

APPLICATION OF $\text{LaBr}_3(\text{Ce})$ SCINTILLATION DETECTORS IN RADIATION MONITORING EQUIPMENT

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Semiconductor Detectors & Nuclear Electronics for Radiation Measurements

Certificate

Standard **ISO 9001:2015**

Certificate Registr. No. 01 100 1334250

TÜV Rheinland Cert GmbH certifies:

Certificate Holder: **„Baltic Scientific Instruments“ Ltd.**
25 Ganību dambis
LV-1005, Rīga
Latvia



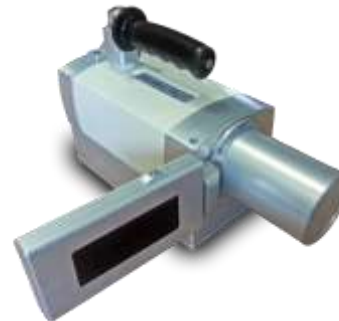
Scope: Design, production, sales and service of analytical equipment.

Proof has been furnished by means of an audit that the requirements of ISO 9001:2015 are met.

Validity: The certificate is valid from 2016-11-05 until 2019-11-04.
First certification 2007.

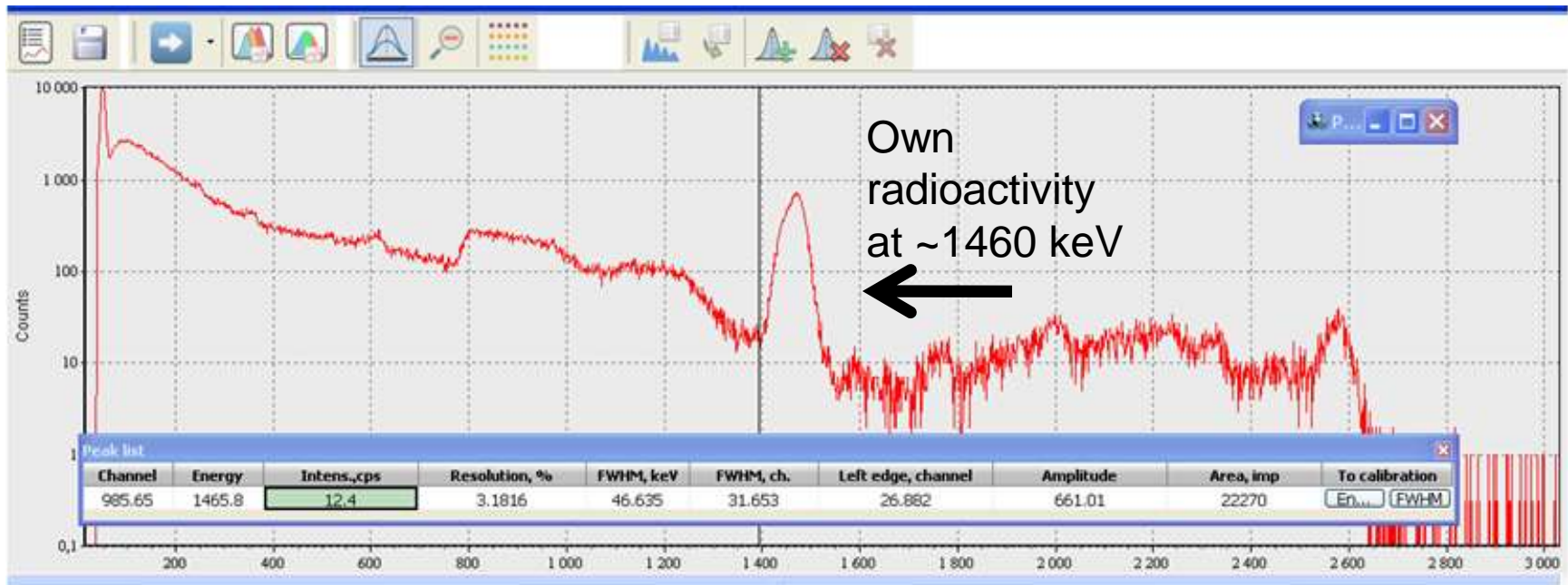
2016-11-05

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KEY PROPERTIES OF SOME SCINTILLATION MATERIALS

	Hygroscopic	Own background	Density, g/cm ³	Decay constant, μs	Light yield, ph/keV	FWHM @ 662 keV (2"x2"), %	Efficiency (5 cm, point, Cs-137, 2"x2"), %	Emission wavelength maximum, nm
NaI(Tl)	+	negligible	3.67	0.23	38	~6.5	~0.65	415
LaBr₃(Ce)	+	significant	5.08	0.016	63	~ 3	~1	380
CeBr₃	+	negligible	5.23	0.018	60	~ 4.2	~1	370
SrI₂ (Eu)	+	negligible	4.60	1-5	90	~3.1-3.6 (1.5"x1.5")	~0.4 (1.5"x1.5")	450



Background spectrum by LaBr₃(Ce) 2"x2" (no shield)

