

# Lung Counting and Accounting for the Uranium Background

Trying to Minimize Bias Near the Decision Level

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Presented at the May 2002 DOE Lung Intercalibration Committee Workshop

# Uranium Lung Counter

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- Four planar germanium detectors
- Shielded room
- Digital signal processing



# Routine Nuclide Library for Lung Counting

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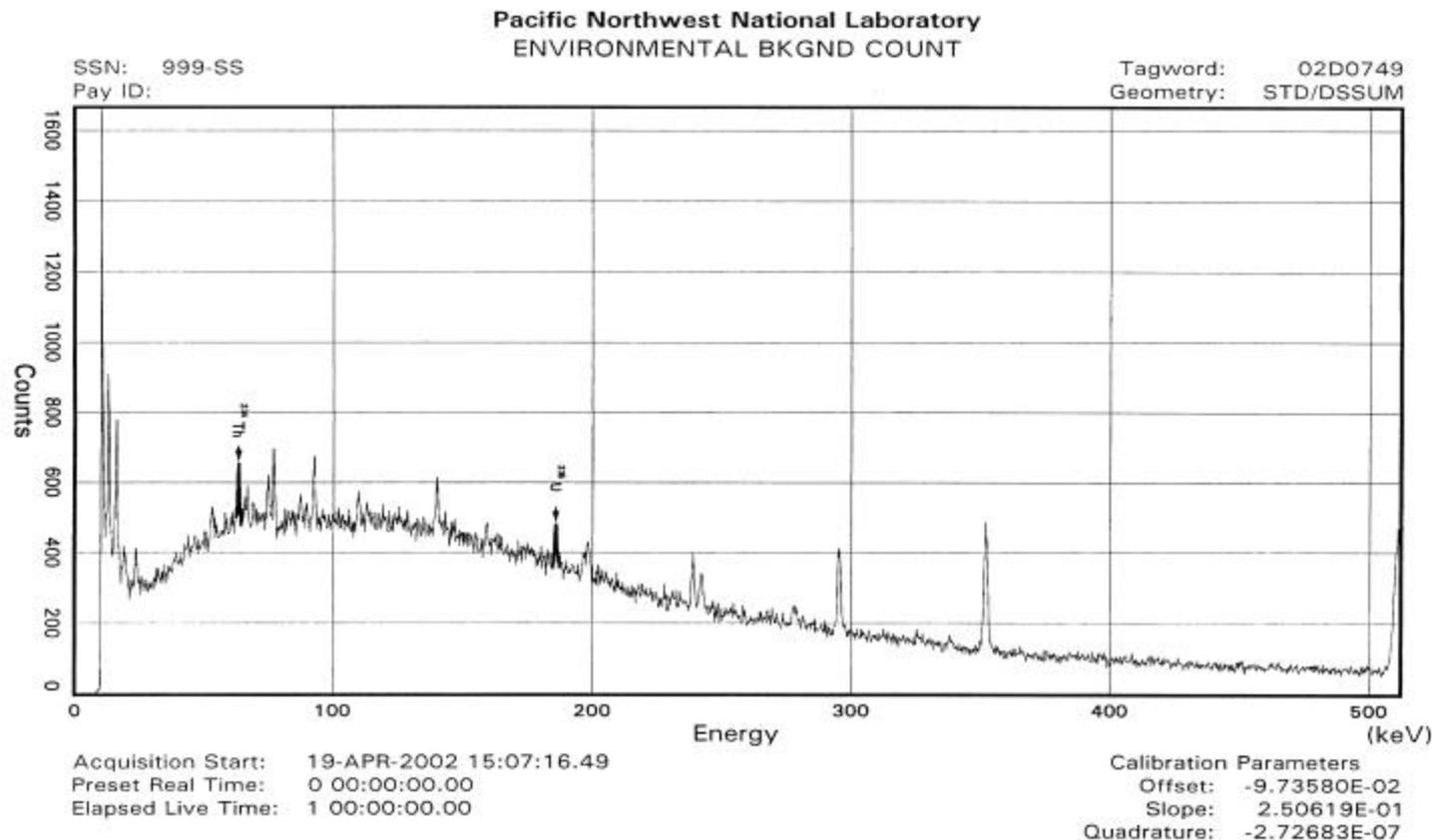
- $^{234}\text{Th}$  (63 keV)
- $^{235}\text{U}$  (185.7 keV)
- $^{241}\text{Am}$  (59.5 keV)

