



Elevated Readings and Cs-137 Detected in Cargo Containers Kuala Lumpur, Malaysia February 2011





Situation

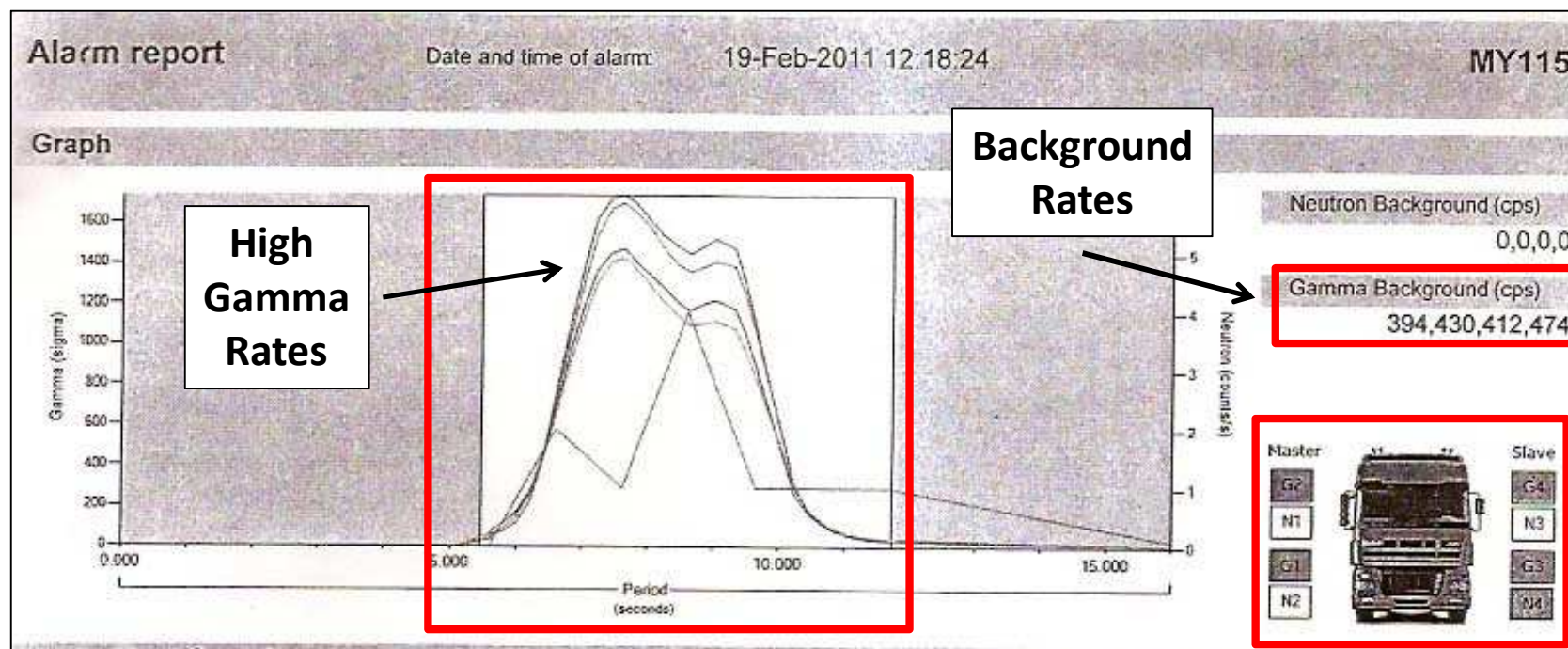


Three 20 foot cargo containers each triggered a gamma alarm at a Megaport Radiation Portal and sent to secondary inspection. In secondary inspection, officials conducted measurements with a Detective HPGe (high resolution), identifying Cs-137, Th-228, Th-232, K-40, Ra-226, Mn-54 and Ir-194, and a Radioisotope Identifier (RIID) (low resolution) identifying Bi-207. The primary concern was the presence of Cs-137 since the other key isotopes identified were Naturally Occurring Radioactive Materials (NORM) and consistent with the zinc ore listed on the manifest. Malaysia Radiation Protection Authority, Customs and DOE further assessed the radiation signature to verify that the high levels were consistent with the cargo and pose no risk to the public. The Cs-137 was found to be an artifact of the measurements.