Key Components of LaBr₃(Ce) Spectrometers by BSI

			
<p>LaBr₃(Ce) crystals/scintiblocs</p>	<p>Photomultipliers</p>	<p>Electronics</p>	<p>Software</p>
<p>Saint-Gobain</p>	<p>Hamamatsu</p>	<p>BSI</p>	<p>BSI</p>

Impact of temperature and magnetic field

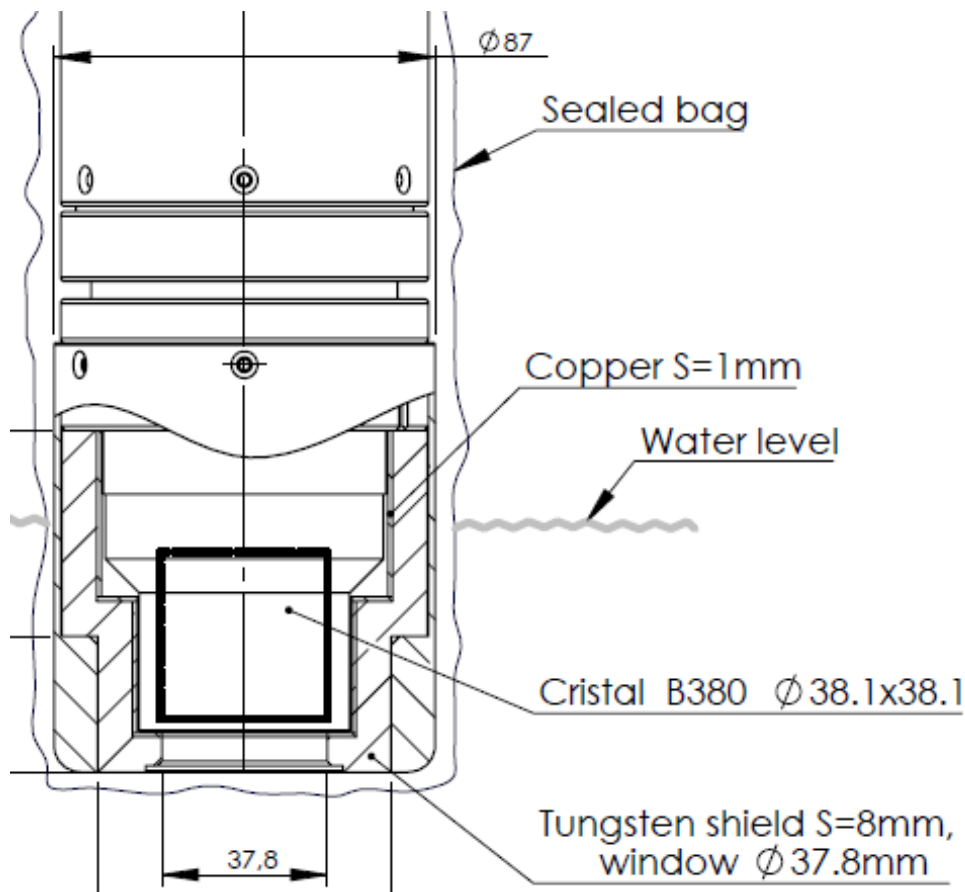
- ❑ PMTs performance sensitive to magnetic fields => Mu-metall shielding
- ❑ Crystall's performance sensitive to temperature =>
 - Thermostatic housing
 - Spectrometer's Stabilization
 - by LED
 - by Am-241 alpha-peak
 - by background K-40 peak
 - by own radioactive impurities

