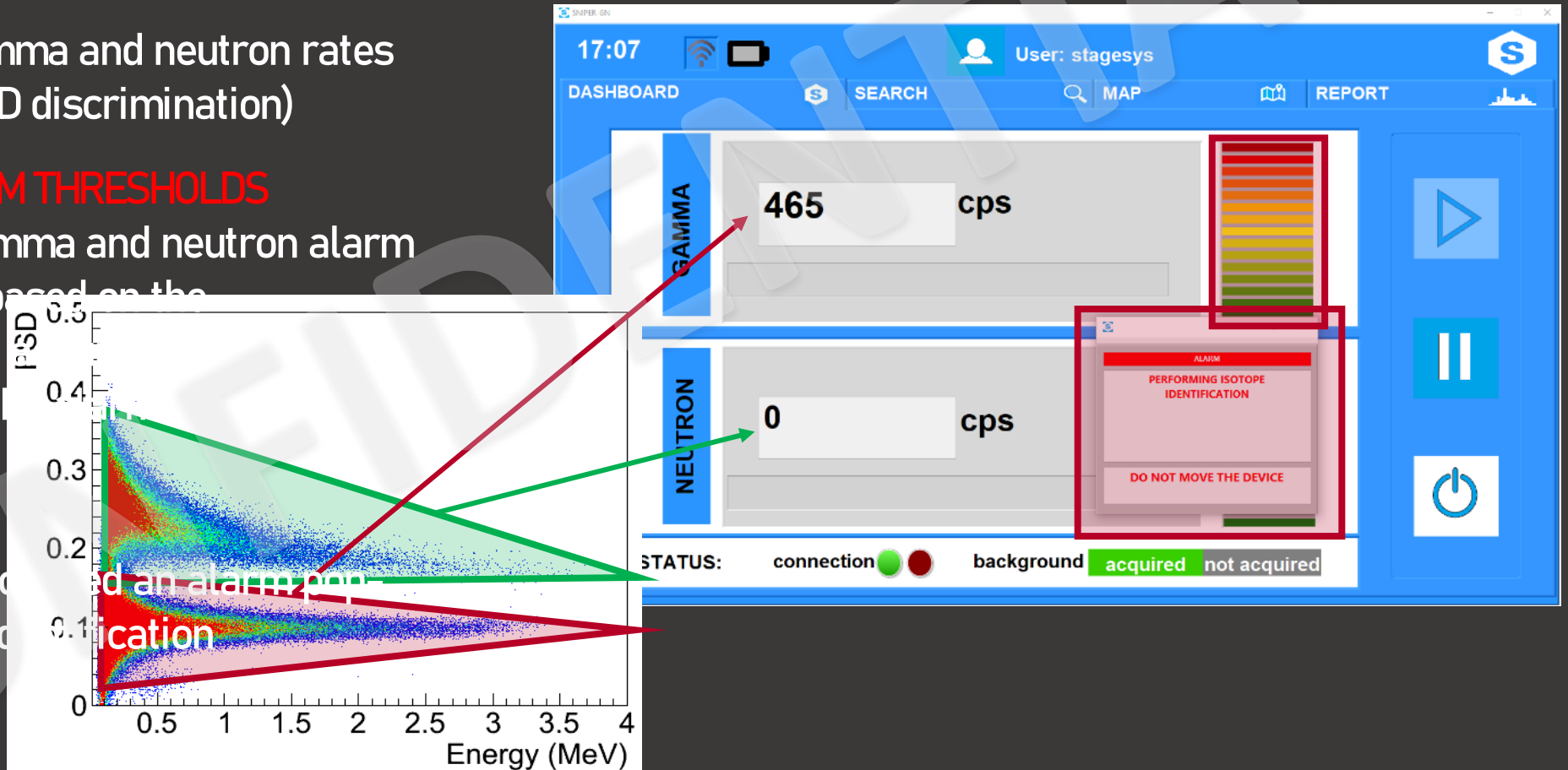
Searching

TREND VISUALIZATION

gamma and neutron rates over the last few seconds with the respective alarm thresholds visualized to enable the hot-spot searching