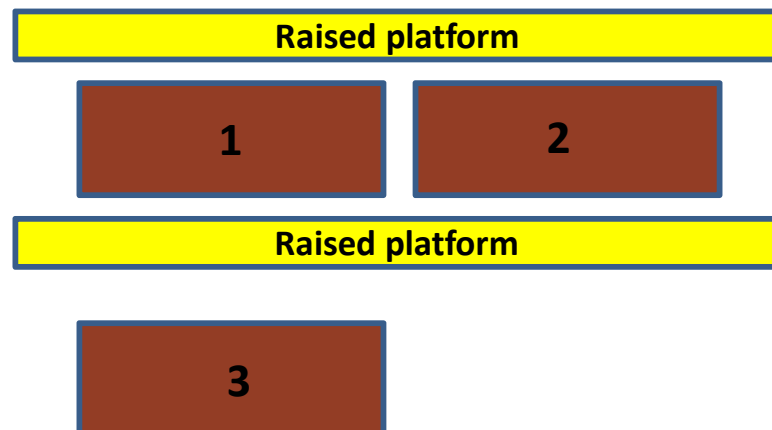
Megaport Radiation Portal Data



The data showed elevated gamma readings which were unusually higher than typically encountered from NORM materials. The amount of radioactive impurities in ores varies by mining location and ultimately will be extracted as part of the ore refinement process.



Container
Geometry
(top view)



3 meters



Concept of Operations



Mission is to characterize the radiation signature and adjudicate the alarms

A Pre-Job safety briefing will be provided to all participants and observers.

Personnel conducting the measurements will be issued an alarming dosimeter.

A radiological characterization map will be conducted using an Identifinder or Health Physics dose rate meter.

Detective HPGe spectra will be acquired of the hotspots and sent to DOE Triage.

All measurements will be documented, manifest obtained and photographs taken of container, container markings and measurement geometry.

If it is deemed necessary to open the container, a source recovery plan will be developed prior to beginning operations.

Note: If any suspicious packages, wires or anything with a hazardous, explosive or other indication of dangerous material is noted, all activities cease, personnel will return to a safe distance and the plan will be re-evaluated.

