Validating Aggressive Air Sampling For Beryllium Clearance

Beryllium Health and Safety Committee Meeting
Lawrence Livermore National Laboratory

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Context

- NNSA facility being replaced
- Legacy beryllium contamination
- Failed to clear using biased wipe sampling
- Sampling for comparison with recognized health-based standard

Aggressive Air Sampling Prerequisites

- Identified surface contamination
- Area must isolatable
- Area visibly clean
- Appropriate PPE
- Adequate power circuits/outlets

Objective

- **Demonstrate Aggressive Air Sampling for Beryllium Clearance**
- **Modeled After EPA Asbestos Clearance**
- **Target:**
  - Not Exceed 20% ACGIH TLV
  - Extreme Re-entrainment Conditions

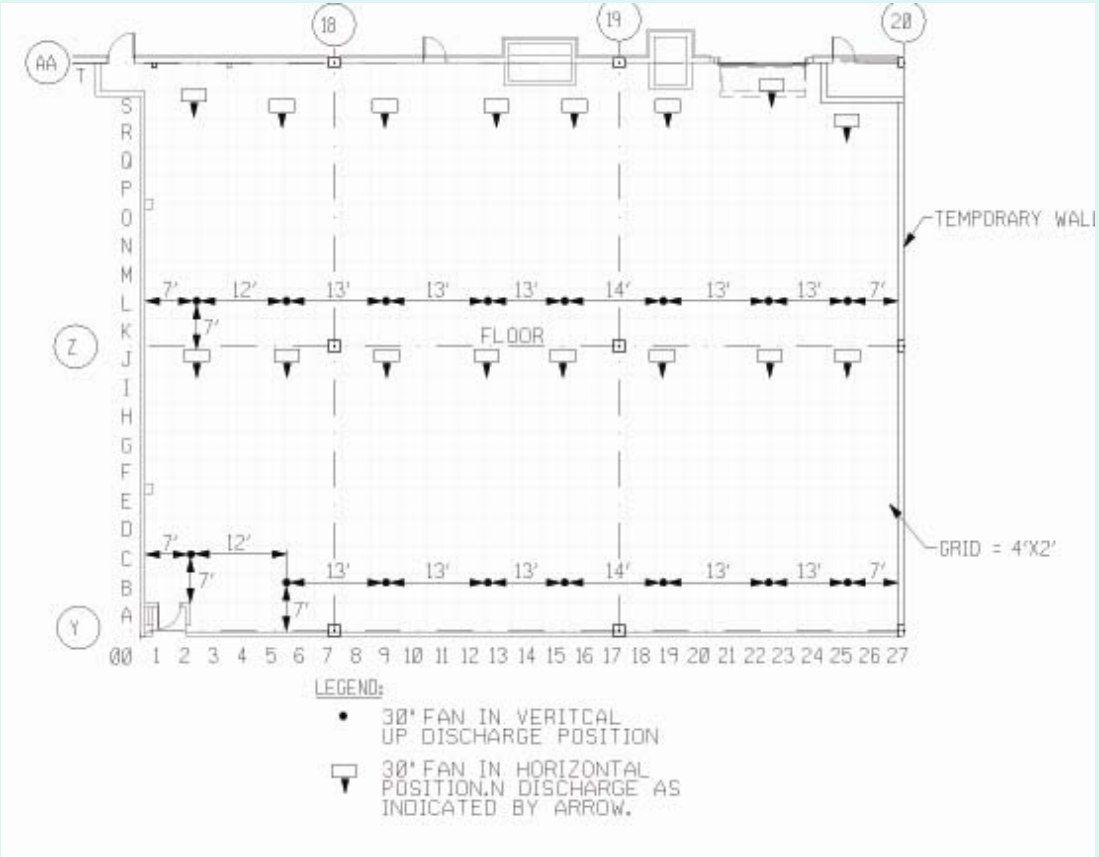
Methods

- Space is 8,500 ft^2 Maintenance Area (about 187,000 ft^3)
- Accumulated Dust on Inaccessible Surfaces
- Prior Surface Levels = 0.02 (RL) to 0.85 $\mu g/100\ cm^2$
- Target = 95/95 UTL of 0.01 $\mu g/m^3$

