NATC CZT Data Analysis Working Group Achievements

Derek Hultquist – Health Physicist, & David W. Miller, NATC Regional Director, D.C. Cook,
American Electric Power
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Overview

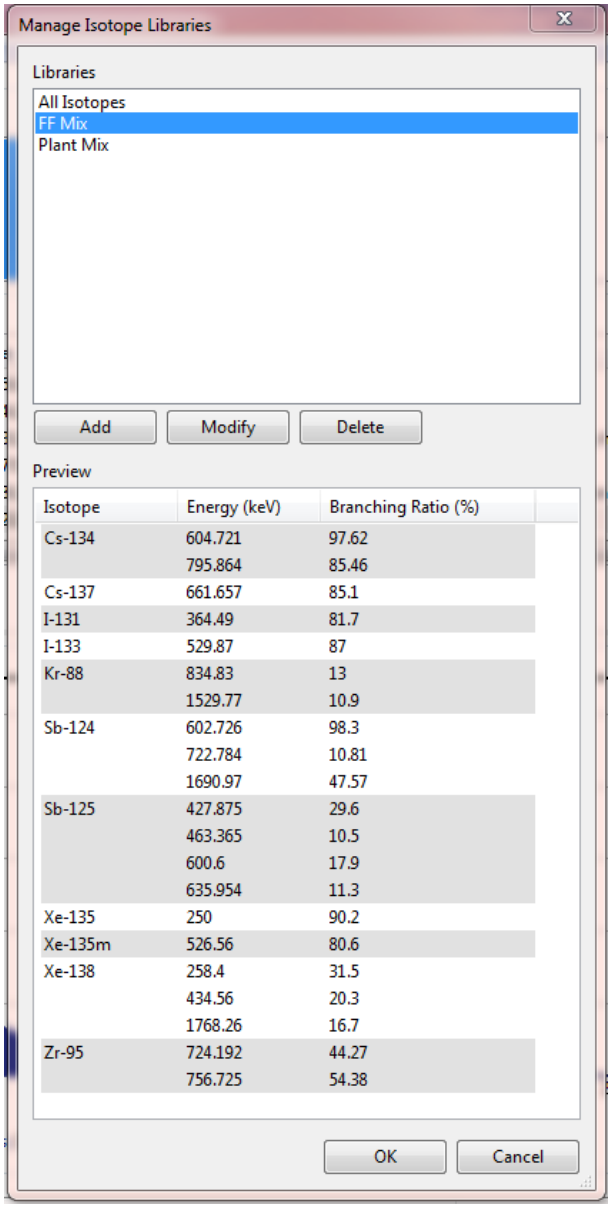
1. **Summary of August 24-26, 2016 CZT Data Analysis Working Group Meeting held at Cook**
2. **Examples of CZT 3D isotopic mapping analyzed by group**:
3. FF/Primary to Secondary Leakage
4. Foreign Material Investigation
5. Particle Investigation / Mitigation
    1. General
    2. Transfer Canal Job Coverage

Failed Fuel & Primary-to-Secondary Leakage Tracking

- D. C. Cook has failed fuel and current primary-to-secondary leakage in U2
- U1 has completed an outage (U1C27) with failed fuel

Failed Fuel & Primary-to-Secondary Leakage Tracking

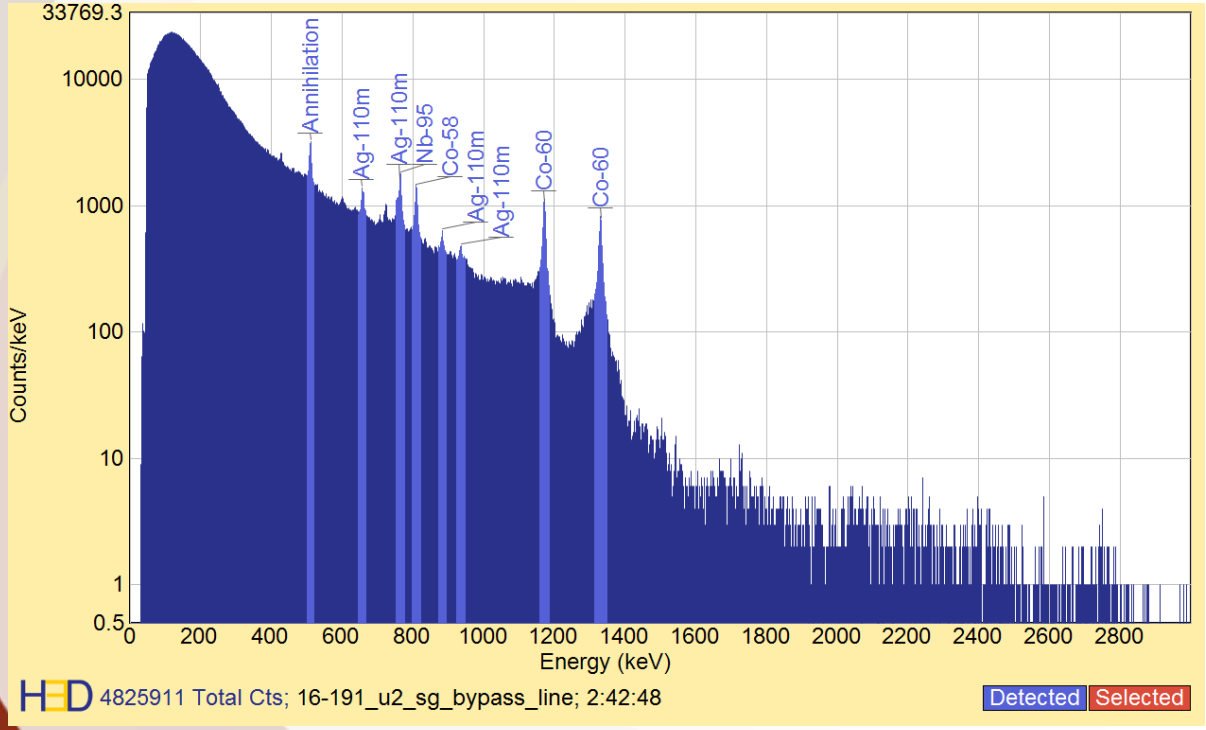
- Tracking & Investigation with CZT
- New Library: Noble Gases / Iodines / Corrosion Products
- Low energy – Lack of imaging

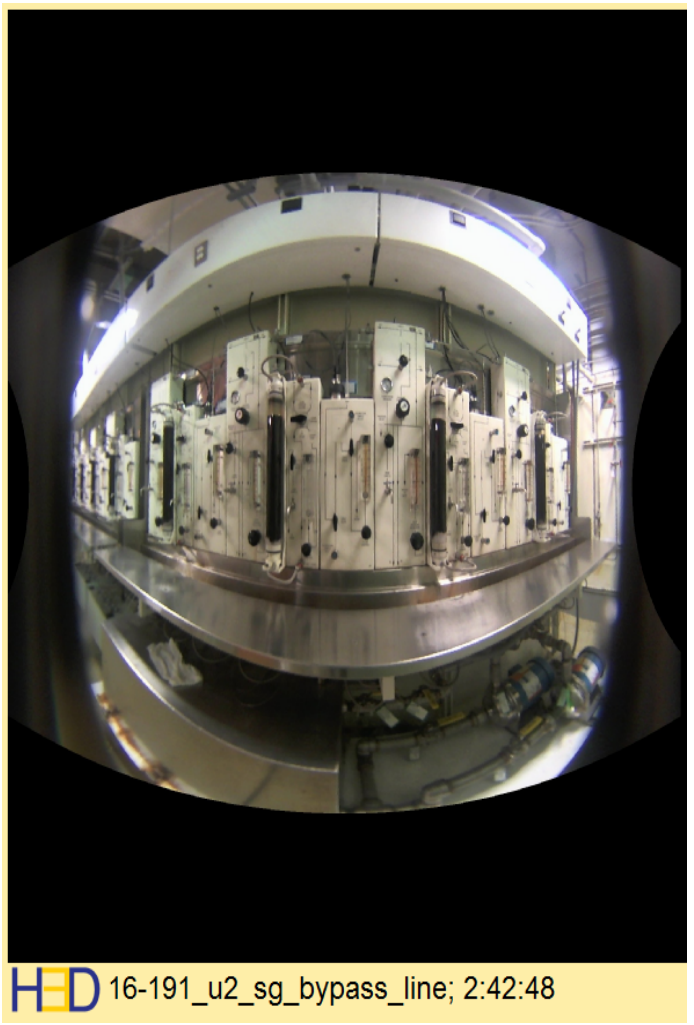


Isotope	Energy (keV)	Branching Ratio (%)
Cs-134	604.721	97.62
	795.864	85.46
Cs-137	661.657	85.1
I-131	364.49	81.7
I-133	529.87	87
Kr-88	834.83	13
	1529.77	10.9
Sb-124	602.726	98.3
	722.784	10.81
	1690.97	47.57
Sb-125	427.875	29.6
	463.365	10.5
	600.6	17.9
	635.954	11.3
Xe-135	250	90.2
Xe-135m	526.56	80.6
Xe-138	258.4	31.5
	434.56	20.3
	1768.26	16.7
Zr-95	724.192	44.27
	756.725	54.38

Failed Fuel & Primary-to-Secondary Leakage Tracking

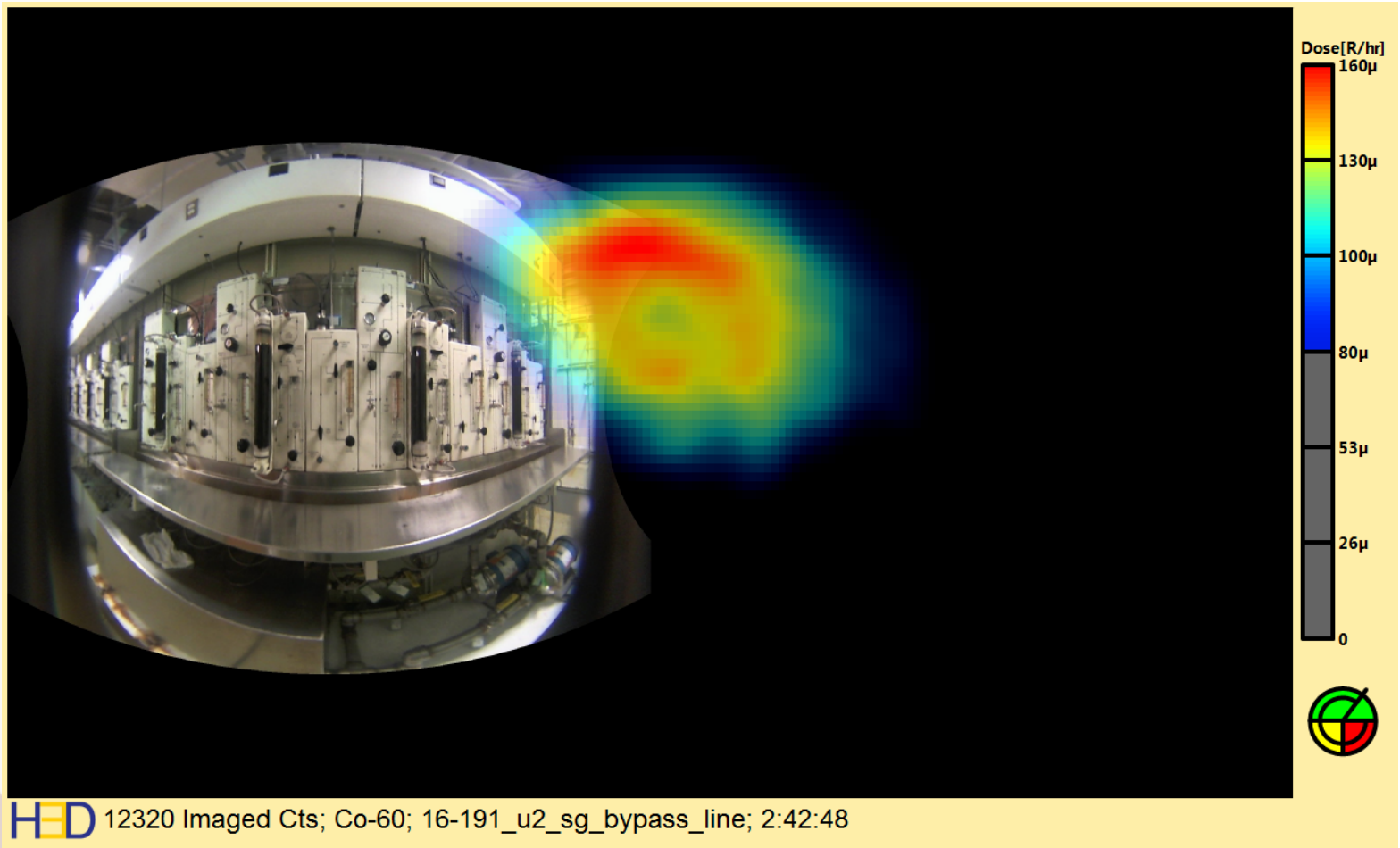
- Not always traceable



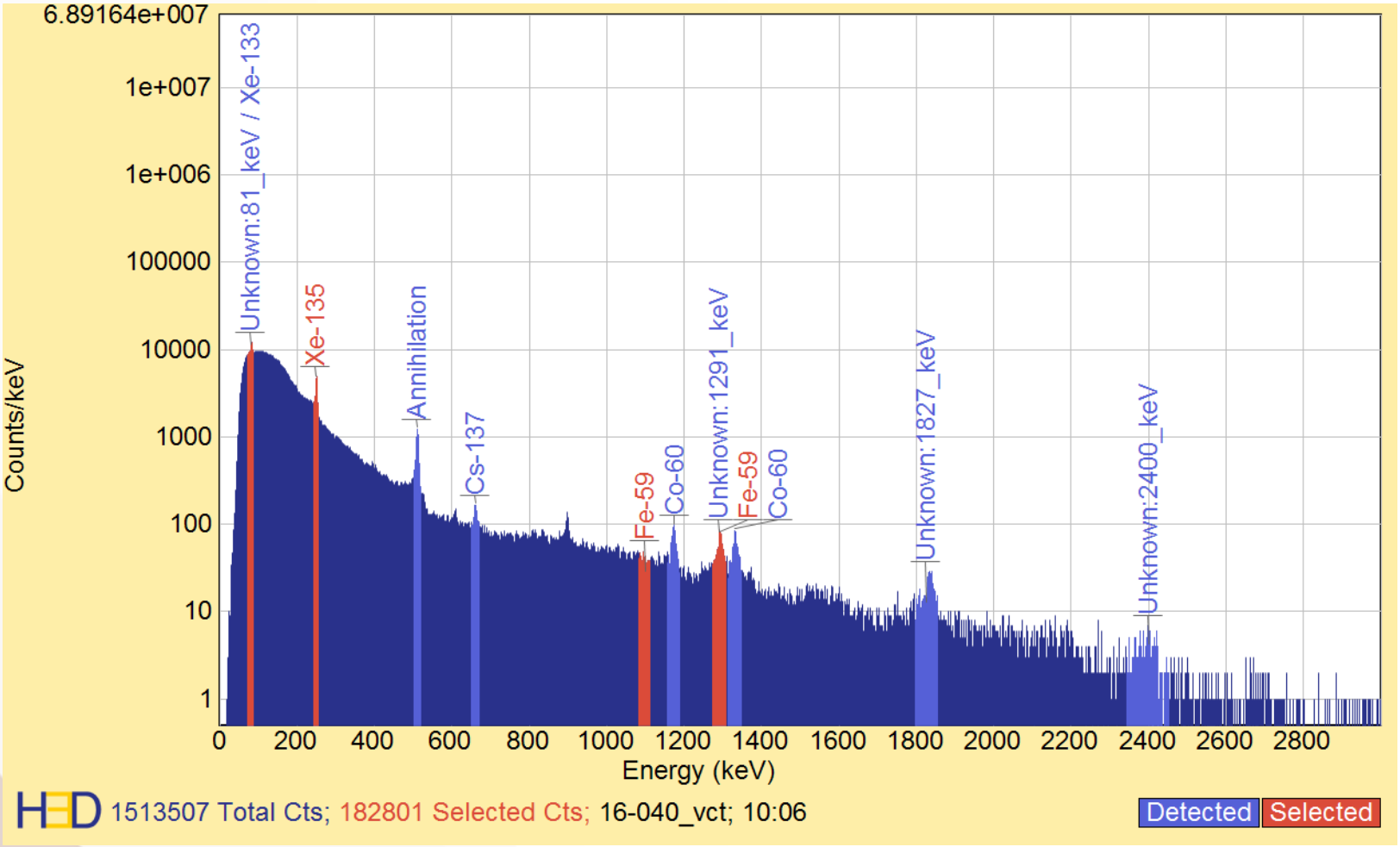


*Not a bad “0”

Failed Fuel & Primary-to-Secondary Leakage Tracking



Increased Dose Rates in VCT



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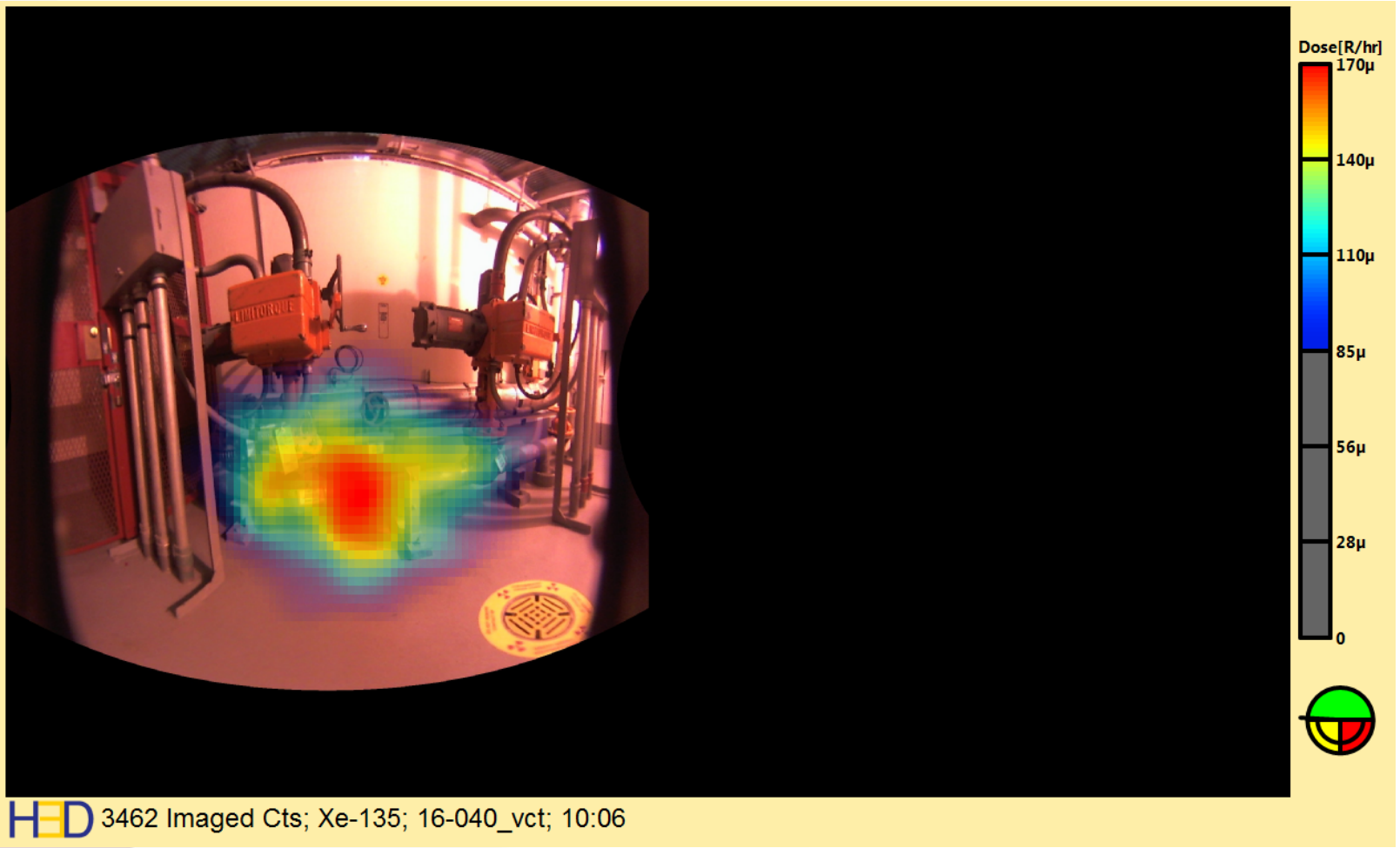

