



LANL experience with the Canberra NetCAM

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Users Group Meeting, Las Vegas, NV**

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by

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Introduction

■ Talk Outline

- Introduction
- Issues encountered
- Evaluation data
- Current status
- Conclusion

Background

- **3/2008 – ASM1000 / AS1700 CAM head selected for RLUOB facility**

- **4/2008 – Management agreed to evaluation of NetCAM dongle as possible replacement of ASM1000**
 - Perceived advantages of NetCAM dongle
 - Cost (\$3.5 K cheaper than ASM1000)
 - Networking capability (built-in web browser)
 - Peak-shape fitting algorithm included

- **8/2008 – Six NetCAM dongles and Alpha Sentry CAM heads purchased for evaluation by RP-2**

Background: NetCAM description

■ NetCAM dongle

- Up to 8 CAM heads can be connected
 - but 1:1 configuration selected for RLUOB
- RS-232 output to PC (terminal emulator) console program
- RJ-45 ethernet connector (unit has built-in web browser)
- Remote monitoring using RadHawk (RadNet-compliant) listener
- Has wireless capability too (not used at LANL)

■ AS1700 CAM head

- 1700 mm² PIPs detector
- Efficiency of ~32% for electroplated distributed ²³⁹Pu source
- Flow rates ~ 2cfm
- firmware version 1.10

Background

- **Immediately obvious that NetCAM not a finished product**
- **Initial assessment report given to Canberra Albuquerque**
 - Highlighted issues and concerns
- **Subsequent meetings led to consensus on path forward**
 - Included action items and completion dates
 - Still a work-in-progress

Initial NetCAM Assessment

Issue

Problem

Dongle design

Black box, firmware difficult to
upgrade

Communications

Not reliable, slow

Documentation

Lack details on algorithms

Web browser/ RadHawk

Inconsistent data, user interface design

Default configuration settings

Not consistent with LANL settings,
could not be successfully changed

Initial NetCAM Assessment

Issue

Problem

Login credentials

Passwords not up to LANL standards

Historical data

Memory overflow caused system to crash

Archival data

No capability to store data

System vulnerabilities

High-level problems with built-in server

Firmware updates

Requires opening dongle removing circuit boards and replacing flash drive

Initial NetCAM Assessment

Issue

Fix

Dongle design

Added hard-wired power cord
Added trouble/alarm status LEDs
Added power switch with status light

Communications

Improved but not all issues resolved

Documentation

Manual updated but questions remain

Web browser/ RadHawk

Browser interface revamped.
Still inconsistent status messages

Default configuration settings

Defaults changed and can be edited

Initial NetCAM Assessment

Issue

Login credentials

Historical data

Archival data

System vulnerabilities

Firmware updates

Fix

Passwords now meet LANL standards

Overflow problem fixed.
Stores up to 24hr of spectral data

RadHawk used to archive data on host
PC

Security concerns resolved

Firmware updates now possible over
Net via Browser interface

Browser interface

CANBERRA Logout Super User
[NetCAM Administration](#)

NetCAM 2.2.5 Pre-release

Rm202B OPERATIONAL	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE
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Rm202B Current Data

CAM CURRENT DATA	CAM ALARM DATA	CAM TREND GRAPHS	CAM HISTORICAL DATA
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Data

Status: Normal	NetCAM Data Time: 04/19/2010 09:43:16
Pu DAC-Hr: -0.07 DAC-Hr	Count Cycle: 60.00 Minutes
Am DAC-Hr: 0 DAC-Hr	Collect Time: 59.97 Minutes
U DAC-Hr: 0 DAC-Hr	Time Till Next Analysis: 0.03 Minutes
Approx. TRU DAC-Hr: 0 DAC-Hr	Flow: 1.18 CFM
Pu CPM: -0.55 CPM	Pu Concentration: 4.08E-12 uCi/cm ³
Am CPM: 0 CPM	Am Concentration: 0 uCi/cm ³
U CPM: 0 CPM	U Concentration: 0 uCi/cm ³

Spectrum

The spectrum plot shows counts on the y-axis (0 to 700) and energy in MeV on the x-axis (0 to 11). There are several peaks: a large one at ~1.8 MeV, a smaller one at ~6.2 MeV (indicated by a red arrow), a very large one at ~7.8 MeV, and another at ~9.0 MeV.

Browser interface

The screenshot displays the NetCAM 2.2.5 Pre-release browser interface. At the top, the CANBERRA logo is on the left, and the text "NetCAM 2.2.5 Pre-release" and "NetCAM System Display" are on the right. Below the header is a navigation bar with "ADMINISTRATION ACTIONS" and "NETCAM CONFIGURATION". The main content area is titled "CAM 1 Configuration" and "Settings for CAM 1". It contains several configuration sections: "CAM Alarm Levels" with sub-sections for "Radiation and Flow Alarm Levels", "High Flow Alarm:" (value: 2.4), "Low Flow Alarm:" (value: 0.6), "Radiation Alarm Calculation Method:" (value: DACHR), "DAC-Hr Alarm Threshold:" (value: 1.0000), "DAC Alarm Threshold:" (value: 100), "No Data in Spectrum Alarm Count:" (value: 3), and "Door Open Timer:" (value: 9). Below these is the "CAM Region of Interest" section with "Area of Interest for detection of radionuclide" and "Width of ROI:". On the right side, a "Configuration:" menu lists various links such as "CAM 1 Configuration", "Server Analysis and Calibration", and "System Permissions for Level One".

Browser interface

CANBERRA NetCAM 2.2.5 Pre-release [NetCAM System Display](#)

NetCAM Administration

ADMINISTRATION ACTIONS **NETCAM CONFIGURATION**

Administration Actions:

Sent Acknowledge Alarm Message

Update NetCAM Time

User PC Time: 04/19/2010 09:21:07
NetCAM Time: 04/19/2010 09:20:23

Synchronize Time Now

CAM Actions

CAM 1

Change Filter

Performance Test

Perform Alpha Efficiency

NetCAM Actions

Acknowledge Alarms

Reboot System

Update NetCAM Firmware

Choose a file to upload: Browse...

Upload File

RadHawk display

RadHawk Client

File Manage Display Data Login Help

Rm202A 94:1

ROI

5.13E00 DAC

Rm202B 91:1

ROI

-4.57E00 DAC

Rm206 93:1

Alpha CAM

7.8E02 cc/s

Rm210 92:1

Alpha CAM

9.03E02 cc/s

TA-36 Deleted devices

Rm202A Alpha CAM

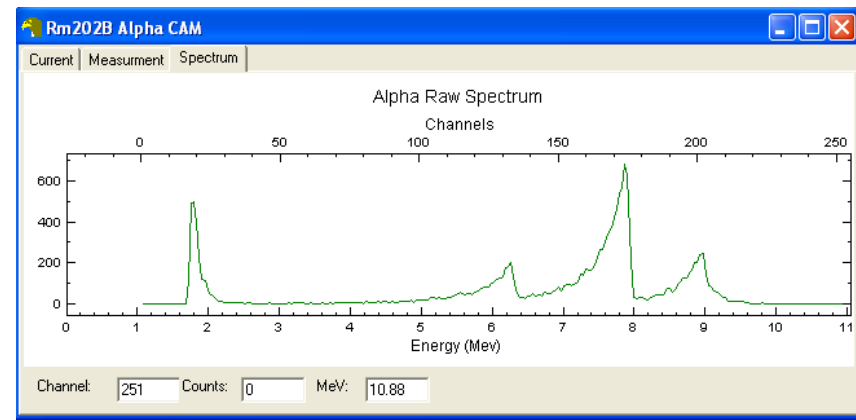
Current Measurement Spectrum

Description	Value
Server Address	94
Monitor Address	1
Unique ID	13000000
Server Status	Normal Operation
Operational Status	Normal
Hardware Status	Normal
Stack Release Rate	0E00 Bq/s
Flow Volume	2.65E08 cc
Flow Rate	6.18E02 cc/s
Filter Collect Time	4.23:02:37
Collection Time	00:13:56
Number of Measur...	1

