

RADIOACTIVE WASTE MONITORING IN NUCLEAR INDUSTRY

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WORLD NUCLEAR INDUSTRY



Operational Reactors - 449
Under construction - 68

Decommissioned - 157
Research Reactors - 480

International Atomic Energy Agency



*International Atomic Energy Agency, Classification of Radioactive Waste: General Safety Guide, IAEA Safety Standards Series No. GSG-1, IAEA, Vienna (2009).

Actions- RAW should be characterised according to its physical, chemical, and radiation properties so that the safest and most economically effective variant for the waste treatment can be chosen

Free Release Monitors

The task for FRM – to decrease amount of Radioactive Waste!

FRMs based on scintillation detectors (crystall and plastic).



Small size FRM,
Chamber volume - up to 200 L,
Sample weight - from 10 up to 50 kg,
Lead Shield – 50 mm



Large size FRM,
Chamber volume - up to 1.5 m³
Sample weight - from 10 up to 50 kg,
Lead Shield – 50 mm

WAMs based on High purity germanium detector (HPGe)

**Waste Assay Monitor
Hercules 200G**



**Waste Assay Monitor
Hercules 200**



**Waste Assay Monitor
Hercules 400/RC**



Sample volume - up to 0.2 - 04 m³

Sample weight - up to 700 kg

Radionuclides measured:

Cs-134, Cs-137, Co-60, Mn-54, Fe-59, Nb-95, Zn-65, Zr-95, Co-58, Cr-51, Ce-144, Hf-181 and Ru-103

Mobile WAMs



WAMs mobile based on hand-cart



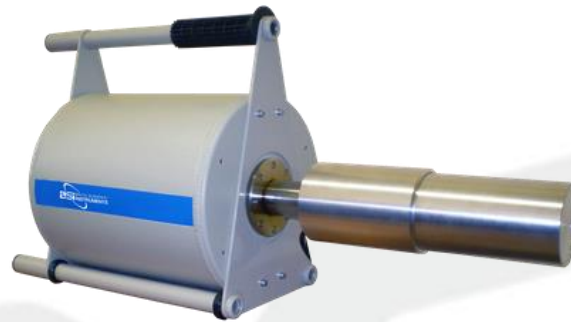
WAMs mobile based on motorized hand-cart with electrical lift



Gamma-detectors



Scintillation detectors CeBr_3

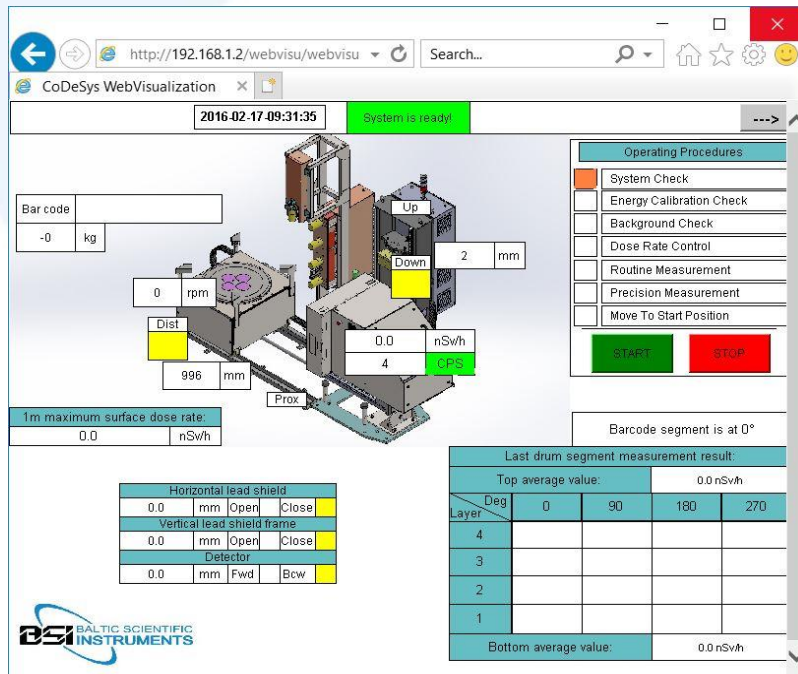


Liquid nitrogen cooled
HPGe detector



Electromechanical
cooled HPGe detector

FRM and WAM software development



2016-02-17 09:31:35 System is ready

Bar code: -0 kg

0 rpm

Dist: 996 mm

Up: 2 mm

Down: 0.0 nSwh

4 CPS

Prox

1m maximum surface dose rate: 0.0 nSwh

Barcode segment is at 0°

Operating Procedures:

- System Check
- Energy Calibration Check
- Background Check
- Dose Rate Control
- Routine Measurement
- Precision Measurement
- Move To Start Position

START STOP

Last drum segment measurement result:

