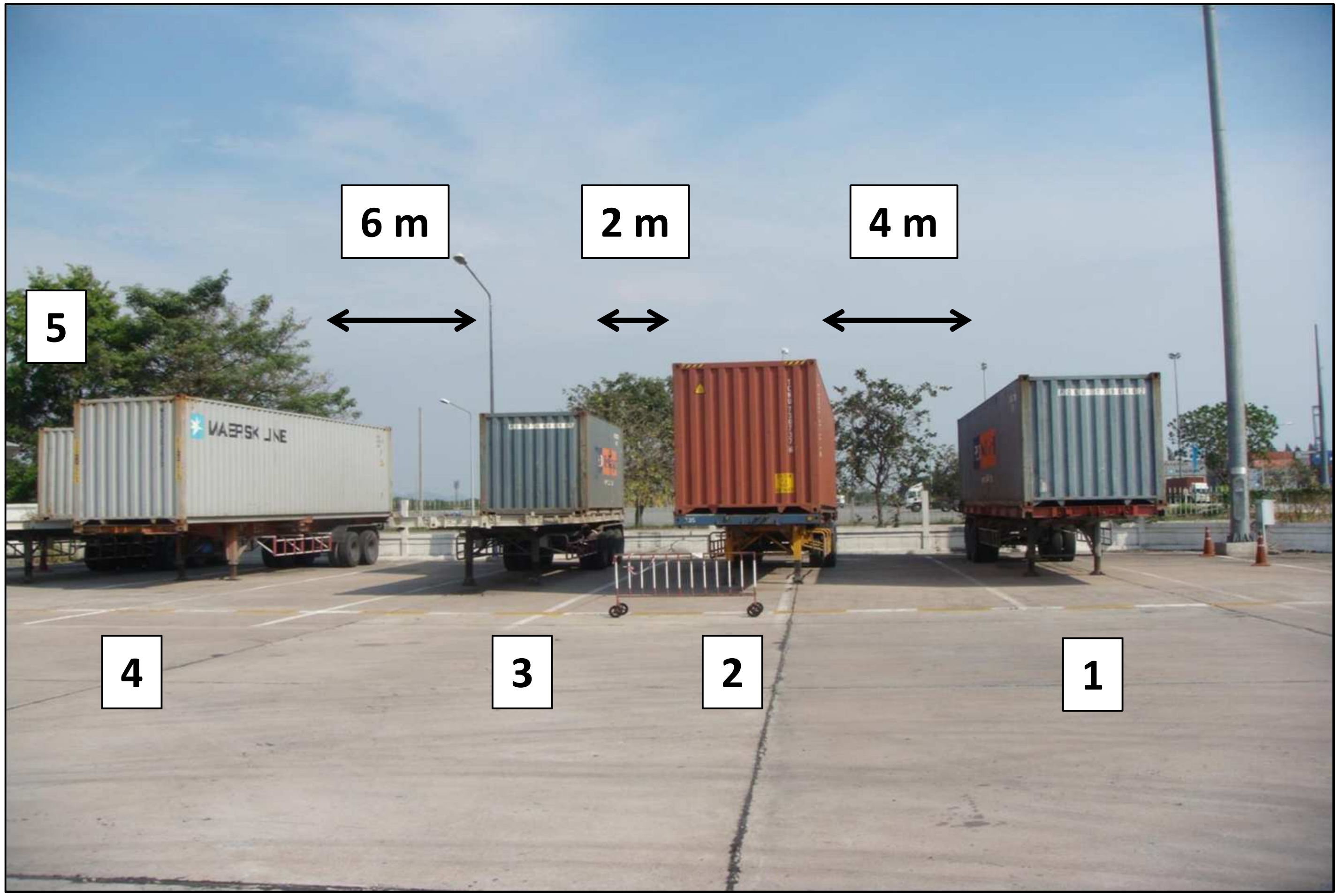
Cesium Contamination in Cargo Containers
Laem Chabang, Thailand
April 2012

Situation

Five cargo containers triggered gamma alarms at a Megaport Radiation Portal and were sent to secondary inspection. The alarms were attributed to Cs-134 and Cs-137. It is not uncommon to find Cs-137, but the presence of Cs-134 was unusual. Thailand Radiation Protection Authority and a DOE team conducted additional measurements on the containers and confirmed the presence of the radioisotopes. The manifest for each of the containers did not indicate any radioactive materials. The containers most likely contained contaminated materials which could pose a risk to the general public. Dose rates were not deemed a hazard to the responders.

