



Advances in Radiation Instrumentation to Achieve Enhanced Characterization of Source Term Reduction Results

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Background on New ALARA Tool: H3D

- Developed at Un of Michigan 2002-2012

- Field tested in 2013 at Cook

- Introduced in 2014 as a new ALARA Tool for RP Analysis of Individual Isotopes in the field

- Initially used to verify adequacy of temporary shielding

NATC CZT Data Analysis Working Group

NATC was asked to develop CZT data analysis working group to share new applications of the new ALARA Tools
Monthly conference call in 2015
32 members from US, Canada, Switzerland and Slovenia

NATC Group is Highly Engaged

Member share in-plant measurements on
NATC MY BOX website

Organized by plant component

NATC working group is excited about the new
CZT ALARA Tool and eager to share new
capabilities and applications each month

Purpose of Presentation

Objective of this presentation is to show
“applied new applications” of the H3D
Based on the unique ability to detect
individual isotopes in the field

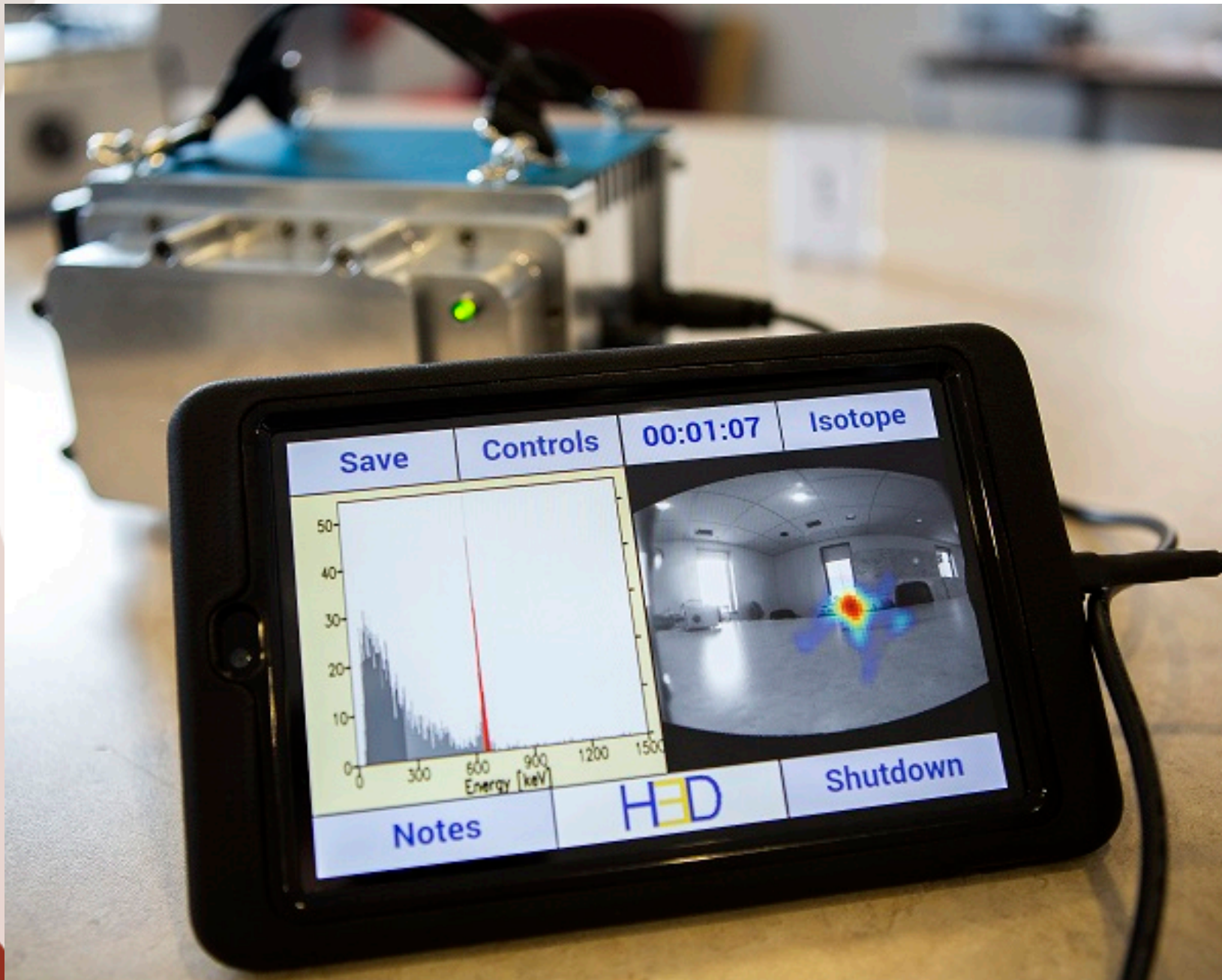
Presentation Overview

1. System Basics
2. Elevated Dose Rates in HTC
3. U1 W CTS Hx
4. Waste Gas System
5. Turbine Building Contamination Verification
6. Contaminated Scaffold Investigation
7. CRUD Trap Isotopic Analysis
8. Low Level Percon Investigation

Polaris-H

Imaging Spectrometer for Nuclear Power Plants

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

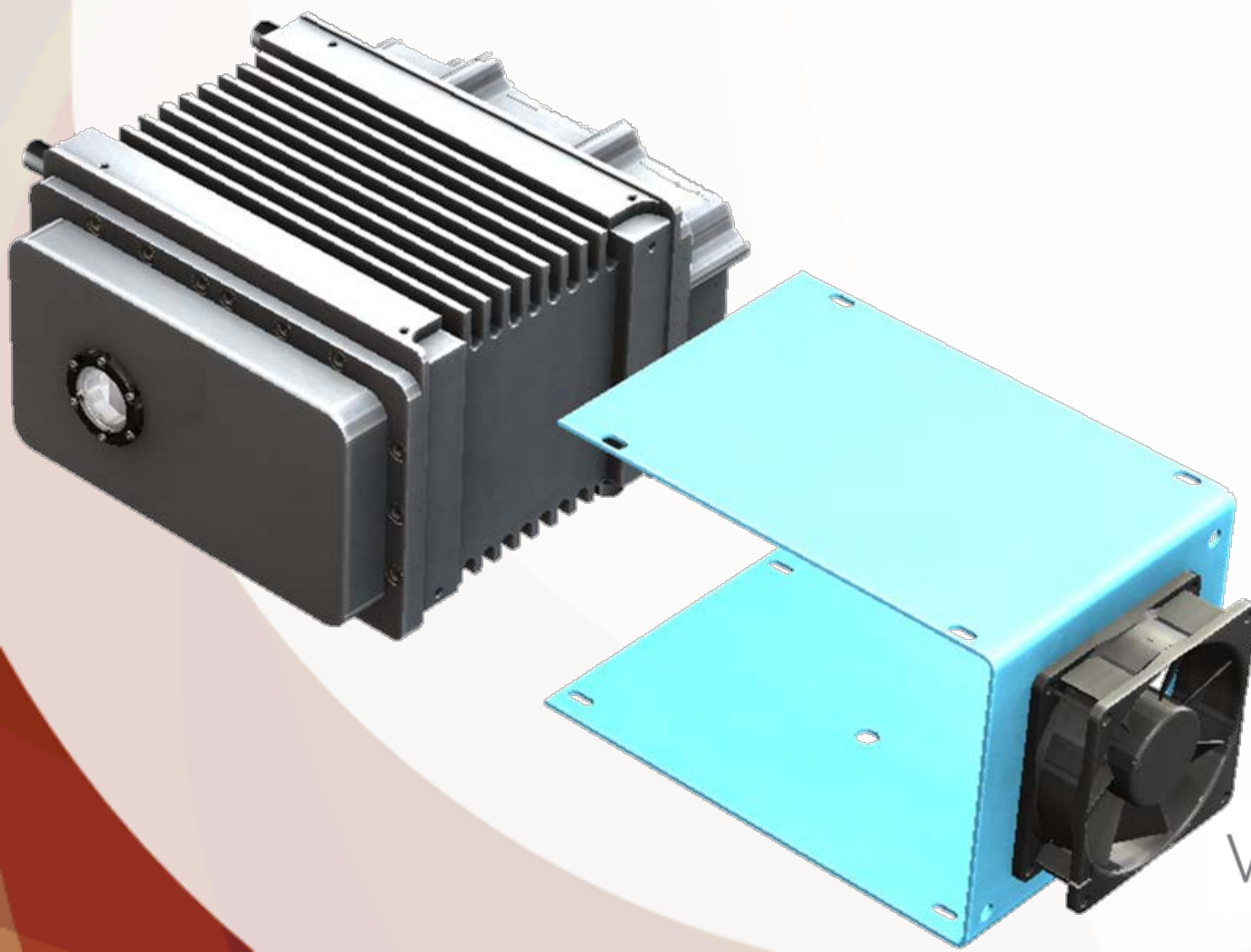
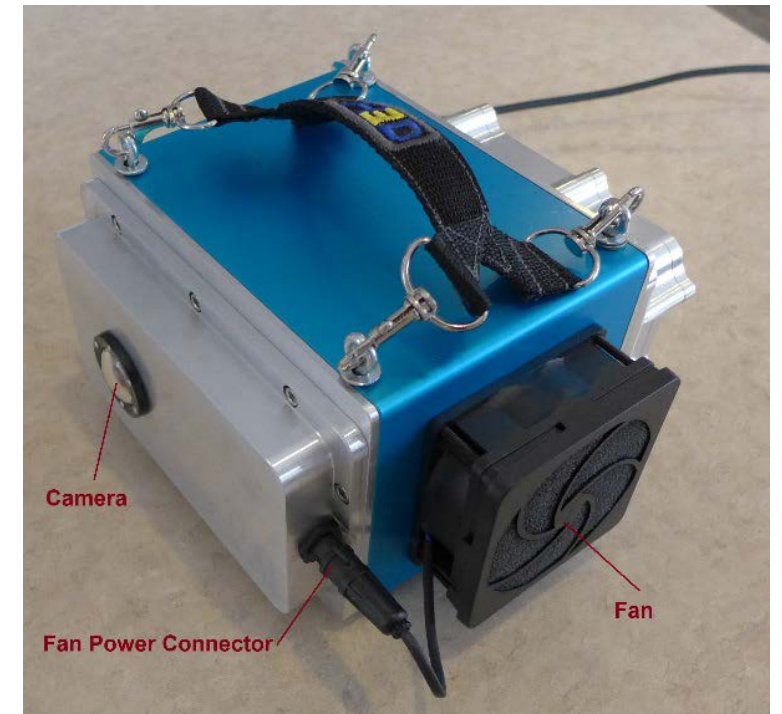


- 8.5 lbs
- Battery operated (5 hr)
- Washable for easy decontamination
- “Simple” user interface
- $\leq 1.1\%$ FWHM energy resolution at 662 keV
- Omnidirectional imaging

Polaris-H

Imaging Spectrometer for Nuclear Power Plants

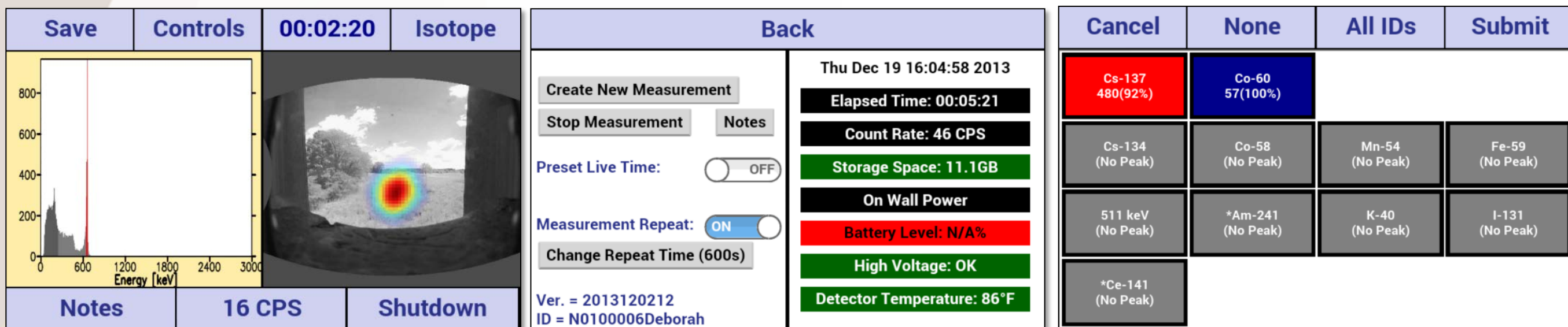
- $\sim 2\pi$ optical camera for overlay of radiation image
- Compton imaging ~ 250 keV to 3 MeV
- Communication with tablet display via Wi-Fi, Bluetooth, USB, or Ethernet to network
- Fan and external fins for temperature regulation



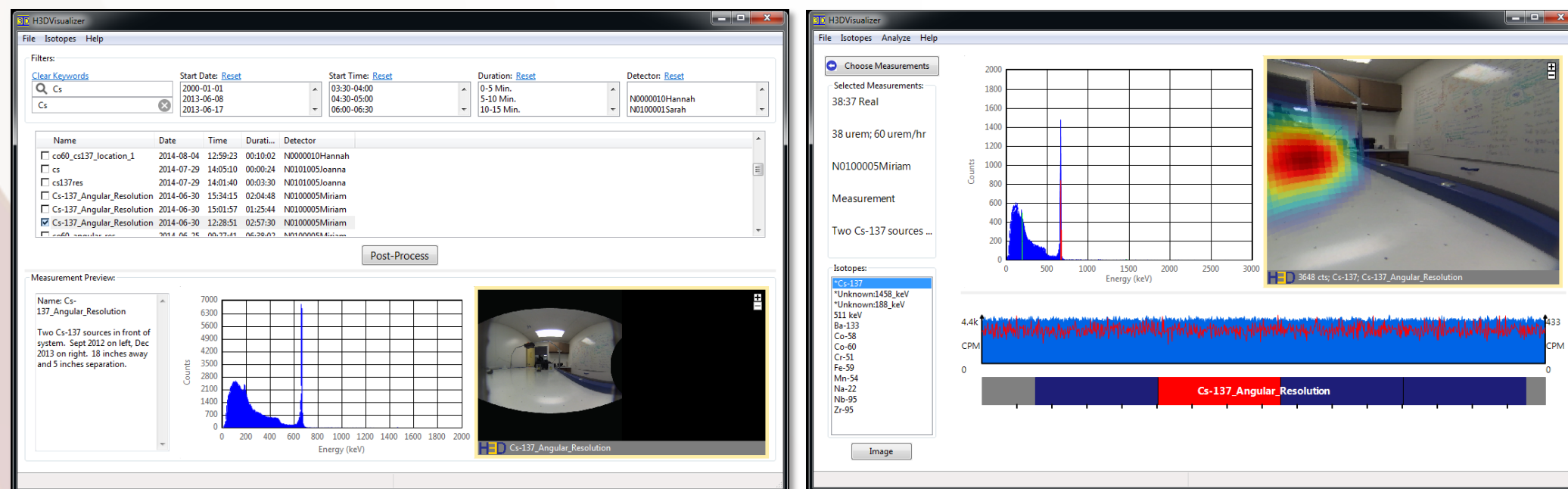
Polaris-H

Imaging Spectrometer for Nuclear Power Plants

- Real-time software on embedded CPU for isotope detection/ID, isotope-specific imaging, data logging, control and regulation.



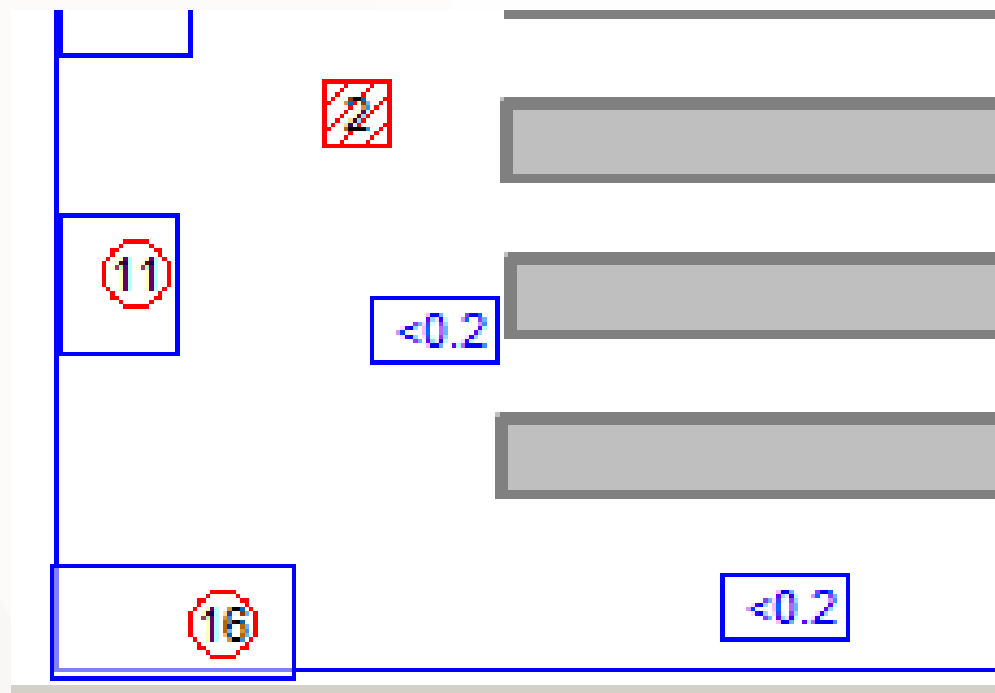
- Post-processing software for time analysis, high-resolution imaging, detailed studies.



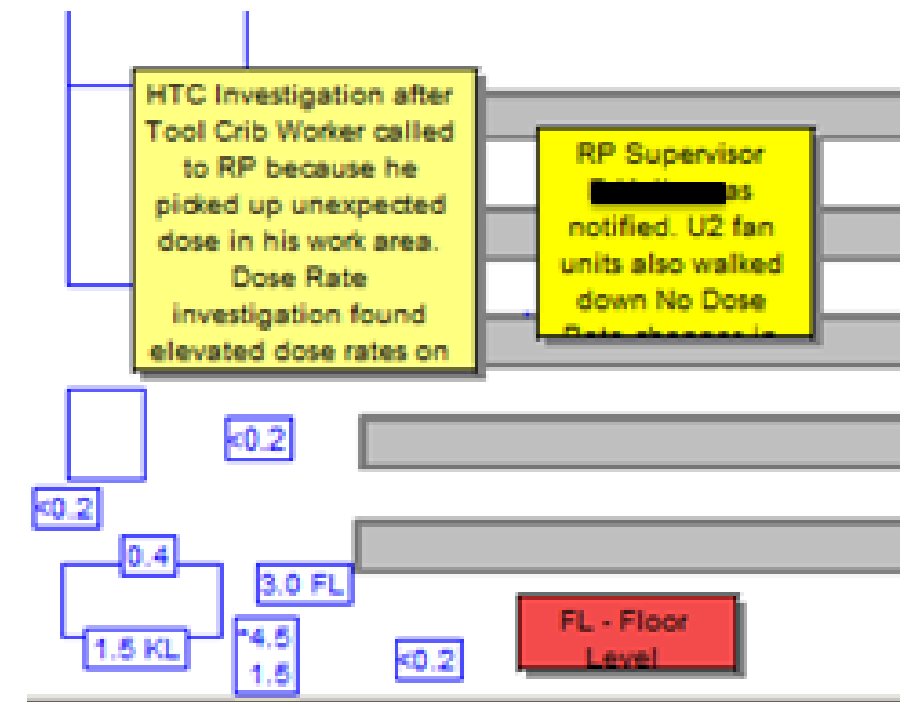
Elevated Dose Rates in Hot Tool Crib

- On 9/10/14, a tool crib worker received an unexpected dose accumulation of 0.1 mRem while in the Hot Tool Crib (HTC).
- Dose was streaming through the floor plugs from a drained demin vessel.