SUBMERSIBLE GAMMA SPECTROMETER FOR FUEL ELEMENT RESERVOIR

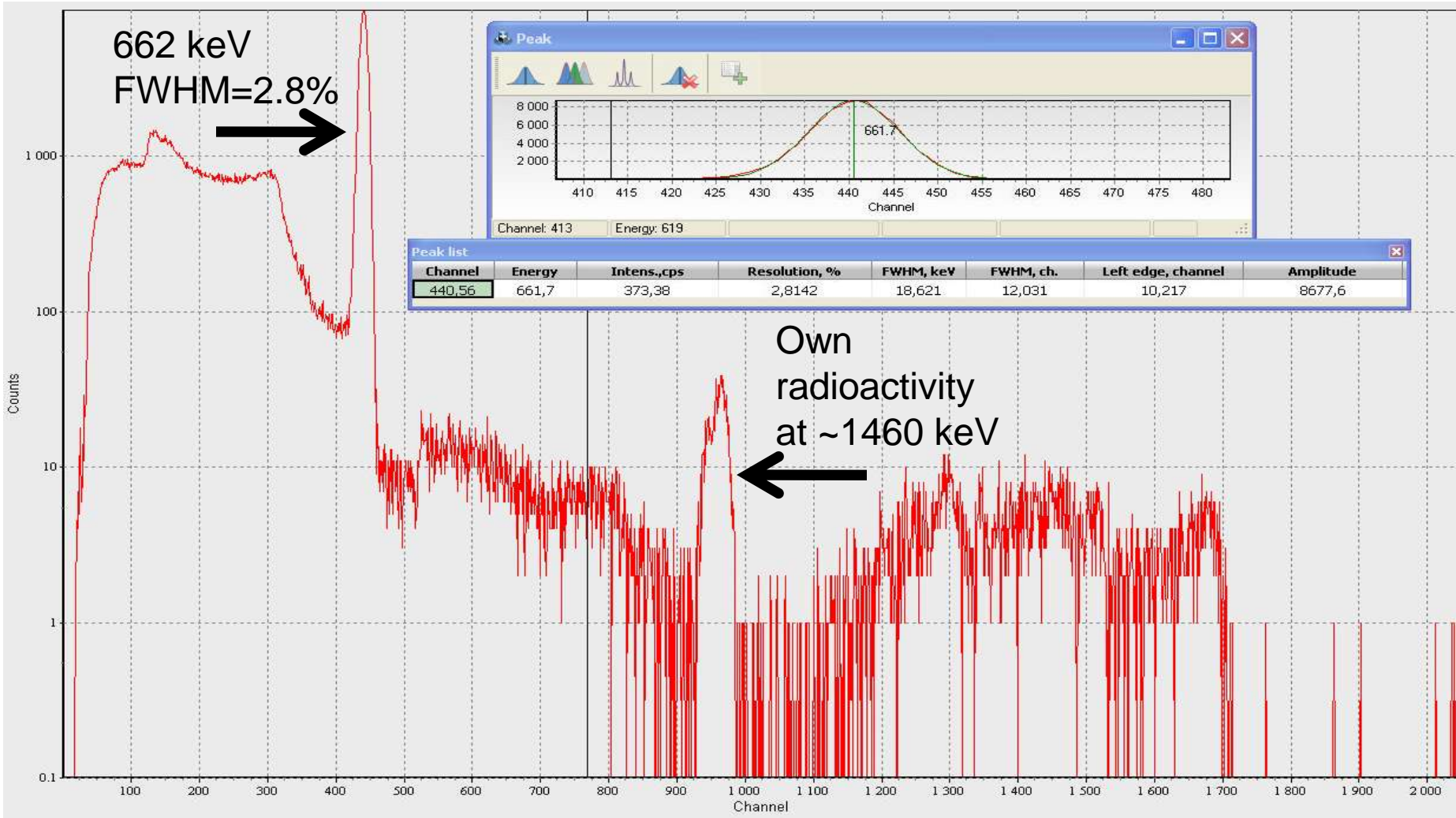


SUBMERSIBLE GAMMA SPECTROMETER FOR FUEL ELEMENT RESERVOIR

Medium resolution gamma spectrometry system with scintillation detector <...> to be used in activities related to the refurbishment of the fuel storage tank and ancillary systems of the TRIGA research reactor (from the request)