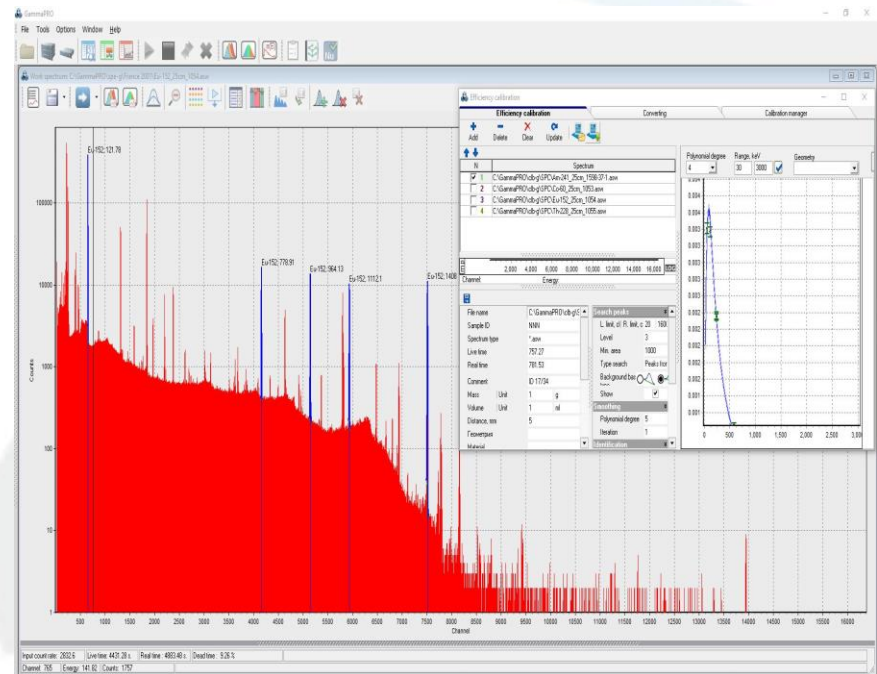
Top average value:		0.0 nSwh			
Layer	Deg	0	90	180	270
4					
3					
2					
1					
Bottom average value:		0.0 nSwh			

Horizontal lead shield: 0.0 mm Open Close

Vertical lead shield frame: 0.0 mm Open Close

Detector: 0.0 mm Fwd Bcw

WAM control software interface



Software gamma-spectra analysis program

Metrological aspects of FRM and WAM

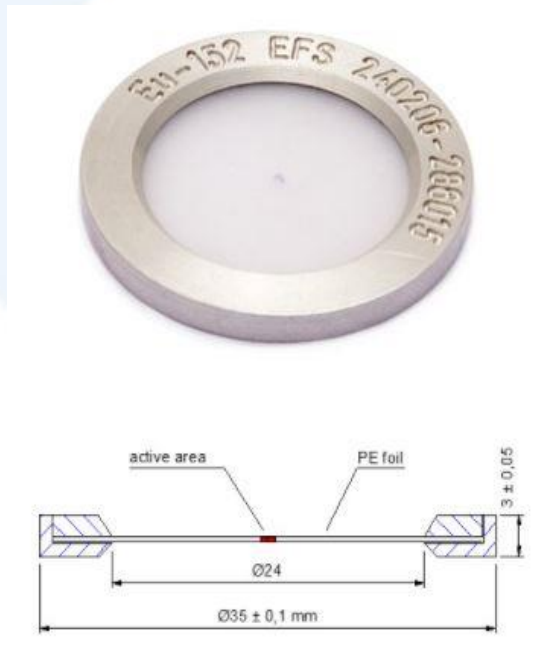
Main problem – production and high cost of a large volume radioactive calibration certified sources



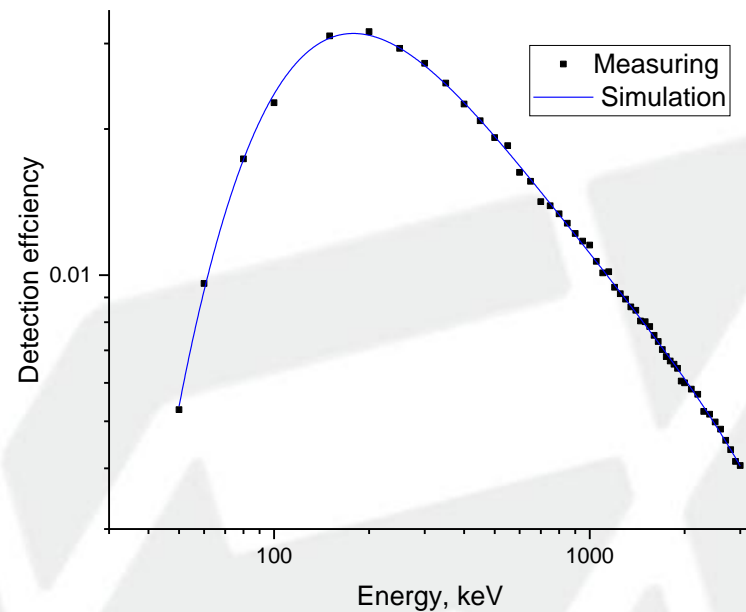
Mix
Cs-137
Eu-152
Co-60

Certified volumetric activity sources of large volume that contain matrix-fillers.

Calculation of the FRM and WAM efficiency curve by Monte Carlo simulation



Standard point-sources for gamma-spectrometry



Registration efficiency (Monte Carlo simulation and experimental measuring) curve of the developed FRM for a point source located in the centre of the measuring chamber.

Conclusions

- Reducing the amount of radioactive waste is very important in nuclear industry.
- The presented FRMs and WAMs can reduce the amount of radioactive waste.

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**Thanks for attention!
Questions?**