

Novel Technologies for In-field Gamma Spectrometry

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European Reference Network for Critical Infrastructure Protection (ERNICIP)

Thematic Group on Radiological and Nuclear Threats to Critical Infrastructure



Detect radiological and nuclear threats to critical infrastructure and mitigate consequences

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Topics being analysed by this network of experts in 2017-2019 are:

- 1) Novel Detection Technologies
- 2) Robotics - radiation detection with unmanned systems
- 3) Reachback - expert support to field teams.

Novel Detection Technologies for Nuclear Security

Objectives (item 1)

Identify benefits from **emerging detection technologies**, such as new materials and segmented detectors, and how they link to list-mode data acquisition standard and reachback.

The following technologies will be considered:

- Novel gamma spectrometers (new materials, detector arrays in list-mode data acquisition);
- Novel neutron measurement systems (thermal and fast neutrons);
- Stand-off measurement systems;
- Radiation imaging systems (gamma, neutron, alpha);
- Source localization technologies

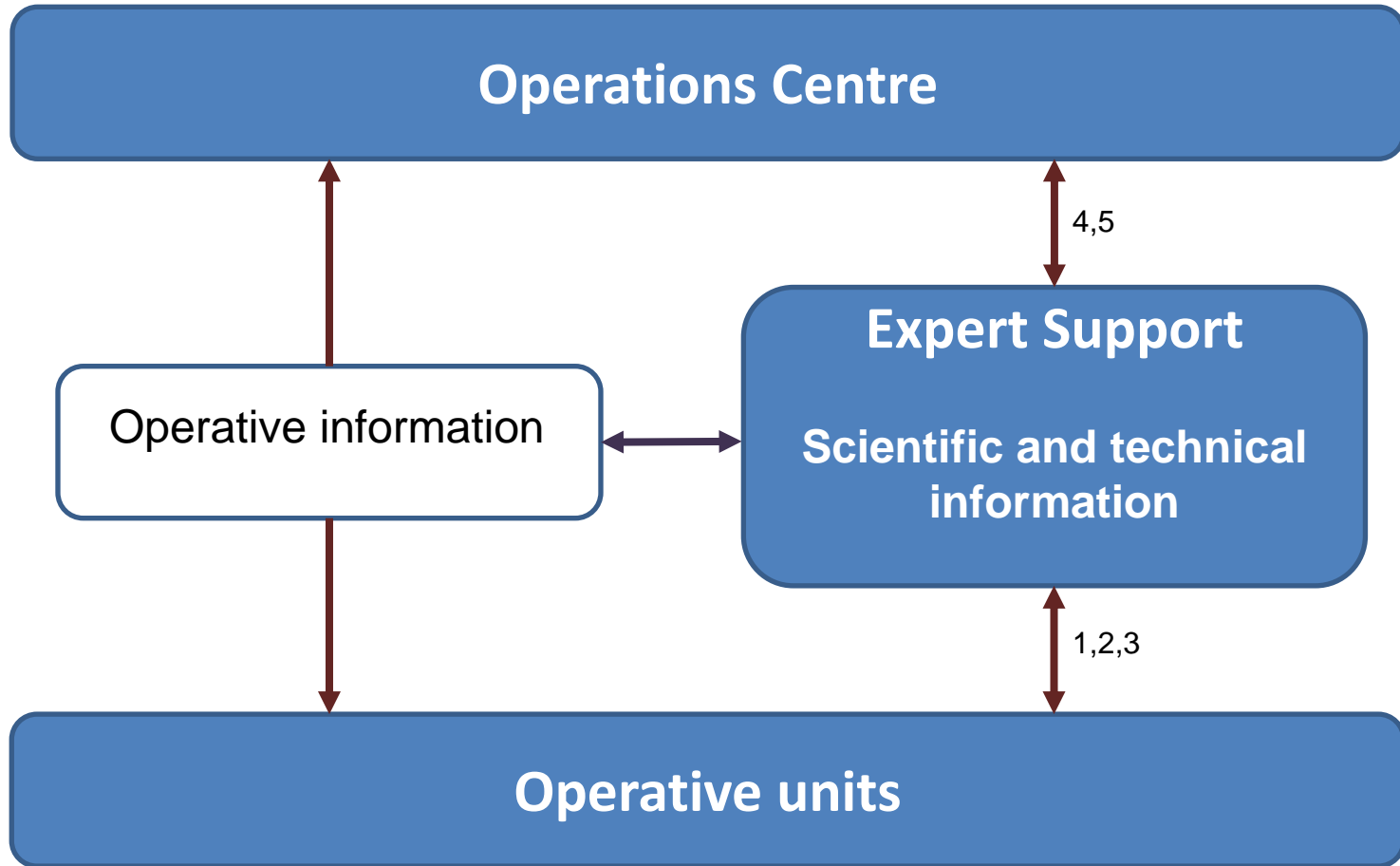
Tasks for RN Field Operations - Challenges

