



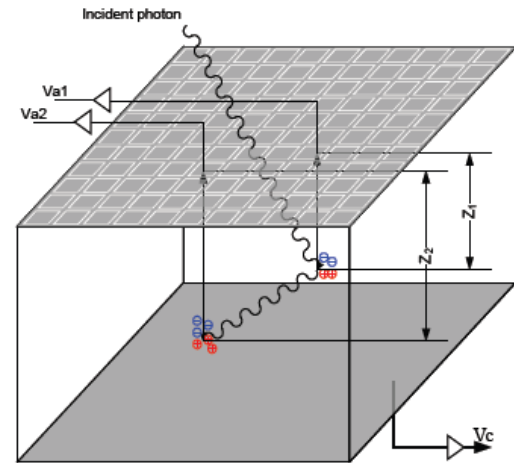
# Polaris-H Imaging Spectrometer Design and Applications

Y. Andy Boucher  
Product Manager

# Presentation Outline

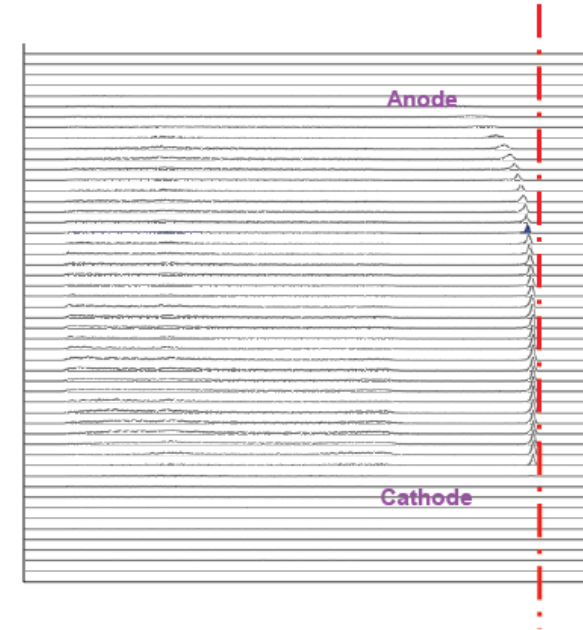
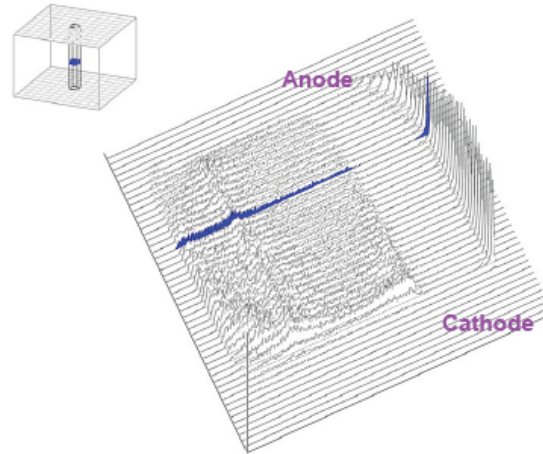
- Introduction to H3D Technology
- Polaris-H Imaging Spectrometer
- Applications for Polaris-H
- New Technology from H3D
- Questions