WARM-UP PROCEDURE

- 2 minutes for the first gamma and neutron backgrounds acquisition and alarm thresholds calculation
- +1 minutes for temperature stabilization of the gamma spectrum

TOTAL: 3 min to be FULLY OPERATIVE

BACKGROUND UPDATE

The background is continuously updated while the user moves around the area (every 30 seconds on the last 3 minutes with a moving average). Gamma and neutron thresholds are also recalculated at the same time
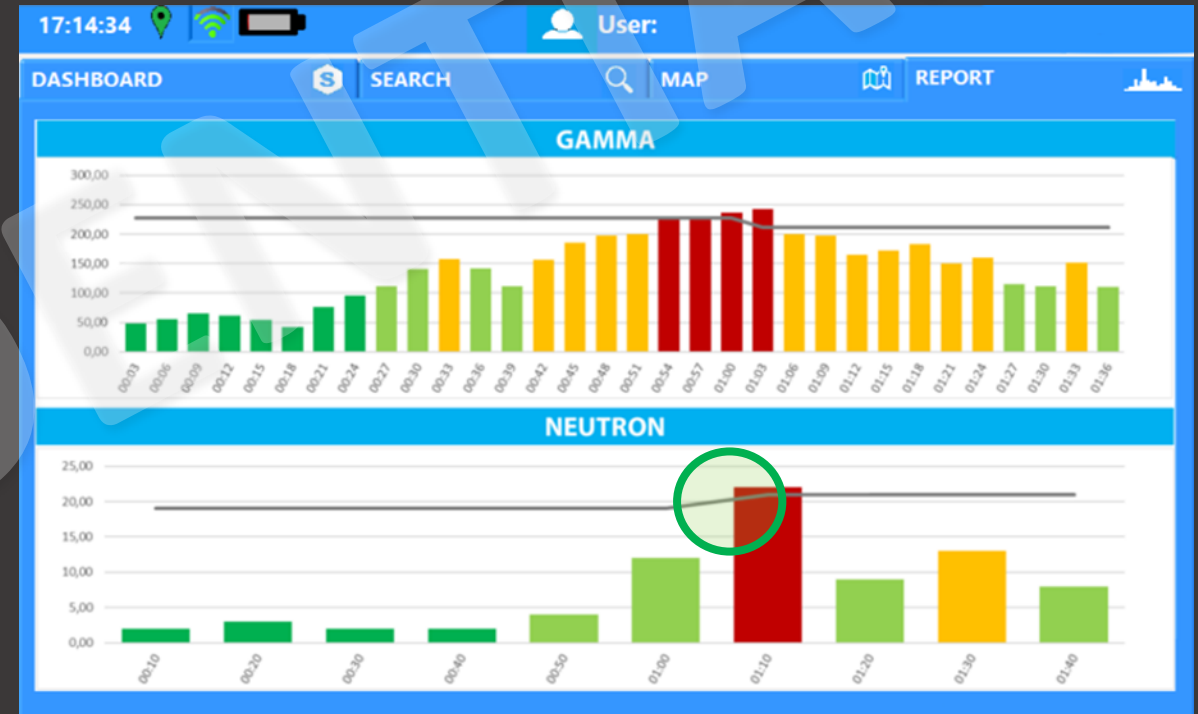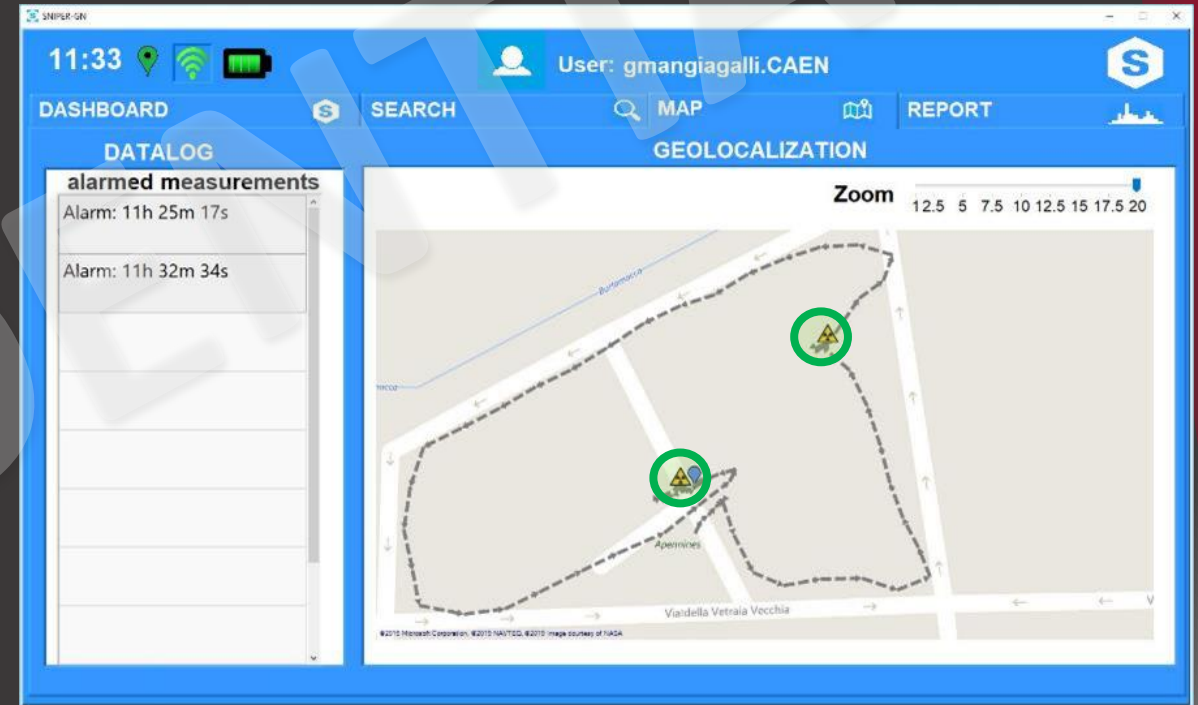
Mapping