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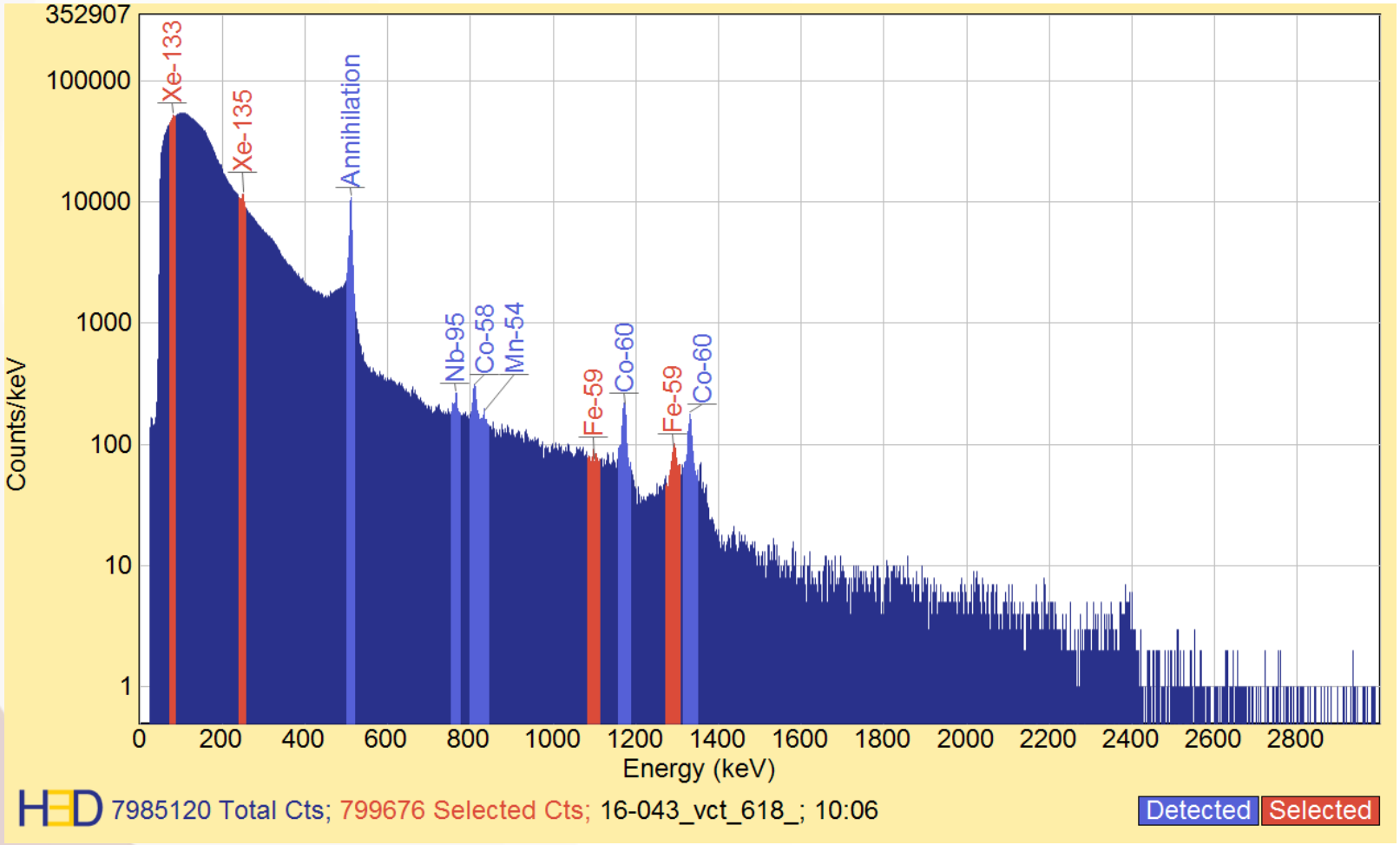

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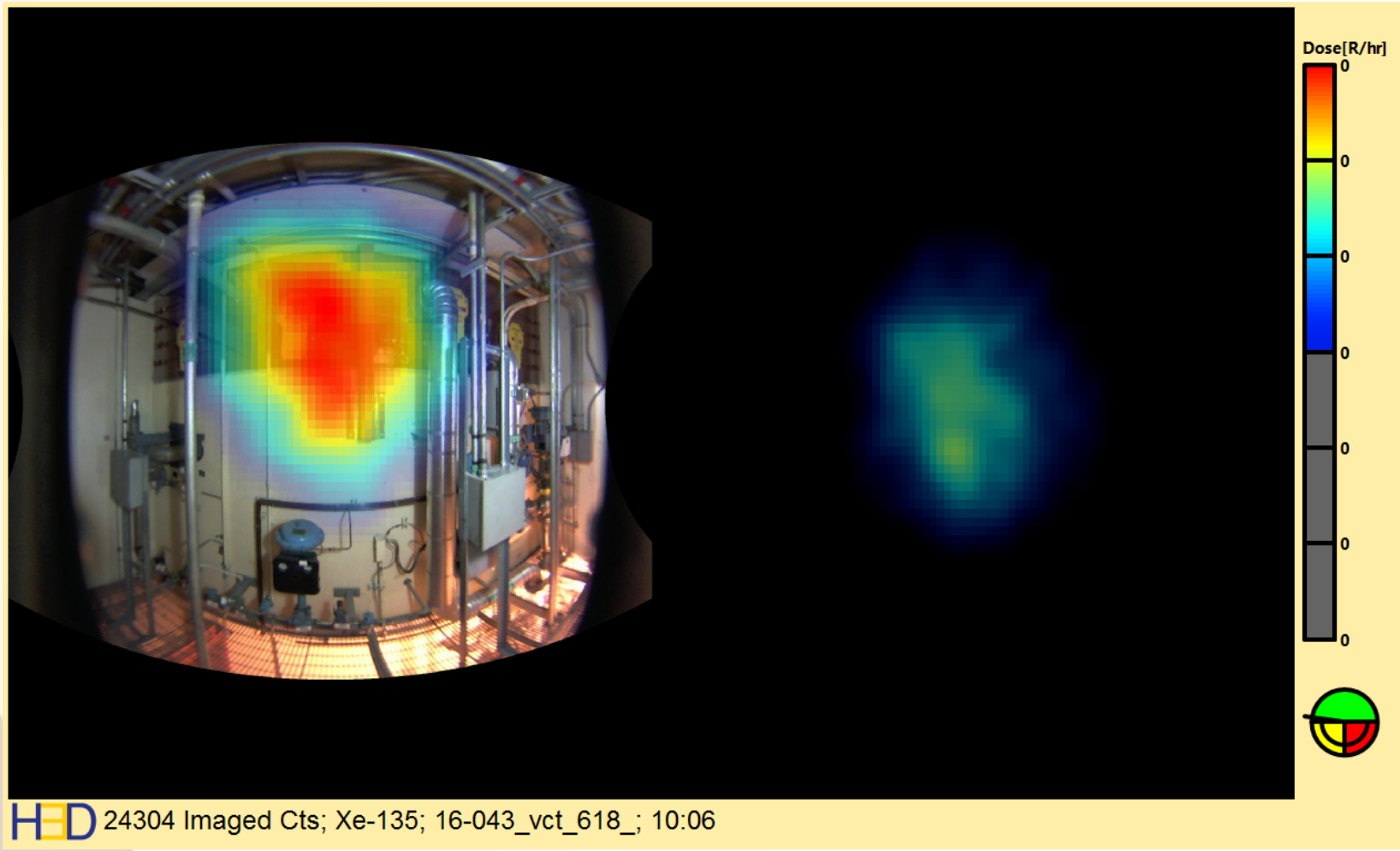
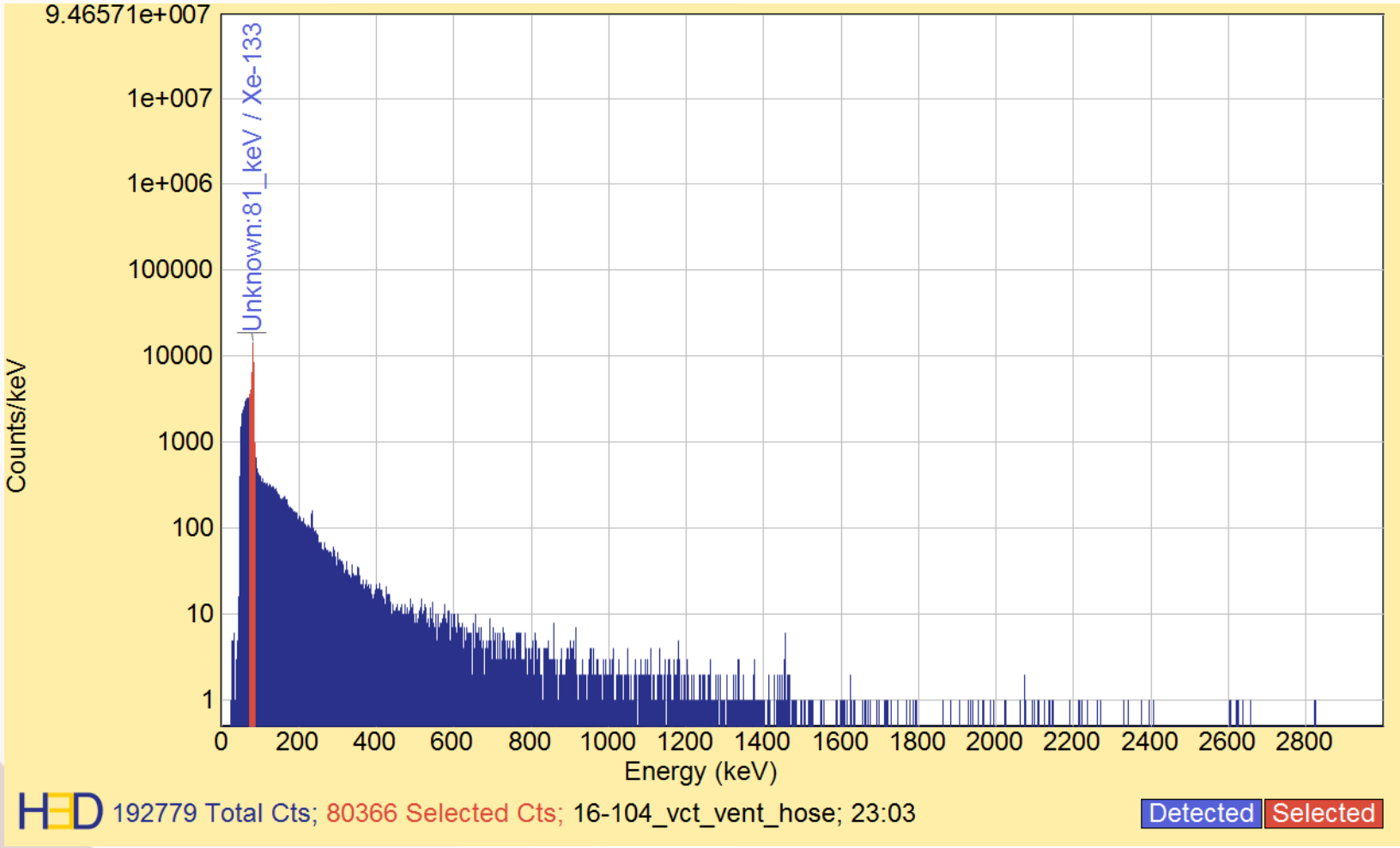


*Trace with energies > 250 keV if possible, preferably short half-lives

VCT bypass Vent hose to Vent Stack



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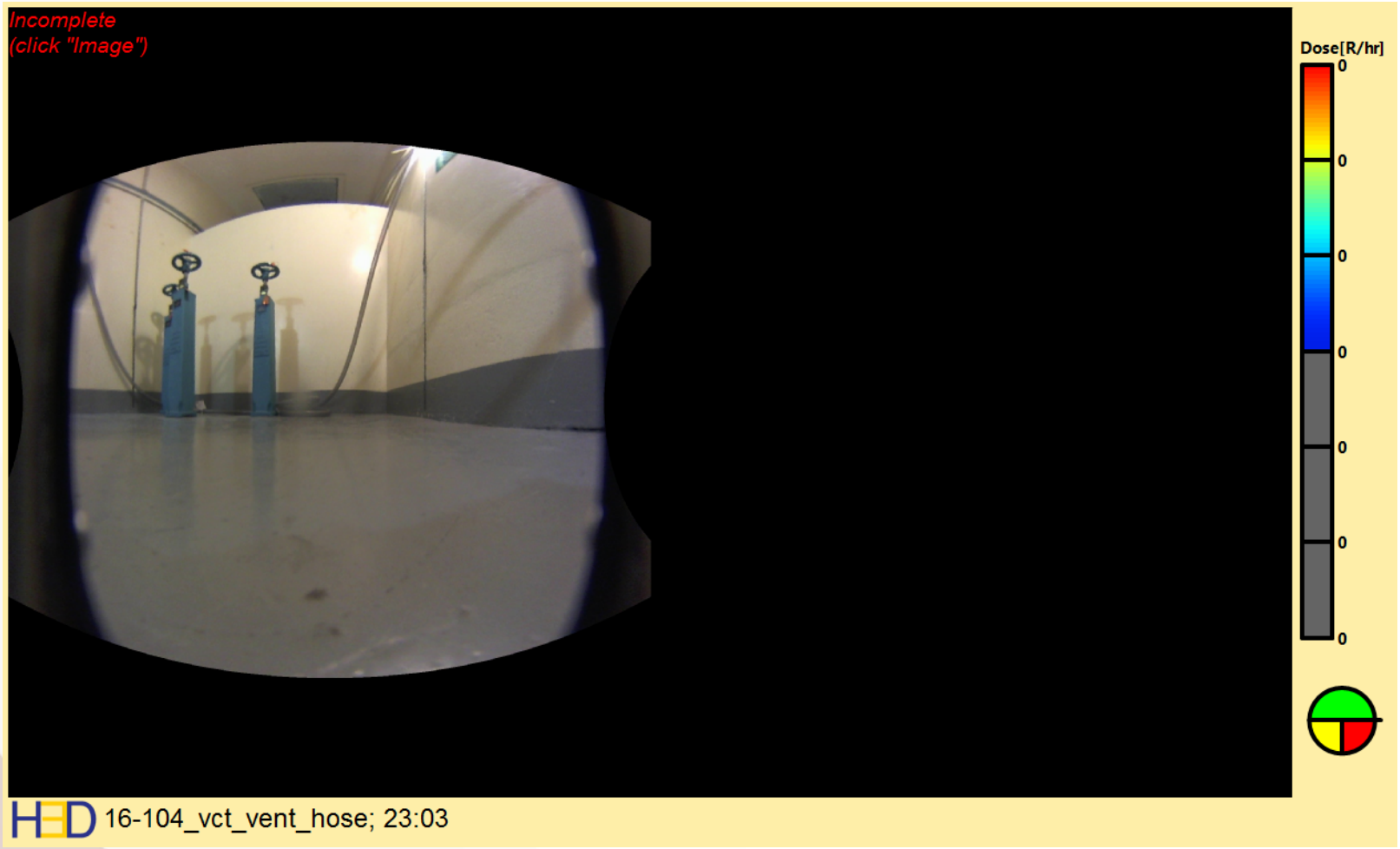
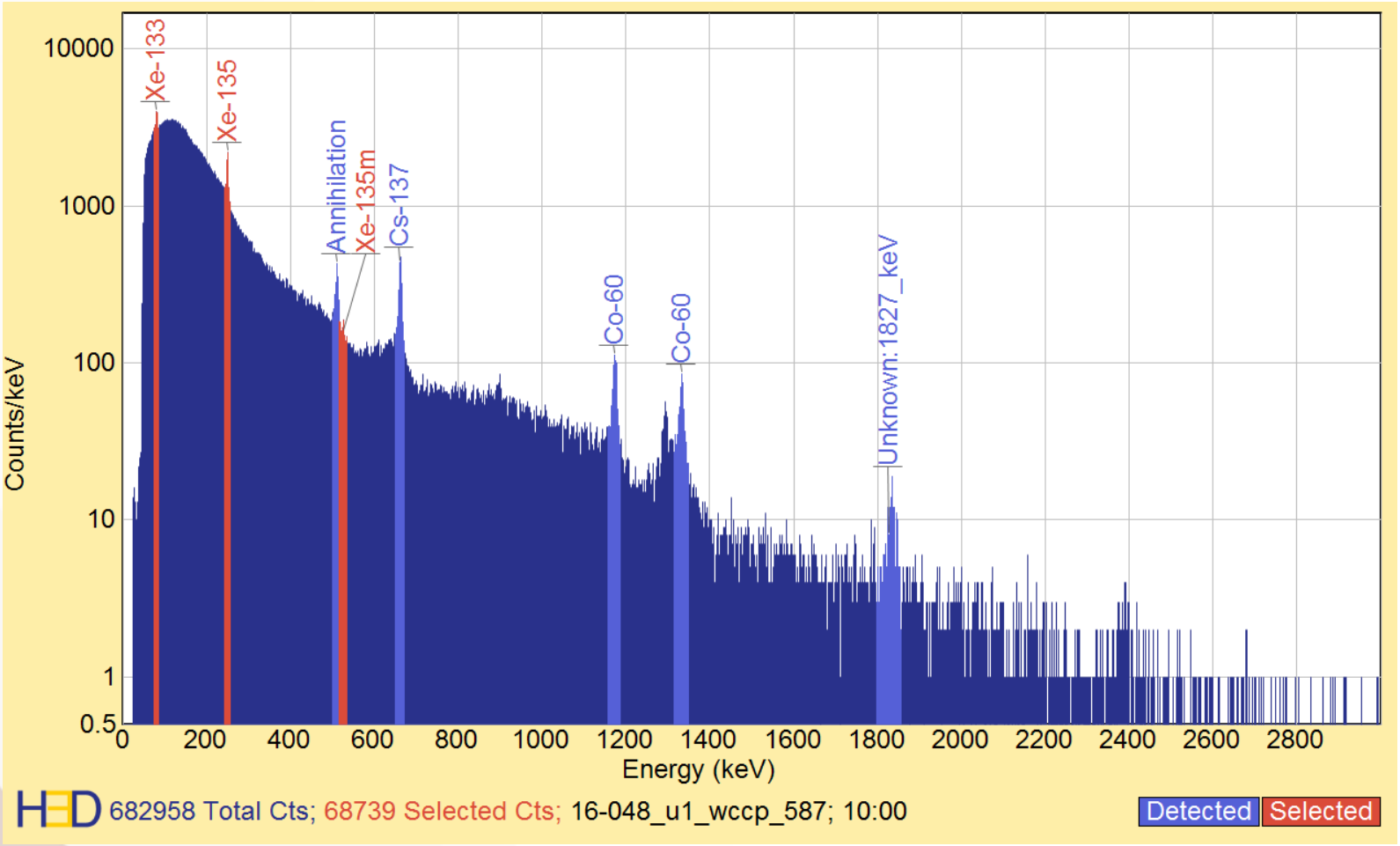


