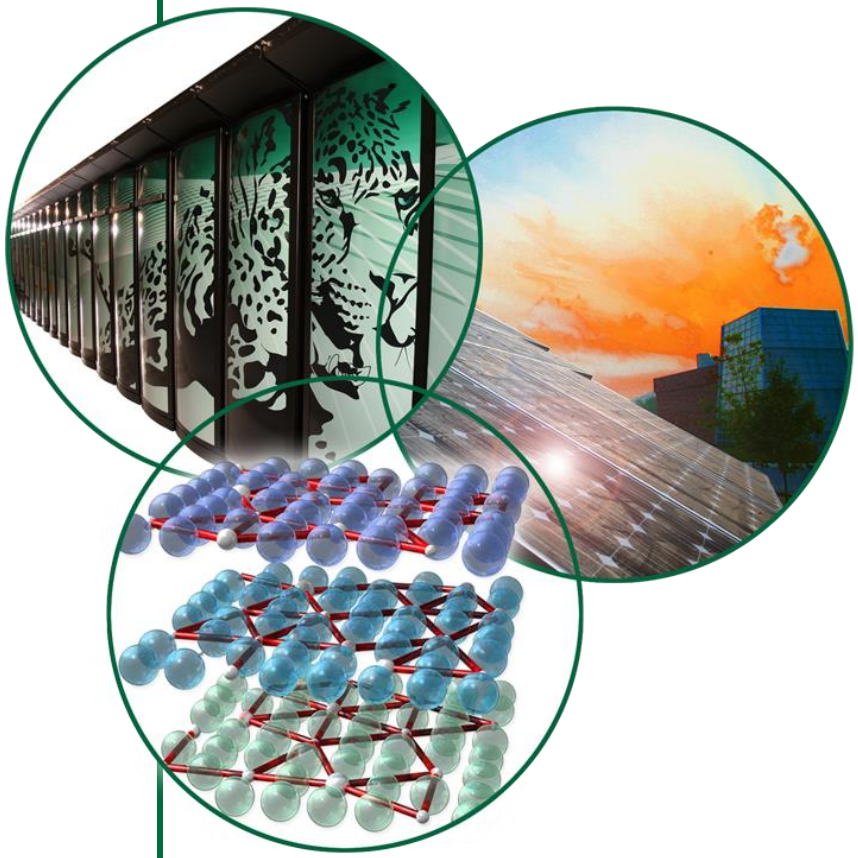
# Improvements to Oak Ridge National Laboratory's Beryllium Program



ISM Summit 2009

Knoxville, TN

August 27, 2009

Presented by K.R. Petherick, CIH

U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

# Short Biography

Kevin Petherick has over 20 years of experience in the fields of industrial hygiene and safety in both general industry and DOE environments. He has been at Oak Ridge National Laboratory since April, 2003 and has been responsible for implementation of the Laboratory's beryllium program as well as other industrial hygiene related programs since late 2004. Mr. Petherick has a Master of Public Health degree in Industrial Hygiene from the University of South Carolina and is an ABIH Certified Industrial Hygienist.

# Culture in 2006

- In 2006, the mind-set at ORNL was that beryllium is only an issue at “production facilities”
  - ORNL is not involved in production, has no “regulated areas”
  - Beryllium use is restricted to 10 CFR 850 exempted “articles” and,
  - Laboratory use of beryllium chemical and compounds

Machining, drilling, grinding, etc., on beryllium and beryllium alloys is no longer performed at ORNL and legacy Be contamination areas have been identified

# Discovery of Adverse Trend

**Several events that occurred or were discovered in early 2006 led to management identification of an adverse trend in ORNL's Chronic Beryllium Disease Prevention Program (CBDPP)**

# Self-Identification of Programmatic Weakness

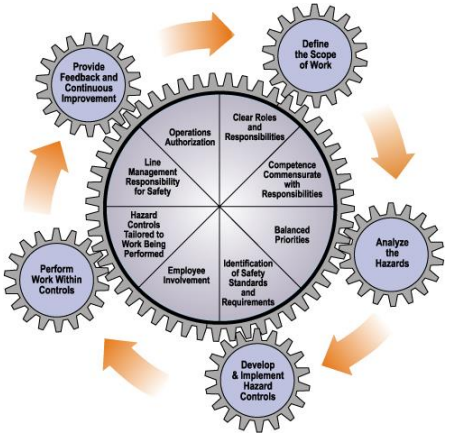
- Identification of the adverse trend triggered an occurrence report:
  - SC-ORO-ORNL-X10BOPLANT-2006-0004, "Management Concern Regarding Inconsistencies in the Implementation of the ORNL Beryllium Program"
- During the Worker Safety and Health Rule (10 CFR 851) voluntary reporting period, ORNL self-identified implementation and programmatic weakness in the Laboratory's CBDPP