REAL-TIME POSITION

The included GPS allows to monitor the real time position on a map

HOT SPOT VISUALIZATION

Alarmed measurements are permanently shown on the map

TRACK STORAGE

The track of the user is recorded and saved in a dedicated file.

ID Report

IDENTIFICATION MEASUREMENT

1 min acquisition (standard requirements) for the identification of the isotopes through peak search

REPORT

automatically generated including spectrum (.spe), identified isotopes, GPS, date, hour, user ...ecc

Also neutron source are identified with discrimination between fissile material (Cf-252), alpha-n (Am/Be and Am/Li) sources, Plutonium and Uranium
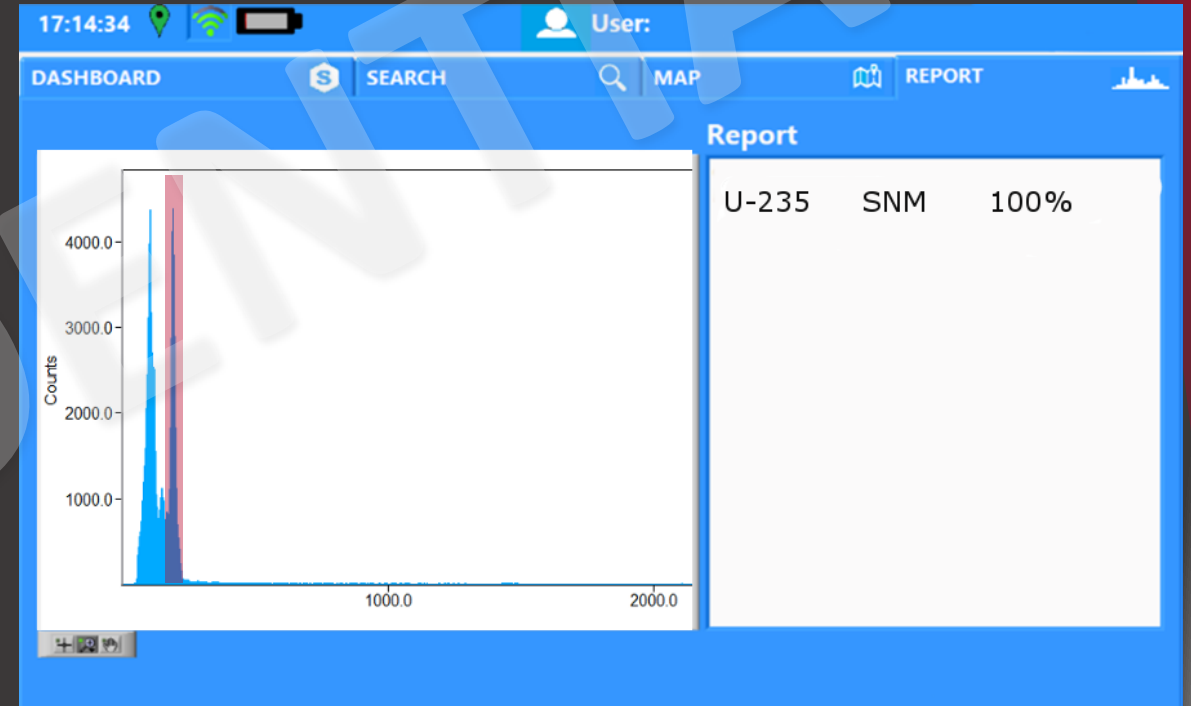
SNIPER-GN Performances

IEC 62327 – 2017 (EU)

Hand Held Instruments for the Detection and Identification of Radionuclides

- 1 s for gamma alarm (500 nSv/h above bkg, moving at 0,5 m/s @ 1m)
- 2 s for neutron alarm (^{252}Cf 20.000 n/s @25 cm)
- 1 min or less for identification of isotope

ANSI N42.34 – 2015 (USA)

Hand Held Instruments for the Detection and Identification of Radionuclides

- 1 s for gamma alarm (100 nSv/h above bkg , moving at 0,5 m/s @ 1m)
- 1 s for neutron alarm (^{252}Cf 20.000 n/s @25 cm)
- 2 min or less for identification of isotope

ANSI N42.53 – 2013 (USA)

Backpack Based Radiation Detection Systems Used for Homeland Security

- gamma alarm (4 ± 5%) photons/(cm^{2}s) moving at 1,2 m/s @ 1m)
- 2 s for neutron alarm (^{252}Cf 20.000 n/s) moving at 1,2 m/s @1,5 m
- 1 min or anything stated by the manufacturer to ID isotopes (at an exposure rate of 5 µR /h 20%)

SNIPER exceeds standards
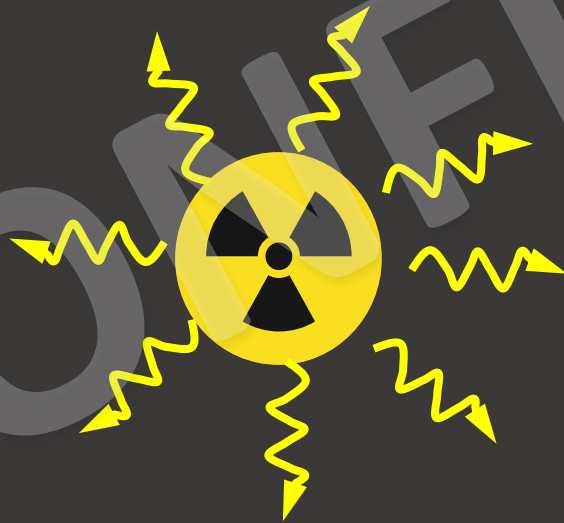
MINIMUM DETECTABLE ACTIVITY TO TRIGGER A GAMMA ALARM

