Lessons Learned from an Airborne Alpha Contamination Event Requiring Implementation of In-Vitro Sampling

Oconee Nuclear Station

OE #32020

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- Implemented EPRI Alpha Guidelines in 2008
- Alpha Level II Plant, with identified Alpha Level III Systems and Components
- Station Weighted Alpha DAC of 5E-12 μCi/mL
- Station β-γ DAC Fraction Action Level of 0.025

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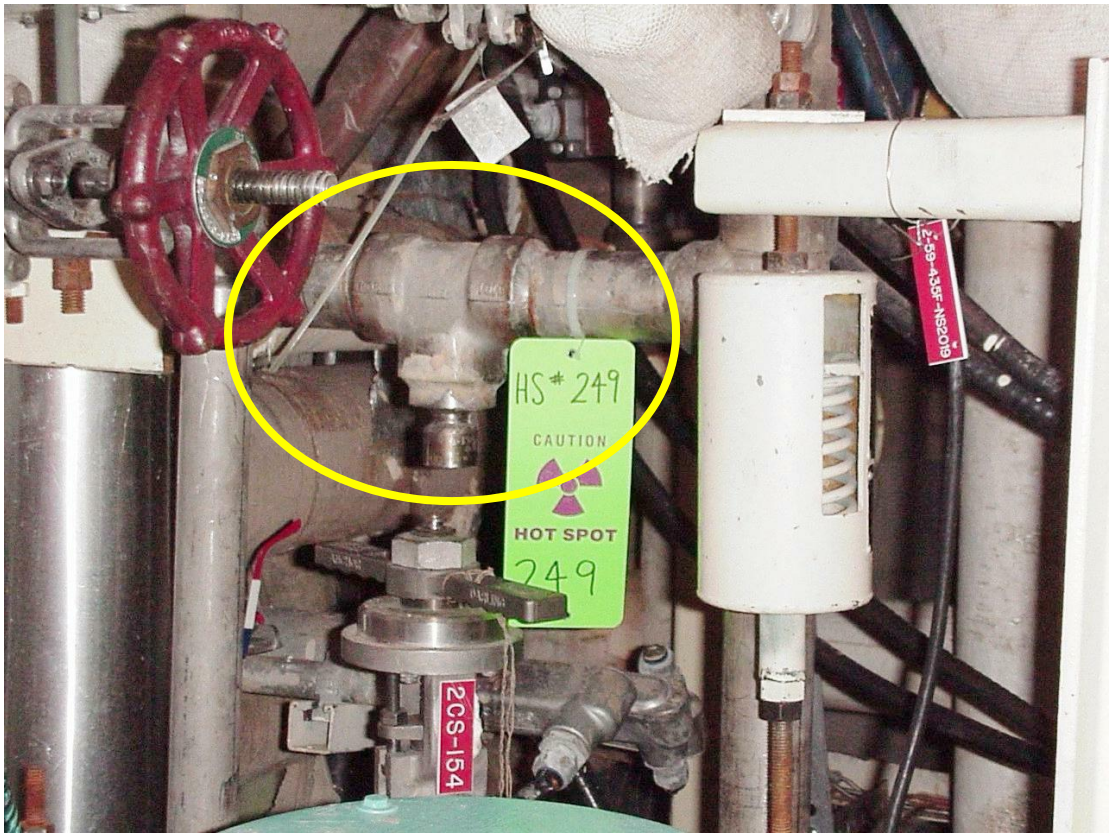
Event Description

- Removal of a Hot Spot



Event Description

- Known Alpha Level III System
- Original RP Prescribed Job Controls:
  - Job air sample collected (2 cfm)
  - Lapels worn by workers (0.14 cfm)
  - HEPA used for contamination control (1000 cfm)
  - Portaband used for cutting primary system piping
- All Air Sample Results < 0.025 β-γ DAC

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Event Description

- Rework requires additional cuts into primary piping
- RP Job Controls (Alpha Level II):
  - Job air sample collected (2 cfm)
  - HEPA used for contamination control (1000 cfm)
  - Portaband used for cutting primary system piping
- Air Sample Results < 0.025 β-γ DAC