Elevated Dose Rates in Hot Tool Crib

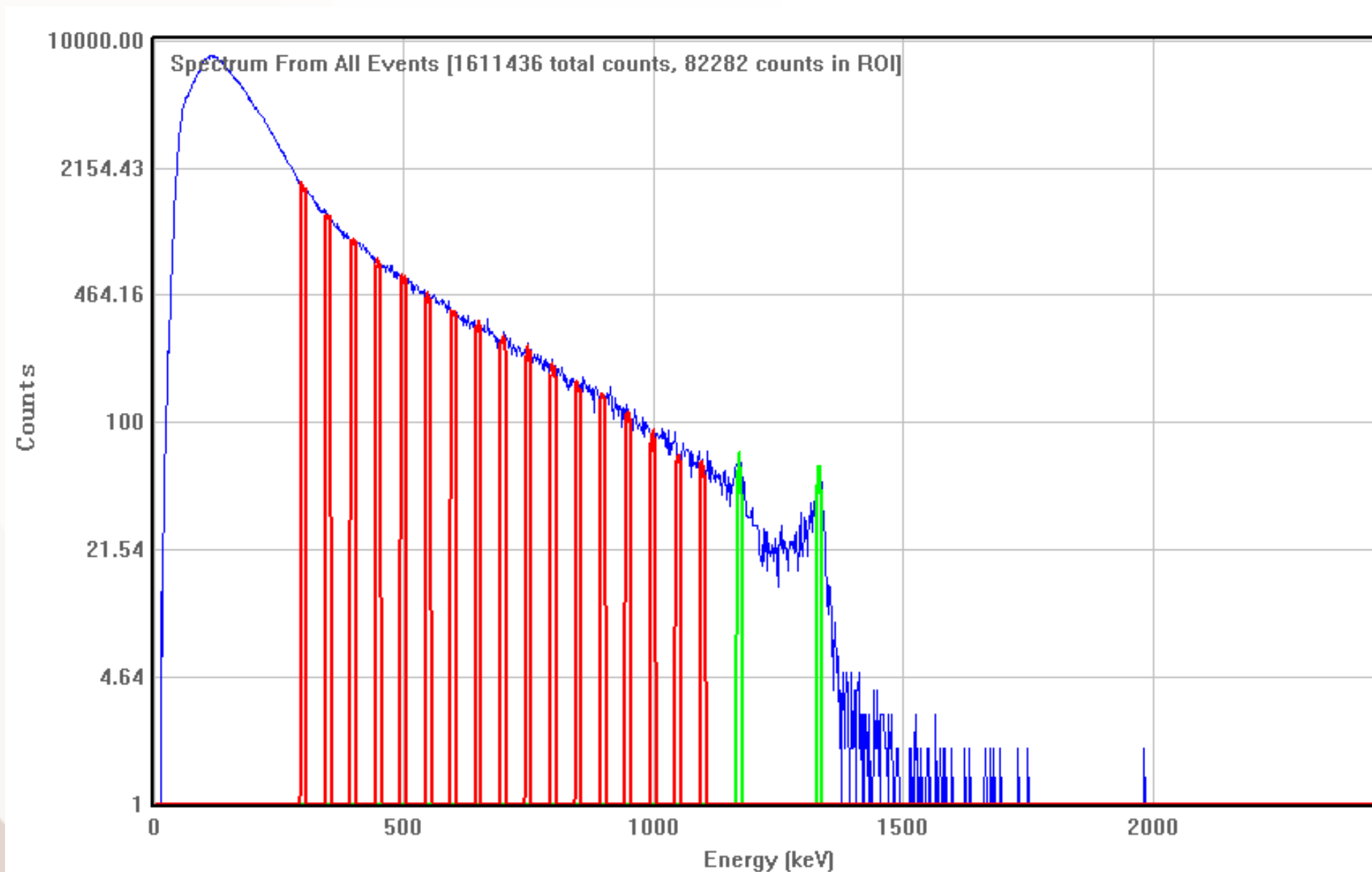


Typical Dose Rates



Elevated Dose Rates (9/10/14)

Elevated Dose Rates in Hot Tool Crib



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Elevated Dose Rates in Hot Tool Crib

Image of Co-60:

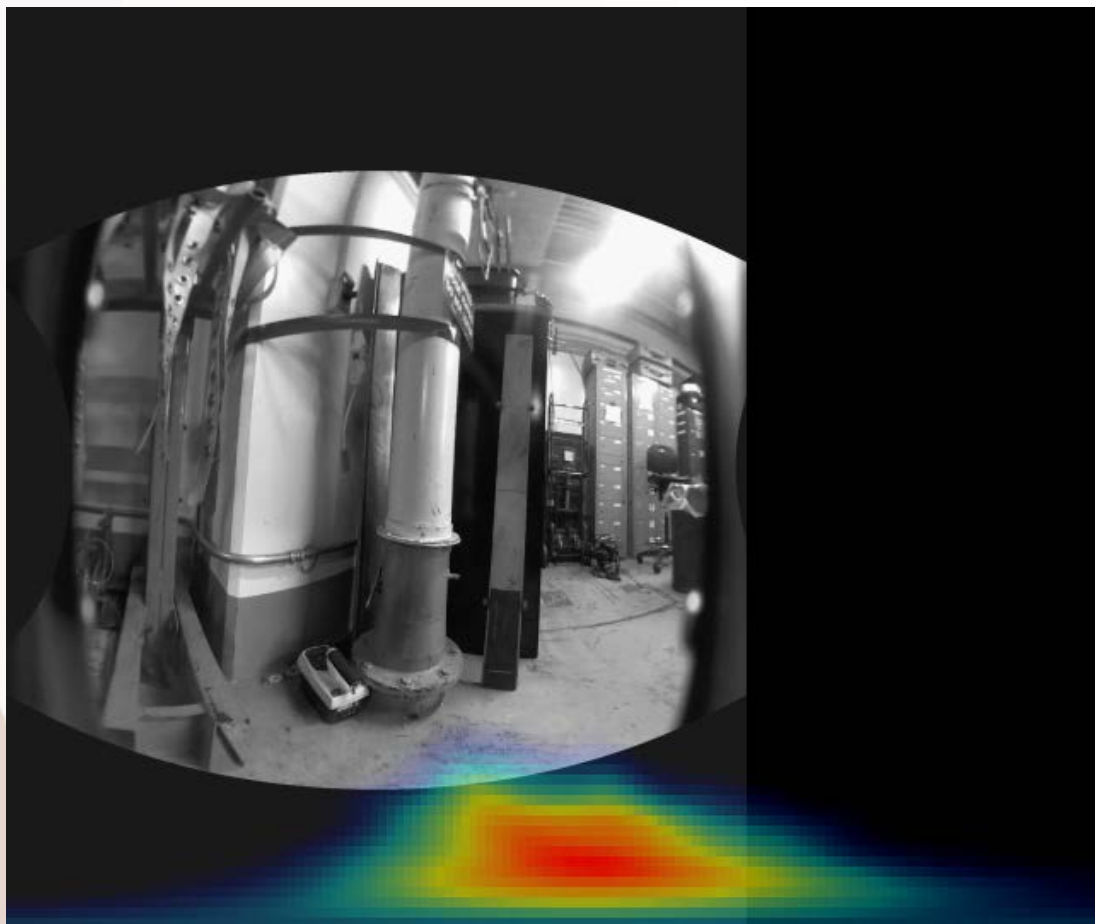
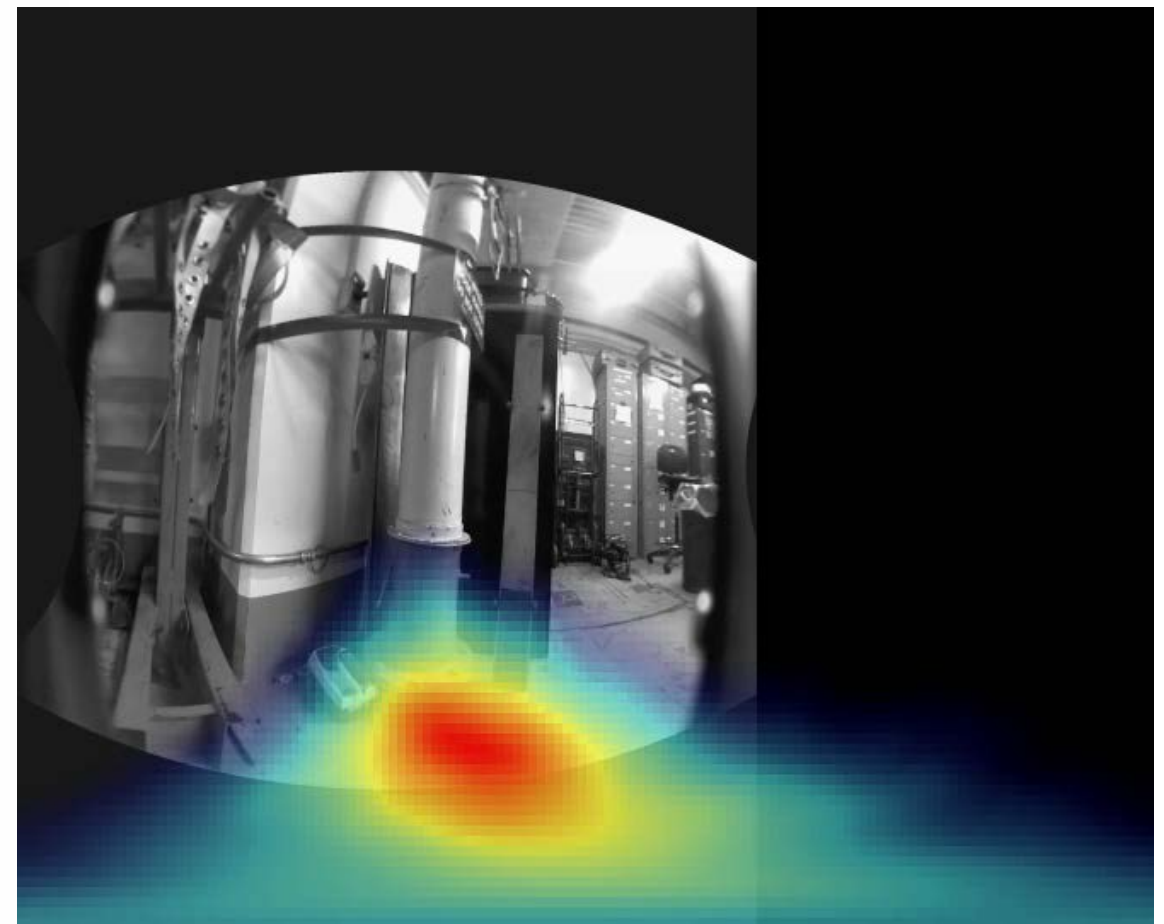


Image of Scatter:



Elevated Dose Rates in Hot Tool Crib

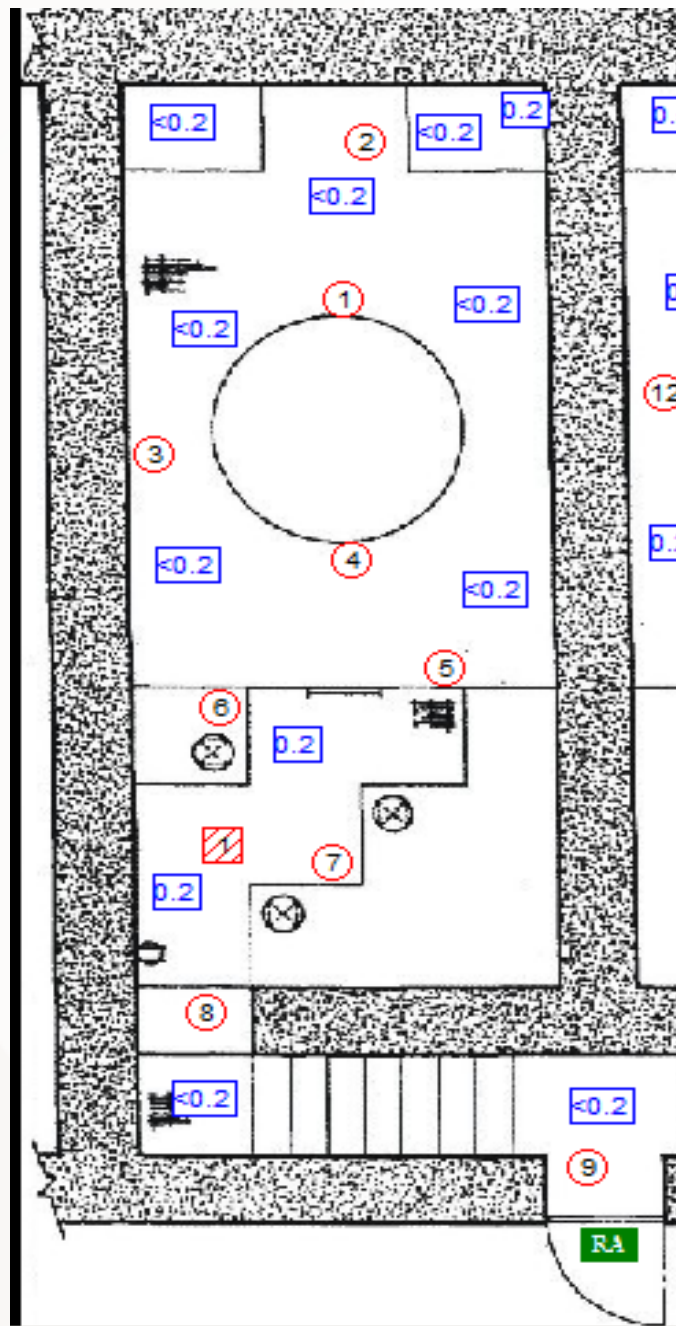
Results of the Imaging:

- HTC Workers Instructed to avoid whole area near floor cover
- Increased Importance to Refill Demin prior to refueling outage
- Filled Demin decreased Dose Rates

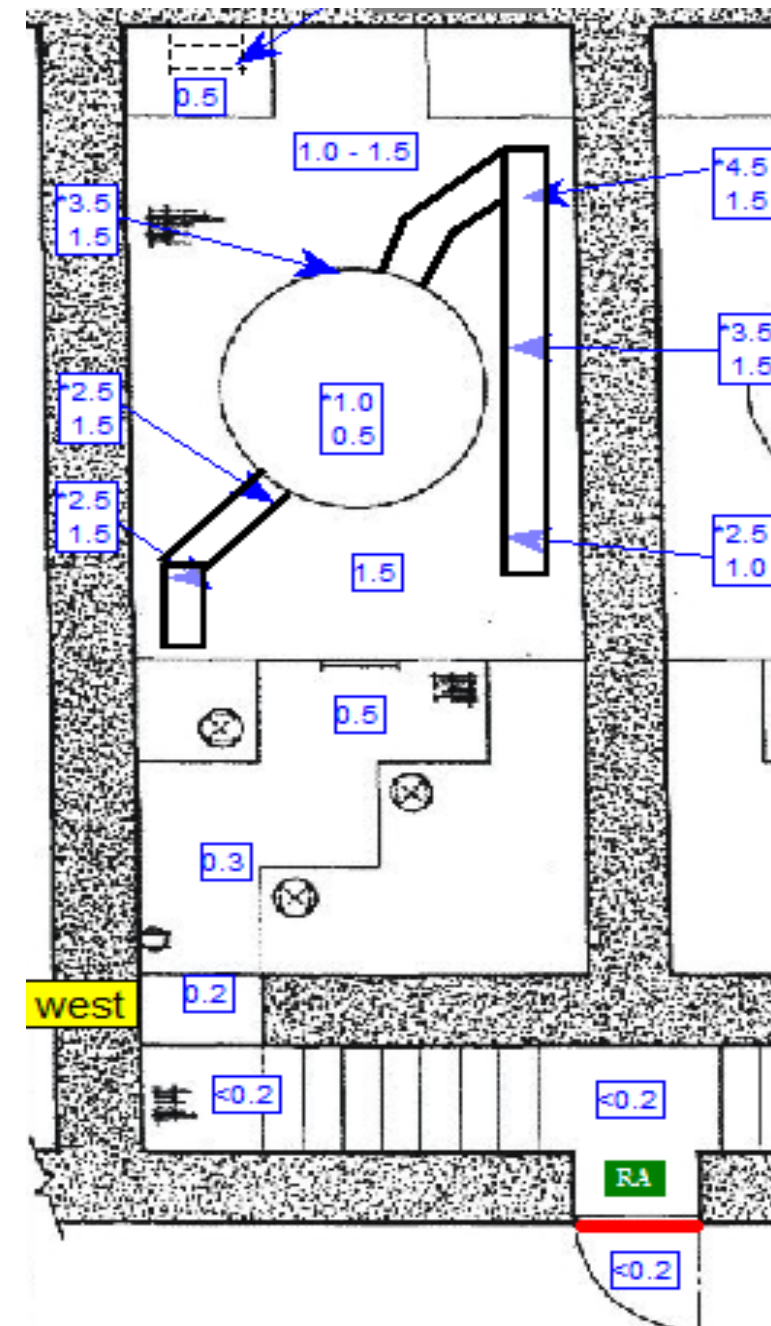
Elevated Dose Rates in CTS Hx Room

- On 11/6/2014 elevated dose rates were found in the U1 W Containment Spray (CTS) Hx Room
- Room already Radiation Area due to E CTS Hx

Elevated Dose Rates in CTS Hx Room

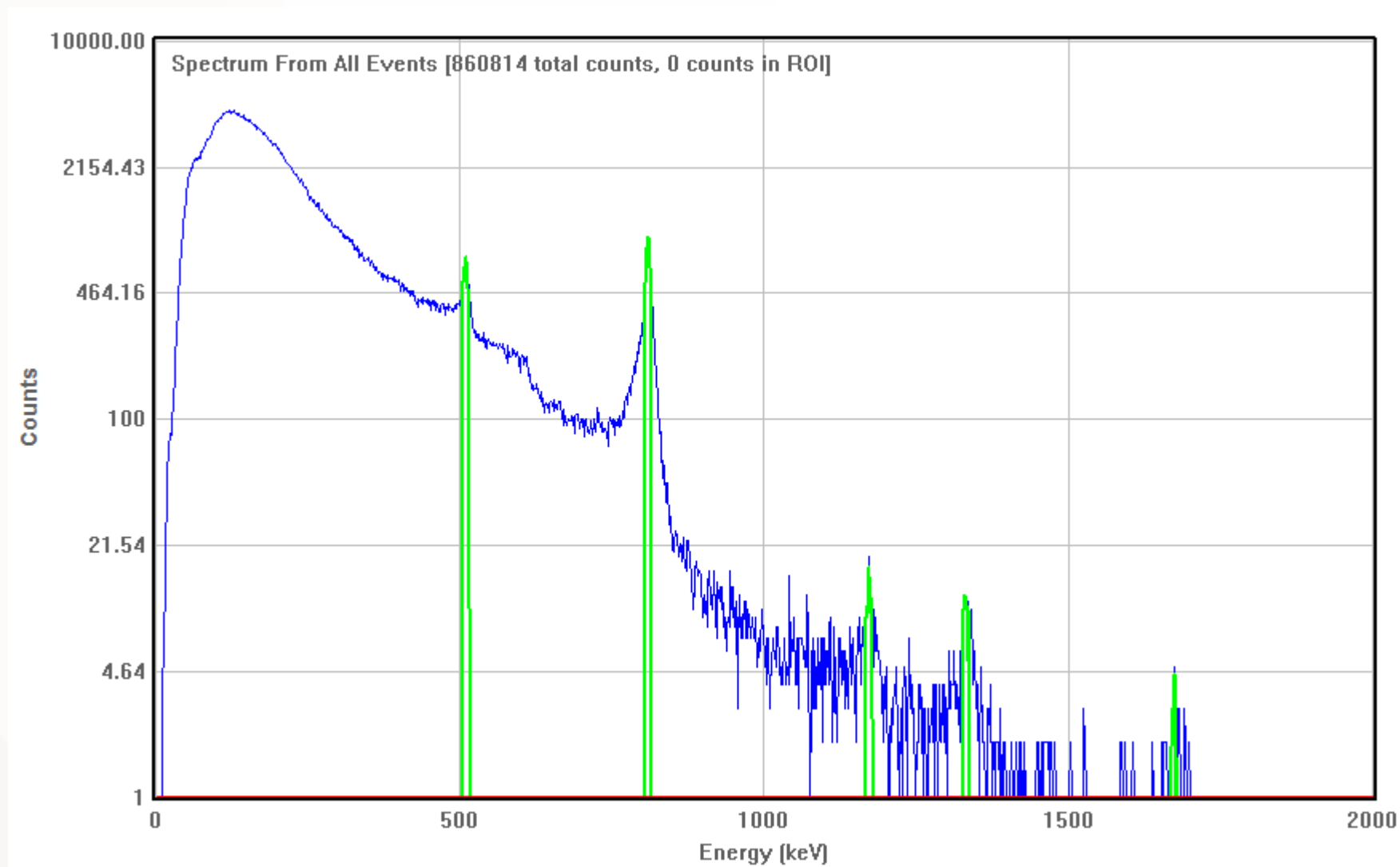


11/3 – Routine Survey

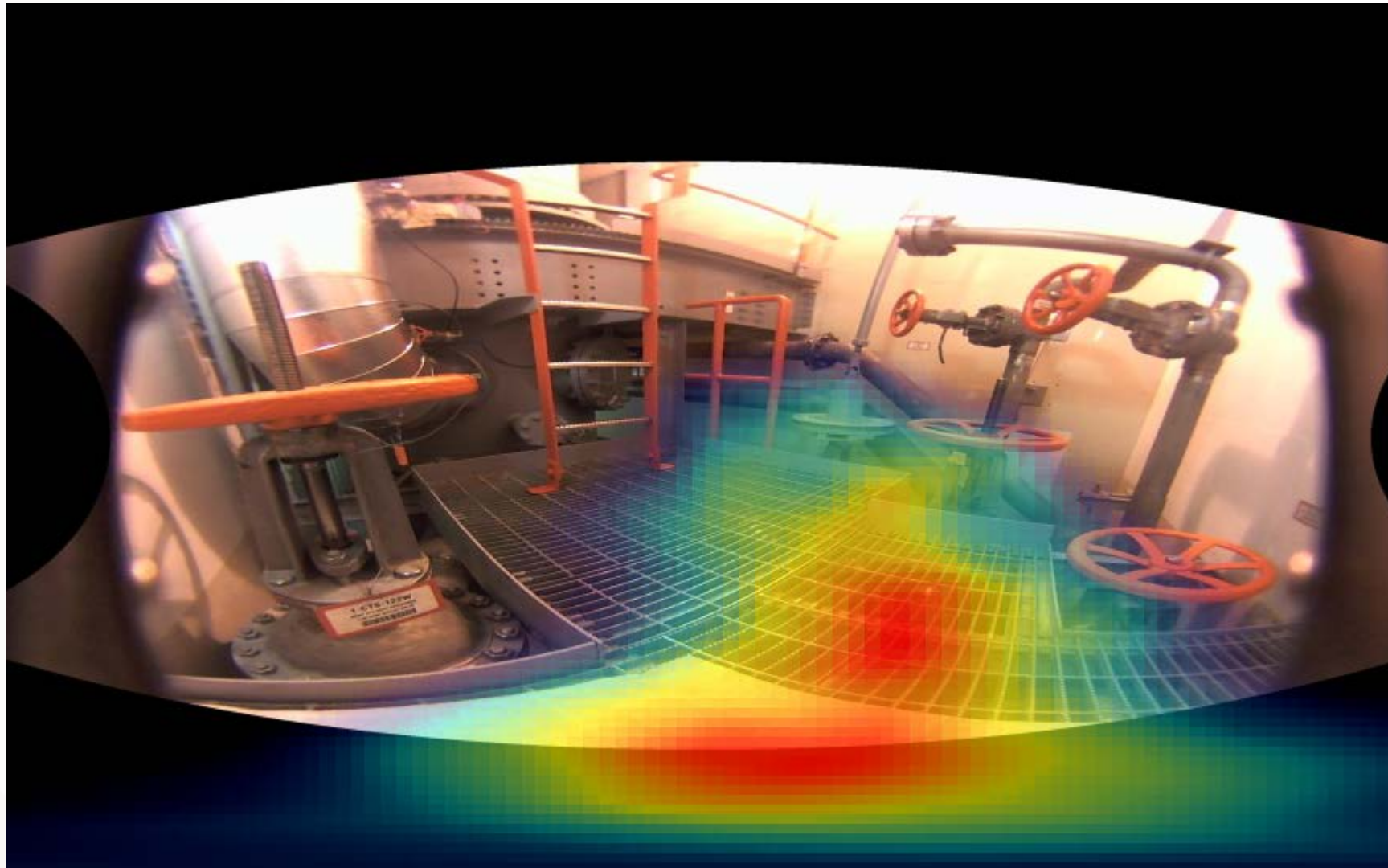


11/6 – Post Leak Testing

Elevated Dose Rates in CTS Hx Room

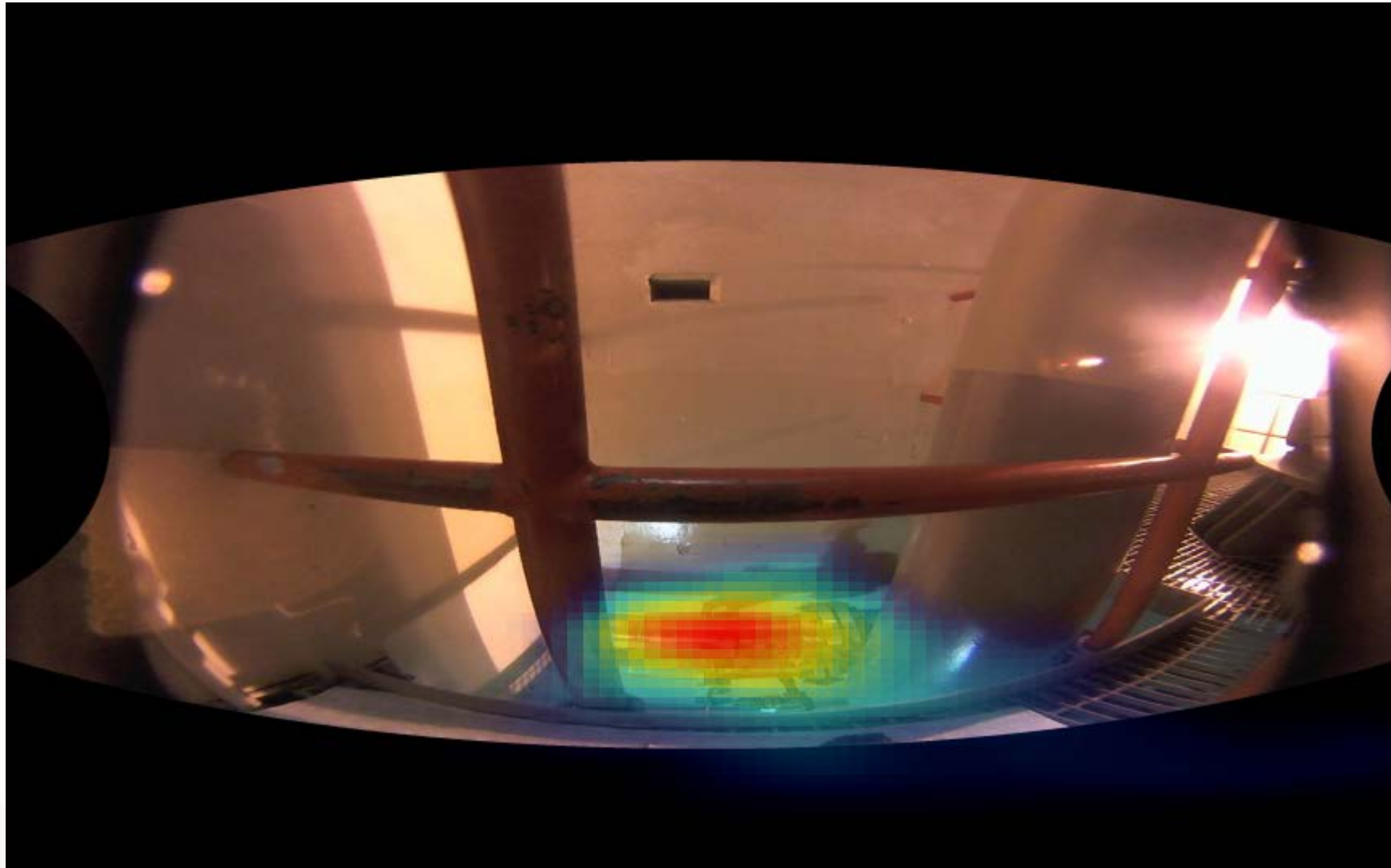


Elevated Dose Rates in CTS Hx Room



Co-58 – Highest contact DR: 2.1 mR/hr
– Highest GA DR: 0.5 mR/hr

Elevated Dose Rates in CTS Hx Room



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Elevated Dose Rates in CTS Hx Room