# Uranium Counter Background

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- Room background spectra contain  $^{234}\text{Th}$  and  $^{226}\text{Ra}$  peaks along with radon progeny and other stuff

# Uranium Progeny in Background Spectrum



# Uranium Series Background Sources

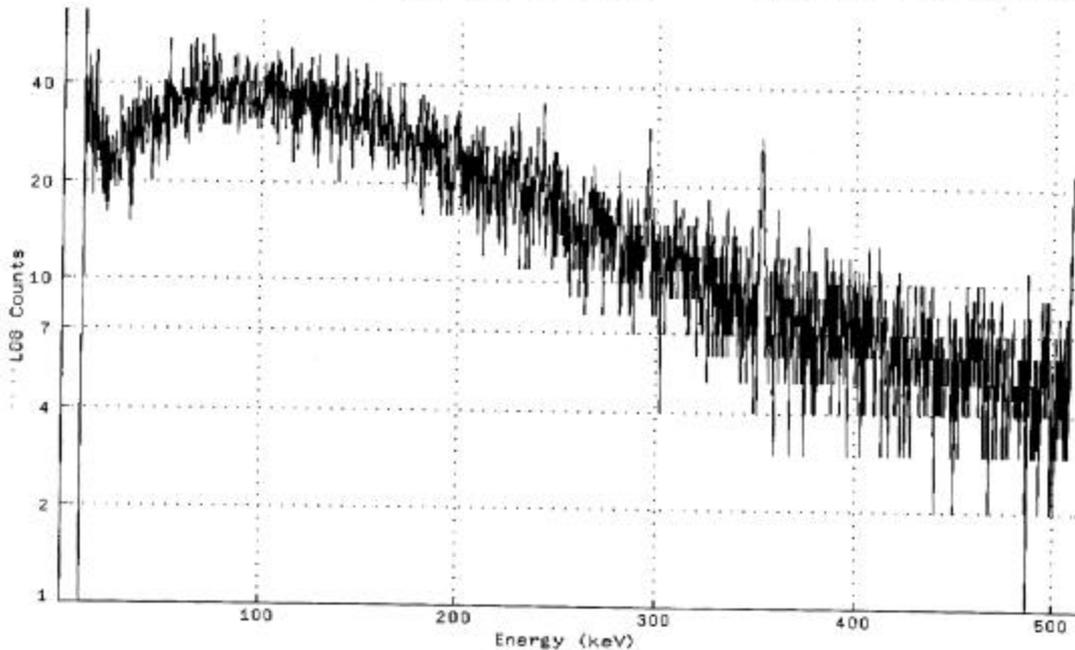
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- Be window and other detector components
- Shielding and mounting system
- Phantoms



# Worker spectrum

Spectrum : DKA100:[USER.INV\_DS] .STD-DSSUM\_200204300820.CNF;1  
Title : LUNGD5 STD/DSSUM Geometry  
Sample Title:  
Start Time: 30-APR-2002 08:20 Sample Time: 30-APR-2002 08:20 Energy Offset: -9.73580E-02  
Real Time : 0 01:00:00.91 Sample ID : URL Energy Slope : 2.50619E-01  
Live Time : 0 01:00:00.00 Sample Type: Individual Energy Quad : -2.72683E-07

