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Type B Investigation Report of Curium-244 Exposure at the CRNL TRU Facility, January 15, 1986

ORNL/M--132

G. L. Love
H. M. Butler
D. T. Duncan
T. W. Oakes

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1. SCOPE OF INVESTIGATION

This Type B Investigative Report provides an evaluation of relevant events and activities that led to, were a part of, or resulted from the release of curium-244 in the Building 7920 facility at ORNL in January 1986 (see Appendix A). Impacts have been evaluated with respect to employee exposures and the costs and loss of productivity resulting from increased bioassay analyses and activities of investigative committees. Management systems evaluated include (1) training of employees performing lab analyses, (2) adherence to procedures, and (3) response to unusual circumstances.

2. SUMMARY

On December 10, 1985, the Chemical Technology (Chem Tech) Division, which operates the Transuranic (TRU) Facility (7920) located at the Oak Ridge National Laboratory (ORNL), placed a sample of curium-244 oxide in hot-cell cubicle 8, which is controlled by the Analytical Chemistry (AC) Division. A request for analyses was submitted by Chem Tech on that date, and the sample was removed by AC personnel to laboratories 108 and 208 for subsequent weighing, dissolution, and analyses. All analyses, except for a gamma scan, were completed by December 17, 1985. Between December 17, 1985, and January 15, 1986, the sample bottle, containing 170.3 mg of curium-244 dissolved in a 25-mL solution of nitric acid, was moved to the storage box in Room 208. The gamma scan was not performed during this time because of equipment failure with the gamma spectrometer. On January 15, 1986, the AC supervisor instructed Analyst Shift Leader I (ASL I) to perform the gamma scan analysis on the curium sample. Although the bottle was labeled and its contents were described, ASL I moved it to an open-port box, in violation of laboratory procedures, to perform further dilutions and analysis. During this operation, curium-244 contamination was carried from the open-port box on the gloves of ASL I, resulting in high levels of surface contamination on the floor, benches, and equipment on the west side of the laboratory. The hands and shoes of ASL I also became contaminated, and, since he did not adequately check himself upon leaving the lab, contamination was spread to the counting room, office, hallway, elevator, and eventually to his car and home.

Analysts on the 1600 to 2400 shift discovered the contamination, decontaminated part of the lab, notified the supervisor and the Chem Tech shift coordinator who summoned health physics (HP) assistance, and continued decontamination for the remainder of the shift.

Following discussions with ASL I on the morning of January 16, 1986, it was clear to the AC supervisor that the most probable cause for the existence of contamination in Room 208 was the work performed by ASL I, which involved the handling of sample CMP-597 on January 15, 1986. It was at this point that attention was diverted from decontamination of the lab toward evaluation of possible exposure to personnel working in Lab 208. Personnel were sent to the whole-body counter (WBC) for evaluation, and initial results indicated that ASL I had been contaminated with approximately 180 nCi of curium-244, most of which was suspected to be external. He was returned to the TRU facility for further decontamination.

The HP survey of the car and home of ASL I did reveal minimal contamination (<3000 dpm) on the steering wheel of the car and on an arm cover of one chair in his home. Subsequent whole-body counts on ASL I and decontamination continued until late on January 16, 1986, when the estimate was given that approximately 1.5 lung burdens would be present if all the activity detected by the WBC were deposited in the lung and remained there. Based on this assumption, chelation therapy with Ca-DTPA

was recommended, and ASL I elected to take the therapy. Subsequent bioassay and WBC data developed over the follow-up period do not support the original estimate of internal exposure of 1.5 lung burdens. Current data indicate that a maximum 50-year dose commitment to bone from this exposure is approximately 42 mrem, which is well below all occupational exposure guidelines and standards. The potential for much more serious exposure did exist due to the quantity of radioactivity and the practices used in this incident.

Analysis of the data pertaining to the curium-244 incident reveals the following conditions as probable causal factors:

1. No readily available means to weigh samples prior to removal from hot-cell 8 (cubicle 8).
2. Failure to adhere to HP guidelines for the amount of material to be handled in glove boxes.
3. Equipment problems with the gamma spectrometer, which delayed gamma-scan analysis for approximately 1 month.
4. Failure to adhere to laboratory safety procedures pertaining to the activity of materials to be handled in an open-port box.
5. Placement of a continuous alpha air monitor (CAAM) that would not detect a release of airborne material in the vicinity of the open-port box.
6. Pressure buildup in the sample bottle from curium decay during the month that the sample was stored.
7. Use of improper gloves in the open-port box, and not wearing two pair of gloves during work in that box.
8. Failure to adequately monitor hands and feet prior to leaving contamination zones.
9. Inadequate communication with AC, especially between shifts. Improved communications would likely have resulted in a more timely determination of cause, personal decontamination, exposure evaluation, and treatment.
10. Inability of WBC equipment to differentiate between internal and external contamination. An early assessment of actual internal contamination is important for classification of the incident as well as for treatment of the individual.

3. FACTS

3.1 BACKGROUND INFORMATION

The Chemical Technology (Chem Tech) Division operates the Transuranic Facility (TRU 7920) for the purpose of separating transuranic elements from targets that have been irradiated at the High Flux Isotope Reactor (HFIR). The Analytical Chemistry (AC) Division provides analytical services within Building 7920. AC occupies several laboratories at 7920, including Lab 208 where the incident under investigation occurred. The AC staff in Building 7920 is comprised of eight analysts and two professional staff members that provided services 24 h/d on a rotating shift basis.

The analysts providing these services are a mix of experienced and new employees. Five of the eight who work rotating shifts are relatively new and have been qualified for work through on-the-job as well as structured training at the High-Level Radiation Analytical Lab (Bldg. 2026). All employees are required to be proficient in their work as well as knowledgeable concerning hazards encountered in their day-to-day assignments. Training records indicate that all new AC personnel in Building 7920 were initially trained; however, there was no AC requirement for periodic refresher training for employees at this facility.

3.2 EVENTS PRECEDING INCIDENT

On December 10, 1985, a sample of curium-244 oxide was transferred from the Chem Tech operating cell to the AC hot-cell cubicle 8 (Appendix B). On December 11, the sample (CMP-597) was removed from cubicle 8 to the AC laboratory in Room 108. The sample was weighed the same day in the glove box in Room 108 and determined to be 170.3 mg. The sample was dissolved in nitric acid on December 11 and made up to a volume of 25 mL in the dissolution box (closed glove box) in Room 208 (see lab layout, Appendix C). All of the analyses to be performed on the sample were completed by December 17, 1985, with the exception of a gamma scan. The gamma scan was postponed because of the inoperability of the gamma spectrometer routinely used for such analysis. Sometime between December 11, 1985, and January 15, 1986, the curium nitrate (CMP-597) solution was moved from the dissolution box in Room 208 and placed in the storage box in the same room (also a closed glove box). This box is normally used for storing wastes and old samples awaiting disposal. Samples being processed through this lab are normally left in the dissolution box until analyses is complete.

3.3 DESCRIPTION OF INCIDENT

Sometime during the day on January 15, the AC supervisor instructed ASL I to complete analyses on sample CMP-597. A gamma scan had been requested on the original analytical service request sheet; however, the

gamma spectrometer had not been operational since mid-December. At approximately 1530, ASL I transferred the sample (CMP-597) from the storage box to the open-port box through the enclosed tunnel connecting the two boxes to make dilutions. ASL I determined the amount of curium-244 in the bottle by inspecting the label and sample work sheet. The activity in the bottle exceeded procedural guidelines for the level of activity to be handled in an open-port glove box. ASL I put on two surgical gloves and two plastic gloves before removing the top from the bottle. Plastic gloves were worn instead of red rubber gloves as specified by the AC operating procedure. After removing the top, ASL I then removed his arms from the glove ports and discarded both of the plastic gloves in a waste container near his feet. He then put another plastic glove on his right hand; his left hand was covered only with a surgical glove. With his left hand he inserted a small bottle containing 9 mL of 1.0 N nitric acid. Using a pipet in his right hand, he transferred 1 mL (approximately 7-mg curium from sample CMP-597 into the 9 mL of nitric acid. ASL I then took the solution in the second sample bottle and counted it with a counter next to the open-port box. Upon noting that the activity in the bottle was too high for the counter, he put the bottle into the open-port box and made another dilution. The bottle with the most dilute sample of curium nitrate was then put on the lab bench beside the open-port box. ASL I then removed the plastic glove and both surgical gloves and discarded them in the waste container outside of the box. The bottle containing the second dilution was put into a plastic bag and sealed. ASL I then left Room 208 and has stated that he does not remember checking his hands and feet before leaving. He then carried the sample to the counting room across the hall, where it was left overnight. The original sample bottle (CMP-597) was then returned through the tunnel to the storage box. The other analyst on shift, Analyst I, was involved in activities outside of Room 208 during this period.

The work that ASL I had planned to do involving analysis of the curium-244 sample neared completion at shift change (approximately 1600), and he left his work area to prepare to go home. He stated that he checked his feet for contamination at the C-zone portal (which is equipped with radiation detection instruments) as he exited Lab 208. Following departure, he went to the TRU facility change room where he washed his hands, changed clothes (removing the coveralls and shoes he had worn and putting on shoes, trousers, shirt, and sweater), and moved to the lunchroom area, which required him to again pass through another contamination checking station. ASL I made no mention of contamination being found. Analyst I followed the same routine. Shift leaders (ASL I and ASL II) exchanged information about activities on the previous shift, as was customary, and ASL I left for home.

Analyst II and ASL II reported to work at approximately 1600 on January 15, 1986, relieving ASL I and Analyst I as chemical analysts at the facility. Analyst II went to Lab 208 to change paper on the autotitrator while ASL II worked in an adjoining lab. During the shift

change briefing between shift leaders, there was no mention of abnormal conditions, and ASL II was told about the sample left in the counting room. Early in the shift, while working in Room 208, Analyst II found that his hands were contaminated to >1000 cpm (full range on the survey meter). He summoned ASL II to advise him of his findings and to assist in a further check for the presence of contamination in Lab 208. Abnormally high ($>10,000$ alpha dpm) levels of contamination were found on the floor surface directly beneath the plating box (open-port box), as well as on plating box surfaces. ASL II and Analyst II both began to decontaminate Room 208, but soon arrived at the conclusion that the contamination was more widespread and involved higher levels than first thought.

