

Secondary Exposure to Metals

Vic Feuerstein CIH

Kathleen Smit CIH

Secondary Exposure to Metals

- Facilities include twenty four hydroelectric power plants and 65 dams ranging in age from 35 to 100+ years of age. Test group includes 4 plants/dams.
- Constructed by different contractors consistent with designs that did not factor in any consideration for a relationship between long-term O&M and metals exposure issues.
- All still functioning as designed as the result of intensive O&M operations on original materials.

Secondary Exposure to Metals

- Medical evaluations in 2003 indicated that exposure to metals was occurring (Zn, Cd, Pb) in a few individuals at one field office.
 - This program was not targeted for metals. These results were chance findings.
- A refocused medical surveillance program initiated in 2004 identified elevated metals in 10 of 13 staff members in the same field office.
 - New program targeting specific trades and duties for each individual.

Searching the Air for the Exposure Source

- Extensive breathing zone air monitoring was negative. None detected.
 - Full crew, entire shifts, multiple days.
 - Parallel total dusts and respirable dust sampling.
- Extensive high volume area monitoring was negative. None detected.
 - Multiple hydroelectric power plants.
 - Work ongoing, entire shifts, multiple days.

Searching the Dusts for the Exposure Source

- Wipe sampling of dusts in the plants and the office areas were positive for metals.
- Literally every surface that the employees contact was sampled progressing from high-use to seldom used.
 - Floors, walls, equipment, controls, computers, lunch table, microwave, telephones, bathrooms, HVAC.
 - Pb, Cd, Cr, Mn, As, Ni, Zn
- The persistence of metals in the work environment and in the body guided the wipe sampling locations.

Metals in the Dust Samples

	Metals					
	<u>Cd</u>	<u>Cr</u>	<u>Pb</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>
Power Plants	8/29	29	28	29	21	28
Admin Office*		+		+		+
Admin HVAC	+	+		+	+	+

*Carpet vacuum sample data.

Searching the Water for Exposure Sources

- Power plants and dams leak. Many are located in mineral rich areas. Water dehydrates and leaves metals.
- Employees come into contact with water during routine O&M activities.
- Employees use non-potable water for hand washing, coffee cups, plant clean-ups etc.
- Bulk sampling of non-potable water positive for metals.

Searching for the Exposure Source in the Soil

- Soil dusts could be a source of metals for the plant dusts.
- Extensive road construction above one of the plants used soil from around the reservoir for ~ 2 miles of road base.
- Soil around office, plants, roads and reservoir tested positive for metals.

Metals in the Water and the Soil

Soil Samples:

- Soil collected:
 - Outside of plant
 - Adjacent to roadwork
 - Source of roadwork dirt
- Soil samples contained:
 - Chromium,
Manganese, Nickel,
Zinc

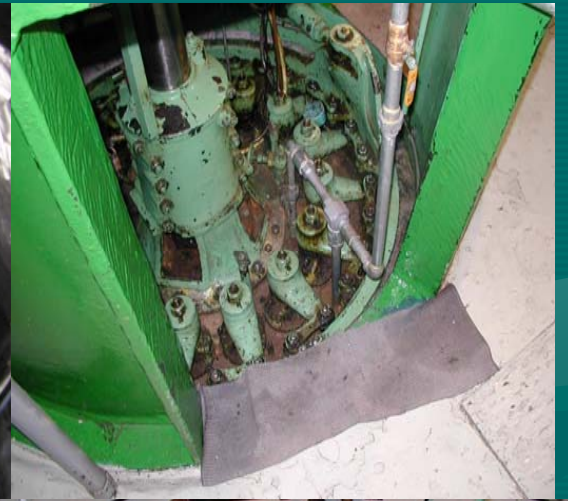
Water Samples:

- Bottled Water contained **zinc**
- Reverse Osmosis treated water contained **zinc**
- Plant water contained **lead, manganese, zinc**

Searching for the Exposure Source

- Fifty years of operations and maintenance with ineffective engineering controls and poor work practice controls would facilitate metal dust contamination on virtually every surface in the plants.
 - Welding, cutting, steel fabrication Alloy gouging cavitation repair work
- Lead coatings on $> 75\%$ of the equipment.
 - Trace to 50 mg/cm² coatings.

Metal Sources in the Plants



Secondary Exposure to Metals

- Secondary exposure as the result of the transfer of metals from dirty hands became a prime suspect.
- Skin wipe sampling was selected to qualify the presence of metals on the hands, face and neck.
- All wipe samples were collected by the same Industrial Hygienist.

Skin Wipe Sampling

- The technique was expanded to include Pb, Cd, Cr, Mn, Ni, As, Zn using Ghost Wipes.
- Skin wipe sampling was conducted on administrative and plant staff prior to any work in the plants at the beginning of the shift to establish a baseline.
- Skin wipe sampling was conducted at the end of the shift to assess work-related exposures.

Metals on Skin

- A total of 29 individual employee days representing the entire crew were sampled.
- All positions sampled including:
 - mechanics, electricians, communication and instrumentation mechanics, utility workers, laborers, hydro-repair personnel, supervisors, manager, engineers and administrative staff.

Searching for the Exposure Source on the Skin

- Skin wipe sampling data demonstrated the presence of the metals on skin.
- Most of the crew had more metals on the skin at the end of shifts.
- Some of the administrative staff demonstrated metals on the skin.

Skin Wipe Sample Data

	<u>Cd</u>	<u>Cr</u>	<u>Pb</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>
Pre-Shift	4/29	1/29	1/29	3/29	3/29	10/29
range ug/wipe	3-10	7	12	5-6	6-7	41-161
Post-Shift	7/29	4/29	6/29	11/29	7/29	18/29
range ug/wipe	5-32	8-10	16-49	3-22	7-21	41-294

Personal Work Practice Controls

- Training on the metals conducted at each plant.
- Occ Med Rx site visit to plants**
- Strategic hand wiping and washing.
- Regular cleaning of high use surfaces & eqt.
- Work clothes and boot changes.
- Wet mopping and HEPA vacuuming
- Prohibition on dry sweeping.

Summary of Metals Sampling

- **Metals not available for inhalation during these sample days.**
 - Exposure source during routine and non-routine operations.
- **Metals available for exposure in potable and non-potable water.**
 - Ingestion exposure source and secondary dust source.
- **Metals on skin available for daily exposure.**
 - Physical transfer, ingestion and secondary inhalation.

Work Practice Controls

- Decline from 77% of crew with elevated metals to 31% of crew with elevated metals.
- Application of “lessons learned” to the other 20 plants in the region.
- Exploration of the skin wipe technologies as a tool for exposure assessment during the application of new coatings.

Thanks for Listening

Vic Feuerstein CIH
Bureau of Reclamation

Kathleen Smit CIH
Northern Analytical Laboratory