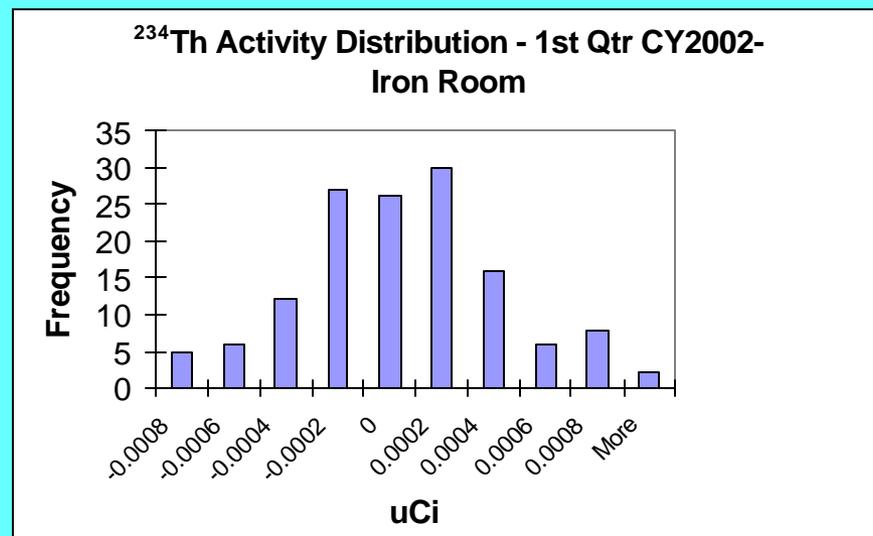
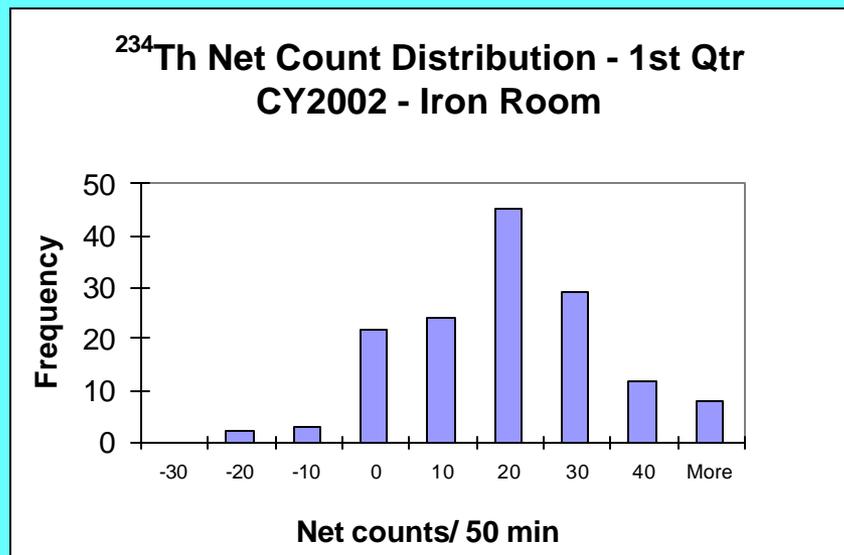