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Event Description

- Job Scope:
  - Buff exterior of existing primary piping ends
  - Socket weld new pipe section into place
- RP Job Controls (Alpha Level II):
  - Job air sample collected (2 cfm)
  - HEPA used for contamination control (1000 cfm)
  - Pipe ends decontaminated to 15,000 dpm β-γ and 15 dpm α
  - Respirator (voluntary use) for buffing

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Event Description

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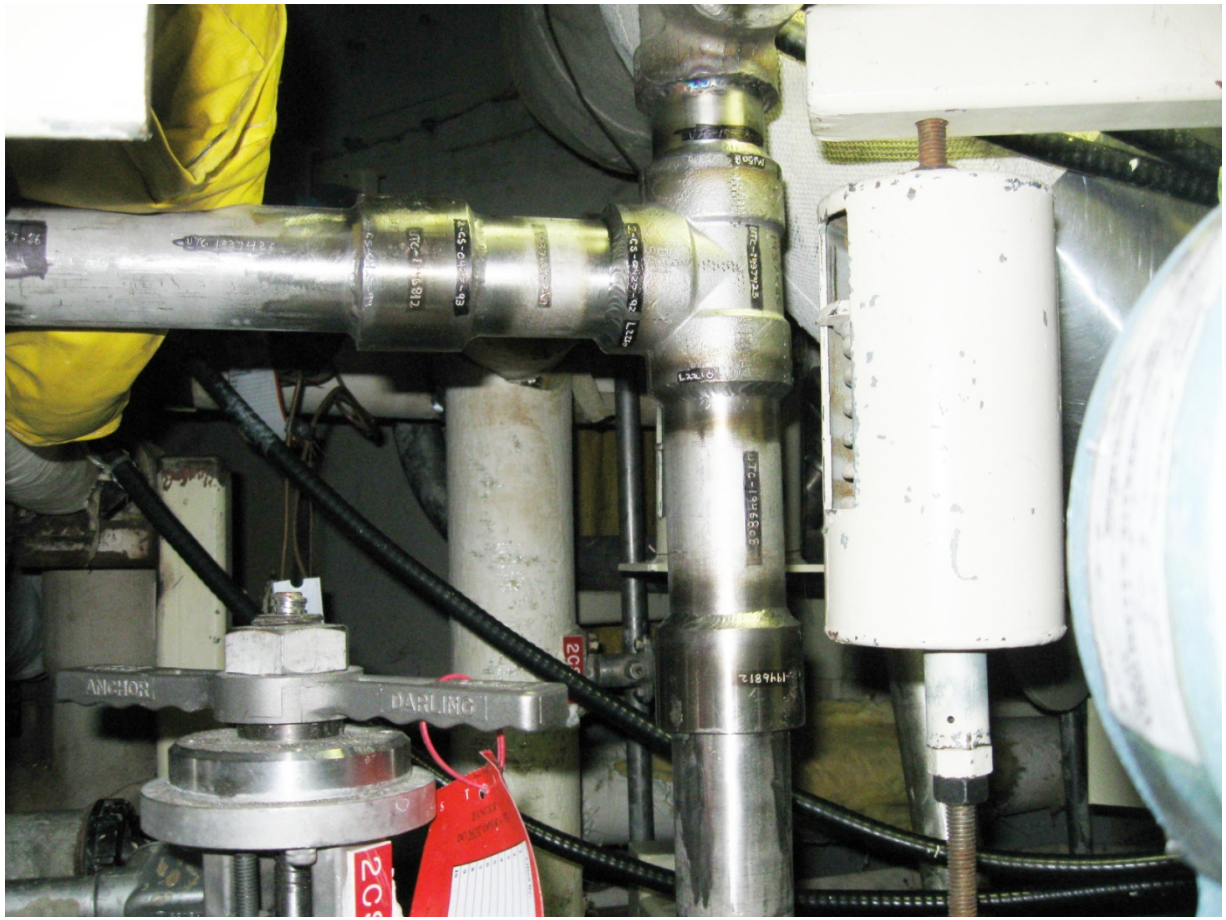

Event Description

- RP Count Room identifies Am-241 in gamma spec, reporting 24 DAC β-γ.
- Lead Technicians assume air sample cross contaminated and inadvertently destroy air sample while isolating “particle”.
- Investigation determines buffing technician used cutting wheel on side grinder to cut 1 inch section of original primary piping without consulting RP.