Methods

- Metals Included as Indices for Air Mixing
  - Copper, Iron, and Calcium
- Air Washed with Leaf Blowers
- Air Suspension Achieved with Fans for:
  - 10 µ Copper MicroBead with Calculated:
  - 5.3 fpm Terminal Settling Velocity

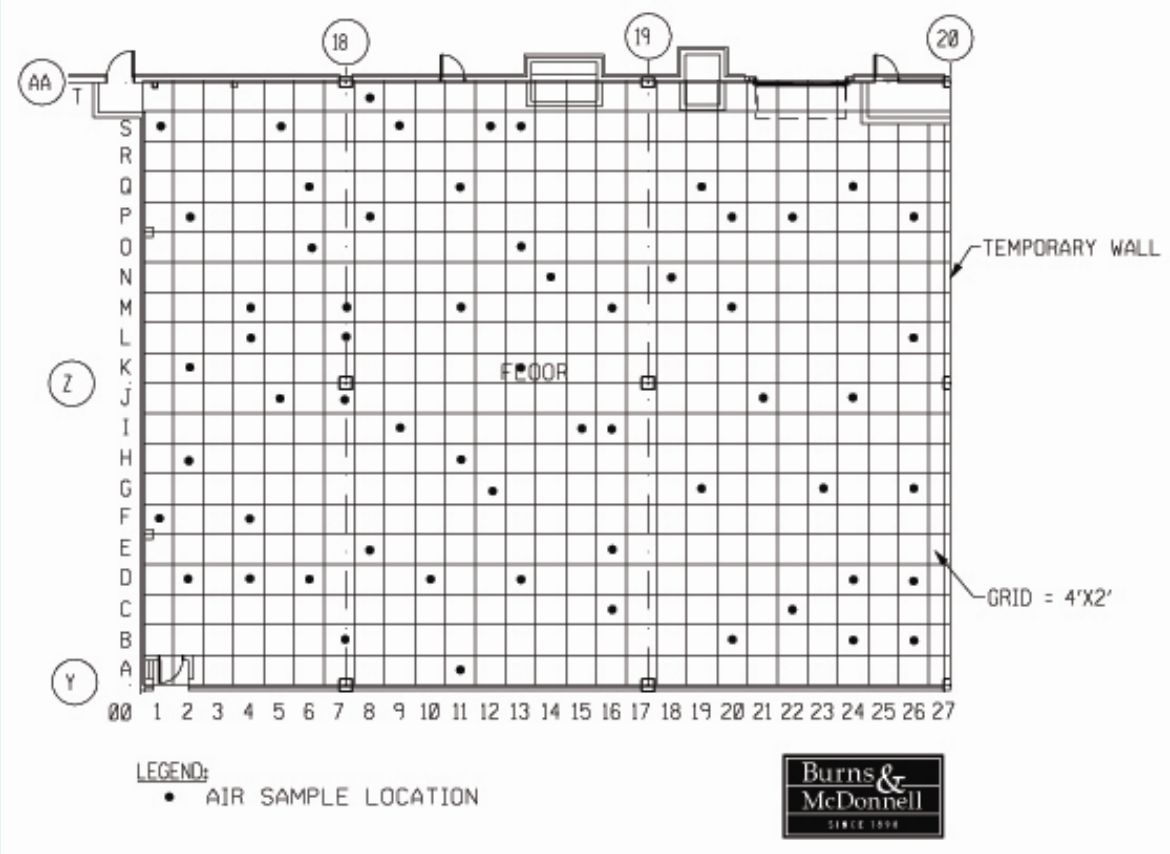
Circulating Fans Positions



Methods

- Negative Air Machines at Minimal Flow
  - When maintaining minimal flow, temperature swings can have significant effect.
- Air Samplers Randomly Located :
  - Grid of Study Area
  - Inlet of Air Machines
  - Outside of Enclosure
  - Ambient Background

Study Area Samplers Positions



Analytical Methods

- Round 1: NIOSH 7300 (modified) for all elements.
- Round 2: OSHA ID-125 ICP/MS for beryllium or OSHA ID-125G (modified) for calcium, copper and iron.
- Both rounds included wall deposits
- Uncensored / raw data used for stats for both rounds .