# Uranium Background

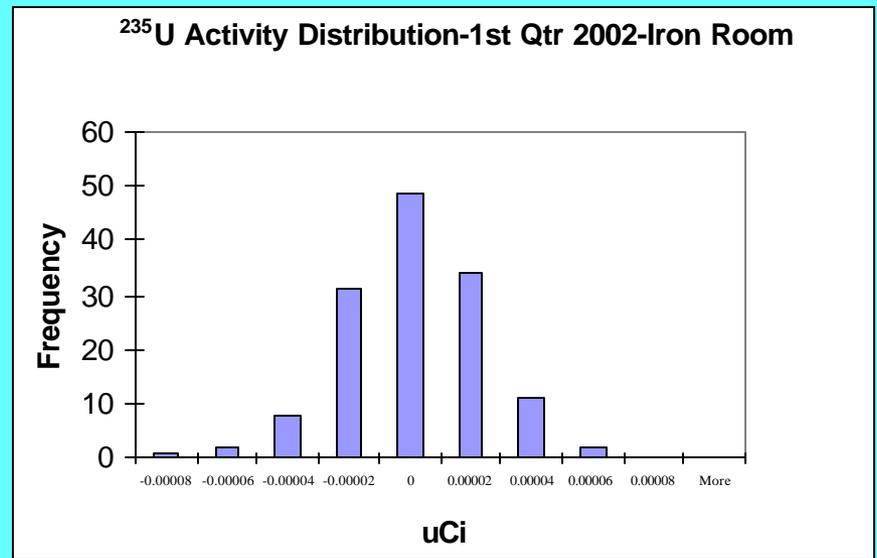
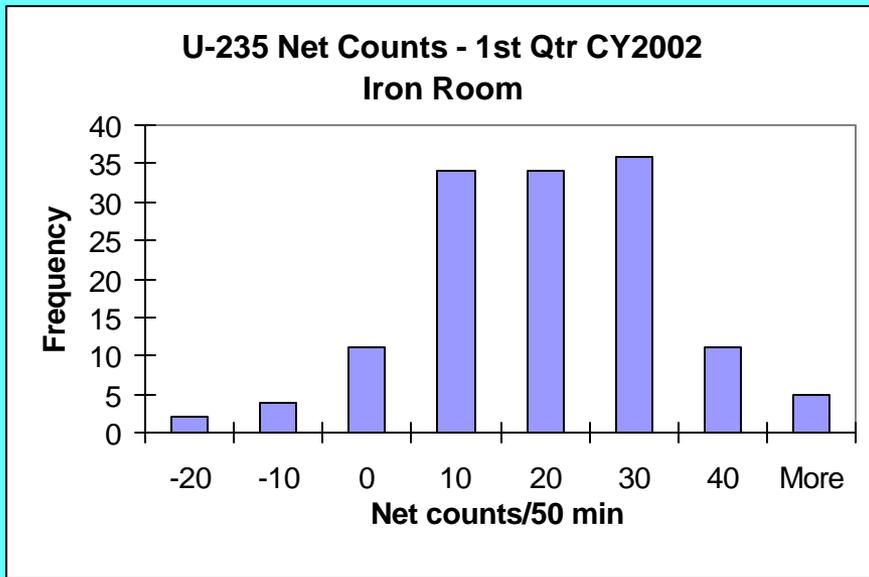
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- Initially did not subtract room environmental background for  $^{234}\text{Th}$  and  $^{235}\text{U}$  measurements
- 15% of results exceeded decision level
- Unacceptable positive bias
- Recount when results >decision level

# $^{234}\text{Th}$ Net Count Distribution with and without Environmental Background Contribution Subtracted in Iron Room



# $^{235}\text{U}$ Count and Activity Distributions



# Uranium Background

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- Environmental background spectra show uranium series peaks (13, 16, 63, 92, 186 keV)
- Peaks not identified in majority of worker spectra
- Software allows for subtracting environmental component (**expback**) when peak present in environmental background spectrum

# Environmental Background Perspective

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## ■ $^{234}\text{Th}$

- Iron Room      Enback 15% of continuum background
- SS Room        Enback 25% of continuum background

## $^{235}\text{U}$

- Iron Room        Enback 17% of continuum background
- SS Room         Enback 19% of continuum background

# Uranium Background

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- Environmental peak count rate subtracted from peaks in worker spectra
- Environmental background spectrum obtained with calibration torso phantom