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

SNIPER exceeds standards

MINIMUM DISTANCE TO DETECT THE NEUTRON SOURCE

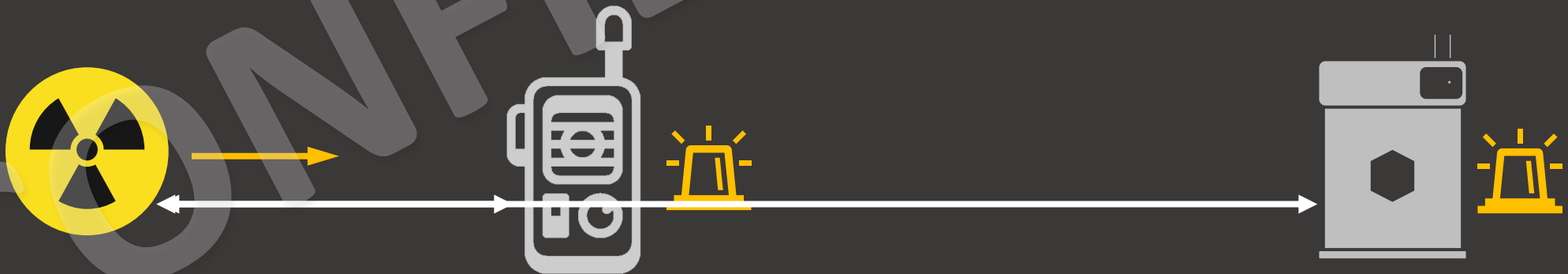International Reference (IEC62327)   25 cm

SNIPER-GN
+identification   125 cm   x5
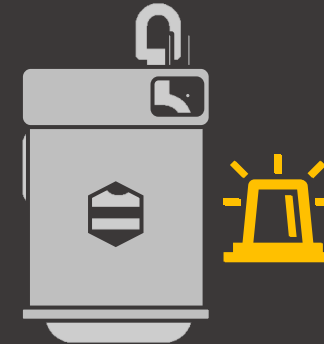
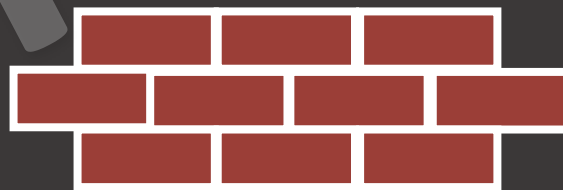# SNIPER exceeds standards

MINIMUM SHIELDING TO DETECT THE NEUTRON SOURCE

International Reference (IEC62327)   5 cm poly

SNIPER-GN
+identification   standard + 5 cm poly
+ 5cm Lead

SNIPER – other performances

|	Gamma detection device	Gamma-neutron device	SNIPER-GN
Gamma counting	✓	✓	✓
1 s gamma alarm for minimum dose rate of	500 nSv/h	500 nSv/h	**50 nSv/h**
Gamma identification in 1 minute	✓	✓	✓
Neutron counting	✗	✓	✓
1 s neutron alarm for 20.000 n/s of Cf-252 at a distance of	✗	25 cm	**125 cm**
1 s neutron alarm for 20.000 n/s of Pu at a distance of	✗	25 cm	**500 cm**
1 s neutron alarm for 20.000 n/s of Cf-252 with a shielding of HDPE of	✗	5 cm	**10 cm + 5 cm lead**
1 s neutron alarm for 20.000 n/s of Pu with a shielding of HDPE of	✗	5 cm	**10 cm + 5 cm lead**
Identification of neutron source in 1 minute	✗	✗	✓
Identification of SNM with shielding, masking or moderation	✗	✗	✓