- Co-58 was primary contributor to increased dose rates.
- Dose Rates coming from line used for leak test
- Recommendation was made to decay system instead of flush system.

Elevated Dose Rates in Waste Gas System

- Unposted Radiation Area found on 609' in S. Waste Gas Compressor Room during routine surveys
- The small heat exchanger found reading 30 mR/hr on contact and 8 mR/hr at 30 cm.

Elevated Dose Rates in Waste Gas System

- No air sample needed to get isotopic on waste gas
- Gamma Spectrum provided on next slide nearly matched composite sample of resin taken for resin characterization.

Elevated Dose Rates in Waste Gas System

Comments:

0.2604 grams of resin from the SRST sluice performed on 12-10-2014.

Efficiency File: 8_ResinVial_1.Clb

Efficiency Desc: RP Detector #8 Resin Vial on Jig

Library: General.lib

Nuclide	Activity uCi/gm	Error %
Be-7	1.298E+00	2.35
Mn-54	1.275E+00	0.57
Co-57	7.185E-02	2.68
Co-58	1.689E+00	0.47
Co-60	5.123E+00	0.19
Zn-65	5.587E-02	16.54
Zr-95	7.471E-02	6.00
Nb-95	1.282E-01	2.53
Ag-110m	4.037E-02	11.78
Sn-113	3.673E-02	11.44
Sb-124	7.499E-03	16.32
Cs-134	3.872E+00	0.25
Cs-137	3.360E+00	0.29
Sb-125	6.310E-01	2.13

Total

1.766E+01

PAGEBREAK

1.766E+01

DC Cook Nuclear Power Plant

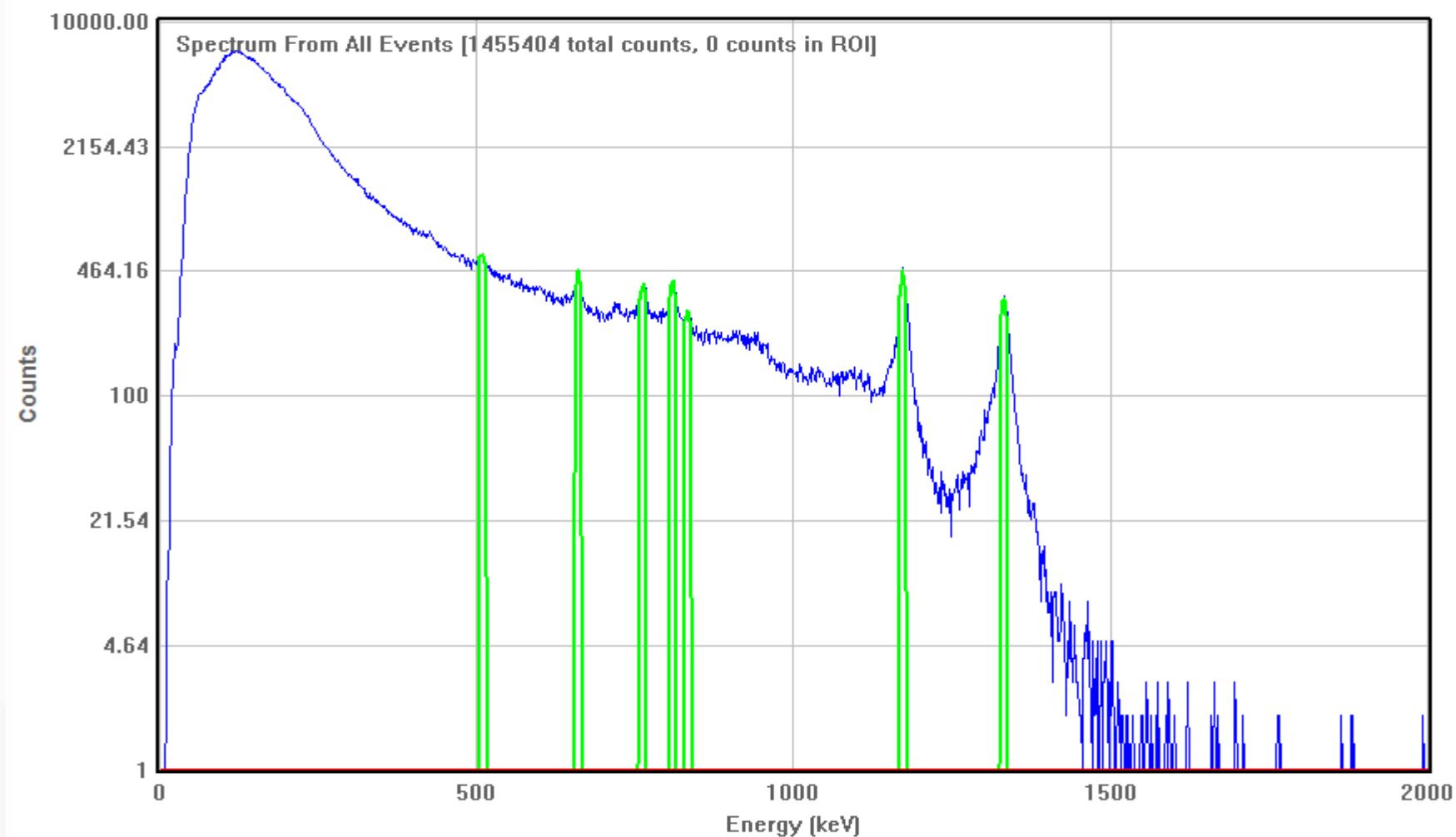
CHEM/RP/ENV Department

Description: Unit#12 SRST resin sample sluiced on 12-10-14

RWP: 2014-1012

*H3 = 1.05 uCi/cc or
1.311 uCi/g*

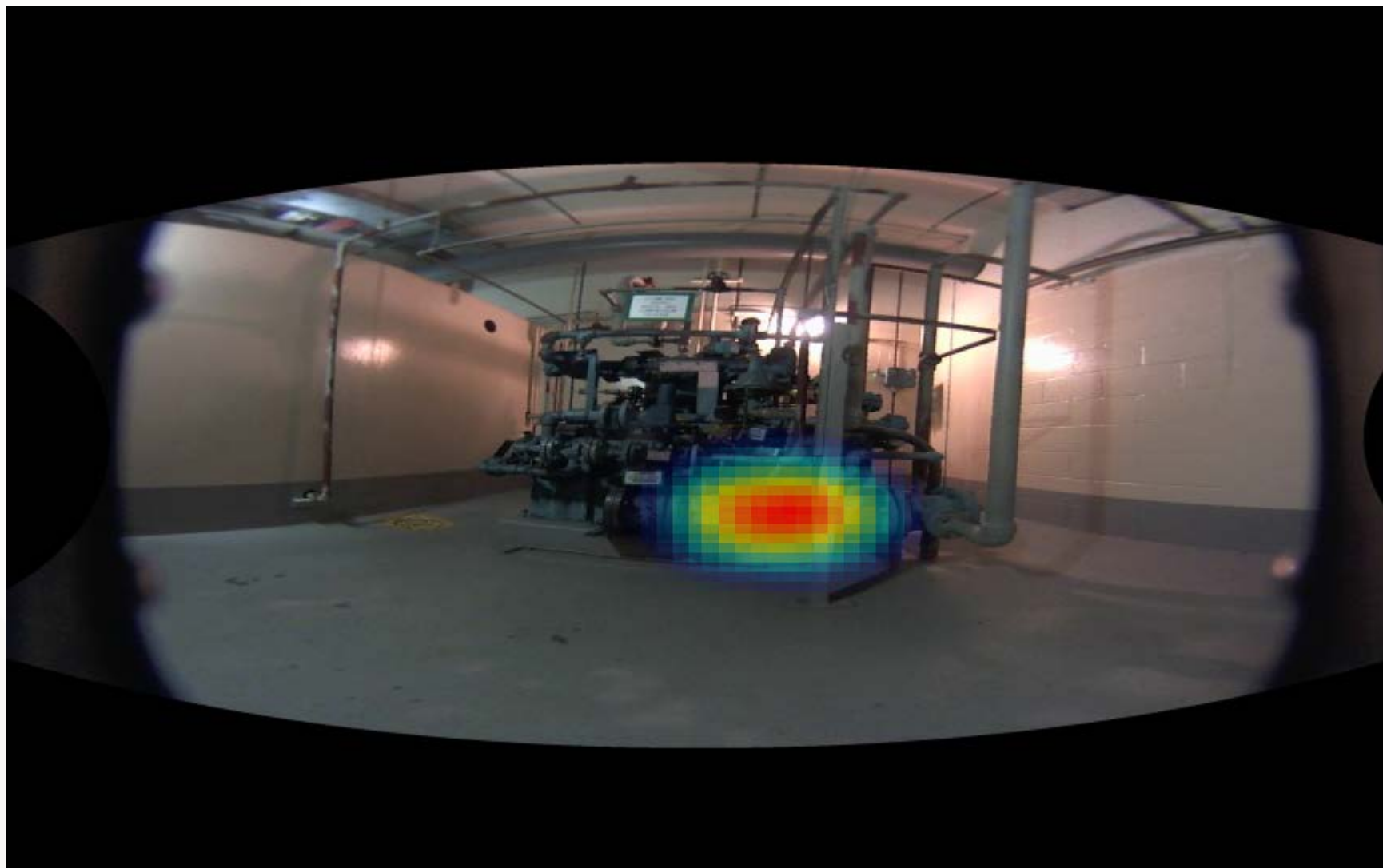
Elevated Dose Rates in Waste Gas System – S. Waste Gas Compressor



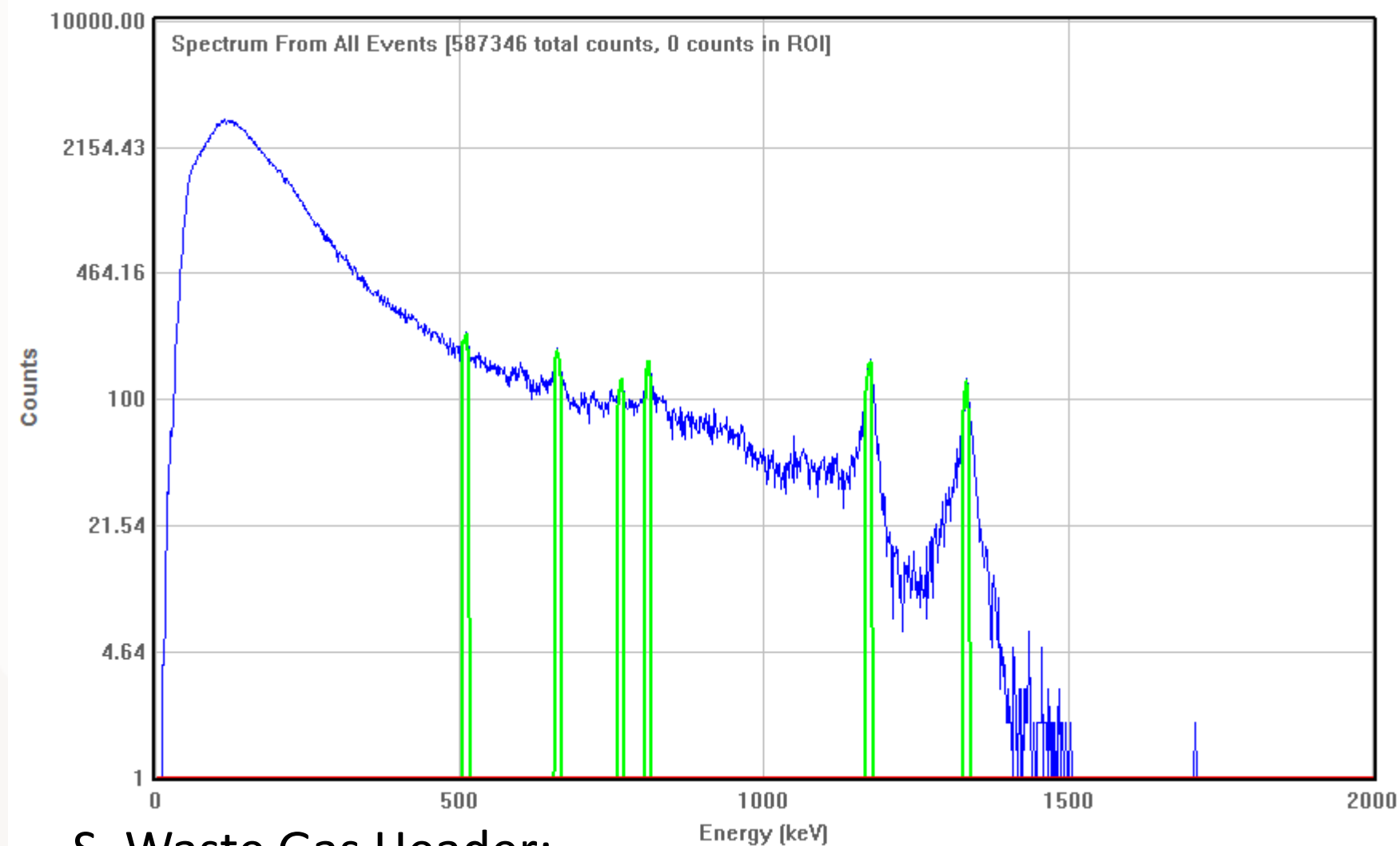
S. Waste Gas Compressor:
Co-58, Co-60, Cs-137, Mn-54, Nb-95

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Elevated Dose Rates in Waste Gas System – S. Waste Gas Compressor