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DIFFERENTIAL PRESSURE RECORDER
0.011
STATUS
PRINTER ON/OFF
MENU
SAVE
PRINT JOB
SELECT
EXIT
POWER ON/OFF
ALARM SILENCE
PAPER FEED
DISPLAY
START JOB
HELP
ENGINEERING SOLUTIONS INC SEATTLE, WA USA
INLETS
Reference
DC IN
+12V max
AUX ALARM
SERIAL
USB

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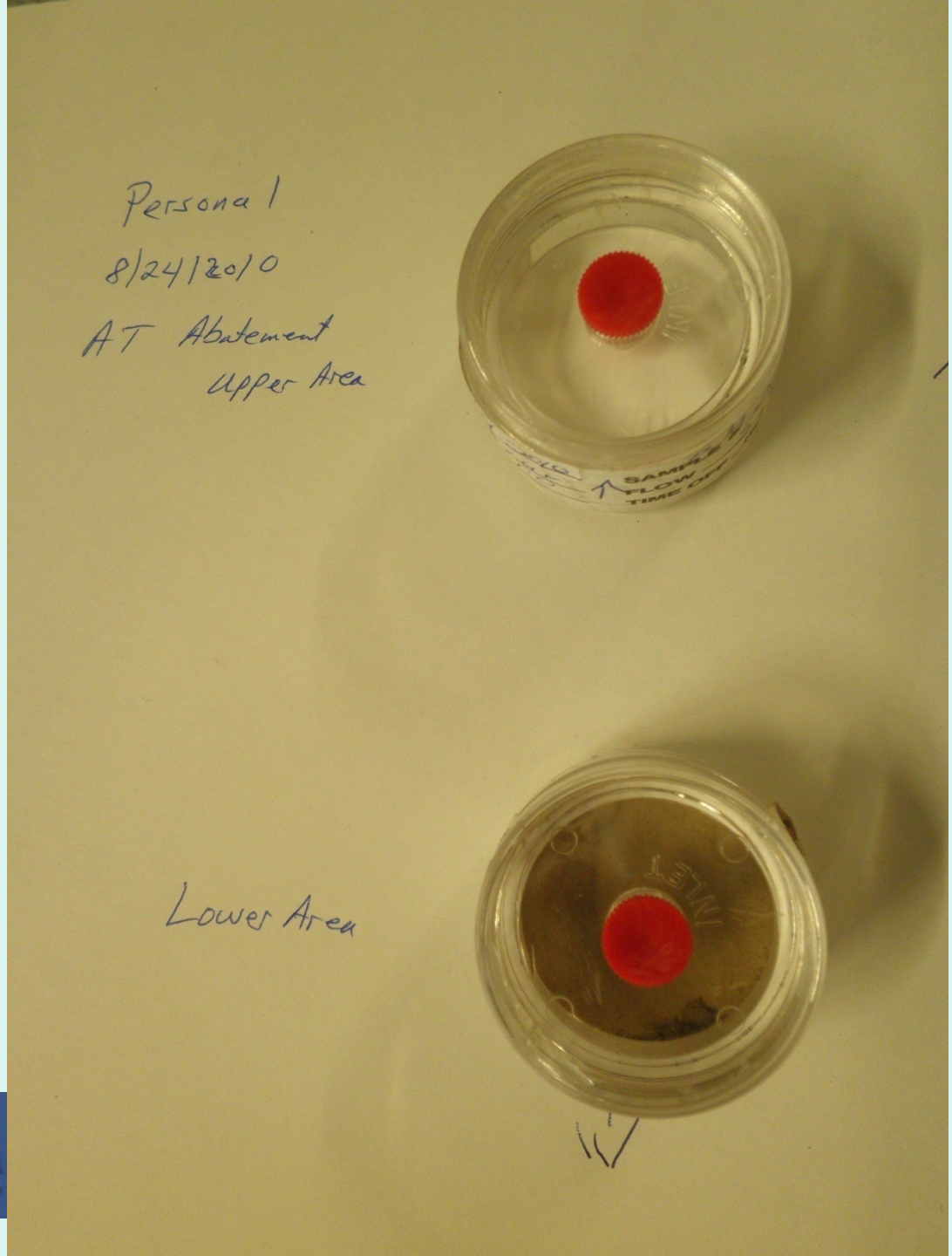

