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B&W Y-12, L.L.C.
RADIOLOGICAL CONTROL ORGANIZATION
TECHNICAL REPORT

Evaluation of Fixed Air Sample Filter Cross-Contamination And Radioactivity Loss

Original signatures and dates are on file.

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Name and Date

Evaluation of Fixed Air Sample Filter Cross-Contamination
And
Radioactivity Loss

June 9, 2010

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Background

A concern was raised by the Y-12 National Security Complex NNSA Health Physicist concerning the possibility of Fixed Air Sample (FAS) filter cross-contamination and activity loss. Issue Number 30327429 was entered into CAPS.

Issue Number 30327429 Issue Statement

B&W has not demonstrated that the current collection methodology for fixed air samples does not result in cross-contamination of samples.

Factual Basis

Fixed head air sample collection cards are placed in a Ziploc bag. All samples for a facility are placed in the same Ziploc bag with samples contacting each other. This method of sample collection can result in cross-contamination of sample cards or loss of sample on sample cards due to sample cards rubbing together. B&W Y-12 has not documented a quantitative review of the process to ensure that that sample loss or cross-contamination does not occur.

Actual/Potential Consequences

Cross-contamination of samples can result in inaccurate sample results.

There were actually two issues of concern identified: 1) potential cross contamination and 2) potential activity loss. Each was dealt with individually.

Cross Contamination

Regarding the cross contamination issue, the FAS filter cards (Whatman-41 filter media is mounted onto a bar-coded paper card) are placed front (contaminated side; side of interest; side that is counted) to back (non-contaminated side) when placed in a zip lock bag (or other suitable container) during collection – this is not in the procedure. Due to the uranium source term at the Y-12 National Security Complex, only alpha contamination is of interest.¹ Alpha particles cannot penetrate the card or filter. Additionally, the filters are recessed into the bar-coded paper card; the recess helps keep the filters from contacting each other. Cross-contamination is not an issue.

Activity Loss

To address the activity loss issue, a Sampling and Analysis Plan (SAP) was developed:

- Collect 30 FAS cards from locations most likely to have positive results [*Population 1*]; place the FAS cards in individual sample envelopes during collection;
- Transport the FAS cards to the RADCON Counting Room;
- Remove the FAS cards from the envelopes while being careful not to externally contaminate the envelopes, e.g, use tweezers;

¹ RCO/TBD-059, *Technical Basis Document for Y-12 National Security Complex Radiological Control Organization Air Monitoring*, 12/30/2009

- Seal each envelope to prevent any loss of contamination;
- Count the FAS cards on low background gas proportional counters (normally used for FAS card counting);
- Use wet chemistry to digest each envelope and 30 identical, unused, uniquely numbered [Population 2] control envelopes, and place the effluent from each onto a planchet;
- Count the planchettes using low background gas proportional counters (required MDA of 0.5 dpm);
- Use the Wilcoxon Rank Sum test to compare Population 1 to Population 2. If statistically different, then determine an activity loss factor.

Sample locations were selected by reviewing previous FAS results. The FAS cards were collected by Y75-56-FO-508, *Fixed Air Sample Collection and Calibration*, placed in individual sample envelopes, transported to the RADCON Counting Room, removed from the sample envelopes, and counted by Y75-56-IN-536, *Operation of a Tennelec Eclipse Low Background Proportional Counter*. Samples were counted for 10-minutes (MDA of 2.03 dpm). The envelopes were sealed, 30 control envelopes were prepared and sealed, and then transported to Analytical Chemistry. The samples were logged under ACO Project Name: YHPSMEARS and assigned Laboratory Sample Identification Numbers: A100630119 to A100630133, A100630068 to A100630082, A100630134 to A100630148, and A100630083 to A100630097.