Charging Pump Rotor Replacement



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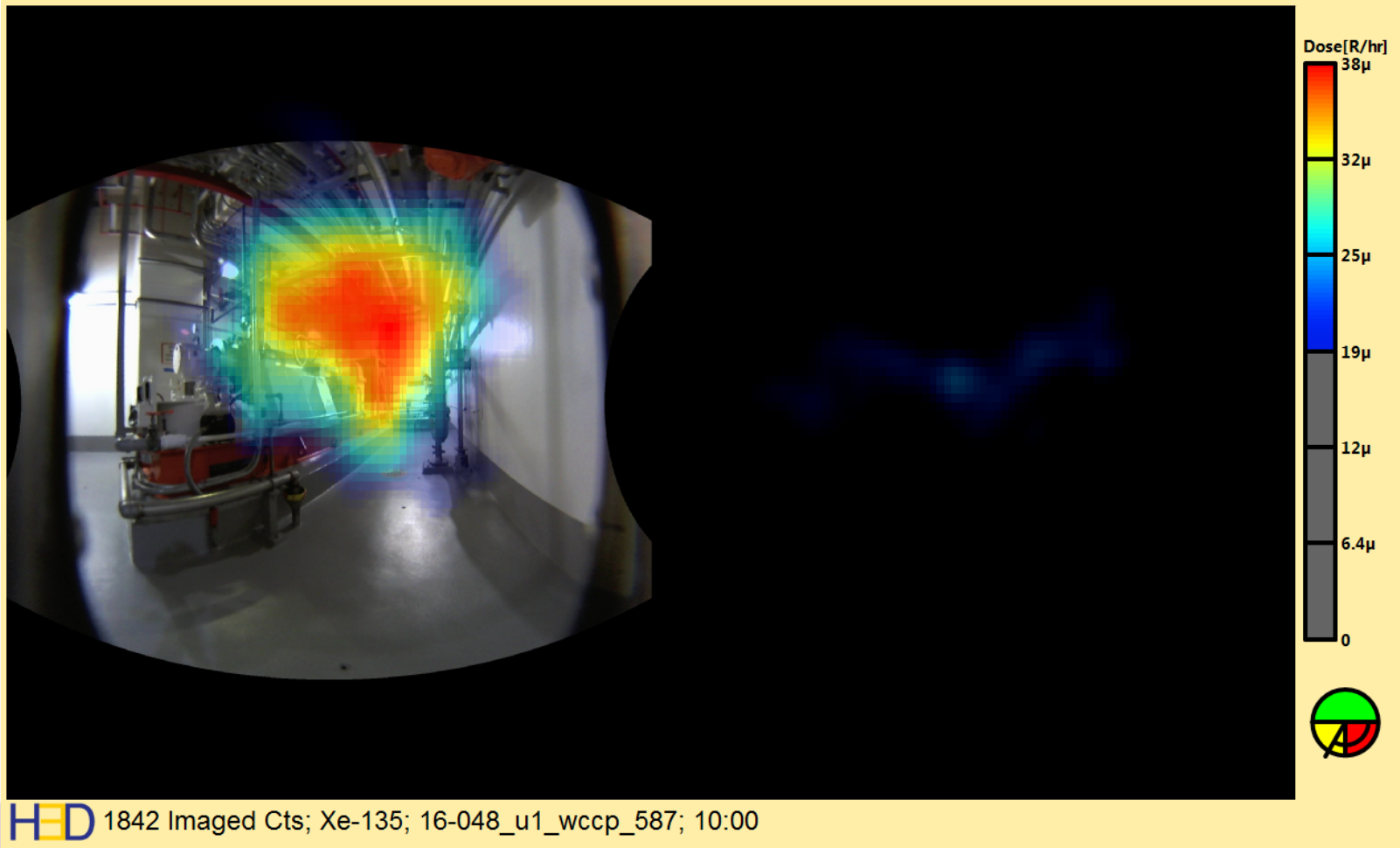
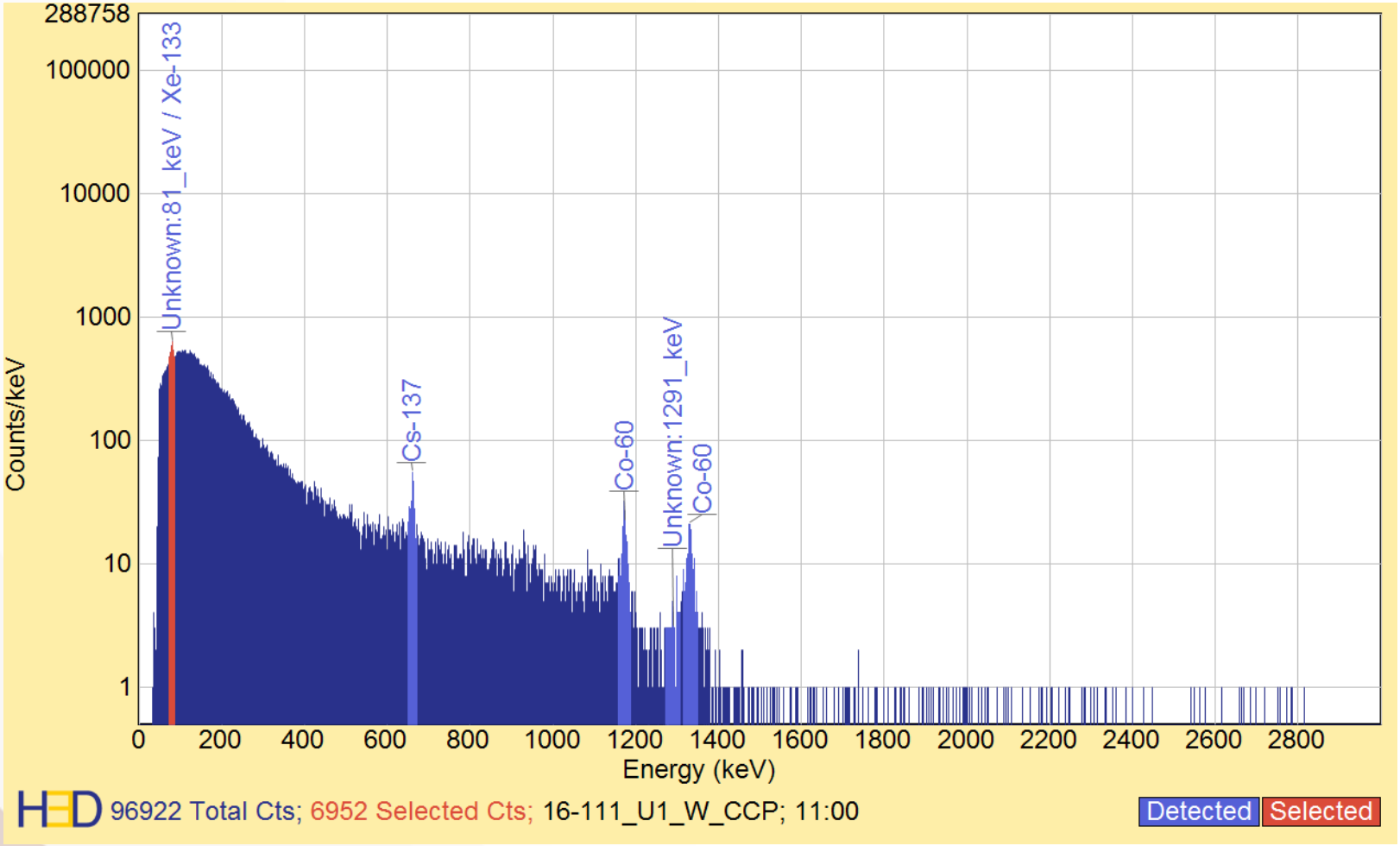


Charging Pump Rotor Replacement

Engineered Controls worked

- No PCM/PM Alarms
- No Uptakes (Lapel)

Charging Pump Rotor Replacement



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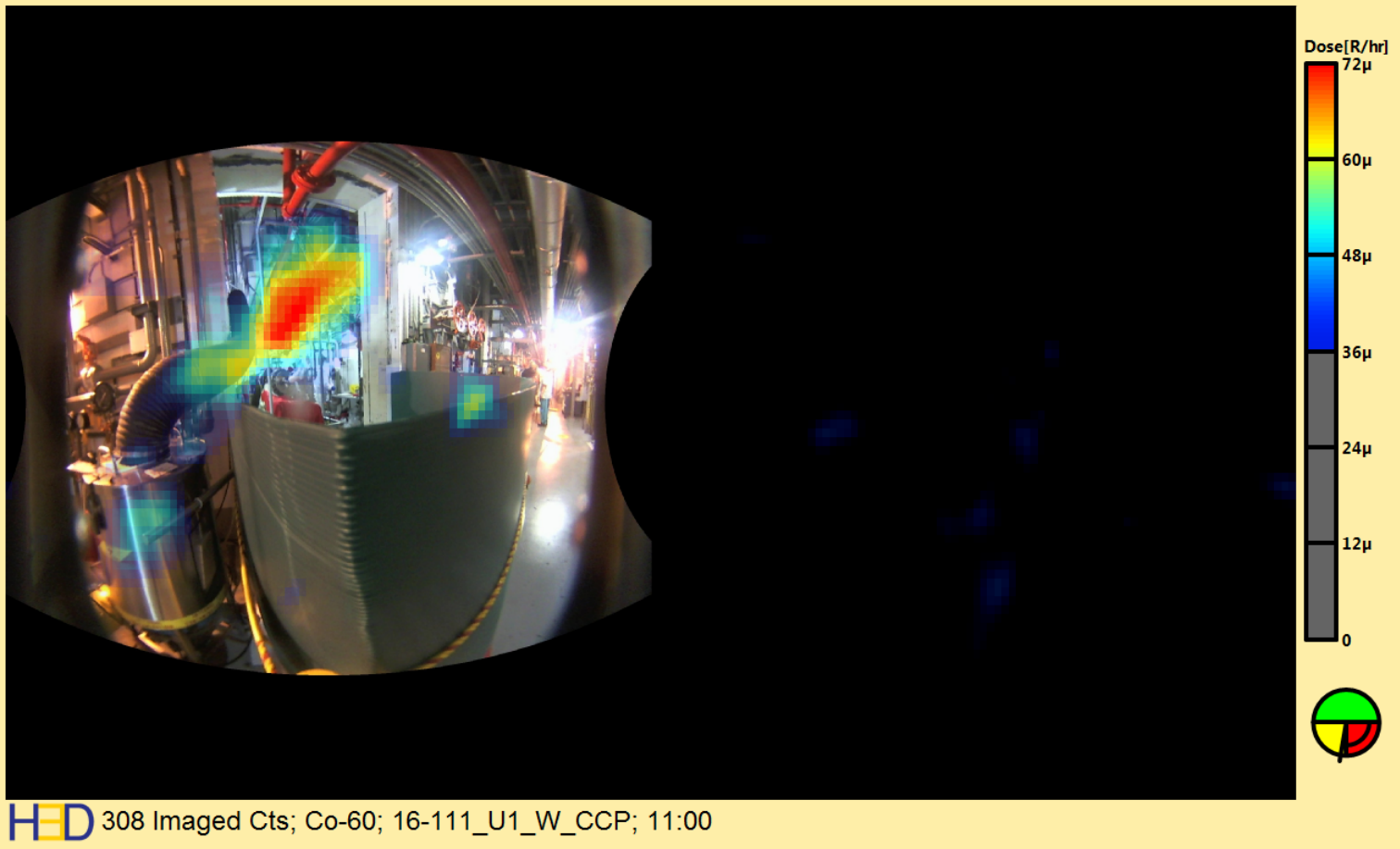
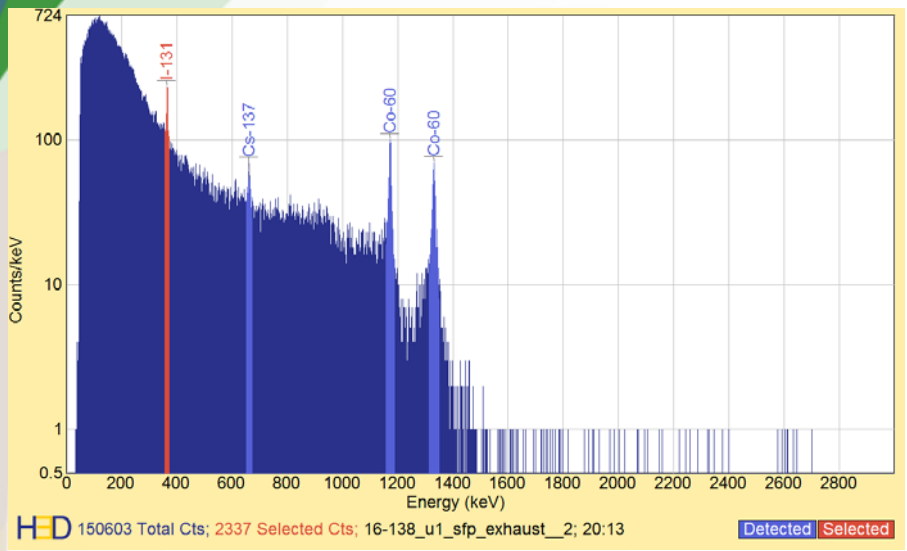


SFP Exhaust Trend

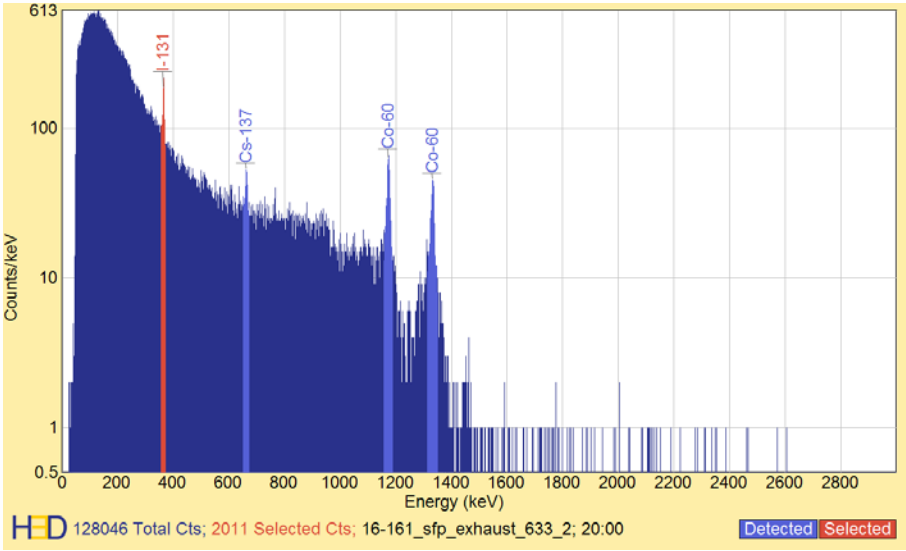
- Failed Fuel Bundle in SFP
- Track Release
- Should drop off with no delta-P

SFP Exhaust Trend

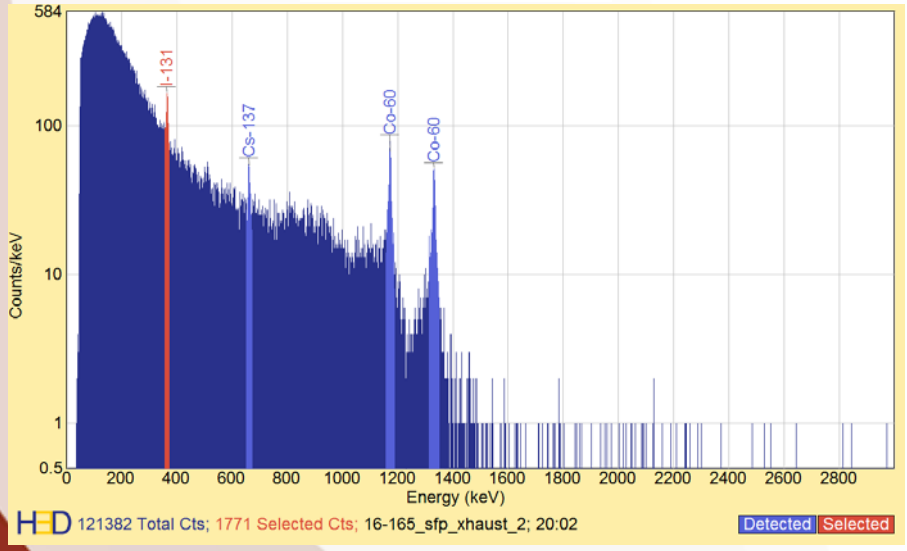
8 day half-life



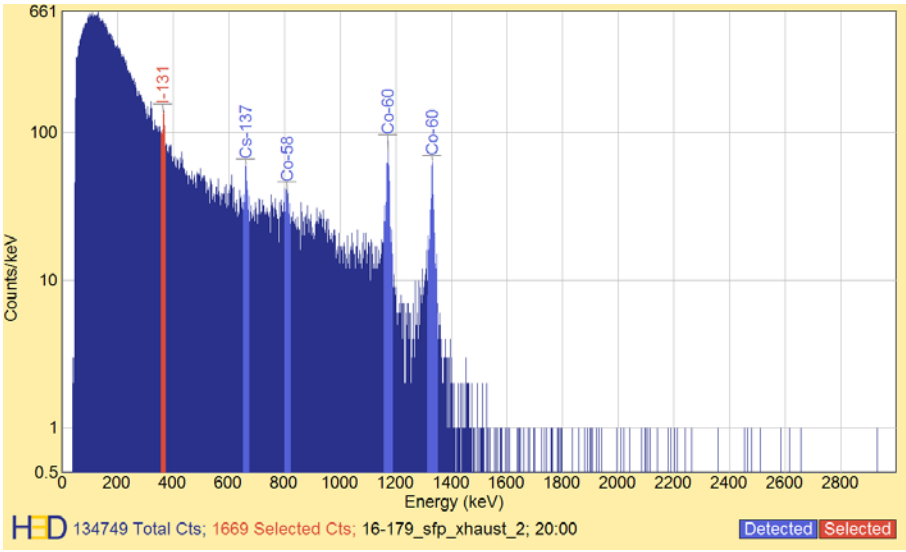
4/5/16



4/12/16



4/18/16



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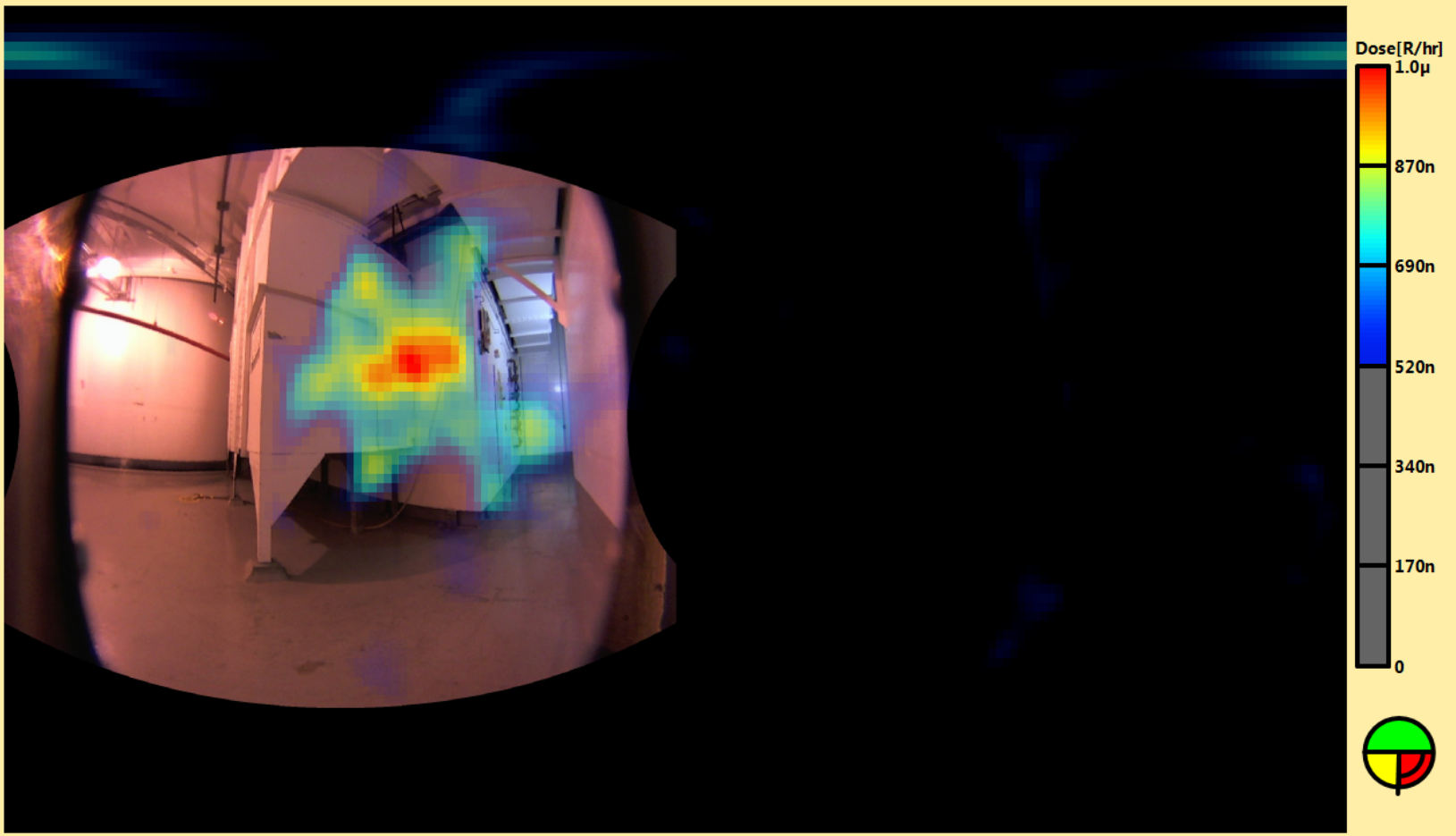
SFP Exhaust Trend