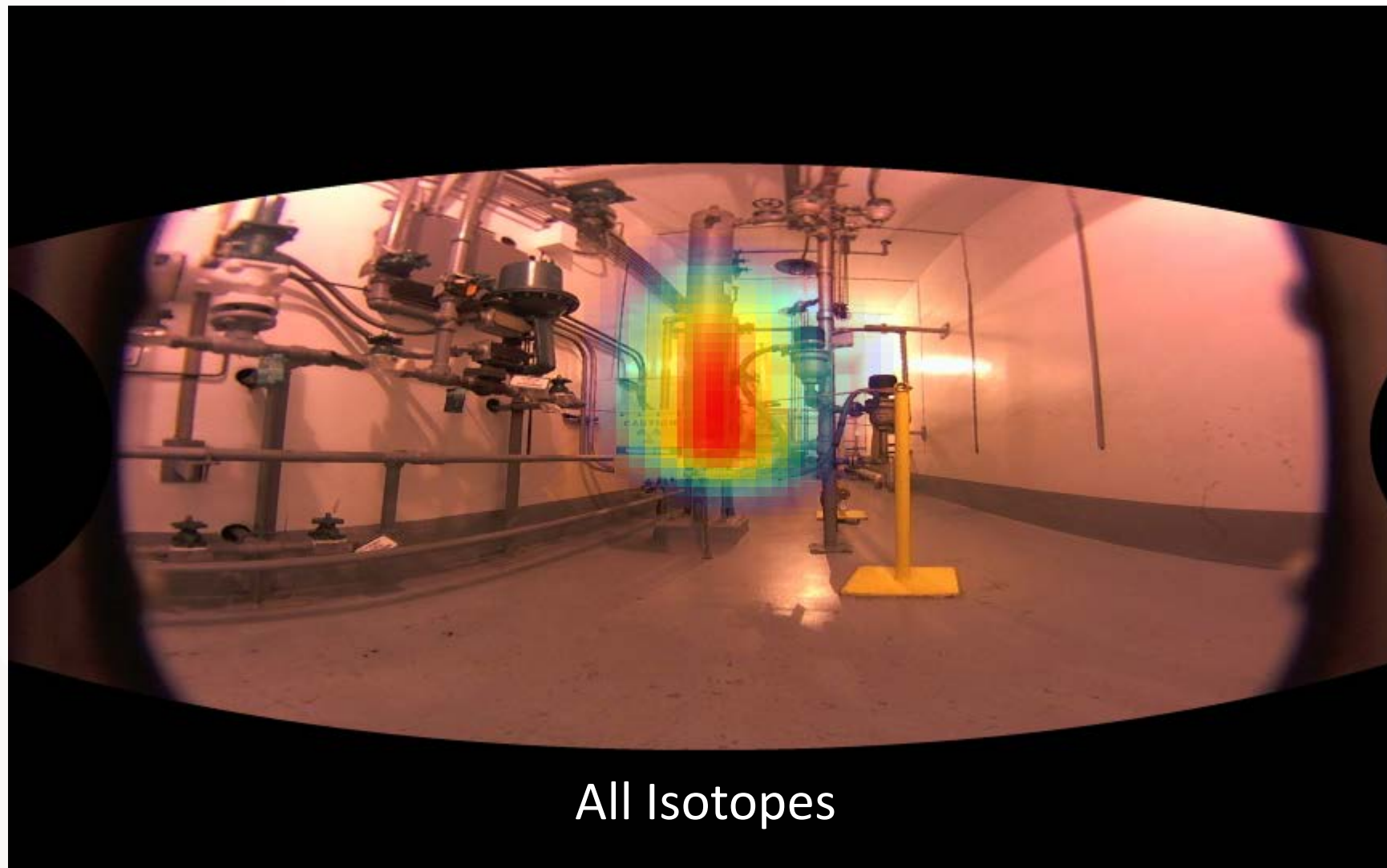


Elevated Dose Rates in Waste Gas System – S. Waste Gas Header



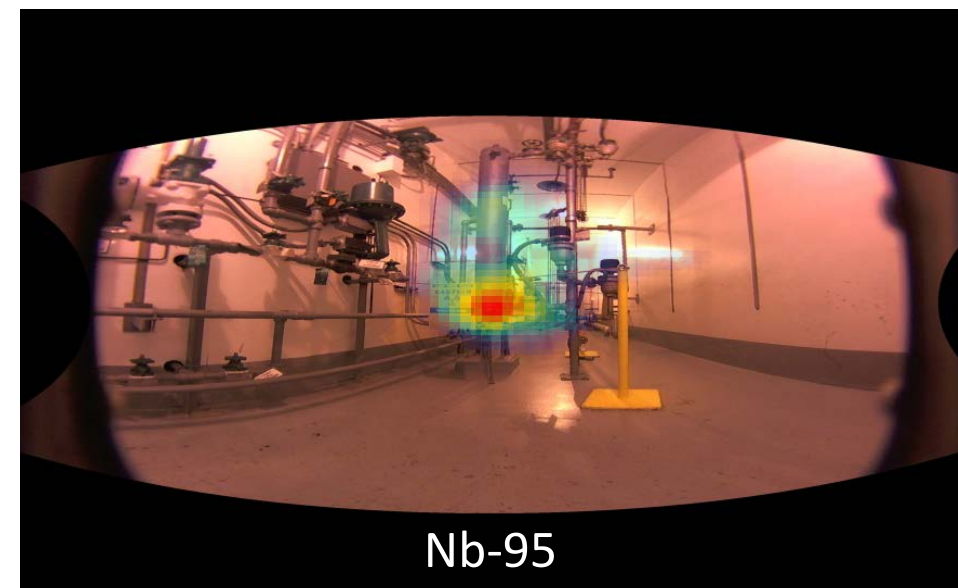
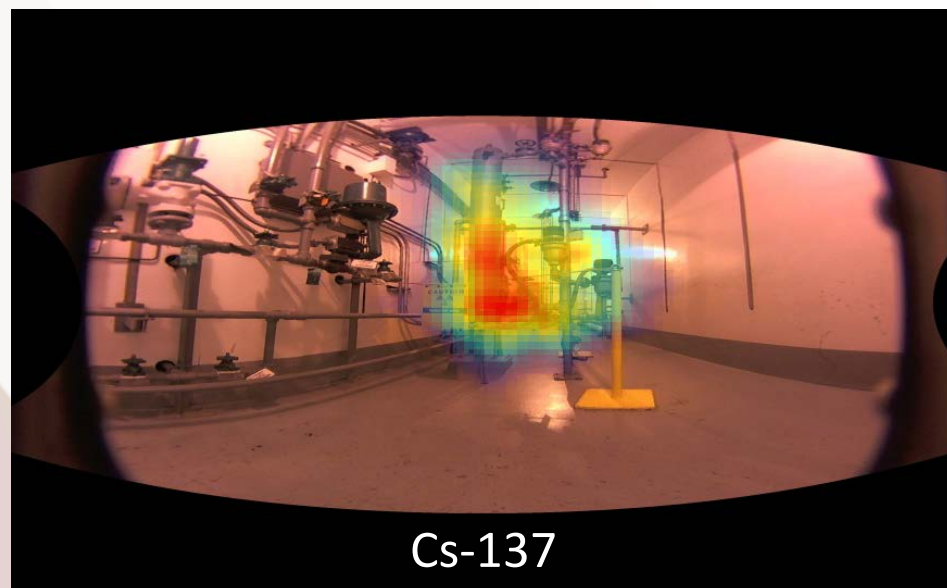
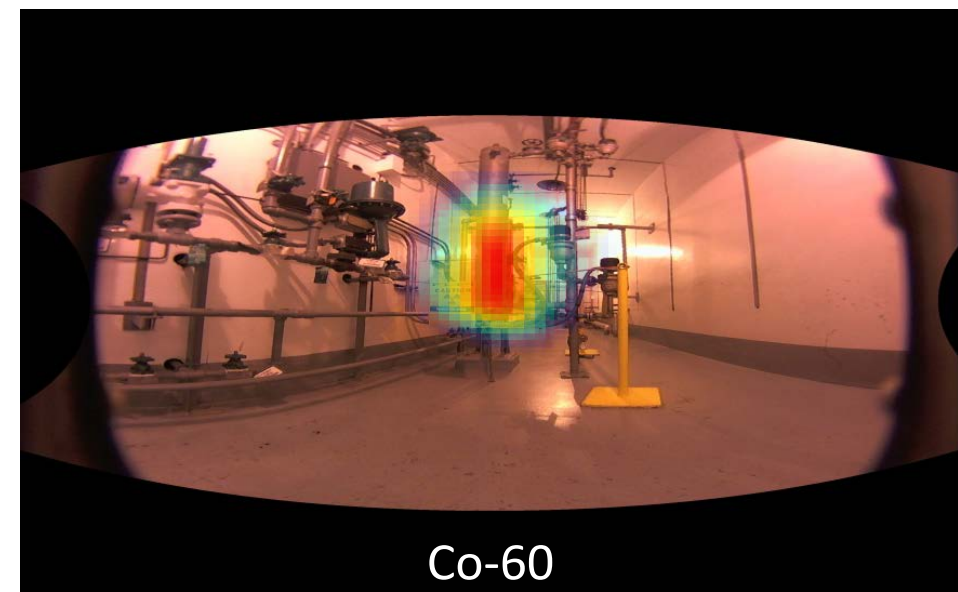
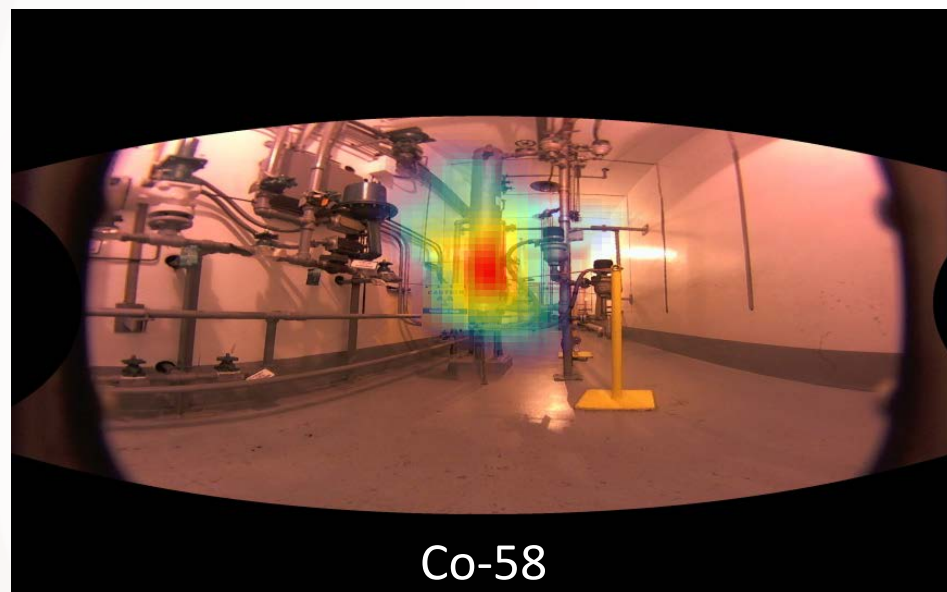
S. Waste Gas Header:
Co-58, Co-60, Cs-137, Nb-95

Elevated Dose Rates in Waste Gas System – S. Waste Gas Header



All Isotopes

Elevated Dose Rates in Waste Gas System – S. Waste Gas Header



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Elevated Dose Rates in Waste Gas System

- When the spent resin storage tank was filled water solid, the vent path allowed water to enter the plant vent header.
- This water cleared out particles entrained in the piping and flowed down to the drain tank.
- The gas / vapor with the radioactive particles was drawn into the south compressor suction.

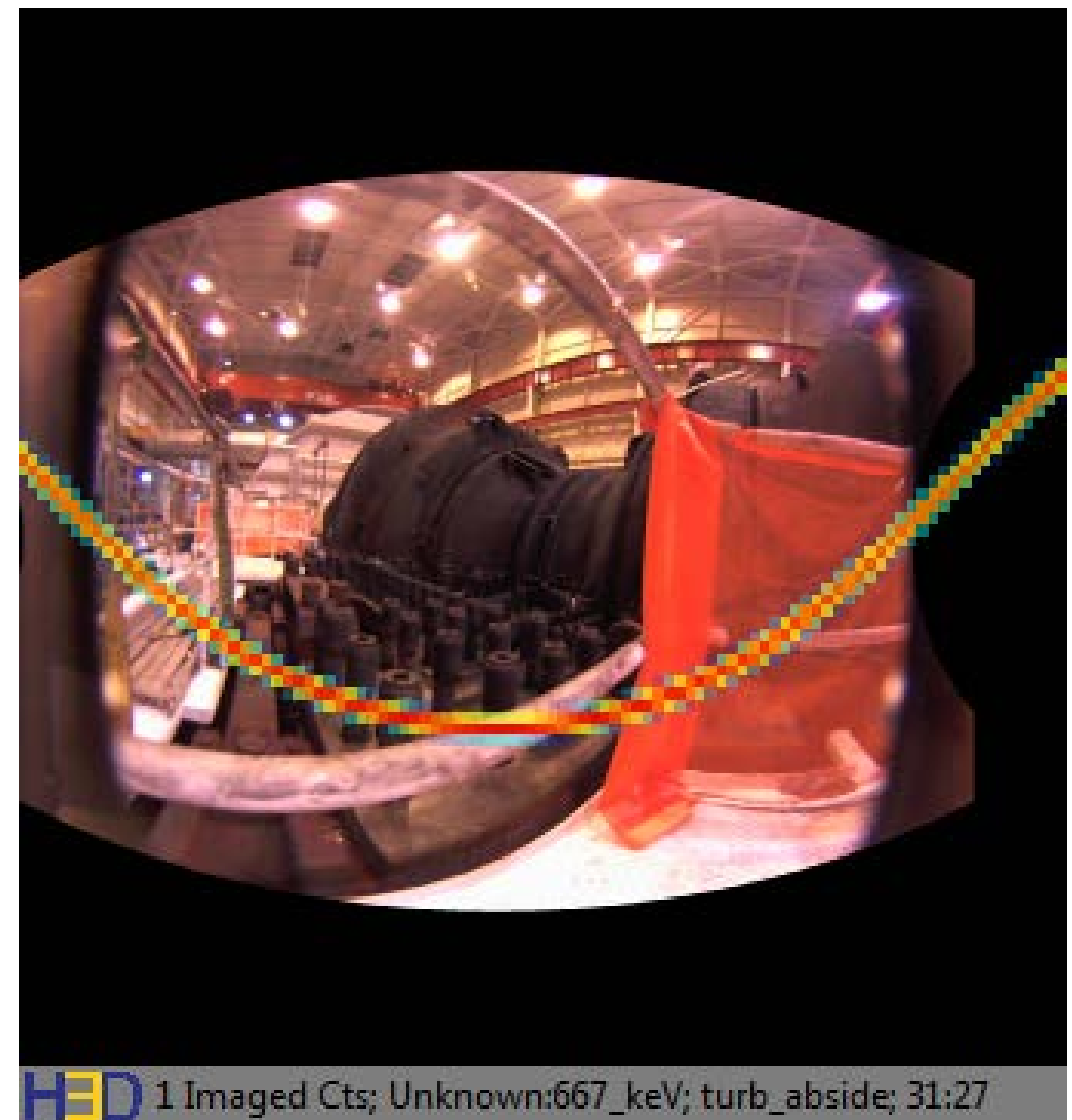
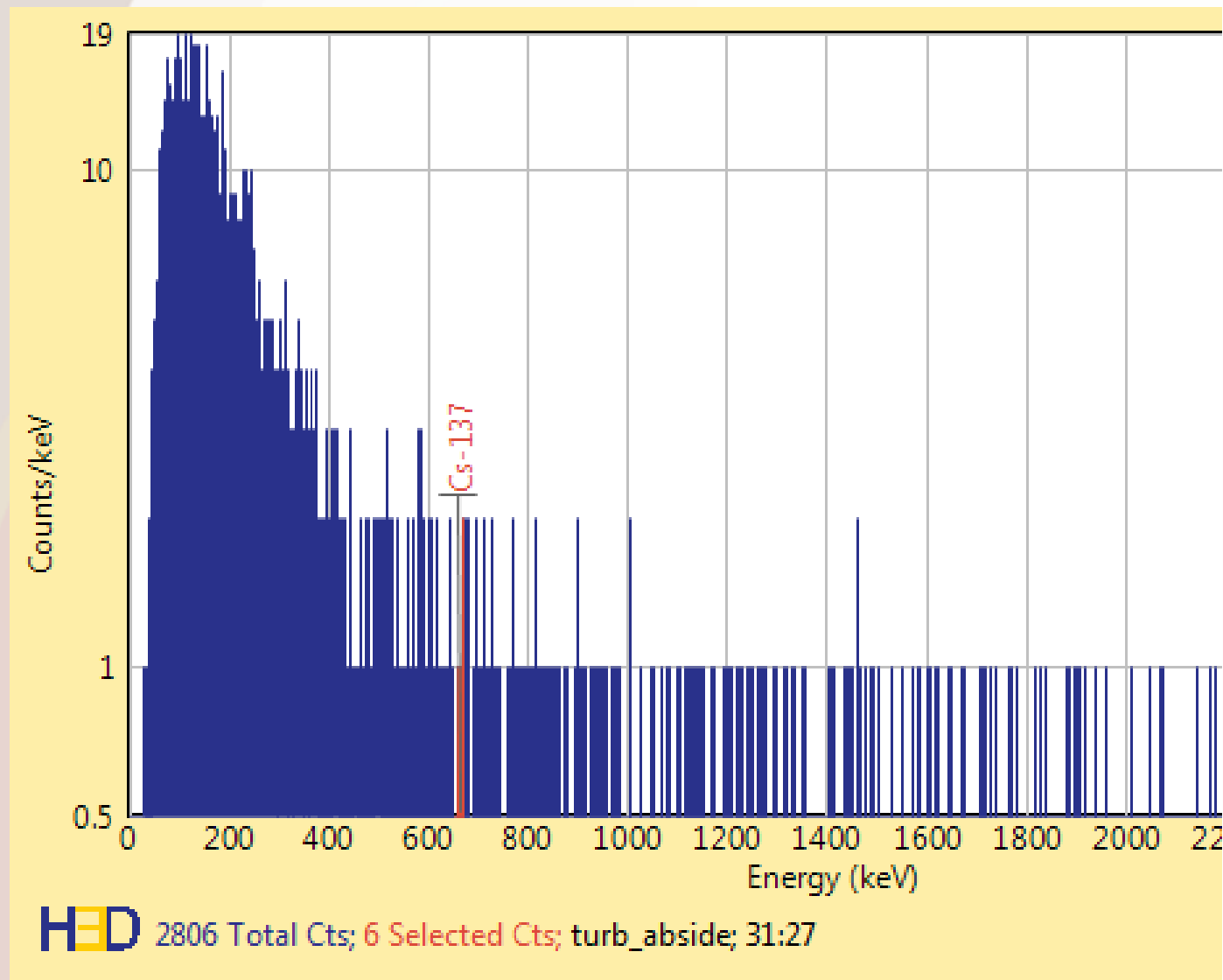
Turbine Building Measurements

Disassembly of two (2) Low Pressure Turbines (LPTs) with aggressive work scheduled

Historical very low levels of fixed contamination found in localized areas.
Work treated as potentially contaminated until shown otherwise

2 CPS – No noticed contamination. It's a good zero!

LPT 'B' O/S of Inner Cover



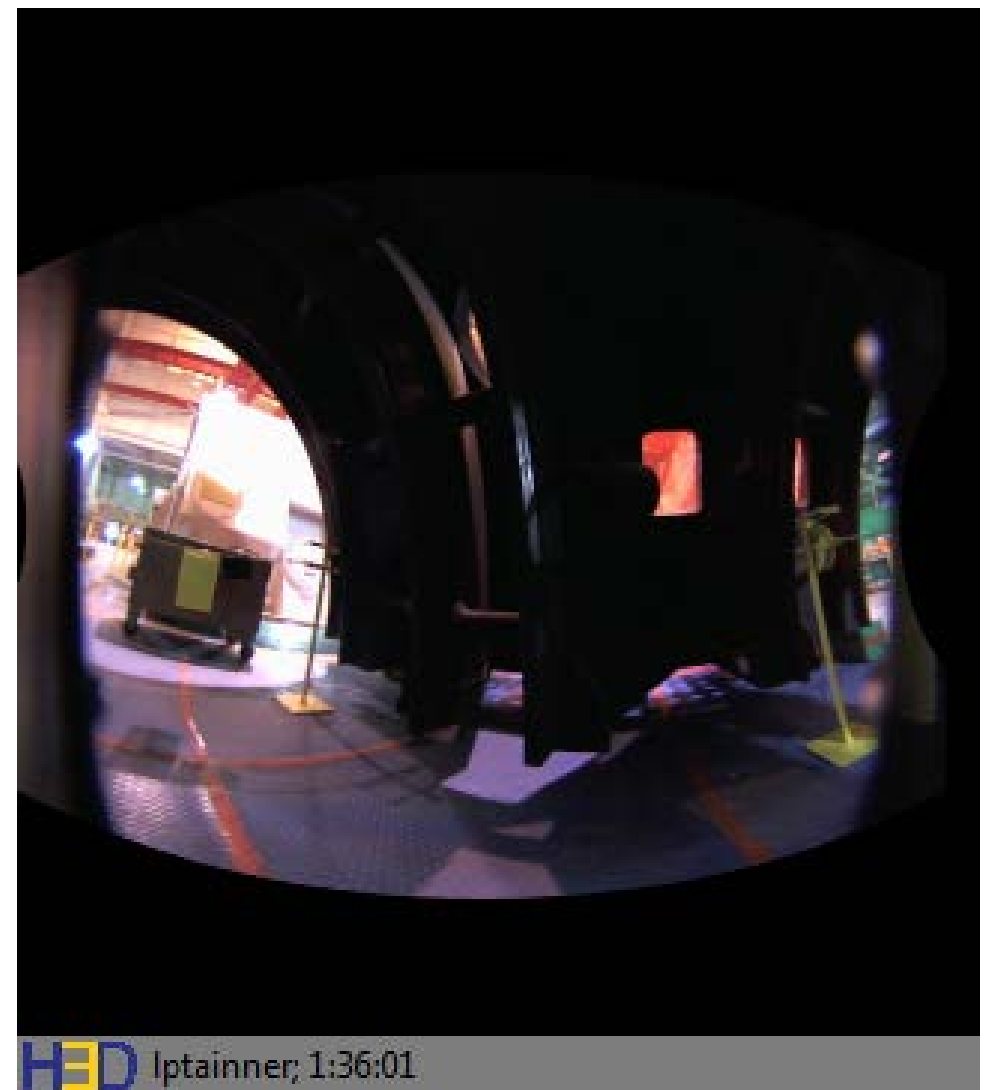
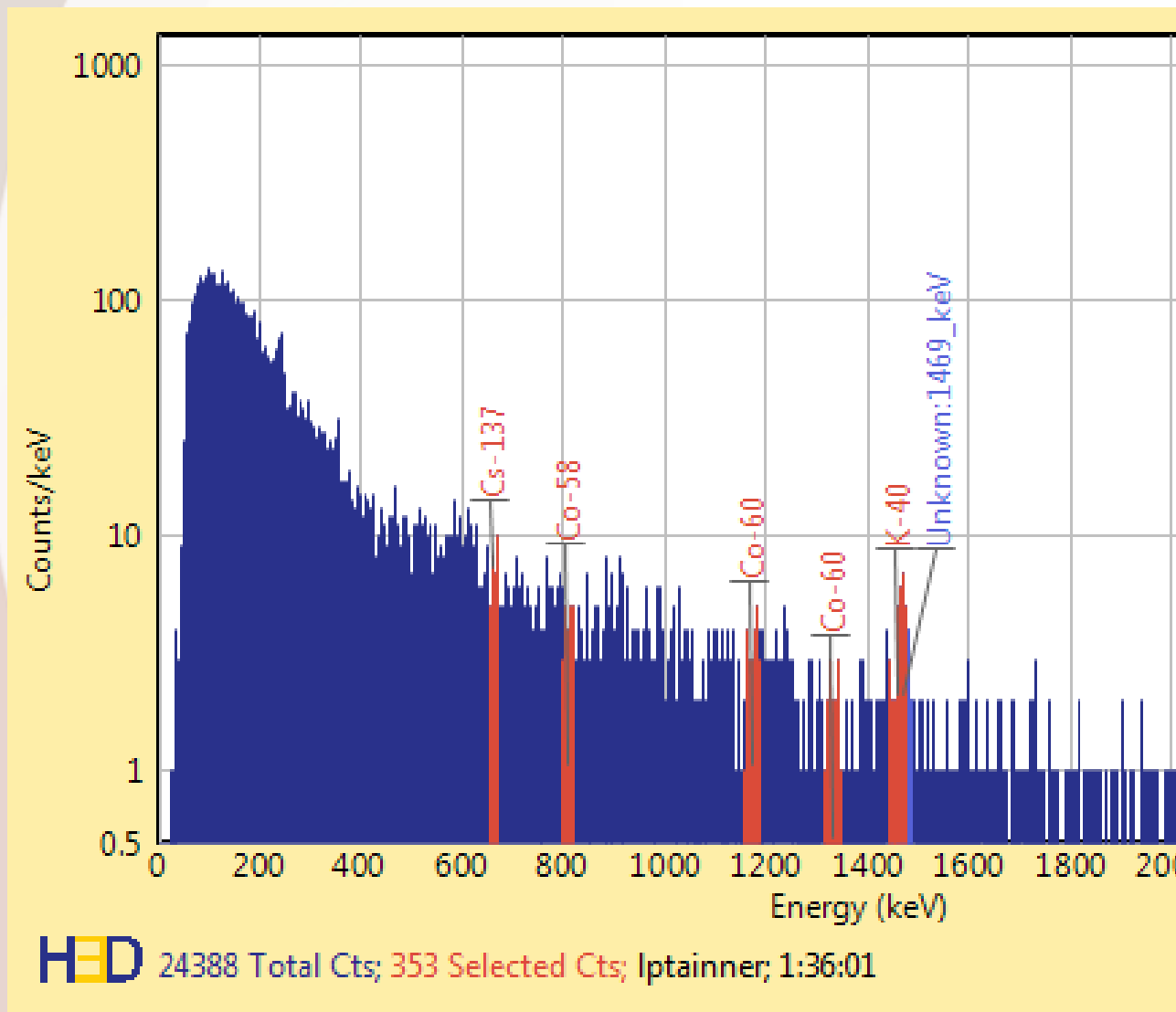
Something needs to be selected. Cs-137
most probable isotope, nothing above bkgd

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LPT 'A' – I/S Inner Cover (Posted Restricted Area from Survey)

1 hour 30 minute measurement – No plant identified peaks



Unknown Peak is K-40 – Software misidentification. Only noted peak on spectrum.
Other isotopes selected as reference

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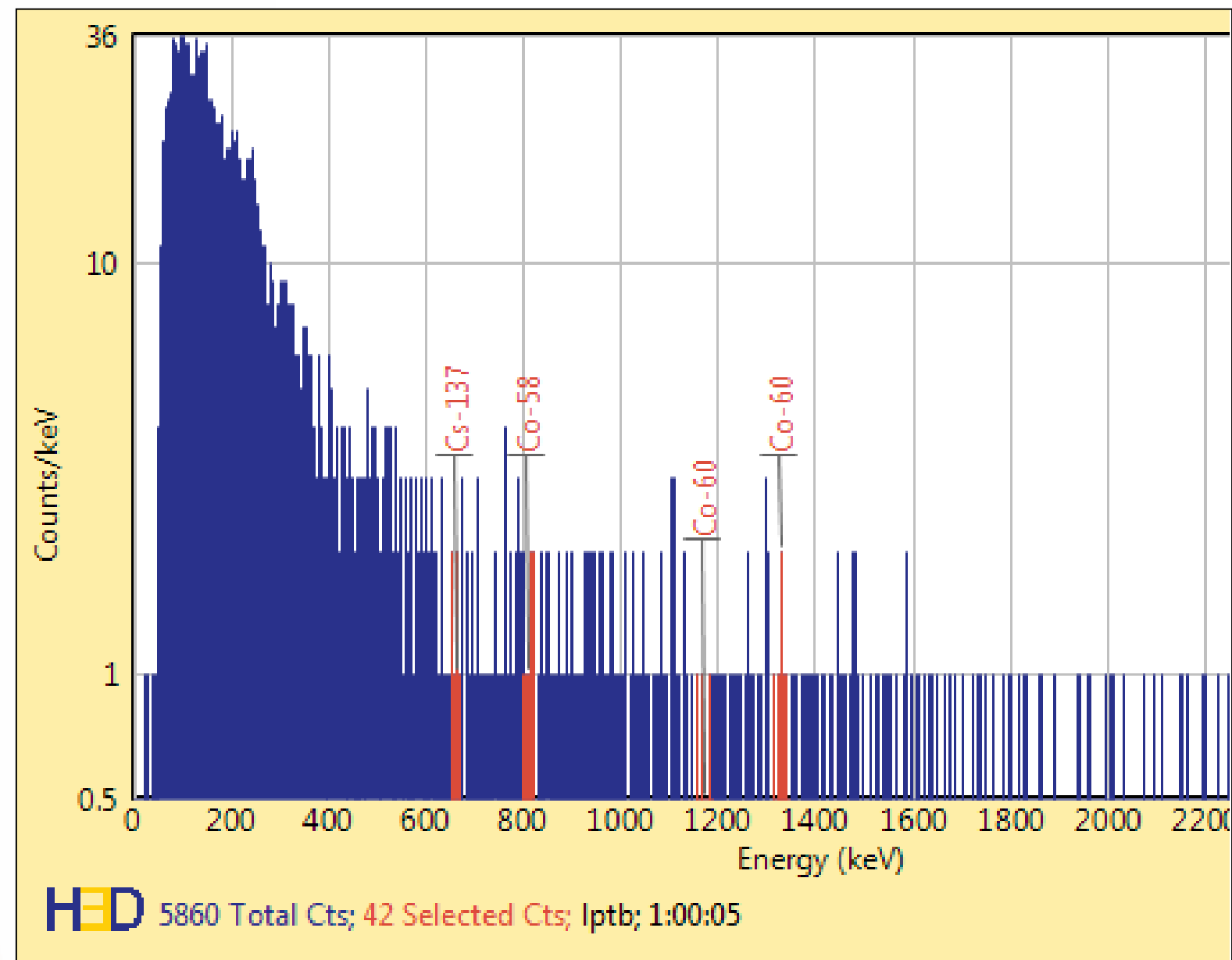


Count Rate 2 CPS!!! – Count Rate in the office buildings 7-8 CPS
No peak received 10 counts in 1 hour.