# Beginning of the Culture Change

- ORNL arrived at the following realization:
  - The Laboratory could not provide the level of protection our Staff expected solely by implementation of the requirements in the DOE CBDPP final rule
  - New internal best management practice (BMP) requirements were needed to adequately protect Staff, guest Users and visitors from potential exposure to beryllium and to ensure compliance with the DOE Release Criteria Limit requirements in 10 CFR 850.31

# Developing Best Management Practices

- **Benchmarking Process**
  - **Brookhaven National Laboratory, Pacific Northwest National Laboratory, Y-12, Lawrence Livermore National Laboratory, etc.**
  - **May 2005 Draft DOE Technical Standard, "Management of Items and Areas Containing Low Levels of Beryllium"**
  - **Worker and Management Feedback**



# ORNL CBDPP Best Management Practices

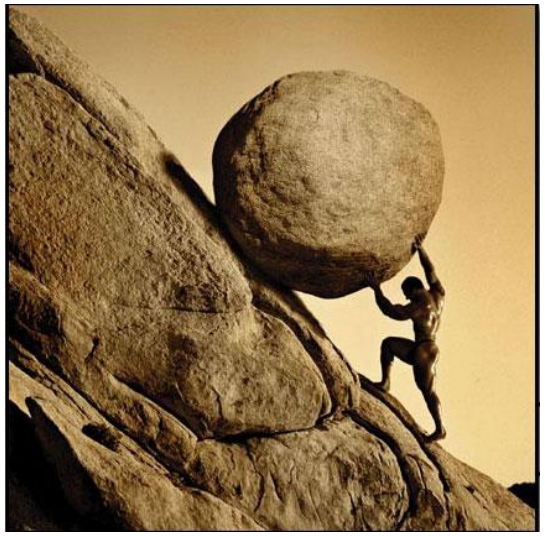
- **ORNL Beryllium BMP 1. Improvement and revalidation of ORNL's beryllium baseline inventory**
  - The primary objective of the revalidation project was to identify and characterize:
    - Known and suspect locations where current and past activities with beryllium were performed,
    - Other locations of legacy beryllium contamination (including equipment and other items from suspect location) which had not been evaluated during or since the initial beryllium baseline inventory and,
    - to identify and notify Staff with potential for exposure to beryllium at those locations.

# ORNL CBDPP Best Management Practices

- Line management from across the Laboratory reviewed historic documents/drawings and interviewed Staff to identify:
  - locations with known or suspected beryllium use history and,
  - equipment and other items, including beryllium articles, used in beryllium activities or from locations with known or suspected legacy beryllium contamination or beryllium use history.
- Staff information that was collected generated 263 beryllium inventory information forms (BIIFs). The majority of individual BIIF's identified multiple facility and/or room locations.

# ORNL CBDPP Best Management Practices

- Historic beryllium survey data was reviewed and known and suspect beryllium use locations and suspect equipment with no or incomplete characterization data was identified



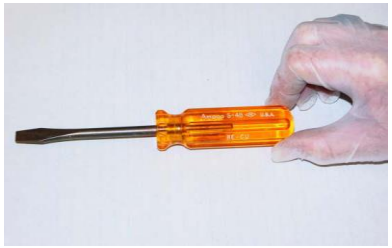
- A risk-ranked schedule for beryllium sampling was developed for characterization
- The entire baseline inventory revalidation project took over 1 ½ years to complete

# ORNL CBDPP Best Management Practices

- Excellent management support and adequate resources/funding provided for execution of the baseline inventory revalidation project
- Support and feedback from the Union and Laboratory Staff was instrumental to the success of the project
- Word of caution: Just like with legacy radiological contamination, isolated instances of legacy beryllium contamination will continue to be discovered
- Beryllium baseline inventories need to be maintained and viewed as a “living document”

# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 2.** Use of beryllium articles and laboratory use of beryllium chemicals/compounds are controlled
  - Use of beryllium articles and beryllium chemicals/compounds are not exempt from ORNL's CBDPP
  - Requirements for evaluation and controlling beryllium articles and chemicals is integrated into Work Control



# ORNL CBDPP Best Management Practices

- **"Beryllium articles" and laboratory use of beryllium chemical/compound are excluded from the applicability of the DOE CBDPP final rule under 10 CFR 850.2(b)**
  - **ORNL experience identified legacy transferable Be contamination from the use, storage and handing of Be articles**
  - **Laboratory use of beryllium chemical/compound can spread transferable Be contamination to facility surfaces, laboratory equipment and local exhaust systems**

# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 3.** **Beryllium hazard assessments (HAs) for all beryllium associated work activities**
  - All uses of beryllium (including Be articles and chemicals/compound) must be evaluated and controls implemented if there is a potential for Staff exposure or the spread of transferable Be contamination
  - H&S Professionals involvement in beryllium HAs
  - A guidance document for conducting beryllium HAs was incorporated in ORNL's beryllium implementation document to ensure comprehensive and consistent HAs are performed

# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 4.** **Beryllium Exposure Prevention Plan (BEPP)**
  - Mandatory development and use of a task-specific BEPP for any activity that has the potential to generate airborne beryllium (at any concentration) or the spread of transferable beryllium contamination
  - All BEPPs are reviewed and approved by the ORNL Beryllium program manager to ensure consistency and appropriateness of controls

# ORNL CBDPP Best Management Practices

## Beryllium Prevention Plan Template

**Beryllium Exposure Prevention Plan (BEPP)**

**Issued To:**

| 1. Effective Date: | 2. Expires: | 3. Extended: |
|---|---|---|

**4. Location of Work:**

**5. Area Designation:**
- ☐ Beryllium Area of Concern
- ☐ Beryllium Regulated Area
- ☐ Unknown (uncharacterized)

**6. Description of Work:**

**7. Pre-job conditions** ☐ See attachment, if available

- ☐ Known or suspected Be legacy contamination
- ☐ Radiation Contamination/Exposure
- ☐ See Attached Survey(s)
- ☐ Known or potential for airborne Be
- ☐ Other Concerns

**8. Conditions Expected During The Job (from previous sampling efforts, if possible)** ☐ See attachment

8-hr TWA: _____ µg/m$^3$ ☐ Other Concerns (List): _____

Smear level: _____ µg/100 cm$^2$ ☐ Unknown

**9. Exposure Monitoring and Surface Samplings**

☐ See attachment, if available

| | | Initial | | Routine | | | |
|---|---|---|---|---|---|---|---|
| | | Yes | No | Yes | No | Frequency | Comments |
| ☐ Personal (BZ) | 8-hr TWA | ☐ | ☐ | ☐ | ☐ | | |
| | STEL | ☐ | ☐ | ☐ | ☐ | | |
| ☐ Area | | ☐ | ☐ | ☐ | ☐ | | |
| ☐ Smear | | ☐ | ☐ | ☐ | ☐ | | |

**10. Training/Medical Required**
- ☐ Site Access Training (Be Awareness)
- ☐ Beryllium Information Training
- ☐ RAD WORKER II
- ☐ Beryllium Worker Training
- ☐ Visitor
- ☐ Asbestos Awareness
- ☐ Current Respirator Fit Test Card
- ☐ Offered opportunity to enter the ORNL Be Medical Surveillance Program
- ☐ Other: _____

**11. Workers**

For Regulated Beryllium Areas and Beryllium Areas (Work Areas)

Name and badge number must be listed for employees entering under this BEPP

☐ See attachment

**Controls to reduce and min. exposures and spread of contamination**

| 12. Required Engineering Controls | 13. Required Administrative Controls | 14. Housekeeping |
|---|---|---|
| ☐ See attachment | ☐ See attachment | ☐ See attachment |