# H3D's Technology

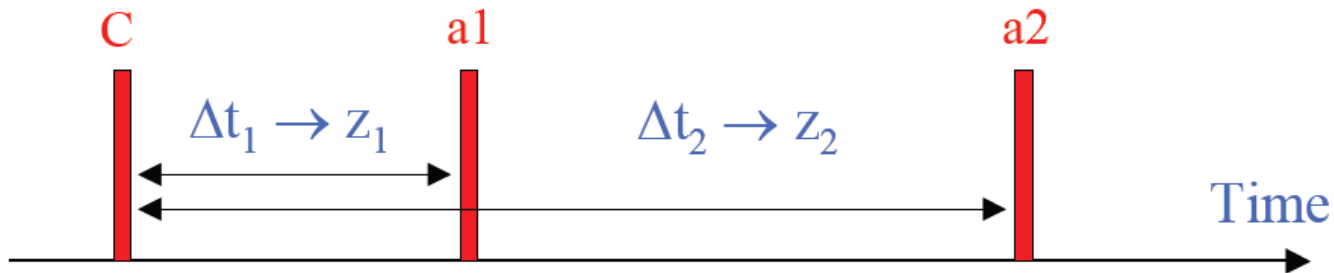


6 cm<sup>3</sup> CZT  
At room temperature

Depth-separated spectra of one pixel

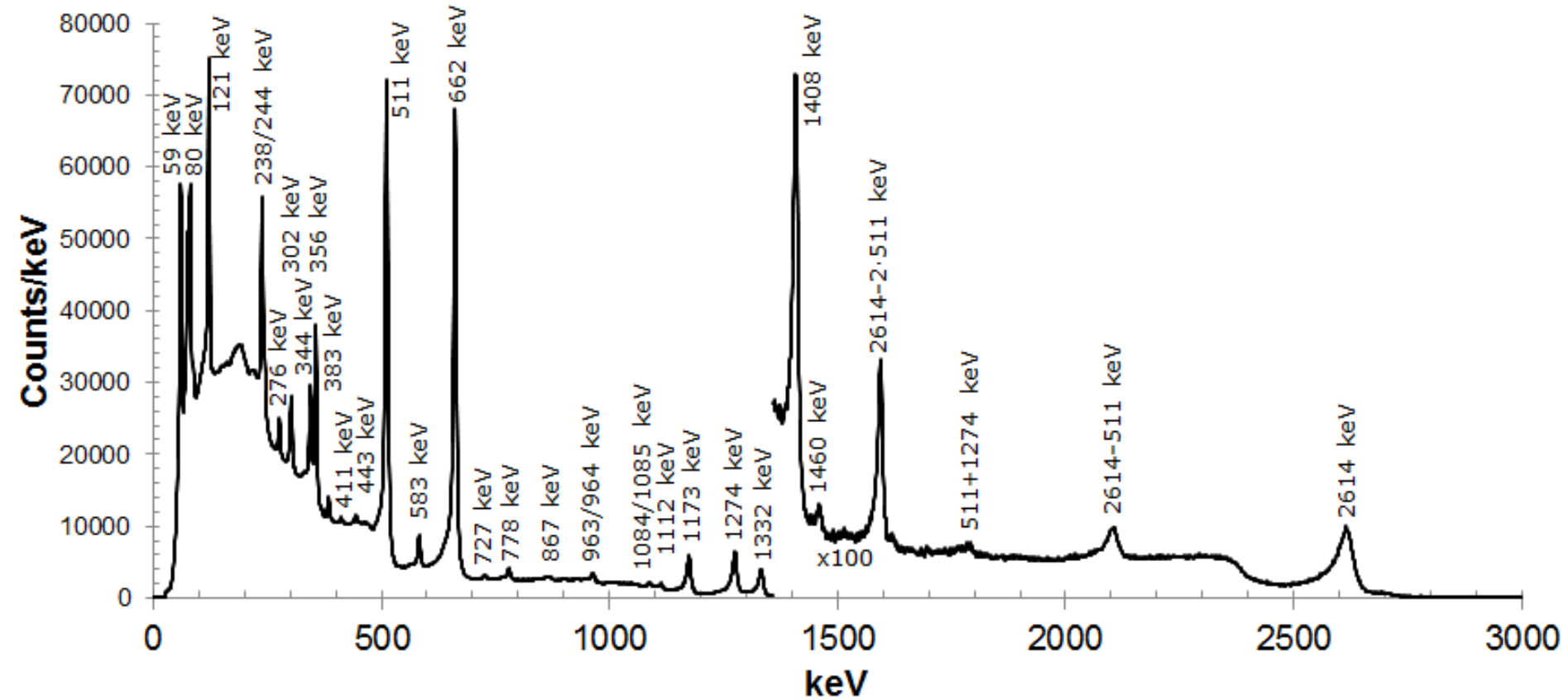


Triggers

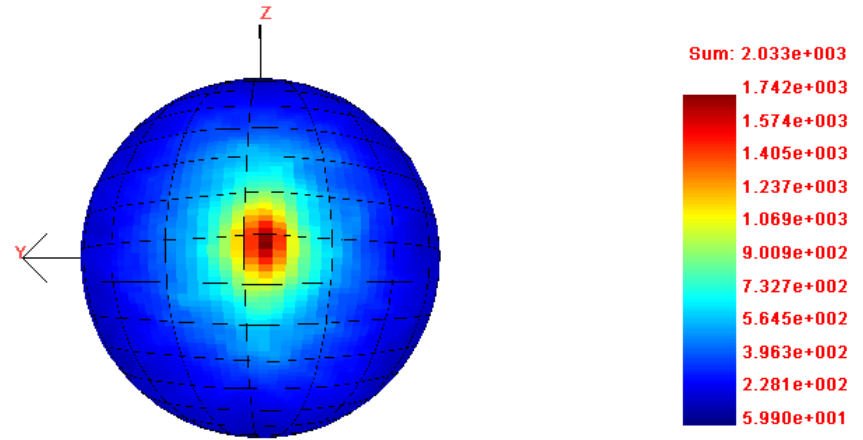
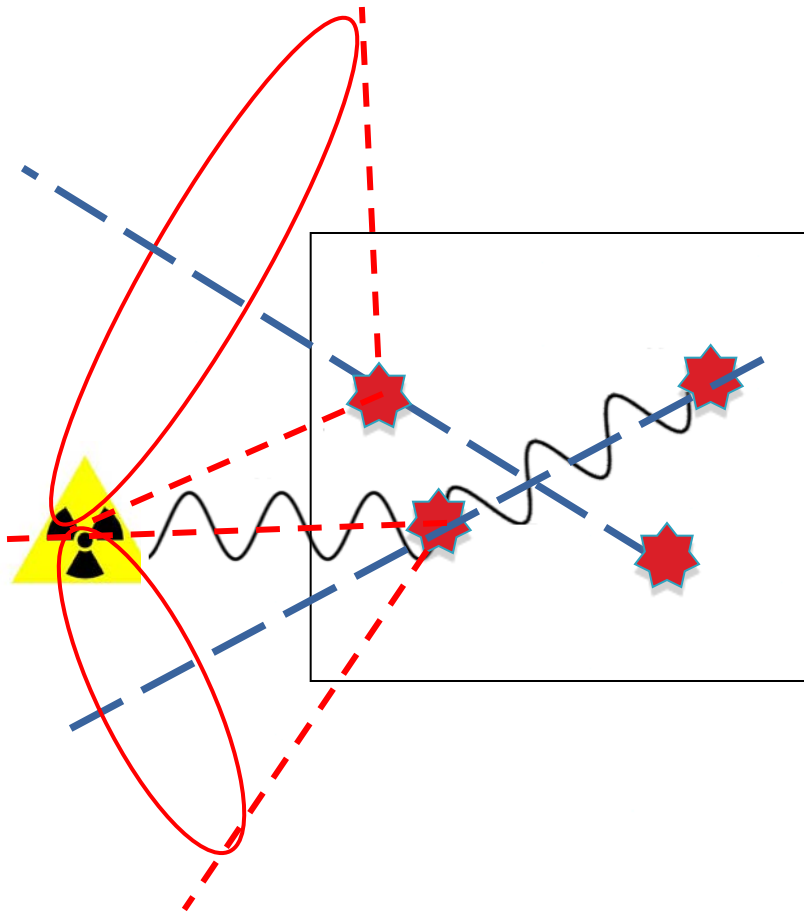