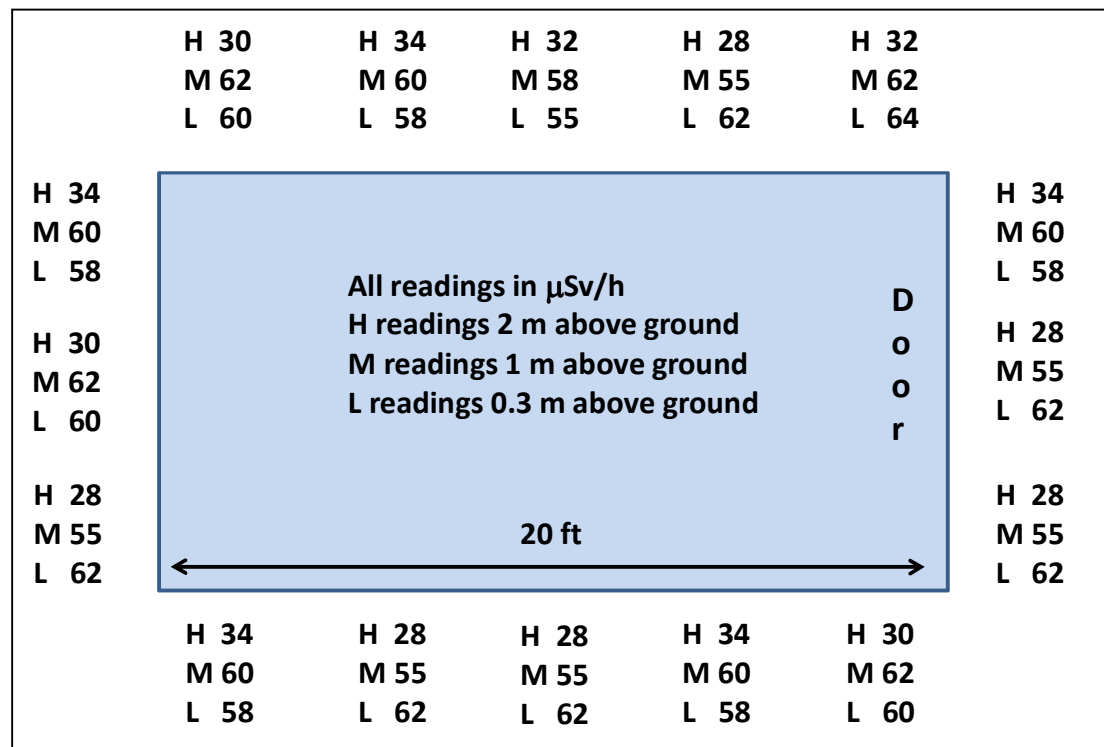


Radiological Characterization Map



A vehicle or cargo container filled with NORM may appear as a ***uniformly distributed*** source with nearly equal dose rates on all sides.

Dose rates may decrease near top of container when bulk of NORM at floor to mid-height level; examples include ores, clay products, fertilizers and ceramics.