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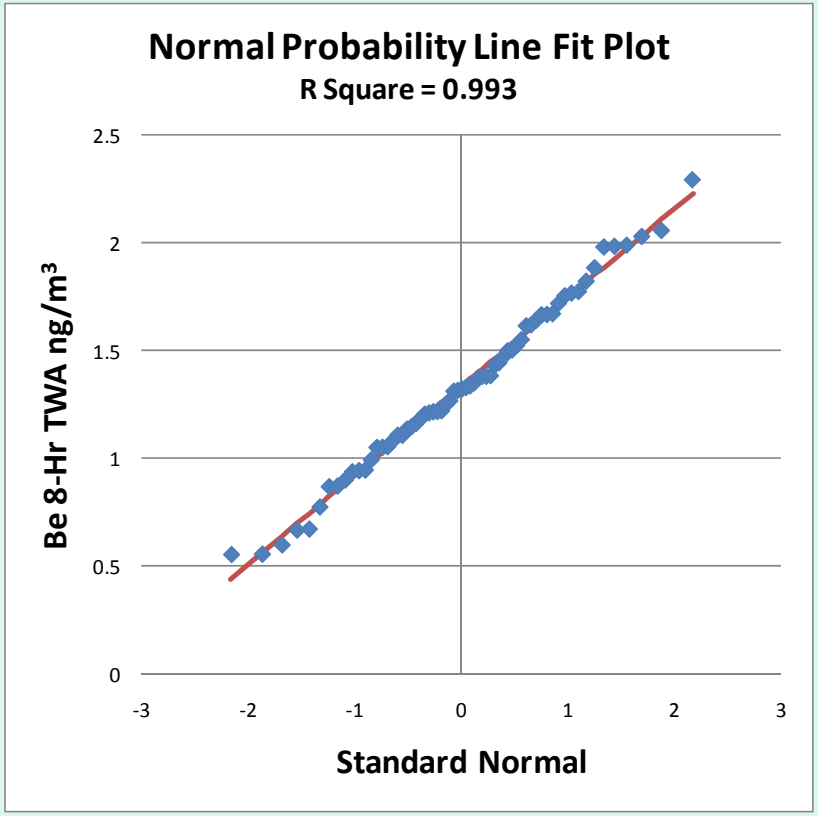
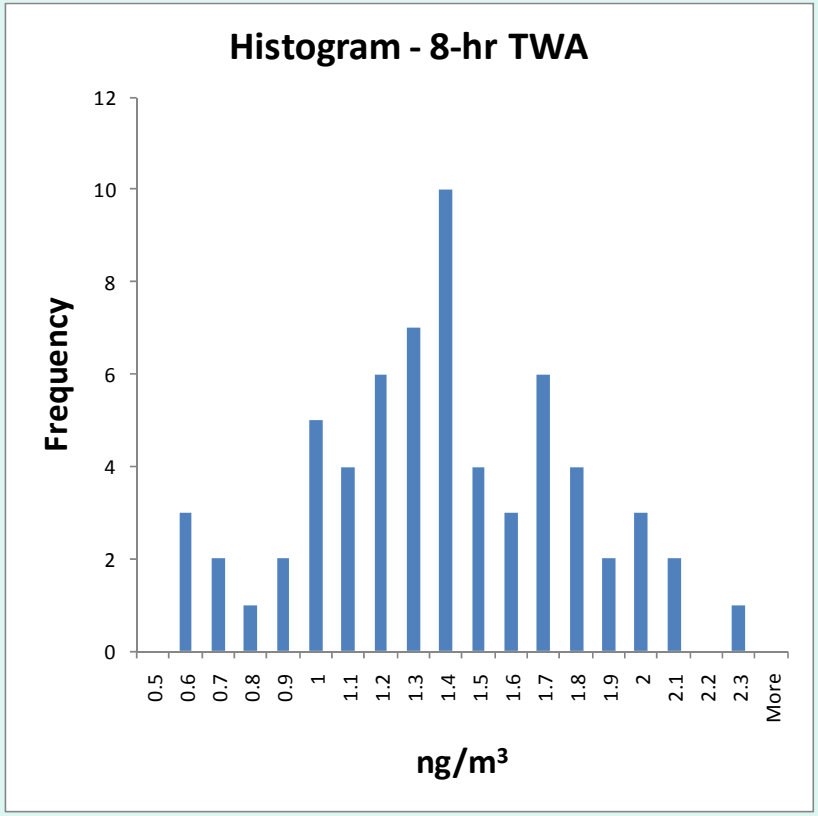
Results