# Spectroscopic Performance

<1.0% FWHM at 662 keV

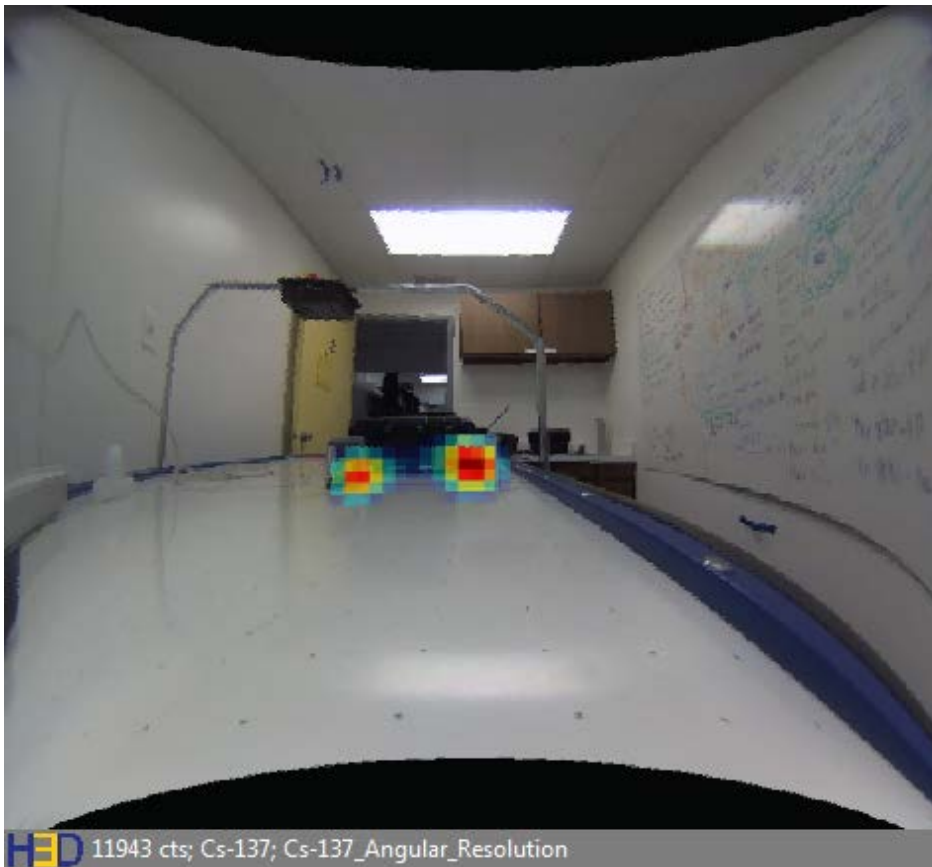


# Gamma-Ray Imaging



Number of photons: 2033

# Imaging Performance



- Can distinguish sources of same energy  $20^\circ$  apart

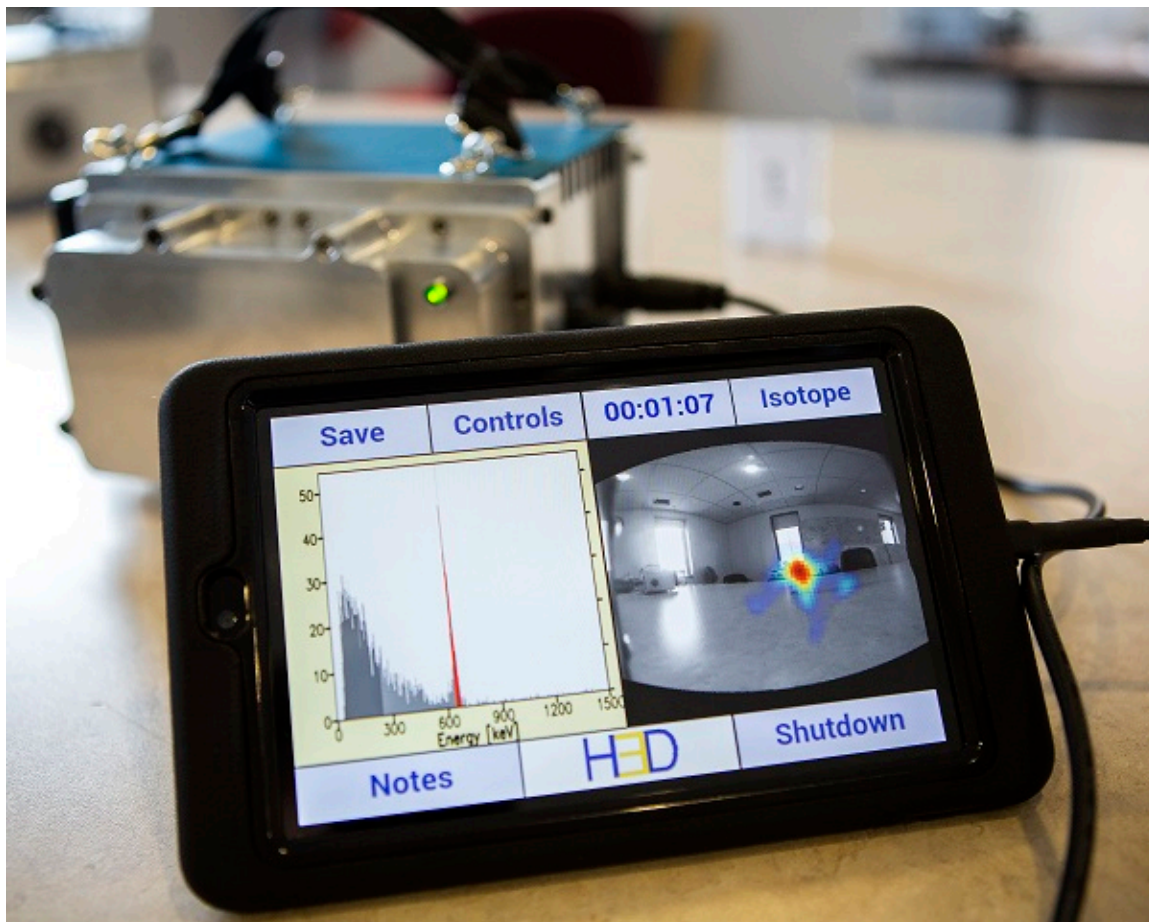


- Can find center of point source to  $\pm 1^\circ$  in any direction