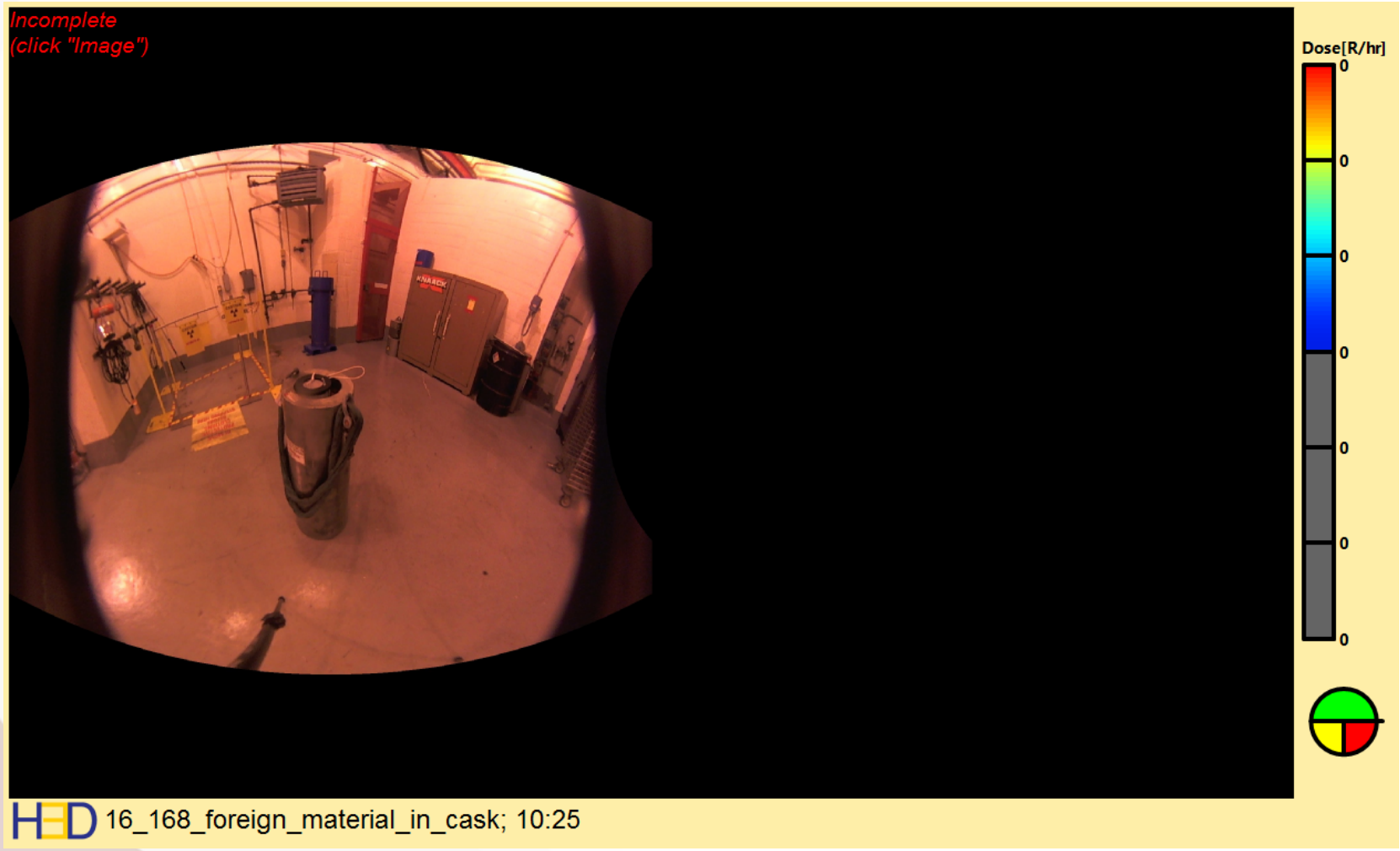
Foreign Material Analysis

- Foreign material found during outage
- Approximately the size of a fingernail
- Contact exposure of 16 R/hr w/ Telepole
- CZT estimated exposure rate of 100-200 mR/hr 30 inches away.

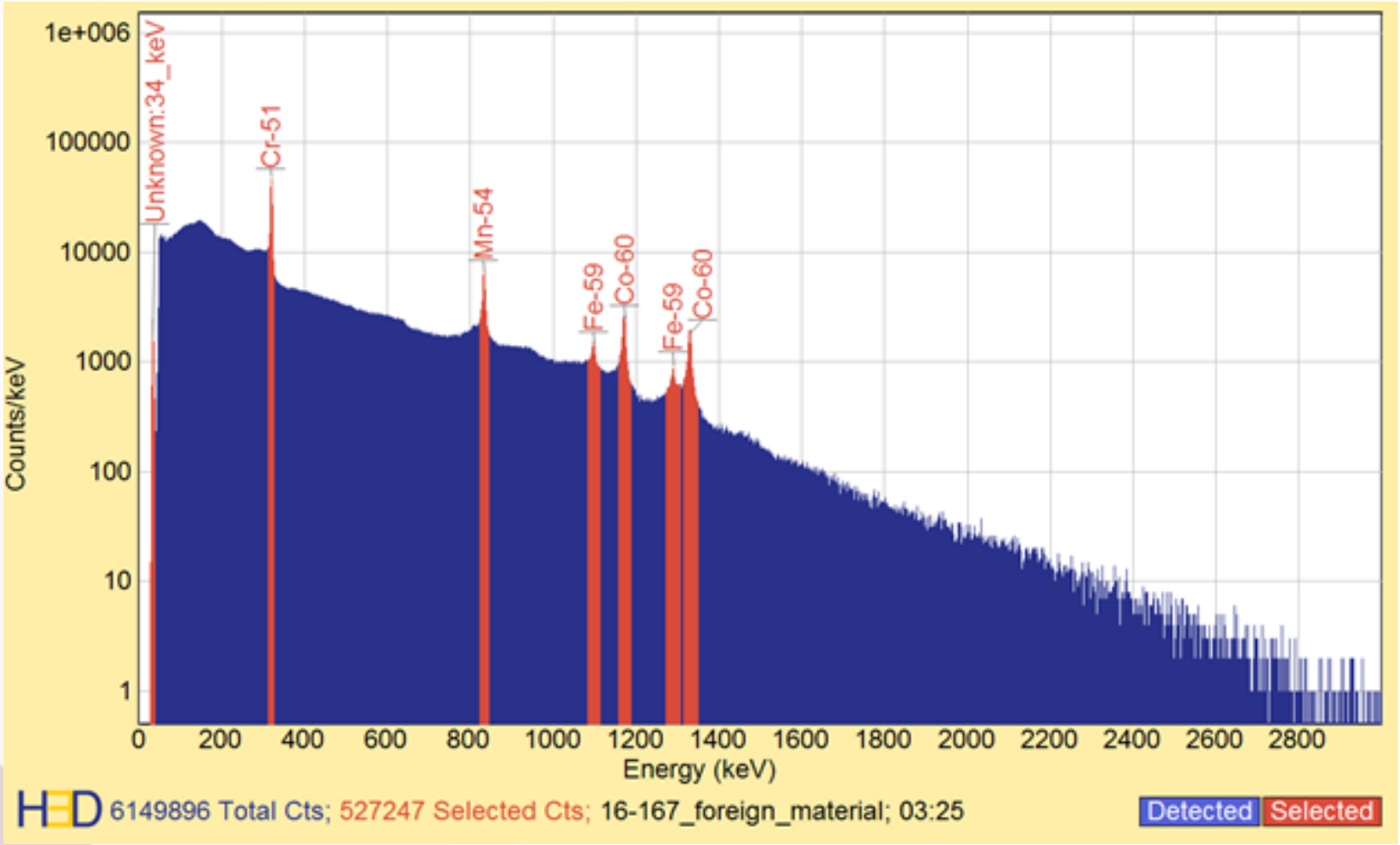
Foreign Material Analysis

- 3 minute, 25 second duration
- 72.7% dead time
- 56 second live time
- The lowest counts seen in a peak energy region was 55,750 for Fe-59
- Only Activation Products seen