The envelopes were batched in three QC groups: ENV-4182, 4183 and 4184 by the Radiochemistry Laboratory at 113C Union Valley. They were prepared by Y50-AC-65-7048, *Preparation of Samples for Radiochemical Analysis* and Y50-AC-65-7074, *Gross Alpha and Gross Beta Radioactivity in Drinking Water (EPA Method 900.0, August 1980)* and counted by Y50-AC-65-7231, *Operation of the Tennelec LB4110 with the Canberra OSUM Software*. A blank and control were prepared with each batch, no spike or duplicate was prepared because the entire sample was used for the preparation and analysis. Each sample was placed in a beaker and ashed in a muffle furnace for 15 hours at 550 degrees Celsius. The ash residues were readily dissolved in 8M nitric acid and the solutions were transferred to plastic centrifuge tubes and diluted to 20 ml with water. One half (10 ml) of the diluted sample was transferred to a tared planchette and taken to dryness on a hotplate. The planchettes were flamed to remove volatile solids, allowed to cool and reweighed to determine the residual mass on each. The samples were counted for 900 minutes in order to meet the required MDA of 0.5 dpm. The Controls and laboratory control samples were all within appropriate QC limits for the method.

The RADCON and ACO sample data is summarized in Table 1, Sample Results. Using the Wilcoxon Rank Sum test, the activity in the sample envelopes (Table 1, ACO Sample Envelope dpm) was determined to be statistically different than the Control envelopes.²

² Bock, Jeffrey, email correspondence to R. Redmond titled "Best Statistical Test," 4/28/2010

Table 1, Sample Results

| Description | FAS Filter dpm | Corrected FAS Filter dpm | ACO Sample Envelope dpm | Activity Loss % |
|------------------------------|----------------|--------------------------|-------------------------|-----------------|
| AT BRIQUETTE PRESS GLOVE BX | 46.35 | 92.7 | -0.71 | -1.76 |
| AT BRIQUETTE PRESS HOOD | 63.11 | 126.2 | 0.51 | -0.32 |
| SOUTH END OF ACID HOOD | 120.64 | 241.3 | 0.40 | -0.22 |
| N END ACID HOOD | 34.92 | 69.8 | 0.98 | 0.08 |
| GLOVEBOX, HEADHOUSE | 105.02 | 210.0 | 1.89 | 0.46 |
| AT STEAM CLEANING HD | 48.64 | 97.3 | 1.69 | 0.79 |
| LOADG S OXIDE DISSOLVER | 34.54 | 69.1 | 1.95 | 1.50 |
| ROD-MILL HOOD | 154.54 | 309.1 | 5.77 | 1.57 |
| ORGANIC POUR-UP ST | 31.11 | 62.2 | 1.93 | 1.63 |
| GLOVEBOX W.OF BEA-LEACHG HD | 312.64 | 625.3 | 12.65 | 1.88 |
| PAN FILTER | 44.83 | 89.7 | 2.66 | 1.95 |
| PRIMARY EVAP | 25.78 | 51.6 | 1.93 | 1.96 |
| SAMPLING HOOD | 158.35 | 316.7 | 7.33 | 2.02 |
| ACID COND. | 64.64 | 129.3 | 3.55 | 2.04 |
| EAST SIDE STEAM CLEANING HD | 47.87 | 95.7 | 2.89 | 2.05 |
| FILTERING/SEPARATING TABLE | 56.26 | 112.5 | 3.55 | 2.34 |
| MUFFLE FURNACE HD | 162.93 | 325.9 | 8.88 | 2.44 |
| MUFFLE FURNACE HD | 130.92 | 261.8 | 8.21 | 2.79 |
| WESTFALIA CENTRIFUGE | 27.30 | 54.6 | 2.44 | 2.79 |
| IN FRONT OF GAS FURNACE HD | 1609.44 | 3218.9 | 97.68 | 3.01 |
| FILTERING/SEPARATING TABLE | 49.78 | 99.6 | 4.22 | 3.31 |
| IN FRONT OF PPR PACG HD | 42.54 | 85.1 | 3.77 | 3.35 |
| TRAP #8 S.W. CORNER | 55.49 | 111.0 | 4.66 | 3.37 |
| R-69 BEAKER-LEACHING HD | 27.68 | 55.4 | 2.89 | 3.55 |
| PAN-UNLOADING GLOVEBOX | 165.97 | 331.9 | 13.32 | 3.74 |
| R-10 BEAKER-LEACHING HOOD | 41.40 | 82.8 | 5.55 | 5.59 |
| DRYING STATION AT SOUTH HOOD | 27.30 | 54.6 | 5.99 | 9.29 |
| GLOVEBOX ALLIGATOR SHEAR | 57.78 | 115.6 | 14.87 | 12.08 |
| GENERAL SALVAGE FILTER PRESS | 29.21 | 58.4 | 8.66 | 13.25 |
| SALT DISSOLVER, E. END | 45.97 | 91.9 | 15.76 | 16.14 |
| Control | NA | NA | 1.71 | NA |
| Control | NA | NA | 1.04 | NA |
| Control | NA | NA | 1.35 | NA |
| Control | NA | NA | 1.51 | NA |
| Control | NA | NA | 1.11 | NA |
| Control | NA | NA | 0.73 | NA |
| Control | NA | NA | 1.09 | NA |
| Control | NA | NA | 0.89 | NA |
| Control | NA | NA | 0.42 | NA |
| Control | NA | NA | 1.22 | NA |
| Control | NA | NA | 0.71 | NA |
| Control | NA | NA | 1.33 | NA |

