Contribution ID: **33** Type: **Poster**

Challenges in Identifying Radioactive Material in Scrap Metal

Tuesday, 8 July 2014 13:00 (1 hour)

Following a ministerial decision in 1999 portal monitors have been installed 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. In the case of portal monitor alarms the Greek Atomic Energy Commission and collaborating laboratories are charged with the responsibility of performing on-site inspections to identify the cause of the alarms, place the radioactive materials under regulatory control and perform the characterization of the material.

The Department of Environmental Radioactivity Monitoring and collaborating laboratories are equipped with the following infrastructure in order to perform isotope identification and activity estimations of the detected items: two laboratory stationary gamma spectroscopic systems (HPGe), three portable HPGe spectroscopic systems and two NaI spectroscopic systems for in-situ gamma spectroscopy, portable detectors for gamma dose rate measurements and total α/β survey meters.

Since the installation of the portal monitors several radioactively contaminated items and orphan sources have been detected in scrap metal. The scope of this work is to present five 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.

Case 1: A large industrial sealed shielding source was detected in an imported scrap metal shipment. Initial measurements performed with a NaI detector identified the isotope as Ra-226, while the HPGe detector revealed that it was in fact a Cs-137 source. The reason for the misinterpretation of the spectrum was the following: the shielding had a crack in the opposite direction to that of the detector and the source beam was reflected on a wall located on that side before reaching the detector. The activity was estimated at 5000 Ci, using the HPGe spectrum along with Monte Carlo calculations simulating the source geometry and shielding.

Case 2: An industrial source with spherical shielding of a 15cm radius was detected with a maximum dose rate on the surface of the shielding of 500 μSv/h. Initially, the isotope could not be identified with the NaI detector because the obtained spectrum showed only the Compton effect of the scattering of the source beam due to the shielding. Further analysis with an HPGe detector identified the source as Cs-137.

Case 3: An industrial source with small shielding and with a maximum dose rate on the surface of the shielding of 20 μSv/h was detected. Due to smaller source activity than in case 2, 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.

Case 4: A natural uranium ore with a mass of 146g and dose rate in contact in the range of 50 -75 μSv/h was detected. Primary gamma spectroscopy measurements with a NaI detector identified the isotope as Ra-226, due to the presence of the 186 and 1001 keV photopeaks. The spectrum obtained with the HPGe detector and after performing interference corrections showed that it was in fact U-238 of a specific activity of 5300 ± 160 Bq/g, 42.7% w/w.

Case 5: A source was detected in a scrap metal load activating the portal alarm. After obtaining the source spectrum with a portable HPGe detector, the isotope was identified as Cs-137 with an estimated activity of 5μCi. However, the calculated activity did not correspond to the measured dose rates, which were considerably higher. Careful examination of the spectrum continuum showed the existence of another source within

the container. A Sr-90 source was identified and the acitivity was estimated to be 10 mCi, according to the bremsstrahlung spectrum.

The cases presented here show that 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.

Country and/or Institution

Greece / Greek Atomic Energy Commission

Primary author: Dr NIKOLAKI, M. (Greek Atomic Energy Commission)

Co-authors: Prof. CLOUVAS, A. (Aristotle University of Thessaloniki, Greece); Dr POTIRIADIS, C. (Greek Atomic Energy Commission); Dr TAKOUDIS, G. (Greek Atomic Energy Commission); Dr SEFERLIS, S. (Greek Atomic Energy Commission); Dr XANTHOS, S. (Aristotle University of Thessaloniki, Greece)

Presenter: Dr NIKOLAKI, M. (Greek Atomic Energy Commission)

Session Classification: Poster Session I