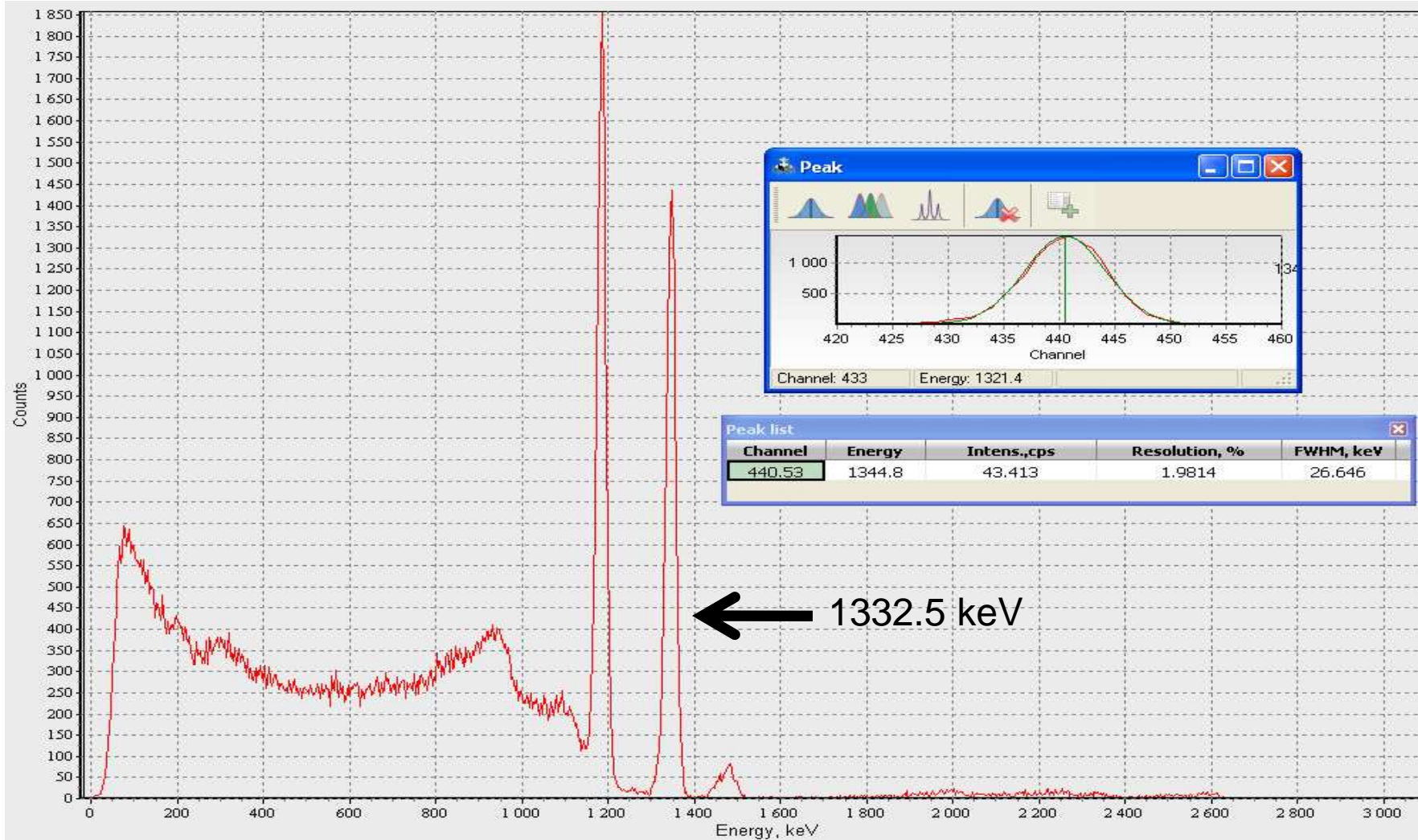


SUBMERSIBLE GAMMA SPECTROMETER FOR FUEL ELEMENT RESERVOIR



Spectrum of Cs-137

SUBMERSIBLE GAMMA SPECTROMETER FOR FUEL ELEMENT RESERVOIR



Spectrum of Co-60

Environmental Radiation Monitoring and Early Warning Systems



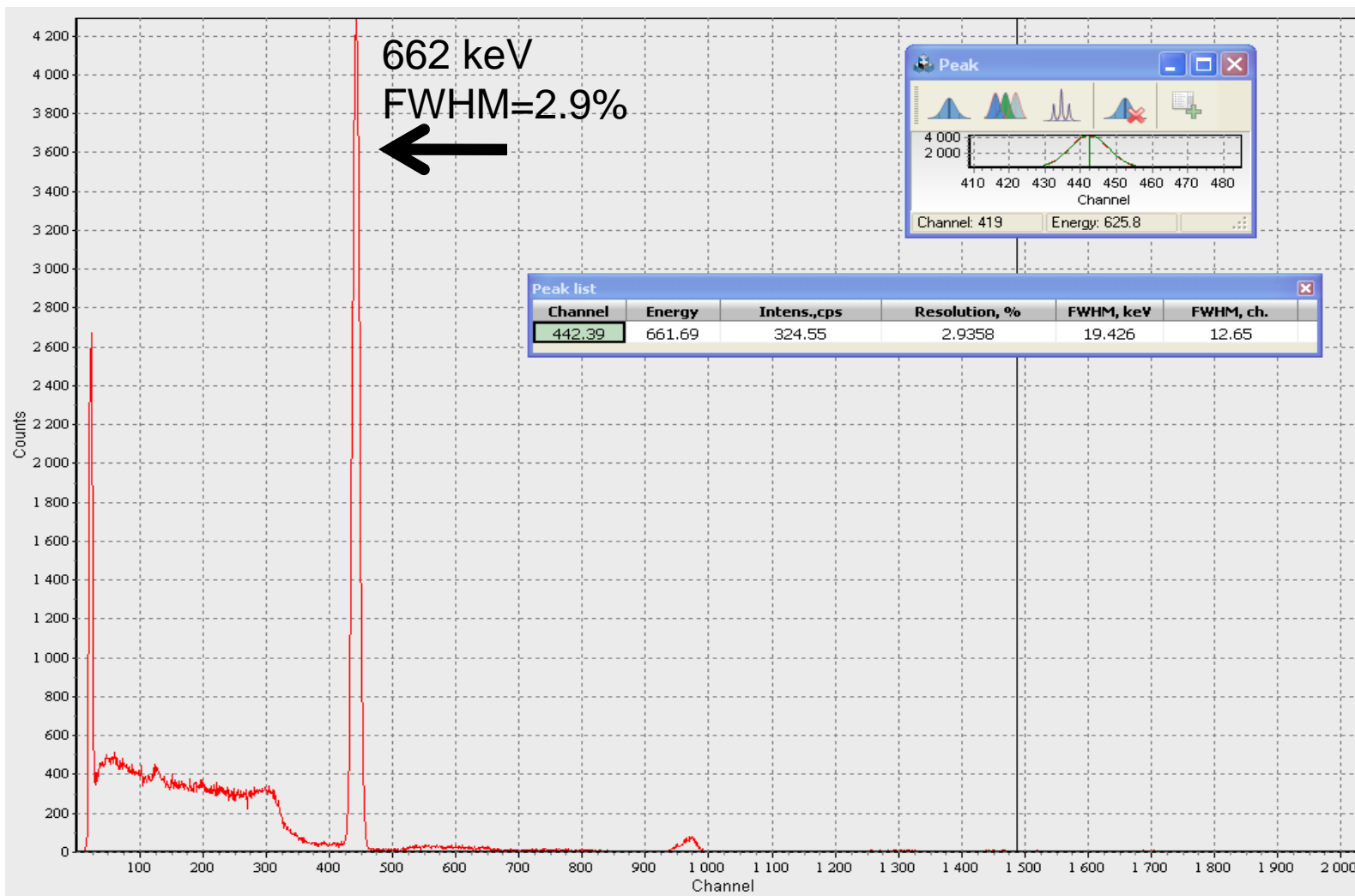
Aerosol monitor for environmental monitoring