**15. Required Personal Protective Equipment**

| Primary Clothing | Gloves | Eye Protection | Shoe Covers | Respiratory Protection | Cartridge Type | Other |
|---|---|---|---|---|---|---|
| ☐ Lab Coat | ☐ Latex | ☐ Safety glasses | ☐ Required | ☐ Half face | ☐ N-,R- or P-100 | ☐ Safety Toed Shoes |
| ☐ Coveralls | ☐ Nitrile | ☐ Goggles | ☐ Other: (specify) | ☐ Full face | | ☐ Other: (specify) |
| ☐ Anti-C's | ☐ Neoprene | ☐ Face shield | | ☐ PAPR | ☐ COMBO | |
| ☐ Tyvek Suit w/ hood | ☐ Leather | ☐ Other: (specify) | | ☐ Other: (specify) | ☐ Other: (specify) | |
| ☐ Paper Suit | ☐ Other: (specify) | | | | | |
| ☐ Other: (specify) | | | | | | |

ORNL-846 (7/2009) Page 1 of 3

**Beryllium Exposure Prevention Plan (BEPP)**

**Other: (specify)**

**16. Warning Signs and Labels (specify):**

**17. Beryllium Emergency - Spill, Release, Breakage Clean-up (Describe possible release scenario and action, including clean-up worker training, exposure monitoring, personal protective equipment):**

**18. Waste Disposal (Describe disposal of resultant waste):**

**19. Hygiene Facilities and Practices** ☐ Hand Washing ☐ Hand Wipes ☐ Eye Wash ☐ Other

**20. Recordkeeping (specify):**

**21. Special Instructions** ☐ See attachment

**22. Approvals**

| Position | Signature | Date | Badge # |
|---|---|---|---|
| Be Program Manager | | | 702813 |
| | | | |
| | | | |
| | | | |

**23. Project Feedback:**

# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 5.** **Expanded Beryllium Warning Labels and Signs**
  - Worker and Management feedback incorporated into the design of enhanced Be labels and signs
  - Additional warning signs were needed to convey the beryllium hazard, area access, PPE and work control requirements for legacy contamination areas
  - Warning labels were developed for:
    - Equipment containing an internal beryllium component,
    - Closed systems with known/suspect internal beryllium contamination and
    - Formerly Be contaminated equipment that has been decontaminated

# ORNL CBDPP Best Management Practices

- **Beryllium label support webpage allows Staff to print labels using a color laser printer and readily obtainable labels**

**Examples of Be warning labels**


# ORNL CBDPP Best Management Practices

## Examples of Be warning labels


# ORNL CBDPP Best Management Practices

## Examples of warning signs for legacy beryllium contamination areas


# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 6.** Internal Operating Procedure (IOP) for characterization of equipment/facility surfaces for transferable beryllium contamination.
  - An IOP for characterization of equipment and facility surfaces was developed to ensure consistency in the approach and execution of sample collection, documentation, interpretation of results and management notification of beryllium surveys results
  - The beryllium characterization IOP was incorporated into mandatory training for IH technicians and H&S Field Support Staff

# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 7.** Use of PNNL developed Visual Sampling Plan software


  - **VSP software was used to develop statistically defendable sampling protocols for characterization of building as well as large equipment**
  - **The software determines the required number of samples, selects sample locations and performs statistical tests and calculations**
  - **Basic and advanced VSP training sessions were held locally for H&S Field Support Staff**

# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 8.** **Formal written notification of beryllium smear survey results are sent to Facility and Area/Line Managers**
  - A mandatory notification form is used to inform the facility manager and area/line manager(s) of the survey results as well as communicate beryllium control actions that Management must implement
  - Use of mandatory form ensures consistency of information provided and ensures associated control requirements are communicated to the appropriate management