SNIPER – practical example

	Gamma detection device	Gamma-neutron device	SNIPER-GN
Detection of common gamma sources – gamma **alarm** trigger (Co-60, Cs-137, I-131)	✓	✓	✓
Identification of common gamma sources (Co-60, Cs-137, I-131)	✓	✓	✓
Detection of SNM (gamma and neutron emitting material like U, Pu, Am/Be …) – gamma and neutron **alarm** trigger	✓ gamma ✗ neutron	✓ gamma ✓ neutron	✓ gamma ✓ neutron
identification of SNM (gamma and neutron emitting material like U, Pu, Am/Be …)	✓ gamma ✗ neutron	✓ gamma ✗ neutron	✓ gamma ✓ neutron
Detection of SNM with mainly n (like Cf-252) or with shielded gamma (like U, Pu, Am/Be in a lead box)	✗ gamma ✗ neutron	✗ gamma ✓ neutron	✗ gamma ✓ neutron extra info: shielded
identification of SNM with mainly n (Cf-252) or with shielded gamma (like U, Pu, Am/Be in a lead box)	✗ gamma ✗ neutron	✗ gamma ✗ neutron	✗ gamma ✓ neutron
ID of SNM like previous point with masking with common gamma source (like I-131)	✓ I-131 ✗ SNM	✓ I-131 ✗ SNM	✓ I-131 ✓ SNM extra info: masked