At this point, approximately 2 h into the shift, the Chem Tech shift coordinator was contacted, and HP assistance was requested. The shift HP Technician I responded. When he arrived at the lab, both ASL II and Analyst II were attempting to self-decontaminate until the contamination discovered on their hands was within release limits (<150 alpha dpm/ 100 cm^2). Both were finally successful in this effort. HP technician I swabbed the nasal passages of both individuals to check for the possibility of exposure to airborne contamination. An analysis of the nasal smears indicated no contamination above background levels. HP technician I then made a general survey of the surfaces in the lab by probing them with a portable alpha survey instrument and by taking smears. The results of that survey are shown in Appendix D. Transferrable contamination up to $12,090$ alpha cpm/ 100 cm^2 was found, and probe readings as high as 2.5×10^5 dpm/ 100 cm^2 were detected, confirming earlier findings by ASL II and Analyst II that the more highly contaminated surfaces were on and below the plating box (open-port glove box). Upper surface contamination levels in the laboratory were consistently higher than background, with all smears taken counting between 40 and 660 dpm/ 100 cm^2 . HP technician also noted that the air monitor in the room (note Appendix C), which operates continuously and gives real-time readings, indicated no increase in activity over the previous 8 h. HP technician I also made smears of surfaces in areas surrounding Lab 208 and found evidence of low levels of transferrable contamination in random locations. The activity on these smears ranged from <20 alpha dpm/ 100 cm^2 to as high as 864 alpha dpm/ 100 cm^2 . The most active smears were found in the office adjacent to Lab 208. Spots of transferrable contamination were also found in the elevator, upstairs hallway, and counting room. HP technician I, assisted by ASL II and Analyst II, checked downstairs areas (hallways, change room, building egress areas, etc.) and found no evidence of widespread contamination other than random spots that registered a few dpm above background.

Because of the presence of transferrable contamination, which was uniformly spread in Lab 208, the HP Technician I recommended the use of respiratory protection in this lab until the condition was corrected or until it was determined that airborne contamination was not present. ASL II and others engaged in decontaminating the lab on later shifts used

respiratory protection. Analyst II worked outside Lab 208 during the remaining part of his shift to decontaminate affected spots found in those areas. He did not participate in decontamination efforts inside Lab 208 because of his beard, which would have prevented effective use of a respirator. Meanwhile, ASL II used his respirator, even though he wore a goatee.

A bag of waste that had been placed in the waste container near the storage box was found to have surface alpha contamination levels that counted 31,000 dpm. This bag was suspected of being improperly removed from the plating box (taken out through open glove ports rather than bagged out) and was considered by ASL II and Analyst II to be the possible cause of the contamination release in Lab 208.

Notification of others began when it became obvious that an unusual condition existed. The AC supervisor was informed of the findings between 1900 and 2000. The Chem Tech staff at TRU, which had been informed of conditions in the lab by AC personnel, informed the Laboratory Shift Supervisor. They also informed the TRU Facility Section Head. The Laboratory Shift Supervisor informed the Director of the Environmental and Occupational Safety Division (E&OSD), who informed the Head of E&OSD's Radiation and Safety Surveys Department. This progression of notification occurred between the hours of 1900 and 2200. The Head of the Radiation and Safety Surveys Department contacted HP Technician I at approximately 2215 to get an update on the occurrence and to discuss the significance of the findings. The TRU Facility Section Head returned to ORNL at approximately 2200 to get an update on the condition in Lab 208. Notifications are documented in logs in Appendixes E and F.

Decontamination of affected areas continued on the 0000 to 0800 shift. The HP Technician II continued to search for contamination outside Lab 208. Company shoes belonging to ASL I and Analyst I, which had been left in the change room, were found to be contaminated. Coveralls worn by Analyst I were also contaminated. The shoes and coveralls were bagged, tagged with a radiation hazard tag, and taken to the facility HP Office. The company shoes worn by ASL I had contamination levels that probed approximately 800 dpm. Shoes worn by Analyst I were less contaminated. The results of contamination surveys are found in Appendix G.

ASL I returned to work at approximately 0745 on January 16, 1986, to serve as AC shift leader on the 0800 to 1600 shift. The conversation between ASL I and the AC Supervisor early in the shift (around 0800) focused on work that ASL I had done on his previous shift. He detailed what he had done and how it was done. It was then that the AC Supervisor began to suspect that the spread of contamination was because of work the ASL I had done with sample CMP-597 on his previous shift, rather than the improper removal of waste from the plating box. This finding was later confirmed when the Waste Isolation Pilot Plant (WIPP) log revealed that the only waste placed in the container was from another operation outside Room 208 (Appendix H).

Surveys to further characterize the extent of the spread of contamination in the TRU Facility continued on the 0800 to 1600 shift on January 16, 1986. Lockers of those involved in the incident were checked. Clothing worn by ASL I was checked, and positive readings (approximately 3000 alpha dpm) were found on a personal shirt and sweater. These items were confiscated for disposal or cleaning. It was common practice for C-zone coveralls to be worn more than 1 d because of the difficulty in getting a supply of clean coveralls of the proper size; however, coveralls worn by ASL I were not available for survey on January 16, 1986.

The Facility health physicist arranged for ASL I and Analyst I to be counted at the WBC. Analyst I was counted late in the morning of January 16, 1986, whereas ASL I was first counted early in the afternoon. Whole-body counts were also scheduled for ASL II and Analyst II on January 18 after they had returned from 2 d off. All counts were negative for levels above background except for ASL I, whose count indicated the presence of curium-244, either deposited internally or externally as surface contamination. Table 1 reflects the result of this and later counts. Tables 2 through 5 reflect the results of urine, fecal, skull, and liver counts, respectively. The HP Technician I, who initially responded to the incident, was not scheduled for a whole-body count.

Not being able to quantify with any certainty the amount of material deposited internally, the Radiation Dosimetry Group Leader directed ASL I to return to the TRU Facility for decontamination. He was found to have fixed deposits of contamination on his hands, in his beard, and on his forehead. The ASL I was further decontaminated, and his beard was shaved. Following decontamination, when it was thought most of the external contamination was removed, he returned to the WBC for further evaluation. A second count revealed a reduction in the relative count rate of a factor of approximately 7 over the prior analysis. The quantification of this second count was estimated to be approximately 1.5 lung burdens of curium-244 activity (approximately 25 nCi), if it was deposited in the lung. Qualitative analysis of the data indicates that most of the curium-244 activity was probably deposited on the surface.

The ASL I went home following the second count, at approximately 1730, accompanied by the Radiation and Safety Survey Department Head, so that a survey of his car and home could be made. The car was found to have detectable levels of alpha contamination on the steering wheel. A count of approximately 3000 alpha dpm was found prior to decontamination efforts. Following decontamination, the levels were found to be reduced to <300 alpha dpm (fixed) and <20 alpha dpm (transferrable). Contamination on other surfaces of the car was not detected. Surfaces in the living areas of the home were also probed and smeared. Detectable levels (approximately 200 alpha dpm) of alpha contamination were found in the cloth arm covers of the lounge chair ASL I called his favorite. The covers were brought back to ORNL for cleaning and were returned to

Table 1. Lung count^a results--Analyst Shift Leader I

Date	Time	Hours after exposure	Bkg (cpm)	Net (cpm)	Curium-244 activity (nCi) ^b	Note
1/16/86	1430	22	2.92	11.05	179.8	Indication of surface contamination
1/16/86	1705	25	2.80	1.56	25.4	Removal of beard
1/16/86	2204	30	2.84	1.61	26.2	Medical decontamination
1/16/86	2343	32	2.87	1.48	24.1	
1/17/86	0944	42	2.90	0.93	15.1	After 1st DTPA
1/18/86	0900	66	2.88	1.09	17.7	
1/19/86	1121	93	2.77	0.14	2.28 ^c	
1/20/86	1045	117	2.80			After 2nd DTPA
1/23/86	1700	196	2.84	0.32	5.21	After day off
1/24/86	1658	220	2.82	0.62	10.1	
1/25/86	1652	244	2.89	0.79	12.9	
1/26/86	1631	268	2.89	0.16	2.6	
1/27/86	1715	292	2.64	0.66	10.7	
1/28/86	1729	316	2.38	0.42	6.84	
1/29/86	1647	340	2.3	0.5	8.4	

^aPermissible lung burden is 14 nCi, as set forth in the Report of ICRP Committee II, "Permissible Dose for Internal Radiation."

^bMinimum detectable true activity (MDTA) for the subject is 4.58 nCi in the thorax, based on counting statistics only. Actual MDTA is probably a factor of 2 higher, based on counting statistics, source distribution, and chest-wall thickness.

^cDecrease likely due to detector position problem.

Table 2. Results of bioassay---Analyst Shift Leader I

Date	Time	Urine volume (mL)	dpm/24 h	dpm/mL
1/17/86	0030	110	0.65/sample	5.91×10^{-3}
1/17/86	1300--1600	1200	0.77 ± 0.21	4.25×10^{-4}
1/17/86	1700--1530	899	2.0 ± 0.5	2.2×10^{-3}
1/18--1/19	1800--1530	620	1.6 ± 0.4	2.5×10^{-3}
1/19--1/20	1730--1545	1250	0.47 ± 0.13	3.8×10^{-4}
1/20--1/21	1800--0800	1260	0.59 ± 0.16	4.68×10^{-4}
1/21	0800--1500	620	0.45 ± 0.12	7.26×10^{-4}
1/21--1/22	1830--2230	1320	0.85 ± 0.25	6.44×10^{-4}
1/22--1/23	2300--1400	1180	0.61 ± 0.17	5.17×10^{-4}
1/23--1/24	1600--1500	1120	0.52 ± 0.14	4.64×10^{-4}
1/24--1/25	1600--1530	720	0.37 ± 0.10	5.14×10^{-4}
1/25--1/26	1530--1940	1260	0.27 ± 0.08	2.11×10^{-4}
1/26--1/27	1730--1700	1380	0.27 ± 0.08	1.92×10^{-4}
1/22	1100--2400	1360	0.30 ± 0.08	

Table 3. Results of bioassay---Analyst Shift Leader I

Date	Time	Fecal		Curium-244 (dpm/g)
		Mass (g)	dpm/24 h	
1/17/86		113.8	262 ± 67	2.3
1/19/86	0600	197. ^a	22 ± 6	0.11
1/20/86	0600	210.5	16 ± 4	7.6×10^{-2}
1/21/86		141.6	8.9 ± 2.4	6.29×10^{-2}
1/24/86		76	6.4 ± 1.7	8.42×10^{-2}
1/25/86		66.5	2.1 ± 0.6	3.16×10^{-2}
1/26/85		179.2	9.7 ± 2.5	5.41×10^{-2}
1/27/86		112.7	1.3 ± 0.4	1.15×10^{-2}
1/28/86		147	2.3 ± 0.7	

Table 4. Results of skull counts---Analyst Shift Leader I

Date	Time	Background (cpm)	Net ^a (cpm)
1/25/86	1731	0.93	-0.16
1/26/86	1655	1.00	0.11
1/27/86	1800	0.91	-0.19
1/28/86	1817	0.71	-0.13
1/29/86	1729	0.65	0.27

^aMDTA = 0.31 cpm.