Measurements

ROI

Description	Value
DAC Hours	-5.52E-01 DAC-hr
Error in DAC Hours	-9.01E-01 %
DAC	4.47E00 DAC
Concentration	8.26E-07 Bq/cc
Error in Concentration	5.61E-01 Bq/cc
Net cps	-7.25E-02 cps
Error in Net cps	-9.01E-01 cps
Uncompensated cps	7.14E-05 cps
Error in Uncompensated ...	7.33E00 cps
Detectability Limit	9.3E-01 DAC-hrs



NetCAM test conditions

Firmware version	2.2.2
CAM head	Alpha Sentry AS1700
Filter media	47mm Millipore 5 μ m membrane filter (FMLB4700)
Flow rate	1.7 cfm (48 lpm)
Detection efficiency	0.34 for distributed ^{239}Pu source
Rn concentration	Typically, 0.1 pCi/l
Cycle times	Variable; 15 – 60 minutes
DAC factors	Taken from 10CFR835 (2007)
dpm per DAC-h	32.0 (for ^{239}Pu)
DAC-h per dpm	0.031 (for ^{239}Pu)
CAMs per dongle	1 or 2
sigma factor	1.65 (default value for Valley mode)
TRU ROI	2.7 – 5.7 MeV (default range)

NetCAM Alarm Algorithms

■ Acute alarm

- Exclusive function of AS1700
- By default; 30 seconds and 400 Pu ROI counts
- Also requires 2:1 (Pu:background) count ratio

■ Chronic alarms

- Data evaluated every 4 minutes and at end of count cycle by dongle
- “Blind man’s differential” approach
- One of two algorithms can be selected for DAC or DAC-h alarm
 - Valley method (ROI-based)
 - Peaks method (based on peak fitting)
 - Fits U composite, ^{239}Pu and ^{241}Am simultaneously
- Effective alarm limit is greater of a user-defined fixed value or dynamic σ -based level

Chronic alarm algorithms

■ Valley mode

- Based on ROI TRU method and exponential tail fitting of Rn/Tn peaks
- Uncertainty analysis based on $k\sigma$ approach
- Default value of $k = 1.65$
- But σ based on total number of counts in TRU and Rn/Tn region

■ Peak mode

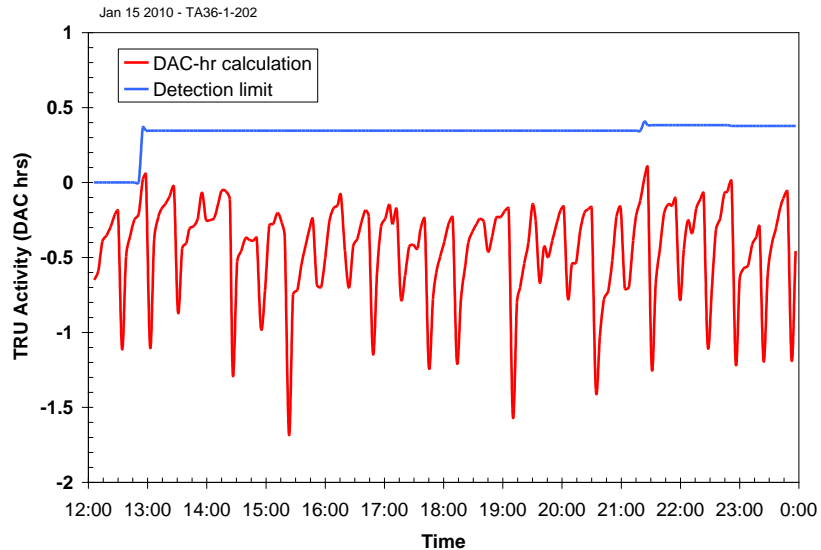
- Based on sequential peak fitting and stripping of Rn/Th peaks
- Fits remaining counts to ^{241}Am , ^{239}Pu and $^{234,235,238}\text{U}$ composite
- Uncertainty based on classic $k_\alpha\sigma_0$ approach (*i.e.* Currie's L_c)

■ User selects alarm mode (DAC or DAC-h) and fixed alarm limit

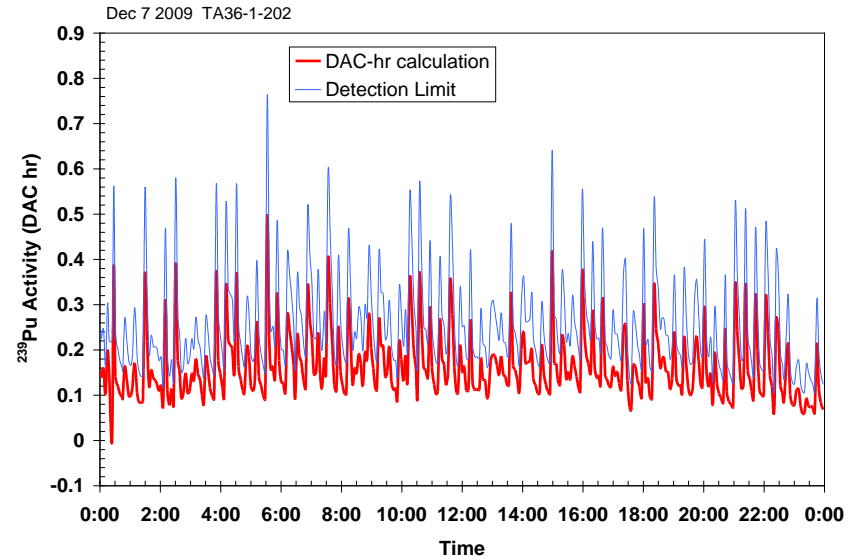
- *But initial testing showed no chronic alarm annunciation at CAM head !!!*