Turbine Building Measurements



HED lptb; 1:00:05



“Co-58” – 3 imaged counts

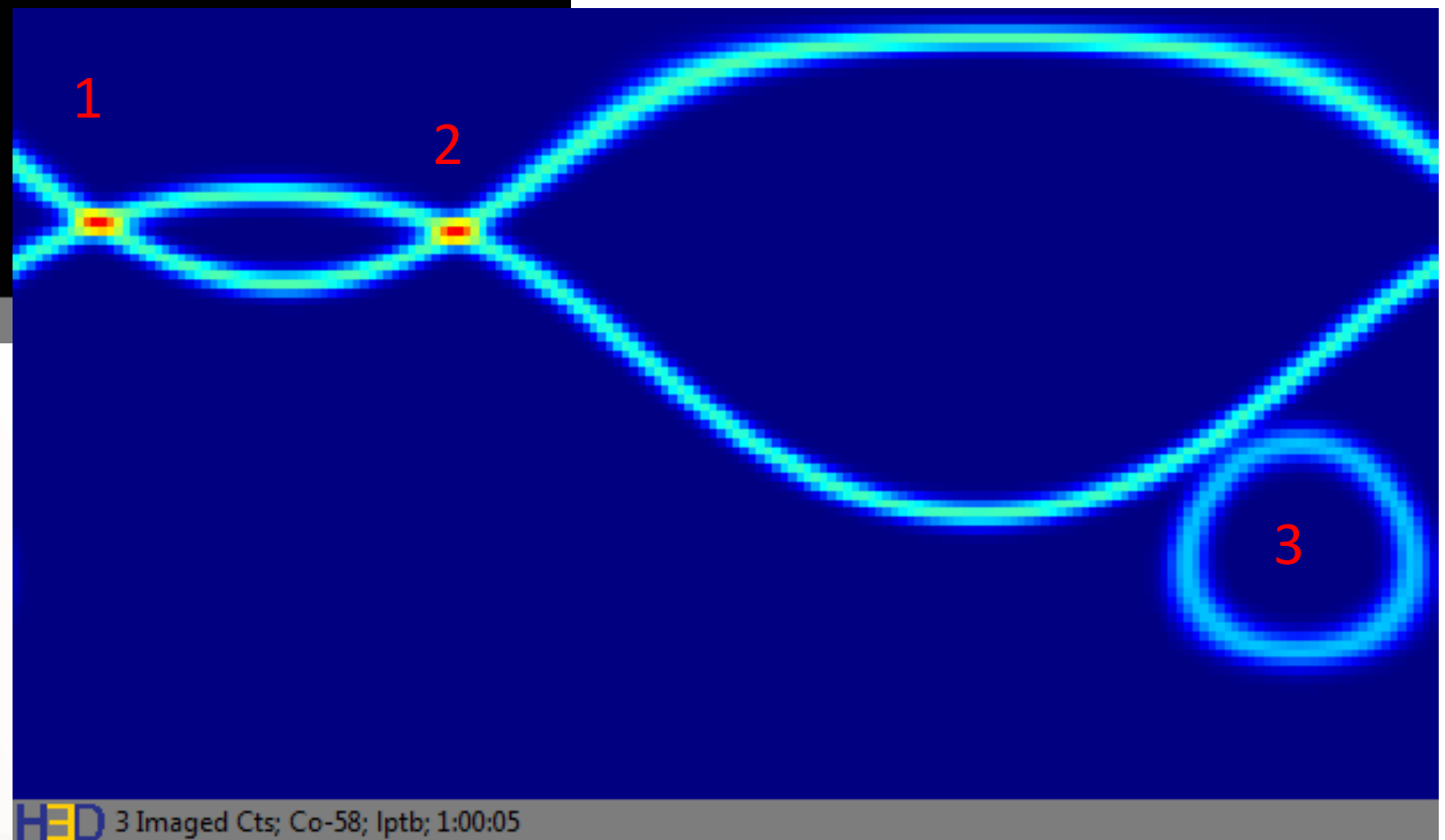
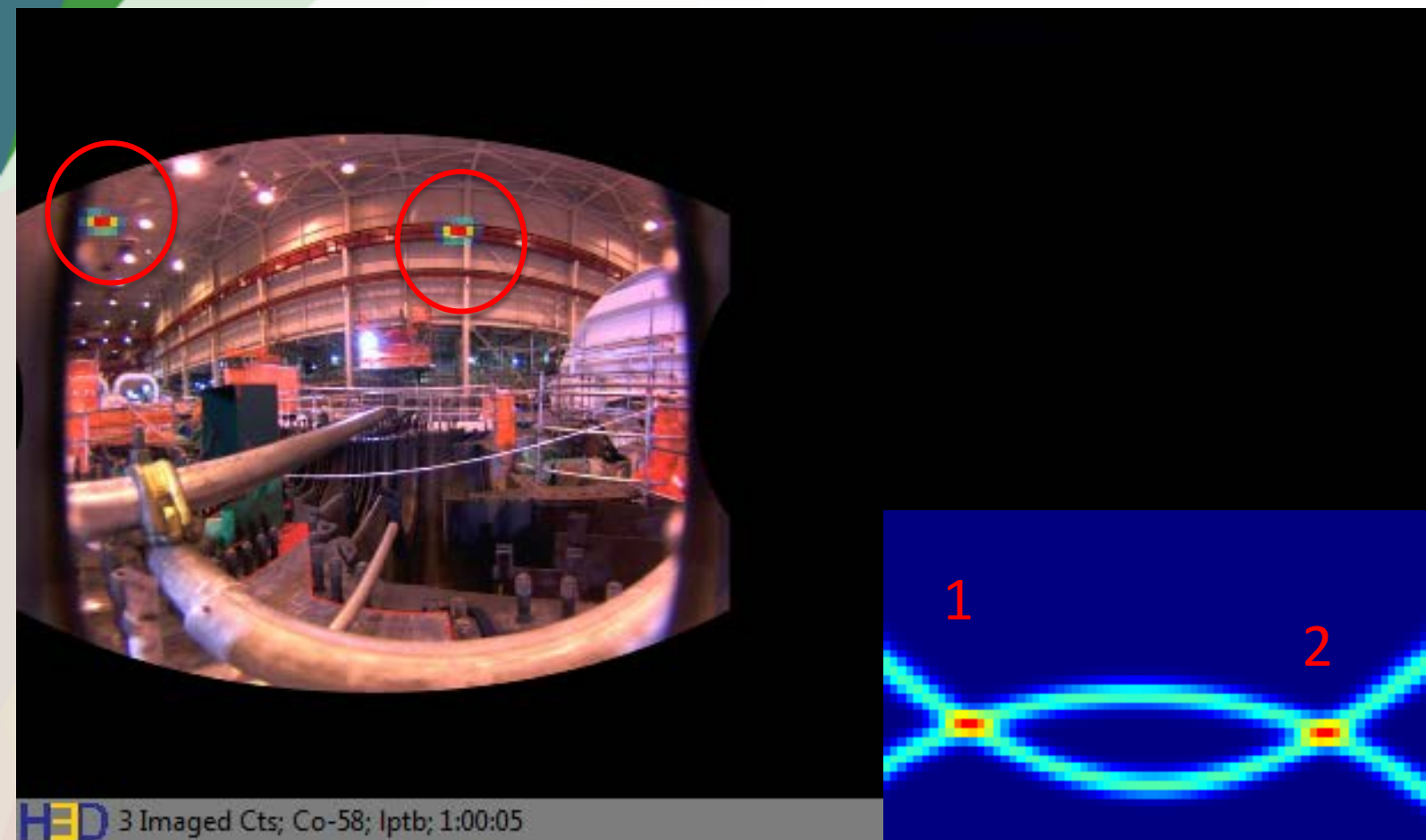
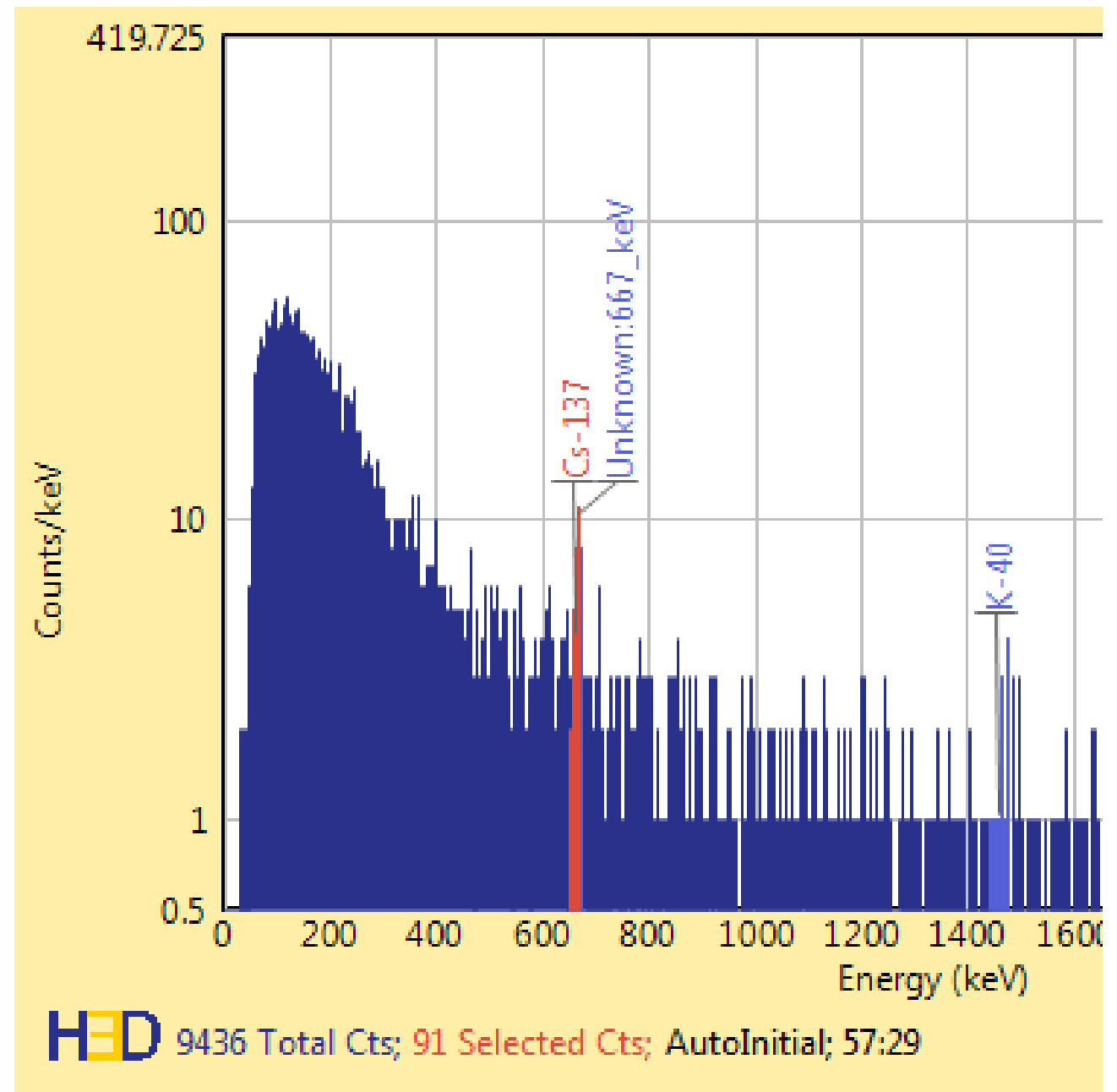
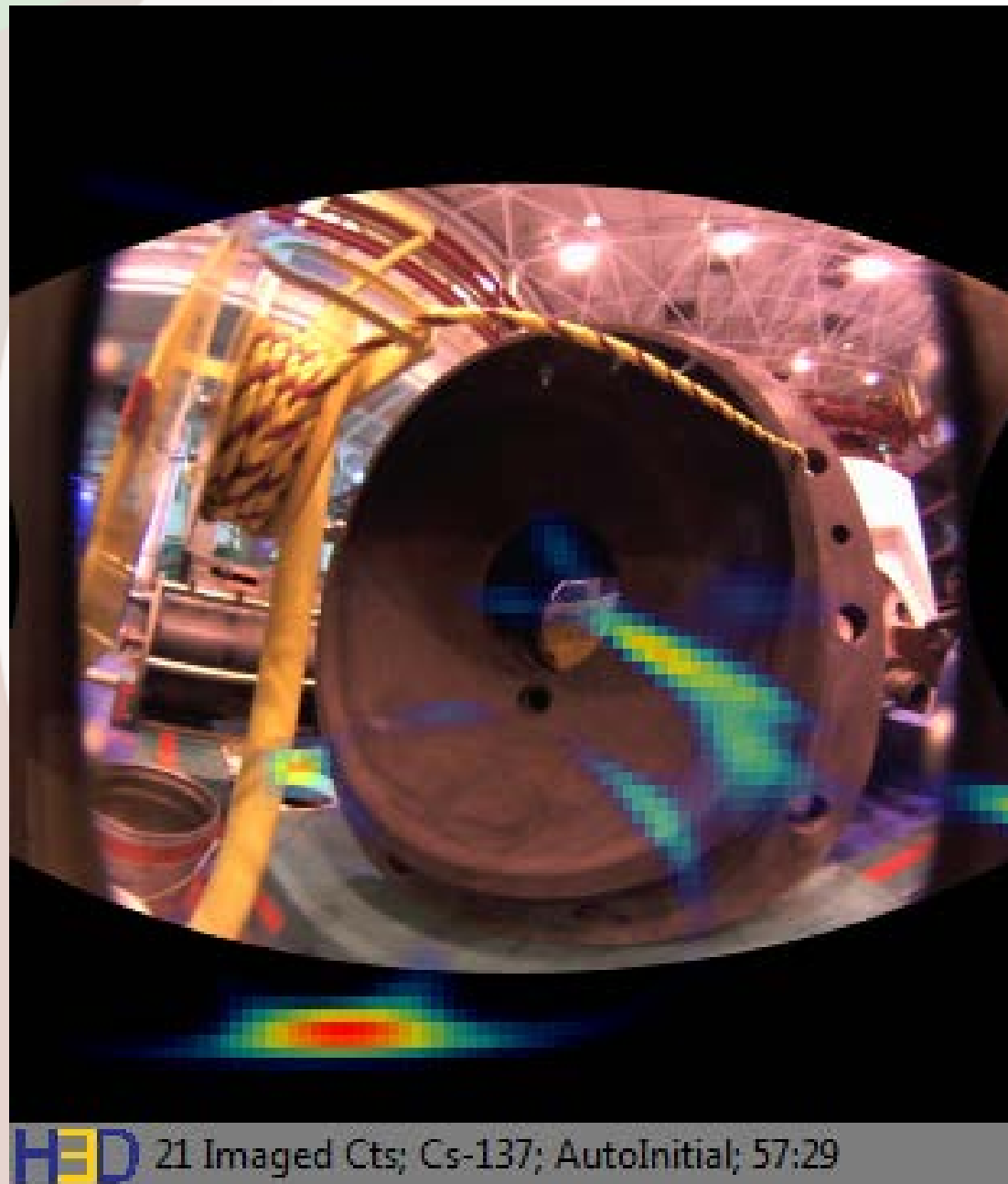


Image is not resolved. The system will image any energy range (>250 keV) programmed regardless of background in the area and whether the isotope is actually present.

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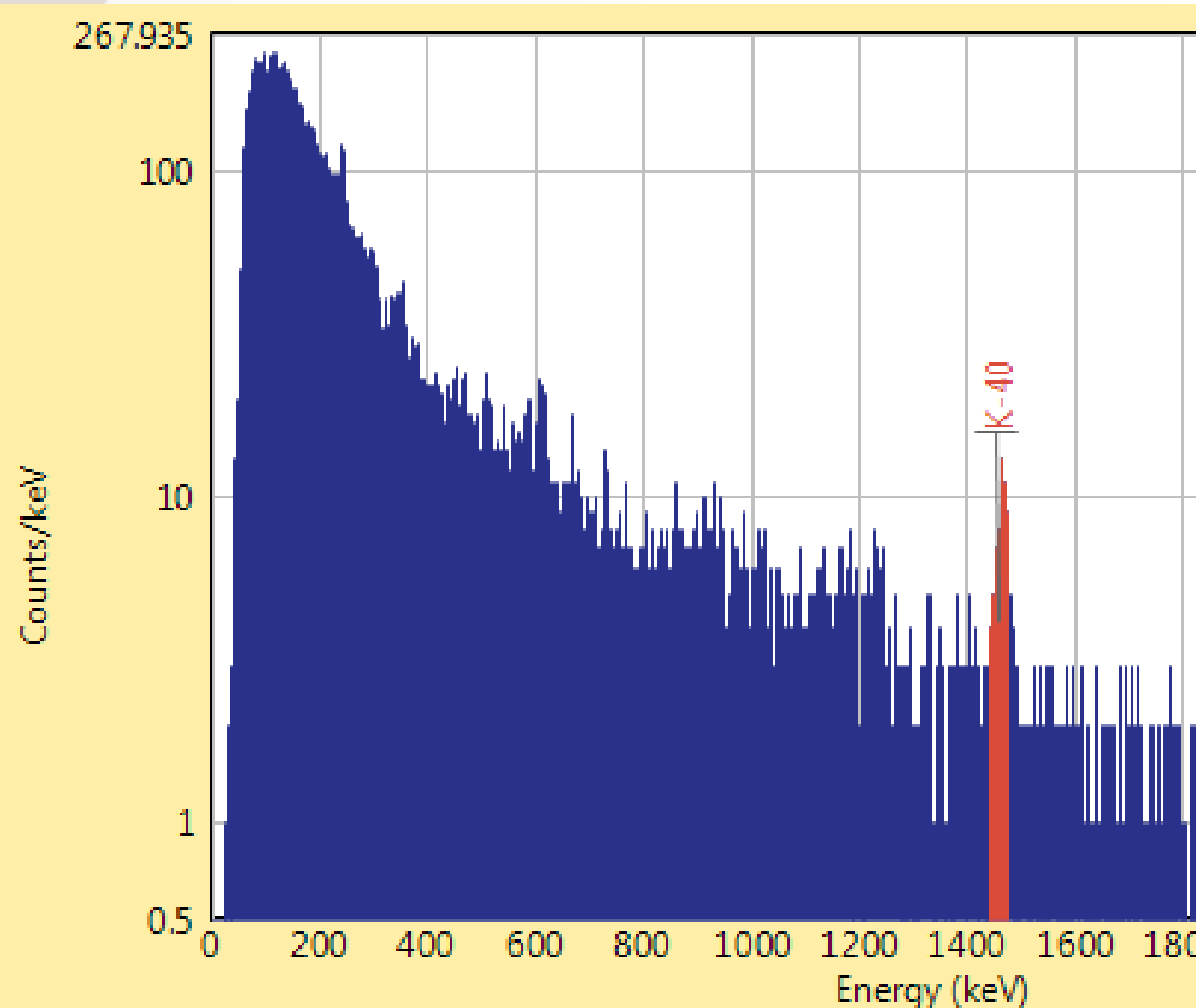


Turbine Stop Valve – Positive Cs-137

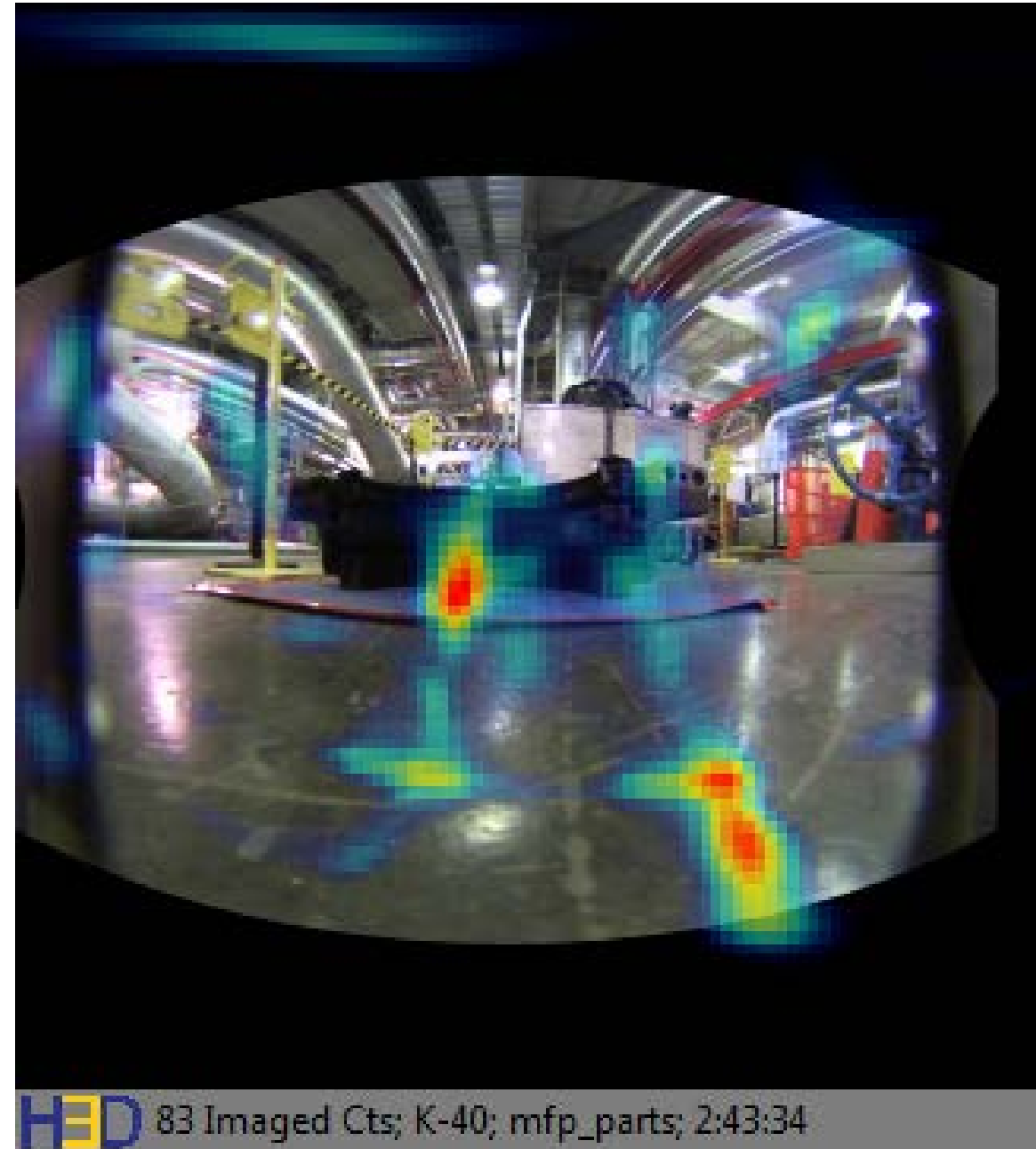


Count Rate of 3 CPS for 58 minutes. Image is not fully resolved to show contamination location. Verification of plant generated isotopes on fixed contamination.