Container Configuration



Five detained cargo containers separated by 2-6 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.

Response Survey Equipment

An I-RAPTER course was being conducted in Thailand so the equipment was drawn from the course equipment inventory and included:

Detective-EX HPGe (2)
Health Physics kit (2) with alpha, beta/gamma probes
Swipes, gloves and Tyvek suits
Radioisotope Identifinder (2) with neutron detector
Laptop with cellular aircard
Radiation pagers (4)
Measuring tapes (2)
Digital camera (1)
Linear radiation monitor (1)
Plastic bags/tape

Dose Rate Assessment

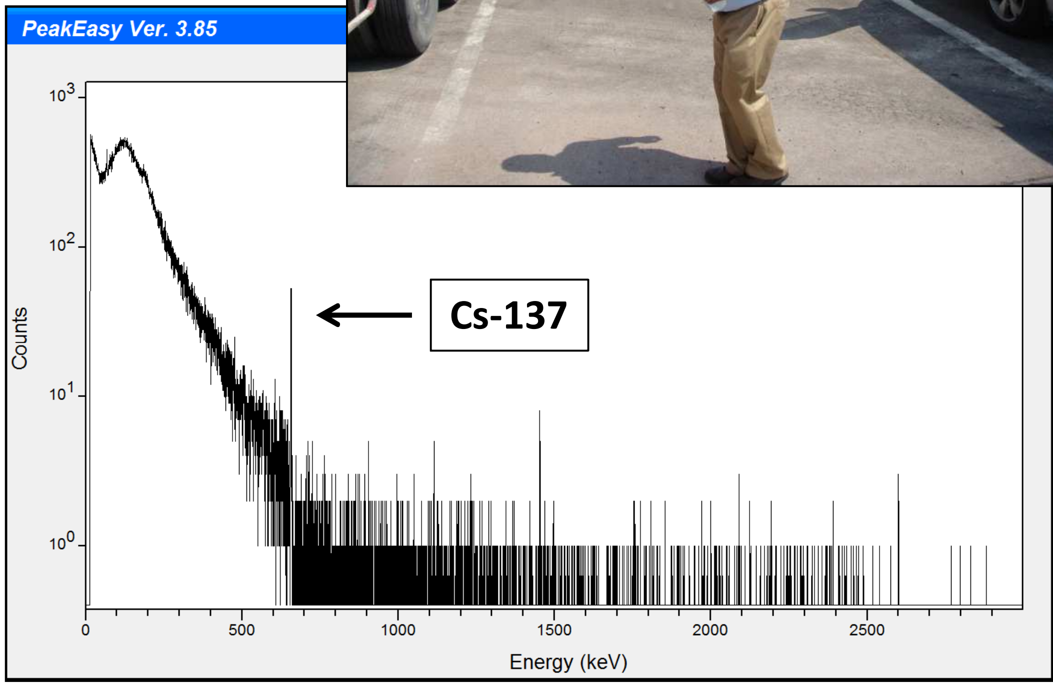
A dose rate assessment of the containers was conducted to determine safety requirements for working around the containers. Dose rates can be measured with a Radioisotope Identifinder or a Health Physics Meter. The highest dose rate detected was 0.27 mSv/h (27 mR/h) at the back of Container 1. The rest of the containers had dose rate less than 1 μSv/h (100 μR/h). The background dose rate at a distance of 50 meters from the containers was 0.05 μSv/h (5 μR/h).