Item	Challenges
Detection	Spectrum acquisition <ul style="list-style-type: none"> • optimum time frame
Identification	False/Innocent/True Alarm <ul style="list-style-type: none"> • Automated • Interactive
Localization	Human knowledge <ul style="list-style-type: none"> • Choke point monitoring • Search operations
Source characterisation <ul style="list-style-type: none"> • Activity • Shield properties 	Scientific expertise <ul style="list-style-type: none"> • Difficult in unknown geometry • Not performed by FLO
Hazard estimation <ul style="list-style-type: none"> • Threat reduction • Risk-informed analyses • Mitigation, resilience 	Safety and Security <ul style="list-style-type: none"> • Simple safety rules • Countermeasures?

Tasks for RN field measurements - Future

Item	Way forward
<p>Detection</p>	<p>List-mode; Robotics; Reachback</p> <ul style="list-style-type: none"> • CBRNE Sensor arrays • Time frame is an <u>analysis</u> issue
<p>Identification</p>	<p>Analysis improvements</p> <ul style="list-style-type: none"> • Embedded in local system • Cloud services (reachback)
<p>Localization</p>	<p>Novel detection instruments</p> <ul style="list-style-type: none"> • Operative use now available • Different technologies
<p>Source characterisation</p> <ul style="list-style-type: none"> • Activity • Shield properties 	<p>Novel analysis methods</p> <ul style="list-style-type: none"> • Possible when source localization issue is solved
<p>Hazard estimation</p> <ul style="list-style-type: none"> • Threat reduction • Risk-informed analyses • Mitigation, resilience 	<p>Well-justified response</p> <ul style="list-style-type: none"> • Source characteristics available

Command and Control (CC)



Tasks for Expert Support

Operational

- Advice to law enforcement
- Advanced measurements
- Initiation of response protocol (together with CC)
- Threat object neutralization - render safe, source recovery
- Safety assessment – consequence analysis

Scientific

- Analysis of measurement data
- Alarm adjudication - nuclear security event?
- Material characterisation - nuclear forensics

Technical

- Instrument deployment
- Quality control of data
- State-of-health of detection systems
- Network management
- Education
- Training and exercises

Expert Support

Different Reachback Services

Level	Name	Functionality - Role
A Advice	Expert Support	POC - Point of Contact Call Centre Advice to Law Enforcement
AA Alarm Adjudication	Expert Support Centre (Reachback Centre)	<i>As above</i> Technical Support <ul style="list-style-type: none"> • Detection systems: implement, maintain, sustain, QC • Training, exercises • MEST with basic capability Scientific Support Analysis support on request Alarm assessment and support to adjudication
AAA Advanced Alarm Adjudication	Advanced Expert Support Centre (Advanced Reachback Centre)	<i>As above</i> Operational Support <ul style="list-style-type: none"> • Integrated to operative units • CBRNE teams, Render safe, Crime scene management,.. Advanced Technical and Scientific Support <ul style="list-style-type: none"> • Operation of large real-time detection networks • Advanced analysis support 24/7 • Material characterization • Alarm adjudication

- **Timeliness**
 - Authorities must counter the threat in a rapidly changing environment
 - Detect, analyze, communicate and act
- **Detection sensitivity**
 - New type of sensors and data acquisition systems
 - Building detection arrays
- **Different needs by different users**
- **Cooperation**
 - National
 - International or bilateral
- **Massive data flow**
- **Lack of international standards**

Lack of Awareness of authorities is the main inhibitor to implement Novel Technologies

- **Blindness to the risk**
 - Threat won't be a problem in my country!
 - Why doing it now?
 - We are a nuclear-free zone!
- **Where the responsibility lies**
 - Somebody else takes care of this!
- **Fear of the costs**
 - Other threats and risks are more important!
- **Need for novel technologies**
 - Not understanding the benefits
 - Not talking the same language (glossary, CEN/TC391 WG2 CBRNE)

The concepts reachback, expert support, and triage are used in different meaning.