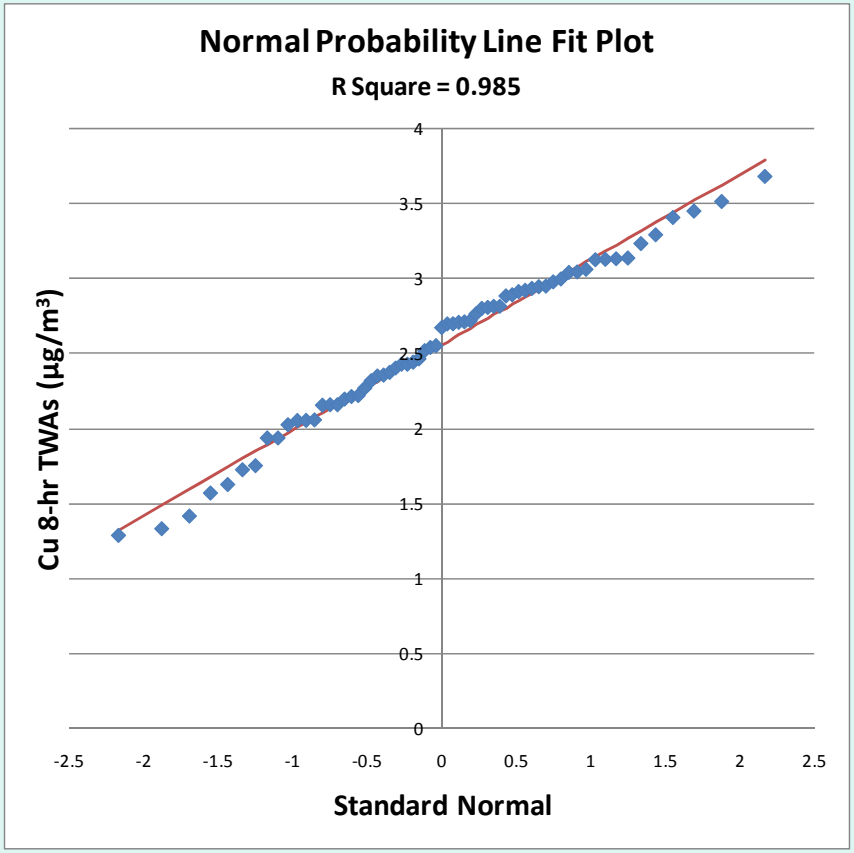
- Round 1 - Excessive Dust
  - Not decontaminated following characterization
  - Of 65 sampling pumps – samples from 31 that operated for the full period were used for stats
  - Bulk Sample < 0.5 mg Be/kg (soils 0.6 – 2.8 mg/kg); Yttrium 5.3 mg Y/kg (soils 30-150 mg/kg).
  - Surfaces post BeAAS < 0.2 µg/100 cm^2
- Round 2 - After Housekeeping
  - Visibly “clean” - ready for clearance testing
  - All 65 samples operated the full period