# Polaris-H Portable High-Resolution Imaging Spectrometer for Nuclear Power Plants

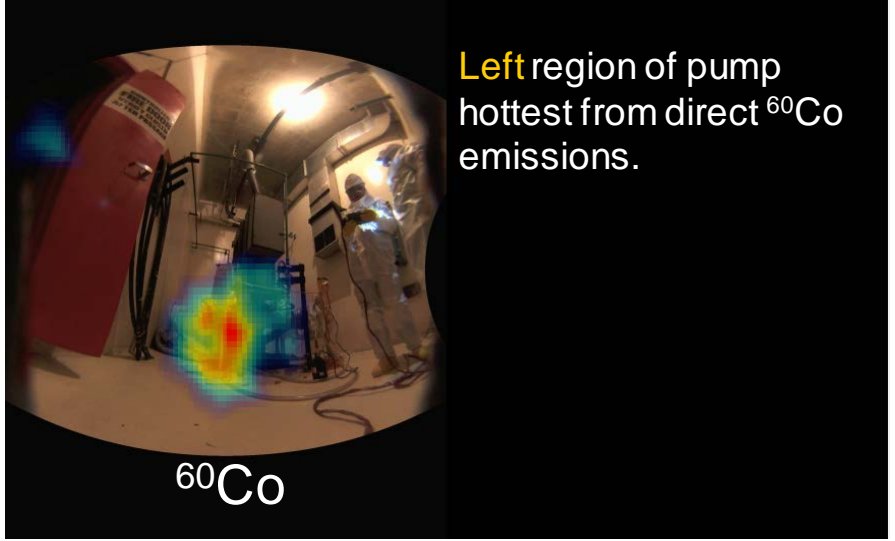
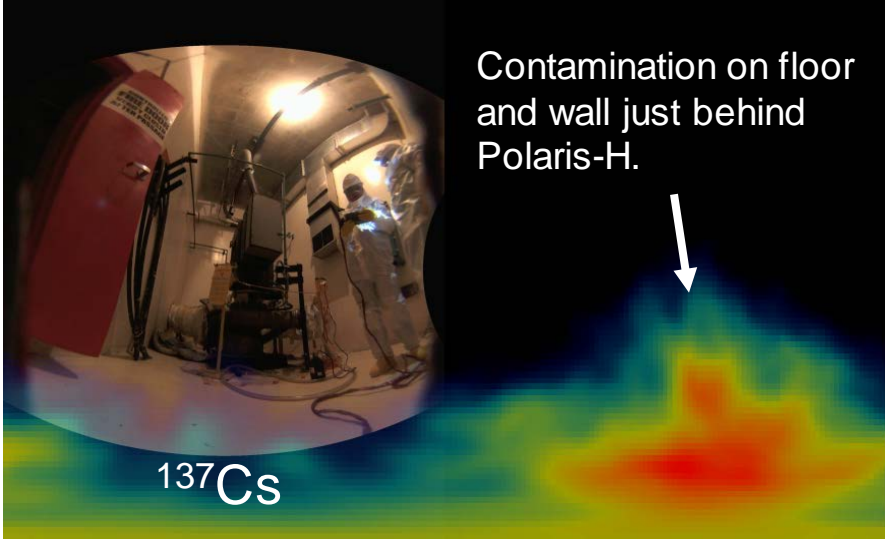
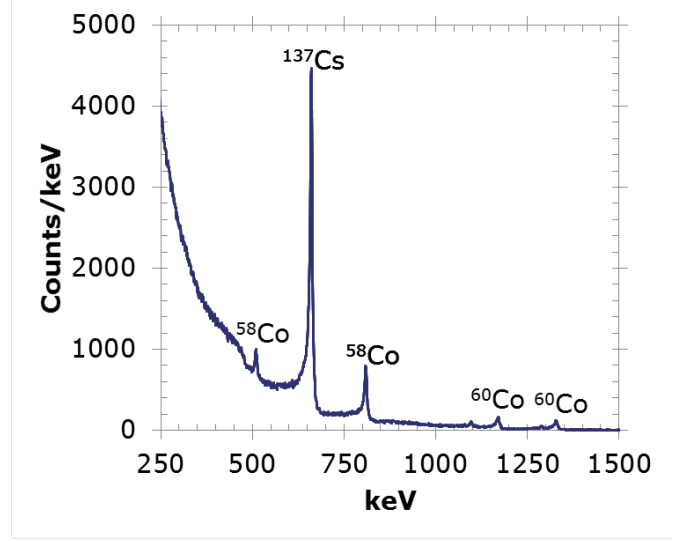
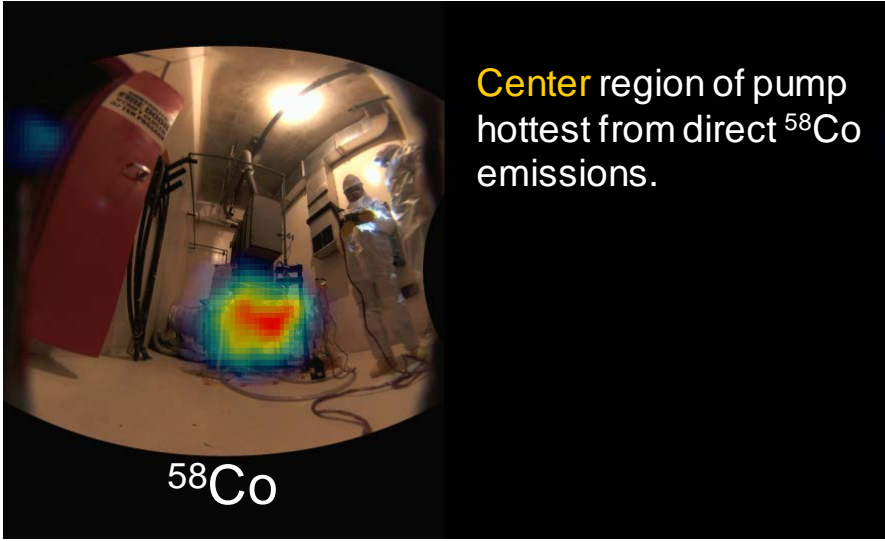
Response to nuclear power plant need for **portable instrument to image in contaminated areas.**



