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NMED 000295

REPORT OF PERSONNEL CONTAMINATION INCIDENT

NeoRx Corporation, May 2, 2000

Summary

An employee was contaminated with very small droplets (9-19 microns, estimated) of high concentration Holmium-166. Decontamination efforts were only partly successful. Contamination levels were monitored and skin doses calculated. The maximum skin dose was calculated to be 42 rem or less (84% of the dose limit). Whole body measurements did not reveal any internal contamination. *Annual exposure limits were not exceeded.*

The immediate cause of this incident appears to be improper use of safety equipment.

The recommended corrective action is to :

- increase the supervision of less experienced workers
- insist on the use of all engineering and process controls
- suspend the affected employee from working with radioactivity for the calander year.

Description of Incident

At approximately 1400, airborne droplets contaminated a manufacturing engineer who was withdrawing a needle from a vial containing Holmium 166 Chloride.

Immediate Actions Taken

- The engineer immediately surveyed himself with a contamination survey instrument which was in the area, removed his contaminated gloves, and called for assistance.
- At 1410 hr he began washing his hands with RadCon, a commercial decontamination agent
- When help arrived, his contaminated protective clothing was removed, he was surveyed and decontamination efforts moved to his face, where contamination had been detected
- D Salmon was contacted in Idaho by the NeoRx RSO at 1440. Readings in cpm were relayed and an initial skin dose estimate was made that indicated that a dose near the annual limit might be received at the current levels of contamination. Salmon emphasized that the dose appeared to be well below the threshold for skin injury.
- Nasal swabs and sputum and urine samples were taken and analyzed in a gamma counter. A whole body count was taken with a 2"X 2" NaI detector and multichannel analyzer at a distance of one meter.
- At 1500 hr contamination efforts were no longer resulted in reduced readings from the survey meter. Strategies for further decontamination were discussed. Salmon advised that harsher methods should only be used under a physician's supervision and suggested transporting the engineer to the University of Washington Medical Center, where additional monitoring could be done and physicians and health physicists were available. NeoRx agreed to this course of action and Salmon contacted J Johnson, UWMC health physicist, and asked her to monitor the patient and to ask for the assistance of the UWMC nuclear medicine department, which has experience in precisely quantifying Ho-166 in humans.
- At UWMC the patient was put in the care of J Rajendran, MD, a nuclear medicine physician experienced with the use and dosimetry of Ho-166. J Johnson provided health physics advice

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and monitored the patient. A whole body gamma camera scan was done with a camera calibrated for Ho-166.

- Dr. Rajendran concluded that there was no detectable internal contamination, that harsh decontamination methods were not justified, and sent the patient home.

Results of Monitoring

Initial readings of about 6 mR/hr in close proximity to the skin contamination were measured with a Victoreen 450B (beta window open). After decontamination efforts were concluded readings were 0.6 mR/hr. These areas read approximately 100,000 cpm with a Ludlum 44-9 pancake detector after decontamination.

At UWMC, monitoring of the patient's face with a gamma camera showed a diffuse area on one cheek which read 100 kcpm with a pancake probe but did not image with the gamma camera. An area on the chin read 60 kcpm, and the forehead read 30 kcpm. These areas also did not image. An area on the neck did image as a point and read 30 kcpm.

The efficiency of the pancake probe for beta particles of this energy is better than 30% (manufacturer's data and numerous references), making the activity in the highest contaminated area about 0.15 uCi, and the total skin contamination on the order of 0.5 uCi.

The NaI detector was calibrated on 5/19/2000 by placing a Cd-109 standard on the surface of a plastic phantom (for backscatter) and counting with the same settings as were used on 5/2 for 5 minutes at one meter. Cd-109 (88 keV) was used because it approximates the principal photon energies of Ho-166 (49-81 keV, 14.4%). The intrinsic efficiency of the detector in this geometry was found to be 0.4%.

The experiment was repeated with two different Co-60 standards. The efficiency was so low (0.01%), that it was concluded that the high energy Ho-166 photons (785-1750 keV, total abundance 1.3%) did not contribute to the whole body count.

The activity represented by the count made on May 2 was calculated to be 0.66 uCi, all of which could be accounted for by the skin contamination already noted. There was no significant internal contamination.

The urine sample was negative.

There was about 0.02 uCi in the first saliva sample, which was reduced to 0.007 uCi by mouth washing.

The nasal swab contained about 0.002 uCi.

Radiation Doses

Skin doses were calculated with VARSKIN MOD2 (Battelle Pacific Northwest Laboratory under contract to USNRC, 1991-1999), using the values for P-32 (mean beta energy 0.695 MeV, Ho-166 mean beta+electron energy is 0.694 MeV). This calculation neglects the effect of photons, but these would be expected to be negligible (NUREG/CR-5873 *VARSKIN MOD 2 AND SADDE MOD 2: COMPUTER CODES FOR ASSESSING SKIN DOSE FROM SKIN CONTAMINATION*, page 15). Rohloff and Heinzelmann calculated the photon dose from Ho-166 to be 15 millirem/hour per uCi/cm^2 (F Rohloff and M Heinzelmann "Dose Rate by Photon Radiation to the Basal Layer of the Epidermis in the Case of Skin Contamination" *Radiation Protection Dosimetry* 63:15-28, 1996)

The area with the highest reading (right cheek, 90-100 kcpm) had diffuse activity over an area that approached the area of the probe (15 cm^2). The skin dose was calculated for distributed sources

of 15 cm^2, 1 cm^2, and for a point source. The doses, averaged over 1 cm^2 were, 2.55 rads, 36.4 rads, and 36.4 rads. Hand calculations were done and were consistent with results from VARSKIN.

Assuming that the initial activity was 10 times as high and in the form of a point source, and the contamination was reduced uniformly over one hour, the dose in the first hour was calculated by VARSKIN MOD 2 to be 5.2 rads, for a total estimated dose of 8 – 42 rem.

This individual's shallow dose for 1999 was 680 millirem.

Internal contamination was not measurable. The Annual Limit of Intake for this nuclide is 2000 uCi

Conclusion

Skin dose 8 – 42 rem (16% - 84% of limit). No significant internal dose.

By

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