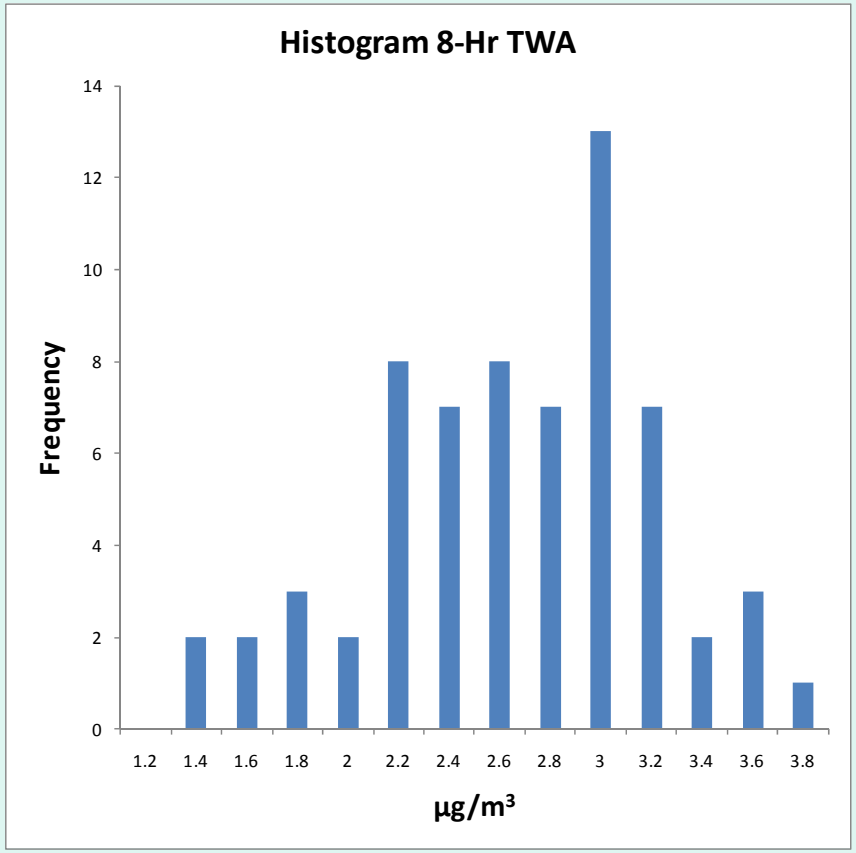
Beryllium Levels Were Normally Distributed