It performs real-time on-line full alpha, beta and high resolution gamma spectrometric analysis.

- ❑ Flow-rate range: program. 2- 6 m³/h;
- ❑ Filters: circular Ø 47 mm;
- ❑ Pump: rotating, oil free, max 18 m³/h - free air.

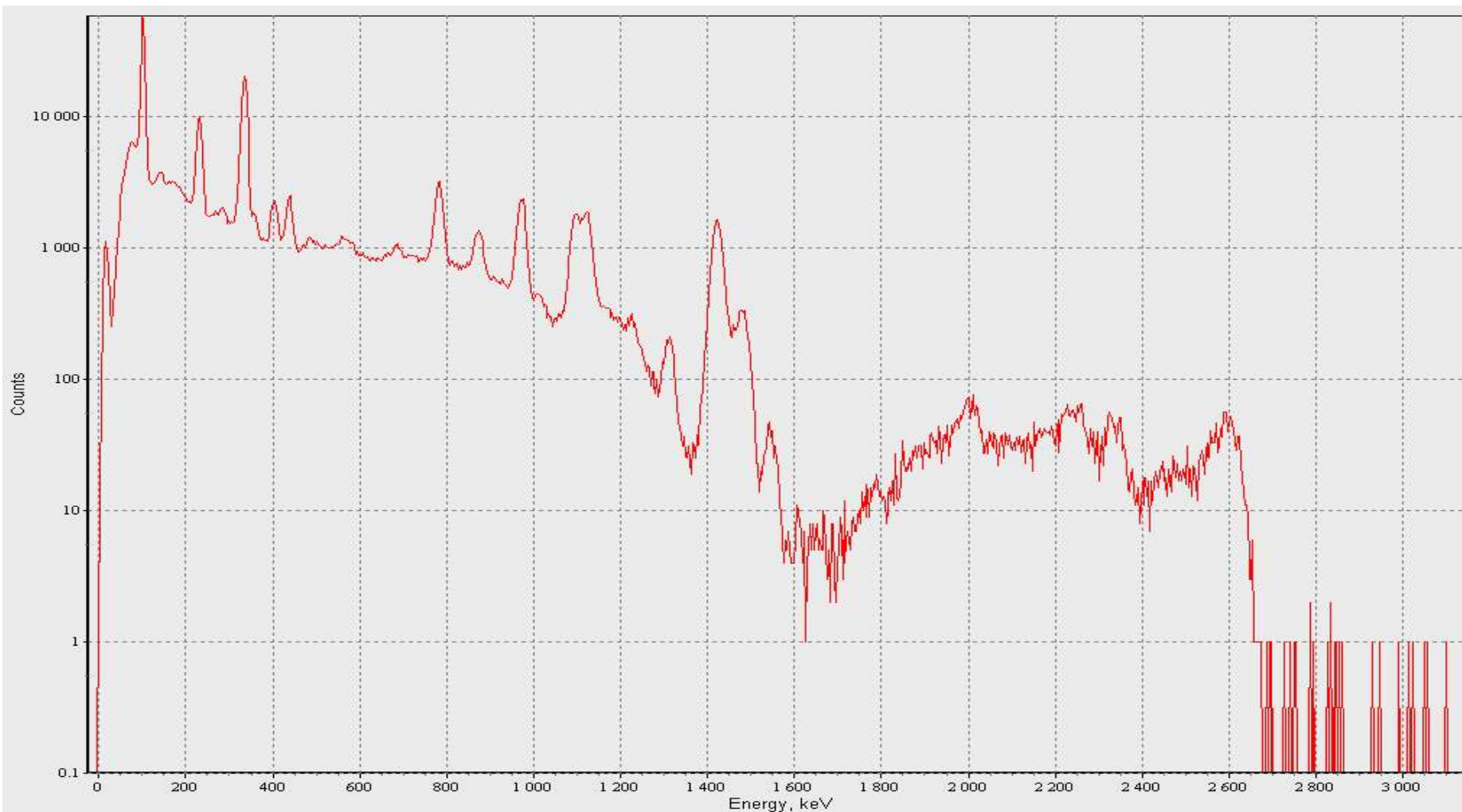


AEROSOL MONITOR FOR ENVIRONMENTAL MONITORING



Spectrum of Cs-137 (LaBr₃(Ce) 2"x2")

