10-95-193

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

November 2, 1995

MEMORANDUM TO: John E. Glenn, Chief
Radiation Protection & Health Effects Branch
Office of Nuclear Regulatory Research

THRU: John D. Kinneman, Chief
Nuclear Materials Safety Branch 2
Division of Nuclear Materials Safety, Region I

FROM: John R. McFadden, Health Physicist
Nuclear Materials Safety Branch 2
Division of Nuclear Materials Safety, Region I

SUBJECT: TRIP REPORT-MIT

On October 26, 1995, J. McFadden, a Region I Health Physicist, observed the splitting of urine samples by an ORNL radiochemist at MIT. The ORNL radiochemist, Mark Laudeman, was observed splitting the last twenty-five percent of 64 original urine samples. This occurred between 0800 and 1200 hours on October 26, 1995. Elizabeth Ullrich, also of Region I, had observed during the splitting of the first seventy-five percent of the samples on the previous day. These urine samples were reported to be from an individual reported to have had an intake of 579 microcuries of phosphorus-32 on August 14, 1995.

Based on discussions with and observations of M. Laudeman, the following was ascertained:

a. the first 33 of the 64 original samples were smaller (approx. 100 ml) than the latter 31 (2500 to 3000 ml);

b. use of the ultrasonic bath for mixing was not attempted due to the small size of the bath and the resultant amount of time that it would have taken to mix the samples in accordance with the attached procedure, "Sample Preparation Procedure for Urinalysis"; magnetic stirring was substituted for the ultrasonic mixing;

c. the volumes, recorded on each original sample container by MIT personnel, were used to calculate the volume of 37% hydrochloric acid to be added; previous 1 ml samples, reportedly taken by MIT personnel, were factored into the calculations;

d. magnetic stirring bars and pipettes/beakers were reused after triple washing and rinsing due to the lack of a supply of disposables;

e. the original 64 sample containers were marked as numbers 1 thru 64 by M. Laudeman prior to the start of sample splitting; the 64 split samples for ORNL and the 64 split samples for LLL were marked as numbers 1 thru 64 on the body and lid of each container; no other sample information was marked on the split samples; a paper record of all sample information on each original sample container was kept; and

f. the smaller split samples (nos. 1 thru 33) for ORNL and LLL (a total of 66) were each about 50 ml in volume; the larger split samples (nos. 34 thru 64) for ORNL and LLL (a total of 62) were each about 500 ml in volume.

The above-referenced deviations from the attached procedure were made by M. Laudeman and were deemed acceptable in his judgement. M. Laudeman's written record of sample identification information was checked against the information on approximately 6 original sample containers, and no discrepancies were noted.

After 1200 hours, arrangements were made by M. Galanek to have specification shipping containers delivered from a commercial supplier on the next day. This was necessary based on ORNL's assessment of the split samples to be "corrosive material" per DOT regulations. The cost of these shipping containers was reportedly approximately $700. An adhesive-label type of security seal was placed on each of the approximately 128 split samples (an example of each type of label used is attached). The licensee stated that MIT personnel would package the samples as soon as the shipping containers become available and that, conditions permitting, the samples would be shipped to arrive at ORNL on Monday, October 30, 1995.

J. McFadden exited with M. Galanek, the associate RSO, at 1600 hours.

Docket No. 030-00763

Sample preparation procedure for urinalysis:

1. Acidify the urine samples with an appropriate aliquot of concentrated HCl (36-38%, 12M) using the volume ratio of 20:1. For example, if you have 100 mL of urine, acidify with 5 mL of concentrated HCl. If the volume of the urine samples can not be accurately measured, use the mass ratio of approximately of 100: 6. For example, if the mass of urine sample is 1002 g, acidify with 60 mg of concentrated HCl. This assumes that the molarity of concentrated HCl is 12M and the anhydrous solute weight % of the urine (g solute/100 g solution) is 0.5% (see Handbook of Chemistry and Physics, D-232 and D-268).