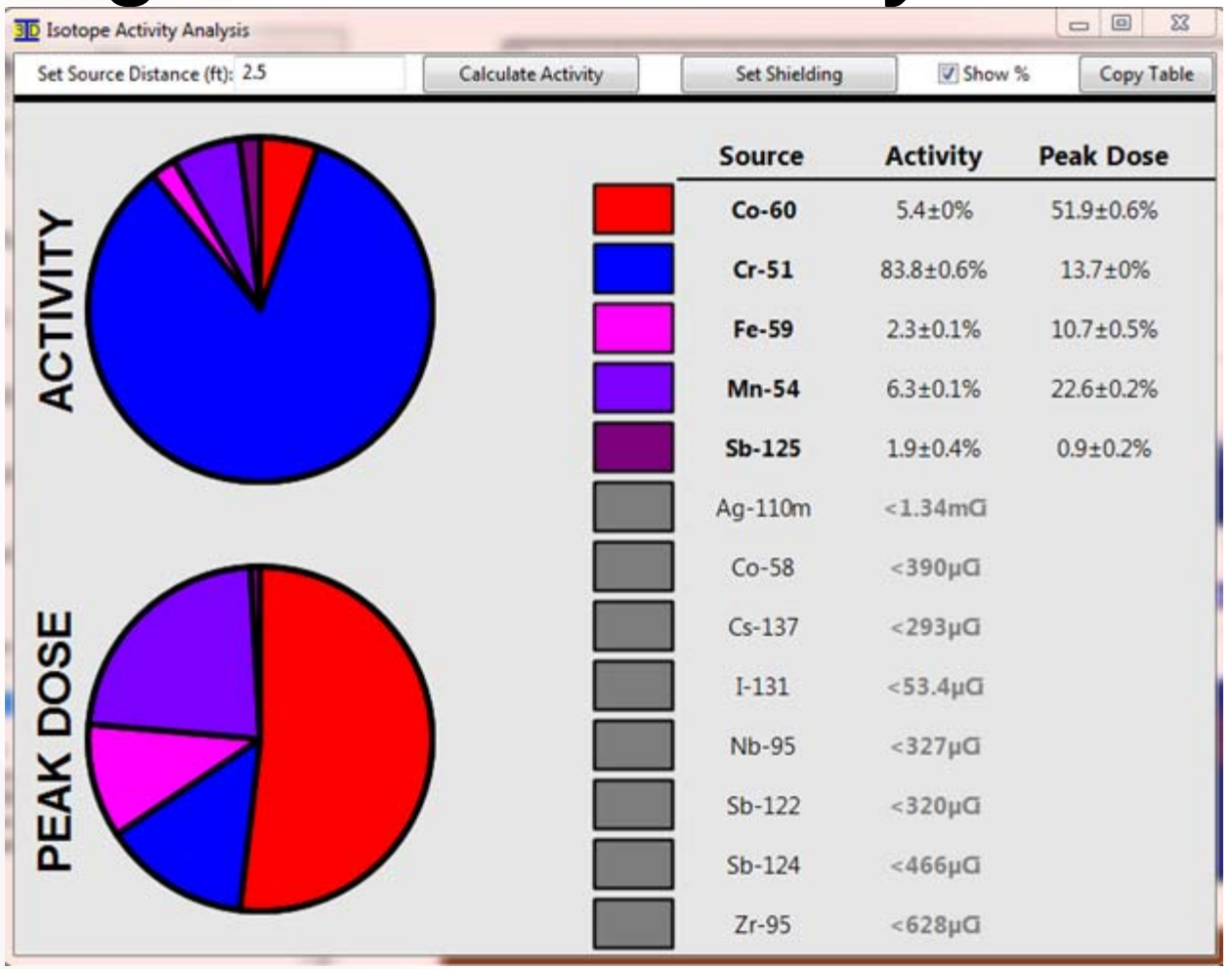
Foreign Material Analysis



Foreign Material Analysis

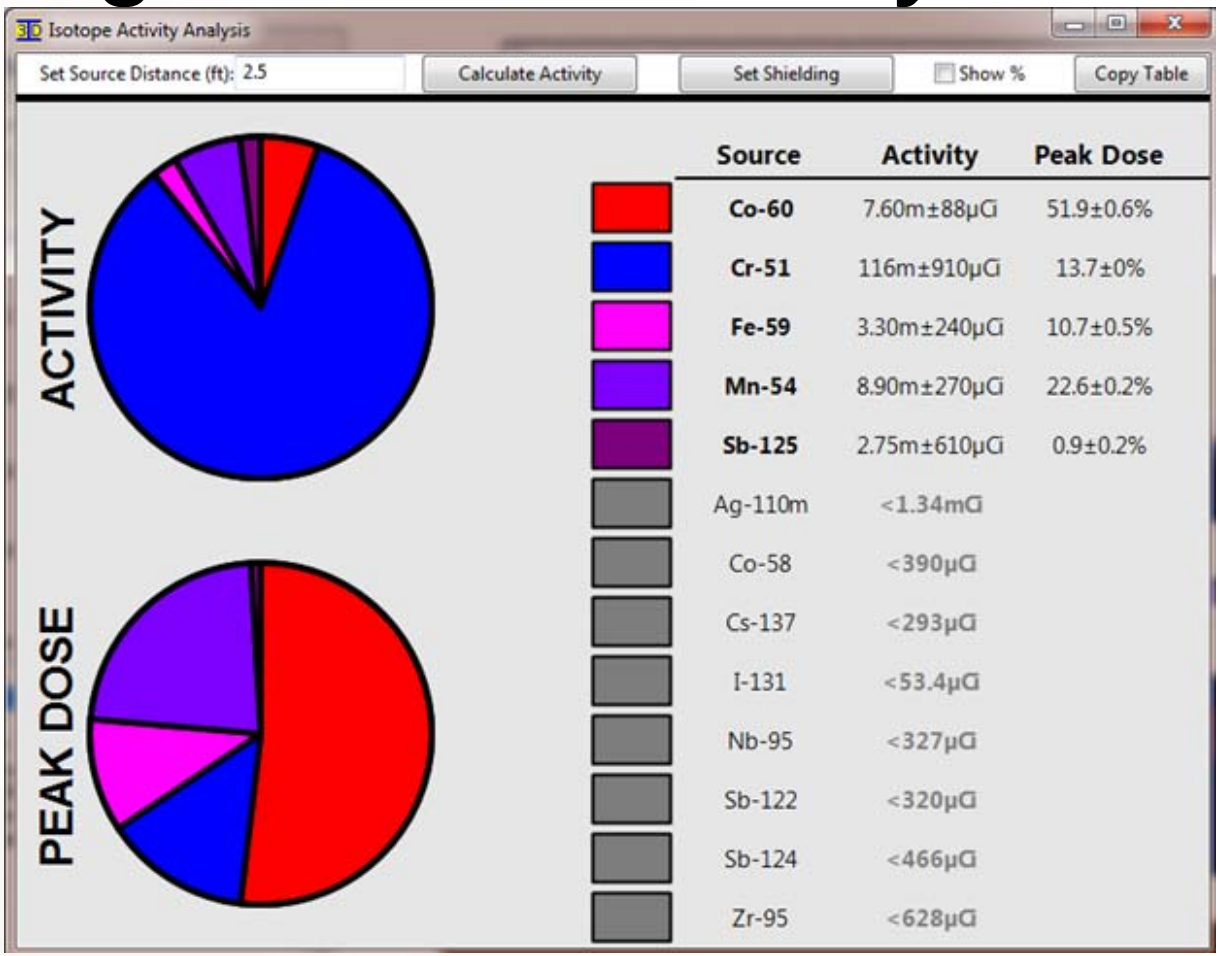


Foreign Material Analysis



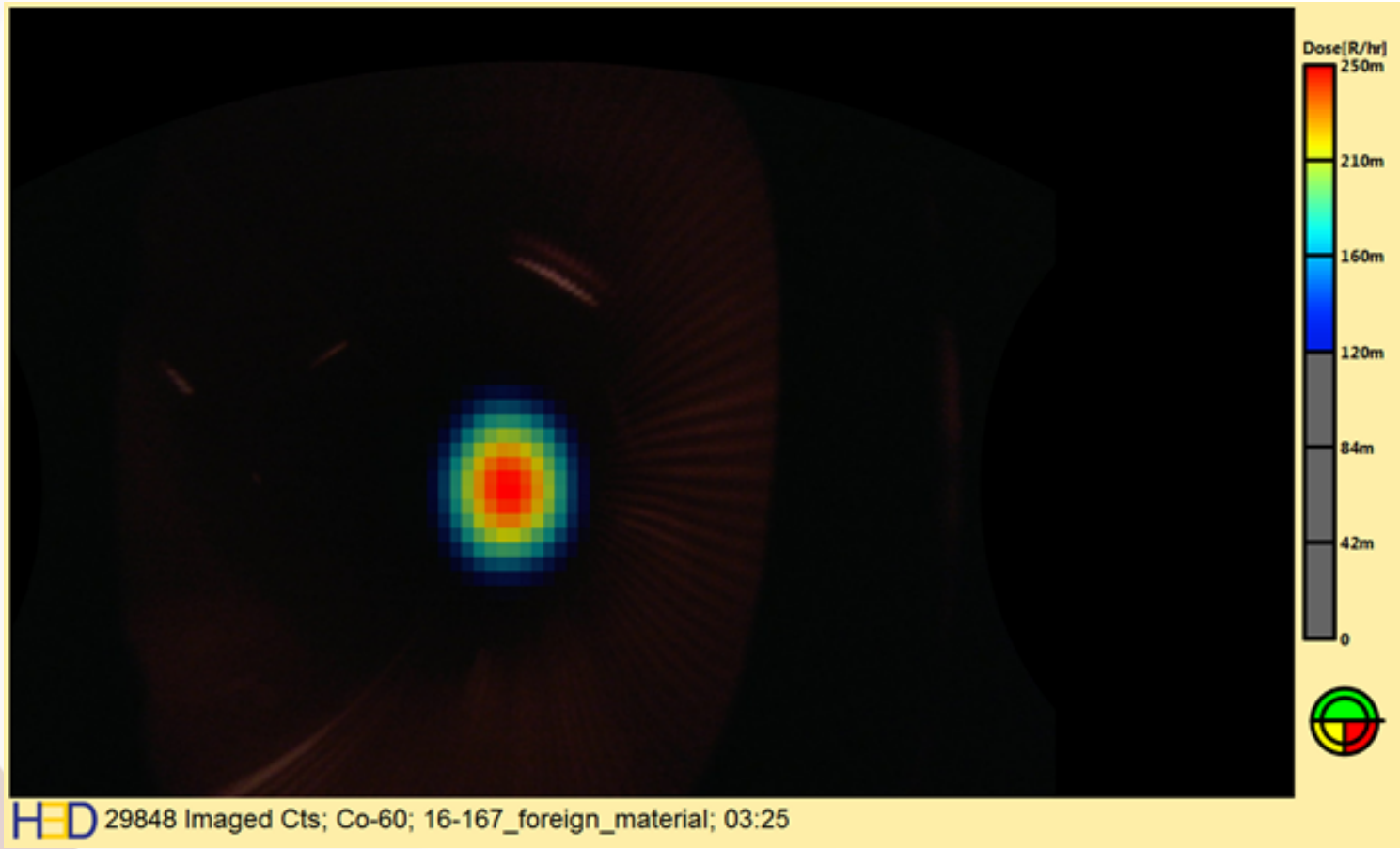
Percent Contributions

Foreign Material Analysis

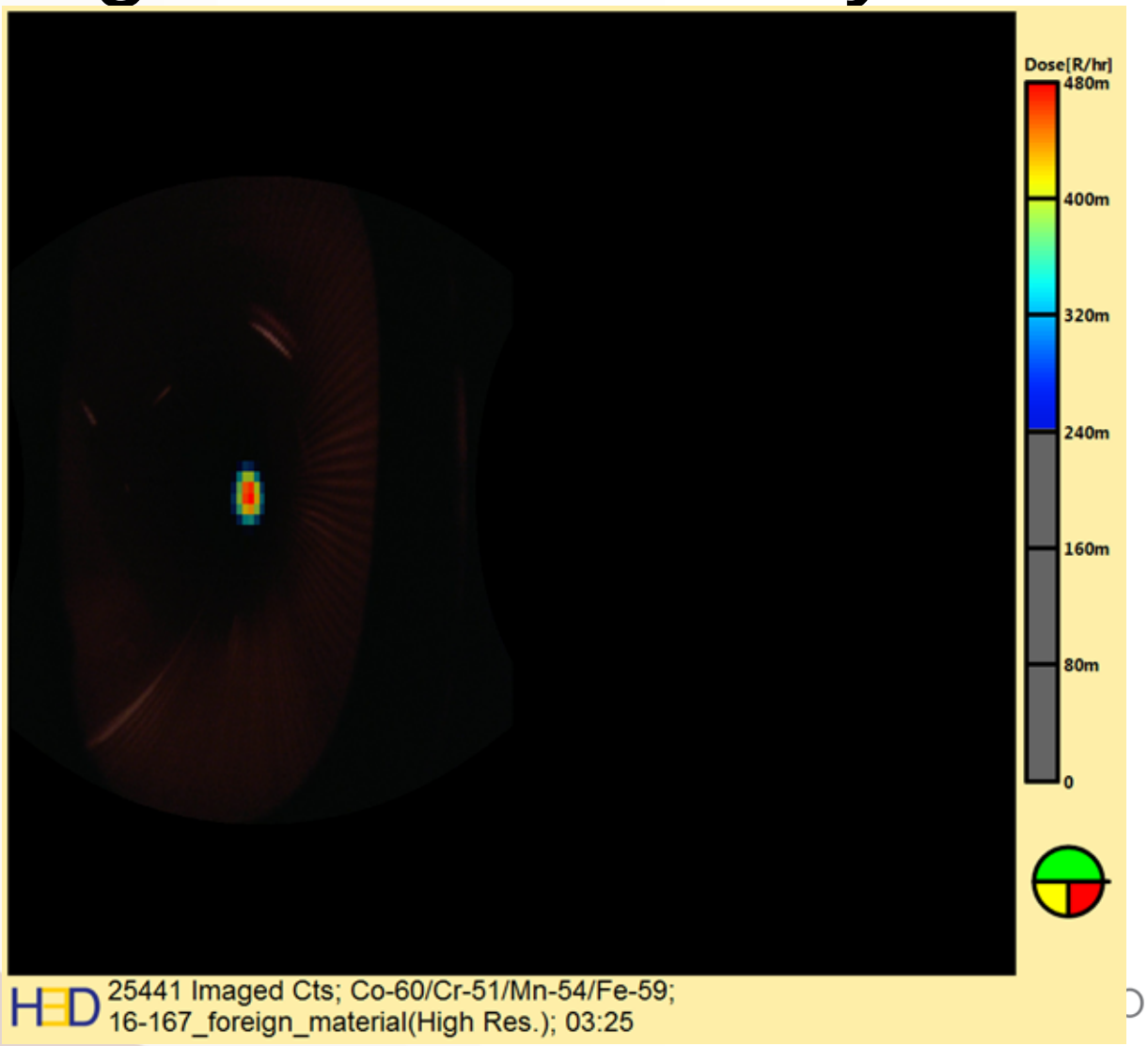


Activity Contributions

Foreign Material Analysis



Foreign Material Analysis



Foreign Material Analysis

Isotope	Half-Life	Gamma Energy	Intensity	Back calculated Activity	Back Calculated % Activity
Co-60	5.27 years	1173 keV	99.97%	7.68 mCi	2.78%
		1332 keV	99.99%		
Cr-51	27 days	320 keV	9.92%	253.8 mCi	91.86%
Fe-59	44.5 days	1099.25 keV	56.5%	5.3 mCi	1.92%
		1291.6 keV	43.2%		
Mn-54	312.3 days	834.8 keV	99.98%	9.52 mCi	3.45%

The initial calculated activity was determined by assuming that criticality ended at 3/23/16 for a duration of approximately 30.5 days (t-t_0) between end of criticality and the measurement. Activity was calculated by using the equation below.

$$A = A_0 * e^{-\frac{0.693}{T}(t-t_0)}$$

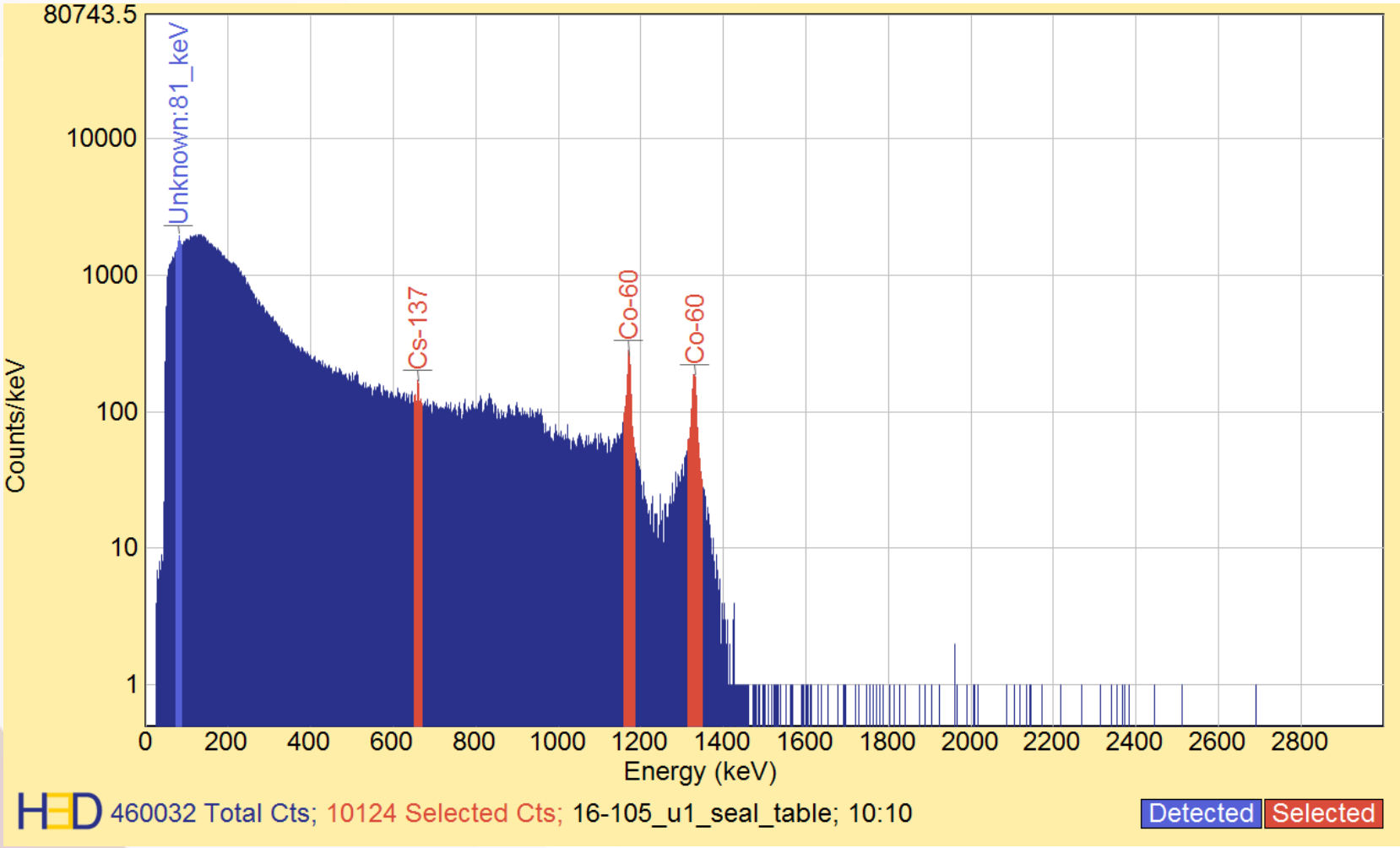
Foreign Material Analysis

- Results indicate high chromium and iron, with very low or non-existent nickel content.
- Not believed to be RCS/Fuel Component Related
- Not the cause of failed fuel. Leak location and size indicate foreign material would likely be on the order of a wire bristle

Particle Investigation / Mitigation

- Cook has a history of legacy or ghost particles with no known origin
- Whole Aux. Building CA at one point
- CZT used to search for contamination

Particle Investigation / Mitigation: Seal Table Eddy Current



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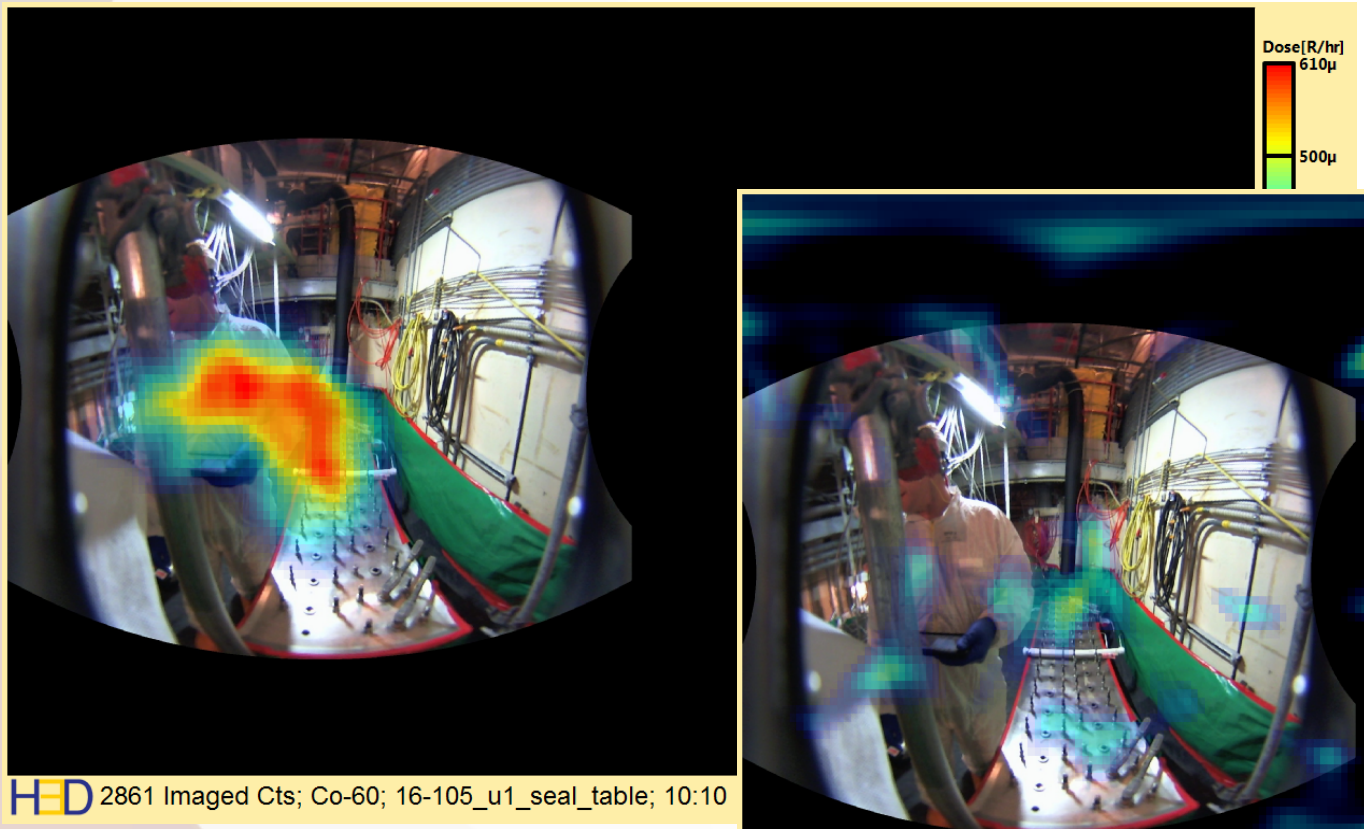
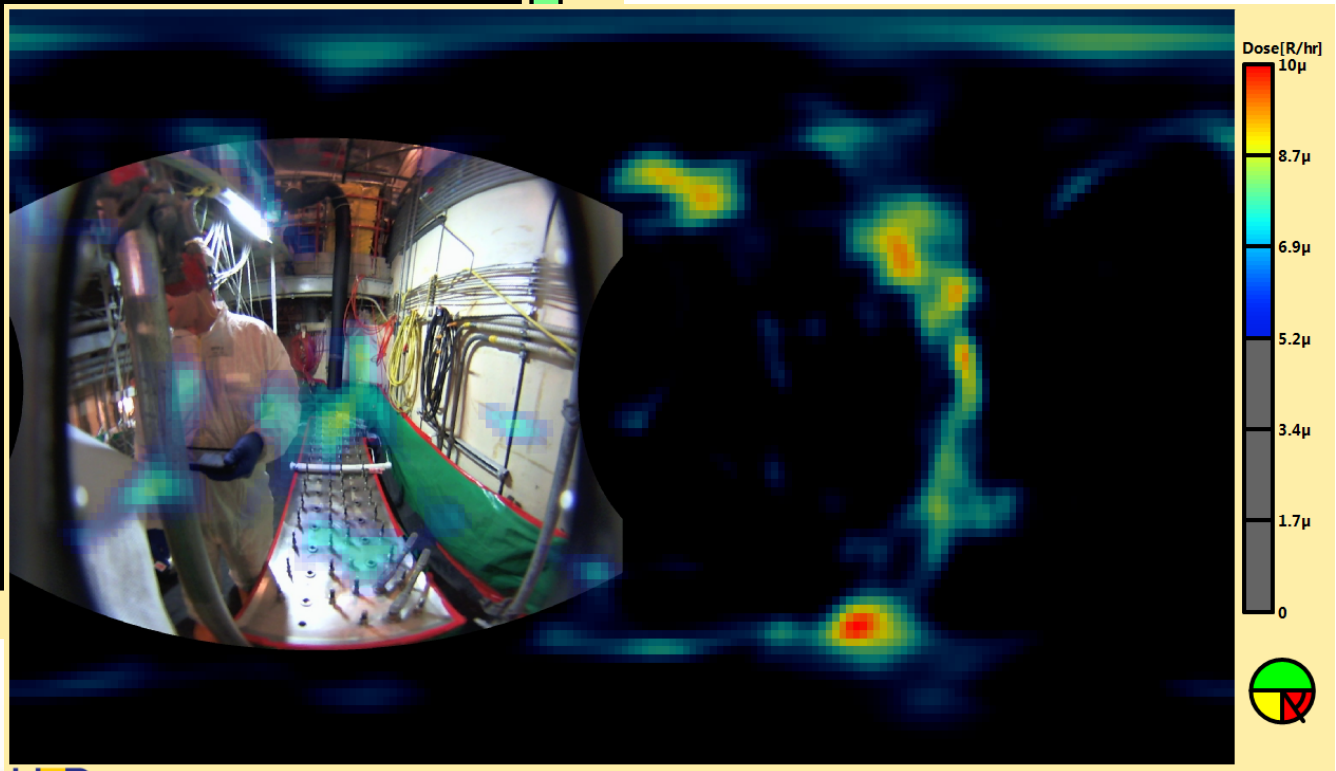
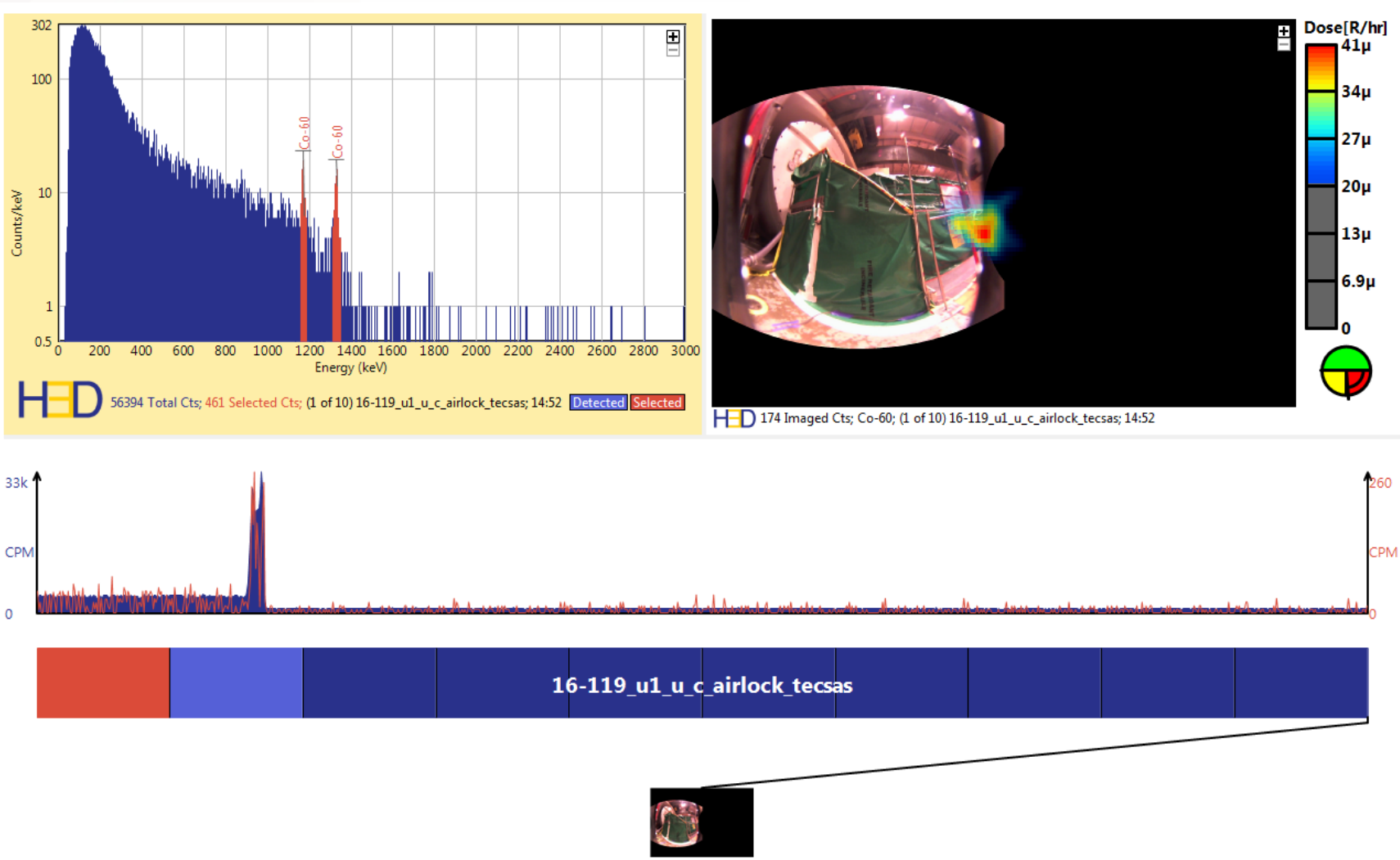