# ORNL CBDPP Best Management Practices

## Example Beryllium Inventory Information Form

| Beryllium Inventory Information for: 2007-0058 | | | |
|---|---|---|---|
| **Directorate (Completing):** Energy & Engineering Sciences Dir | | | **Division (Completing):** Nuclear Science & Technology Division |
| **Date Entered:** 04/12/2007 | **Completed By:** | | **Work Telephone Number:** |
| **Beryllium Activity:** beryllium contamination found at 5510 on four pieces of equipment originating from old beryllium lab in 3550, then to Y-12 (9204-3) and then to 5510 | | | |
| **Dates of Use:** 1970s - present | | | **Beryllium Type(s):** |
| **Form(s) of beryllium used:(e.g. solid,powder,etc.):** particulate contamination | | | |
| **Quantity of Beryllium used (if available):** | | | **Units:** |
| Use Location(s): | | | |
| **Building used In:** 5510 | | | **Room used in:** 108, 115, 119 |
| **Specific Location Used within Room:** 108 - glove box 115 - diffusion pump and evaporator 119 - furnace, Stanat rolling mill | | | |
| Storage locations if different from Area Used | | | |
| **Building Stored In:** | | | **Room Stored In:** |
| **Specific location stored within room:** | | | |
| **Beryllium controls ( Administrative, Engineering, PPE, etc.) implemented, if known:** enclosed operations, training | | | |
| **Sample Data, if available:** IHIM nos. 10670 (initial discovery) and 10733, 108 | | | |
| **Type of Equipment Used:** | | | **DOE/ORNL Equip. No, If known:** |
| Location(s) to where equipment was moved or relocated, if applicable or known | | | |
| **Building Moved To:** | | | **Room Moved To:** |
| **Specific location moved to within room:** | | | |
| **Facility/operations contact (current UT-B and subcontractor employees) knowledgeable of historic Beryllium operation/activity.** Note: Also list contacts now working in other division(s). | | | |
| **Name** | **Badge No.** | **Position at time** | **Work Telephone No.** |
| | | research staff | |
| Edit | | | |

# ORNL CBDPP Best Management Practices

- **ORNL Beryllium BMP 9.** Obtained capabilities for timely analysis of beryllium smear samples
  - Ability to conduct in-house beryllium analysis of surface smear and exposure air samples was developed
  - ORNL was the first DOE Office of Science operation to obtain AIHA Laboratory Accreditation for analysis of beryllium air samples using the fluorescence method

# ORNL CBDPP Best Management Practices

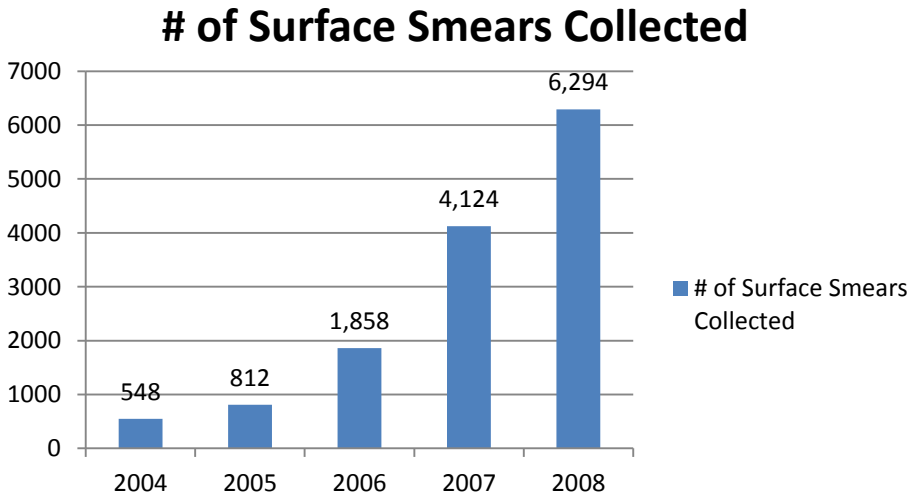
- **ORNL Beryllium BMP 10. Establishment of a Beryllium Board**
  - **Composition of the Board includes labor representatives, line and facilities management and H&S professionals**
  - **Mission is to review and provide feedback on beryllium practices and policy issues at the Laboratory**
    - **Planning and execution of beryllium baseline inventory revalidation project**
    - **Method for communication of results of beryllium smear surveys and required controls to management and workers**
    - **Beryllium signs and labels**

# Current Culture

- Operations & Maintenance (O&M) as well as Research & Development (R&D) Staff are cognizant of legacy beryllium contamination at the Laboratory and that appropriate Work Planning and Control is required prior to conducting work involving beryllium or work inside a legacy beryllium contamination area
- Laboratory Staff has developed a questioning attitude toward beryllium

# Current Culture

- Requirements for beryllium hazard assessment and beryllium controls are integrated into O&M and R&D Work Control
- This shift in culture is evidenced by the increased number of beryllium smear samples collected



# ORNL CBDPP Best Management Practices