Table 5. Results of liver counts---Analyst Shift Leader I

Date	Time	Background (cpm)	Net ^a (cpm)
1/18/86	1001	2.28	-0.19
1/25/86	1712	1.26	-0.06
1/26/86	1715	1.29	0.02
1/27/86	1740	1.19	0.22
1/28/86	1754	1.15	0.41
1/29/86	1709	1.17	0.12

^aMDTA = 0.31 cpm.

him on January 17, 1986. No transferrable contamination was detected on other surfaces in his home. The results of this survey are shown in Appendix J.

ASL I was asked to return to ORNL late on the evening of January 16, 1986, for further decontamination at the Medical Facility and for further evaluation at the WBC. Further decontamination resulted in the removal of two deposits above the shoulders, one on the neck and another on the forehead. His hands were further decontaminated until levels below 50 alpha dpm were present.

At approximately 2100, a series of whole-body counts was performed, with and without shielding of the facial area, in an attempt to differentiate between surface contamination and internal deposition. These counts were consistent with the second count and indicated that curium-244 was still present and that the quantity, if deposited in the lung and if it remained there, would equate to approximately the 1.5 lung burden level (25 nCi). If the activity detected was deposited only on the surface, as suspected by WEC staff, it would equal approximately 3 nCi.

A check of the occupational exposure history for ASL I revealed no exposures exceeding radiation protection standards, with the last routine WBC performed on October 9, 1984, and the last urinalysis in November 1985.

On January 17, 1986, ASL I was placed on restriction from work in C-zone areas to prevent the possibility of additional contamination and exposure.

At approximately 2300 on January 16, 1986, an estimate, based on a conservative interpretation of the findings at the WBC, was given to the Medical Director that no more than 1.5 lung burdens of curium-244 was possible for ASL I. This estimate was made on the basic assumption that all activity detected by the WBC was originating from the lung. The WBC personnel were still strongly suspicious as to the probable presence of surface contamination that would significantly bias the WBC findings to the high side. Other bioassay data from urine and feces analysis would not be available until the next day. The Medical Director consulted with the ORNL Director of Environmental and Occupational Safety Division (E&OSD), the ORNL Executive Director, the Energy Systems Environment, Safety, and Health Office, a medical expert from ORAU on the use of DTPA, and ASL I. The decision was made to recommend treatment with DTPA. The Medical Director informed ASL I of the situation at hand, of the preliminary indication of internal contamination, and of his recommendation for treatment with DTPA. ASL I was given information on DTPA (Appendix K) and indicated that he understood his condition, the potential health effects of the exposure, and the proposed treatment. He elected to receive the drug based on his knowledge and on the information given to him by the Medical Director. He signed a consent form prior to receiving the treatment (Appendix L). Prior to treatment, blood and urine samples were taken to aid in the future determination of any side effects he might incur from the treatment. The next morning he

was instructed to collect a urine and fecal sample each day for analysis by the HP bioassay laboratory.

ASL I continued to be followed with daily WBC, 24-h urinalyses, and daily fecal analyses until February 3, 1986, when the frequency was reduced to twice a week based on levels seen in the results. On January 18 a second dose of DTPA was recommended by the Medical Director, based on WBC and urinalyses indicating elevated levels of curium-244 in or on the body. ASL I accepted the second treatment and did not report any concern or discomfort.

4. ANALYSIS

4.1 EVENTS LEADING TO INCIDENT

Chem Tech is responsible for providing the sample to be analyzed and the request for analyses. The sample is provided in cubicle 8 (hot cell 8). At that point the sample becomes the responsibility of AC, which is responsible for transferring the curium oxide sample to Lab 108 for weighing and then to Lab 208 for dissolution and subsequent analyses. Guidelines are established for the mass of material that can be safely used in glove boxes (HP Procedure A-7); however, no specific guidelines are established for the removal of material from a hot cell. No provisions were made at cubicle 8 to weigh the sample prior to removal to determine if the sample met limits for safe handling of material in glove boxes.

The total amount of sample removed from the hot cell and taken to the weighing box was not documented. However, we know that 170.3 mg of material was taken from the weighing box in Room 108 and dissolved in 25 mL of nitric acid in Room 208. How or why the sample was taken from the dissolution box in Room 208 and placed in the storage box or who was responsible for that action, is unknown. All of the analyses were completed by December 17, with the exception of the gamma scan. According to the AC Supervisor, the gamma scan had not been completed because the equipment malfunctions were not repaired until sometime in January. There were no established guidelines or limits as to how long a sample would remain in the AC labs prior to being returned to Chem Tech operations.

4.2 THE INCIDENT

Based on his past experience, the ASL I, upon seeing the bottle in the storage box, recognized that the activity in the bottle was too high for safe handling outside the dissolution box. However, for his convenience, he moved the sample bottle from the storage box into the open-port box for further dilutions prior to the gamma scan. Apparently, when he opened the bottle in the open-port box, a significant amount of curium activity was released. The fact that the bottle had been in the laboratory for approximately 1 month may have resulted in a buildup of pressure through radioactive decay, and may have contributed to the material dispersion when the bottle was opened. This material then may have attached to or been adsorbed on the gloves and sleeves of the ASL I. When he removed his gloves from the open-port box, some of the curium nitrate material probably fell to the floor and contaminated the area around the open-port box. The open-port box is maintained under a slight negative pressure and, therefore, it is unlikely that curium nitrate escaped from the box as an airborne release. The material on the floor, on the ports, and on the lab bench subsequently contaminated the hands and feet of ASL I, which resulted in the spread of contamination throughout the counting room, the office, the hallway, and the elevator.

In the process of the investigation, both from interviews and firsthand observations, indications of poor adherence to procedures and questionable C-zone work habits were noted with regard to several AC employees. Examples would include work with solutions that exceed established limits for activity in open port boxes, the suspected consumption of food and use of tobacco products in C-zones, failure to check for contamination prior to leaving C-zones, and the presence of facial hair on several individuals.

4.3 IMPACTS OF INCIDENT

4.3.1 Impact on Employees

One employee received an estimated 50-year committed-dose equivalent of no more than 42 mrem to the bone. This dose estimate was based on results from urinalyses and assumes that all of the curium-244 activity excreted came from bone, the worst possible case. This exposure is well below the radiation protection standards established for occupational exposure. However, it should be noted that the potential for a much more serious exposure existed because of the quantities of radioactive material involved.

Although it is possible for other employees in the area to have inhaled or ingested small quantities of the material, these quantities were sufficiently low so that they were not detected above background by in vivo and bioassay techniques.

4.3.2 Other Impacts from Incident

The impact on employee health appears minimal, but other impacts resulting from the incident are of sufficient magnitude to justify mention. Laboratory costs in HP analytical time and WBC for evaluation and follow-up as a result of this incident have been considerably high. The man-hour cost of investigations and analytical costs for exposure evaluations are estimated to exceed \$50,000.

Another impact would be the delay of the routine WBC schedule and HP urinalyses programs while evaluating the ASL I on a priority basis.

A potential adverse impact should also be noted regarding public perception of ORNL operations, because contamination was detected on personal property off-site.

4.4 PREVENTION PLANNING/IMPLEMENTATION

4.4.1 Procedures and Administrative Controls

Several procedures that were in place to enhance the safety of operations at the TRU Facility were violated. The ASL I clearly violated regulation 1 of H.P. Procedure 3.5 by exiting Lab 208 without monitoring himself for contamination. Lab 208 is a permanently established contamination zone, requiring that a check be made prior to egress. Facility procedures addressing proper egress from contamination zones

were also violated. The AC procedure, (Appendix M) outlines such a requirement in Sects. 2.3 and 4.1. Section 4.1 states that "Personnel must monitor themselves before leaving the Lab. Before leaving the building through the change room, all persons should be thoroughly monitored. Frequent monitoring of hands and arms (gloves and sleeves) while working in the glove box areas would help detect sources of contamination and check its spread."

Procedures addressing the quantities and concentrations of material that may be handled in the open glove box in Lab 208 were also violated. Section 5.3(h) of the Operating Procedures and Safety Rules for the TRU Analytical Lab, Building 7920 (Appendix M) states that "High levels of alpha activity must be handled in the glove box in Rooms 108 or 208. Samples or dilutions that need to go into the open port box in Room 208 for alpha plating must be less than 10^8 alpha cpm/mL." The sample the ASL I was handling on January 15, 1986, had concentrations of alpha activity approximately 4 orders of magnitude above this limit. Appendix A of the HP Manual states as a guideline rather than a procedure that quantities exceeding 100 mg of a radioisotope such as curium-244 cannot be safely handled in a facility having no better containment capabilities than a glove box. An open box, which allows insertion and retraction of the hands, offers even less protection. Better labeling of samples would improve the awareness of the analyst about solutions that have a concentration exceeding this limit.

Health Physics guides for monitoring of individuals at TRU were not properly implemented, as evidenced by the date of the last WBC on the ASL I. Several factors could have contributed to this noncompliance. These include such examples as difficulties encountered in routinely scheduling shift workers to be counted in a counter operated on day shift and the overall operational availability of the WBC.

4.4.2 Employee Training

There appears to be an absence of periodic formalized and structured HP training within the AC group at the TRU Facility. Although many of the AC personnel are relatively new to this area, they are formally educated and have had good general training in past work assignments. Most training specifically related to TRU operations is obtained on the job. Formalized training for this group is difficult because scheduling conflicts with rotating shifts. There was no formal retraining or recertification program for employees, and it is not clear how procedural or other changes in their work are transmitted and carried out.

4.4.3 Physical/Equipment Controls

The physical facilities in the form of containment equipment, glove boxes, and ventilation systems appeared adequate for work with the radionuclides customarily used there, as long as the established safety and analytical procedures were adequately followed. Most primary and

backup ventilation systems for hoods and glove boxes were checked in accordance with lab procedures. The one exception with regard to these checks was the open-port box or plating box involved in the incident. When checked after the incident there was adequate flow, but there was no inspection sticker on this box from lab technical inspection to indicate the date and flow found on the last inspection. Such a sticker, however, may have been removed during decontamination efforts.

The passive role of the air monitor in Lab 208 appears to have played some role in the events following discovery of the contamination. Most of the analysts interviewed expressed a lack of confidence in the ability of the air monitor to detect the presence of airborne contamination (see Appendix C); something should be done to restore confidence in its function. The air monitor was found to be operating properly by the facility health physicist and it is likely that there was little airborne contamination present during the occurrence. If there was any airborne contamination, it dissipated quickly because others entering the Lab shortly after the occurrence were found to be contamination-free except for hands and shoe covers.

The need for additional air monitors properly located to more readily detect contamination that might escape from the open-port box was discussed by several persons interviewed, and evaluations are now under way to determine how best to meet the perceived need for additional monitors.

The breakdown of the gamma spectrometer also indirectly contributed to the incident, because the sample was held over in the lab while awaiting the repair of this instrument so that the gamma scan analysis requested originally could be completed.

Contamination monitoring equipment located in the exit of Lab 208, as well as equipment at the building egress checking station, were present and functioning properly. They simply were not used adequately.