Radiological Characterization Map of NORM

Dose rates: 50-72 $\mu\text{Sv/h}$ at contact; 8-15 $\mu\text{Sv/h}$ at 1 m

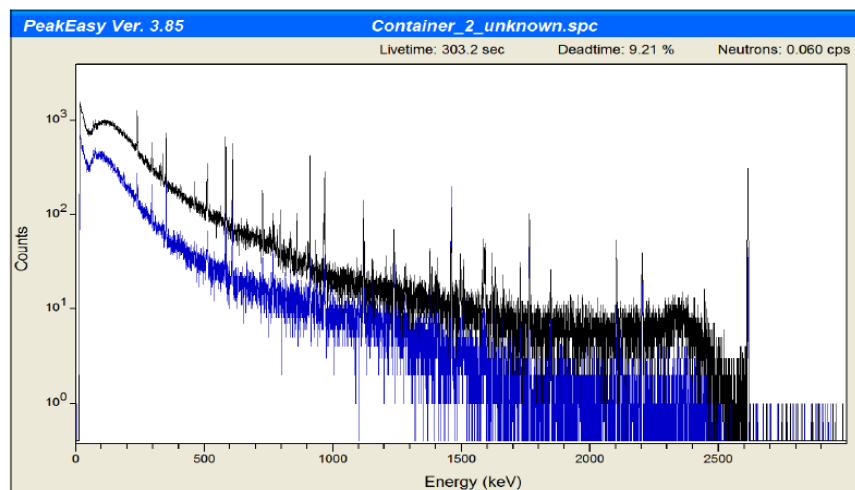


DOE Triage Report



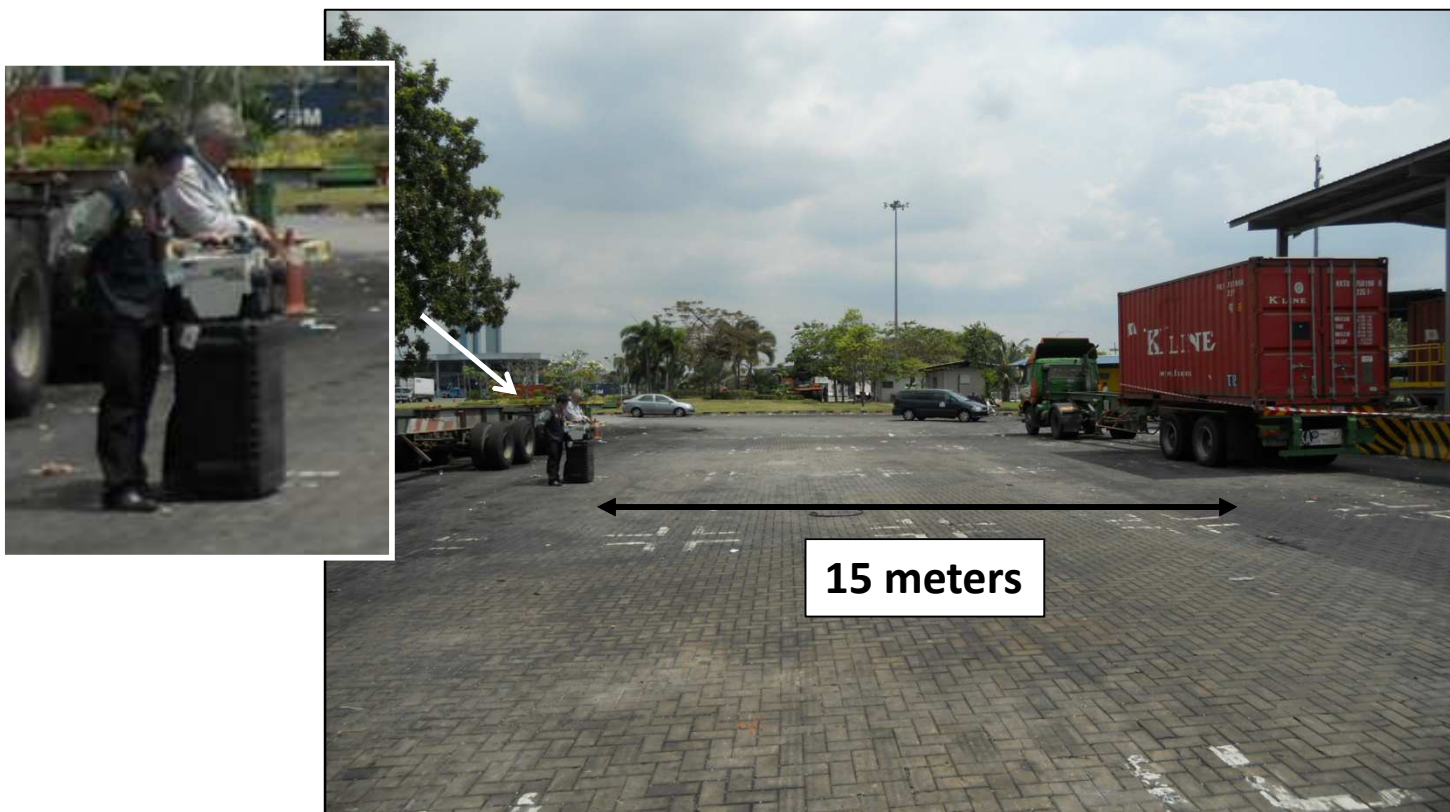
Short synopsis of the analysis results.

Data do not indicate a threat. Only NORM isotopes are present, in particular thorium and its daughters. Radium daughters and potassium-40 are also observed in the unknown spectrum but they are present in the background spectrum at equal intensities so do not appear to be from the container. Observation of NORM thorium is consistent with a load of ore.



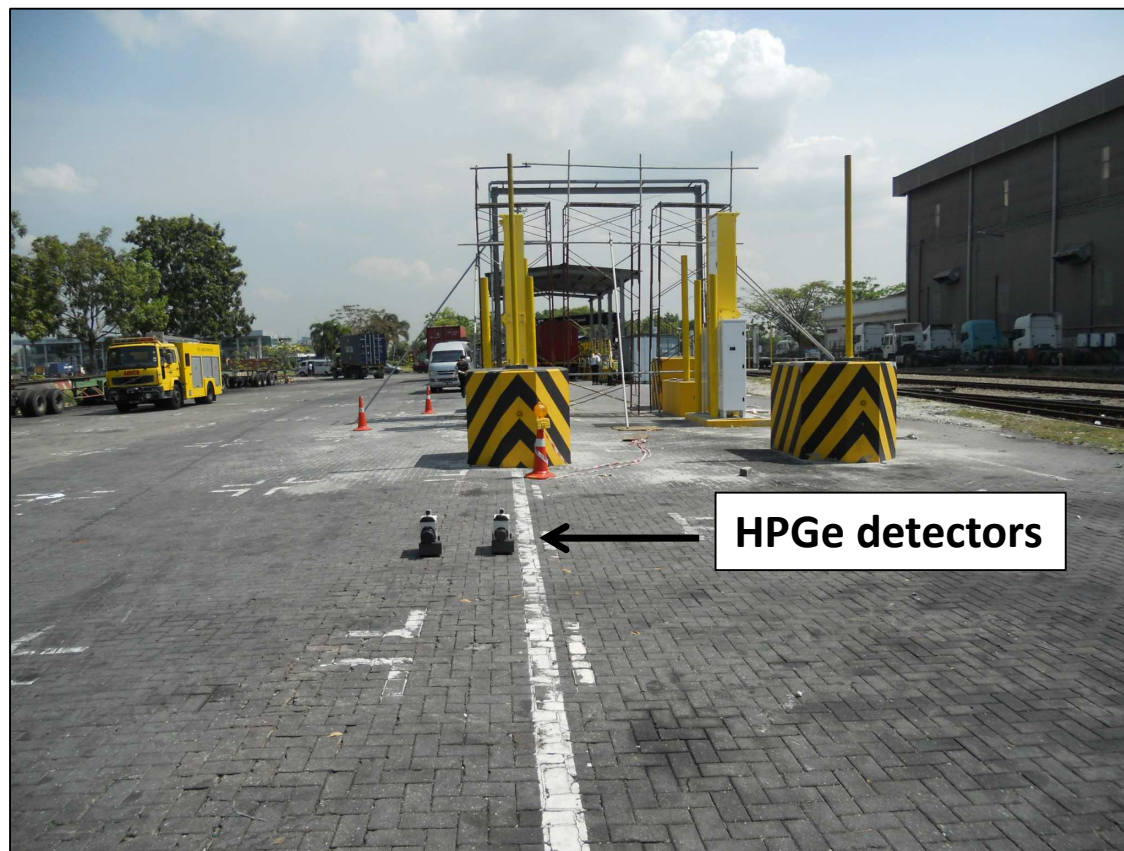
The Detective HPGe spectrum is complex with numerous gammas attributed to U-238 (Ra-226, Ra-228), Th-228 and Th-232, all of which are NORM. ***Elevated radiation levels are attributed to Th-228 and Th-232 isotopes in the ore.***