- 8.5 lbs
- Battery operated (6+ hr)
- Washable for easy decontamination
- “Simple” user interface
- $\leq 1.0\%$  FWHM energy resolution at 662 keV
- Omnidirectional imaging



# Isotopic Imaging Analysis

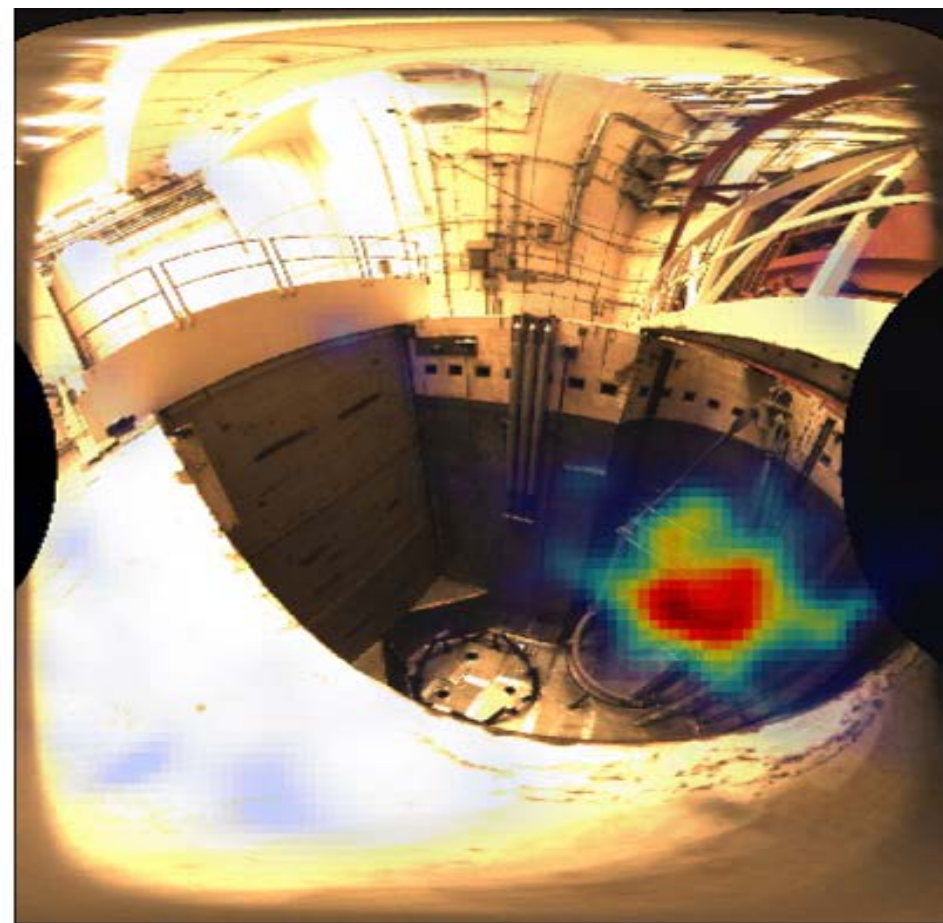
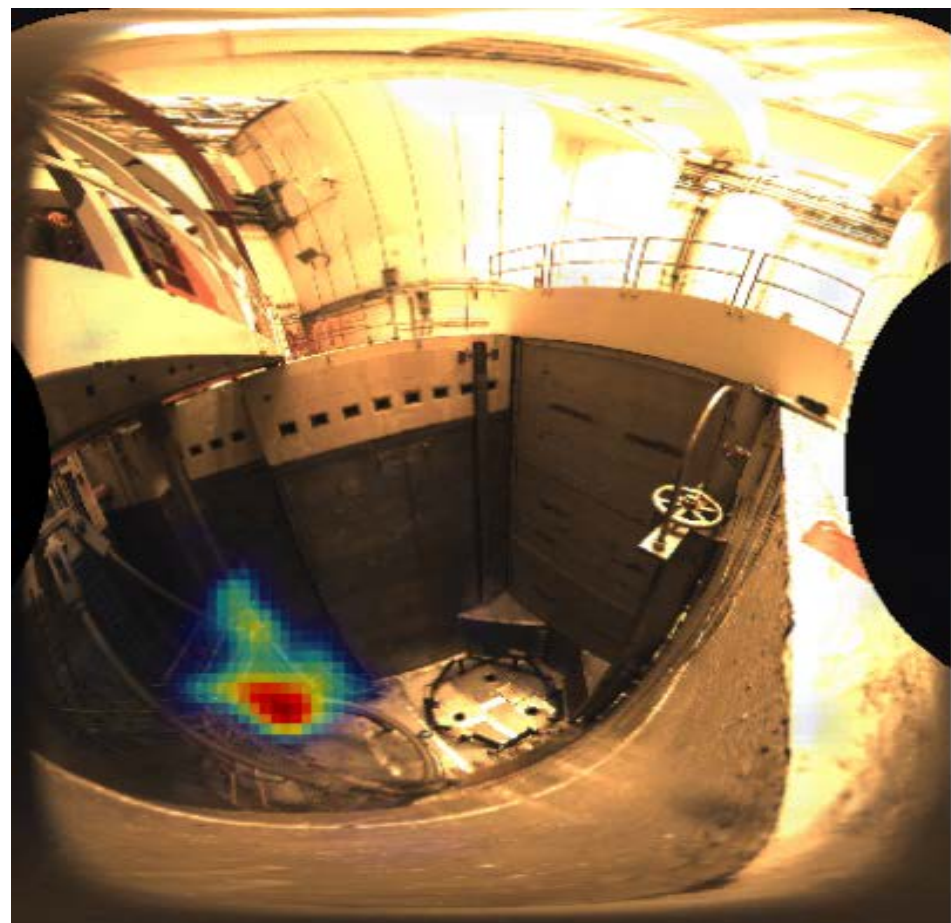






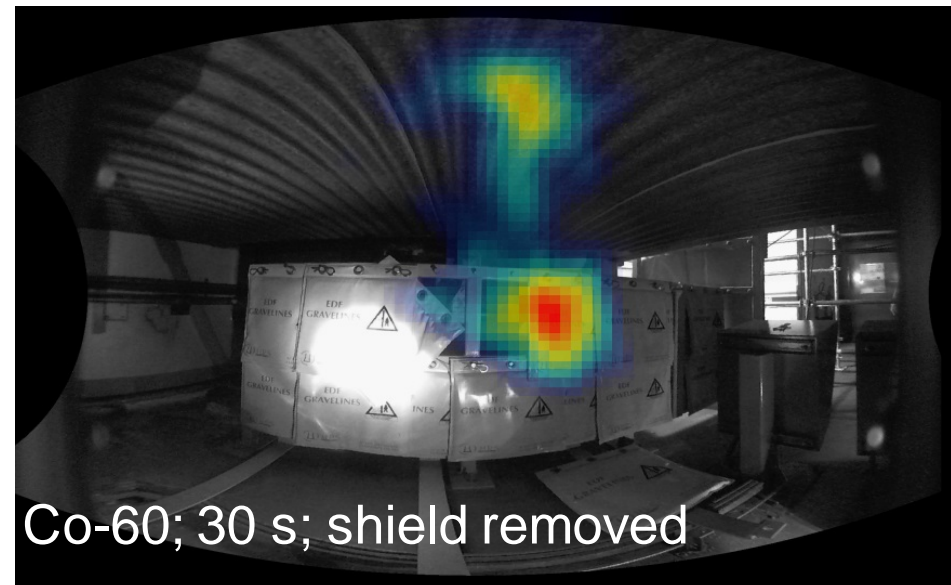
# Location of Primary Source Term, Pre-job Briefing

- Be able to show workers where the contamination is before they begin to work in the area...