Valley vs Peaks mode: Background monitoring

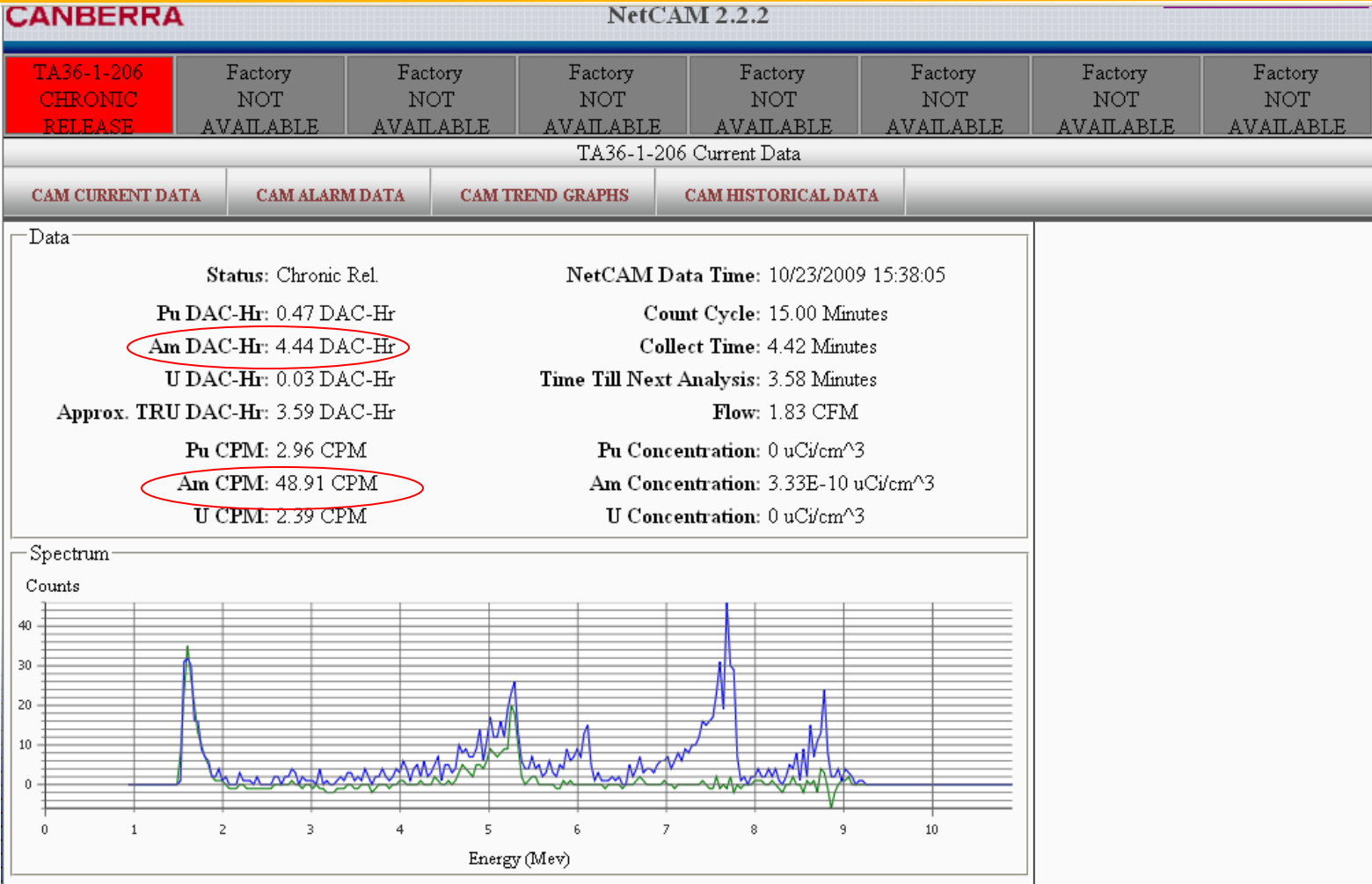
NetCAM : Valley Method DAC hr calculation