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Event Data

- Air Sample Results:
  - 23.98 DAC β-γ of which 23.93 DAC Am-241
  - Gross alpha counts could not be obtained to determine total DAC due to destruction of air sample filter
  - Gamma spec of respirator cartridge and removed pipe section also identified Am-241
  - Gamma spec of new welding rod did not have 59 keV peak
- Smear Sample Results:
  - Inside primary piping 200,000 dpm β-γ and 559 dpm α (Activity Ratio of 358)
  - Grinding dust pile 200,000 dpm β-γ and 2,627 dpm α (Activity Ratio of 76)
  - Removed pipe section 16,000 dpm β-γ and 639 dpm α (Activity Ratio of 25)

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Event Data

- Primary resin 10CFR61 alpha distribution used to estimate:
  - Gross alpha activity of 1.72E-10 μCi/mL
  - Total alpha DAC of 39
  - DAC Ratio of 780
  - Preliminary internal dose of 220 mrem CEDE
    - 1 hour lung detector MDA for Co-58 of 0.5 nCi
    - Internal Retention Fraction for Co-58 in lungs
    - Inhalation

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Bioassay Challenges

- Destroyed Air Sample
  - Estimated preliminary internal dose calculation
  - ANI criteria for collecting in-vitro samples of 200 mrem CEDE.
  - NRC PI criteria for unintended exposure of 100 mrem CEDE
- In-Vivo Measurement No Detectible Activity
  - Unable to determine Inhalation versus Ingestion

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Bioassay Challenges

- Procedure for in-vitro sample collection limitations:
  - Inventory of sample collection kits
  - Inventory of ice chests for individuals to transport samples
  - Elapsed time for sample collection start
  - Duration of sample collection
  - On-site storage of samples until complete
  - Requested analysis of samples by contract laboratory
  - Shipping requirements as radioactive material
  - Shipping requirements from contract laboratory
  - Internal dose calculations from analysis results

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Lessons Learned

- In-vitro sample collection to start immediately
- Collect minimum number of total samples from each individual
  - Aids inhalation versus ingestion retention modeling
- Samples stored in freezer until collection complete
- Requested analysis of samples:
  - Individual sample analysis
  - Gamma spectroscopy
  - Am-241, Pu-238, Pu-239/240, Cm-242, Cm-243/244
- Gamma Spectroscopy requirements for shipping samples
- Samples shipped frozen in cooler