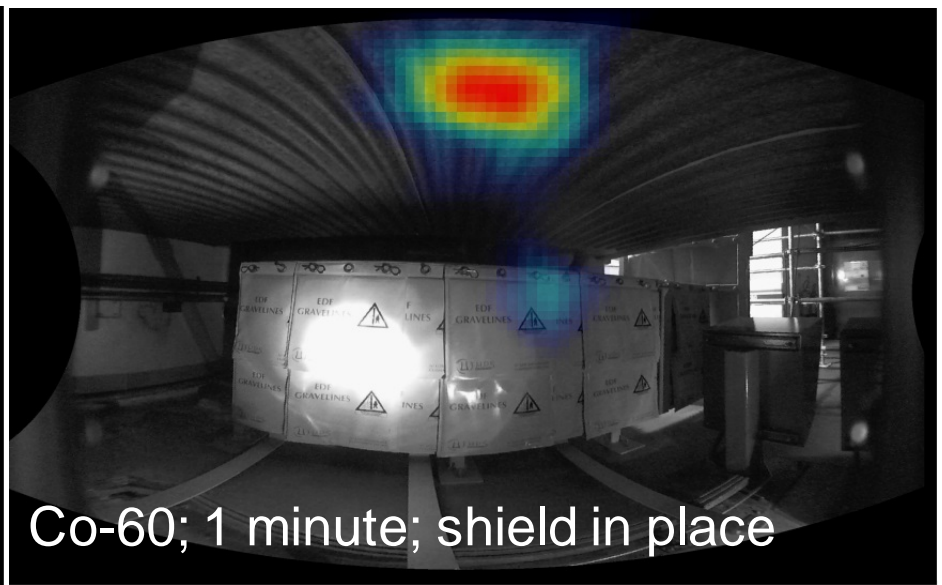




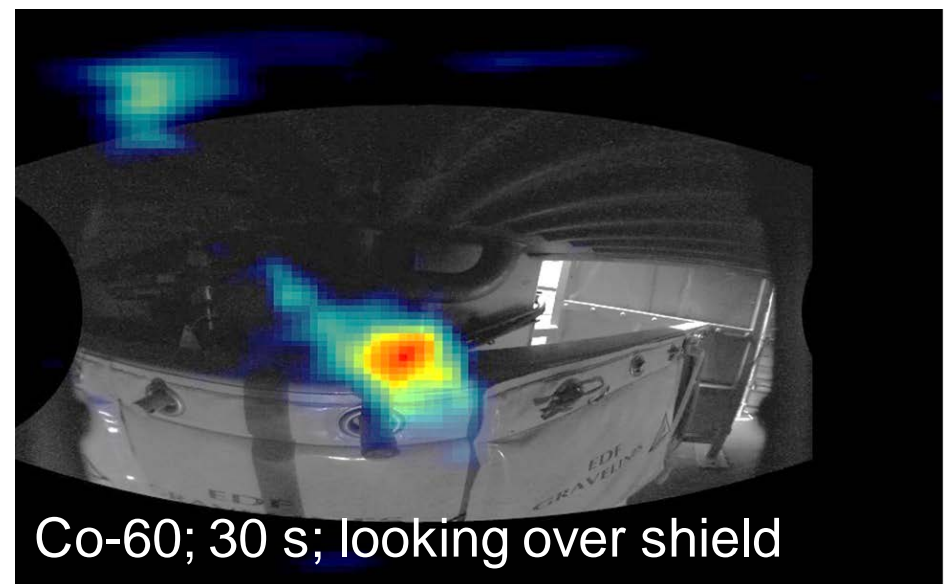
# Shielding Design and Optimization



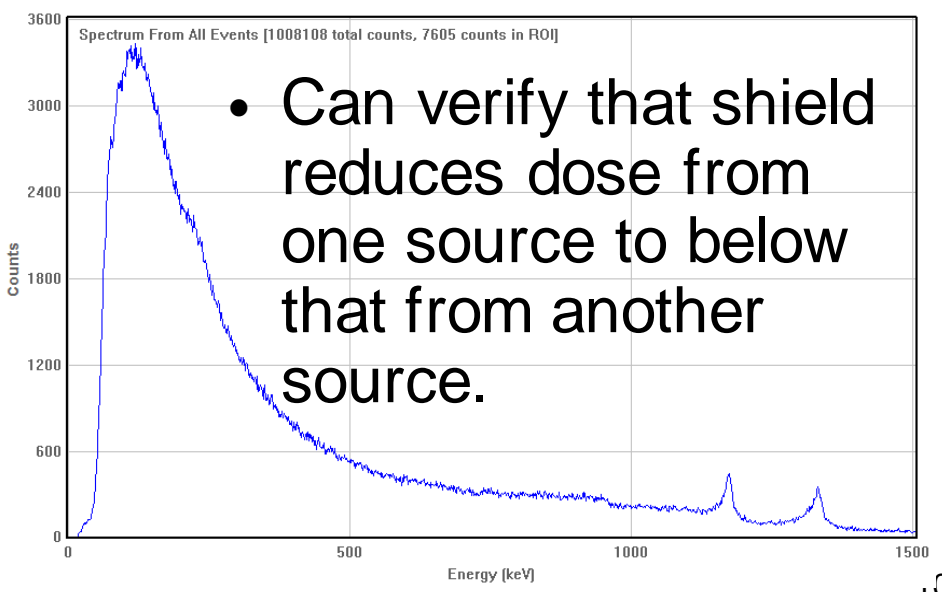
Co-60; 30 s; shield removed



Co-60; 1 minute; shield in place

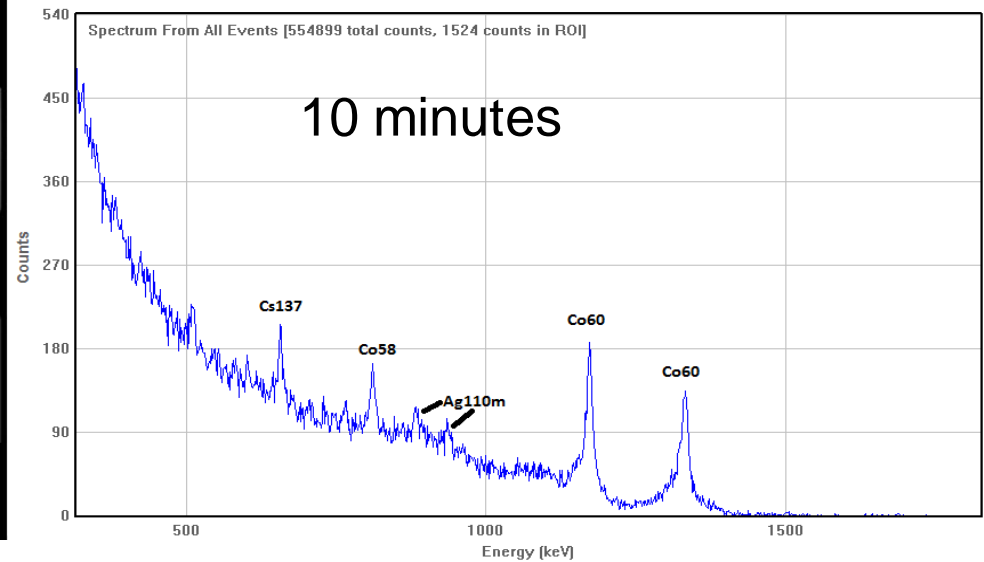
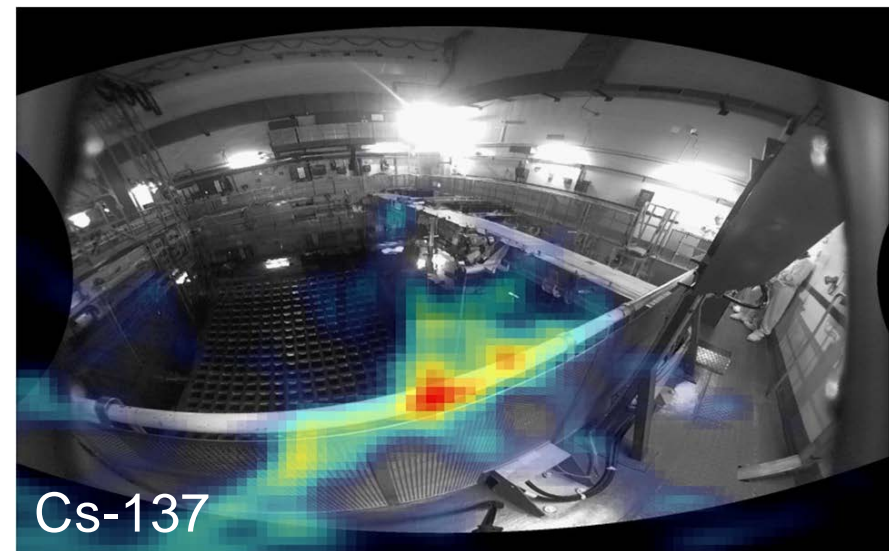
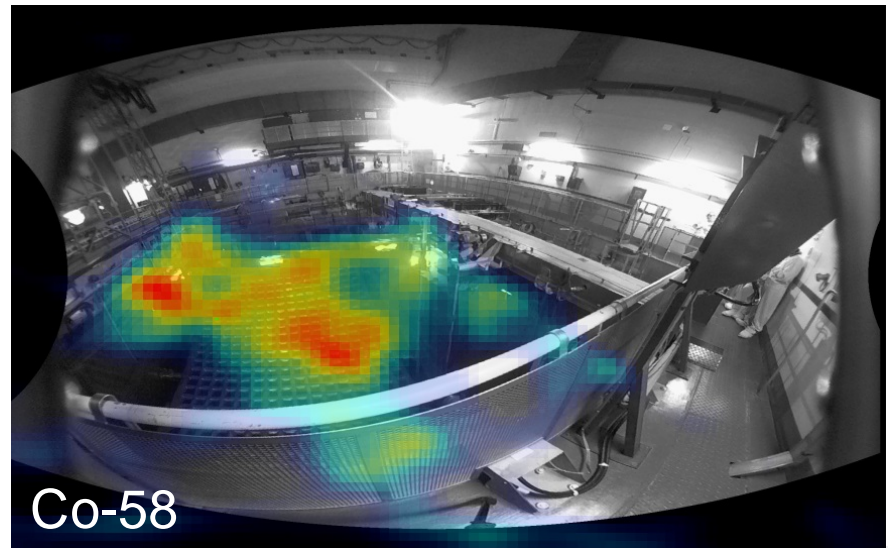
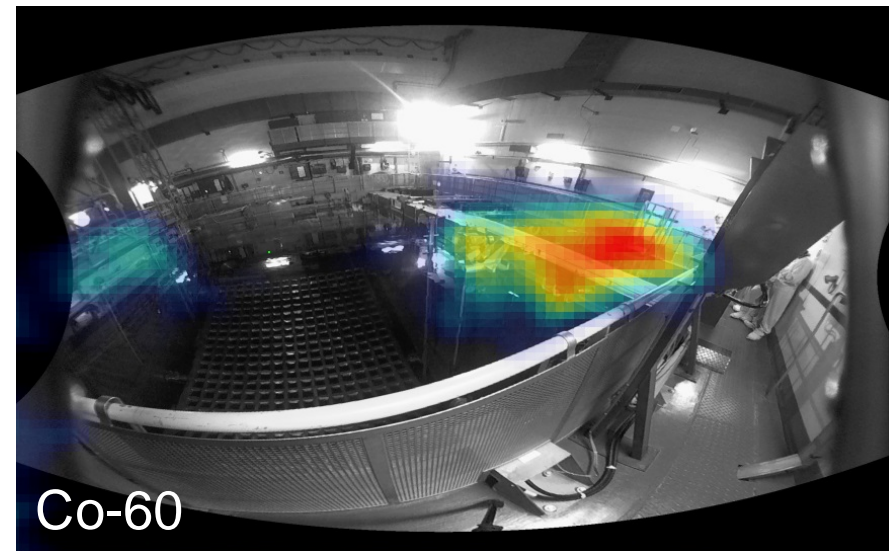