NetCAM: Peaks Method DAC hr Calculation

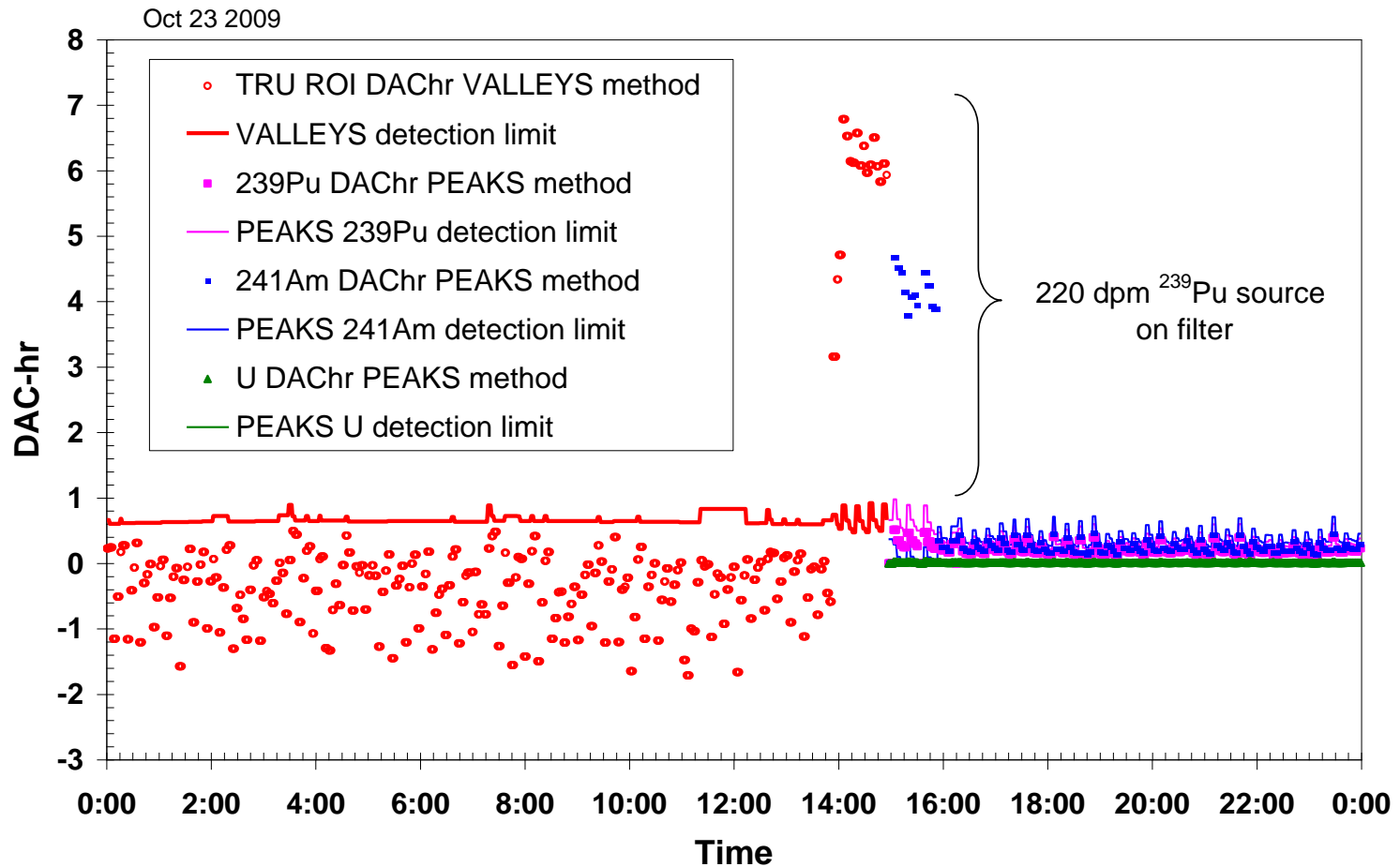


Peaks mode: 220 dpm ^{239}Pu source



Valley vs Peaks mode: 220 dpm ^{239}Pu source

NetCAM : DAC-hr calculation



Valley mode: 150 dpm ²³⁹Pu source

CANBERRA

NetCAM 2.2.2

TA36-1-206
ACUTE RELEASE

Factory
NOT
AVAILABLE

Factory
NOT
AVAILABLE

Factory
NOT
AVAILABLE

Factory
NOT
AVAILABLE

Factory
NOT
AVAILABLE

Factory
NOT
AVAILABLE

Factory
NOT
AVAILABLE

TA36-1-206 Current Data