Contamination-zone apparel and supplies may be a problem, as exhibited by the (1) use of plastic gloves vs red rubber gloves, and (2) by the fact that some analysts were wearing coveralls for more than 1 d because of the difficulty encountered in having clean coveralls of the desired size available for a daily change.

Primary means of communication between shifts was via verbal exchange between shift leaders. AC shift logs were very sparse with regard to information and were essentially useless in tracing the events of incident.

4.5 INCIDENT RESPONSE PLAN/IMPLEMENTATION

4.5.1 Analytical Chemistry Response to Incident

The ASL I obviously did not check himself adequately for the presence of contamination as he left his work area (Lab 208) nor when he left Building 7920 on January 15, 1986. Egress from Lab 208 and Building 7920 would have required that he pass through two checking stations, both of which were found to be functional when checked later. He claimed

to have checked himself at both stations but admitted that he may have checked only his shoes. It is possible that a check of the shoes at the second checking station would have revealed nothing above background, but there should have been positive findings on the shoes he wore out of Lab 208. The amount of contamination that he carried away on his hands, face, beard and other areas is difficult to estimate. Surfaces that he was known to have contact with after he exited Lab 208 were not grossly contaminated, but obviously some contamination was present. The steering wheel of the car that he drove home on January 15, 1986, for example, probed approximately 3×10^3 alpha dpm when first checked. The handle of the alpha checking station instrument in Lab 208 was contaminated to several thousand dpm and thought to be, but not known to be, contaminated by him. Surfaces in the counting room adjacent to Lab 208 had spots counting >100 alpha dpm but <1000 alpha dpm. It is not likely that levels higher than those found on the plating box were carried away because he was wearing gloves. Of those levels (25,000-50,000 alpha dpm) 10 to 20% may have been present on his hands as he departed from Lab 208.

The presence of facial hair on the ASL I likely played a role in this incident, because curium-244 activity detected at the WBC was reduced by a factor of 7 after his beard was removed as part of the decontamination efforts. Most of the AC personnel interviewed for this investigation were wearing beards at the time of the incident. One analyst did not participate in the decontamination of Lab 208 because the presence of facial hair prohibited his wearing a respirator. Others shaved prior to performing work. At least one used respiratory protection with the presence of facial hair, which may not have permitted an effective seal against the face.

It is ORNL policy that respiratory protection will not be worn with facial hair that could interfere with the sealing surfaces of the respirator. However, there is no policy prohibiting facial hair for personnel working in C-zones or in areas where there are recognized increased risks and potential for internal contamination. Contamination of ASL I's beard may have contributed to ingestion of curium-244.

The merit of contacting ASL I or Analyst I at home the night of the incident was reviewed. The initial decision to not call was based on the assumption that all persons leaving the building would have checked themselves for contamination and taken corrective action immediately. This was not the case. Had contact been made with the ASL I that evening, chances are that he would have recalled his actions and permitted more immediate action to be taken with regard to exposure evaluation. The use of DTPA, if advised, is most effective if given within the first few hours after the suspected intake. In this case, the first individuals were sent to the WBC approximately 20 h after the possible exposure, and some were evaluated on the weekend, 3 d later. Inquiries as to policy and experience in similar incidents in the recent past (last several years) indicated that similar delays had occurred.

Confusion exists surrounding the disposition of coveralls worn by the ASL I on January 15, 1986. We think they were placed in a C-zone clothing hamper for transfer to the Laundry, but this was never confirmed. A determination of contamination levels on the coveralls would have been of some value.

4.5.2 Health Physics Response to Incident

Initial actions taken at the scene during the response to this incident were appropriate and were instrumental in preventing the further spread of contamination to other areas and limiting the exposure of others. Once it was determined that personnel internal exposure was a possibility, the necessary steps were taken to quantify any exposure to personnel, except for the health physicist responding to the incident initially. Some members of the Committee feel he should have been counted.

The capability to provide accurate and timely evaluation and assessment of internal exposure to the individual involved in this incident was seriously restricted by several factors within the HP organization (Health Physics and Radiation Safety Survey Department). These factors include the following:

1. Failure of 7920 Radiation and Safety Survey personnel to check for or discover external contamination on the employee involved prior to sending him to the WBC.
2. The fact that the ASL I had not had a WBC since 1984 severely affected the ability of the WBC staff to accurately quantify an intake. Health Physics Guide HP A-12 recommends that persons working in jobs such as his be scheduled for WBC quarterly and urinalysis monthly.
3. The sensitivity of the WBC itself was compromised by the failure of high-resolution detectors necessary to detect transuranics at low levels, as well as to distinguish between internal and external deposition. High-resolution equipment has not been fully operational for at least a year. Current limits of detection for curium-244 are approximately 0.5 lung burdens (5-7 nCi), approximately 50% of Maximum Permissible Organ Burden at the 95% confidence level for curium-244 deposition. Distinction between surface and internal deposition is severely compromised by the equipment currently used. New detectors are on order, and it is anticipated that they will be operational by late summer 1986. This new equipment, if used in conjunction with the old, is expected to improve the WBC sensitivity to a level that would allow more accurate assessment of internal exposures. Repair of the older system and use with the new detectors will also likely improve on-line time. Whole Body Counter data, as reported during this incident (Tables 1, 4, and 5), gave no expected

range of variance for the data. A more realistic format would include estimates of accuracy stated as +/- values for each data point. Procedures for reporting WBC results and actinide lung burden estimates are under development but have not yet been published.

4. Initial exposure estimates were based entirely on data from whole body counts. Data from bioassay samples, which could also be used in making estimates of exposure, became available 4 d later. These data indicated a considerably lower estimate of intake. In the review of bioassay data, quality control documentation for bioassay lab cross checks and curium standards for determining the efficiency of analytical procedures used for urine and fecal analyses are being developed, but have not been published.

4.5.3 Medical Response to Incident

Equipment on hand at Medical for handling such a decontamination task was excellent, as was the training of personnel to perform such tasks. Use of the microprobe was effective in pinpointing sites of external contamination (for further decontamination) in an attempt to reach a more accurate definition of the estimate of internal deposition in the patient.

Response planning for chelation therapy is based on the concept that chelation treatment is indicated as soon as it is known that an incident with potential for internal exposure from a radioisotope such as curium-244 has occurred, unless there are other medical concerns with the patient that would be contradicting. Medical's decision during this incident was based on information provided by those quantifying a possible internal exposure, from the WBC, knowledge of the incident and the extent of contamination, and through consultation with another expert physician on chelation therapy for radiation incidents.

Adequate information on facts regarding DTPA was available and was given to the patient. The patient stated that he was satisfied with the information provided to him, and that he had no apprehension about his decision to take the treatments (Appendix L).

Laboratory experts continue to debate the true extent of internal exposure in this case. Spectral analysis of WBC results did not indicate the presence of curium-244 in the body. Also, during this incident the overall count rate more rapidly approached that of background than would have been expected in a true internal deposition of curium-244 in the lung.

Skull and liver counts remained insignificant throughout the incident. Since curium-244 moves to liver and bone rather quickly, a true internal deposition should result in positive liver counts within a relatively short period. This is further confirmation that there was little or no inhalation of the compound.

Regardless of the outcome of this debate, the medical response to this incident was in accordance with accepted practices as outlined by medical experts and the National Council on Radiation Protection and Measurements Report 65, entitled Management of Persons Accidentally Contaminated with Radionuclides (1980).

5. CONCLUSIONS

5.1 FINDINGS

1. The sample (CMP-597) was removed from hot-cell cubicle 8 on December 10, 1985. This sample exceeded HP guidelines outlined in HP Procedure A.7 for maximum quantities to be openly handled in a glove box. The sample was eventually placed in a closed glove box (dissolution box in Room 208) on December 11, 1985.
2. All requested analyses for sample CMP-597 were completed on December 17, 1985, with the exception of a gamma scan, which was postponed due to inoperability of the gamma spectrometer.
3. At some time after December 17, 1985, the sample was transferred from the dissolution box to a storage box in Room 208. This was contrary to routine handling of such samples.
4. On January 15, 1986, the ASL I was instructed by the AC Supervisor I to complete a gamma scan on sample CMP-597. At this point, he located the sample in the storage box and moved it to the open-port box to prepare dilutions and to complete counting. According to Laboratory Operating Procedures, the sample concentration was too high to be handled in an open-port box.
5. While performing this task, the ASL I became contaminated but did not detect the presence of this contamination when exiting Lab 208 or Building 7920. If established procedures had been followed, the presence of contamination would have been detected immediately and the incident would have had less impact.
6. Contamination was spread outside Lab 208 (C-zone) to other areas in Building 7920, to the ASL I's home, car, and personal clothing.
7. Information exchanged between shift leaders was less than adequate to alert for the possibility of a problem in Lab 208.
8. Contamination was discovered in Lab 208 by the 1600 to 2400 AC shift personnel early in the shift. Approximately 2 h into the shift, HP assistance was requested in defining areas of contamination and the need for further decontamination.
9. There is a lack of documented periodic training for radiation safety in the AC group at Building 7920.
10. Precautions were taken to prevent further spread and protect employees from additional exposure. These included establishing Lab 208 as a respirator area until decontamination was complete.

11. An AC employee involved in the decontamination of Lab 208 used a respirator even though facial hair was present in areas where the respirator should seal.
12. Once the true cause of the contamination was identified, action was initiated to assess the potential for employee exposure. A total of four AC personnel were analyzed at the WBC. However, the health physicist responding to the incident was not sent for evaluation.
13. The ASL I was the only employee found to be contaminated. On the initial examination at the WBC, he was found to have external contamination present and was returned to the TRU Facility for decontamination. Deposits of contamination were present primarily in his beard as well as on his skin.
14. An accurate assessment of the internal exposure to the ASL I was difficult because of the current equipment limitations of the WBC at ORNL, lack of recent WBC data on him, and the presence of external contamination which could not be fully resolved from a true internal deposition.
15. There is no formalized Quality Assurance Plan within the Environmental and Occupational Safety Division that addresses potential deficiencies and preventive, corrective actions with regard to the evaluation of personnel exposures in this type of contamination incident.
16. It is the physician's decision to recommend chelation therapy. The general practice at ORNL in such cases is that chelation therapy should be initiated as soon as there is confirmation of an incident that presents the potential for personnel internal exposure to a radioisotope for which chelation treatment is effective.
17. Based on preliminary exposure estimates, chelation therapy was initiated on ASL I. Two doses were administered, and follow-up on its effectiveness continues.
18. No radiation protection standards for occupational exposure were exceeded as a result of this incident; however there was a real potential for a more serious exposure due to the practices which led to the incident.

5.2 PROBABLE CAUSES

1. Equipment was not readily available in cubicle 8 of the hot-cell area for weighing samples prior to transfer to radiochemical labs.