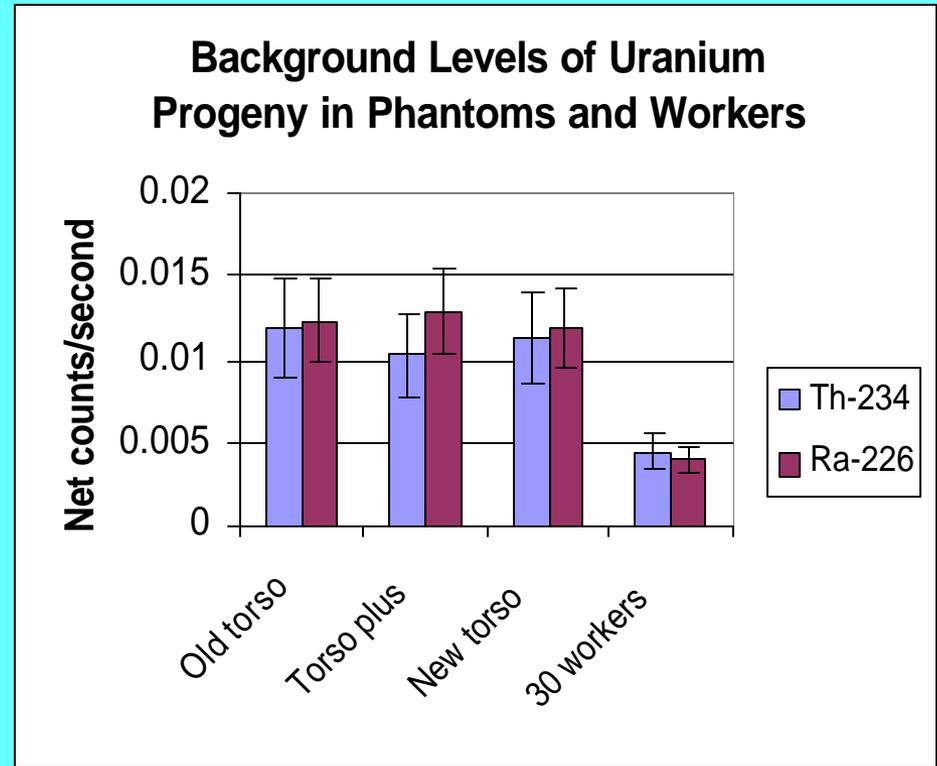
# Torso Phantom Used for Calibration

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# Environmental Uranium Levels