CAM CURRENT DATA

CAM ALARM DATA

CAM TREND GRAPHS

CAM HISTORICAL DATA

Data

Status: Acute Release

NetCAM Data Time: 11/24/2009 08:25:36

Pu DAC-Hr: 4.73 DAC-Hr

Count Cycle: 20.00 Minutes

Am DAC-Hr: 0 DAC-Hr

Collect Time: 2.57 Minutes

U DAC-Hr: 0 DAC-Hr

Time Till Next Analysis: 1.43 Minutes

Approx. TRU DAC-Hr: 5.57 DAC-Hr

Flow: 1.77 CFM

Pu CPM: 48.73 CPM

Pu Concentration: -1.21E-11 uCi/cm³

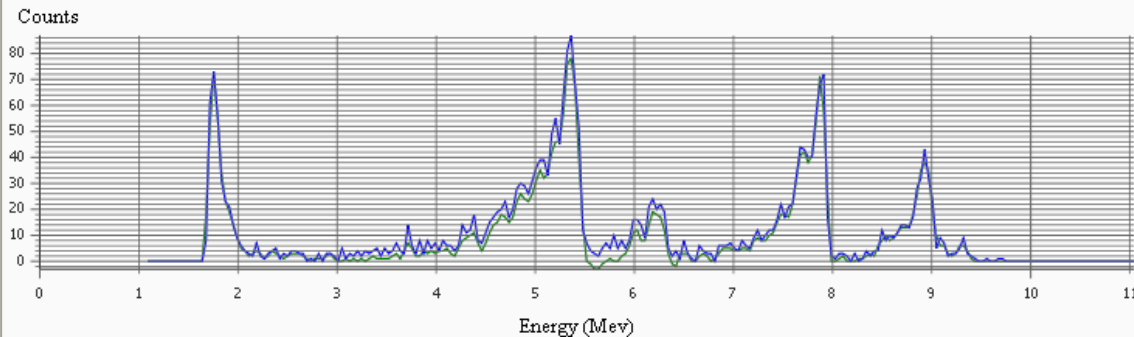
Am CPM: 0 CPM

Am Concentration: 0 uCi/cm³