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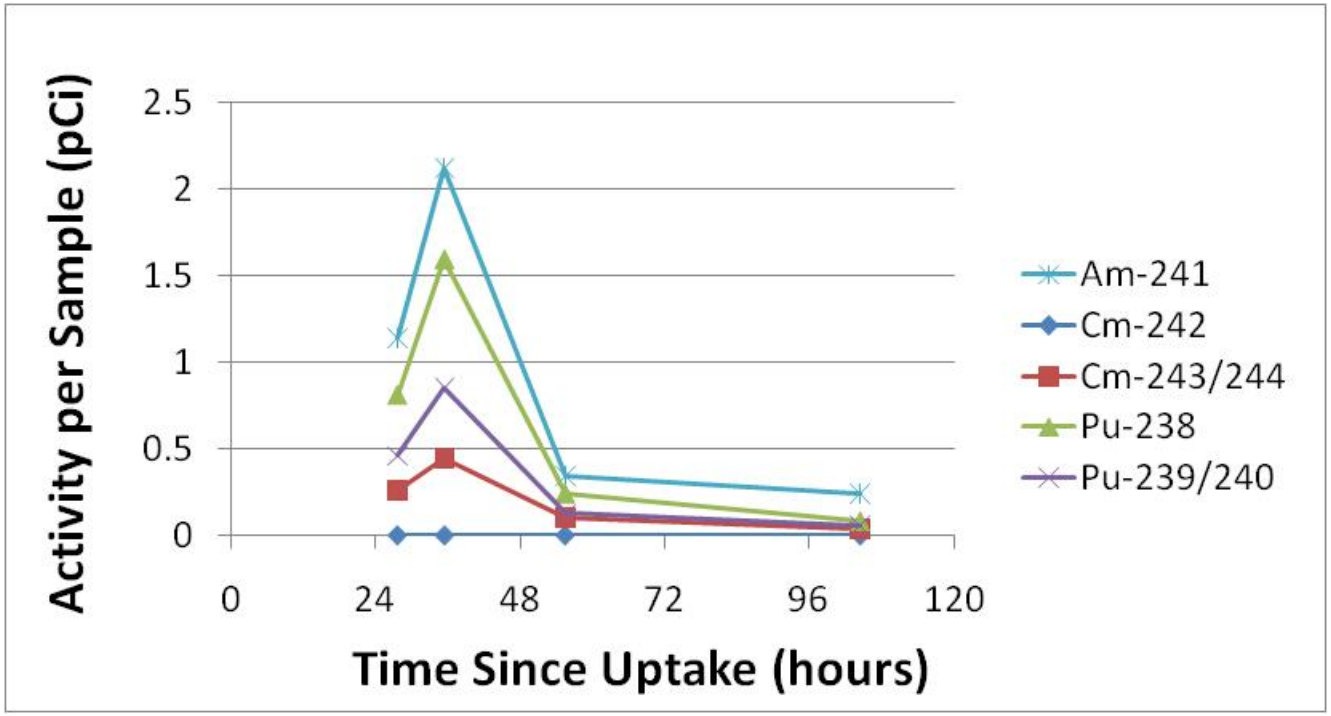
Lessons Learned

- Internal Dose Calculations from In-Vitro Sample Results:
  - Samples analyzed individually to ensure sufficient collection



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Lessons Learned

- Internal Dose Calculations from In-Vitro Sample Results (cont):
  - Summed nuclide results to obtain total nuclide activity for composite of samples
    - Assumed zero activity for samples where nuclide was below detection limits
  - Determined NUREG 4884 Internal Retention Fraction in accumulated feces for inhalation of each nuclide based on time between intake and final collected sample
  - Determined Internal Retention Fractions and Committed Dose Equivalent Factors for inhalation based on the 10CFR21 recommendations in oxide form: Am-241 (W), Cm-242 (W), Cm-243/244 (W), Pu-238 (Y), Pu-239/240 (Y), Co-58 (Y), Co-60 (Y), Cs-137 (D), Nb-95 (Y), Zr-95 (W)
    - Assumed Internal Retention Fractions for Cm-243/244 (W) were same as Cm-242 (W)
    - Assumed Internal Retention Fractions for Zr-95 (W) was same as Zr-91 (W).