Common (military) definition

- Reachback is process of obtaining products, services, sensor data, and information with expert analyses, communication between field level and experts, applications, forces, equipment, or material from organisations that are not present in the incident scene.

Alternative definitions

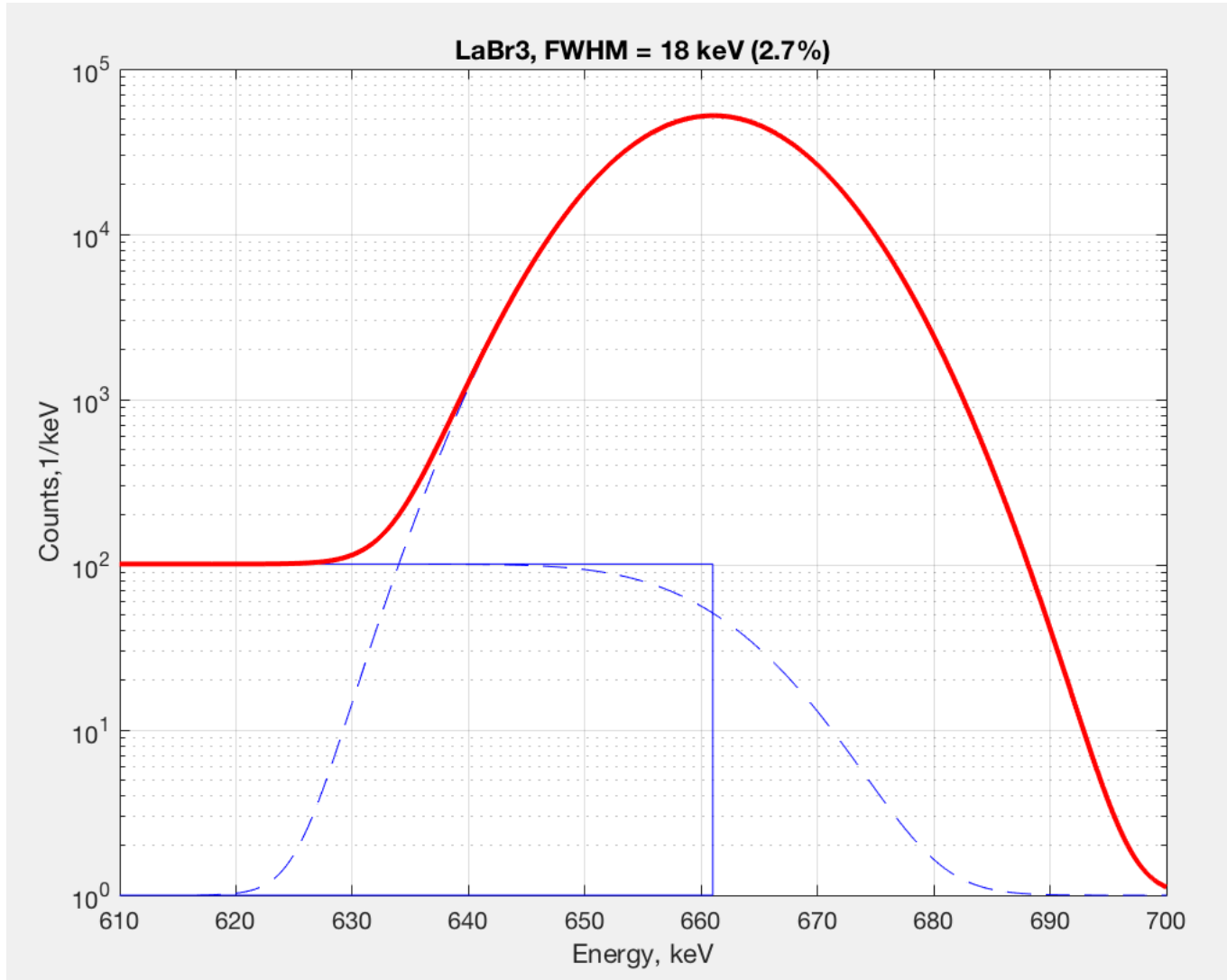
- Reachback is a (virtual) network of subject matter experts to provide advisory, technical, and coordination assistance.
- Expert Support is an operational or technical capability that can be deployed to the field to resolve a potential or actual nuclear security event.
- Triage refers to the analysis services of a reachback centre to find out the unusual observations (alarms) from a massive amount of data.