- Phantom count time – 12 hours
- Workers' count time – 50 minutes

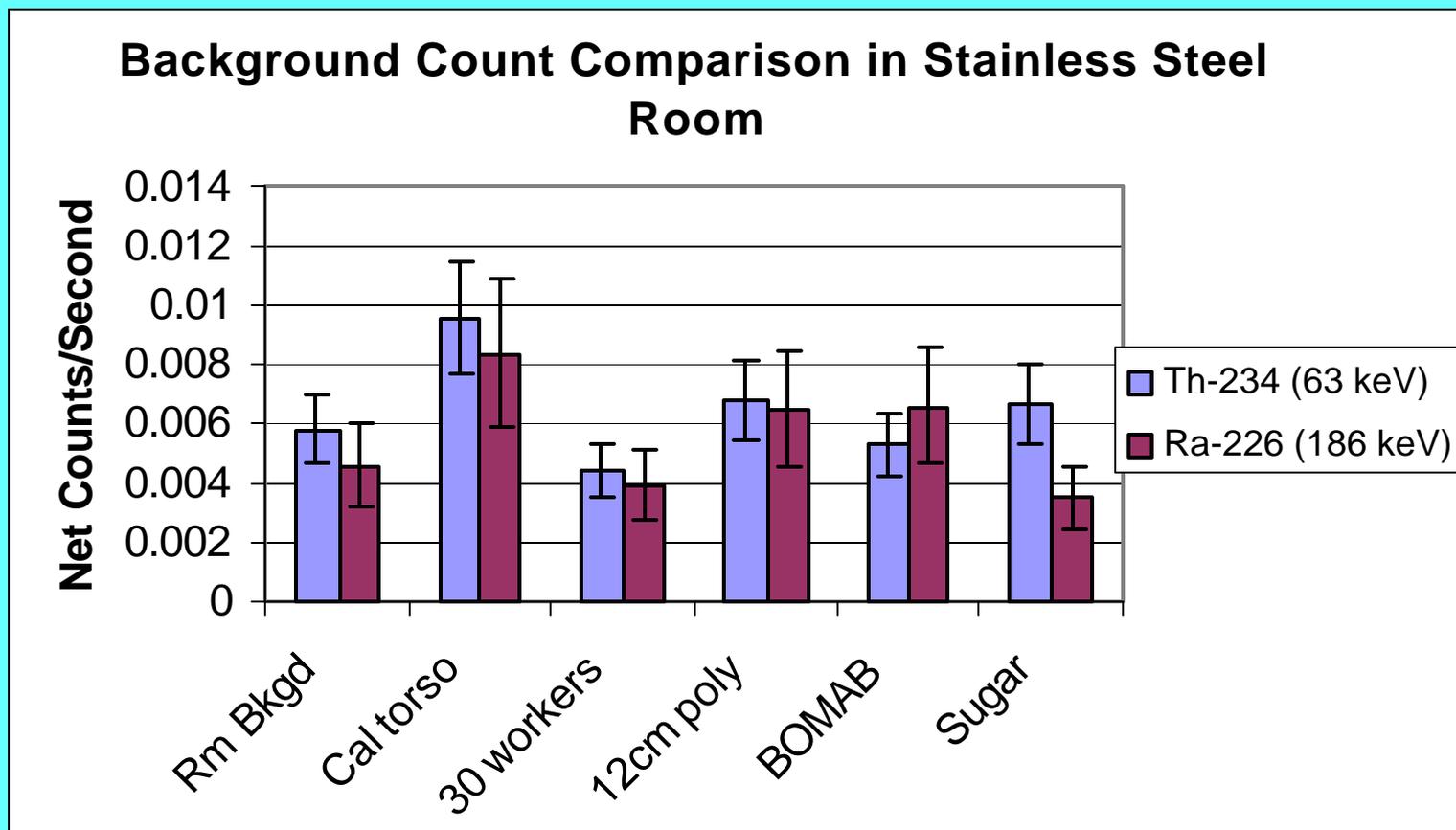


# Uranium Background

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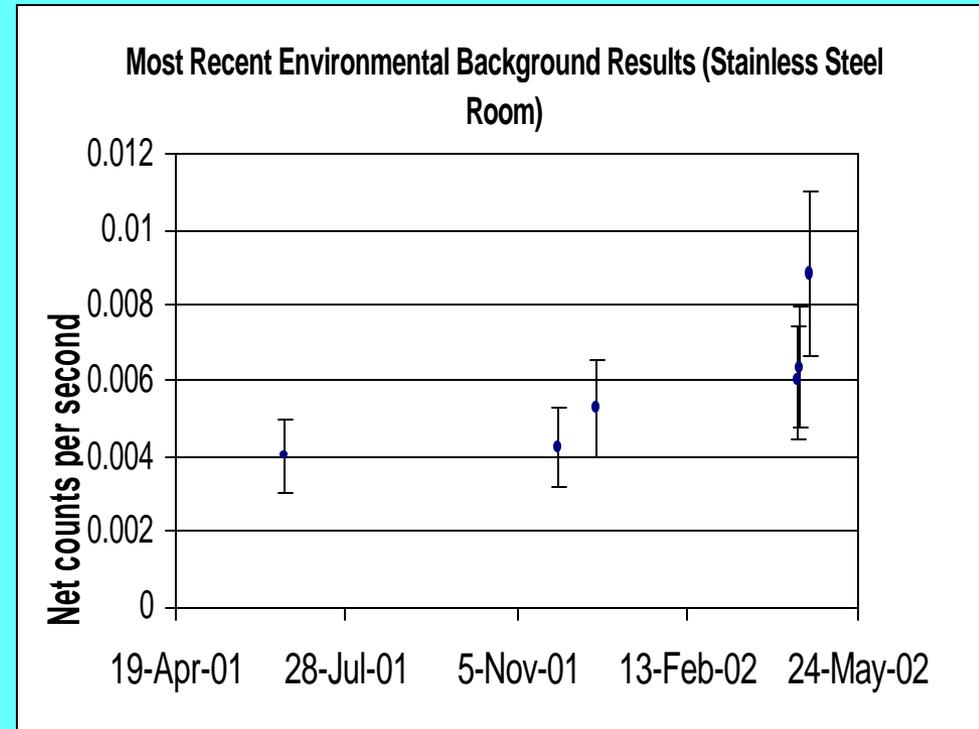
- Subtracted the environmental component for results exceeding the decision level
- Tested sugar sacks, polyethylene slabs, solid and water-filled phantoms, no shielding
- Polyurethane-filled BOMAB chosen