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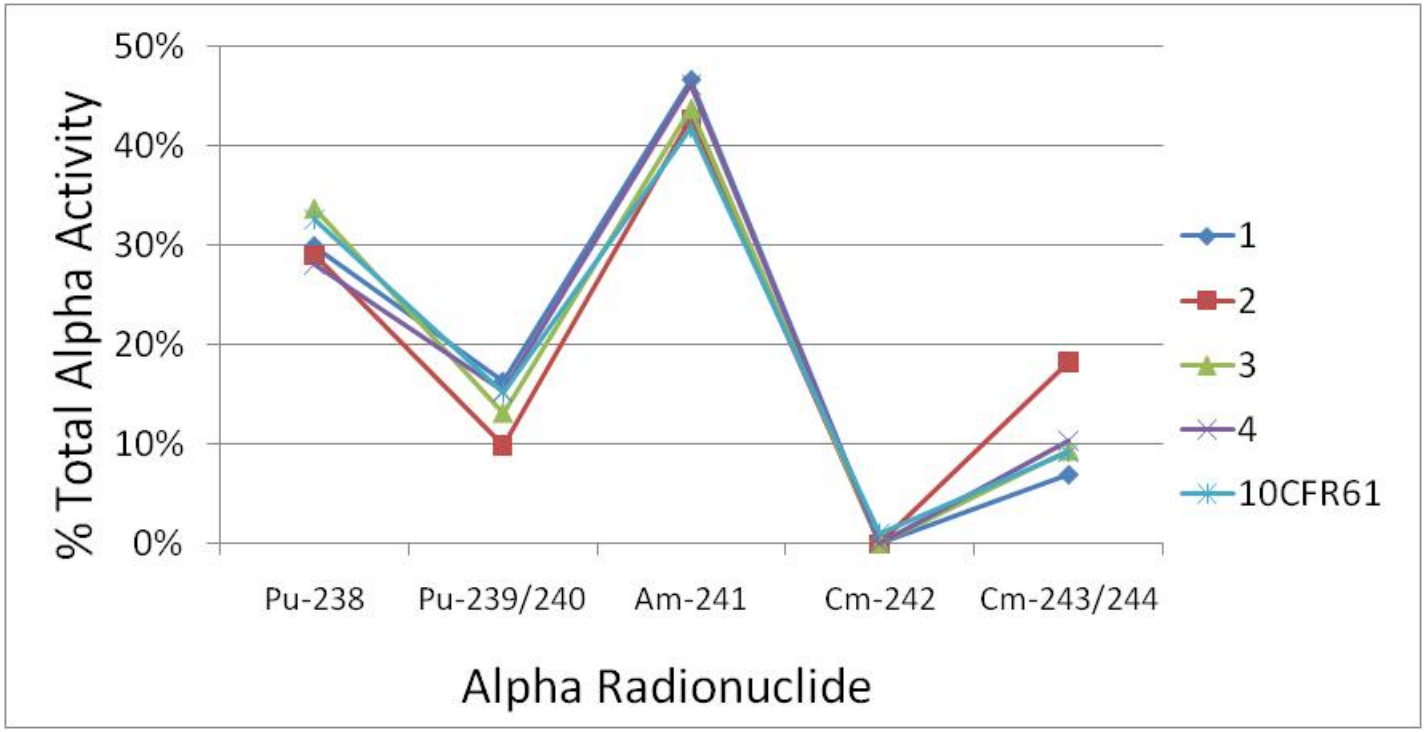
Lessons Learned

- Internal Dose Calculations from In-Vitro Sample Results (cont):
  - Alpha nuclide distributions from individual's combined samples consistent with each other and with 10CFR61 Primary Resin sample results



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Lessons Learned

- Recognizing and Minimizing Risk associated with Alpha Contamination:
  - Created process for screening all work requests
    - Identifies jobs with potential for high smearable or airborne alpha contamination
    - Determines proper Management over-site for at-risk jobs
    - Incorporates Management approval of job controls in place for at-risk jobs
  - Included clear and concise examples of what can NOT be done during job scope discussions in briefings
    - For the worker: NO grinding, beating, heating, welding, etc without contacting RP
    - For the RP Technician: NO grinding, beating, heating, welding, etc on known or suspected Level III areas without respiratory protection or Supervisor approval

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Lessons Learned

- Recognizing and Minimizing Risk associated with Alpha Contamination (cont):
  - Increased use of glove bags as engineering control

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Lessons Learned

- Training and Awareness:
  - Site Management
    - Time and resource impact of proper planning, control, and execution of high risk alpha contamination jobs
    - Regulatory, liability, time, and resource impact of improper planning, control, and execution of high risk alpha contamination jobs
  - General Workforce
    - Significance of alpha contamination hazard
    - Where and how come in contact with alpha contamination hazard
    - Responsibility for properly mitigating alpha contamination hazard
      - Clear and complete job scope descriptions during briefings
      - Notifying RP when job scope changes or conditions change
      - Use engineering controls provided by RP
  - RP Technicians
    - Importance of identifying Am-241 and the effects that identification has on procedure action levels

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Questions

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