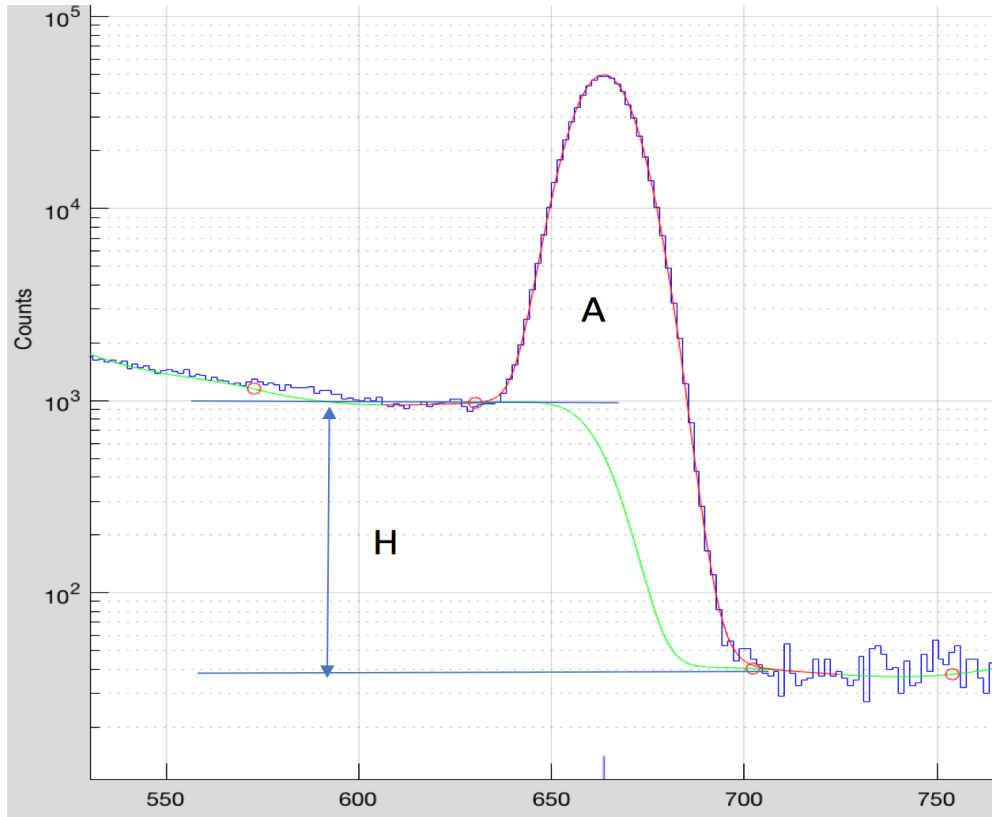
Examples of Novel Technologies

Separate presentations by
ERNICIP RN Thematic Group Members

1. Source shielding, Harri Toivonen
2. Source localization, Sakari Ihantola
3. Novel detection materials, Olof Tengblad
4. Listmode data acquisition, Jan Paepen

Cs-137 peak and step induced by Compton scattering





Cs-137 measured
with RavidPro200
Backbag spectrometer

Step ratio

$$SR = H/A$$

SR

- is the property of the shielding around the detector!
- can be utilized for the analysis of the shield properties (thickness of Pb) (NKS project RadShield, 2017)

Novel in-field technologies provide timely knowledge through reachback to detect radiological and nuclear threats and to implement a balanced response.

$$\int I(1, 2, 3) * RB dt = I(4, 5)$$

THE END

Categorization of Terms for Nuclear Measurements and Related Information Products