U CPM: 0 CPM

U Concentration: 0 uCi/cm³

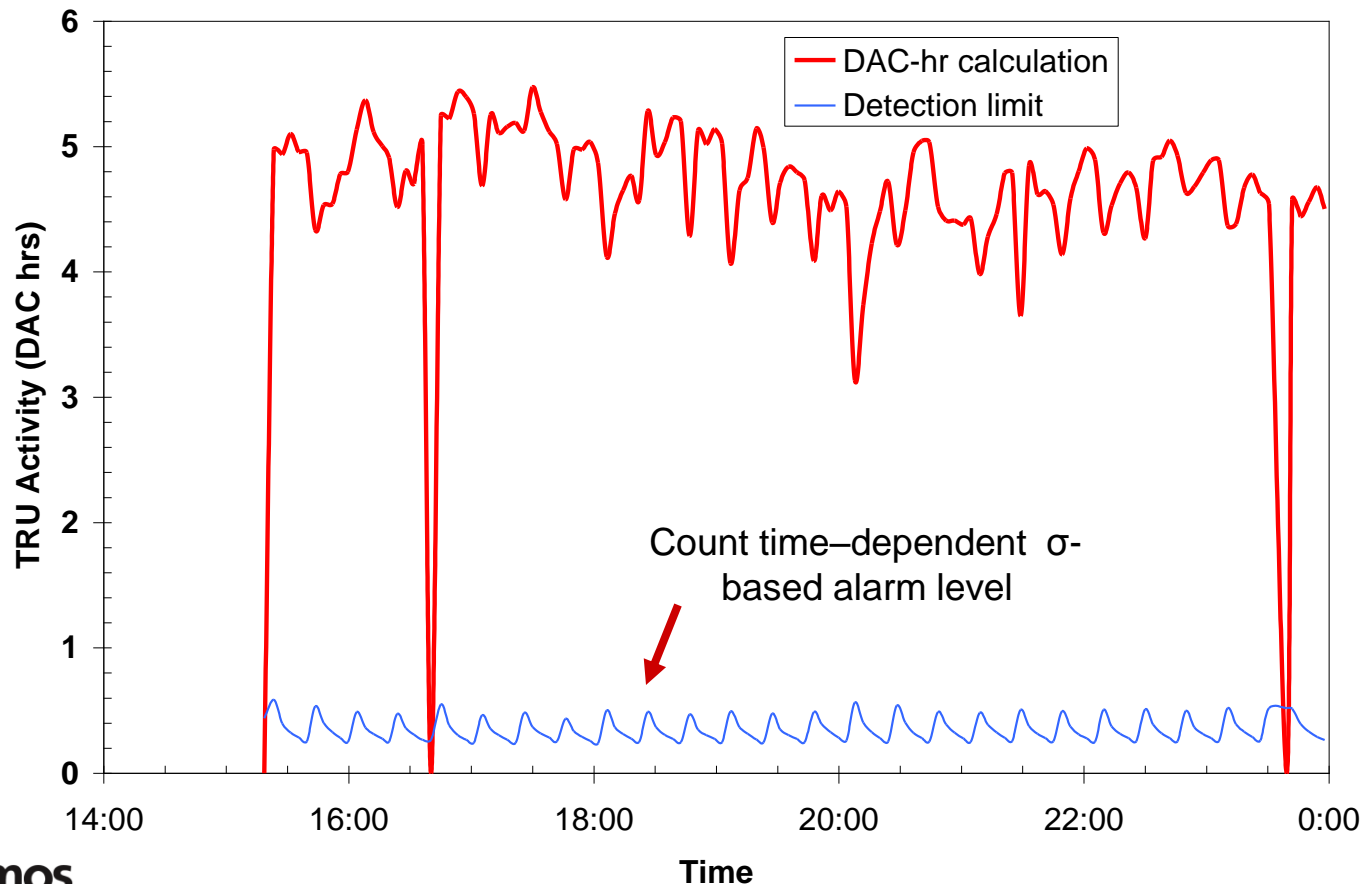
Spectrum



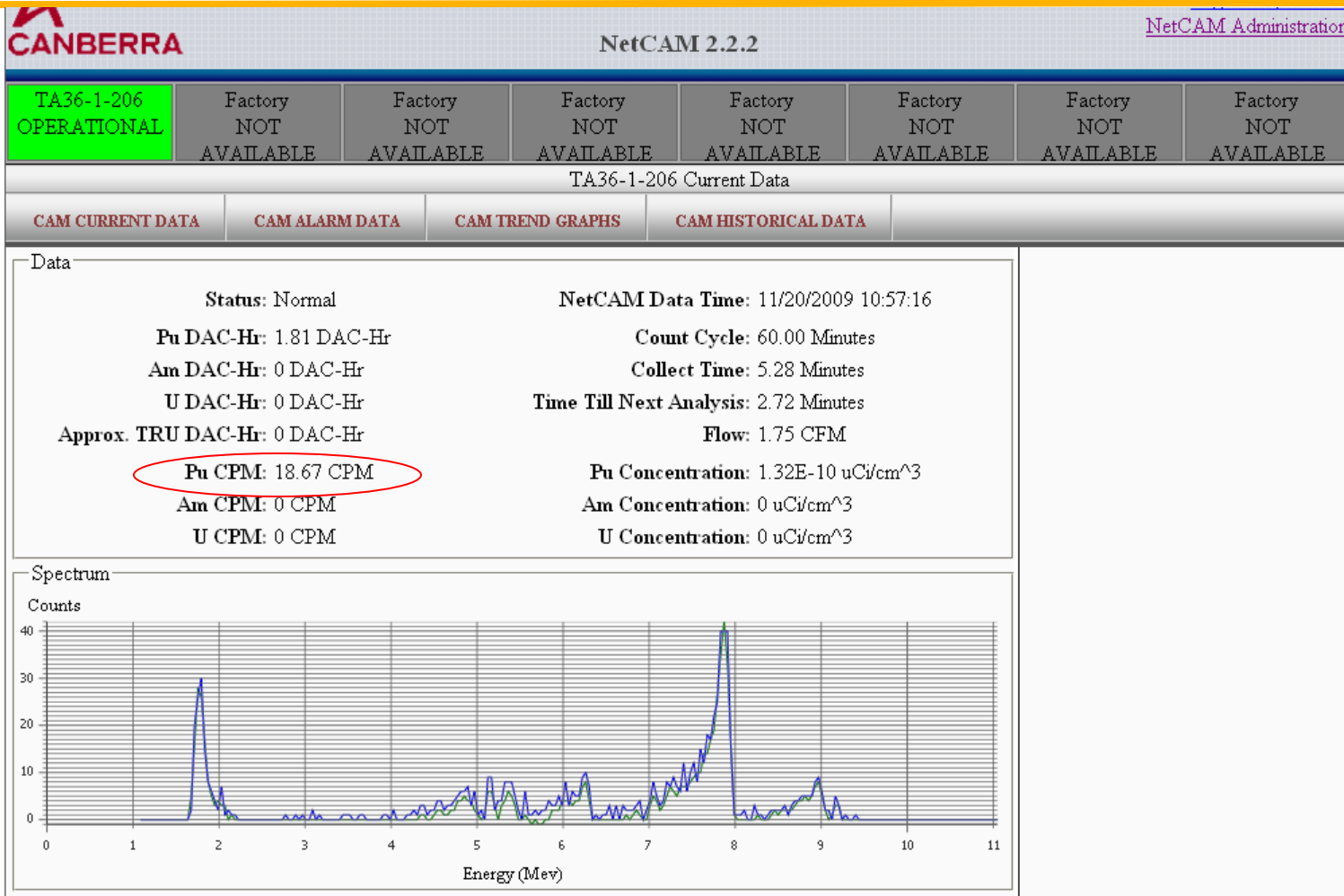
Valley mode: 150 dpm ^{239}Pu source

NetCAM : Valley Method DAC hr calculation

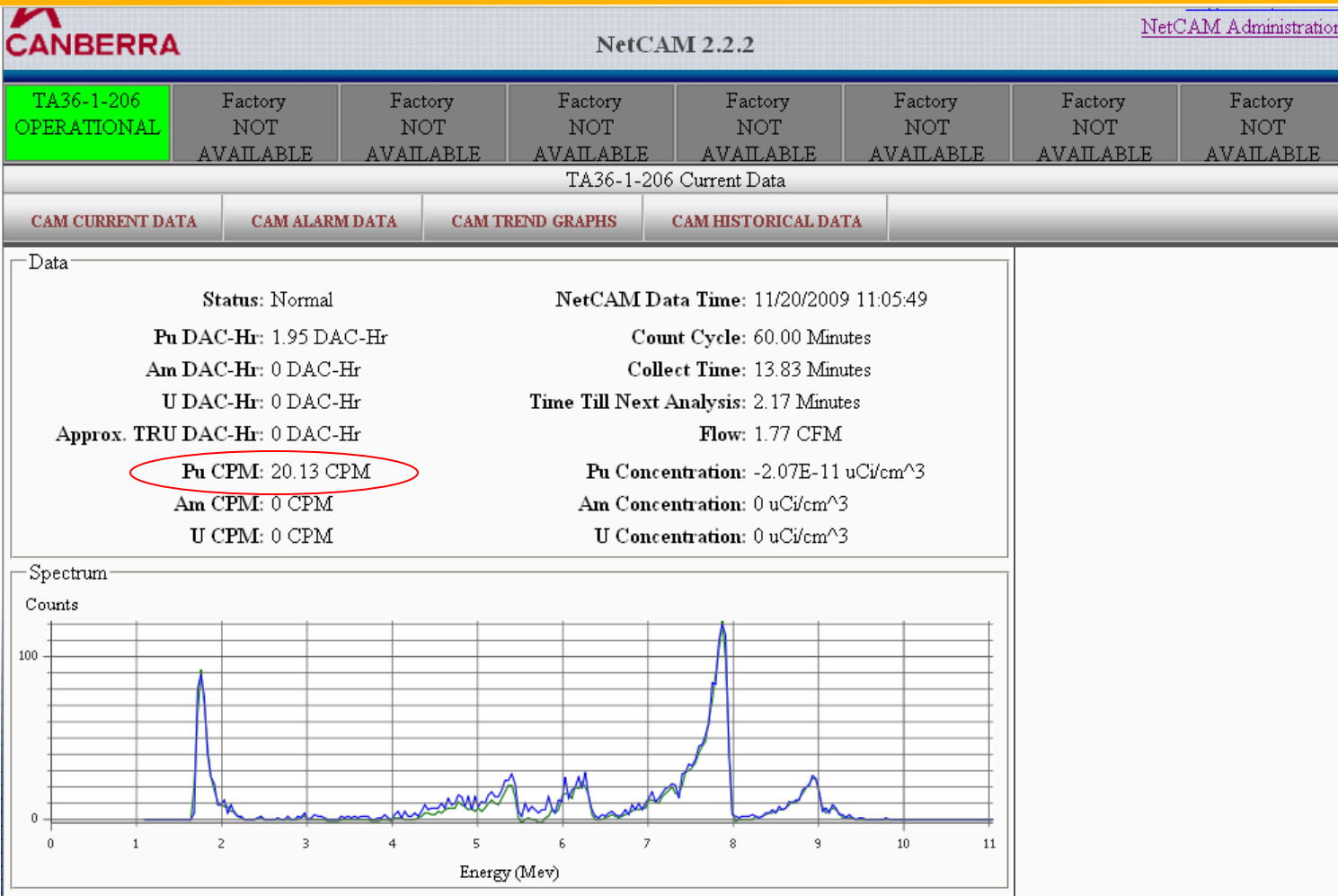
Nov 23 2009 - TA36-1-202



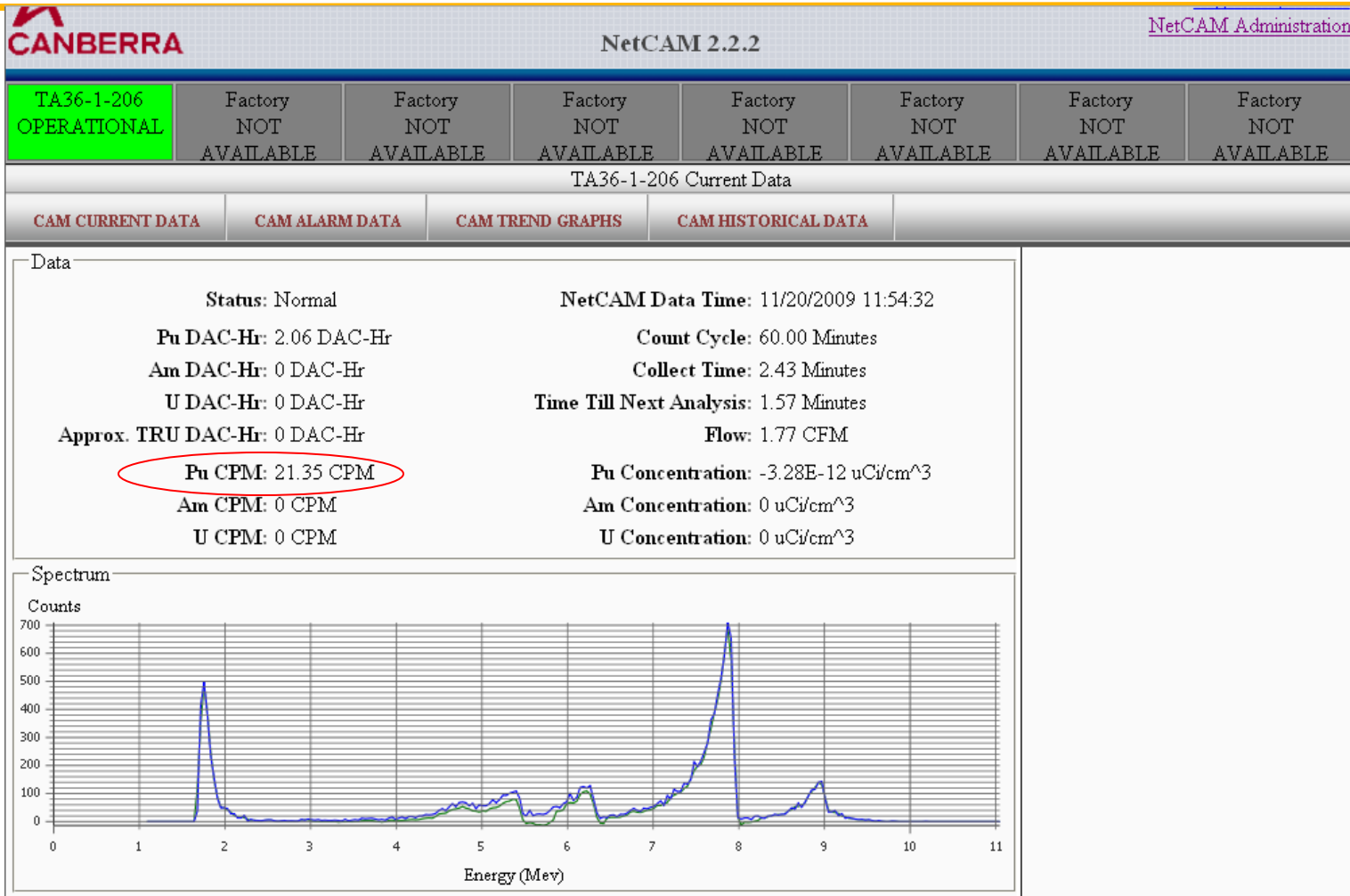
Valley mode: 75 dpm ^{239}Pu source after 4 minutes



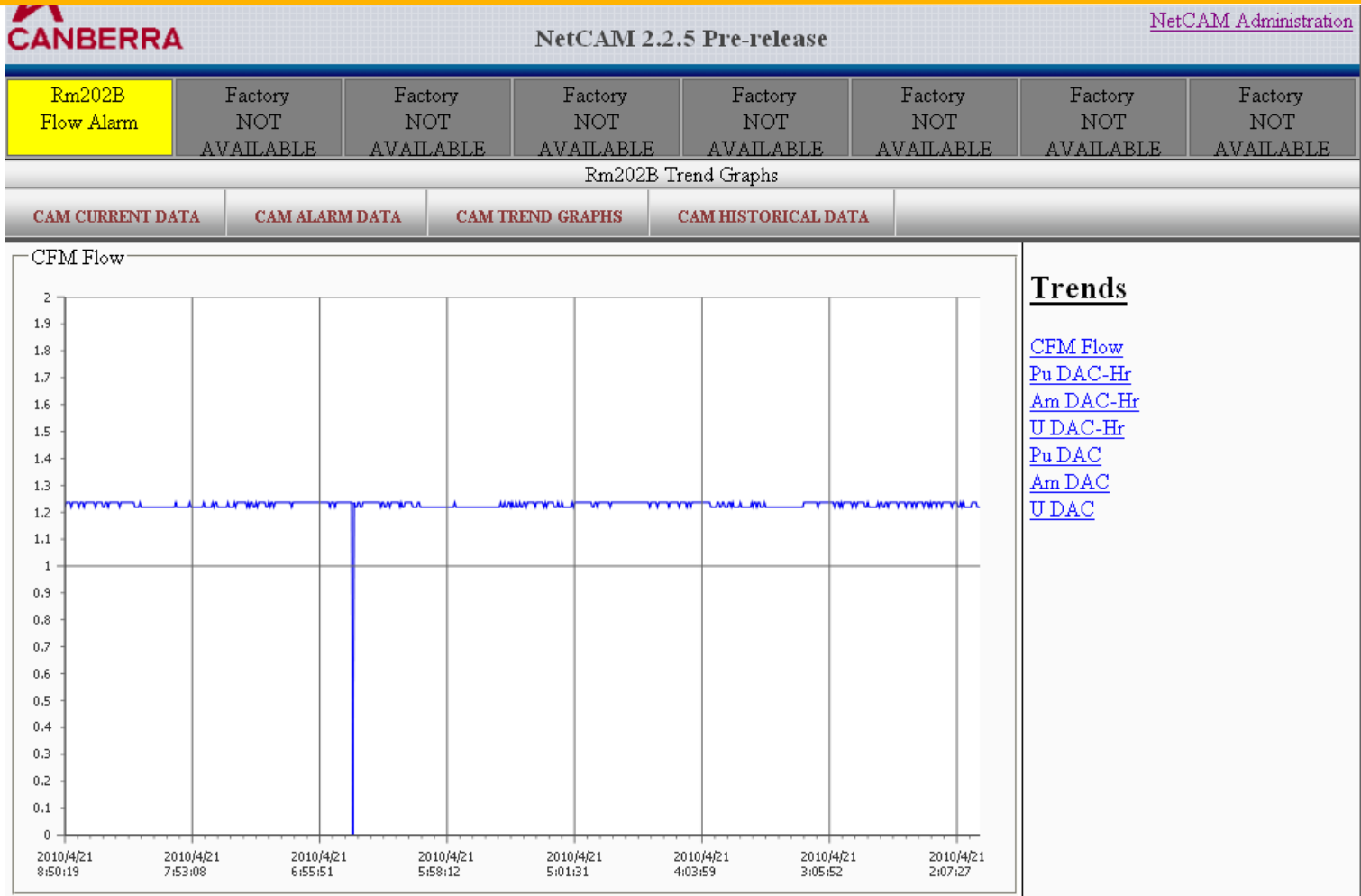
Valley mode: 75 dpm ^{239}Pu source after 12 minutes