2. Homogenize samples using an ultrasonic bath. After 1/2 hr , if the solids in the sample are not completely redissolved, use a glass stirring rod and mix the solids into solution.

3. Identify the 250 mL plastic container with the provided label. **Note on the label the sample I.D, sample collection time and date, total volume of sample collected for the void period, volume or weigh of urine before acidifying and corresponding volume or weigh of added concentrated HCl to the sample.**

4. Pipette a 100 - 200 mL aliquot of the acidified urine sample into the 250 mL container using a disposable pipette. If 100-200 mL of sample is unavailable, pipette 50 mL of the acidified urine into the container. **Be certain to use a different pipette for each sample to avoid the cross-contamination between samples.**

5. Cover the top of the 250 mL container with Parafilm before capping. Ensure the cap is tight to avoid spillage . Attach the label to the 250 mL container using Scotch tape to ensure the label does not fall off during shipping.

Note:

If portions of the urine samples are to be sent to another laboratory for analysis, please check with that laboratory and determine if they can analyze acidified (HCl) samples. If the other laboratory does not want to process acidified samples, remove and set aside aliquots to be sent to the other laboratory before implementing this sample procedure.

Please call Son Nguyen (510-423-7400) or Dave Hickman (510-422-8958) if you have questions regarding this procedure.

10-26-95

SECURITY SEAL

SEAL NO. 023821

RECORD SEAL NO. ON SHIPPING DOCUMENT

10-26-95

SECURITY SEAL

INVESTIGATE IF BROKEN

SECURITY SEAL

This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s., UN 2910.

10-26-95

RADIATION PROTECTION Fax 919-571-4148 Aug 7 '95 17:59 P.02/10

BRIEF INCIDENT REPORT:

(Submit this completed form to Dayne Brown upon conclusion of incident)

Date/Time of Occurrence: April 1988 Location: Duke Univ + Medical Center

Incident Number: 215

Type of Incident: C (see codes below)

Brief Description: (response/outcome) Limit equivalent of approximately 10 typed lines.

Duke Univ. + Medical Center had a PhD to receive an internal exposure to P32 on or about April 1988. The calculated exposure whole body dose 31.15 Rem. Activity 5.96 mCi ± 8.7 ...
How the person received this amount of P32 could not be determined. See report

Codes/Type:

(C) Contamination
(E) Exposure (badge readings included)
(IR) Industrial Radiography
(LF) Licensed Facility
(LS) Lost Source
(RM) Radioactive Material
(O) Other: fire, illegal possession/disposal, theft, etc.
(SS) Sealed Source
(T) Transportation, includes air shipments
(NPP) Nuclear Power Plant (reported to this office for state inspection)

1982

Duke University - Duke University Medical Center
DURHAM, NORTH CAROLINA

February 21, 1990

RADIOLOGICAL SAFETY OFFICE

POSTAL CODE 27710
TELEPHONE (919) 684-2194
P. O. BOX 3155

Mr. Cecil Brown, Chief
Radioactive Materials Section
Division of Radiation Protection
N.C. Dept. of Environment, Health, & Natural Resources
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Dear Cecil:

RADIATION INCIDENT REPORT

Licensee: Duke University Medical Center

License Number: NC 032 0083 3

Date of occurance: On or about April 16, 1988.

Incident: Ingestion of Phosphorus 32 Orthophosphate by employee.

Individual Exposed: Susan L. Deutscher PhD.
SS# 310 62 7280
Date of Birth: May 1, 1958

Calculated Ingested Activity: 5.96 $\pm$ 3.03 milliCuries.

Calculated Whole Body Dose: 31.15 Rem.

Cause of Incident: Unknown (possible cause scenarios attached).

Remedial Action Taken: No procedural changes; strong re-emphasis on existing laboratory procedures.