HED 2861 Imaged Cts; Co-60; 16-105_u1_seal_table; 10:10

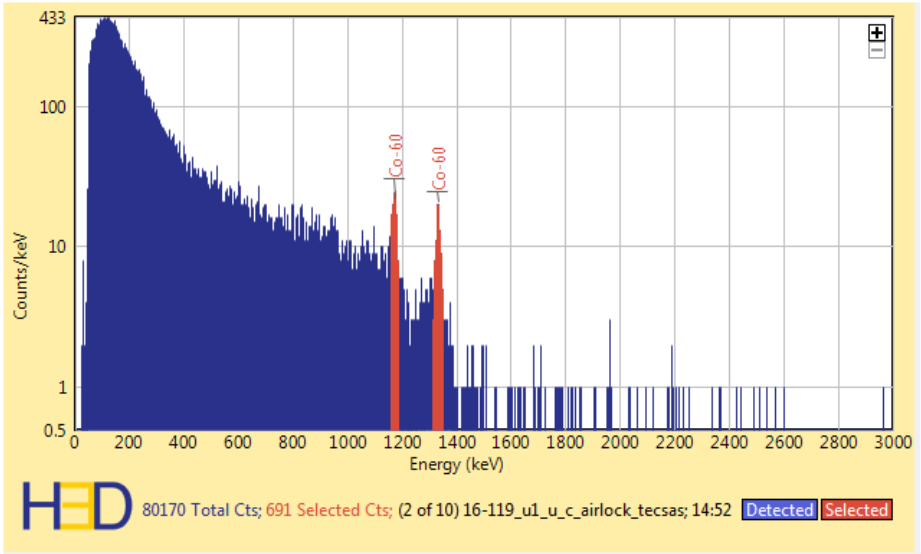


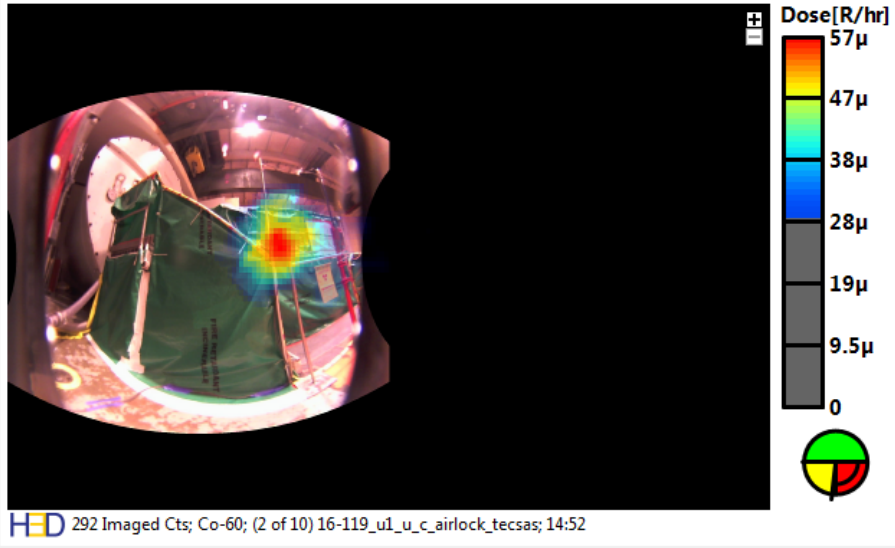
HED 594 Imaged Cts; Cs-137; 16-105_u1_seal_table; 10:10

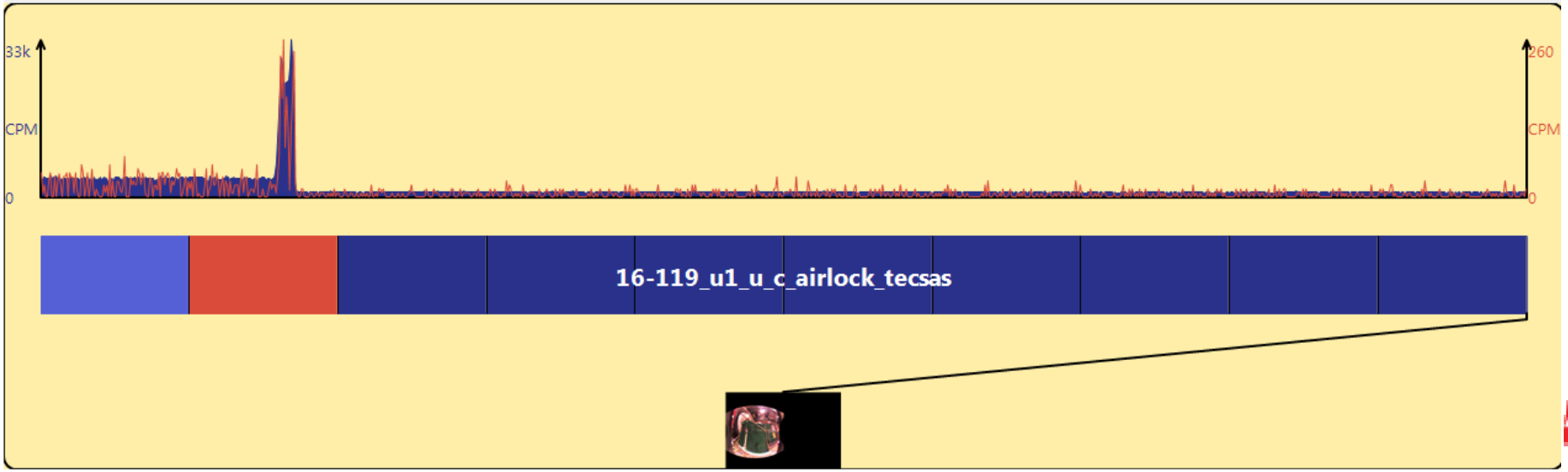
Particle Investigation / Mitigation
TESCA Seal: Moving Material



Particle Investigation / Mitigation
TESCA Seal: Moving Material







Particle Investigation / Mitigation
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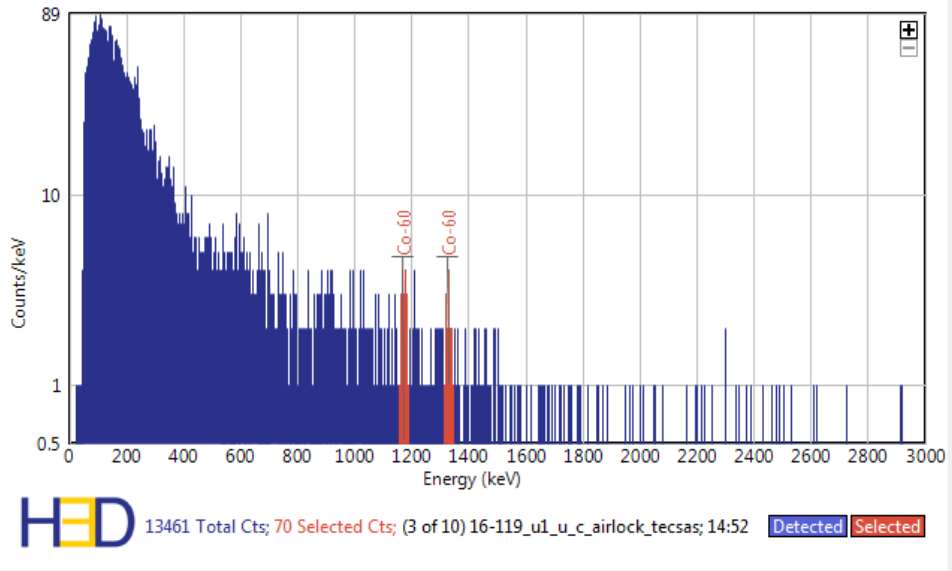
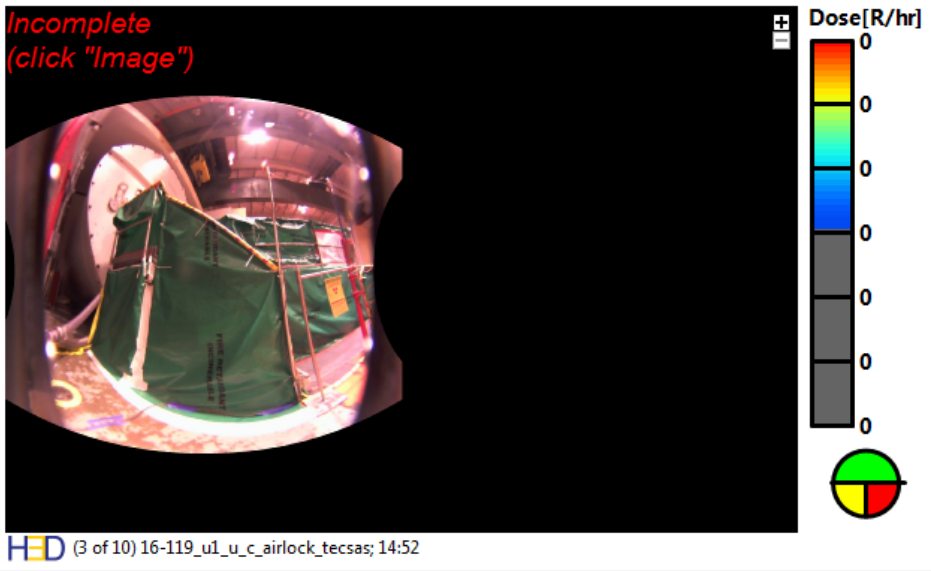
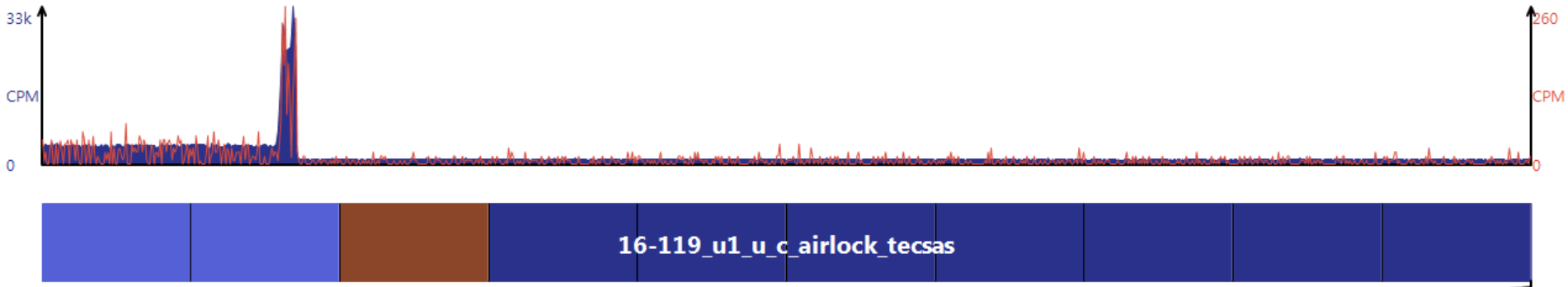
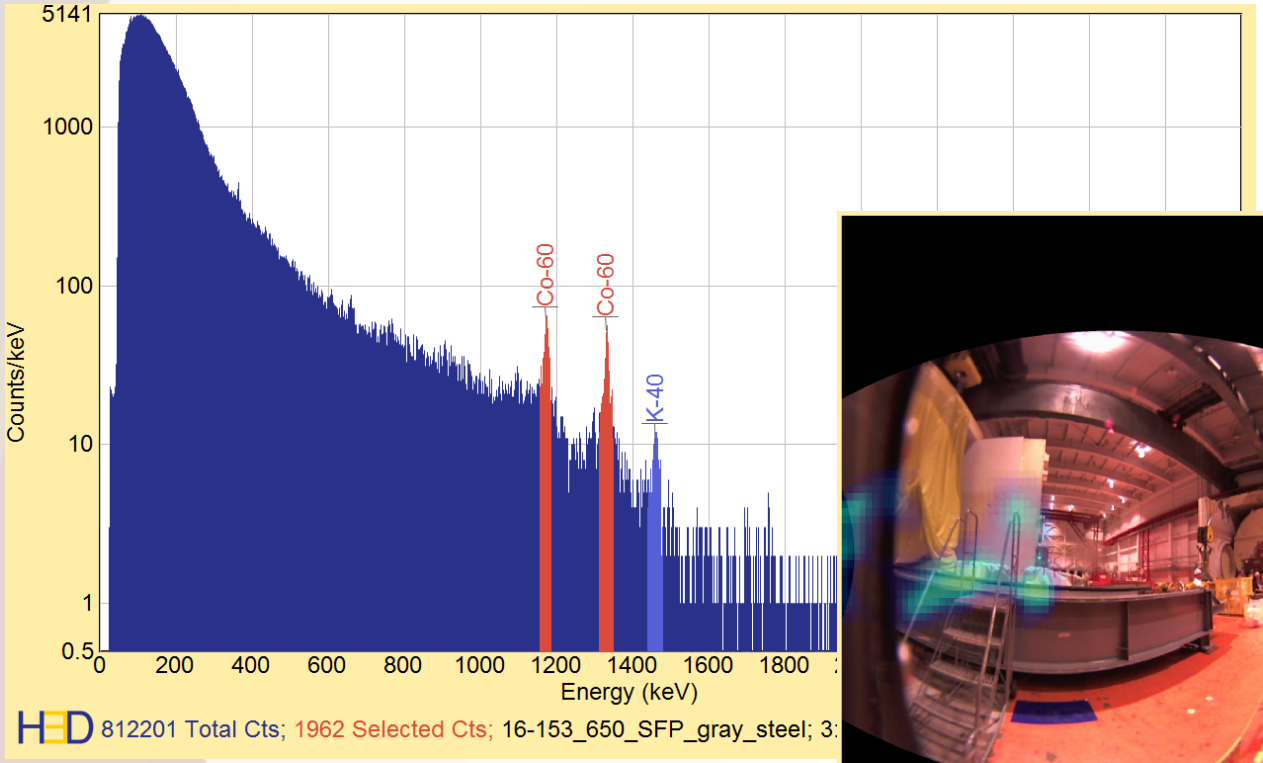


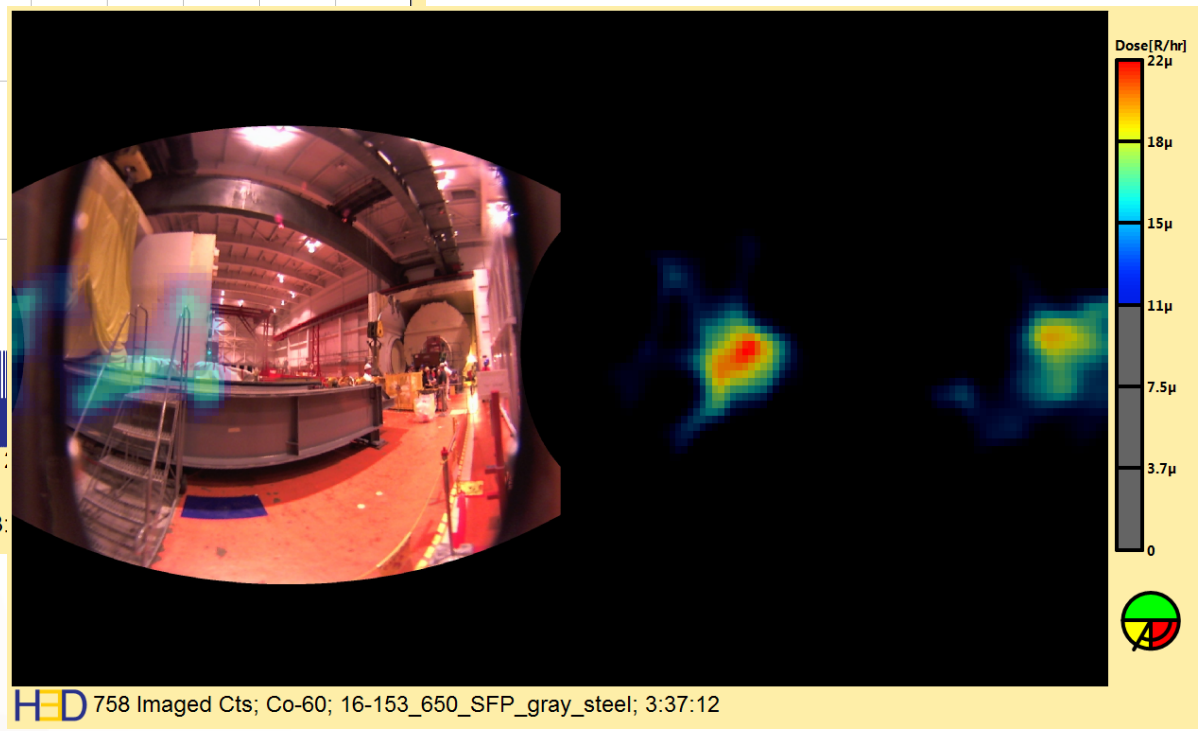




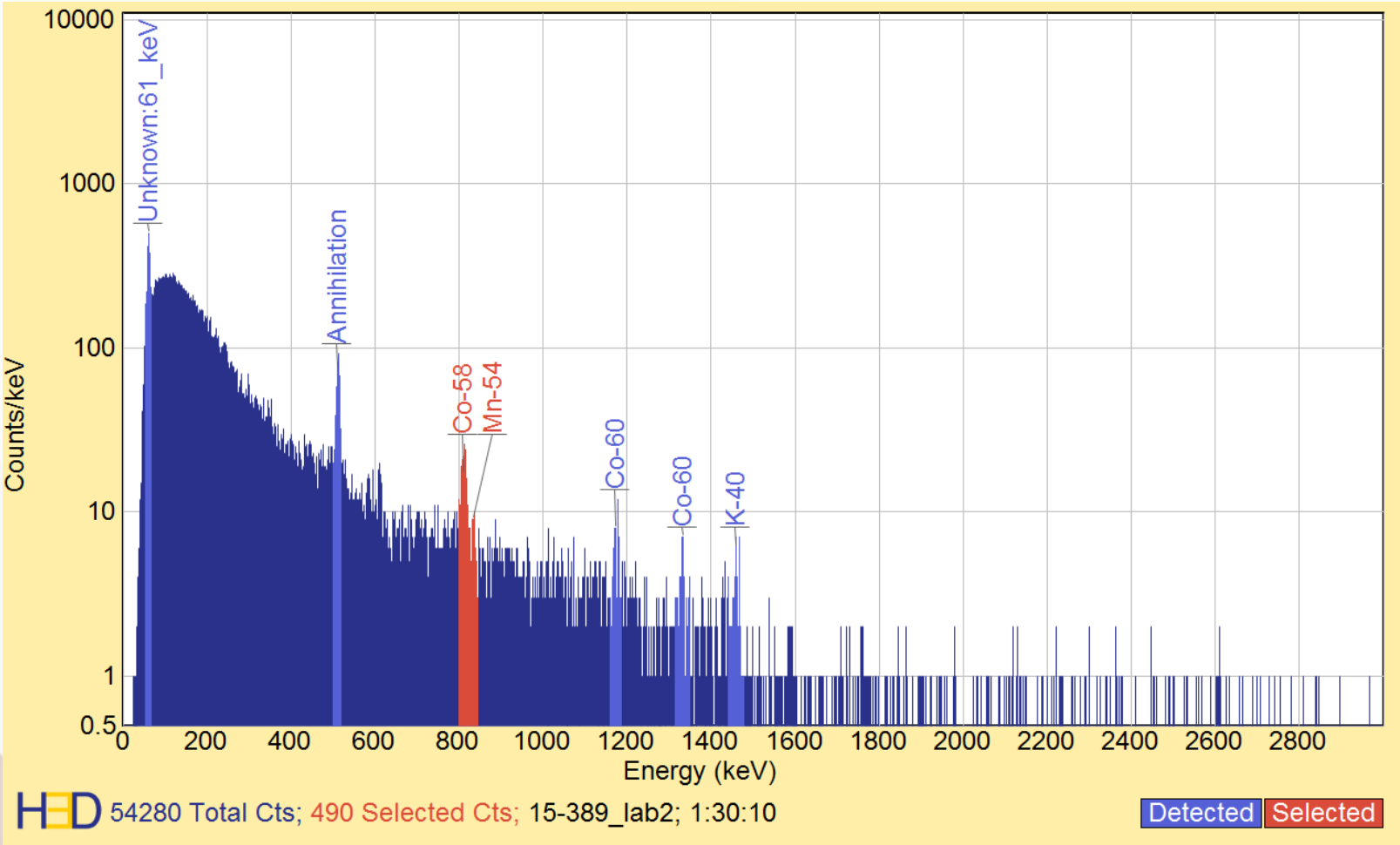
Particle Investigation / Mitigation Gray Steel Move