2. Knowledge of and adherence to procedures and guidelines governing the amount of material to be handled in glove boxes was less than adequate.
3. Equipment problems with a gamma spectrometer required the sample to be stored for approximately 1 month. This probably contributed to the sample being moved to a storage box and ultimately to the open-port box. This prolonged storage may have resulted in a pressure buildup from radioactive decay and sudden release of pressure when the sample bottle was opened.
4. Knowledge of and adherence to procedures and guidelines governing concentrations of material allowed to be handled in the open-port box were less than adequate.
5. Location of radiation monitoring equipment may be less than adequate for detecting airborne radioactive material in the vicinity of the open-port box.
6. Adherence to lab operating procedures and safety rules regarding work in contamination zones was less than adequate.
7. Communication between shifts in AC at Building 7920 was less than adequate.
8. Adherence to HP and Radiation Survey procedures for handling of personnel involved in radiation contamination incidents was less than adequate.
9. The Health Physics capability to make timely and accurate assessments of exposures to individuals involved in contamination incidents is less than adequate.
10. Quality Assurance activities regarding assessment of exposures for individuals involved in contamination incidents are less than adequate.

5.3 JUDGMENT OF NEEDS

1. An overall evaluation of radiation safety policies and procedures needs to be made regarding the removal of material from hot cells. This evaluation should include methods for implementation and compliance.
2. An evaluation of the AC employee training program should be conducted, with emphasis on site-specific radiation safety guidelines and policies as well as methods for refresher training as applicable.

3. Evaluation and revision of AC operating procedures is needed, with emphasis on sample control and labeling, sample tracking, and sample analysis scheduling to limit sample retention in AC labs.
4. Employees should be made aware of the importance of adherence to established procedures and should receive periodic retraining in these procedures.
5. Consideration should be given to adding radiation monitors for alpha contamination at a location that provides a quick evaluation of airborne releases near the open-port box.
6. Stricter enforcement of established procedures and guidelines governing work in contamination zones is necessary by the AC Division. In addition, certain practices now allowed, such as the use of chewing tobacco in C-zones, should be evaluated with particular emphasis on the application of the ALARA philosophy.
7. Improved communication of activities and incidents between shifts in AC should be established.
8. Evaluation of lab policy regarding allowing facial hair on employees working in C-zones should be carried out involving HP, Industrial Health, and AC divisions.
9. Evaluation of current HP practices, as compared with HP guidelines and procedures outlined in the HP manual, should be performed.
10. In vivo and bioassay monitoring capabilities should be reviewed with attention directed toward (1) use of sufficiently sensitive equipment and procedures; (2) availability of sufficient back-up equipment; (3) sufficient staffing and equipment to maintain routine, as well as priority analyses; and (4) proper adherence to HP Procedures that cite the required frequency of routine (background) assessments.
11. A quality assurance review should be performed and documented for the areas of whole body counting, bioassay, and HP procedures addressing management of incidents involving the spread of contamination to individuals and other facilities. Needs identified in this assessment should be followed by our implementation plan for improvement of these operations.

SIGNATURE PAGE

The investigation was conducted and the report prepared by:

G. L. Love (Chairman) - Energy Systems ES&H

H. M. Butler, ORNL

D. T. Duncan, ORDGP

T. W. Oakes, Energy Systems, ES&H

APPENDIXES

APPENDIX A. LETTER OF APPOINTMENT

Internal Correspondence

MARTIN MARETTA ENERGY SYSTEMS, INC.

January 23, 1986

G. L. Love

Investigation of Curium-244 Contamination and Internal Exposure Incident,
January 15, 1986

With the concurrence of W. Furth, you are hereby appointed chairman of an investigation board to investigate the January 15, 1986, incident involving an ORNL employee's internal exposure to Curium-244. The following Energy Systems employees are appointed as members of the board:

D. T. Duncan, Head of Health Physics and Industrial Hygiene Department,
ORGDP

T. W. Oakes, Coordinator of Environment and Health Physics Environment,
Safety, and Health

H. M. Butler, Department Head, Radiation and Safety Survey Department,
ORNL

You are to perform a Type B investigation of this incident and prepare an investigation report in accordance with DOE Order 5484.1 requirements. The scope of the investigation is to include all the factors which contributed significantly to the cause and extent of the incident and measures taken to prevent recurrence. This investigation is to be the first priority assignment of the board members, and they are relieved of their other duties to the extent necessary to carry out this assignment. Your board will have the full cooperation of area staff in conducting this investigation and in the preparation of the report.

Please submit a copy of the report to me by February 25, 1986, to be forwarded to DOE-ORO as requested by February 28, 1986.

Herman Postma

Herman Postma, 4500-N, I-210 (6-2900)

lc

cc: G. G. Fee
W. Furth
K. Jarmolow
K. W. Sommerfeld
R. S. Wiltshire
File - NoRC

APPENDIX B: SAMPLE ANALYSIS DOCUMENTS

0.2-0.4 g

UCN988
1988

UNOX, 9C

COUNTING DATA SHEET

-6001

SERIES NO.	CONSTITUENT	ABSORBER	FACTOR	COUNTED BY									
660X-j	Gm, EAWAK, NATS-X			R. J. P. D. 11/11									
SAMPLE CODE	DILUTION AND ALIQUOT	DATE	HOUR	CTR. NO.	MIN.	SCALE	COUNTS	TOTAL CTS.	CPM	BKG.	CCS	CCS	REF. 11/11/58
MR-597	0.1703g / 25% K/K / 100	10/15/1960		2	1			131423	229545	-7	229518	2.1148E	235E12
9410				2	1			227616					
all 5.80 OF V													
<p>2PU</p> <p>0.1703g / 25% K/K / 100</p> <p>THIS # IS IN CPM / 58</p> <p>NOT 13g / 58</p> <p>36117</p> <p>36117</p> <p>27</p> <p>36290</p> <p>1.174E</p> <p>4.24E8</p> <p>3966</p> <p>47.4%</p> <p>104</p> <p>2.6%</p> <p>3970</p> <p>should be 1.383E / 58</p> <p>Ref</p>													
<p>Newt</p> <p>0.1703g / 25% K/K / 100</p> <p>10/15/1960</p> <p>6</p> <p>4</p> <p>10825</p> <p>4206</p> <p>17</p> <p>4158</p> <p>1.4826E</p> <p>6.21E7</p>													
<p>SC8</p> <p>0.1703g / K / 100</p> <p>10/15/1960</p> <p>5</p> <p>4</p> <p>12862</p> <p>5715</p> <p>12</p> <p>4803</p> <p>1.4826E</p> <p>1.12E7</p>													

Dissolve in HNO_3 - HF

SECRET

660X-1

ANALYST

COMPLETED

THE

CHECKED BY (SUPERVISOR)

DATE 12-11-85

CURVE FACTOR

ANALYSED FOR

Weight of Dissolve

[illegible]

APPENDIX C: LABORATORY 208 LAYOUT AND PHOTOGRAPHS

LABORATORY 203, BUILDING 7920

LAYOUT OF ROOM 208, BUILDING 7920

APPENDIX D: PRELIMINARY REPORT OF RADIATION INCIDENT

RI No. 1-3-96

PRELIMINARY REPORT OF RADIATION INCIDENT

Basis for Report: H.P. Manual, Procedure 2.6, 3.

Division: Analytical Chemistry Bldg. or Area: Building 7920 (TRU)

Date of Incident: 1/15/86 Time of Incident: Approx. 6:30 a.m.

Date Reported: 1/15/86 Time Reported: Approx. 8:00 a.m.

Probable Type of Incident: Minor X Radiation Event

Type of Hazard: Contamination X Personnel Contamination Personnel Exposure

Type of Material: Alpha X B,Y Other Unknown

Division Director(s) W. D. Shults Supervisor J. L. Botts

J. R. Stokely

Description:

(See attached sheet for description)

<u>Personnel Involved:</u>	<u>Name</u>	<u>Badge Number</u>	<u>Division</u>
	R. T. Pack	26127	AC
	M. E. Garcia	26177	AC
	J. D. Mayton	22945	AC
	C. C. Foust	3770	AC

Reported: L. E. Thompson

998c:ac

cc: C. D. Berger
J. S. Bogard
G. H. Burger
H. M. Butler ✓
A. S. Garrett, Jr.
M. W. Knazovich
D. C. Parzyck
Division Director(s)
HPR
RCO(s)
Supervisor(s)

A contamination problem was reported at 6:30 p.m. on January 15, 1986 by Analytical Division personnel from Building 7920. Upon investigation, various areas were found to be contaminated. The maximum smear readings are summarized below:

Lab 208 - Floor	12,090 d/m α
Lab 208 - Upper Surfaces	864 d/m α
Lab 208 - Exterior of Plastic Bag Containing Waste	31,000 d/m α
Elevator	176 d/m α
Office	864 d/m α
Counting Room	453 d/m α
Hallway (Upstairs)	66 d/m α

The floor in Lab 208 had already been mopped once before the above smears were taken. The CAA monitor located in the room indicated no abnormal air activity. Counts of nasal smears taken from R. T. Pack and M. E. Garcia were not above background. Garcia had 1200 d/m α contamination on his right hand. Pack had 400 d/m α contamination on his right hand. Both men decontaminated their hands to release limits. Probe readings on surfaces of the plating box glove ports showed a maximum level of 250,000 d/m α .

It is suspected that the problem occurred on the 8-4 shift, probably late in the afternoon. Upon checking the change room, two pair of shoes were found to be contaminated (max. probe 800 d/m). The shoes belonged to J. d. Mayton and C. C. Faust of the Analytical Chemistry. It is also suspected that the cause of the occurrence was due to an attempt to dilute a sample containing considerably more activity than the ungloved glove box that was used in the operation could safely accommodate. Migration of material following withdrawal of contaminated gloved hands probably enhanced the problem. The contaminant was identified as ^{235}Cm .

All other areas of the building appear clean. Clean-up of the contaminated areas is in progress. Contaminated areas were zoned. Filter cartridge masks are required during clean-up of Lab 208. The elevator and hallway are now clean. This data will be transmitted to the shift office 12-8 shift HP for follow-up.

All individuals involved will be counted at the Whole Body Counter and urine samples will be collected for analysis.

APPENDIX E: ANALYTICAL CHEMISTRY LOG
(JANUARY 10-24, 1986)

A. Chem Log

45

1-10-86 D 4-12
Garcia + Pate here

1-11-86 "C" (12-8)
Peralta + Jones here.

1-11-86 A [8-4]
Patera, here Wills (V)

1-11-86 D 4-12
Garcia + Pate here

1-12-86 "C" (12-8)
Peralta + Jones here.
Steve called - 0045 for another day of V

1-12-86 A [8-4]
Patera, here Wills (V)

1-12-86 D 4-12
Garcia + Pate here

1-13-86 "C" (12-8)
Peralta here 4 hrs - V 4 hrs. Jones here
Steve called @ 0700 for another day of V.