"This report is furnished to you under the provisions of Section10 NCAC 03G.2520 (c); Overexposures & Excessive Levels & Concentrations."

Sincerely,

David B. Jorgensen

Duke University Medical Center
DURHAM NORTH CAROLINA
27710

DEPARTMENT OF MICROBIOLOGY
AND IMMUNOLOGY

TELEPHONE (919) 684-3389
BOX 3020

February 10, 1990

David B. Jorgensen
Assistant Radiation Safety Officer
Radiation Safety Office
Duke University
Box 3155
Durham, NC 27710

Dear David,

I am writing to describe to some of the events of which I am aware surrounding the internal radioactive contamination of the Research Associate, [redacted]; in my laboratory on or about April 16, 1988. Unfortunately, I was out of town at the time this incident was discovered and most of the facts surrounding the events were collected by your office. My assessment is derived from discussions with members of the lab when I returned on April 22 and my knowledge of the procedures in-force in the laboratory.

There are several potential theories that have occurred to me, but most of them seem far-fetched and very unlikely. Furthermore, it is difficult to justify this as a freak accident because of the unusually large dosage that [redacted] apparently received. I only hope that the estimated dosage is in far excess of the actual dose that she obtained. In the end, however, I must conclude that this was an accident rather than an intentional poisoning.

There were three persons in the laboratory using ^{32}P during the period that the contamination is thought to have occurred. In one case, [redacted] student in my lab was conducting an experiment late one evening that required handling in excess of 20 millicuries of ^{32}P orthophosphate. He was labeling cultured mammalian cells by diluting the radiolabel from a commercial vial containing 25 mCi in 58 microliters into 2 petri dishes (3.5 MCi per

dish) containing 25 milliliters each of growth medium. This is a method commonly employed in the laboratory to obtain high specific activity ribonucleic acids. Members of the laboratory often work late at night and I prefer this kind of high level work to be done in isolated areas preferably when other workers are not around. Thus, there was nothing irregular about these events.

[redacted] was and is a good friend of [redacted] and she may have passed through the lab during the experiment. She does not recall entering the lab on that Saturday evening, but does remember passing by the next morning when the experiment was still in progress and greeted [redacted]. She was working on a manuscript at the time and not conducting experiments. [redacted], [redacted] and [redacted], another fellow in the lab had just returned that week from a meeting in Colorado. The next morning, she remembered entering the laboratory and talking with [redacted] as he prepared the final extract, but she kept her distance from him. The experiment usually progresses with labeling in the 25 ml cultures overnight, the medium is disposed the next morning (along with at least 95% of the input label) and the cells in the culture prepared. Thus, on Sunday morning most of the 7 mCi was in liquid waste. The only other ^{32}P compound in use during that period was gamma ATP (5 mCi) which was used in sub-millicurie amounts per experiment. This was used in the same laboratory bay where [redacted] worked and by a student with questionable technique at that time ([redacted]), but I have found no reasons to suspect this as the source of [redacted] contamination. [redacted] was also using ^{32}P that week, handling as much as a millicurie from the same gamma ATP source.

The following week when I inventoried the radioisotopes in the laboratory, the disposal containers had all of the expected radioactive waste when calculated to the dates of the experiments. There is potential error in the inventory, however, in the event that other workers added ^{32}P to the container and neglected to record the addition or if there had been residual activity in the container from previous weeks. Another potential source of error in our inventory could have been from other laboratories on our floor who may have disposed of ^{32}P in our container and not recorded the entry. This would have been irregular and is not likely. Thus, I believe our

accounting for the ^{32}P in the laboratory to be accurate to within 1 or 2 millicuries, and I wish we could have been more precise. However, given the circumstances; this was the best that we could do.

