Contamination control monitoring at the Los Alamos National Laboratory's Plutonium Facility

Plutonium airborne contamination creates a particular hazard because of the possibility of intake by inhalation. To preclude excursions of radioactive materials into the operator's breathing zone, controls are used to prevent contamination. Measures to control radioactive contamination include eliminating or minimizing the spread of contamination and preventing cross-contamination. Contamination control philosophy at the plutonium facility is conveyed in one simple statement: *Detect the contamination closest to the source as possible*! Speed and distance when self-monitoring is critical to detecting plutonium contamination. Responding correctly to an alarm or monitor not working properly minimizes the consequences of plutonium *contamination*. Performing a full body frisking correctly and using the Peer-checking tool also minimize the consequences of plutonium *contamination*.

By Michael E. Cournoyer

INTRODUCTION

Plutonium is primarily an alpha emitting radioactive material and is particularly hazardous if taken into the body.[1] Plutonium airborne contamination poses a particular hazard because of the possibility of intake by inhalation.[2] Inhalation is the most common mode of uptake of radioactive material in the working environment.

In addition to the hazard to the worker, radioactive materials can be spread to unwanted locations, e.g., by the cross-contamination of tools, equipment, or workers.[2] Airborne contamination depositing on surfaces is another source of contamination. To preclude excursions of radioactive materials into the operator's breathing zone, a variety of controls are used to prevent contamination.

The most effective protection from radioactive materials is engineered barriers and has been incorporated through architectural and structural design.[3] Engineering controls at the plutonium facility include differential ventilation pressure zones, High-Efficiency Particulate Air filtration, gloveboxes, and radiation shielding. Gloveboxes used for radioactive materials are maintained at a lower pressure than the surrounding room atmosphere, so that relatively small leaks result in air inflow rather than radioactive release.[4] In addition, gloveboxes are constructed of stainless steel to provide structural stability.

An *As Low As Reasonably Achievable* (ALARA) program augments these passive safety features by providing an indication of the effectiveness of engineering controls and proper work practices in preventing the release of radioactive material.[5] The detection and control of radioactive contamination are an integral part of an aggressive ALARA program.[6]

Measures to control radioactive contamination include eliminating or minimizing the spread of contamination and preventing cross-contamination. An effective contamination control philosophy reduces the risks of the following: intake of radioactive material, spread of radioactive material to uncontrolled areas, limit the buildup of radioactive material in the workplace, and limit and or reduce source material that is not contained in an engineered barrier. The contamination control philosophy at the plutonium facility is conveyed in one simple statement: *Detect the contamination closest to the source as possible*!

This report discusses the features of contamination monitoring instruments, contamination monitoring requirements, contamination monitor's issues including contamination monitor not working properly, and response to a contamination monitor alarm.

CONTAMINATION MONITORING INSTRUMENTS

The primary access control point in the plutonium facility is the entry and exit portal between the uncontrolled area and the radiologically controlled area (RCA). Within the RCA are radiologically buffered areas (RBAs). They provide secondary boundaries within the RCA to minimize the spread of contamination. RBAs are considered part of the RCA. Gloveboxes are located within the RBAs.

To maintain radiological control, radiological control technicians (RCTs) routinely survey buildings, rooms, and equipment. This practice

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aids in early detection of contamination and is required by Federal law.[7] Personnel who work with or around plutonium also perform periodic surveys. For instance, when working in gloveboxes, glovebox workers check their hands whenever they withdraw them to verify that the glovebox gloves are not breached.[8] Personnel monitoring by an RCT is usually conducted whenever contamination of the body or clothing is suspected or as required by exit monitoring when self-monitoring is not feasible or not allowed.

Plutonium is best detected with an alpha detector because it is primarily an alpha-emitter. The standard alpha detector used at the plutonium facility is an air-proportional probe.[9] The probe is "air-proportional" because the electronic pulse is proportional to the energy deposited in the air of the probe. A standard alpha detector is stationed at each glovebox workstation. See Figure 1.

Hand and foot monitors (HFMs) with detachable handheld detectors are located at the exits of RBAs. See Figure 2.

These devices can monitor the hands and feet during a period of a few seconds–dependent on background radiation levels present in the area and the personnel contamination limit of concern. After the hands and feet have been monitored, the detachable handheld detectors can be used to monitor the remainder of the body. Notice the blue pad, i.e., sticky mat that the worker steps on before placing his booty on the HFM monitor. Sticky mats are used to help prevent contaminants from leaving the RBA.

Prior to exiting RBAs to the RCA, workers first monitor themselves with a HFM. Next, when exiting the RCA, personnel again monitor their booties and hands on a hand and foot monitor, remove their booties, and use the Personnel Contamination Monitor (PCM). The PCM provides personnel with an external whole body monitoring system. They are located at the exits of the RCA. See Figure 3.

The contamination detectors within the PCMs are capable of performing a survey of the whole body in a period of a few seconds, dependent on background radiation levels present in the

Figure 1. A standard alpha detector.

Figure 2. A standard hand and foot monitor.

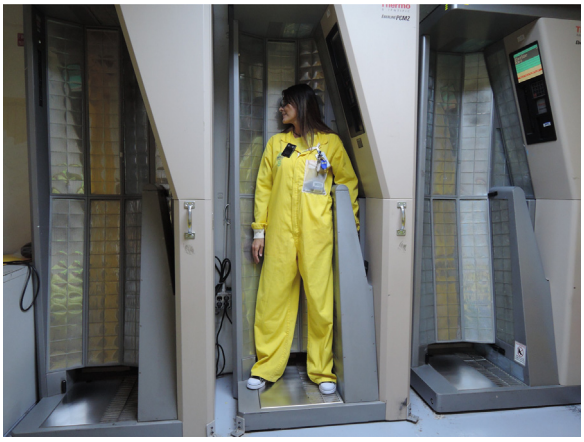

Figure 3. A Personnel Contamination Monitor.