SNIPER new features
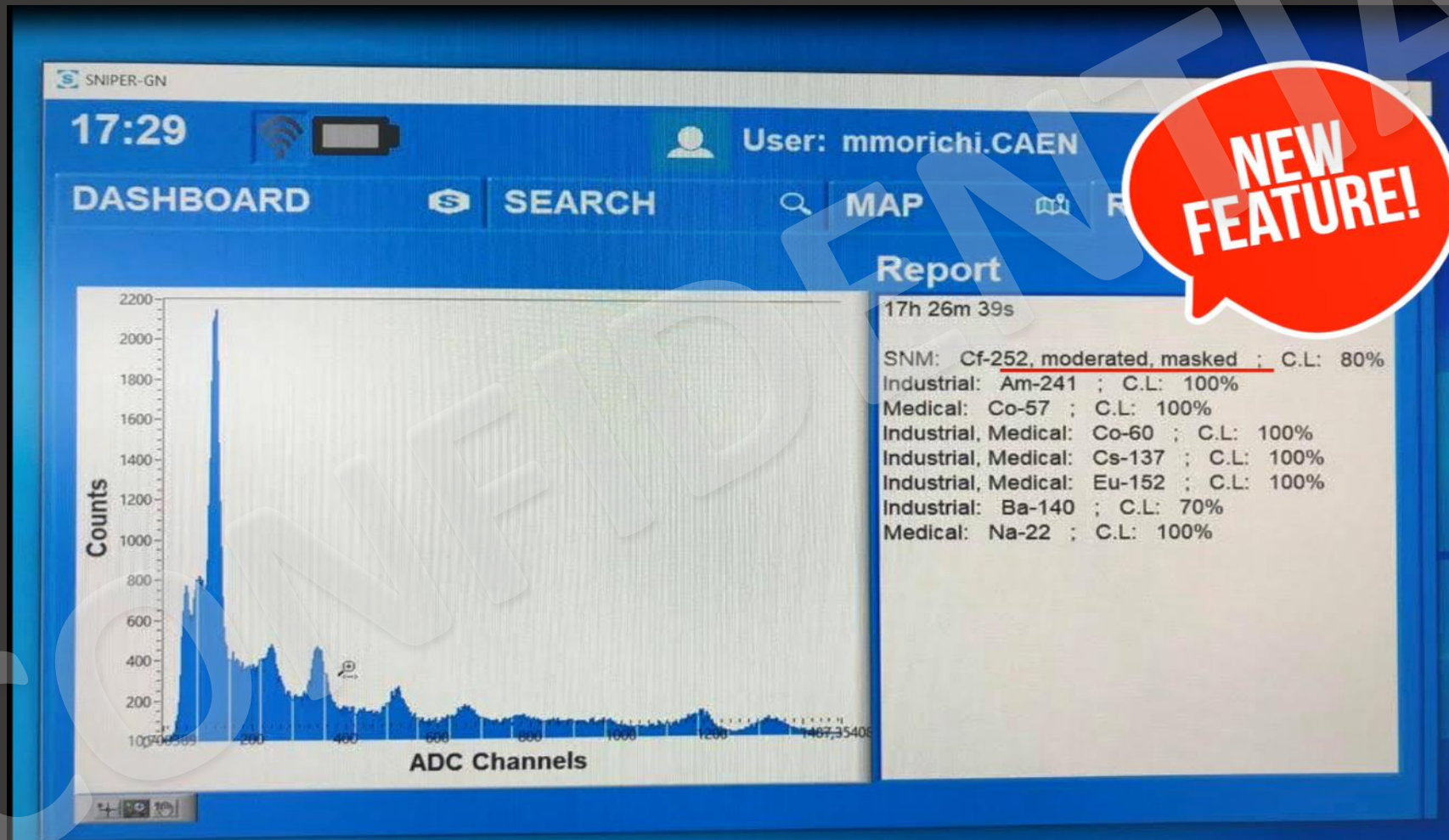