Co-60; 30 s; looking over shield

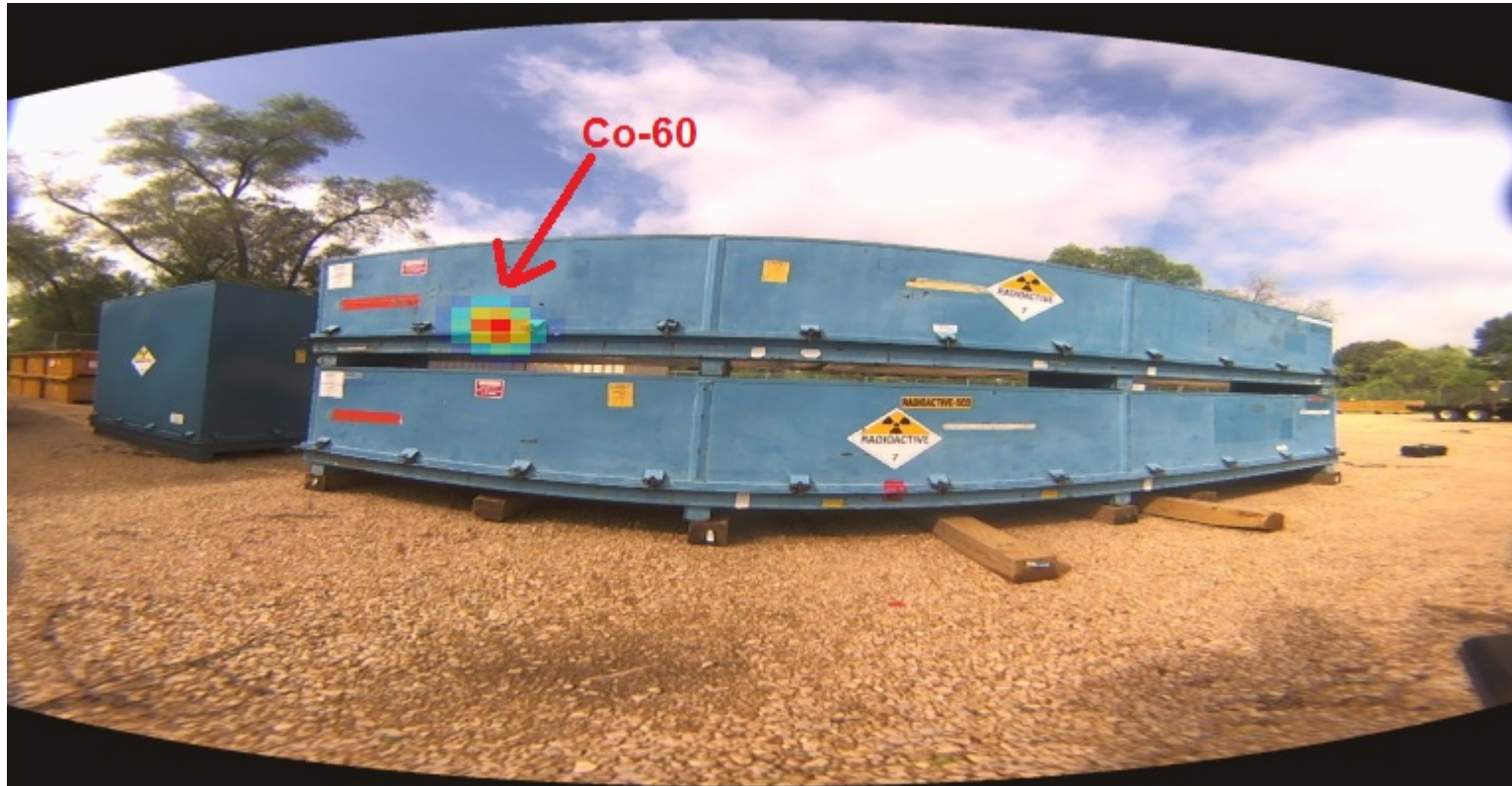




# Contamination Control – Fuel Pool

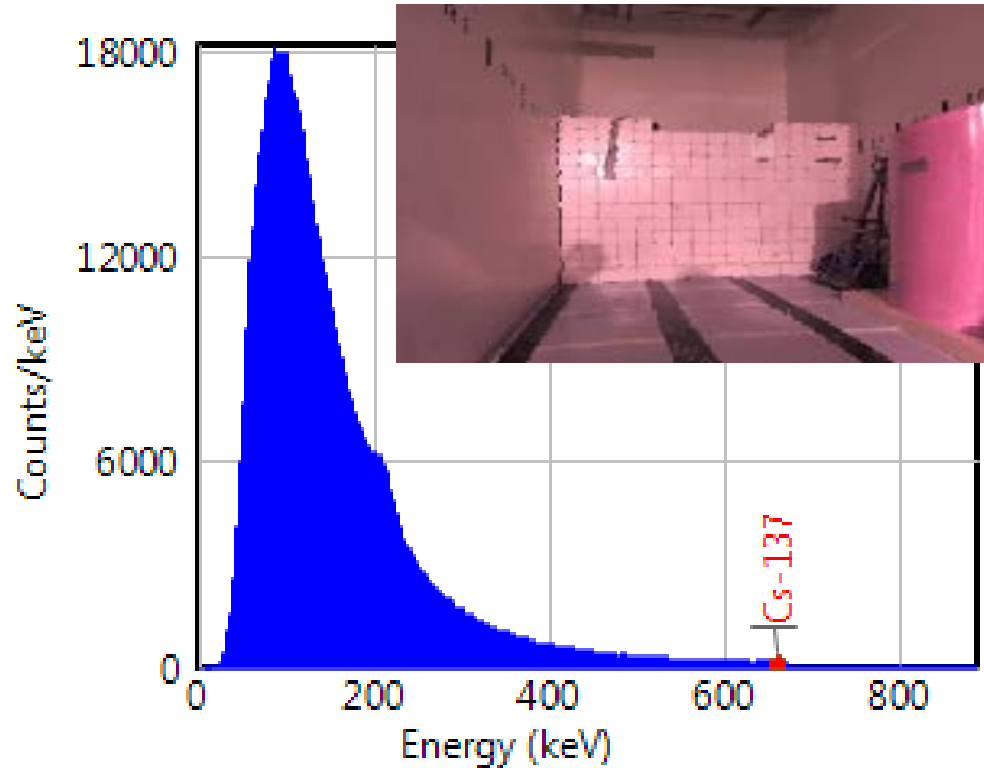
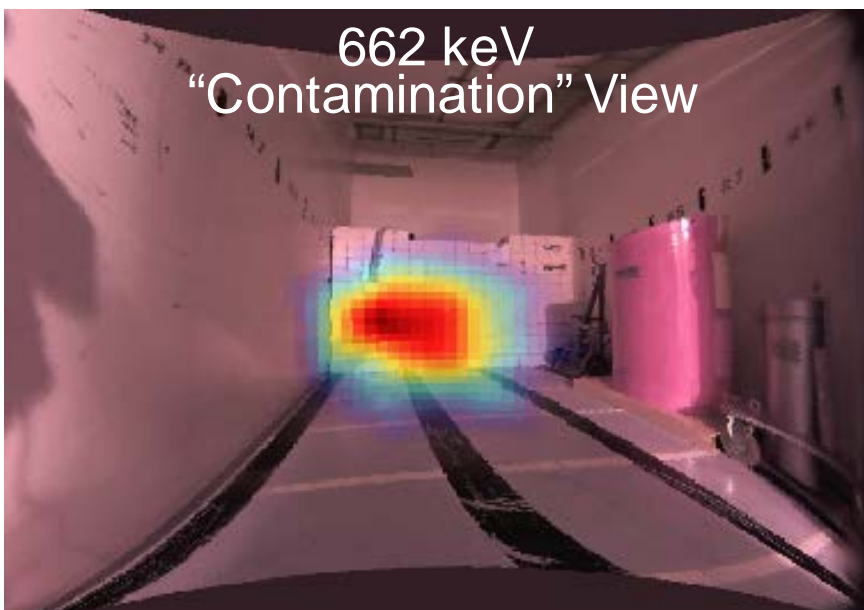
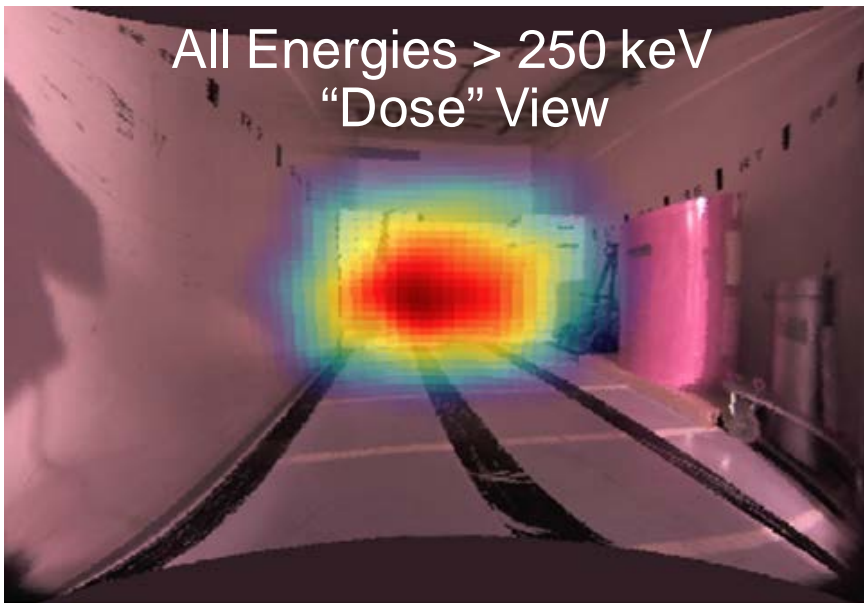


# Locating Isotopes in Shipping Containers



Co-60; 17 min.