Auxiliary Feedwater Pump Seal



HED 44097 Total Cts; 199 Selected Cts; mfp_parts; 2:43:34

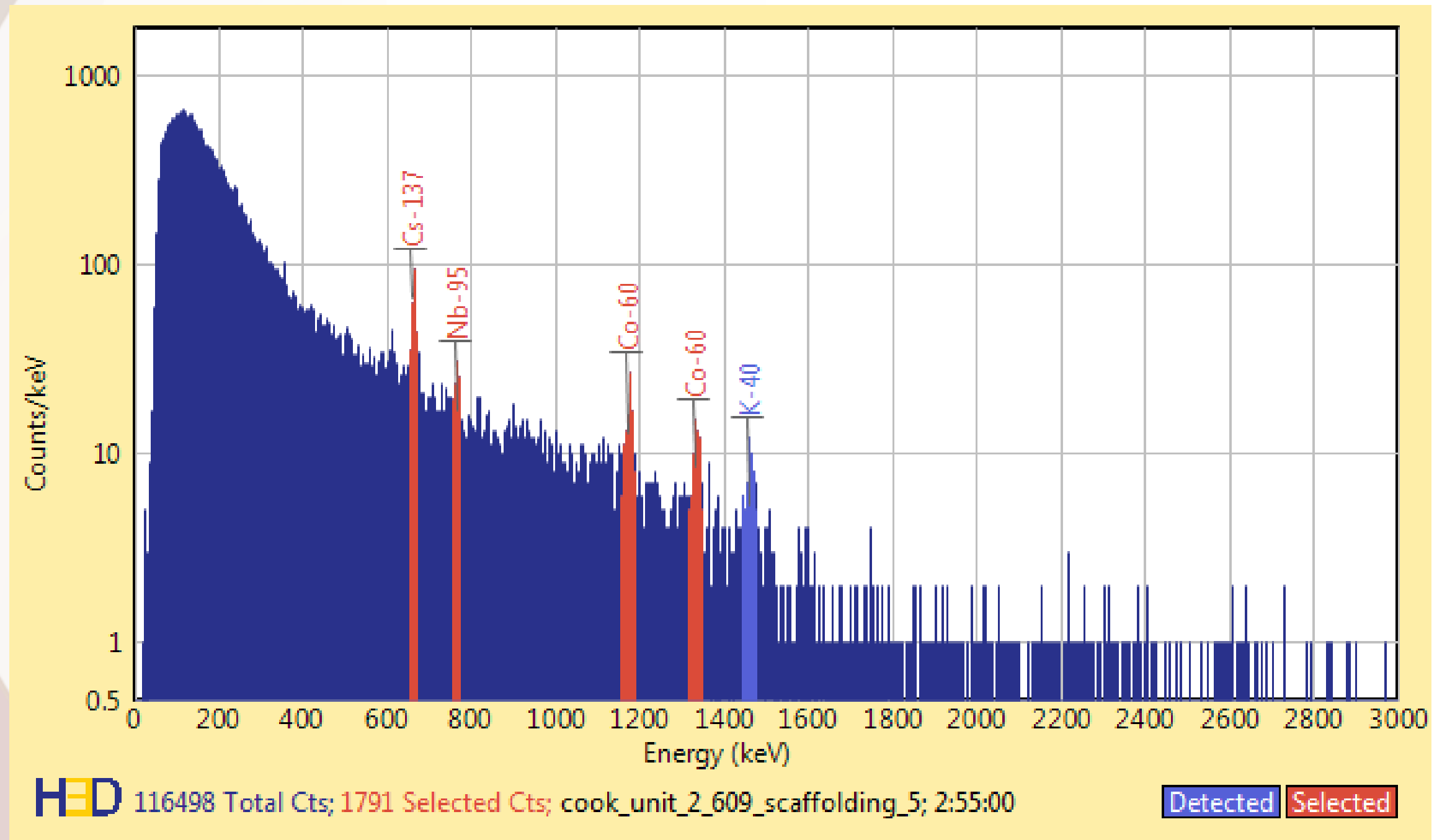


HED 83 Imaged Cts; K-40; mfp_parts; 2:43:34

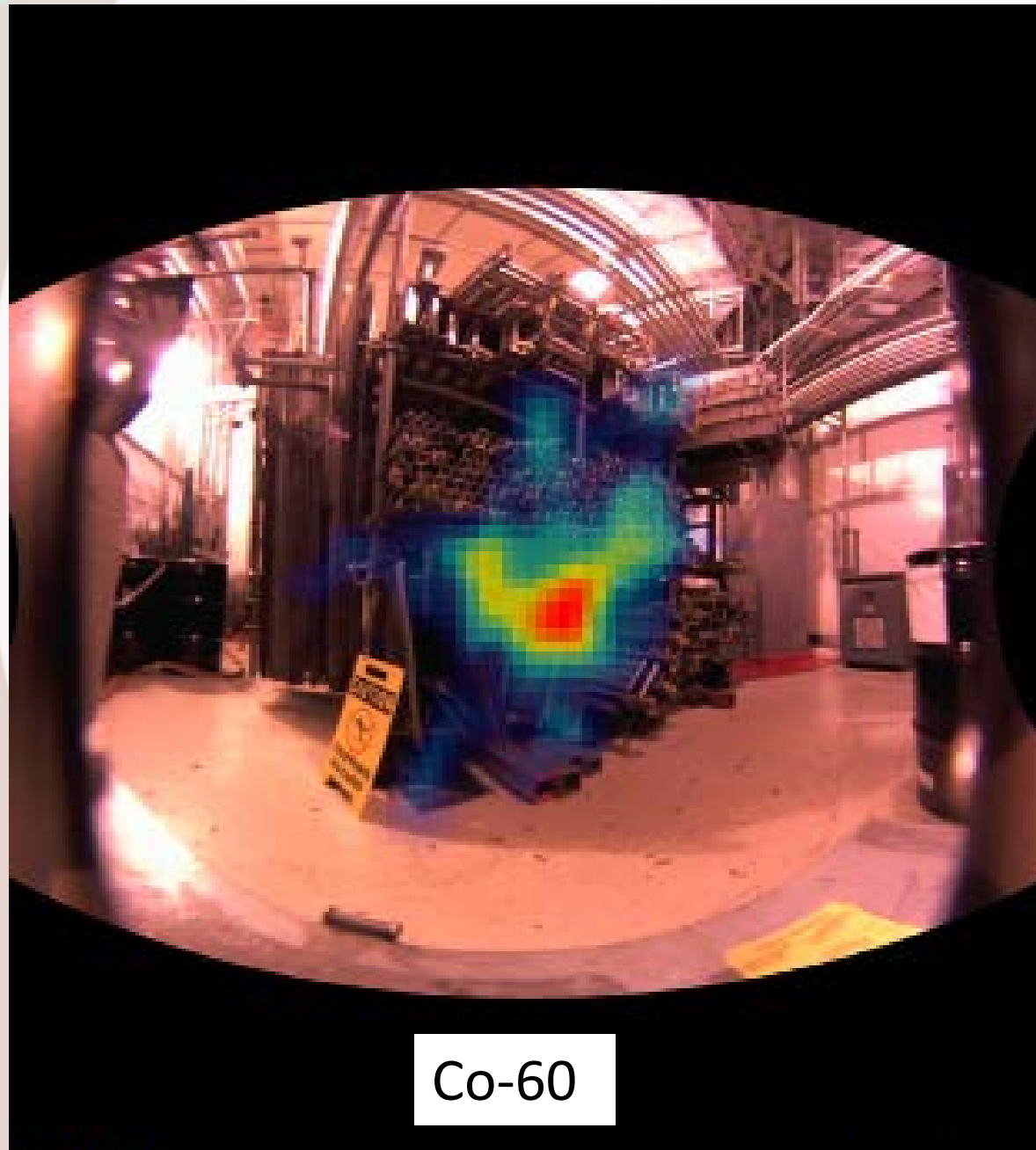
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Scaffold Rack Contamination

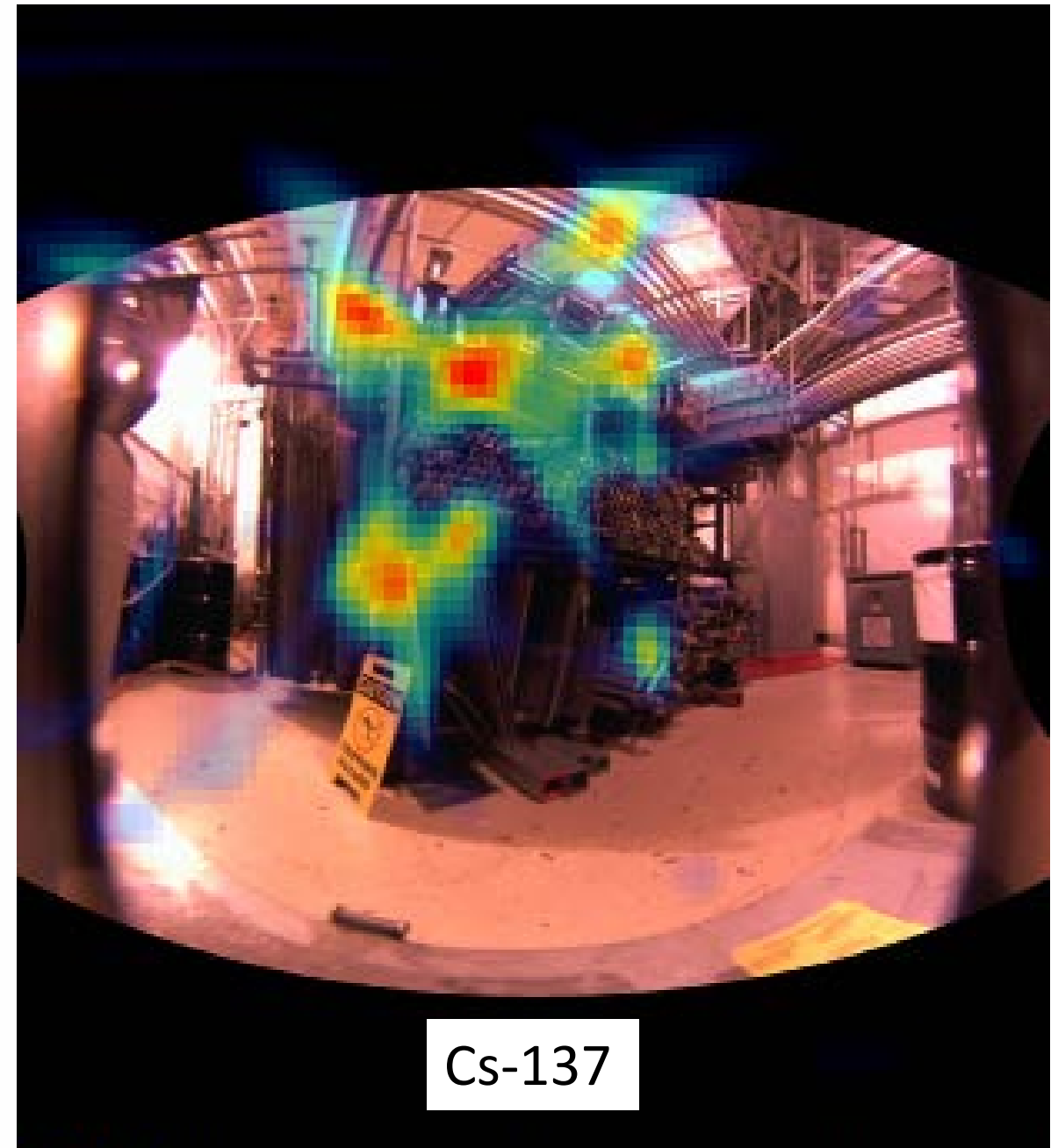


Scaffold Rack Contamination



Co-60

HED 209 Imaged Cts; Co-60; cook_unit_2_609_scaffolding



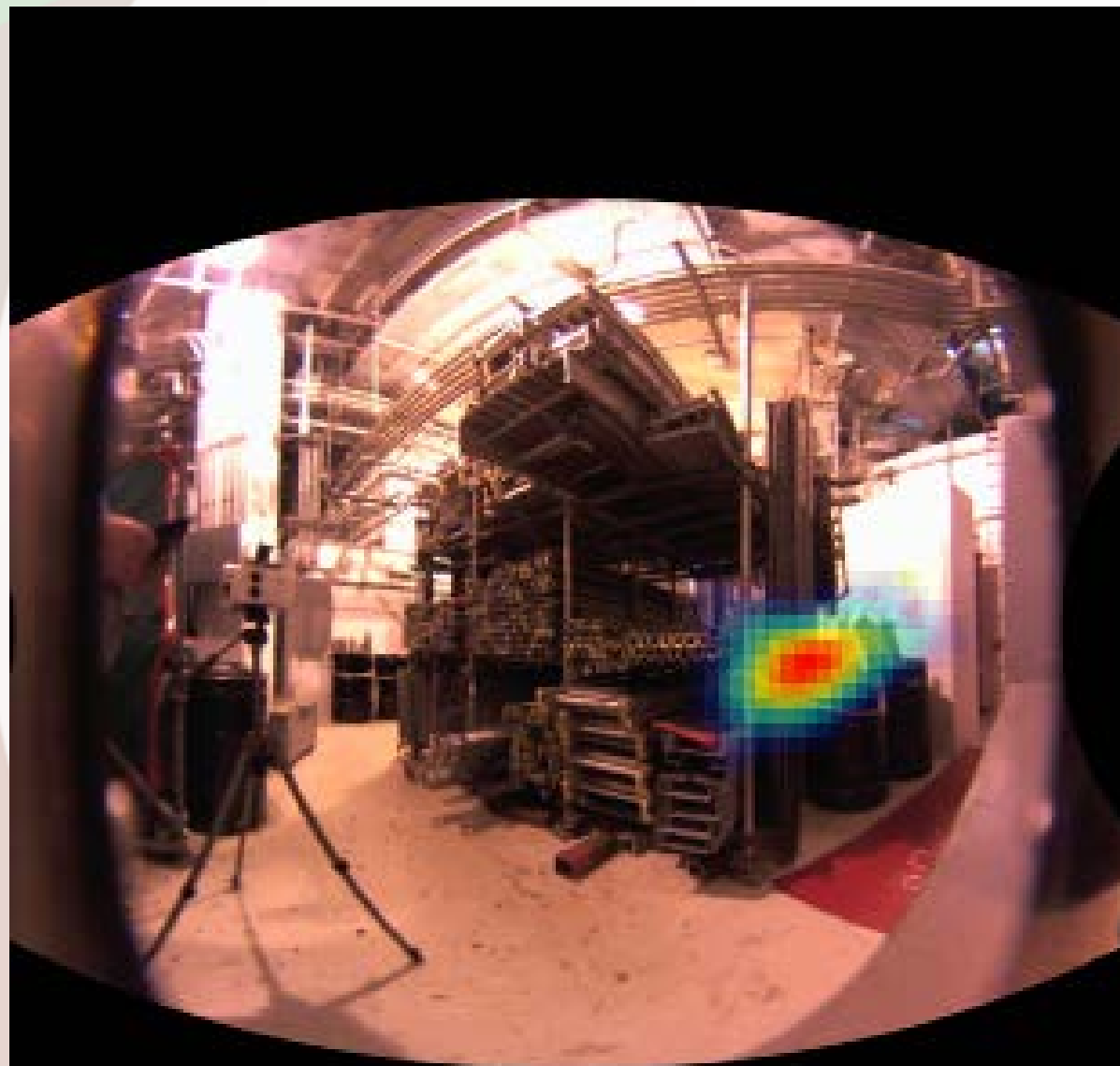
Cs-137

HED 249 Imaged Cts; Cs-137; cook_unit_2_609_scaffolding

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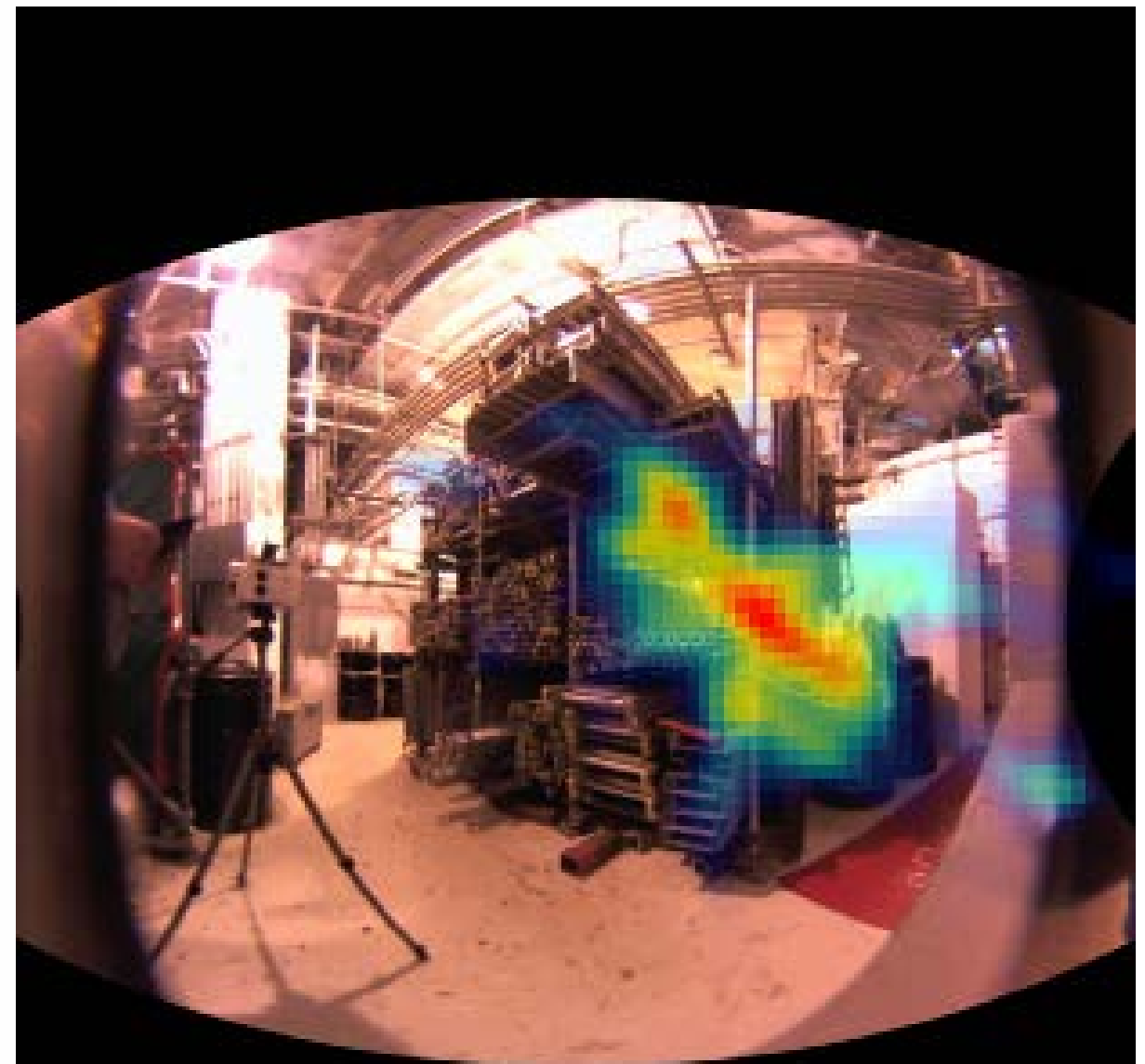


