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PVT Technology Refresh

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BACKGROUND & PROBLEM

The U.S. Department of Homeland Security (DHS) has deployed over 1700 radiation portal monitor (RPM) systems at United States Ports of Entry (POE) Over the last decade. With an original estimated operational life of 10 years, performance degradation, component supply, and obsolescence are now concerns as the systems age. Polyvinyl Toluene (PVT), or plastic, scintillator detectors may need to receive a technical refresh to maintain maximum security at their sites of installment. The Domestic Nuclear Detection Office (DNDO) is researching options to extend the service life of RPMs via a refresh of the RPM technology.

INTRODUCTION

These Critical Operational Issues were used to assess system capabilities:

- COI 1: Does the Technology Refresh Solution (TRS) provide detection capabilities equal to or better than the existing RPMs?
- COI 2: Are impacts on the flow of commerce at CBP inspection checkpoints from the TRS no greater than existing RPMs?
- COI 3: Can the TRS be installed within the current system envelope?
- COI 4: Does the TRS appear to maintain or increase long term RPM system sustainability?

Keeping these four issue in mind, ten vendors' RPMs were evaluated at a test site at Pacific Northwest National Laboratories (PNNL) and the data was analyzed at Sandia National Laboratories (SNL).

PROCESS

These methods of collecting data were imperative to the evaluations being consistent between vendors:

- Different methods of moving an isotropic source through the RPMs were utilized, such as in a vehicle or a "Source Shuttle" positioned mid-height of the RPM.
- Any vehicle used was equipped with a speed-measurement tool.
- Background radiation levels were tracked 24/7 to ensure no anomalies factored into the evaluations.
- False alarm rate tests were conducted overnight when no alarms were expected, as well as with different quantities of concealed Naturally Occurring Radiological Material (NORM).
- Ten radiological tests were conducted with procedures based on ANSI N42.35-2006 or TM-017 specifications.



Source Shuttle at Mid-height Position



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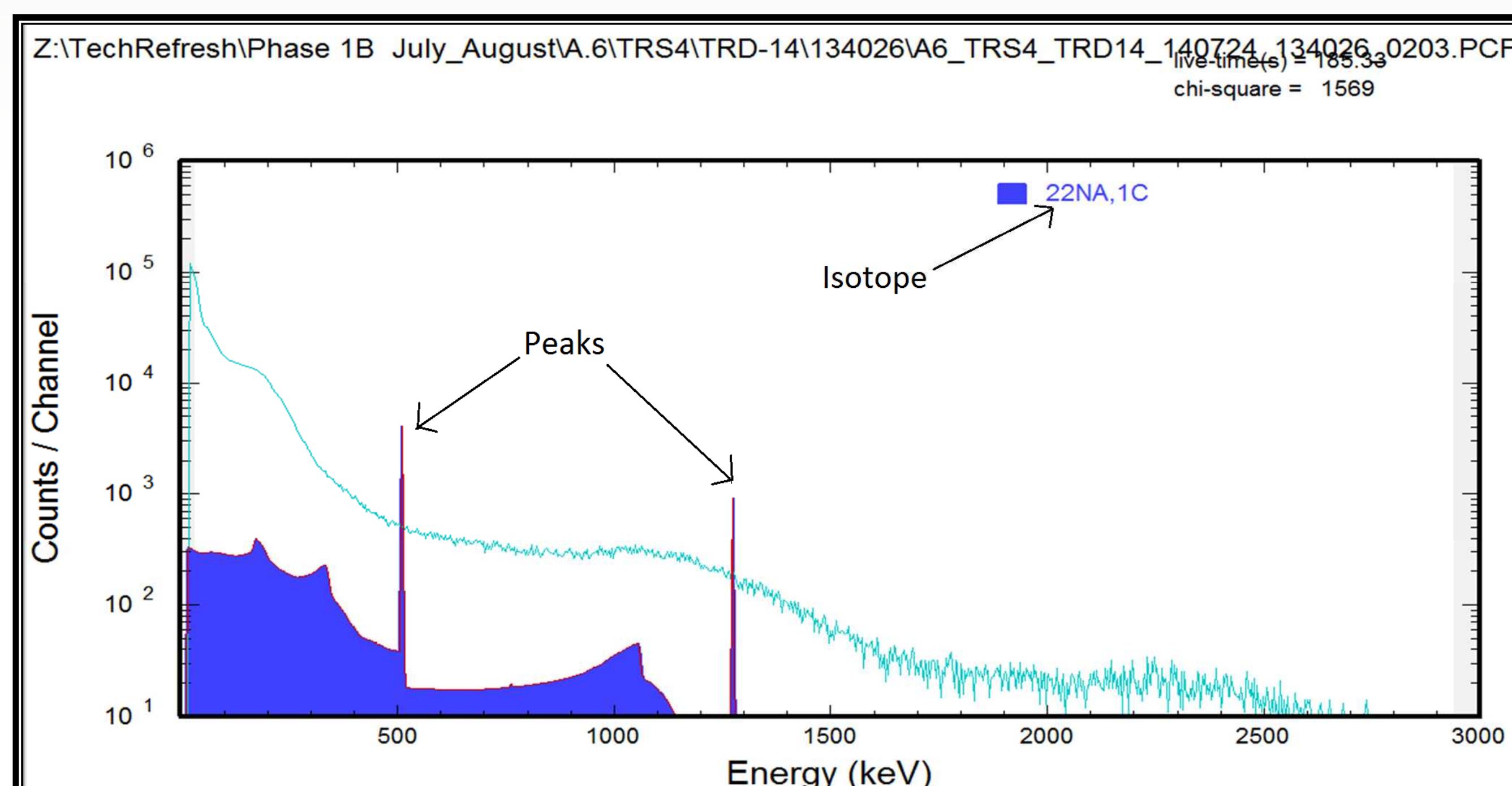
ANALYSIS