Stud Racks are to the right of the detector. Low level contamination (<100 ccpm) found





Particle Investigation / Mitigation
Hot Chem Lab Percon



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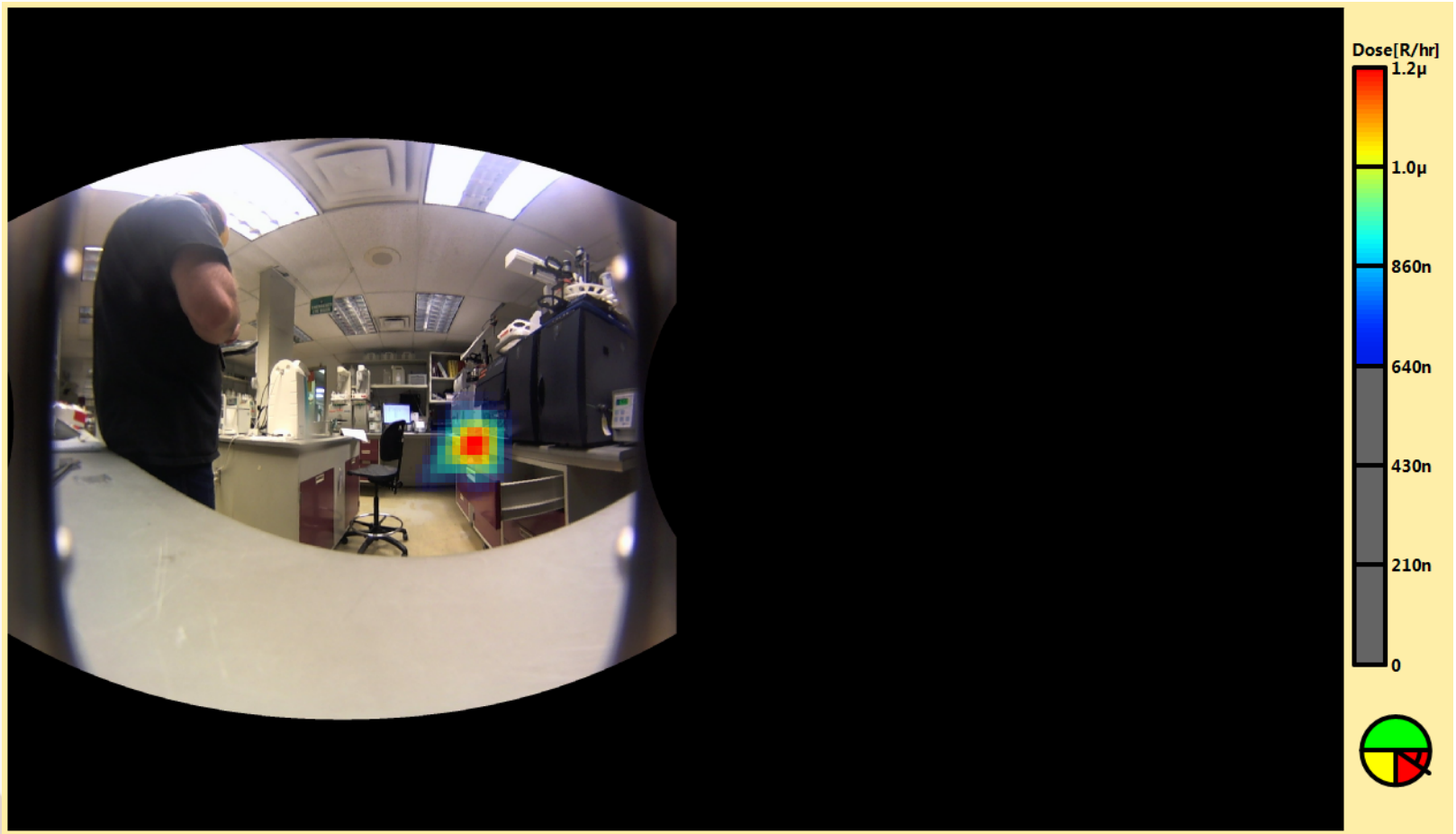


HED 139 Imaged Cts; Co-58/Mn-54; 15-389_lab2; 1:30:10

Transfer Canal Job Coverage

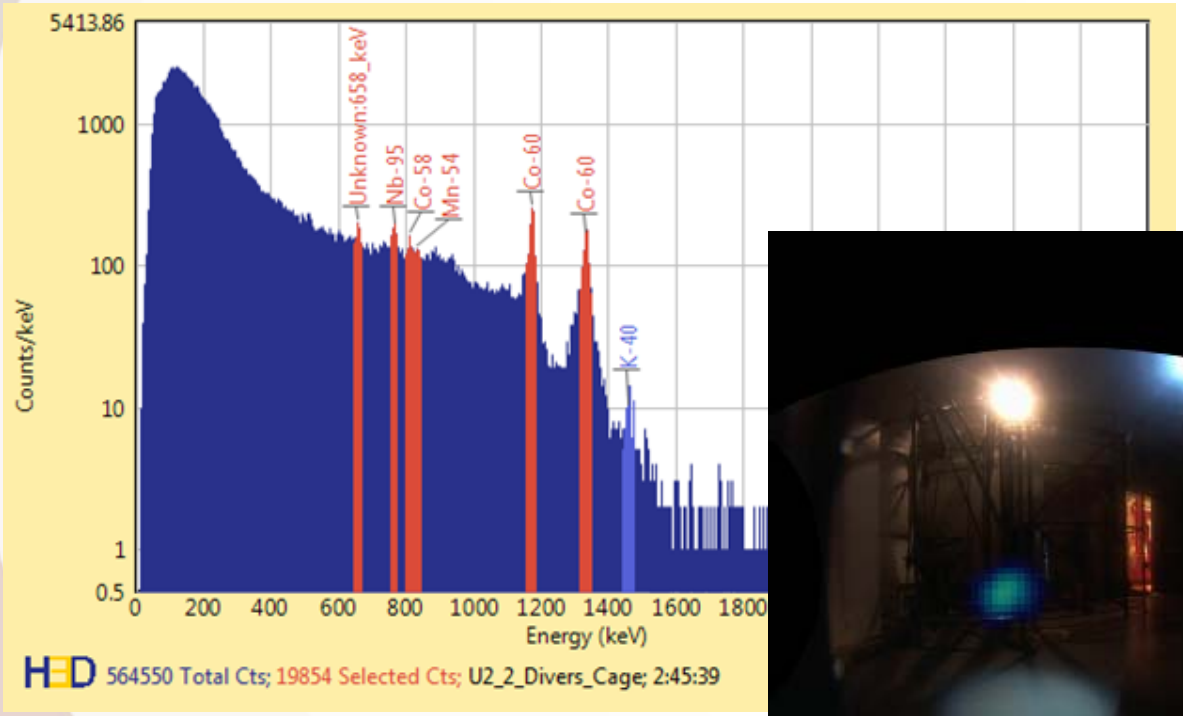
Challenges

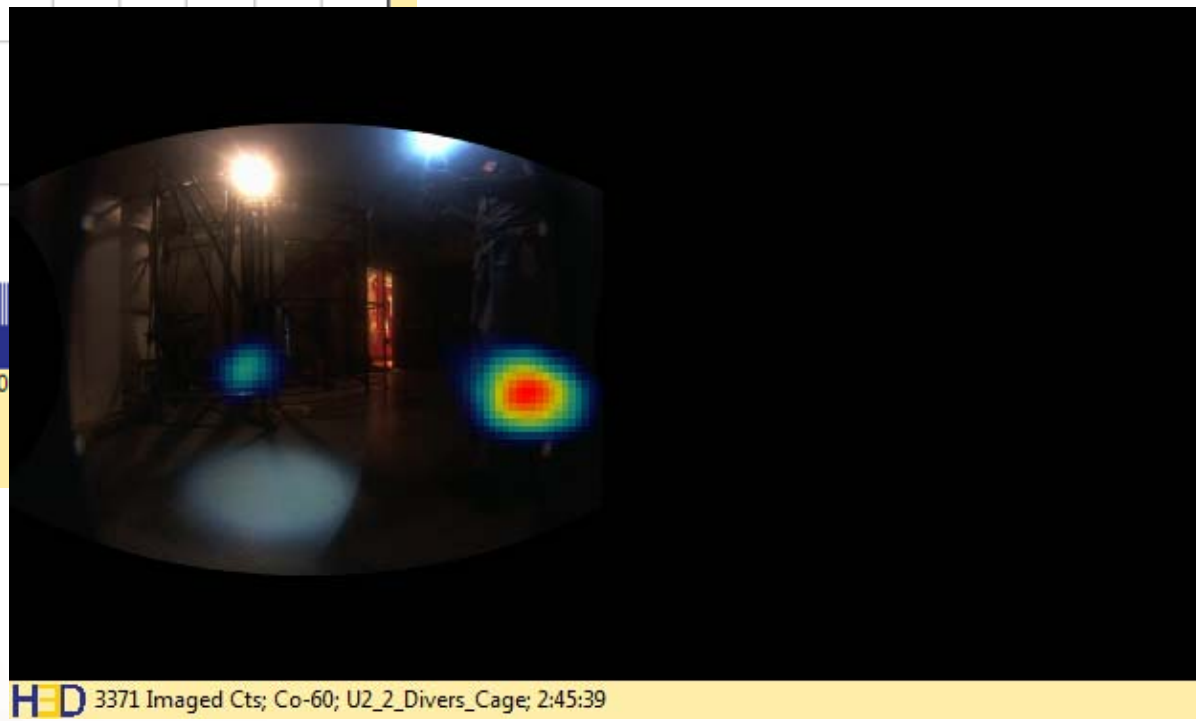
- Alpha Level III (First in Cook History)
- HCA/RPA
- Infrequently Entered (Previous Entry was 2007)
- Multiple particles found during surveys
  - 1 Percon attributed to the project

Transfer Canal Job Coverage

- Coverage techs used CZT to validate contamination control
- Documented in RP Survey Program
- Used with other tools
  - Airflow test
  - Masslinn / Tacky Roller / Surface Covers

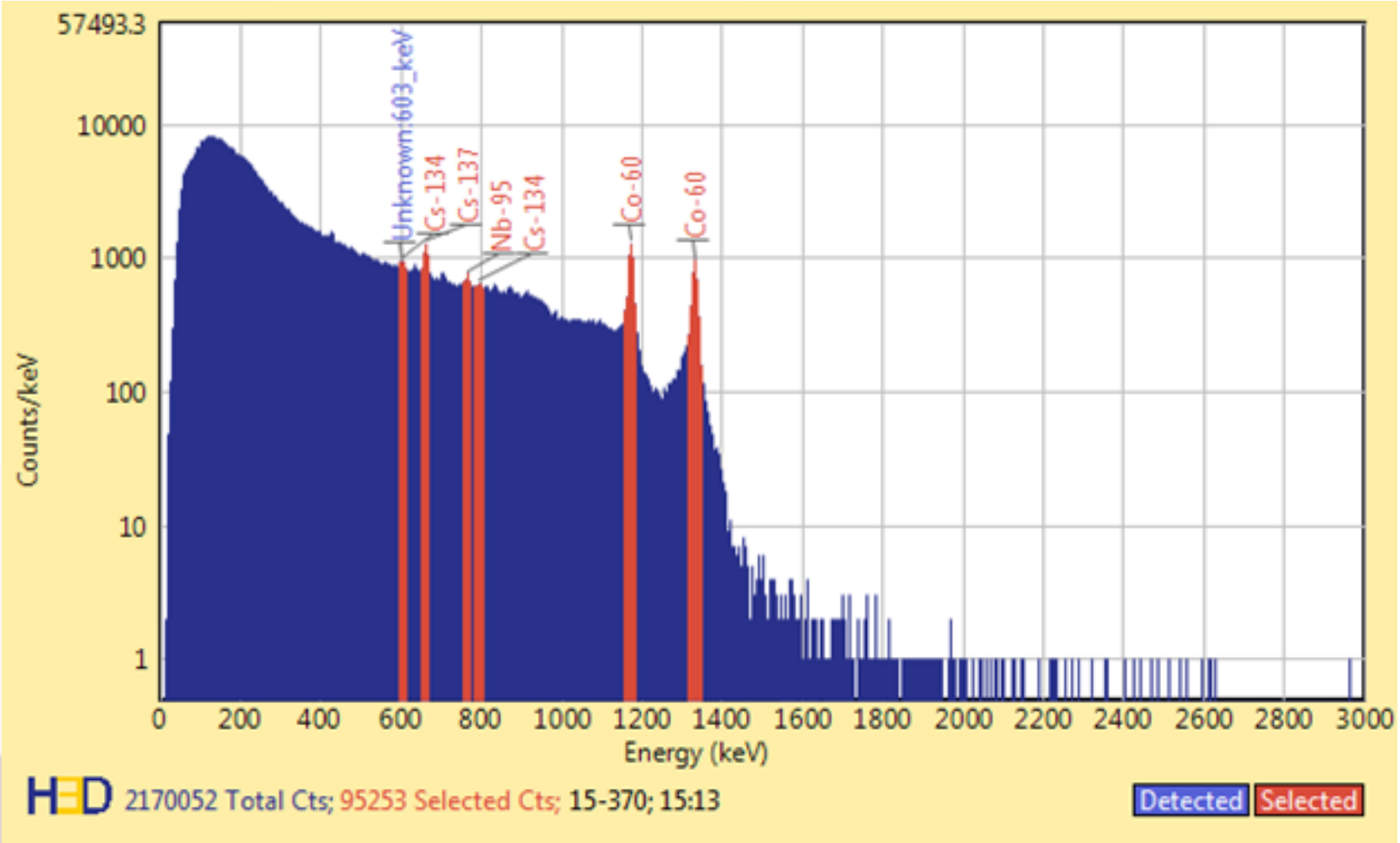
Transfer Canal Job Coverage





Particle Search – Red is Check Source, Particle found on scaffold

Transfer Canal Job Coverage



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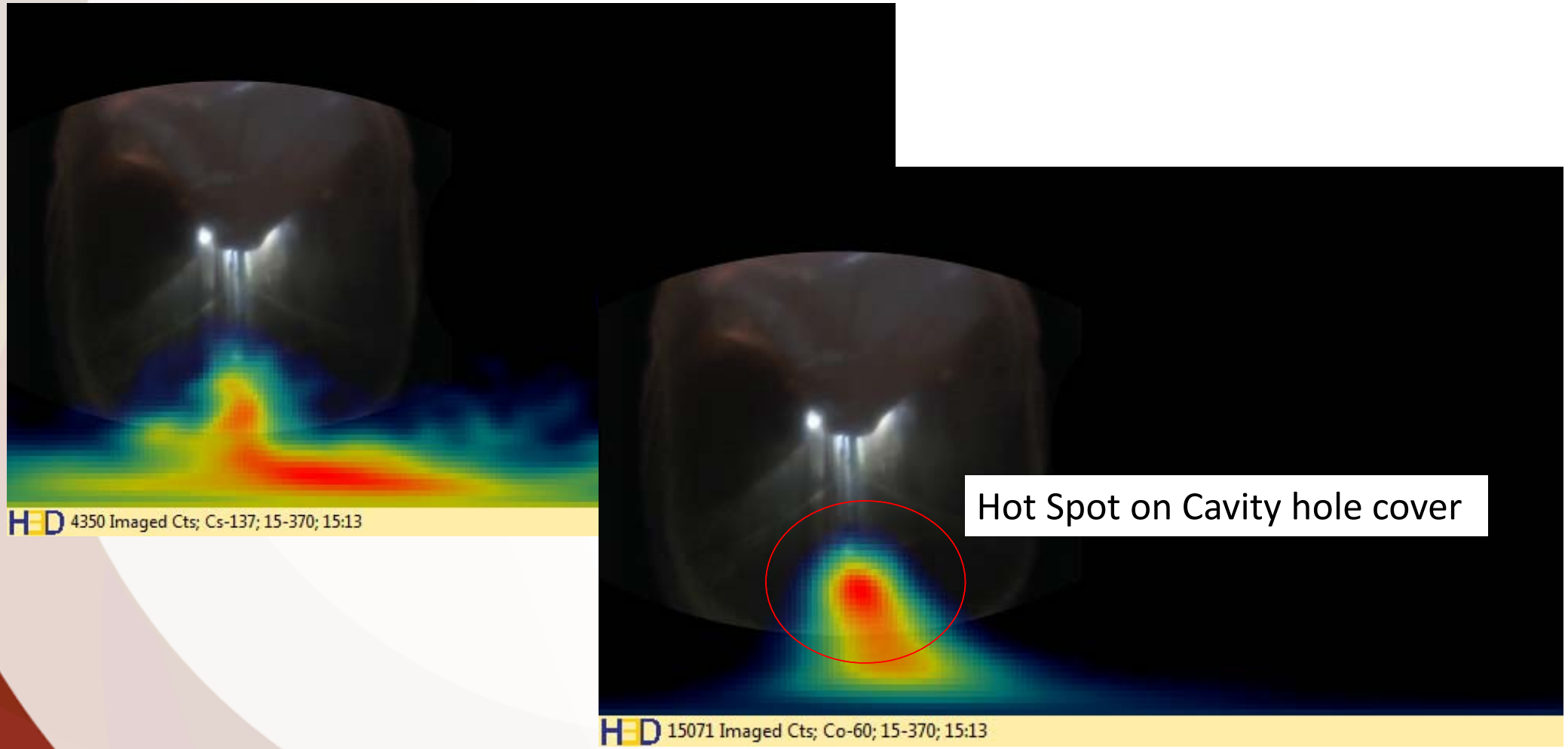