1-13-86 "A" [8-4]
Bothe, Patera, here. Pate, Wills (V)

Only one 3" type marking tape in Bldg 7R20
order of LK. There are 12 rolls in supply
room or lab. If need more call Chuck.

Someone has been putting back some samples
in the gamma detector without first placing
them in a plastic bag. This is an excellent
way to contaminate the detector. Samples
should never be put in the shield
inverted. - Please make sure that they are.

[Signature]

1-13-86 D 4-12

Darren & Paul here

1-14-86 "C" [12-8]

Peralta & Jones here.

1-14-86 A [8-4]

Butler, Nelson, here.

1-14-86 D 4-12

Darren & Paul here

1-15-86 "C" (12-8)

Peralta & Jones here.

1-15-86 8-4 "B"

Truman & Mayton & Butts here
Peele on v.c.

1-15-86 4-12

Darren & Paul here

Ref *ms* On 9-15 found contaminated at beginning of shift.
Thought of & sawing into contaminated.
All shift crew on 9-15 7:00 am
The right glass got 7:00 am
Then a part of plastic on 7:00 am
... ..

1-16-86 "C" (12-8)
Peralta & Jones here

1-16-86 "A" [4-12]
Wells, Peters, here.

Open face box & points seem to be in good shape, face of boxes smear ok by me, still picking up contamination of other course. Bench tops next to both sinks cleaned and smear OK by me. RPL.

1-17-86 "C" [12-8]
Peralta & Jones here

Terry and Mary -

(last) Burger at R. John body counter -
will be at the counter in the morning, 1/18/86 at 6:00 a.m. He has requested that both of you have a whole body count one of you should be there at 6:00 a.m. and the other at 7:00 a.m. You have also been requested to submit a urine sample at that time. You should call the lab during the shift and have it ready to submit when you go to the counter.

n/2

RPL

W

n/2

To All The Crew
I'm sorry for my crewed-up.
C. Farnham

1-17-86 "A" shift [4-12]
Wells, Peters, here.

6600 down @ 2120 hrs. Saw heavy back up, H.C. Turned off internal temp. of CR - 80°F, please leave H.C. on until recycled forms or container.

1-18-86 D 12-8
Kerrin & Pack here

1-18-86 8-4 "B"
Tom & Mayton here

1-18-86 4-12 "A"
Wells, Peters here.
6600 back in operation 1700 hrs, ¹⁷⁰⁰
no one called in, adjustment & calib. made
Charlie - be sure to count QY in C.L.
on your shift tomorrow and read
instructions on work sheet for rest
of week.
1/2 hr, 1/2 hr instruments in 208 are properly
charged, turned others into H.P. office.

1-19-86 D 12-8
Kerrin & Pack here

1-19-86 8-4 "B"
Tom & Mayton here

Note: 1/ you have time - Jim would
like the TF data & time cards
All on Computer - I didn't get
finished yet

1-19-86 11 shift [4-12]
Wells, Peters, here.

John - Jim broke off part of a tooth aneurism
be back coming in tomorrow because of dentist.

the cylinder on deck left side M.T. and all tape for
reprints in plate box are new, Holbrook's done.

1-20-86 D 12-8
Dorian & Paul here

FC Truck does not have any breaks.

1-20-86 8-4 "B"
Fann, Mayton, Paul & E. H. here
TRUCK IN HOSPITAL

1-20-86 A 4-12
Wells here. This is personal.

1-21-86 12-8
Dorian & Paul here

1-21-86 8-4 "B"
Fann, Mayton, Paul & E. H. here

1-21-86 4-12 "A"
Wells, Petrus, here.

1-22-86 D 12-8
Dorian & Paul here

CAM Alarm in Ka 102 not notified
NE 6000 in having printing problems.

1-22-86 "C" (8-4)
Pereles, Fann, Kott & Paul here.
There is a new dump list on desks
in front of Cell 8 completed 1-22-86
for new

1-22-86 A 4-12
Wills, Peter here.

Chatter said about on Robinson to dispose of 1 liter
empty bottles cell 8, was going to store in cell 9
until to dispose of but he rejected that. MFD

*NO 0600 setting up. First strange #3 (see
instant) then we didn't print at
all when std. was. Send

1-23-86 D 12-8
Darin & Pack here.

it glue on Cag bar is contaminated.

Switch on Talk Fris. right LAD.

1-23-86 "P" (8-4)
Peralay, Jones

Terry & Manny - The M&M Review
committee on the Cm incident would
like to talk to you ^{both} tomorrow AM at
8:00, so please stay over! jdp

Terry - The Pu Valencia scans
Look good except it is all Pu TV

The Pu RT peak is more needle like
and would be to the left of the
peak you call as Pu 6 (over)

Note - Do not use the Cam until
until we get a new bellows - and
a glove box JP

1-23-86 4-12 "B"
Jamm & M. J. here
6600 Not operating

1-24-86 12-2 D
L. J. & P. J. here

P. J. model in car. 750

1-24-86 'C' (8-4)
Peralas, Gomez Kott. - here P. J. 5,

APPENDIX F: CHEMICAL TECHNOLOGY LOG
(JANUARY 15 AND 16, 1986)

Jan. 15, 1986

"B" Shift

Nº 45
Wed. 8-4

de Leon, Galloway, Goodman, and Wilson (AV/1200-1600 here)

1) Operational Safety Requirements

- A) OSR status checks taken at 0757: Requirements met for normal operations.

2) Building Conditions

- A) Building checks reported normal at ~0830.

- B) Tank Material Inventory taken.

- C) Alarms accounted for.

- D) Changed out KOIL in L-131 Scrubber (SRL-106 Oil = 5.2% CO_2 = 0.1%)

3) 9B-Pu-1

- A) Completed transferring the 2nd BATCH of extraction raffinate from T-72 $\rightarrow$ T-604 via T-734. (started on 12-8 shift). Flushed the route both ways w/ ~0.5 liter H_2O .

- B) Sparged T-604 for 30 min., then settled for 30 min.

- C) Transferred the 2nd BATCH of extraction raff. from T-604 $\rightarrow$ T-40 via P-604. Flushed route both ways w/ 0.5 liter H_2O .

- D) Added the 1st Am (m Flush to T-72 via V T72-4 (1.25 liters of 2.4% HCl & 750 ml H_2O flush in)

- E) Sparged T-72 for 1 hr., then settled for 30 min.

- I) Transferred the 1st Am (m Flush from T-72 $\rightarrow$ T-604 via T-734. Flushed route both ways w/ ~0.5 liter H_2O .

- ii) Sparged T-604 for 30 min., then settled for 30 min.

- II) Transferred the 1st Am (m Flush from T-604 $\rightarrow$ T-40 via P-604. Flushed route both ways w/ 0.5 liter H_2O .

(Cont.)

Jan. 15, 1986

"B" Shift

No 46
Wed. 8-4 (cont.)

- I) Added the 2nd Am-Cm FLUSH to T-72 via V-T72-4.
- J) Sparged T-72 for 1 hr., then settled for 30 min.
- K) Transferred the 2nd Am-Cm FLUSH from T-72 → T-604 via T-734. Flushed route both ways w/ ~0.5 liter H₂O.
- L) Sparged T-604 for 30 min., then settled 30 min.
- M) Transferred the 2nd Am-Cm FLUSH from T-604 → T-40 via T-604. Flushed route both ways w/ 0.5 liter H₂O.
- N) Added the 3rd Am-Cm FLUSH to T-72 via V-T72-4.
- O) Sparged T-72 for 1 hr., then settled for 30 min.
- P) Transferred the 3rd Am-Cm FLUSH from T-72 → T-604 via T-734. Flushed route both ways w/ ~0.5 liter H₂O.
- Q) Sparged T-604 for 30 min. Settling until 1625.
- R) Added 2.5 liters of phase modifier (6.2% DBHQ in 2-ethylhexanol) to T-72 via V-M71-9.
- S) Sparged T-72 for 15 min. Ready to add 1st Pu STRIP at 5.C.

4) 98-Pu-1 Chemical Makeup

- A) Made up 2 x 20 liter BATCHES of Pu STRIP solution (6.7% HCl - 0.1% HUNH₂·HCl). Mixed and sampled as Pu-ST-176 & 177.
Pu-ST-176 II' = 6.9% (OK) Pu-ST-177 II' = 7.0%.
- B) Remixed and sampled BATCH #2 as Pu-ST-178. II' = 7.0%.
- C) Adjusted BATCH #2 w/ 700 ml H₂O. Mixed and sampled as Pu-ST-178. II' = 6.8% (OK)

c) Leach of Materials from Waste Buckets

- A) Transferred the 4% HNO₃ in the BIN MARK to T-79 via floor filter.

(cont.)

Jan. 15, 1986

"B" Shift

No 47
Wed. 8-4 (cont.)

- b) Flushed the material in the BAIN MARIE $\rightarrow$ T-79 w/ 2 volumes of H_2O .
- c) Canned some of the trash in the S.S. tray that had dried.
- d) Removed the material from the BAIN MARIE to the S.S. tray to dry. Inventoried these items.
- e) Completed emptying the "rusty" bucket to the BAIN MARIE. Inventoried these items.
- f) Added 1.5 liters 4% HNO_3 to the BAIN MARIE. In @ 1530.

SHIFT STATUS:

- 1) T-604 contains 3" (last) Am-Cm FLUSH Settling until 1625 before transferring to T-40.
- 2) T-72 is ready to add 1st Pu STRIP fuel at S.C.
- 3) Contents of bucket #1325 & "rusty" bucket are drying S.S. tray.
- 4) Remainder of "rusty" bucket is in BAIN MARIE w/ 1.5 liters 4% HNO_3 since ~1530. Leaching @ S.C.

K. Wilson
2

January 15, 1986

1st Shift

No

48

Wed. 4-12

Arthur, Barrera, Owen, Brewer

- 1) O&R status checks taken at 1600. Requirements met for normal operations.
- 2) Building conditions reported normal ~1700.
Alarms accounted for.
Tank material inventory taken
- 3) 9B-Pu-1 Flushing
 - a) Terminated T-604 sparge and settled ~30 minutes.
 - b) Transferred 3rd flush from T-604 → T-40 via P-604 and flushing route both ways with 0.5 L H₂O.
 - c) Sparged T-40 ~1 hour and sampled as PU-CP-453.
Submitted per request sheet. Flushed sampler with 25250 ml H₂O. Sample in Sub 8 at S.C.
 - d) Set T-40 up to heat. Evaporating to ~2 in per item 3 b/c S.I.
- 4) 9B-Pu-1 Stripping
 - a) Completed 15 minute sparge of 4 modifier.
 - b) Added 1st Pu strip to T-72 via decan + 2 x 250 ml H₂O flush (10 L total)
 - c) Sparged T-72 ~3 hours, and settled 30 minutes.
 - d) Transferred T-72 → T-73U → T-604 and flushed route both ways with 0.5 L H₂O.
 - e) Sparged T-604 30 minutes and settled 30 minutes.
 - f) Set route T-604 → P-604 → T-54. Used new poly line in Sub 4.