DOE Triage Report – Container 1

Hotspot at Rear of Container

The gamma spectrum from the hotspot indicated a Cs-137 point source. A Detective HPGe measurement of the hotspot was taken at a distance of 3.5 meters in order to keep detector dead time less than 5%. The contact dose rate was 0.27 mSv/h (27 mR/h) at the back of the container. The activity was estimated to be approximately 37 GBq (1 Ci).

This source posed a serious health risk outside of the container.

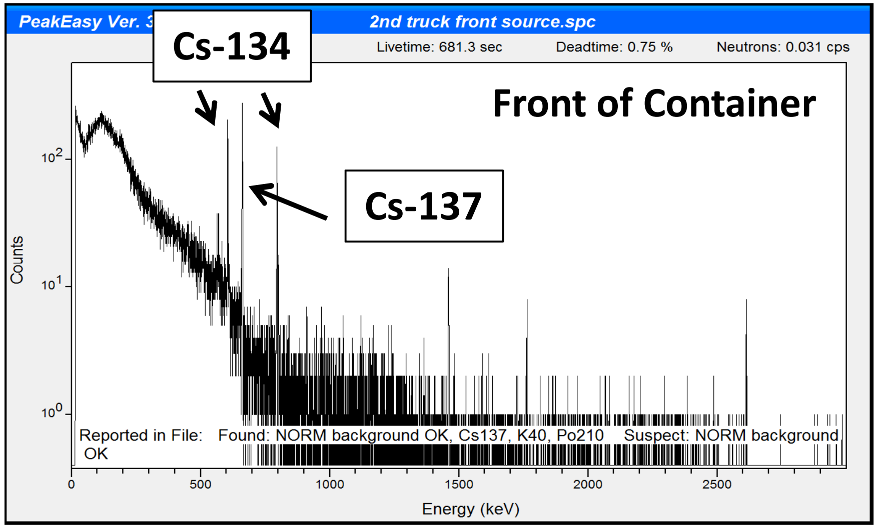


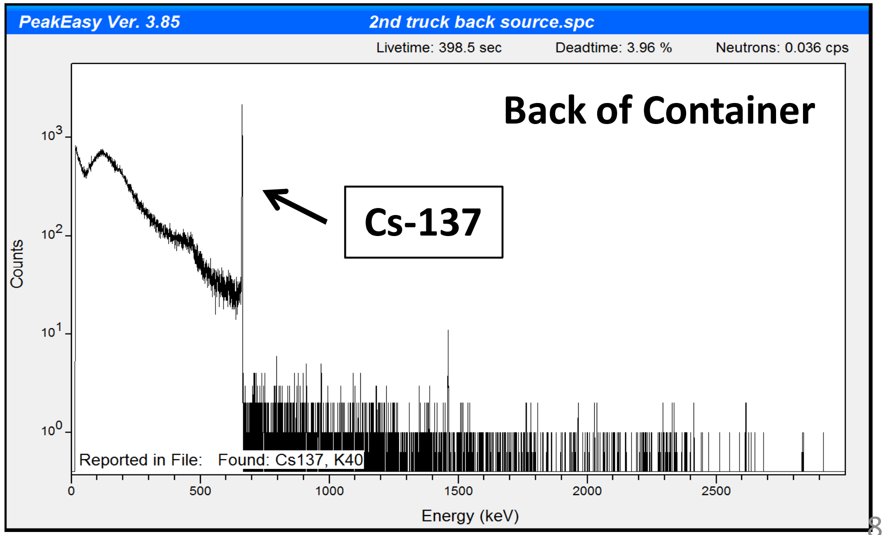
DOE Triage Report – Container 2

Front and Rear Hotspots

The gamma spectrum at the front of the container showed evidence of Cs-134 (605 and 796 keV) and Cs-137 (661 keV). Cs-137 has a half life of 30 years and Cs-134 has a half life of 2.1 years. This container originated in Japan and the isotopes are consistent with fission product contamination from the Fukushima Reactor Accident in March 2011. The gamma spectrum from the back of the container showed only Cs-137. The manifest indicates used auto parts. Activity estimates were about 370 kBq (10 μCi) at the front and 18 MBq (0.5 mCi) at the rear of container.