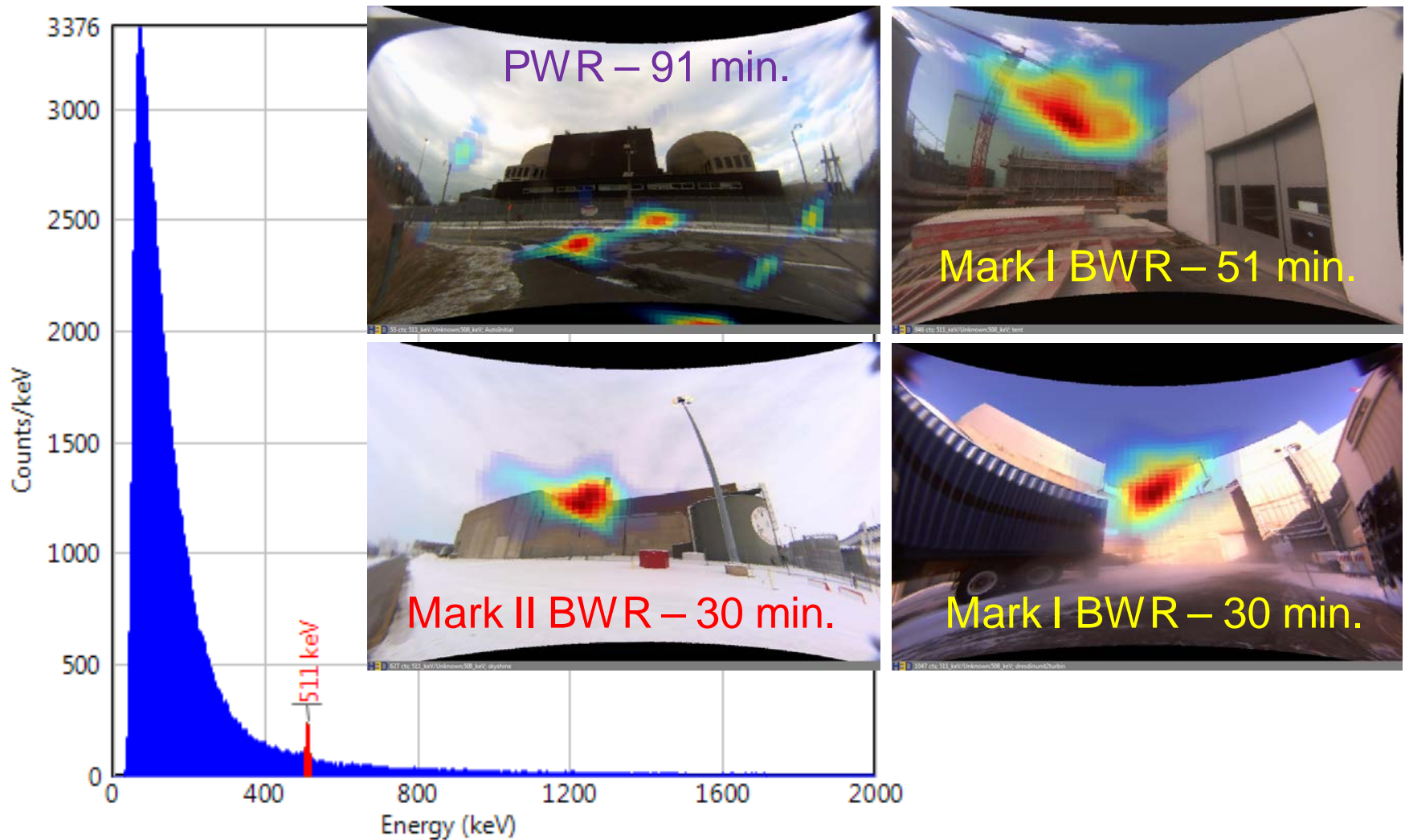
# Dose Imaging – Shielded Sources



- See buildup from shielding when image all energies, but only see source direction when only image 662-keV peak.



# Sky-Shine

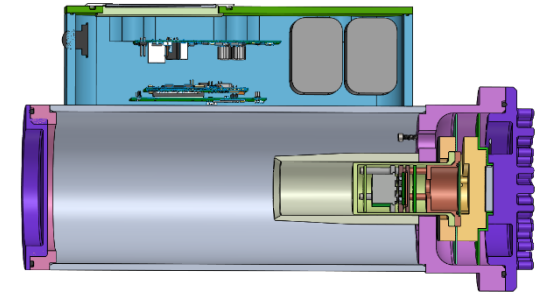


- Imaging 511-keV line from pair production, can image sky-shine outside of turbine building at BWRs.



# Polaris-P Imaging Spectrometer for Nuclear Power Plants and Safeguards

Response to need for **portable instrument to take quantitative imaging measurements.**



- Tungsten Collimator
- Battery operated (6 hr)
- Washable for easy decontamination
- “Simple” user interface
- $\leq 1.0\%$  FWHM energy resolution at 662 keV
- 60 degree FOV

# Apollo Handheld High-Resolution Imaging Spectrometer for Security Applications

Response to homeland security need for **handheld RIID with high resolution and works at room temperature.**

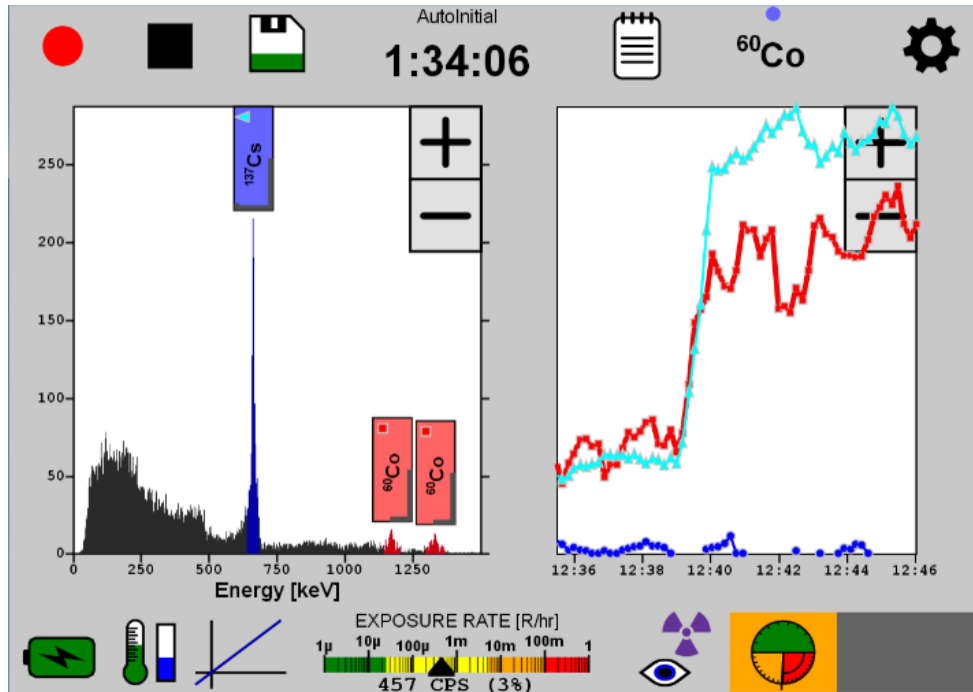


- 6.5 lbs
- Battery operated (11 hr @ room temperature)
- 16 or 24 cm<sup>3</sup> CZT
- “Simple” user interface via embedded screen or tablet
- $\leq 1.0\%$  FWHM energy resolution at 662 keV
- Omnidirectional imaging
- Post-Processing using H3D’s Visualizer software

# Polaris-S Spectrometer

## Spectrometer for Nuclear Power Plant Applications

Response to NPP need for permanent mount spectrometer for monitoring real-time isotopic trends



- $\leq 1.0\%$  FWHM energy resolution at 662 keV
- Energy Range: 50 keV – 3 MeV
- Data storage on removable USB drive
- View real-time data on tablet over network communication



# Summary

- Polaris-H developed for nuclear power plant applications.
- Provides  $<1.0\%$  FWHM energy resolution at 662 keV and isotope specific images.
- Efficiency ( $\sim 1\%$  relative) is sufficient for generally high count-rate environments of nuclear power plants.
  - Paired with energy resolution, detection of  $10\ \mu\text{Ci}$  check sources at 1 m in 1 min.
- Other H3D technology can meet other needs and applications at nuclear power plants



H3D, Inc.