CHALLENGES IN IDENTIFYING RADIOACTIVE MATERIAL IN SCRAP METAL

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Introduction

Since the installation of portal monitors at the entrances of the three major steel industries in Greece in order to facilitate the detection of radioactive material in scrap metal and to address the illicit trafficking threat several radioactively contaminated items and orphan sources have been detected in scrap metal.

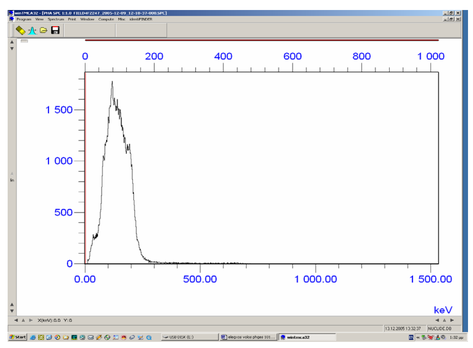
The scope of this work is to present noteworthy cases that have occurred and the challenges encountered in identifying the isotope in the detected orphan sources and other radioactive material employing gamma spectroscopy, specifically regarding the interpretation of the spectra acquired with NaI and HPGe detectors.

Methods

Equipment for isotope identification and activity estimations of the detected items: laboratory stationary and portable HPGe gamma spectroscopic systems (HPGe), NaI spectroscopic systems, portable detectors for gamma dose rate measurements and total α/β survey meters.

Radioactive objects located in the scrap metal load

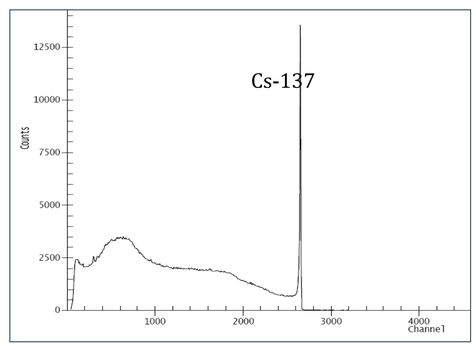
Results



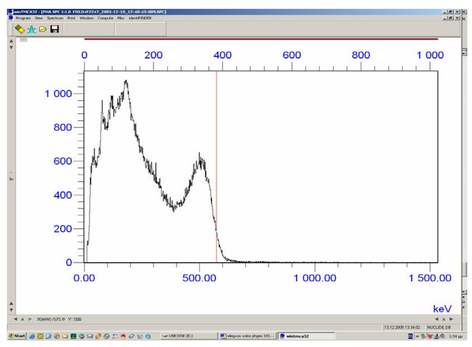
NaI spectrum in contact with the shielding

Imported scrap metal load:

- Cs-137 industrial source, dose rate up to 20μSv/h
- Ra-226 Part of lightning rod
- Ra-226 military device, dose rate up to 70 μSv/h
- NORM contaminated pipes dose rate up to 3 μSv/h
- Cs-137 industrial source, radius 15cm, dose rate ranging from 3- 500μSv/h, estimated activity 500 Ci (HPGe spectrum and Monte Carlo calculations)



HPGe spectrum in contact with the shielding

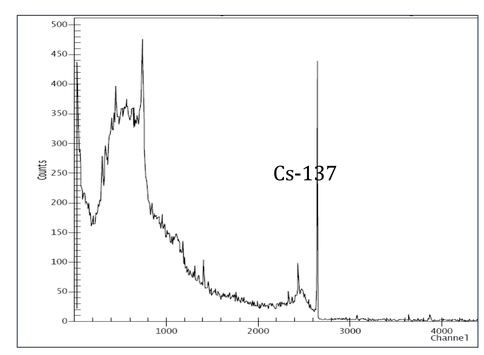


NaI spectrum at 2m distance from the source window

NaI detector identified the isotope as Ra-226, while the HPGe detector revealed that it was a Cs-137 source.

Reason for spectrum misinterpretation:

- a crack in the shielding in the opposite direction of the detector caused the source beam to reflect on a wall before reaching the detector
- the Compton effect of the scattering of the source beam due to the shielding

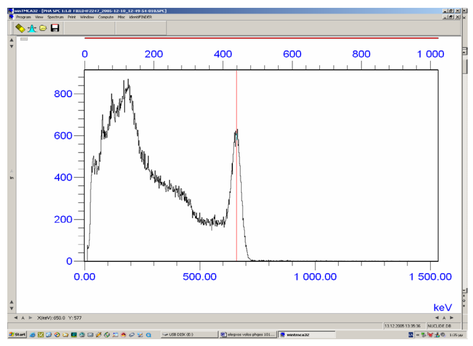


HPGe spectrum at 1m distance from the source window

Industrial source with small shielding, maximum dose rate 20 μSv/h.

Isotope identification as Cs-137 with a NaI detector was possible despite the pronounced superposition of the Compton continuum, due to scattering on the shielding.

Dose rate measurement in contact with the source



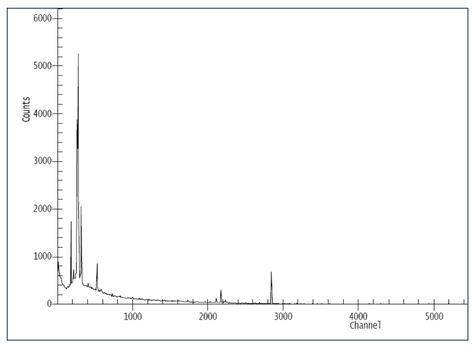
Gamma spectrum in contact with the source

Natural uranium ore (146g,) 50 -75 μSv/h

NaI detector : Ra-226, due to the presence of the 186 and 1001 keV photopeaks.

HPGe detector : U-238 of a specific activity of 5300 ± 160 Bq/g, 42.7% w/w.

Identification with NaI detector



HPGe detector spectrum

Conclusions

Isotope identification and activity determination of orphan sources and radioactive material located in scrap metal requires not only the conduction of measurements with gamma spectroscopy detectors, but also careful examination of the acquired spectra and awareness of equipment limitations.

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