Low level loose contamination is suspected and proper protective clothing should be used when opening the container.



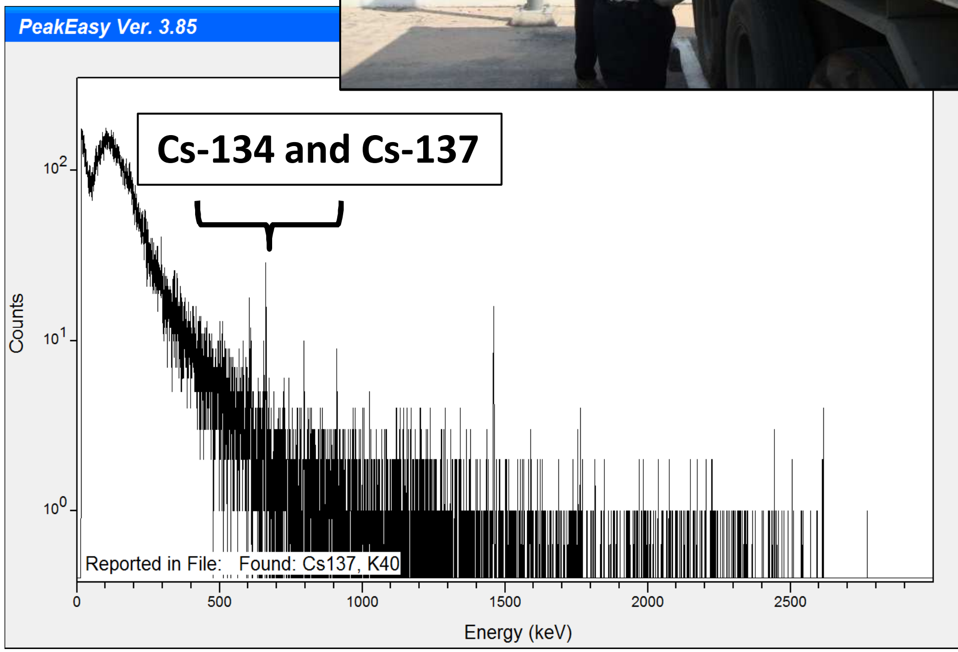


DOE Triage Report – Container 3

Hotspot in Back Section

The gamma spectrum indicated weak intensities for both Cs-134 and Cs-137 sources, similar in intensity to the natural background. The hotspot was located at the bottom of the container about 3.5 meters from front. The contact dose rate was 1 μSv/h (100 μR/h). Activity estimates were about 7 MBq (0.2 mCi). Due to the close distance of the containers, the measurement could have been picking up the sources from Container 2. The container manifest indicated scrap metal from South America.

This source posed a potential health risk outside of the container.