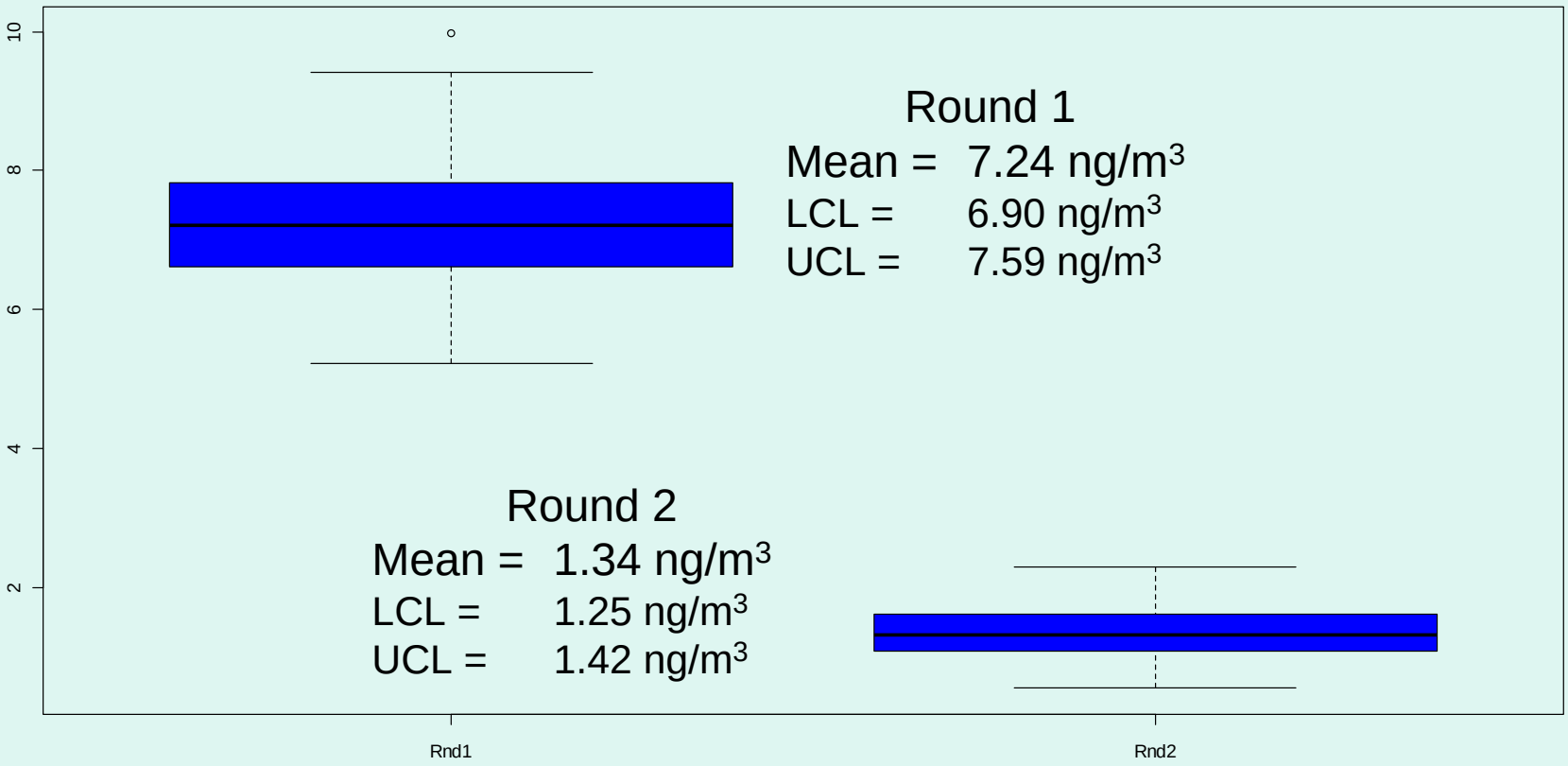


Copper Levels Were Also Normal





Round 2 Levels Are Significantly Lower than Round 1



Results – Round 1

Beryllium 8-Hr TWAs

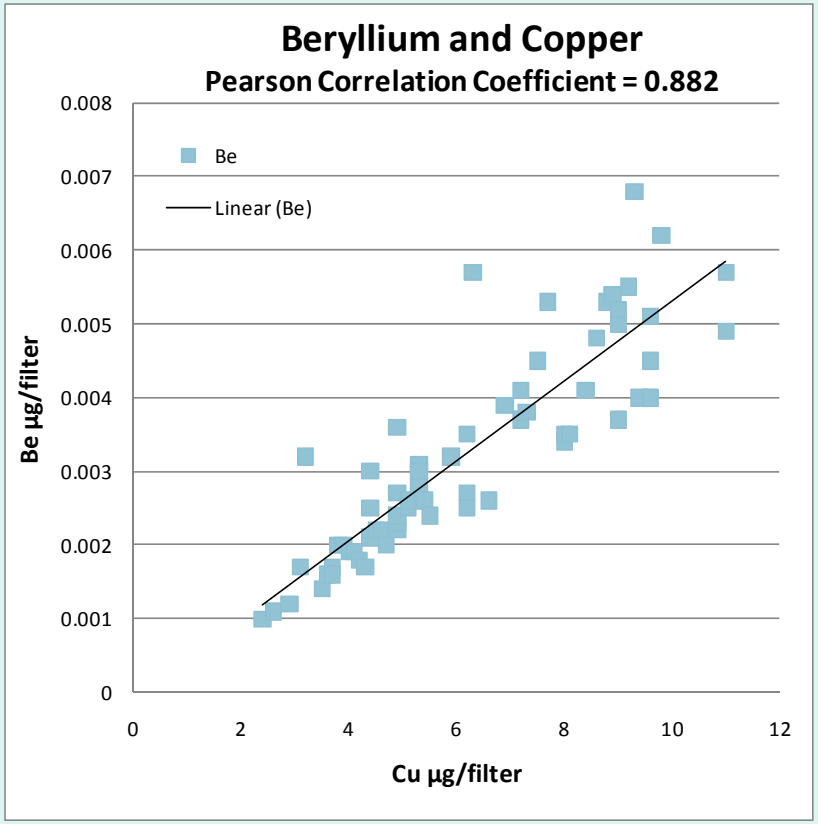
• Number of samples (n)	31
• Arithmetic Mean	7.24 ng/m^3
– LCL 95%	6.90 ng/m^3
– UCL 95%	7.58 ng/m^3
• Standard Deviation	1.11 ng/m^3
• Coefficient of Variation (CV)	0.15
• 95th Percentile	9.07 ng/m^3
• 95-95 Upper Tolerance Limit	9.70 ng/m^3