AEROSOL MONITOR FOR ENVIRONMENTAL MONITORING



Spectrum of Eu-152

MOBILE GAMMA SPECTROMETRY SYSTEM FOR RADIATION CONTROL OF POLLUTED AREAS

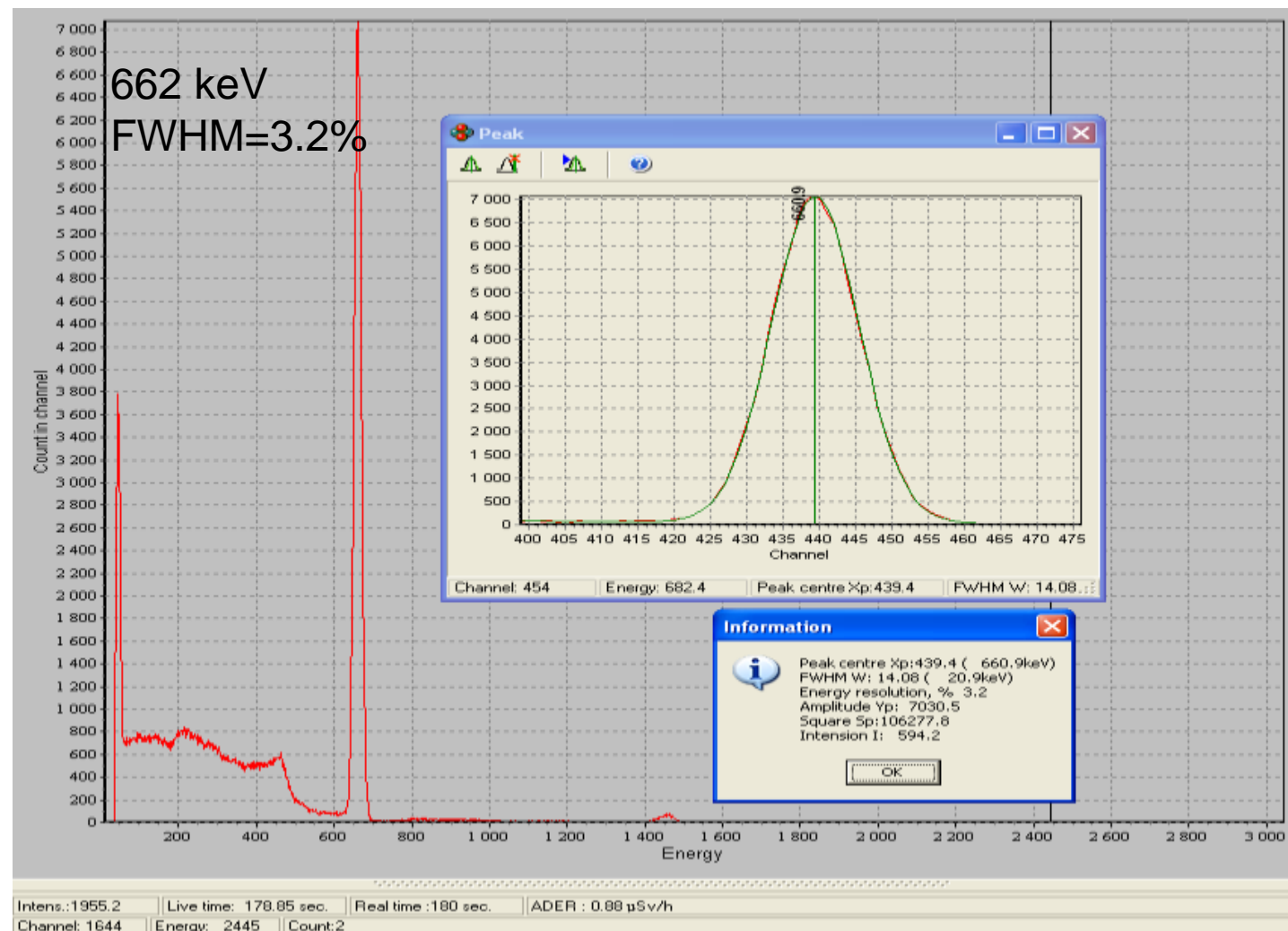


Radiation monitoring of industrial and other areas for:

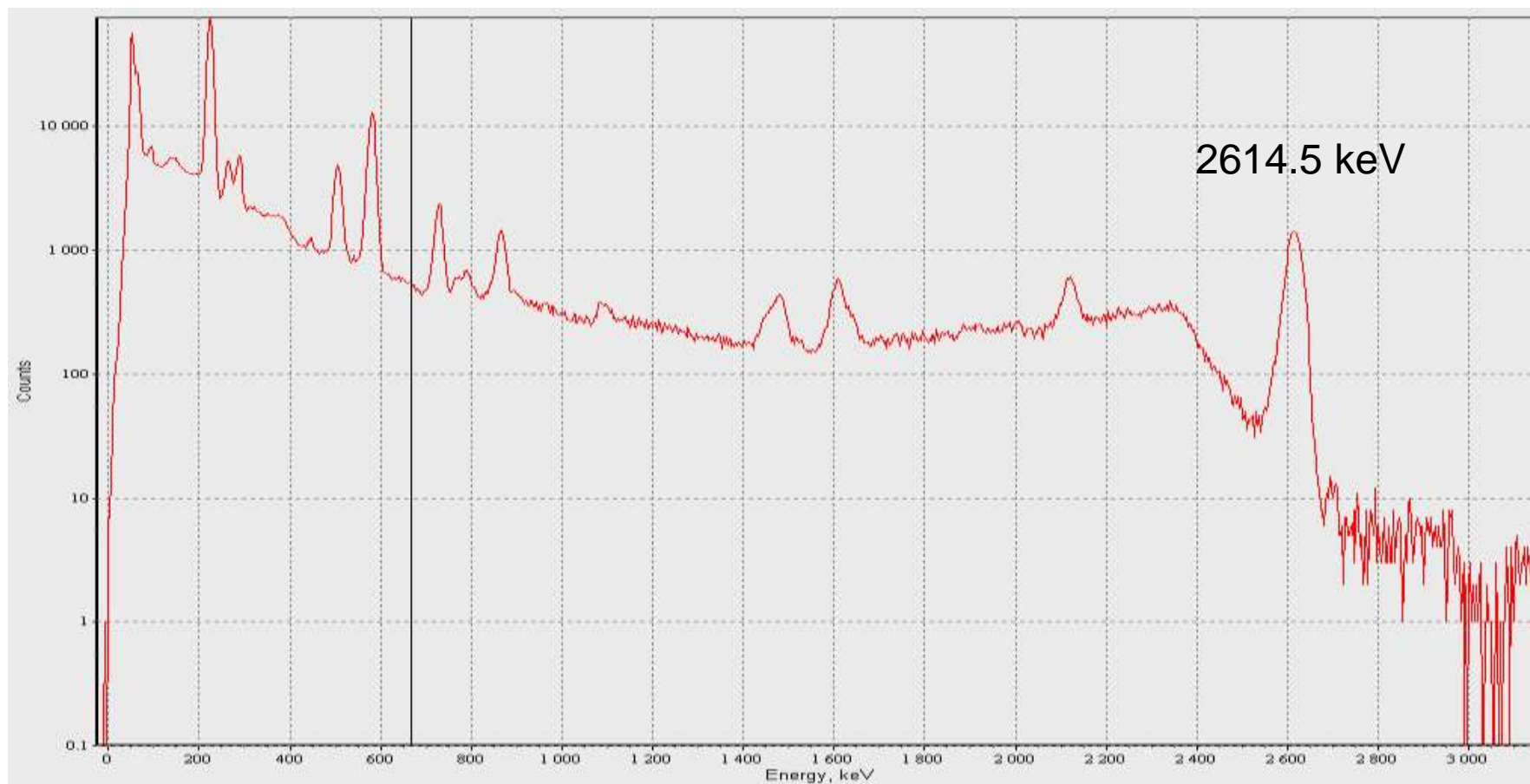
- decommissioning of radiation hazardous sites;
- examination of polluted sites and areas of radioactive fallout precipitation;
- free release of sites/areas;
- environmental remediation of used/polluted areas.

FEATURES OF THE MOBILE GAMMA SPECTROMETRY SYSTEM

- 2 x \varnothing 51x51 LaBr₃(Ce) detectors;
- Multichannel Analyzer Polynom for 2 detectors;
- Gain stabilization by La-138 full energy peaks at 32-37 keV and 1436 keV;
- FWHM @ 661.7 keV: 3.2% or better;
- Thermostatic housing with liquid cooling;
- Ambient temperature range: -40 °C to +60 °C;
- Offroad electrodriven car as a mobile platform;
- GPS navigation with RTK correction.