Source to Detector Distance



The long source to detector distance was required to keep the Detective HPGe detector dead time less than 5% in order to collect high quality gamma spectral data.

Background Measurements



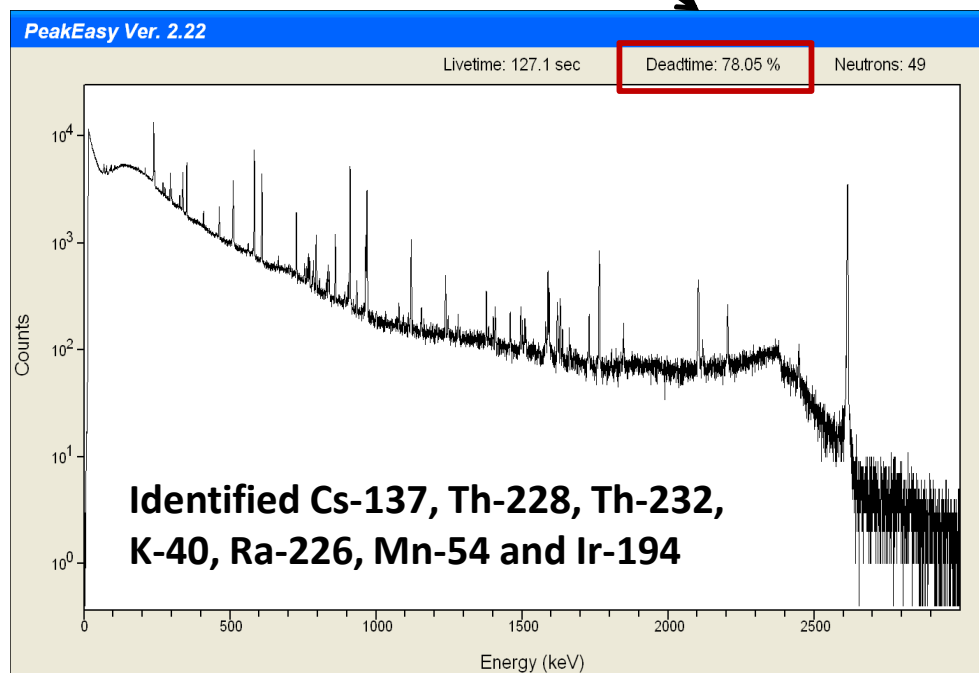
In order to acquire background measurements, the Detective HPGe detectors were placed about 50 meters from the cargo containers.