As part of a routine cleanup of the cold room on Wednesday, April 20, 1988, lab members were scanning samples to be disposed using a beta counter and discovered that [redacted] body registered radioactive counts. Those involved at that time were [redacted], another postdoctoral fellow and [redacted]. As I understand the events, your office was called immediately and all members of the group (about 12 persons) were alerted. Everyone stopped work and began a complete scanning of the laboratory. They found no apparent contamination of any surfaces, containers or instruments. Likewise, there was no detected contamination of any other individual. This was also the finding when your office monitored the laboratory. As you are aware, all of the paperwork and records were in order. Much of what I have described and subsequent events are documented in your reports.

The potential scenarios that I can think up are the same ones that you and I have discussed.

1. Intentional poisoning: We can never be certain of the kinds of mischief or deceit that might lurk in the minds of some sick personalities. I am not aware of any person in my laboratory or in the Department that would intentionally do such a thing. There may have been some of the usual petty jealousies or professional resentments among lab workers that one finds in any working environment. There is not a single suspect in my view that would carry out an act like this, however. It seems to me that there would be more direct and severe ways to poison another individual than using ^{32}P. On the other hand, it might be just marginal enough to torture and obsess the victim over a long period of time. I know of no other bizarre or abnormal episodes or events that might suggest that a pathological personality resides amongst us. Over the years there have been a few mysterious gifts appear on the desks of lab workers for which the donor has remained anonymous. We have written these off as gifts from secret admirers. Otherwise, nothing

unusual has happened of which I am aware during the 11 years that my lab has functioned.

[redacted] was handling the largest amount of ^{32}P during the time of the contamination of [redacted], thus, he would be a potential source. [redacted] and [redacted] were friends and spent time together. They were mutually interdependent professionally and socially. It is not possible that [redacted] would have intentionally contaminated [redacted] for many reasons. Most importantly, he was the only one handling over a millicurie of ^{32}P that week and would be the obvious suspect. Thus, an intentional poisoning would not be carried out by the only individual known by everyone to have it in hand. [redacted] is my very best student and a solid citizen. He spends at least one third of his time generously helping others who have problems with their experiments. One might speculate about other potential motives, but I would not support this as a viable scenario for a source of intentional contamination.

2. <u>Intentional self inflicted contamination</u>: Much like the above scenario, one can not know the inner workings of the mind of another individual. To the best of my knowledge, no psychological analyses have been performed in this case. There are many ways to pursue attention and this could be imagined as one such method. I discount this scenario because: 1) [redacted] was shocked and highly distressed by this entire event. There has been an effort on her part to keep the episode quiet. I was fearful that a version of these events might be leaked to the local newspapers. I instructed all members of the lab to deal only with proper authorities and not to talk to anyone from the press. It is clear that now after almost 2 years there have been very few people that are aware that Susan received this contamination. Obviously, she did not attempt to make it a visible event. 2) [redacted] is happily married and I presume hopes to have children one day. She is highly intelligent and informed about the potential consequences of radioactive damage. Her husband is a friend of everyone in my laboratory and there was celebration at their wedding. I can not imagine that anyone in the group or [redacted] herself would endanger their hopes for a happy and healthy future. I am not in a position to evaluate deep-seated psychological motives, but self infliction is not consistent with what I know about [redacted]

For example, [redacted] is very health conscious. She is constantly dieting, excorcising and making herself attractive. Therefore, self-infliction seems untenable to me as an adequate hypothesis to explain this episode.

3. <u>An ususual and bizzare accident:</u> For loss of any other rational explanation, I am left with this conclusion. We are very careful with radioactivity in my laboratory. We do occasionally handle amounts of ^{32}P that are considered large (20 to 30 millicuries). To the best of my knowledge, there has never been a serious accident or potential contamination except for one minor case in the early 1980s when some radioactive (1 or 2 microcuries) tubing was thrown into the wastebasket by a starting medical student. That was quickly discovered and remedied.