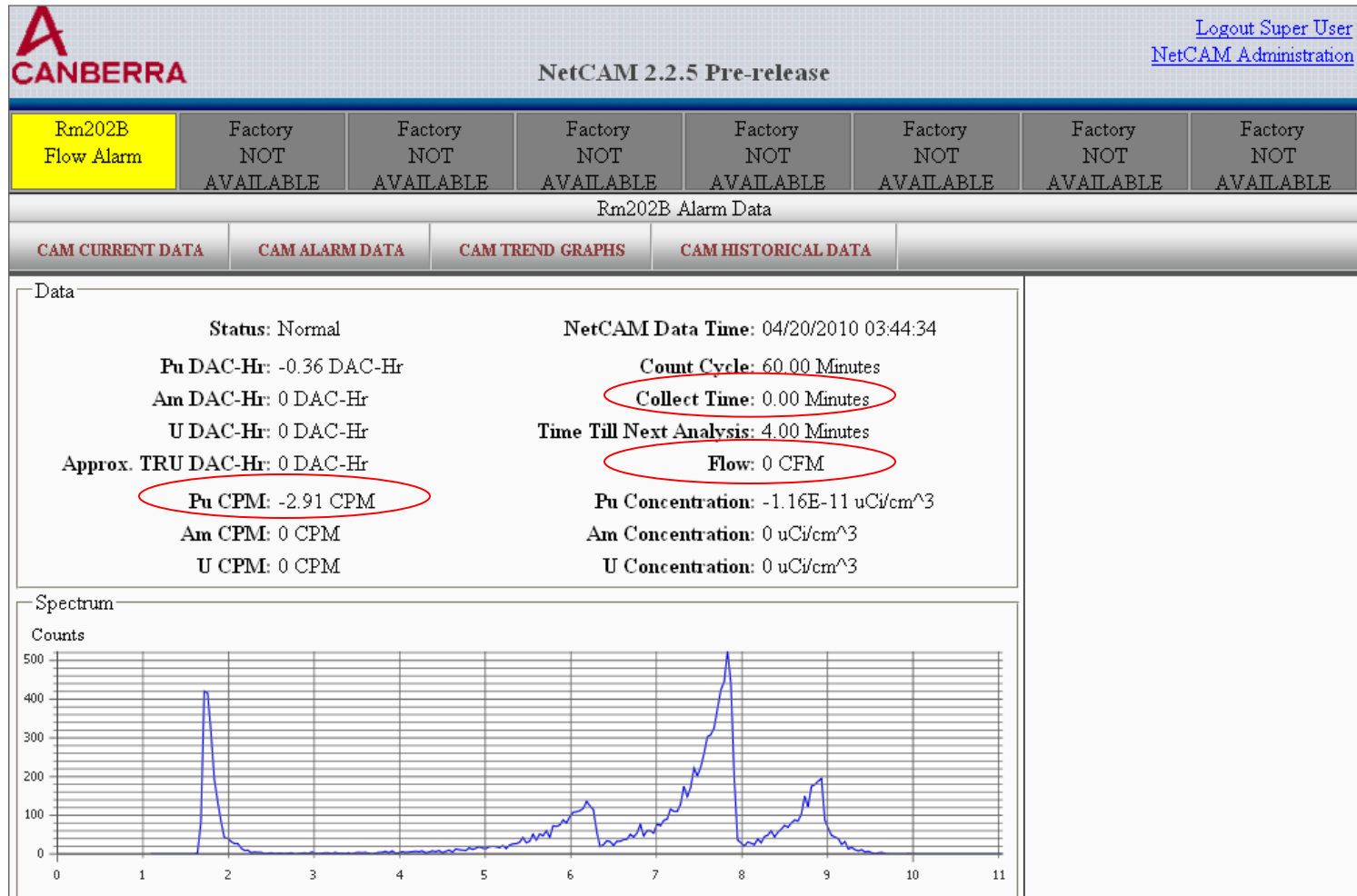
Valley mode: 75 dpm ^{239}Pu source after 60 minutes



Issues to be resolved: No flow rate data



Issues to be resolved: End of cycle flow alarm message



Issue: inconsistent messages

The screenshot displays three windows. The top window, 'RadHawk Client', shows three ROI status boxes: 'Rm202A 2:1' (yellow, 0E00 DAC), 'Rm202B 2:2' (green, 8.99E-01 DAC), and 'Rm210 2:10' (yellow, Alpha CAM, 9.6E02 cc/s). The middle and bottom windows are 'NetCAM 2.2.5 - Mozilla Firefox' instances. The middle instance shows a table with 'Rm202A OPERATIONAL' and 'Rm202B OPERATIONAL' in green, while other units are 'Factory NOT AVAILABLE'. The bottom instance shows 'Rm210 OPERATIONAL' in green, with other units 'Factory NOT AVAILABLE'. Arrows indicate that the 'Rm202A' and 'Rm202B' data from the RadHawk Client is reflected in the middle NetCAM window, while the 'Rm210' data from the RadHawk Client is reflected in the bottom NetCAM window, despite the middle window also displaying 'Rm210' data.

Unit	Status	Availability
Rm202A	OPERATIONAL	Factory NOT AVAILABLE
Rm202B	OPERATIONAL	Factory NOT AVAILABLE
Rm210	OPERATIONAL	Factory NOT AVAILABLE
Other Units	Factory NOT AVAILABLE	Factory NOT AVAILABLE

Issue: Hi-background alarms

CANBERRA Logout Super User
NetCAM Administration

NetCAM 2.2.5 Pre-release

Rm210 OPERATIONAL	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE
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Rm210 Alarm Data