SNIPER new features
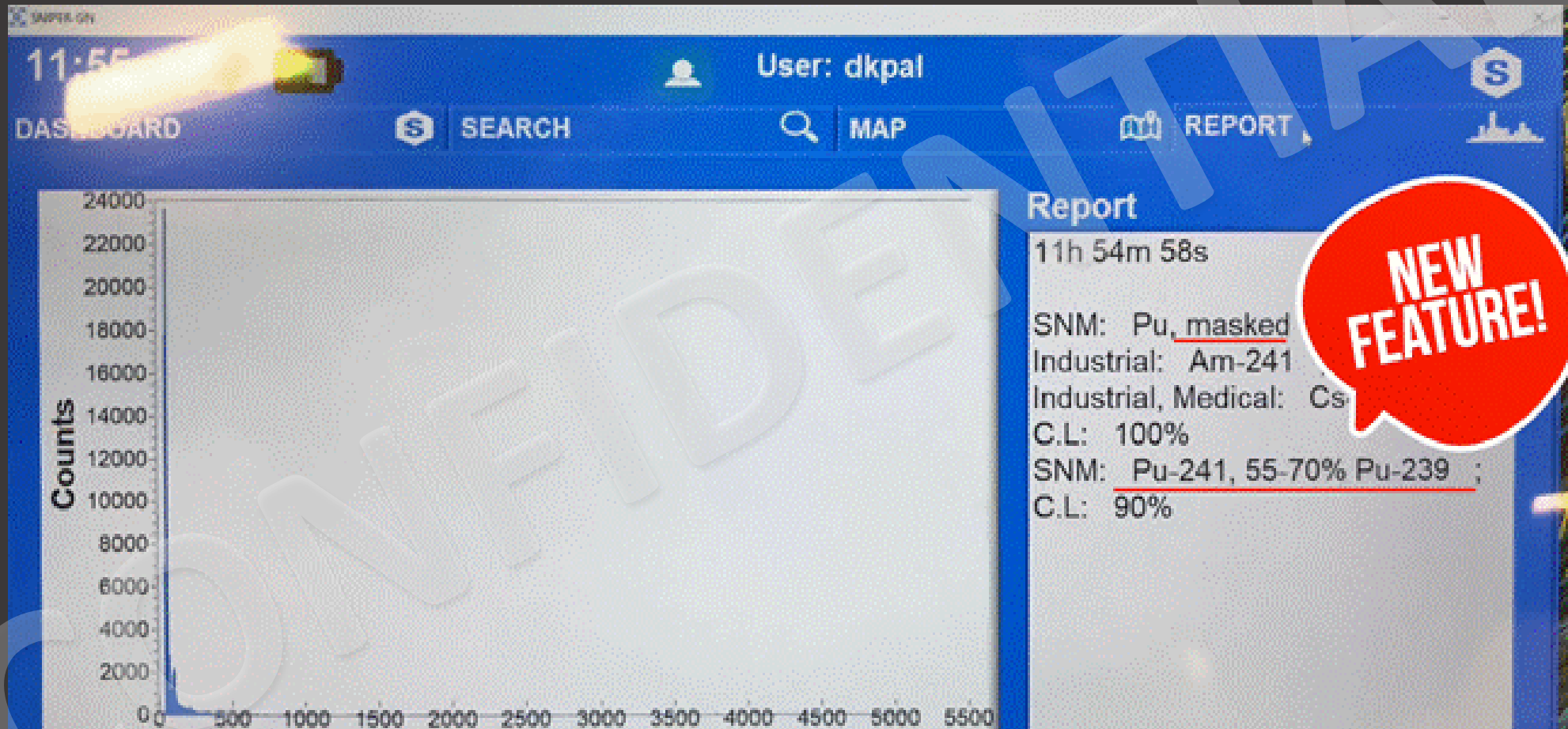
SNIPER ALARMING