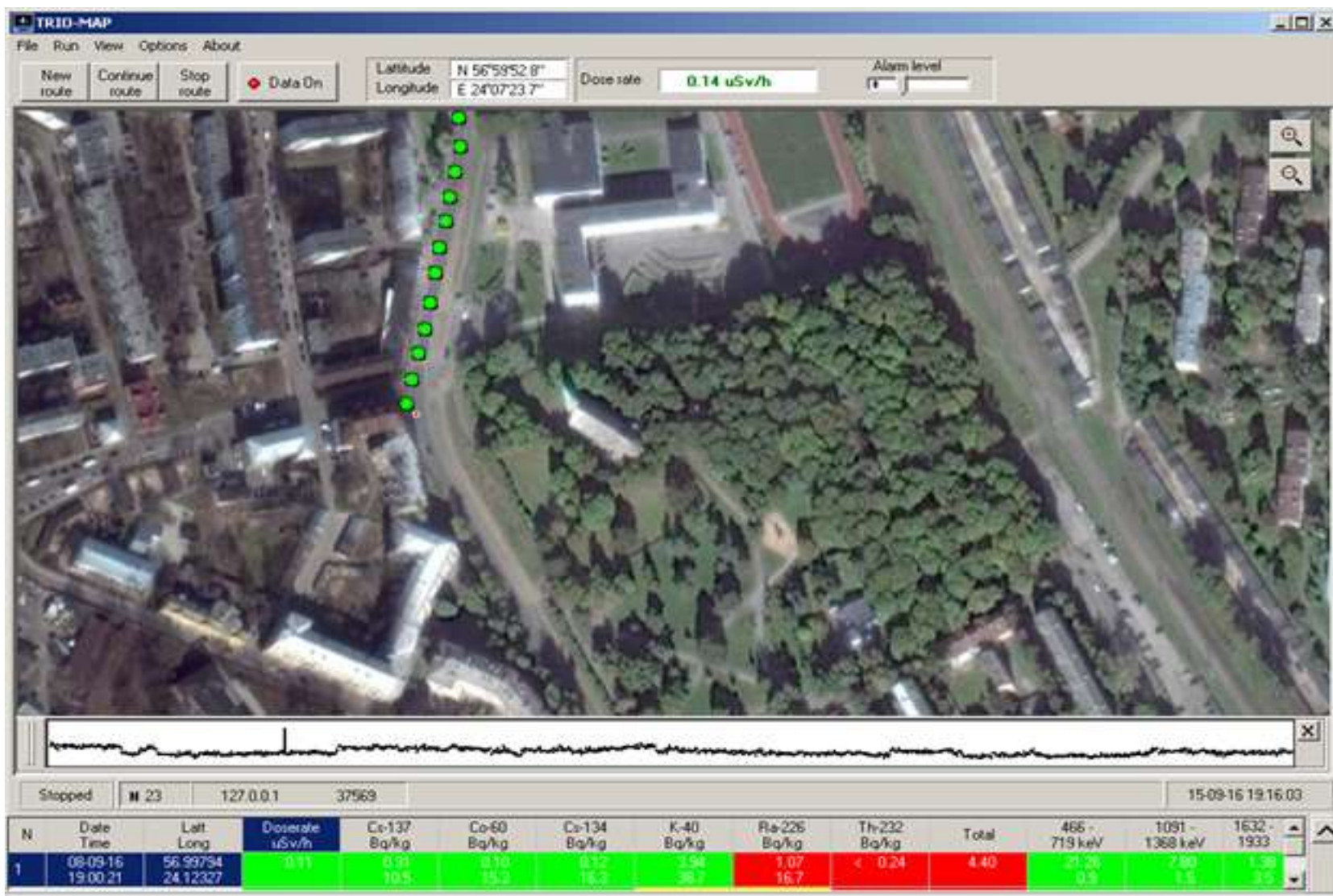
Spectrum of Cs-137



Spectrum of Th-228

SOFTWARE FEATURES

- Standard spectrometry software functions
- Special functions such as:
 - Data exchange with the navigation system
 - Smart indication of measurement and calculation results
 - Map view



ACTIVITY CALCULATION

Activities are calculated by the Matrix Method. The reference spectra are calculated by the Monte Carlo method. The expanded uncertainty of the surface and specific activity calculated does not exceed 30% ($k=2$).

Distance between the detector's endcap and the ground, cm	Radionuclide	Measured activity range, Bq/cm ²
25	¹³⁷ Cs	0.035 1300
	⁶⁰ Co	0.021 650
	¹³⁴ Cs	0.024 500
40	¹³⁷ Cs	0.04 1400
	⁶⁰ Co	0.023 720
	¹³⁴ Cs	0.025 560
60	¹³⁷ Cs	0.046 1600
	⁶⁰ Co	0.028 820
	¹³⁴ Cs	0.028 620

The limits of the ranges calculated have an error of 50% ($P=0.95$). Each measurement time is 300 s, the detectors are oriented against the ground.

Distance between the detector's endcap and the ground, cm	Radionuclide	Measured activity range, Bq/g
25	^{137}Cs	0.0074 125
	^{60}Co	0.0034 50
	^{134}Cs	0.005 50
	^{40}K	0.19 930
	^{226}Ra	0.01 50
	^{232}Th	0.013 40
40	^{137}Cs	0.0086 130
	^{60}Co	0.0038 55
	^{134}Cs	0.0054 55
	^{40}K	0.20 1000
	^{226}Ra	0.01 50
	^{232}Th	0.014 45
60	^{137}Cs	0.0090 1300
	^{60}Co	0.0040 650
	^{134}Cs	0.0055 500
	^{40}K	0.21 500
	^{226}Ra	0.01 50
	^{232}Th	0.015 50

The limits of the ranges calculated have an error of 50% ($P=0.95$). Each measurement time is 300 s, the detectors are oriented against the ground.

**THANK
YOU!**