CAM CURRENT DATA **CAM ALARM DATA** **CAM TREND GRAPHS** **CAM HISTORICAL DATA**

Data

Status: Hi Background NetCAM Data Time: 04/19/2010 11:44:52

Pu DAC-Hr: 0.21 DAC-Hr Count Cycle: 15.00 Minutes

Am DAC-Hr: 0 DAC-Hr Collect Time: 0.00 Minutes

U DAC-Hr: 0 DAC-Hr Time Till Next Analysis: 4.00 Minutes

Approx. TRU DAC-Hr: 0 DAC-Hr Flow: 1.89 CFM

Pu CPM: 2.8 CPM Pu Concentration: 3.18E-11 uCi/cm³

Am CPM: 0 CPM Am Concentration: 0 uCi/cm³

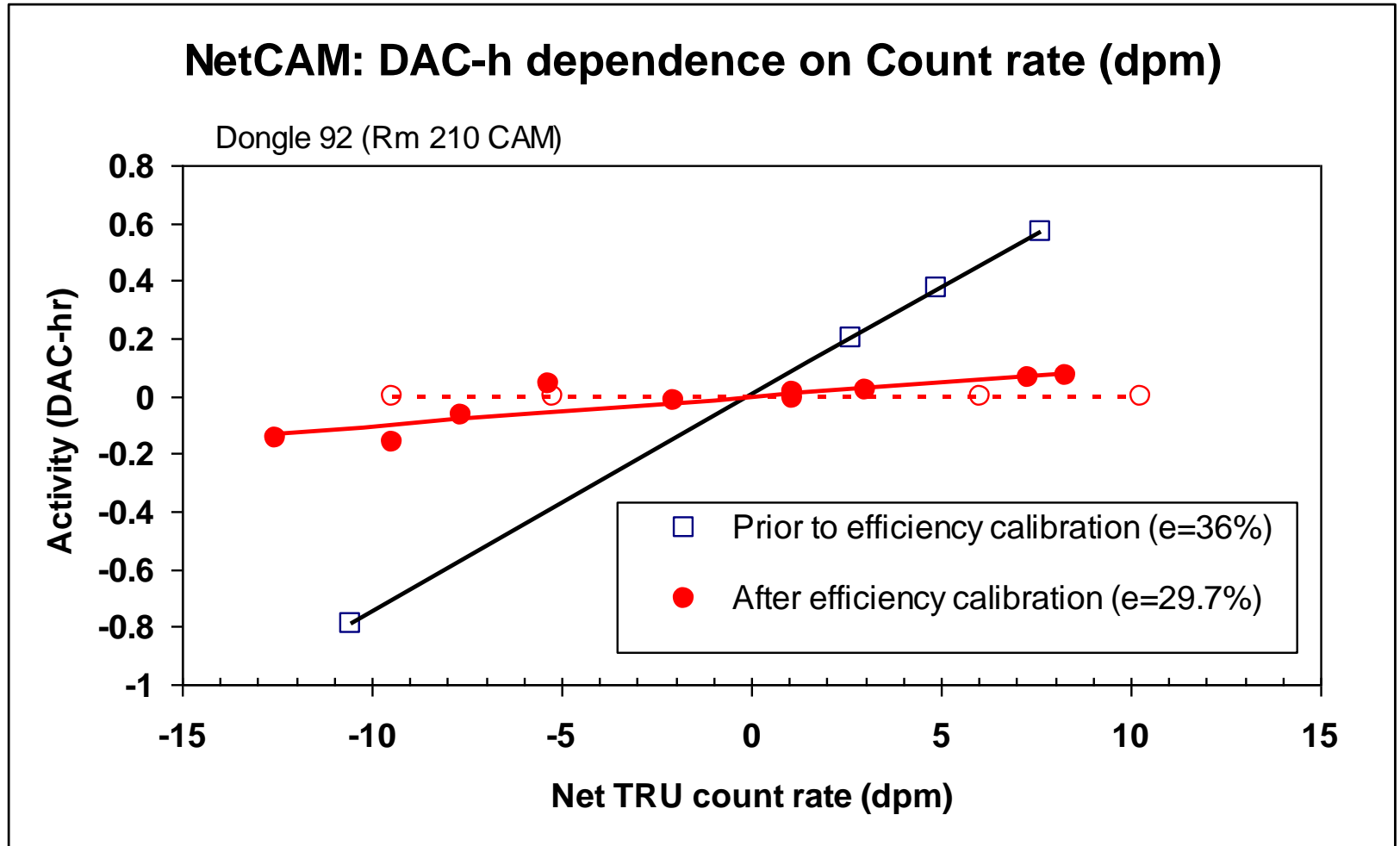
U CPM: 0 CPM U Concentration: 0 uCi/cm³

Spectrum


Counts

Energy (MeV)

Issue: post-efficiency calibration problem



Issue: post efficiency calibration problem


NetCAM 2.2.5

[Logout Super User](#)
[NetCAM Administration](#)

NetCAM_91A OPERATIONAL	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE	Factory NOT AVAILABLE
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NetCAM_91A Current Data

CAM CURRENT DATA
CAM ALARM DATA
CAM TREND GRAPHS
CAM HISTORICAL DATA

Data

Status: Normal

Pu DAC-Hr: 0.22 DAC-Hr

Am DAC-Hr: 0 DAC-Hr

U DAC-Hr: 0 DAC-Hr

Approx. TRU DAC-Hr: 0 DAC-Hr

Pu CPM: 91.4 CPM

Am CPM: 0 CPM

U CPM: 0 CPM

NetCAM Data Time: 03/17/2010 15:01:40

Count Cycle: 15.00 Minutes

Collect Time: 8.83 Minutes

Time Till Next Analysis: 3.17 Minutes

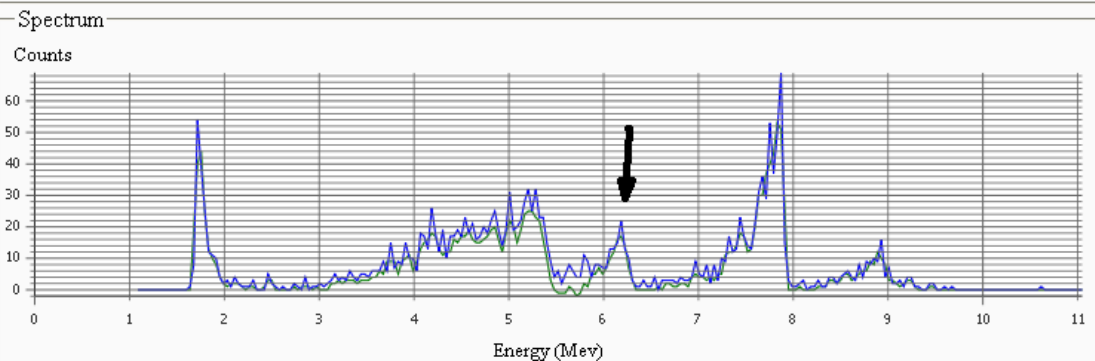
Flow: 2.27 CFM

Pu Concentration: 3.11E-12 uCi/cm³

Am Concentration: 0 uCi/cm³

U Concentration: 0 uCi/cm³

Spectrum



Counts

Energy (MeV)

Energy calibration shows chronic offset of ~ 200 keV

Expect 11 cpm ≈ 1DAC-h

NetCAM outstanding issues

- **AS1700**
 - Acute alarm operates in a differential mode
 - Possibly does not reliably update minimum count requested by user
- **Energy calibration chronically too high by 100-200 keV**
- **Valleys mode**
 - Consistently over subtracts background
 - More stable than Peaks mode
- **Peaks mode**
 - More sophisticated approach but also more prone to problems
 - Excellent Rn/Tn peak fitting – very stable.
 - Mis-identifies isotopes (probably due to energy calibration problems)

Issues to be resolved

■ Alarm algorithms

- Problem with acute alarm algorithm (differential)
- More info on chronic alarm algorithms incl. uncertainty analysis requested
 - Double differential mode ??

■ Efficiency calibration problem

- Browser does not display efficiency
- Obvious problem in cpm → DAC-h conversion factor after a calibration

■ Robustness/Resiliency/Reliability needs improvement

- Currently 99+% duty time

■ Local display needed to facilitate routine operations

- e.g Filter changes and performance checks

Lessons Learned

- **Software/Firmware issues extend to all vendors**
 - Customers seen as beta (maybe alpha testers)
 - Have to work with vendor to resolve issues
 - Need Corporate champion to lead fight within vendor
 - Vendor sometimes reluctant or unwilling to make changes
 - Legacy problems probably lurking in all codes
 - Documentation lacking or inconsistent with code

Summary

- **Valley mode preferred mode of operation**
 - More stable performance
 - Reproducibly able to detect 2 DAC-h ^{239}Pu source in 4 minutes
 - No false alarms at 4 DAC-h alarm limit in 0.1 pCi/l Rn background
 - Combined 6 months of operation

- **Dongle hardware very reliable**
 - Simple design
 - No faults in combined 3+ years of operation

- **Much progress made over past 18 months**
 - But more work to do
 - Need to have confidence that system will behave as expected
 - Next firmware release expected in mid-May.
 - Still front runner for RLUOB CAM