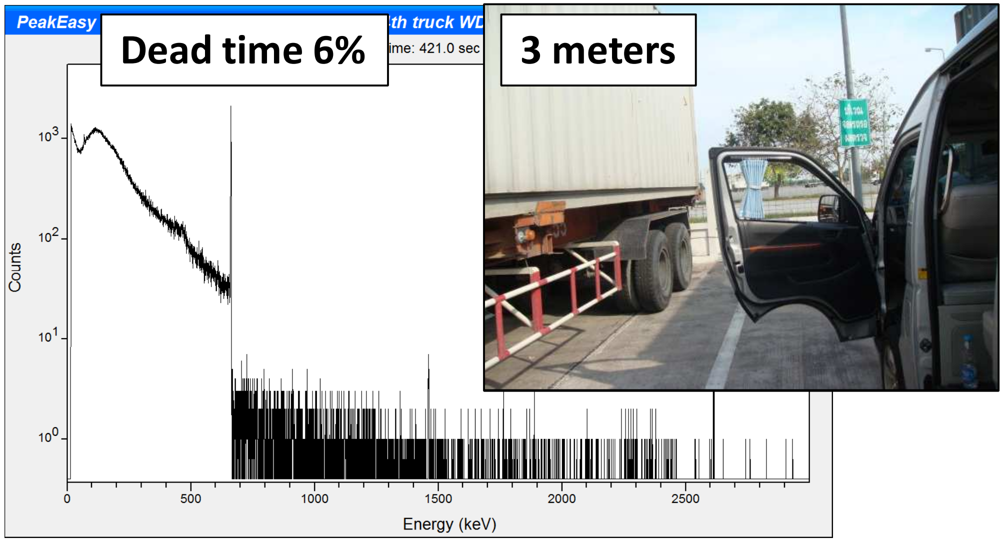


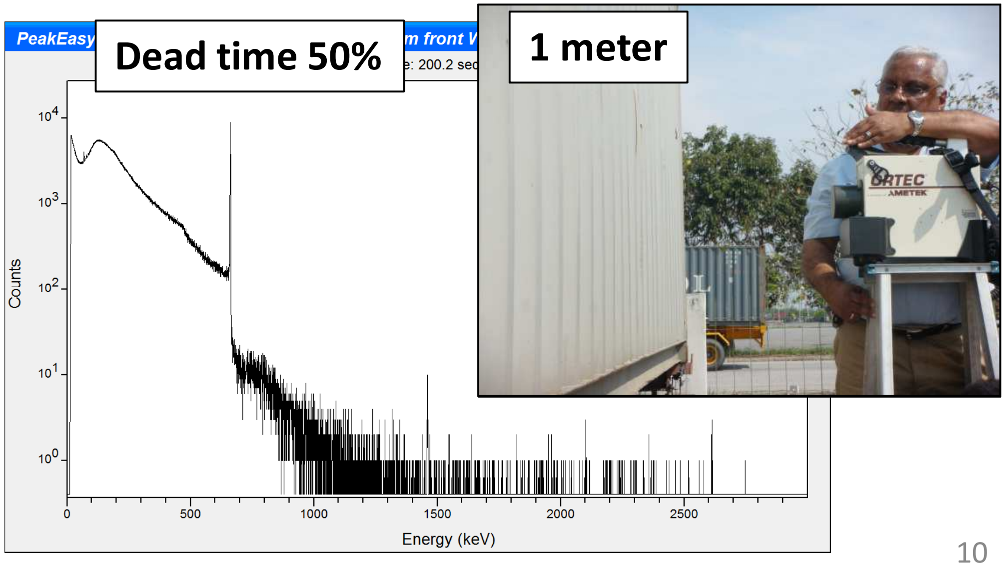
DOE Triage Report – Container 4

Hotspot at Container Mid Section

At 1 meter from the hotspot, the Detective HPGe dead time was almost 50%. Moving to a distance of 3.5 meters reduced the dead time to 6% and provided quality data indicating Cs-137. This source could also be a discarded orphan source. The manifest for the container was not available. The activity was estimated to about 1665 MBq (45 mCi).

This source posed a potential health risk outside of the container.





Measurement Challenges

Detained containers in secondary inspection which are parked to close to each other make individual container measurements difficult.