Scaffold Rack Contamination



Co-60

HED 369 Imaged Cts; Co-60; 603_aux_unit_2_scaffolding



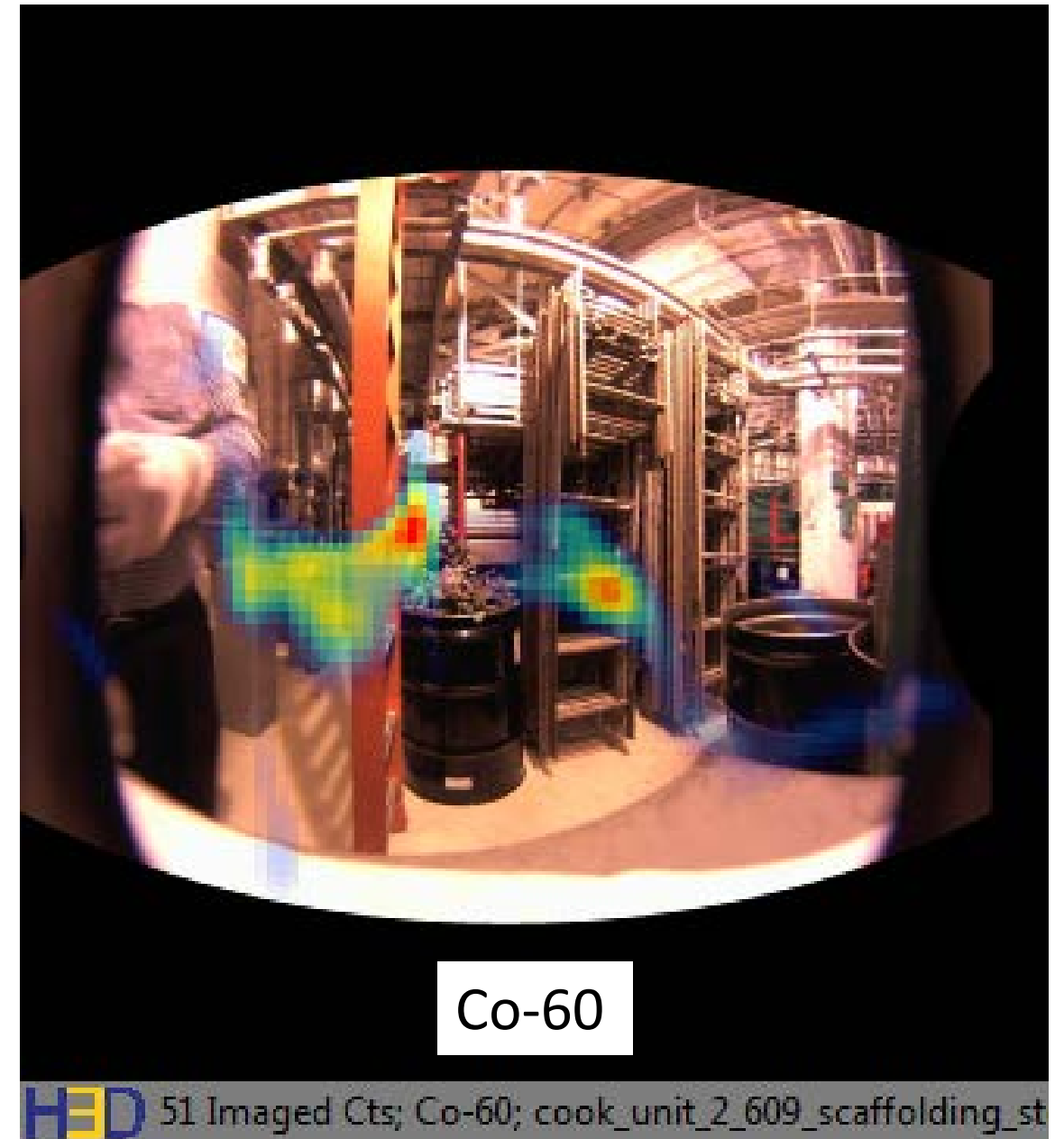
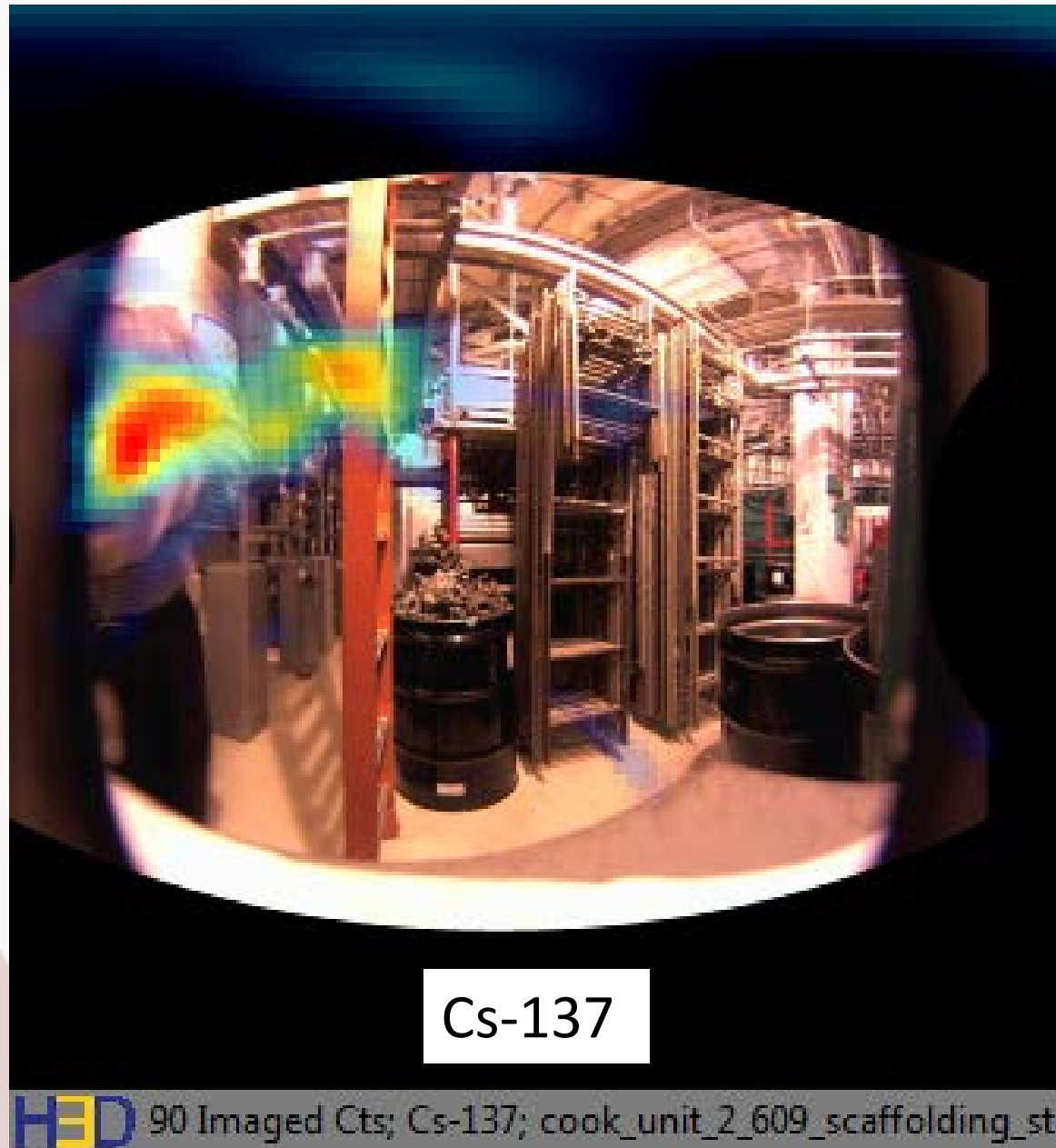
Cs-137

HED 217 Imaged Cts; Cs-137; 603_aux_unit_2_scaffolding

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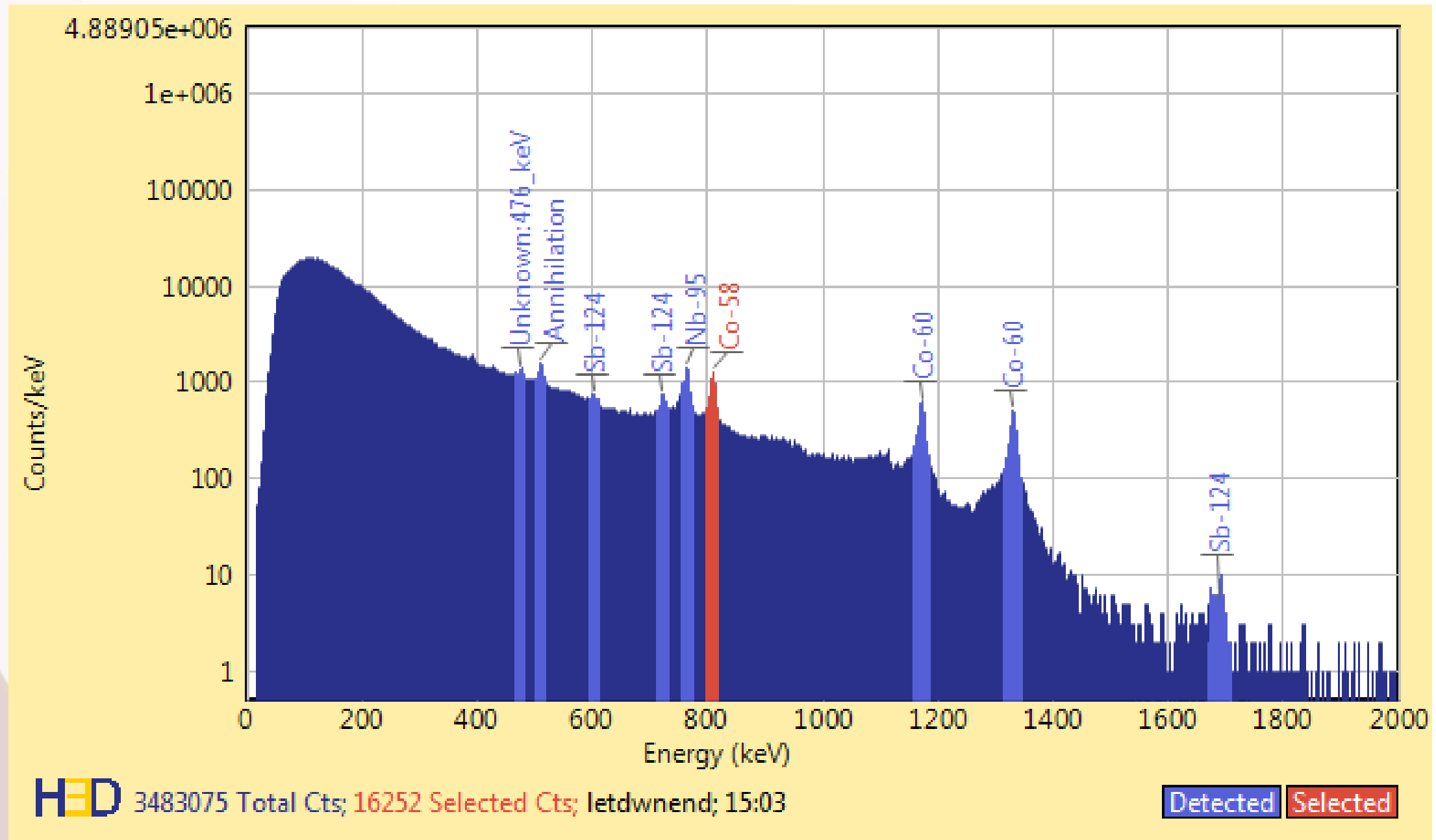


Scaffold Rack Contamination – Behind Scaffold



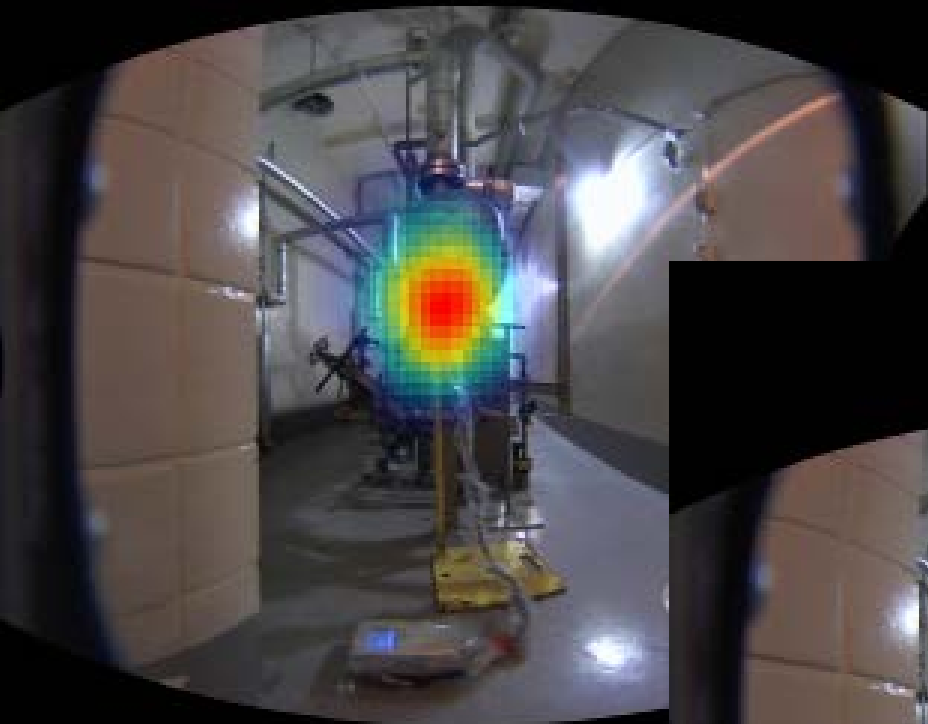
10.4 mR/hr contact w/Ion Chamber –
Lowest recorded dose rate

CRUD Location Isotopic – Letdown Hx Endbell



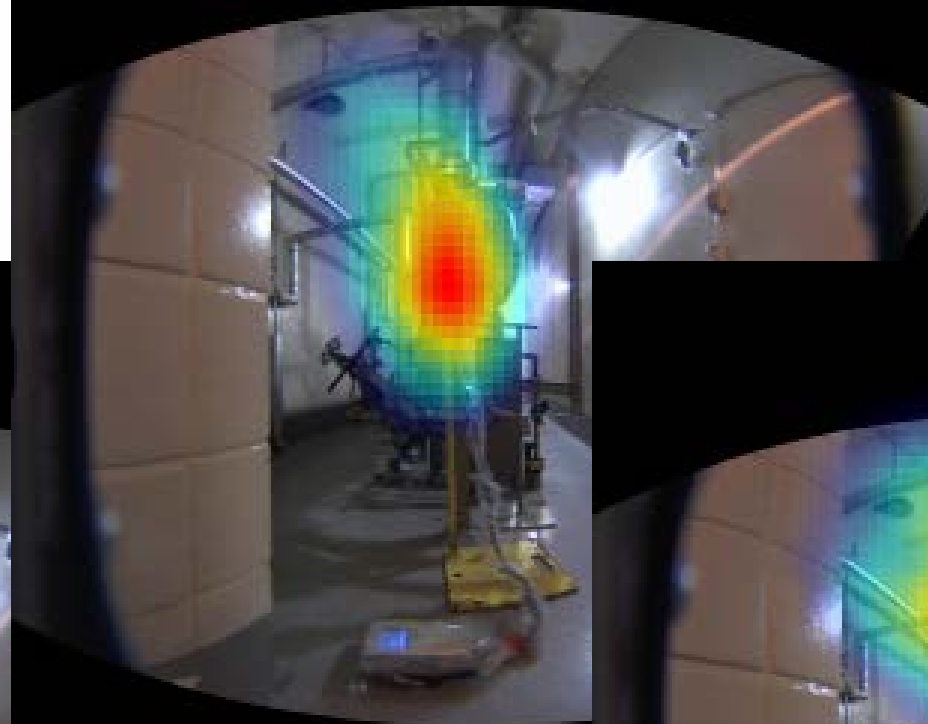
CRUD Location Isotopic – Letdown Hx Endbell

Sb-124



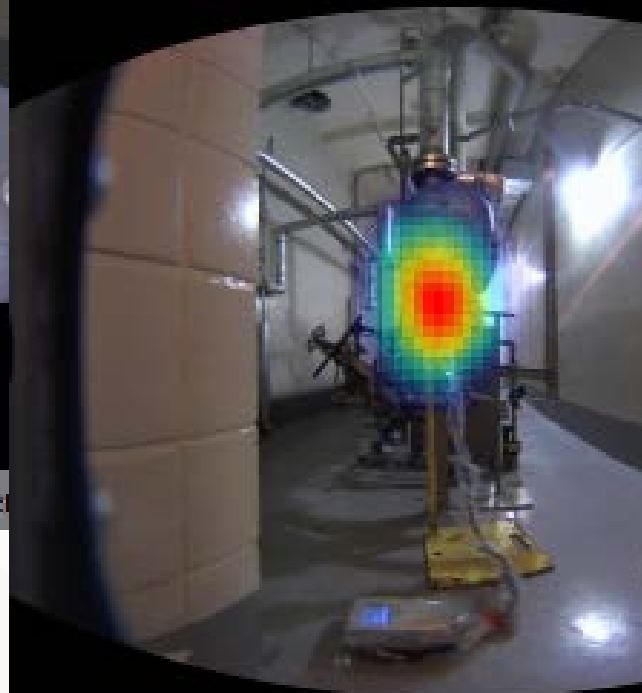
HED 6181 Imaged Cts; Sb-124; letdownend; 15:03

Co-60



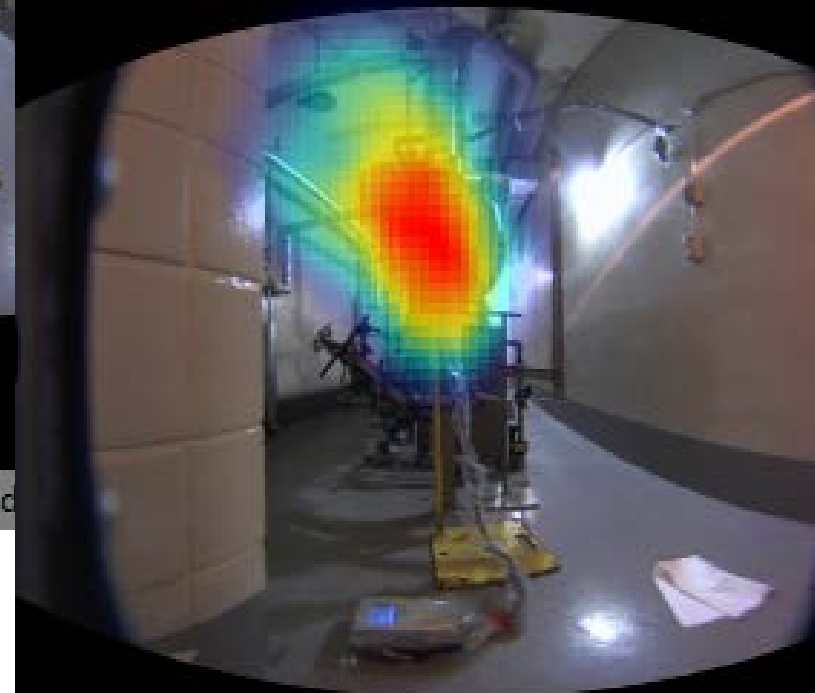
HED 7156 Imaged Cts; Co-60; letdownend; 15:03

Nb-95



HED 5998 Imaged Cts; Nb-95; letdownend; 15:03

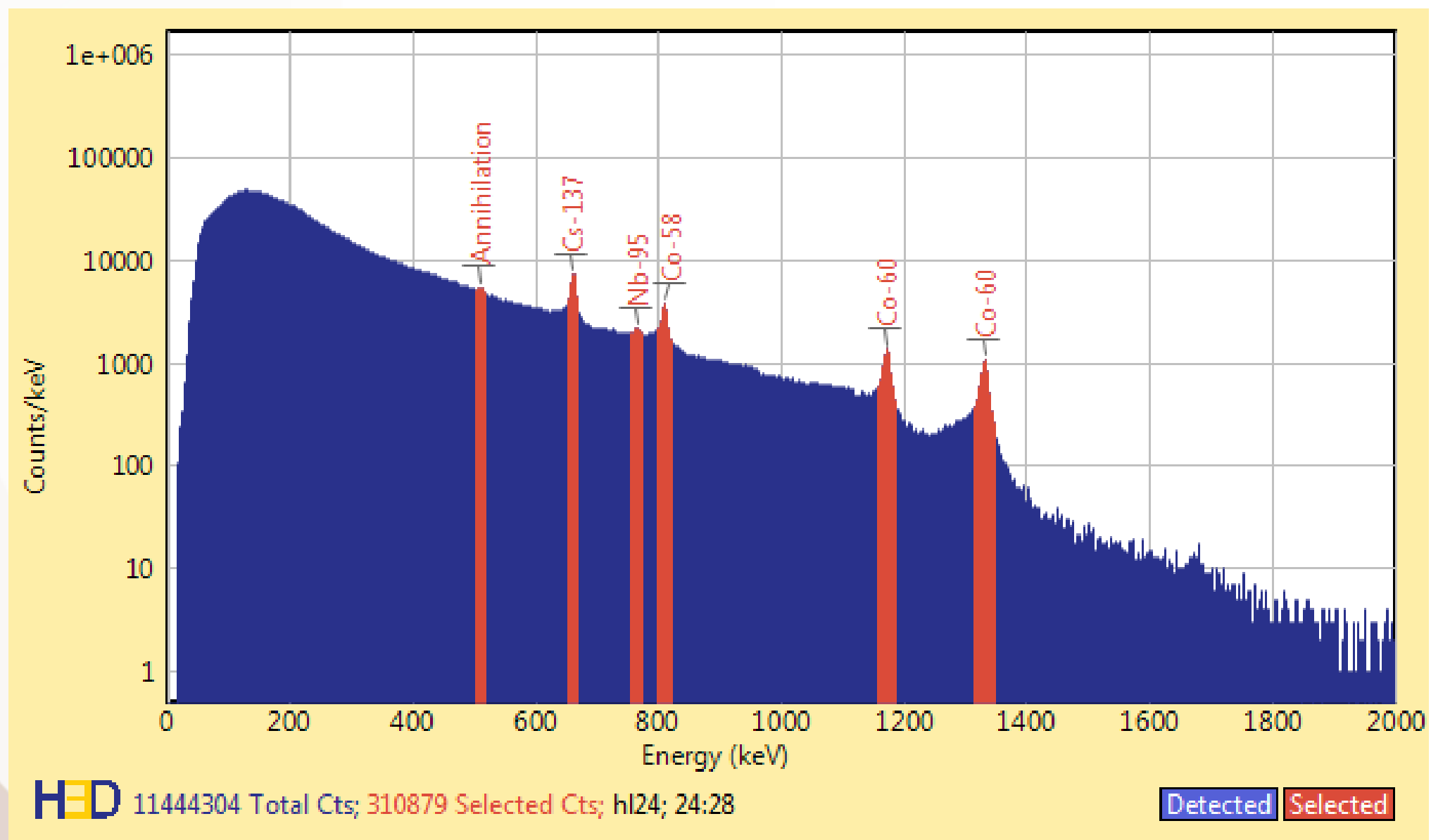
Co-58



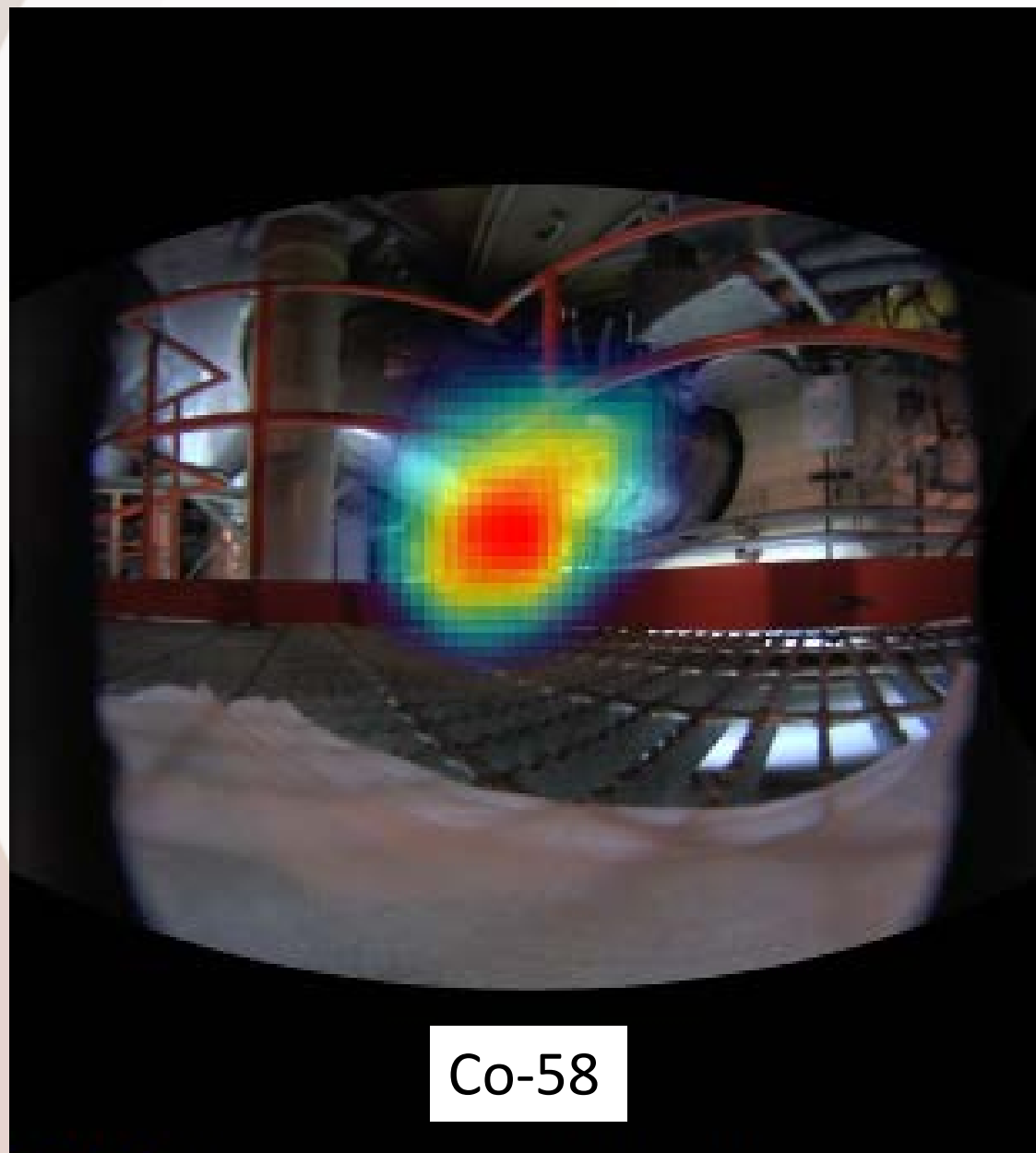
HED 4874 Imaged Cts; Co-58; letdownend; 15:03