# Background Comparison in Stainless Steel Room



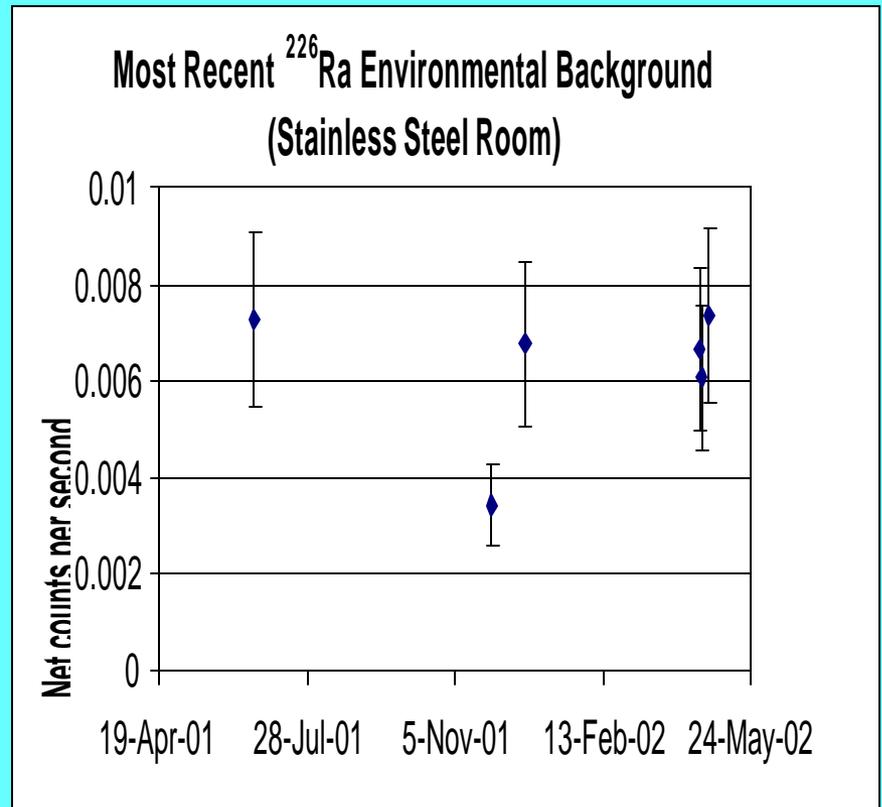
# $^{234}\text{Th}$ Environmental Background Count Rate

- Increasing trend
- BOMAB phantom used
- Daily room background results show no increasing trend



# $^{226}\text{Ra}$ Environmental Background Count Rate

- Relatively consistent results
- BOMAB phantom used
- Daily room background results show no increasing trend



# Conclusions

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- Important to obtain accurate estimate of environmental background for  $^{234}\text{Th}$ ,  $^{235}\text{U}$  and other naturally occurring radioactive material
- Calibration phantoms are not designed to be used to estimate background levels and can introduce bias
- Measurement of the room background without a surrogate body present may adequately approximate the  $^{234}\text{Th}$  and  $^{235}\text{U}$  environmental background levels