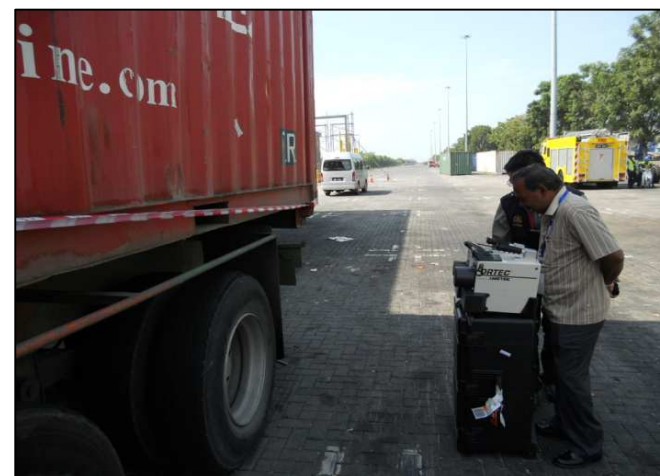
Issue 1: High Detector Dead Time



High Dead Time



At 1 meter, the Detective HPGe has 78% dead time. As a result, for a 300 second spectrum, the electronics is busy for 173 seconds and can also introduce artificial peaks from pulse pile-up.





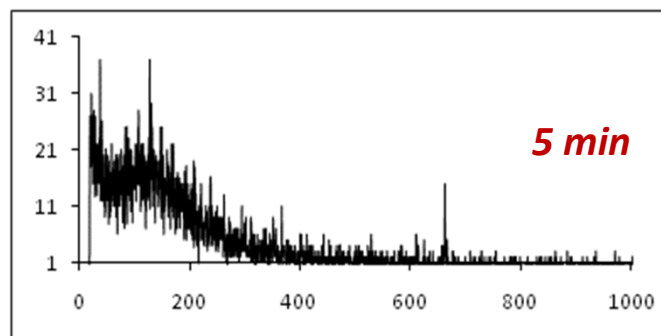
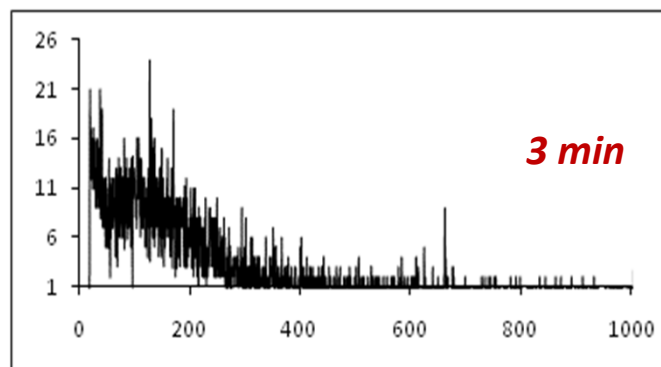
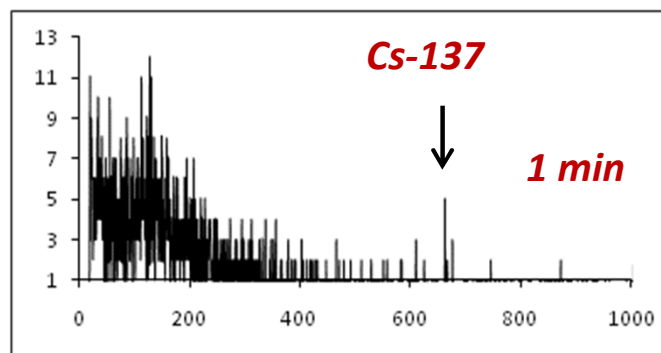
Issue 2: Cs-137 Pickup from RIID



0.5 kBq
(15 nCi)
Cs-137

If a RIID is too close to a Detective HPGe during a measurement, the internal Cs-137 calibration source in the RIID can be detected

Keep RIID at least 5 meters from the Detective HPGe





Lessons Learned



- Ores can produce higher than normal radiation levels due to elevated concentrations of thorium isotopes
- The higher activity levels in some ores may require significant source to detector distance (> 10 meters) for measurements with RIIDs and Detective HPGe detectors to keep dead time below 5%
- Some RIIDs contain small quantities of Cs-137 for calibration and gain stabilization which can be detected in a Detective HPGe spectrum if the unit is too close during a measurement



Summary



- Manifest showed 120 metric tons of zinc ore in 3 cargo containers
- Dose rates were significantly higher than most NORM shipments, but still a safe level
- Radiation signature indicated a uniformly distributed source decreasing with height signifying a potential NORM material
- Spectra sent to Triage and assessment is no serious health risk
- Acquisition of quality gamma spectra (low dead time) required detector to source distances of 12-15 meters