Two postdoctoral fellows in the laboratory ([redacted] and [redacted]) have been pregnant during the time of [redacted] contamination and the whole group is extremely conscious about the location and monitoring of all radioactive (and chemical) materials. There are 4 medical doctors working as postdoctoral fellows and 3 MD/PhD students in the laboratory. They contribute to the health-conscious atmosphere and the radioactive state of the lab is discussed every Thursday morning in my regular laboratory meetings. A rotating "radiation monitor" also called the "radiation bitch" has the responsibility to ride the other workers and to inform me of any hot-spots or irregularities in the handling of radiation. I would state that we have significantly stepped up our vigilence in these respects with intense rules and even aggressive commands to keep all foods or drinks away from the laboratories. We have reviewed the rules of radiation safety and again emphasized the use of latex gloves (sometimes double), lab coats and radiation shields. A designated "hot sink" is monitored frequently, as are the benches and equipment. All of these procedures were in effect before the contamination of [redacted], but they have been re-emphasized. Thus, we can not determine that any breakdown in our procedures provide an explanation for the accident.

Any single scenario that I might propose to have occurred would be based upon speculation, because I know of no evidence for a specific

trail of contamination. I should point out that [redacted] maintains that he did not spill any radiolabel and fully accounted for all of the material that he handled that week. I must agree that my inventory seemed to account for the ^{32}P on hand at that time within the potential range of error mentioned above.

[redacted] and others often shared rice cakes and other similar foods and a small spot of ^{32}P was found by your office on the outside of a package in her desk. This is suspected as a possible source of ingestion because it was the only contaminated spot found anywhere in the laboratories or offices by us or by the Radiation Safety Office during their inspection. [redacted] is certain that he did not eat rice cakes that weekend, but this remains our only clue to a potential source of consumable radiolabel. It is possible that [redacted] came along either Saturday night or Sunday morning and ate a rice cake that had been contaminated. We do not know how the contamination occurred, if indeed, this was the source.

There are many unexplained aspects to these events that leave gaps in our understanding.

1. How could as much as 3 millicuries of radiolabel get transfered into her body? That constitutes about 10% of the total in the lab at that time. If it was derived from the radiolabel that [redacted] was handling, it would have been about 5 microliters. The transfer or loss of that quantity would be noticed. Furthermore, a trail of additional contamination would be likely. Except for the small amount found on the rice cake package (20K cpm I was told) there was no other contamination detected.

2. It seems very unlikely that a precise microdrop containing 2 or 3 millicuries could flick off and land directly and cleanly on [redacted] lip or food. Especially at the distances required for such a freak event. Here, also, one would expect to find a trail of contamination around on various surfaces.

It seems likely that memories of the precise events and movements during those two days (Saturday and Sunday) may have been clouded by the time they were reconstruction on Wednesday or Thursday. However, lab workers are trained to remember and reconstruct their

every step during experiments. Perhaps the contamination occurred during a moment of relaxation from the intensity of the experiments and the person forgot some movements or events involving the food or drinks. There may always remain unanswered questions concerning this event.

I must conclude, therefore, that a freak and incredible accident occurred on that weekend that still defies a complete explanation. We have stepped up our efforts to prevent a similar event like this from happening again; but in the end, I fear that it is almost impossible to fully defend oneself against such things. If it was intentional on the part of anyone, we can not control the inner workings of that individual. If it was accidental, it was so bizzare and unpredictable that it is not likely to happen again. We are highly vigilent in our monitoring of radiation and follow the rules as closely as possible. Beyond these measures, I know of no complete assurance that this problem can be resolved any further. We remain open to any suggestions, probings or preventative measures that you or your office may provide.

Thanks for all of your concern and your time in helping us and in particular [redacted]. As you know this has had a significant emotional impact upon her and these events will weigh heavy on her mind for many years to come. We can only hope that the published studies are correct which conclude that she is not likely to suffer any ill effects from this contamination in the future.

Please let me know if I can be of further help.

Sincerely,

[redacted]

[redacted]
Professor