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RADIOLOGICAL SCIENCES DEPARTMENT INVESTIGATION

RADIATION INCIDENT CLASS I, No. 608-C

By

H. BURNSTEDT 7/22/91

Verified By

Nature: Several employees (Separations - Operations - Power) externally and internally contaminated with plutonium after a process leak occurred in the Control Room of the 233-S Building, 200-West Area, on June 18, 1956.

Description: At about 6:30 A.M. one of the two Process Operators regularly stationed at 233-S was performing routine work in the Control Room, heard a nearby Poppy alpha detector "breaking down". He checked and found the instrument appeared to be in operating condition as it would respond to a high level source. Further checking indicated that he was contaminated and that nearby horizontal surfaces were contaminated. This information was phoned to the Shift Supervisor who told the Operator that he would be right out and to throw a pair of shoe covers out the door. On arriving, the Supervisor donned the shoe covers and then quickly checked the Poppy response and confirmed the report of the Operator. Both men then left the building. Just outside they met the other Process Operator assigned to 233-S, returning from the lunchroom. The second Operator was handed a smear, previously taken and checked by the Supervisor, and told to check it on a Poppy in the load-out-room, a room adjacent to where the contamination was originally found. When the Supervisor heard the load-out-room Poppy break down as the smear was checked he instructed both Operators to stand by just outside the building while he went for monitoring assistance. Radiation Monitoring survey results revealed:

1. Shift Supervisor
 Exposed skin surfaces 5 - 10,000 d/m
 Personal clothes 5 - 10,000 d/m
 Nasal smears 5,000 d/m (radioanalysis shows 1.8×10^5 d/m)
Nasal blow 20,000 d/m
2. Process Operator "A" who reported the contamination
 General skin contamination > 40,000 d/m
 Personal clothes > 40,000 d/m
 Nasal smears 30,000 d/m (radioanalysis shows $\sim 1 \times 10^6$ d/m)
3. Process Operator "B" - checked the smear
 Exposed skin surfaces 2 - 10,000 d/m
 Personal clothes 5 - 10,000 d/m
 Nasal smears 5,000 d/m (radioanalysis shows 1.2×10^4 d/m)
4. Five Other Men - in or near 233-S that shift
 Exposed skin surfaces to 3,000 d/m
 Personal clothes to 3,000 d/m
 Nasal smears negative (radioanalysis shows one smear of 1.2×10^3 d/m)

see case file for change in PRK letter
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5. Control Room 233-S Building

Horizontal surfaces from 1×10^5 to 7×10^6 d/m
Air sample filter paper - $> 7 \times 10^6$ d/m

6. Lunchroom - 202-S (possibly carried there by one of the several men who entered 233-S earlier)

Spot on one chair - 500 d/m

Dosimetry: Decontamination efforts were started promptly, and, for the two Operators and the Supervisor, continued under the direction an Industrial Physician. Decontamination efforts for Operator "A" progressed slowly, partially because he had been working stripped to the waist to avoid the heat and partially because of a skin disorder. The initial bioassay results for each of these men indicate some deposition of soluble plutonium. The formal interpretation of the bioassay results of all those involved in the incident will be issued separately.

Discussion: It has been estimated that the actual spread of plutonium to the 233-S Control Room started shortly before 6:00 A.M. as results of routine Radiation Monitoring surveys and personnel surveys prior to this time were all negative. The origin of this airborne plutonium was the failure of an air-actuated diaphragm valve between a plutonium nitrate concentrator and a receiver vessel. This failure allowed an acidic plutonium nitrate solution to work back through a copper air supply line located in the 233-S Control Room. The acid solution then corroded the copper, and about half a cupful of solution drained to the floor. Another estimated half cupful was found under the Control Room vent of the same air supply line. Once the solution got into the Control Room there apparently was sufficient air flow and heat (the plutonium concentration is effected by steam) to transport radioactive aerosols throughout the building.

The first indication of gross airborne contamination came from the breaking down of the Poppy as there are no alpha air monitors presently available that can provide a prompt alarm for high level airborne alpha activity. Such instrumentation is still in the developmental stage. Both Process Operators have indicated that there has been considerable difficulty in maintaining poppies at 233-S because of line voltage changes that frequently caused a poppy to break down. Thus the action of Operator "A", who checked the poppy, is commendable, especially when he had been partially conditioned to expect poppy breakdowns to be attributable to voltage variations rather than gross airborne contamination.

The ventilating system for the 233-S Building is such that the change room and control room are under a positive air pressure with the air flow being toward the process area and the outside air. Apparently there was sufficient air flow to result in ground contamination up to 5,000 d/m over an estimated 200 square feet directly outside the gravity-type dampers and opened door of the building. This offers an explanation as to why several men, who never actually entered the building at the time of the incident, were found with low level contamination.

There must have been gross airborne contamination of a magnitude hitherto unknown at 233-S. In fact, Operator "A" first suspected the source of the contamination to be outside the building as the process operating conditions appeared normal. To illustrate the levels, the Supervisor estimates he was in the building not more than two minutes, yet in that short interval he became significantly externally and internally contaminated! Also, Operator "B" was probably only in the load-out-room a few seconds, without respiratory protection, while checking the smear.

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Causes: 1. Installation and use of a valve and venting system that resulted in the uncontrolled gross spread of contamination. (C-1)
2. Unavailability of continuous and automatic alpha air monitoring equipment forestalled a possible earlier detection of this situation. (A-5)
3. Failure to take positive preventive measures, after initial indications of an abnormal condition, possibly increased the extent of personnel contamination. (A-1)

Recommendations: 1. Maintain in more reliable condition the alpha monitoring equipment for this location.
2. Expedite the development of continuous automatically-indicating alpha air monitoring equipment.
3. Review process piping and equipment at this and similar locations and attempt to modify and/or replace existing equipment to forestall or eliminate future incidents of this type. Extend this review into future design considerations.
4. Incorporate into appropriate regulations throughout HAPO the minimum personal clothing requirements for various work locations.
5. This incident points out the fact that serious radiation hazards can arise quickly and unexpectedly and that the first reaction has to be both fast and correct. Therefore, it is recommended that the principle of "believe the worst - double check later" -- directly after the initial recognition of a radiation hazard, be re-emphasized to HAPO workers.

JW Vanderbeek:ceo

RADIOLOGICAL SCIENCES DEPARTMENT

June 28, 1956

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