Scoring criteria was outlined before data analysis. Some of the RPM's output could only be analyzed by software like GADRAS (Gamma Detector Response and Analysis Software), PeakEasy, and Cambio. We used these tools to convert the data into readable CSV files. From there, it was only a question of analyzing the data to find:

- Gamma absolute efficiency
- Relative Background Reduction
- Gamma Spectral Response
- Neutron Detection
- False Alarm Rates
- Data uncertainty and error propagation applying to each figure

All efficiencies were reported in net count rate above background in microCurie of source activity.

The sources used were ^{241}Am , ^{133}Ba , ^{57}Co , ^{60}Co , ^{137}Cs , ^{90}Sr , and ^{252}Cf .



GADRAS software is used to read input from some vendors to get counts-per-second data in csv files.

PROCESS

- COI1

"Three of the vendors demonstrated superior performance in the key areas of alarm categorization and improved sensitivity to threat surrogates." These results indicate recent software improvements and updates in detector design would be beneficial.

- COI2

One system marginally failed a false alarm test, but three systems offered promise of reduction of false alarm rates over baseline systems.

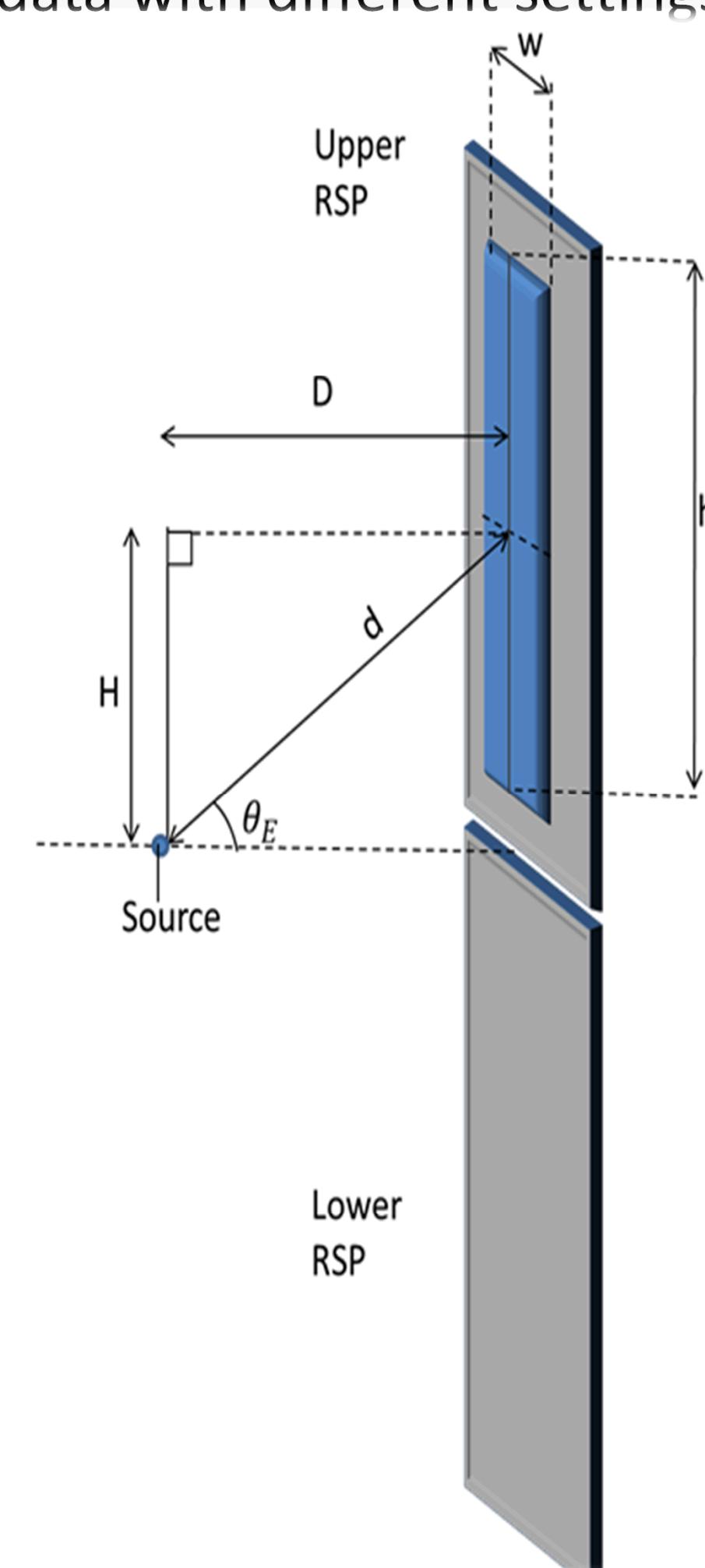
- COI3

All but one system had no problems with installation within the current deployed system envelope.

- COI4

All but one system showed new capabilities to improve sustainability, such as self-calibration features and self-health monitoring features. It was noted that the ability to replay occupancy data with different settings is a highly valuable algorithm.

Different geometries of RPM's must have different solid angle considerations.



CONCLUSION

These evaluations proved that recent advancements in detector technology as well as software would be beneficial to the current deployed system envelope. Sustainability, detection efficiency, and false alarm rate are all categories that would be substantially benefitted by a technical refresh.

FUTURE WORK

A Phase II Limited Operational Assessment will compare selected alternatives against the baseline system currently used at a Customs and Border Protection (CBP) Port of Entry. The data collected in Phase I (described in this poster) will be used as an Analysis of Alternatives (AoA) by DND and does not imply any acquisition of any vendor's technologies.

REFERENCES

1. Department of Homeland Security Domestic Nuclear Detection Office. (2015). *Test Report-PVT Technology Refresh Documentation*. Albuquerque: Department of Homeland Security.
2. Arrieta, M. (2014). Solid Angles of Non_1.docx.