January 13, 1976

D Shift

No

49

Wed. 4-12

- g) Leak checked route discharge with $\sim 1\%$ 0.5N HCl.
OK.
- h) Transferred ~~T-54~~ T-604 $\rightarrow$ T-54 and flushed route both ways with 0.5L ~~H₂O~~ 0.5N HCl.
- i) Added 2nd Pu Strip to T-72 via decun. ($\sim 4.75\%$)
Sparged 1 hour and settled ~~30 hours~~ 30 minutes.
- j) Transferred 2nd Pu Strip from T-73 $\rightarrow$ T-604 via T-730 and flushed route with 0.5L H₂O both ways.
- k) Sparged T-604 30 minutes settling till ~ 0005 .
- l) Added 2.5 L ϕ modifier to T-72 via V-M-1-9. Sparging for 15 minutes after addition.
- m) Added 3rd Pu strip (10L) to T-72 via decun. T-72 sparging till ~ 0230 .
- n
- 5) T-79 Leaching
- a) Took solution in Bin Marie to T-79. Flushed with 2 full volumes H₂O.
- b) Sparged T-79 > 1 hour and sampled as PVC-313. RH Gr₂ pulse = 3 NF. Sample in Cub 2 at SR.
- c) Material drying in Cub 4 at SR.
- 6) Contamination in 2nd Floor Lab and Offices.
- a) ~ 1800 A.C. reported contamination in Lab 302. Cont. to Shift HP L.E. Thompson Jr.
- b) Contamination originally discovered when MEG and RFP got hot winds from a probe at 202 check-out. They had not been in glove boxes, hoods etc. at the time a probe itself was hot.

January 15, 1976

D Shift

N:

50

Wed 4-12

- c) HP took smears in Lab 208. Hottest spots were open glove box ports, floor in front of open glove box & a bag of trash (3100 d/m trash, 12090 d/m & 3760 d/m)
- d) Additional smears showed contamination in Counting Room 205, AC office 204 and corridor 200A in front of these offices. Also slight contamination in elevator.
- e) 1st Floor corridors and change room smeared ok
- f) Air monitor in Lab 208 showed no activity, however HP took nasal smears of MEK and RTP.
- g) Notified LJK and continued HP contact with LSS Aasmus.
- h) AC cleaning offices and lab at S.C. next shift HP will need to recheck areas.
- i) Note that water used in mopping floors is being held in 55 gal SS drum due to PWD tie up
- j) LJK in ~0230.
- k) HP Thompson reports nasal smears ok. no problem.
- l) Note need to tag and replace cover on SS drum containing mop H₂O. per LJK.

Status:

- 1) T-54 has 1st Pu Strip.
- 2) T-60 had 2nd Pu strip settling till 0005.
- 3) T-72 has 3rd Pu strip sparging till 0230.
- 4) T-40 evaporating to ~30.
- 5) Samples in Lab 7 on T-75 & T-40. Each material drying!
- 6) Need to contact shift HP for recheck on and floor contamination

R. W. Bowers

January 16, 1986 "C" Shift 01
 Shipwash - V, Hobson, Pendleton, Woodall 12-8

1.) OSR status checks taken @ 0005: Requirements met for normal operations.

2.) Building Checks

A.) Systems Normal

B.) Alarms Accounted for.

C.) Tank Material Inventory Taken

3.) Building Contamination

A.) H.P. (Richmond) smeared Lunch room - No activity on table, chairs, etc above floor. - Floor showed some counts but all $< 20 \text{ d/m}$ - Mopped Lunch room floor @ his request.

B.) H.P. Smeared Change Room - No activity found.

C.) H.P. Smeared room 208 - Highest reading was 1350 d/m & (above floor surface)

D.) Smear sheets (data) @ Control Desk

4.) T-604 - 98 Pu1 - Pu Stripping

A.) Pumped T-604 $\xrightarrow{\text{Pu}}$ T-54 and flushed $\rightarrow$ 0.5% of 0.5% HCl. This was -w 2nd str.p.

B.) Received 3rd strip from T-72 sparged 30 min and settled 30 minutes - holding for room in T-54

5.) T-40 - boiled all shift towards 2L volume

(continued)

January 16, 1986

C Shift

N^o 02
12-8 (Continued)

6.) T-54 - 9B Pu 1-Product - Pu

A.) Had 1st Strip and received 2nd Strip

B.) Set up T-54 to boil and boiled rest of shift.

7.) T-72 - 9B Pu 1

A.) Sparged until 0234 & settled until 0304

B.) Transferred 3rd Pu Strip T-72 ~~T-72~~ T-604 and
flushed $\leftrightarrow$ O.S.P.H₂OC.) Added 4th Pu Strip M-70 ~~down~~ T-72, sparged
1 hour and settled Holding for room in T-604

8.) Bucket Material Leaching CUB #4

A.) Located clean empty bucket #0316

B.) Started to package Leached waste - but still wet
@ S.C. - Waiting until dry

9.) T-79 - PVC-313 - Waiting on results

Status 1.) T-40 boiling $\tau = 2\ell$ 2.) T-54 boiling for room for a 10 ℓ Strip Solution3.) T-604 Has 3rd Pu Strip (10 ℓ) waiting for T-544.) T-72 Has 4th Pu Strip (5 ℓ) waiting on T-604

5.) T-79 No results of sample pulled on 4-12

D.E. Woodall

Jan. 16, 1986

"B" Shift

No. 03.
Thur. E-4

de Leon, Galloway, Goodman, and Wilson (4v/1200-1600 here)

1) Operational Safety Requirements

A) OSR status checks reported at 0805: Requirements met for normal operations.

2) Building Conditions

A) Building checks reported normal at ~0830.

B) Tank Material Inventory taken.

C) Alarms accounted for.

D) Changed out KOH in L-131 Scrubber (SRL-107 O₂ = 5.20%
CO₂ = 0.1%)

3) 9B-Pu-1

A) Completed boiling T-54 down to ~5 liters, then cooled to < 40°C.

B) Transferred the 3rd Pu STRIP from T-604 → T-54 via P-604.
Flushed the route both ways w/ 0.5 liter H₂O. 0.5% HCl.C) Set T-54 up to boil. Started boiling T-54 down for room.
Will be boiling at S.C.D) Transferred the 4th Pu STRIP from T-72 → T-604 via T-734.
Flushed the route both ways w/ 0.5 liter H₂O.

E) Sparged T-604 for 30 min., then settled for 30 min. Waiting for T-54 boil down.

F) Added the 5th Pu STRIP (4.5 liters 6.7% HCl - 0.1% H₂NNH₂·HCl & 250 ml H₂O flush in) to T-72 via V-T72-4.

G) Sparged T-72 for 1 hr., then settled for 30 min.

(cont.)

Jan. 16, 1986

'B' Shift

N^o 04
Thur. 8-4 (cont.)

H) Sampled T-72 (5" Pu strip) as PU-PP-532. Requested
Gra and a pulse. Flushed the sampler back to T-72 w/
1x 250 ml H₂O. Sample is in lab at S.C.

I) T-40 is still boiling down to 2 liters per 1/10-13/86 S.I.
Item 13. Need to check zero on T-40 LL.

4) Waste Bucket Monitoring.

A) CER monitored 3 full buckets of waste and 4 empty waste
buckets.

B) Stored these all in Cub. 4.

5) Misc. Items.

A) Pipefitter switched T-72 sparger back to T-72 from T-73.
T-73 is back to normal also.

B) Rm. 208 contamination was cleaned up on 8-4.

C) Contaminated mop water from clean up overnight and today
was sent to F-126 from glove box drain in DECON ROOM by
CEW. (~40 liters cont. H₂O.) Flushed in w/ ~40 liters H₂O.

SHIFT STATUS:

1) T-54 is boiling down to hold more strips at S.C.

2) T-604 contains 4" Pu strip. Waiting on T-54.

3) T-72 contains 5" Pu strip. Sample is in Cub. 8 on this ship.
Waiting on T-604.

4) T-40 is still boiling to 2 liters at S.C.

K. Wilson

Jan. 16, 1986

A-Shift

No

05

4-12 Thurs.

Groover, Johnson, Potter, and HyHan

1. OSR status checks taken at 1600: Requirements met for normal operations

2. Building Conditions

A. Building checks reported normal - 1715.

B. Tank material inventory taken and alarms accounted for.

3. T-40 (9B-PU-1)

A. Continued boiling T-40 until volume reached ~2 liters.

B. Cooled and diluted back to ~20 liters with 0.1^N HCl.

Flushed in with 2x 1 liter H₂O.

C. Sparged > 1 hour. Sampled as PU-CP-453. Sample is in Cub 8 at shift change. H⁺ reported as 0.5^N.

4. Pu Stripping (9B-PU-1)

A. Boiled T-54 down to ~4 liters.

B. Transferred 4th strip from T-604 to T-54.

C. Transferred 5th strip from T-72 to T-604.

D. Sparged T-604 30 minutes and settled. Transferred 5th strip to T-54.

E. Set T-54 up to boil and started heating up to make room for additional strip collections. In progress at shift change.

F. Had not received results on 5th strip. Went ahead with phase modifier addition and 6th strip addition. T-72 sparges until 0040.

G. Made up 11 liters of 6.7^N HCl - 0.1^N HONH₂·HCl. Sampled as PU-ST-180 H⁺ = 6.8^N. OK to use.

Jan. 16, 1986 (cont.)

A-Shift

No

06

4-12 Thurs

5. T-79

- A. Received results on PVC-313. Results < specs. Jetted T-79 to F-115. Flushed with 2x 5 liters H₂O.
- B. Have not flushed buckets to T-79 yet (listed in shift instructions).

6. Miscellaneous Items

- A. Noted that Pressure Gauge on P-407 was indicating 680 psi. Is this normal??
- B. Received and calculated results on ~~PU-CP-452~~ PU-CP-452 (T-40 prior to buildown).

STATUS

- 1. T-54 is boiling for room to receive 6th strip.
- 2. T-40 is holding until 8-4:30 reviews results.
- 3. T-72 contains 6th strip and is sparging until 0040.
- 4. T-604 is ready to receive another strip.
- 5. T-79 is empty and flushed.