DYNAMIC GAMMA ALARM TEST
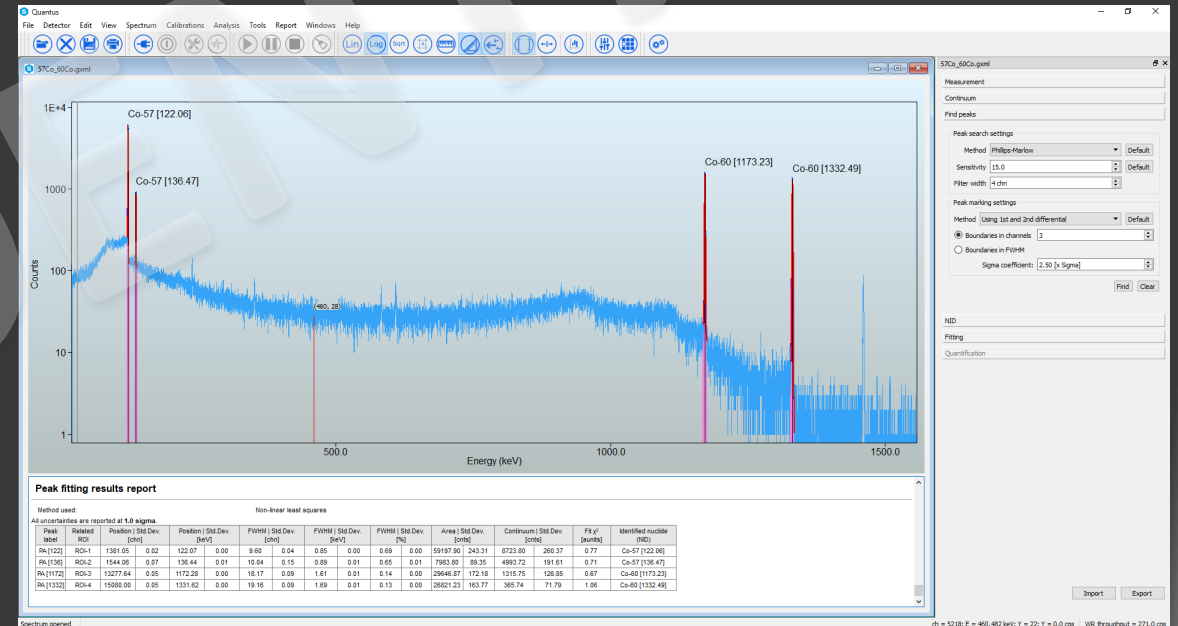
SNIPER performance

 Data reach-back through Wi-Fi connection

 Reports are stored on personal PC and in the internal SD (up to 100.000 reports)

 Spectrum can be analyzed with CAEN QUANTUS software

Live time data are:

- n and gamma live count rate
- n and gamma alarm thresholds

Files produced are:

- Path file – is the GPS track followed by the instrument during the session
- Skipped identification list – is the list of skipped identification after alarm notification
- Identification report

Each report includes:

- Data and hour of report generation
- Latitude and longitude coordinates
- List of identified isotopes (with CL and isotopes category)
- Spectrum (.spe file format, with energy calibration)