~10 mR/hr on platform, 28 mR/hr contact

CRUD Location Isotopic – S/G Hot Leg Loop 2

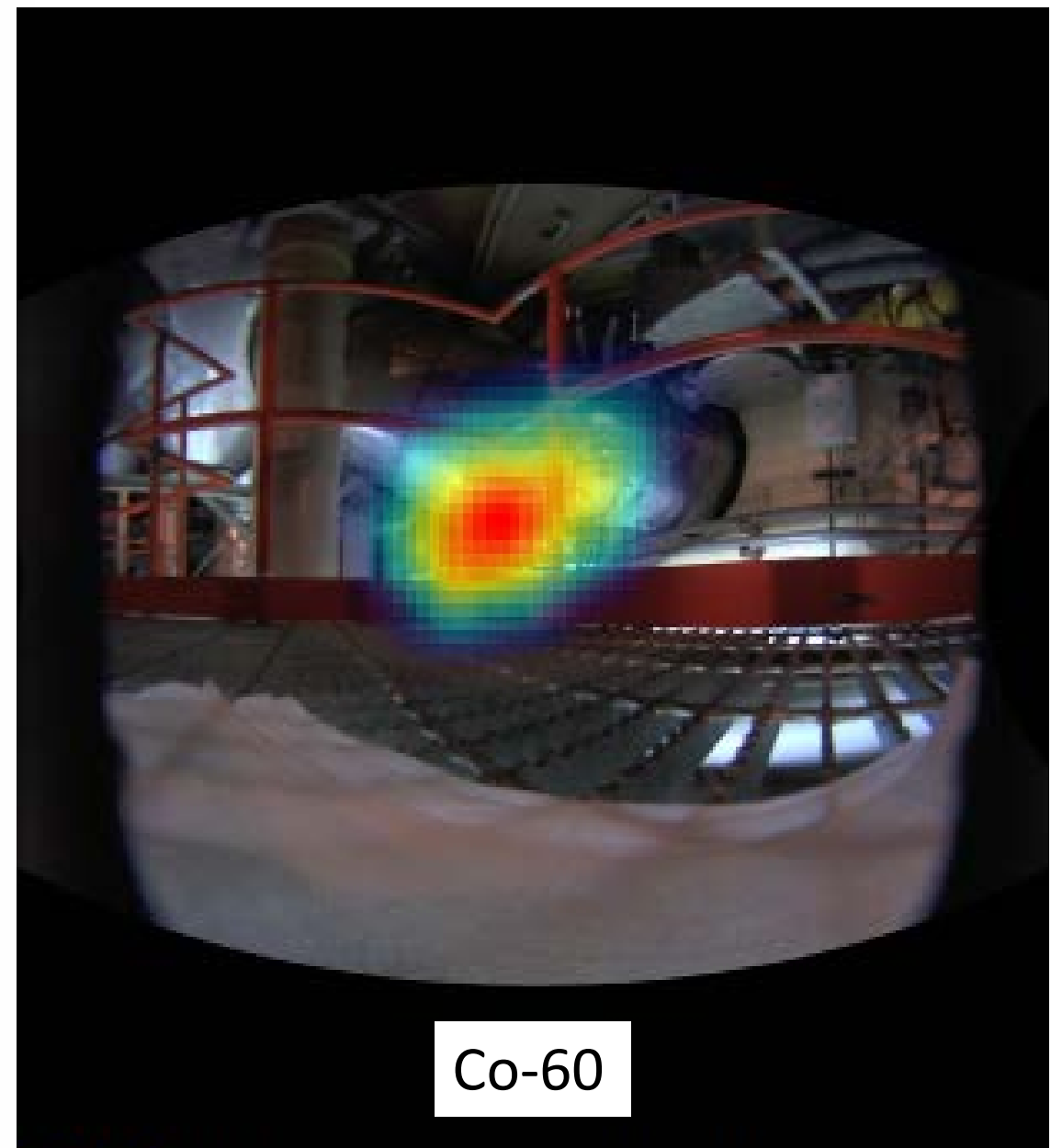


CRUD Location Isotopic – S/G Hot Leg Loop 2



Co-58

HED 18096 Imaged Cts; Co-58; hl24; 24:28



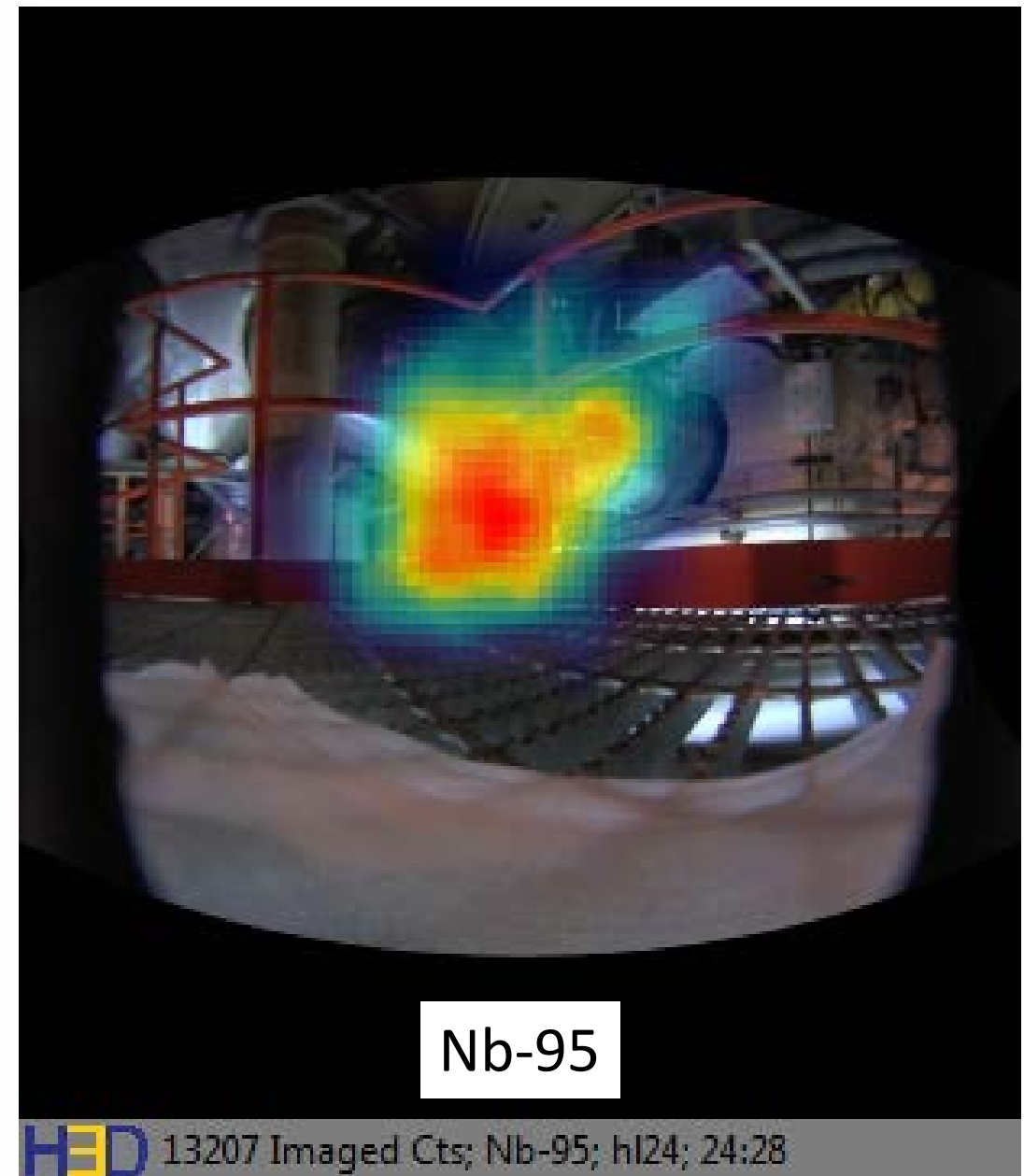
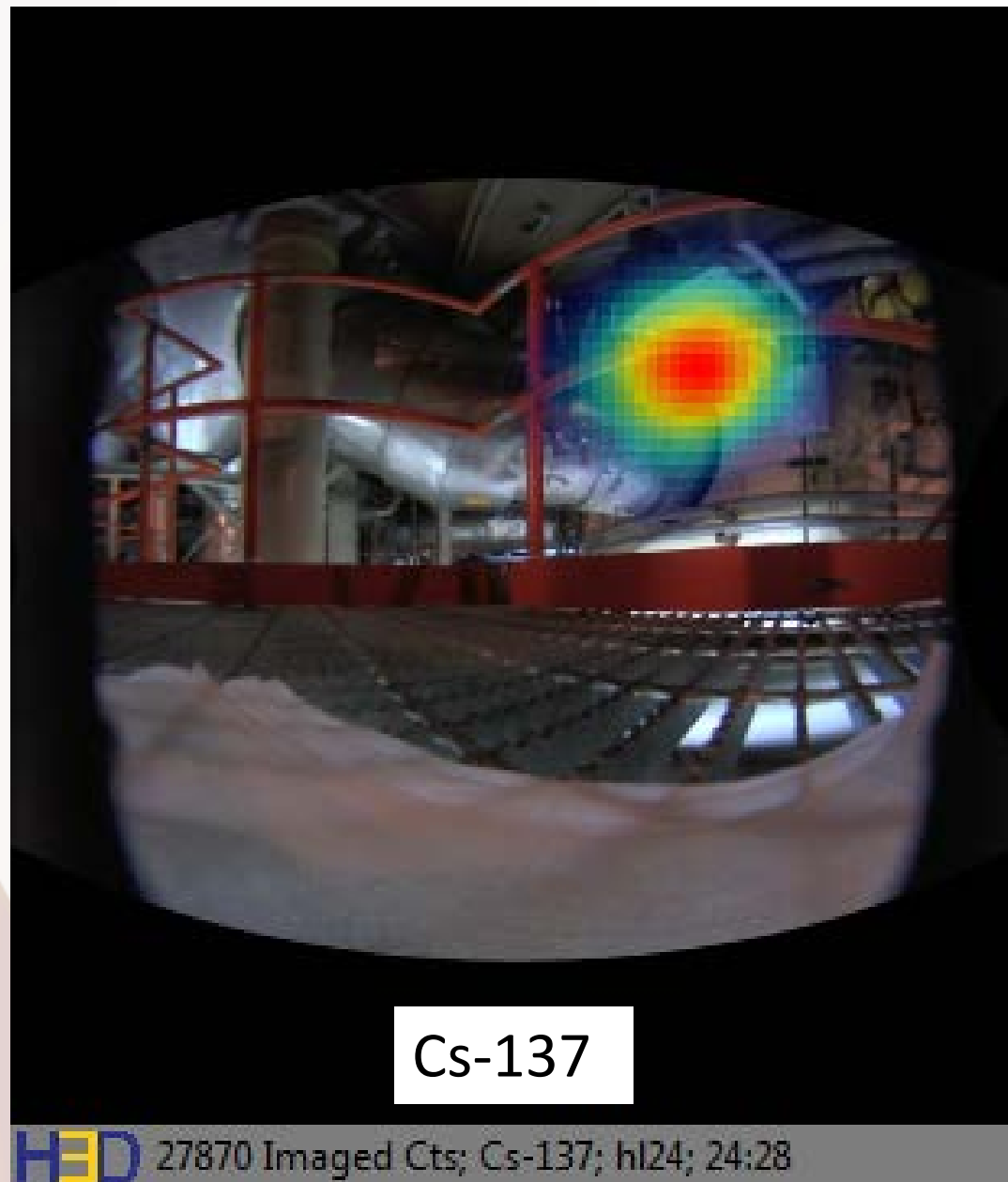
Co-60

HED 18171 Imaged Cts; Co-60; hl24; 24:28

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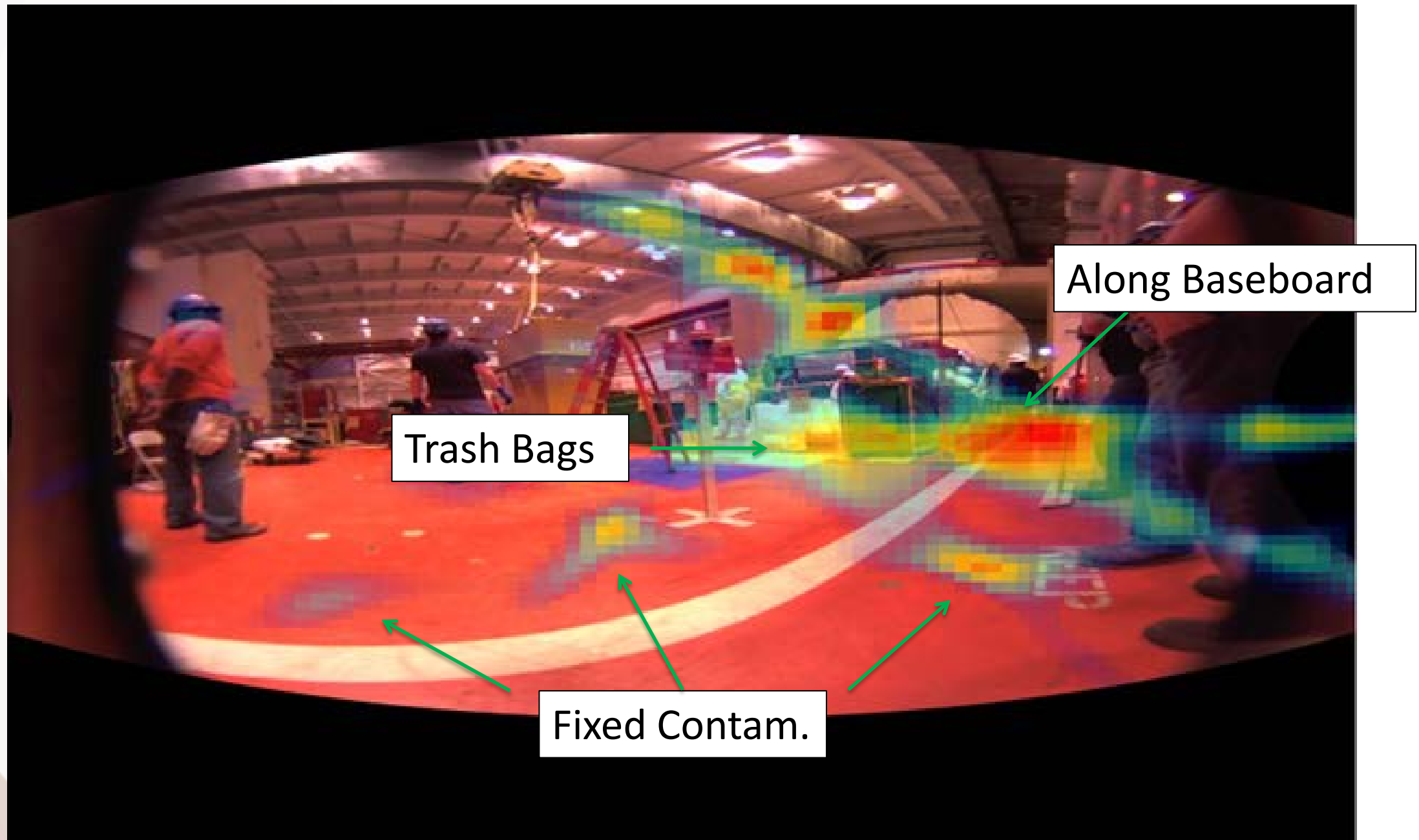


CRUD Location Isotopic – S/G Hot Leg Loop 2



Note: 30 minute count imaged 100 counts. For good resolution, distributed contamination should have minimum 1000 counts (5 hour image).

Percon Investigation(s)

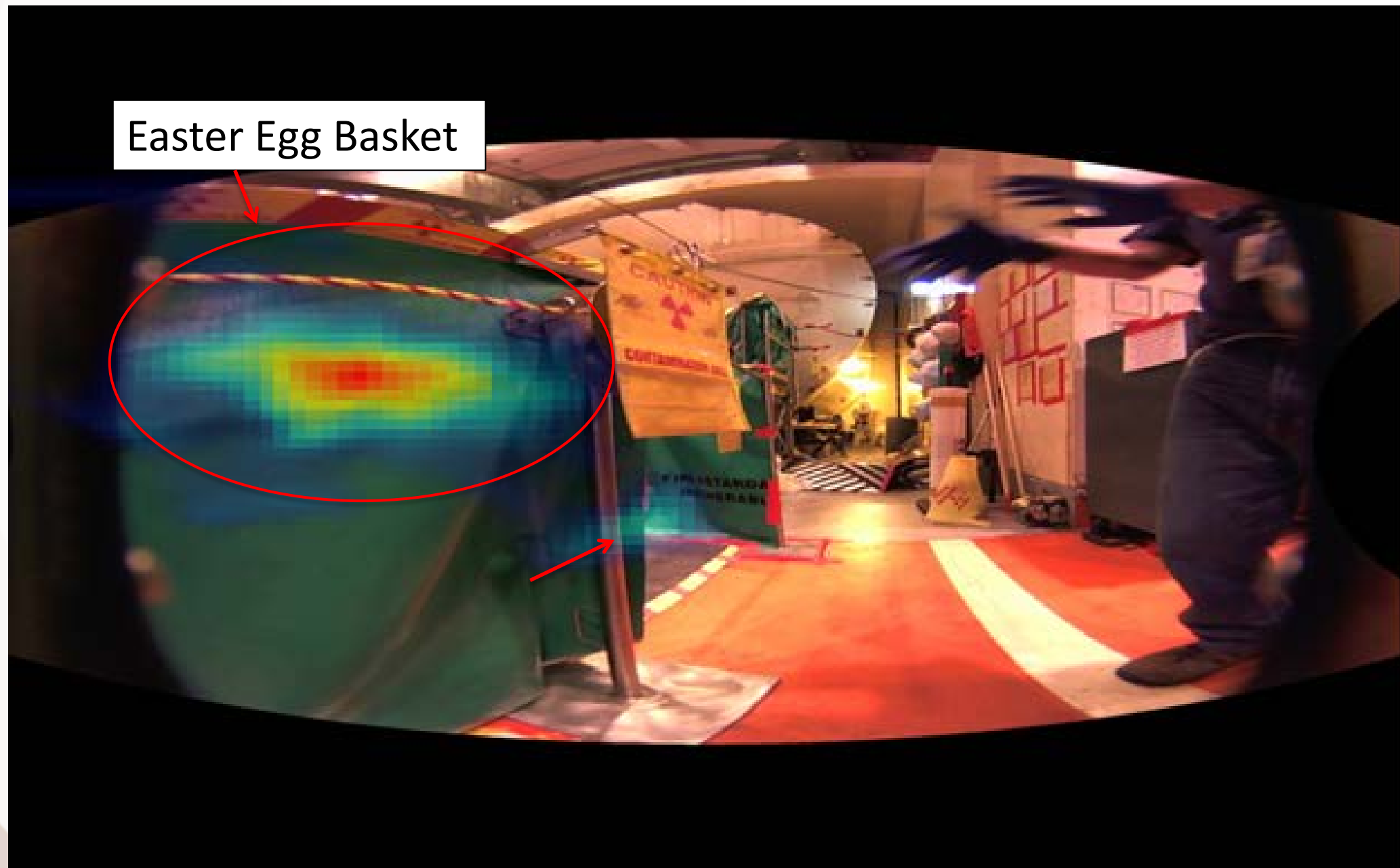


Percon Investigation(s)



Drained Transfer Canal did not show release of particles

Percon Investigation(s)



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Questions?



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