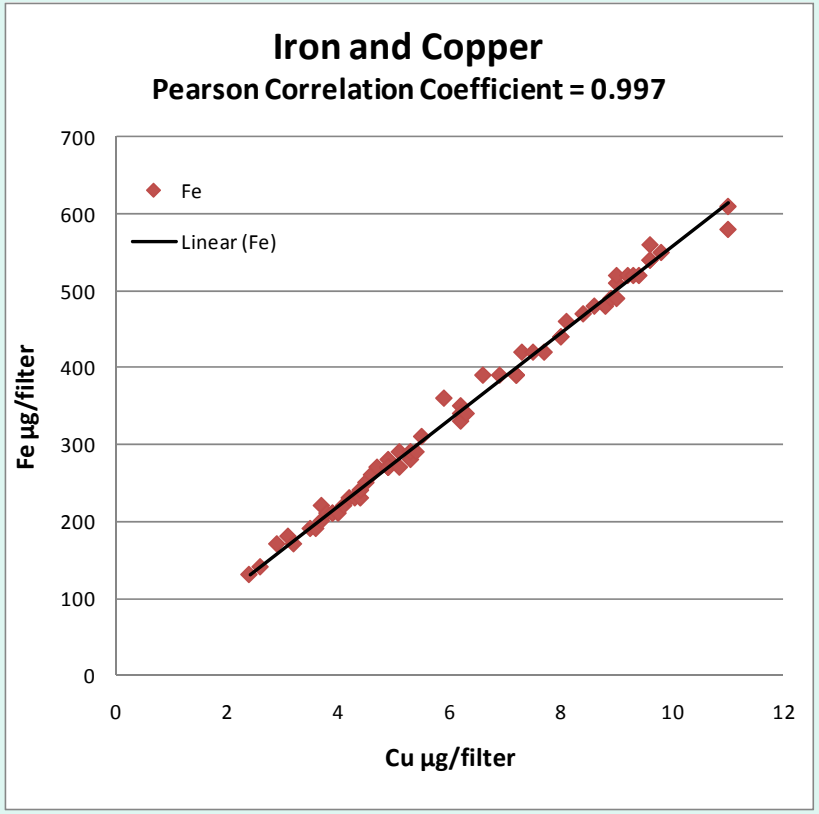
Results – Round 2

Beryllium 8-Hr TWAs

• Number of samples (n)	65
• Arithmetic Mean	1.34 ng/m^3
– LCL 95%	1.25 ng/m^3
– UCL 95%	1.42 ng/m^3
• Standard Deviation	0.39 ng/m^3
• Coefficient of Variation (CV)	0.30
• 95th Percentile	1.99 ng/m^3
• 95-95 Upper Tolerance Limit	2.16 ng/m^3

Elements in the Aerosol were Highly Correlated





Interim Conclusions

- Aggressive air sampling can distinguish between clean and contaminated space
- Thorough mixing was achieved justifying the EPA recommended mean of 7 samples for comparison with the administrative limit
- Provides some insight on the level of health protection provided by surface loading limits.
- Such an area could be released as non-beryllium workspace for healthy adult workers