Benchmarking and Design of Beryllium Facilities

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Workshop on Beryllium Applications and Health & Safety
June 28, 2017
Benchmarking Facilities

U.S. Department of Energy Sites

Atomic Weapons Establishments, Cardiff and Reading

Joint European Torus

Private Industry; Brush Wellman (currently Materion)
Topics for Discussion

- Engineering controls
- Facility design/layout
- Sampling program and data
- Level of staffing
- Programmatic and procedural controls
- Medical surveillance program
Outcome of Benchmarking

- Facilities had different approaches for the level of operational, facility, personal protective equipment, and exposure monitoring controls or methods
- Medical surveillance varied from employee required to voluntary
  - UK philosophy differed in that invasive tests were not acceptable
- Sampling logic and the use of data varied drastically
Approach

- Facility design similar to the Atomic Weapons Establishment’s facilities
- Key to this decision came from strong leadership from a metallurgist who had prior experience working in a facility with poor beryllium controls with resulting worker disease
Basic Logic for Facility Design

- Hospital Operating Room Level of Cleanliness
  - Class 10,000 clean room
  - Once-through filtered supply air
  - 10-12 air changes per hour

- Clean-room design considerations such as recessed lighting
Design Resource

- American Conference of Governmental Industrial Hygienists Ventilation Manual
- Provides good practice for ventilation design
Design Features

- Use room pressure differentials based on risk of airborne beryllium particle generation
- Use ante rooms to further separate high risk operations
- Have separate administrative and process exhaust air handling systems
- Areas supporting Be operations should be on the beryllium exhaust system
Laminar Flow of Room Air

- Sounds easy in theory, but difficult to accomplish
- Allow for thorough design and testing
Process Exhaust
Performance Requirements

- Flanged connections
- Long radius elbows
- 45° branch inlets
- Full port shut-off valves
- Flex hose: heavy duty see-thru smooth inner wall with outer plastic sleeve

- Process exhaust
  » Minimum of 500 sfpm (2.5 m/s) capture face velocity for dry machining operations

- General exhaust
  » Minimum of 125 sfpm (0.65 m/s) face velocity on enclosures, hoods
Three Levels of Process Exhaust

- Primary Exhaust—at point of operation (tool point)
- Secondary—Enclosure Exhaust
- Tertiary—Room Exhaust
Engineering Controls

- High velocity custom capture hoods
  - 7000-12000 feet per minute (35-60 mps)
- Exhausted enclosures
- Cyclones for particulate
Zone Pressure Control

- Air leak paths into beryllium areas should be eliminated to reduce zone control problems
- Seal all electrical system conduits (control system wiring, fire protection, communications wiring) that penetrate into the beryllium areas
Smooth Surfaces

- Easy to clean
  - Non porous with limited texture
- Reduce surfaces where dust can accumulate
- No seam flooring
- No wood
- No unsealed concrete
Basic Facility Layout

- Entrance
- Lunch Room
- Storage
- Operations Offices
- Locker Room Showers
- Laboratory
- Receiving
- Barrier Bench
- Buffer Area
- IH Sampling Equipment
- Laundry
- Equipment/Exhaust System
- Staff Offices
- Ante Room
- Basic Facility Layout

- Staff Offices
- Beryllium Area
- Ante Room
- Entrance
Analysis Capabilities On-Location

- Air and surface sampling should be used as a daily control measure and upset condition assessment
- Sampling is needed for verification that decontamination has been mitigated
- Recommend the laboratory be near but not in the facility due to upset conditions when ventilation system is down
- Laboratory should be adequately staffed with trained personnel to include back-ups
Limit Personnel

- Facility access by badge reader
  - Normal operations mode
  - Ventilation system shut down mode
- Link to worker being up-to-date on training and medical surveillance
Industrial Laundry

- In-house
- Dryer connected to beryllium process exhaust with a bag out for lint
- Water to process waste water system
- Water soluble laundry bags (dissolve at higher temperature)
Redundancy

- Seamless transitions are needed
  - Stand-by/redundant feature must be immediate or loss of zone pressure/flow control may occur
- Three exhaust fans are recommended with two on-line
- Have redundant supply fans
- Have redundant operations or stations (Two machines versus only one)
Location, location, location

- Equipment, isolation points, and controls need to be outside the beryllium area as much as possible to allow for preventative maintenance and repairs without exposure.
- All potentially contaminated equipment should be indoors.
- Duct work should be outside of the main beryllium area as much as possible.
- HEPA plenums need to be in an area that can be isolated and controlled.
Controls

- Control system needs to be industry level product such as Allen Bradley, not commercial level controls
- Intelligence must be used for controlling sequencing of back-up power
- Minimize or eliminate the use of “one-of-a-kind” software, equipment, or systems as well as equipment/software that is proprietary
Controls for Filter Replacement

- Use Nuclear Grade Filtration Systems that are designed to be safely maintained and tested
Environmental Emission Controls

- Use multiple filtration steps with HEPA filtration for final stage
- Include a stack sample port
Quality and Durable Equipment

- Use high quality components
- Use components that last (i.e., LED lighting vs fluorescent)
- Stainless steel
- Reputable manufacturers
Staffing for Design

- Strong management with a vision
- Ventilation engineer
- Industrial hygienist
- Facility engineer
- Excellent Industrial Architectural and Engineering Firm
- Workers/operators
- All must have prior experience in control of beryllium operations or work closely with those who do
Conclusions

- Industrial controls are not sufficient for control of beryllium operations
- Nuclear controls seem a bit high
- Clean room type technology with high quality components is a good approach
- Staff with experience in control of beryllium operations is a must for the design and initial implementation phases
Questions?