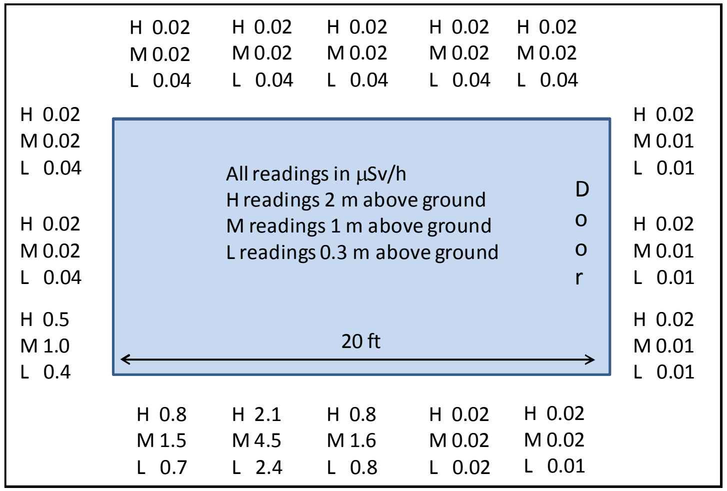
Additional Useful Tools

A tele-probe can be used to map a container which is on a trailer

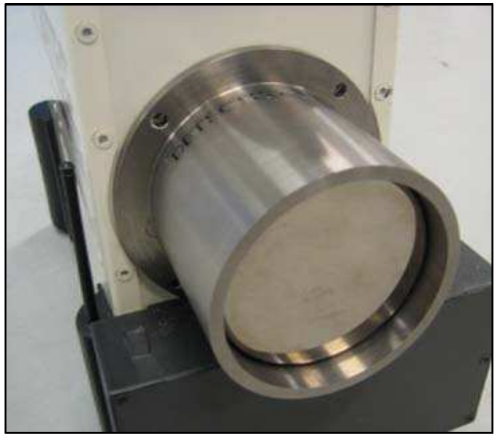
Radiological Characterization Map

To map the radiation signature, measure the dose rate at low, middle and high points at one meter distances around the container.

The shape of the radiation source contains information about the radiation source.



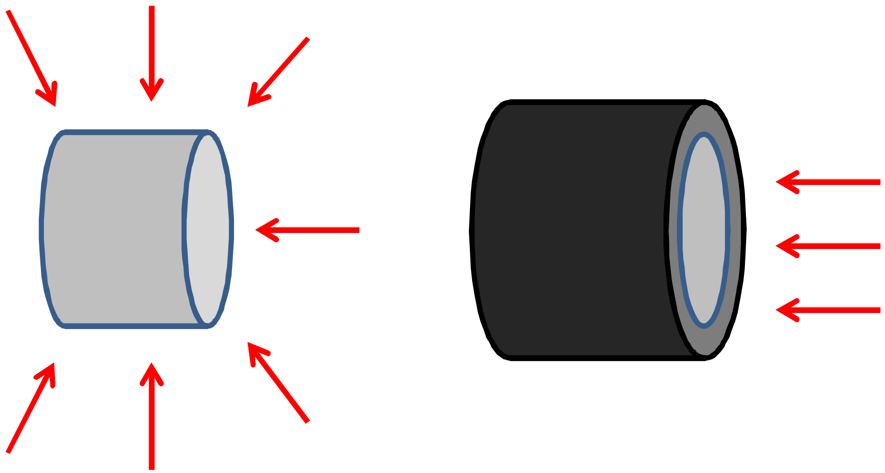
Additional Useful Tools



A collimator is a dense material that shields the detector from the sides

Detector Collimator

The collimator allows the detector to focus on the hotspot of interest while shielding the detector from other nearby radiation hotspots. Without the collimator, the detector would pick up all hotspots within its field-of-view, including hotspots behind the detector.



Uncollimated **Collimated**

Lesson Learned

- It is difficult to evaluate detained containers which are parked near each other due to interfering signatures. Containers detained for evaluation should be at least 50 meters from other containers and accessible on all sides.

- Determine if the containers are on the ground or on a trailer. A tele-probe can be used to conduct a radiological characterization map when the container is on a trailer.

- A collimator can be used with a Detective HPGe to limit the detector field-of-view and focus the measurement on the hotspot of interest.

- Measurements of dose rates at container contact and directly back until ¼ dose rate can be conducted in order to determine the source distance inside the container.

Summary

- Five containers were detained in secondary inspection, four of which contained radioactive cesium. One container showed no evidence of radiation.

- One container from Japan contained both Cs-134 and Cs-137, an indication of fission products from the Fukushima accident. The material inside the container most likely contained loose, removable contamination.

- Dose rates and activity estimates of two of the point sources indicated the sources posed serious health risks if removed from the containers.

- The close container configuration made it difficult to measure each container without picking up radiation from the nearby container.