| Description | FAS Filter dpm | Corrected FAS Filter dpm | ACO Sample Envelope dpm | Activity Loss % |
|-------------|----------------|--------------------------|-------------------------|-----------------|
| Control | NA | NA | 1.15 | NA |
| Control | NA | NA | 0.56 | NA |
| Control | NA | NA | 0.18 | NA |
| Control | NA | NA | 0.24 | NA |
| Control | NA | NA | 1.11 | NA |
| Control | NA | NA | 0.84 | NA |
| Control | NA | NA | 1.51 | NA |
| Control | NA | NA | 0.47 | NA |
| Control | NA | NA | 0.78 | NA |
| Control | NA | NA | 1.04 | NA |
| Control | NA | NA | 1.04 | NA |
| Control | NA | NA | 1.67 | NA |
| Control | NA | NA | 0.29 | NA |
| Control | NA | NA | 0.31 | NA |
| Control | NA | NA | 0.95 | NA |
| Control | NA | NA | 0.78 | NA |
| Control | NA | NA | 0.69 | NA |
| Control | NA | NA | 0.87 | NA |

The actual FAS filter activity (Table 1, Corrected FAS Filter dpm) was determined by correcting the RADCON Counting Room results (Table 1, FAS Filter dpm) with an alpha-self absorption factor of 0.50 - the alpha self-absorption factor previously determined for FAS filters³. The activity loss for each Sample envelope was then determined by subtracting the average Control envelope activity (0.92 dpm⁴) from the ACO Sample Envelope dpm and calculating the percent loss. The activity loss ranged from -1.76 to 16.14 percent. *The average activity loss is 3.22 percent.* No apparent correlation exists between FAS filter activity and activity loss.

A review of regulatory guidance and a query of air monitoring subject matter experts⁵ revealed that guidance does not currently exist in regard to air filter "activity loss" during handling. The closest regulatory guidance is Regulatory Guide 8.25, Air Sampling in the Workplace (June 1992), section 6.2 Efficiency of Collection Media, which states "if penetration of radioactive material into the collection media or self-absorption of radiation by the material collected would reduce the count rate by more than 5 percent, a correction factor should be used." Although "activity loss" is not due to penetration and alpha self-absorption (which have already been accounted for⁶), the criteria should still apply. The 3.22 percent activity loss is well-below the Regulatory Guide 8.25 criteria. Additionally, the Y-12 National Security Complex uses uranium derived air concentrations (DACs) that are 35 to 50% more restrictive than the 10 CFR 835 (2007) DACs. Activity loss is negligible and does not need to be accounted for in calculations.

³ RCO/TBD-025, Technical Basis for Routine Fixed Air Sample Result Calculations at the Y-12 Plant, 9/10/97

⁴ 29 of 30 Control envelopes had alpha activity above the critical level (L_c)

⁵ Air Monitoring Users Group, email correspondence R. Redmond to AMUG, 11/30/2009

⁶ RCO/TBD-025, Technical Basis for Routine Fixed Air Sample Result Calculations at the Y-12 Plant, 9/10/97

Conclusion

Cross-contamination and activity loss during handling of air sample filters can result in inaccurate sample results; however, cross-contamination is not an issue because of the sample collection method and activity loss is negligible. There is one recommendation: Y75-56-FO-508, *Fixed Air Sample Collection and Calibration*, should be revised to specify that FAS should be collected front (collection side) to back; this will ensure that FAS are collected in the same manner by Radiological Control Technicians.