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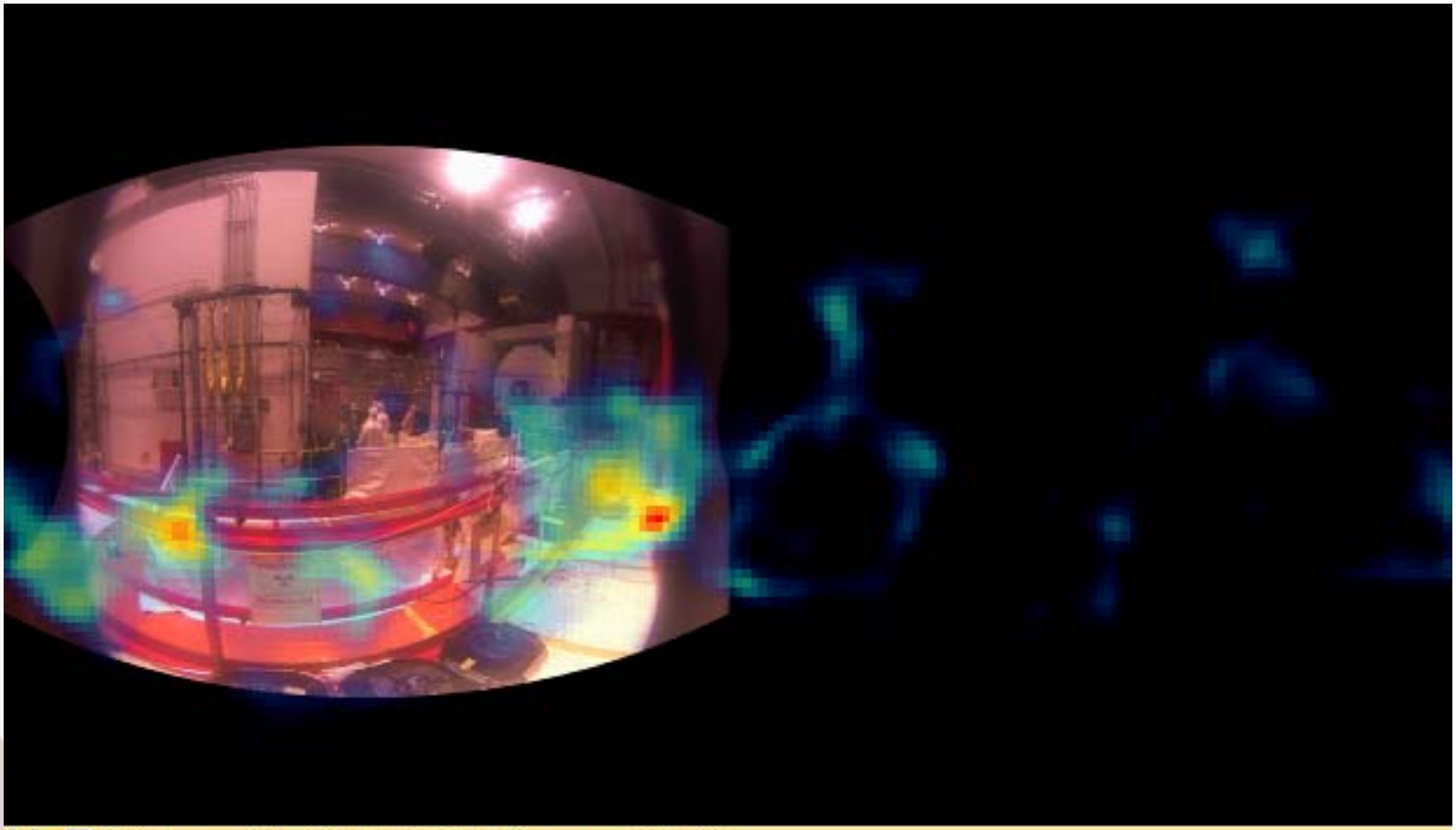

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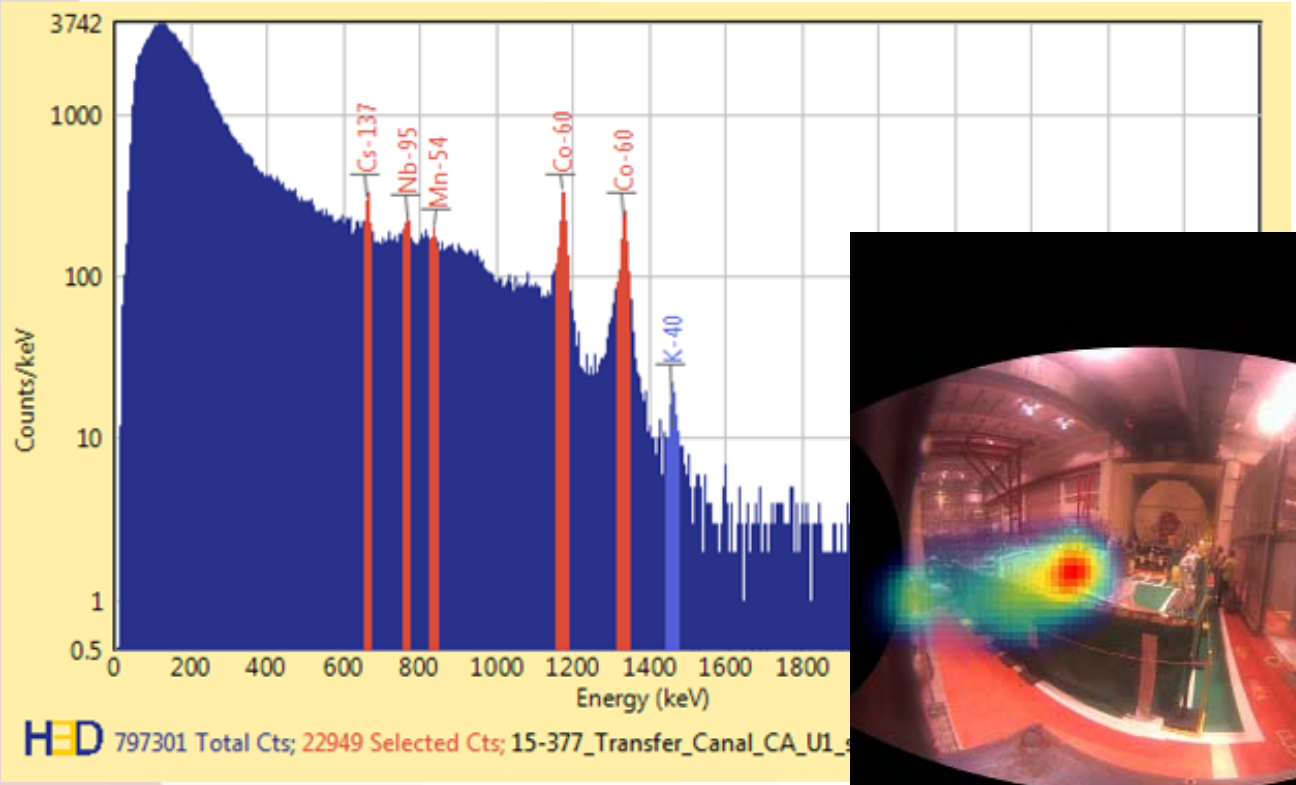
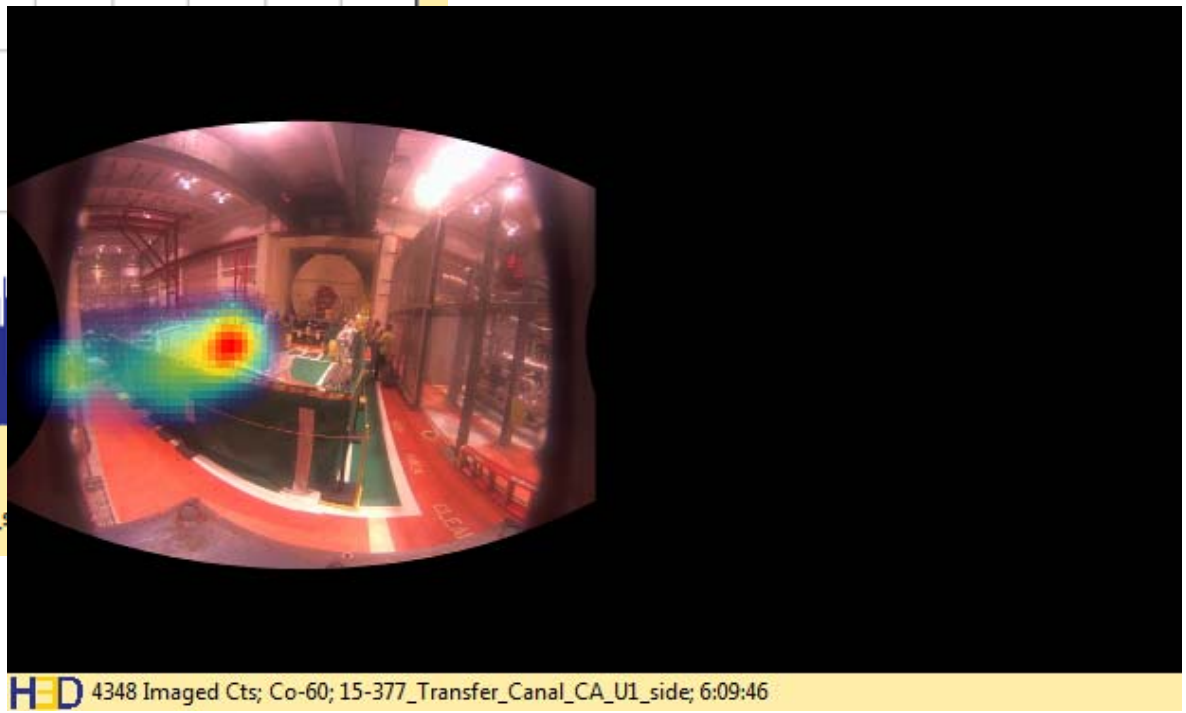


POI previously HEPA, now man basket



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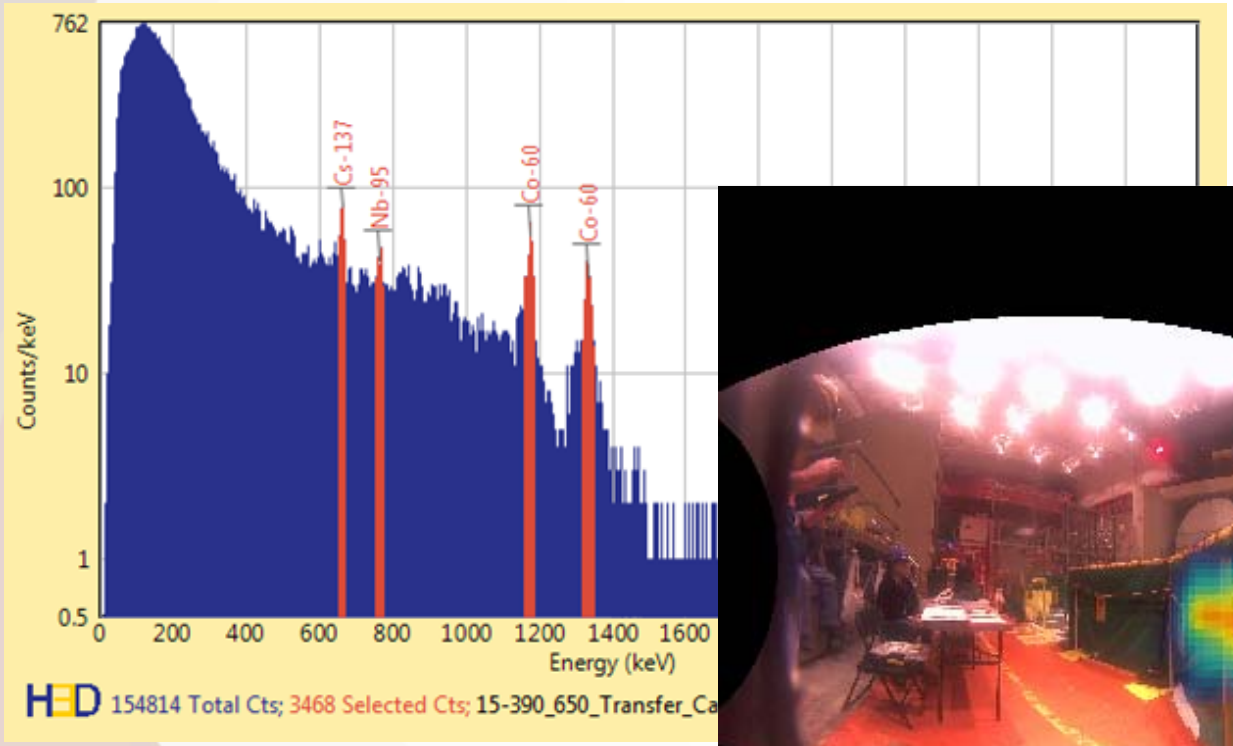
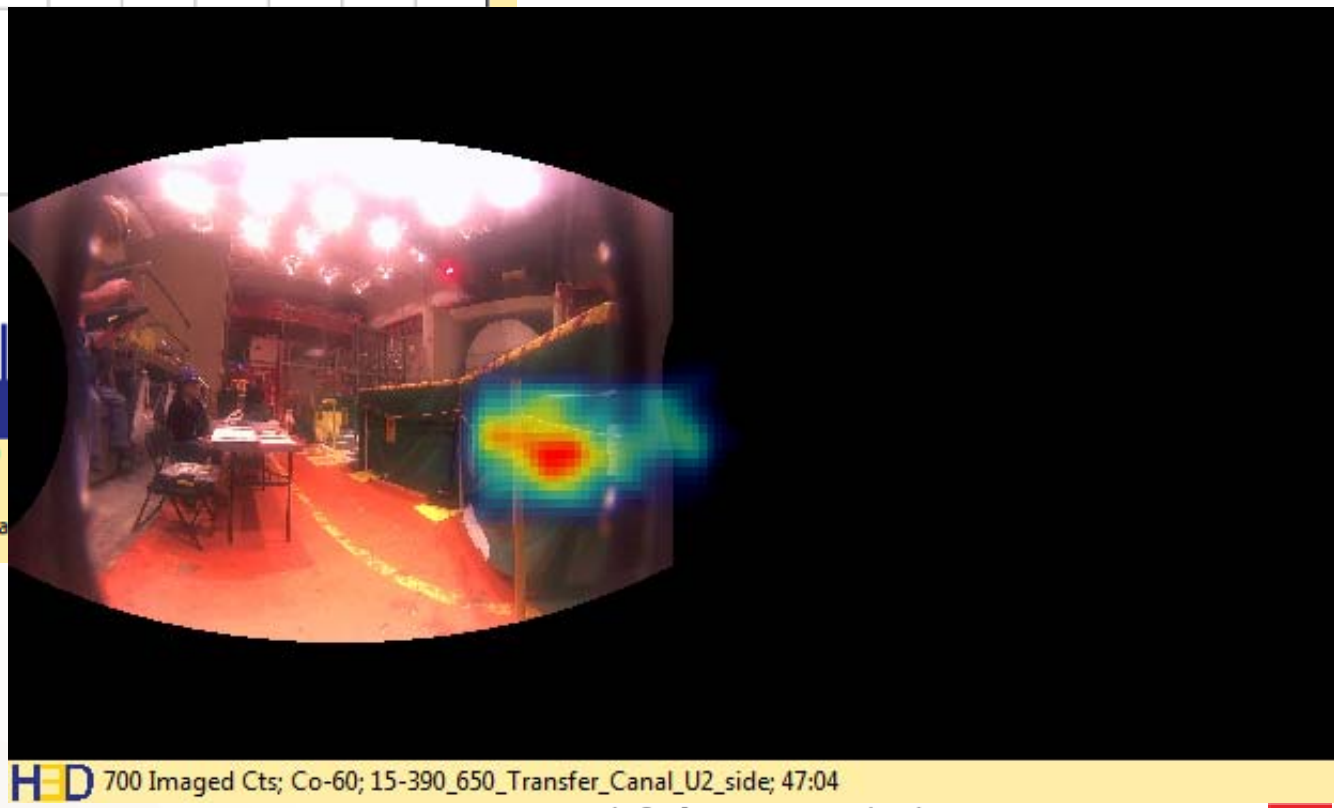
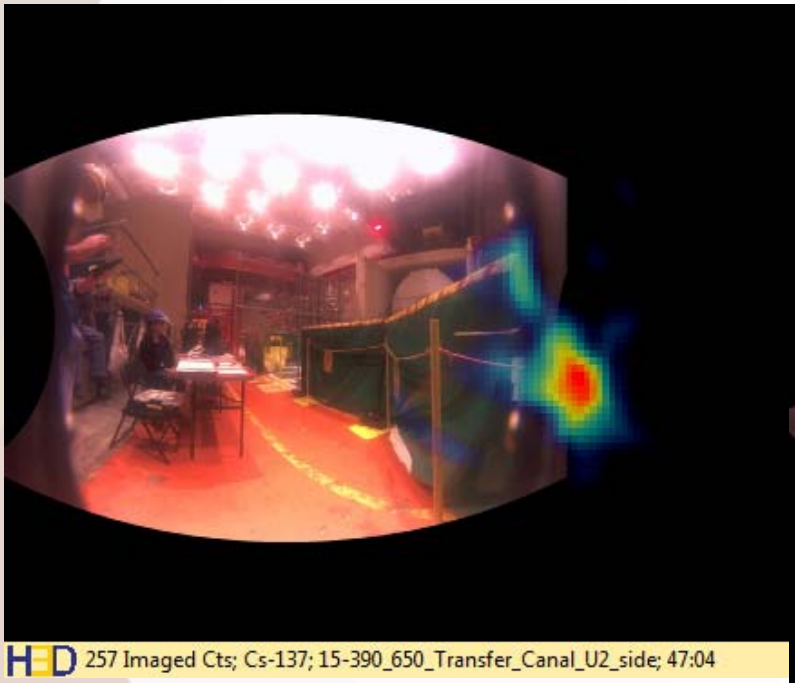
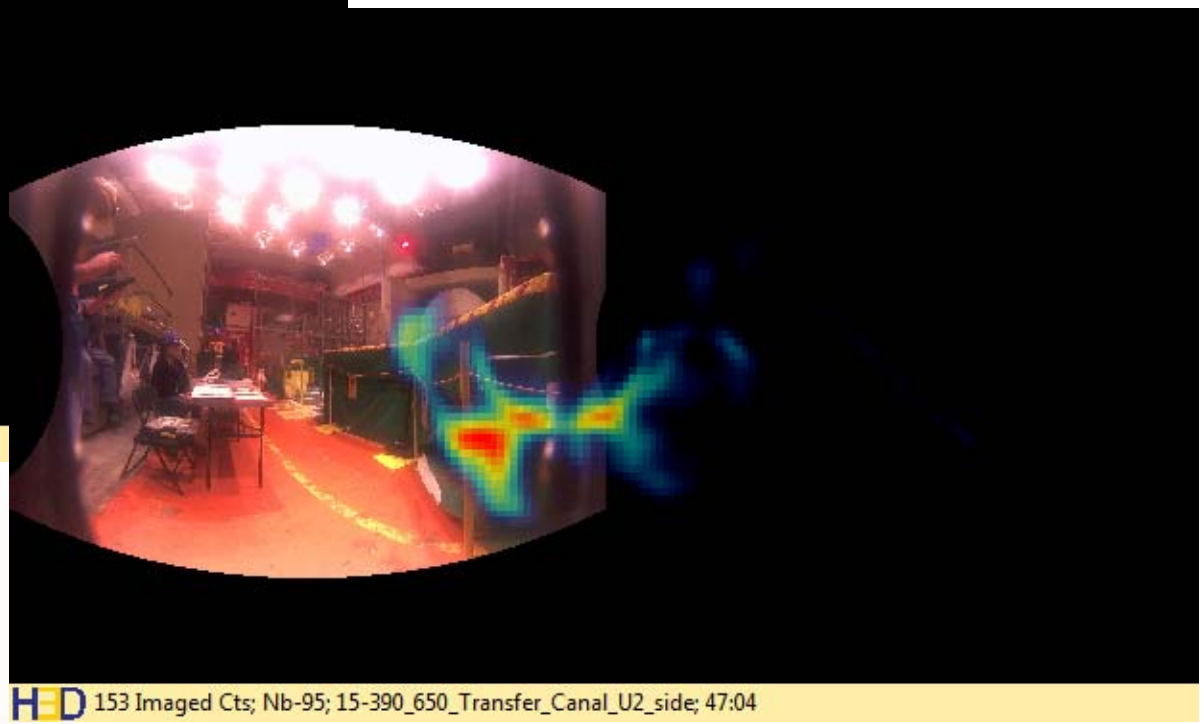




Transfer Canal Job Coverage





Questions?