T. D. R. Btm

January 17, 1986 "C" Shift N^o 07
 (Shipwash - V), Hobson, Pendleton, Woodall 12-8

- 1.) OSR status checks taken @ 2358: Requirements met for normal operations.
- 2.) Building Checks
 - A.) systems Normal
 - B.) Alarms Accounted For - Cave Alarm @ 0530 - Low Argon - Switched to West Cylinder. Punch Listed
 - C.) Tank Material Inventory Taken.
- 3.) T-72 - 9B-PU-1 - PU stripping
 - A.) Sparged 6th strip until 0040 - settled 30 min and transferred T-72 ~~T-72~~ T-604 (10L)
 - B.) Added 7th strip M-70 ~~decon~~ T-72 - sparged one hour & settled (SL)
 - C.) Sampled 7th strip as PUPP-533 Results higher than the 5th strip ??
- 4.) T-54 - 9B-PU-1 - PU - Product
 - A.) Boiled to < SL, Cooled
 - B.) Started collecting 6th strip from T-604
- 5.) T-604 9B-PU-1 (Diluent Wash)
 - A.) Received 6th strip - sparged 30 minutes & settled
 - B.) Started transfer 6th strip T-604 ~~T-604~~ T-54

(continued)

January 17, 1986

"C" Shift

No 08
12-8 (continued)

6.) Bucket Leach CUB #4

A.) Flushed empty buckets # 0152, # ?99? and # 047
to T-79 with H₂OB.) Swabbed floor & pan & bucket (poly) with damp
swabbs - drying @ S.C.C.) Straightened up and cleaned up in general in
CUB #4

7.) TURF

A.) Operator called saying "High Radiation" Alarm @ TURF

B.) Checked - it cleared immediately - no action taken.

8.) Results received on T-40 - PUCP 45B

Status 1.) T-72 has 7th Pu Strip results of PUPP-533 high.2.) T-604 transfer of 6th Strip to T-54 in progress3.) T-54 has been boiled down & is receiving 6th Strip.

D. E. Woodall

**APPENDIX G: HEALTH PHYSICS SURVEY RESULTS
FOR JANUARY 16, 1986, IN TRU FACILITY**

SMEAR SAMPLE DATA

NAME (INP&S): <i>Kelly</i>	PHONE: <i>4-707</i>	BLOC. NO. (INP&S): <i>7920</i>	LOCATION (SMEARS TAKEN): <i>208</i>	DATE: <i>1-21-86</i>
SMEARS NUMBERED:	RESULTS REQUIRED:	DATE COUNTED:	COUNTER OPERATOR:	
FROM: _____ TO: _____	DATE: _____ TIME: _____			
GIVE D/M ONLY ON SMEARS OVER:				
_____ d/mc				
_____ d/mB				

a	B	LOCATION (*)	a	B	LOCATION (*)	a	B	LOCATION (*)
1			34	30	<i>Sink Ledge</i>	67		
2			35			68		
3			36			69		
4			37			70		
5			38			71		
6			39			72		
7			40			73		
8			41			74		
9			42			75		
10			43			76		
11			44			77		
12			45			78		
13			46			79		
14			47			80		
15			48			81		
16			49			82		
17			50			83		
18			51			84		
19			52			85		
20			53			86		
21			54			87		
22	—	<i>Counter Top East</i>	55			88		
23	<i>24</i>	<i>Floor East</i>	56			89		
24	—	<i>Glendon East</i>	57			90		
25	<i>240</i>	<i>Floor Middle East</i>	58			91		
26	—	<i>Hood East</i>	59			92		
27	<i>6.30</i>	<i>Floor Back East</i>	60			93		
28	<i>150</i>	<i>Hood Ledge West</i>	61			94		
29	<i>48</i>	<i>Floor Back West</i>	62			95		
30	<i>66</i>	<i>Sink Top</i>	63			96		
31	<i>15</i>	<i>Floor Front of Sink</i>	64			97		
32	<i>60</i>	<i>Floor West of Sink</i>	65			98		
33	<i>325</i>	<i>Glendon Back</i>	66			99		

UCN-1632 (a) Give only if required.
1 7-67

NAME: <i>John K. Kuter</i>		PHONE: <i>4-7071</i>	BLOC. NO. (INPS): <i>7920</i>	LOCATION (BUREAU TAKEN): <i>208</i>	DATE: <i>1-16-86</i>
SHEARS NUMBERED:		RESULTS REQUIRED:		DATE COUNTED: <i>1-16</i>	COUNTER OPERATOR: <i>JR</i>
From: <i>20</i>	To: <i>200</i>	Date: <i>1-16</i>	Time: <i>0830</i>		
GIVE D/M ONLY ON SHEARS OVER:		REMARKS: <i>Particulates still on floor</i>			
<i>20</i> d/mg					
<i>200</i> d/mg					

a	B	LOCATION (°)	a	B	LOCATION (°)	a	B	LOCATION (°)
1			34			67	300	— Floor E
2			35			68	75	—
3			36			69	75	—
4			37			70	75	— East
5			38			71	12	— Close parts
6			39			72		
7			40			73		
8			41			74		
9			42			75		
10			43			76		
11			44	160	400	77		Upper W
12			45	16	—	78		Surfaces
13			46	90,000	60,000	79		center
14			47	—	—	80		
15			48	36	—	81		
16			49	90	—	82		
17			50			83		
18			51	18	—	84		
19			52	33	—	85		
20			53	—	—	86		East
21			54	—	—	87		
22			55	—	—	88		
23			56	—	—	89		
24			57	45	—	90		LA
25			58	21	—	91		West
26			59	90	—	92		
27			60	75	—	93		
28			61	320	—	94		Floor W
29			62	1600	—	95		center
30			63	290	—	96		
31			64	270	—	97		
32			65	60	—	98		
33			66	75	—	99		rear elev

SMEAR SAMPLE DATA

NAME (PSS): <i>Lee Thompson</i>		PHONE:	BLDG. NO. (INPSS): <i>7920</i>	LOCATION (SMEARS TAKEN): <i>upstairs</i>	DATE: <i>1-15-86</i>
SMEARS NUMBERED:		RESULTS REQUIRED:		DATE COUNTED:	COUNTER OPERATOR: <i>LT</i>
From <i>20</i>	To <i>200</i>	DATE:	TIME:	<i>9:00 AM</i>	<i>12:00 PM</i>
GIVE D/B ONLY ON SMEARS OVER:		REMARKS:			
<i>20</i> d/mc		<i>Hallway, Office, Counting Rm & LAB 208</i>			
<i>200</i> d/mB		<i>probe max 250,000/m</i>			

α	β	LOCATION (*)	α	β	LOCATION (*)	α	β	LOCATION (*)
1	-	-	34	-	-	67	282	-
2	31,000	-	35	-	-	68	486	230
3	54	(9-1)	36	-	-	69	537	-
4	150	25' 208	37	176	-	70	2460	-
5	633	(94) upper	38	48	-	71	90	-
6	96	(95) surface	39	-	-	72	543	-
7	1560	(96)	40	-	-	73	195	-
8	2	(97)	41	-	-	74	1209	3760
9	10	(95)	42	-	-	75	153	-
10	40	(94)	43	-	200	76	148	-
11	-	-	44	-	-	77	6630	-
12	-	-	45	-	-	78	2454	-
13	-	-	46	-	-	79	372	-
14	-	-	47	-	-	80	450	-
15	-	-	48	864	-	81	605	-
16	-	-	49	393	-	82	240	-
17	-	-	50	-	-	83	264	-
18	-	-	51	-	-	84	135	-
19	-	-	52	66	-	85	132	-
20	-	-	53	-	-	86	90	-
21	-	-	54	-	-	87	-	-
22	-	-	55	24	-	88	-	-
23	-	-	56	453	-	89	-	-
24	-	-	57	36	-	90	-	-
25	-	-	58	24	-	91	-	-
26	-	-	59	-	-	92	-	-
27	-	-	60	-	-	93	-	-
28	-	-	61	-	-	94	-	-
29	-	-	62	48	-	95	-	-
30	-	-	63	60	-	96	-	-
31	-	-	64	48	-	97	-	-
32	-	-	65	120	-	98	-	-
33	-	-	66	222	-	99	-	-

APPENDIX H: WASTE ISOLATION PILOT PLANT LOG

CERTIFICATION OF TRANSURANIC WASTE PACKETS

Your signature certifies a numbered packet containing no fires, free liquid, sludges, pyrophoric, explosive, toxic, or corrosive materials, compressed gases, fissionable isotopes ($>27 \text{ g/ft}^3$), or heat sources ($>0.1 \text{ watt/ft}^3$).

[illegible]

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**APPENDIX I: HEALTH PHYSICS SURVEY RESULTS FROM
THE HOME OF ANALYST SHIFT LEADER I**

SMEAR SAMPLE DATA

NAME (HP&S) H. BUTLER	PHONE	BLDG. NO. (HP&S) 4500S	LOCATION - SMEARS TAKEN First Auto - House	DATE 1-16-86
YEARS NUMBERED: FROM 1 To 64	RESULTS REQUIRED:	Date	Time	DATE COUNTED 1-16-86
IVE D/M ONLY ON SMEARS OVER: 20 d/m α 200 d/m β	REMARKS:	BKG = 3 d/m EFF = 259.		

a	β	LOCATION (*)	a	β	LOCATION (*)	a	β	LOCATION (*)
1 - (4)	-	Stem (from)	34 -	-		67		
2 -	-		35 -	-		68		Stem, whole for lead
3 -	-		36 -	-		69		200-3000 4m before
4 -	-		37 -	-		70		being wiped off - 43cm ²
5 -	-		38 - (1)	-	Stem	71		after cleaning
5 - (5)	-	Stem (10)	39 -	-		72		
7 -	-		40 -	-		73		
8 -	-		41 -	-		74		Cluster from Front
9 -	-		42 -	-		75		hunk of fat - both
3 -	-		43 -	-		76		2 1000 4m
1 -	-		44 -	-		77		
2 -	-		45 -	-		78		
3 -	-		46 -	-		79		
4 -	-		47 -	-		80		
5 -	-		48 -	-		81		
5 -	-		49 -	-		82		
7 -	-		50 -	-		83		
8 -	-		51 -	-		84		
9 -	-		52 -	-		85		
5 -	-		53 -	-		86		
1 -	-		54 -	-		87		
2 -	-		55 -	-		88		
3 -	-		56 -	-		89		
4 -	-		57 -	-		90		
5 -	-		58 -	-		91		
6 -	-		59 -	-		92		
7 -	-		60 -	-		93		
8 -	-		61 -	-		94		NOTE: VALUE IN
9 -	-		62 -	-		95		() INDICATE COUNTS
0 -	-		63 -	-		96		ABOVE BACKGROUND.
1 -	-		64 -	-		97		
2 -	-		65 -	-		98		
3 -	-		66 -	-		99		

CN-1632 (4) Give only if required.

APPENDIX J: DTPA FACT SHEET

DTPA Fact Sheet

- Animal experiments in the 1950's and 1960's showed that internal contamination by plutonium and related actinide metals could lead to bone cancer.
- Additional experiments showed that these metals could be made to leave the body by drugs called chelating agents.
- The best of these chelating agents is "DTPA"; a short name for trisodium calcium (or zinc) diethylenetriaminepentaacetate, an FDA approved drug for the treatment of plutonium contamination.
- When given orally, by aerosol (breathing a mist of it) or by injection into the muscles or into the blood by vein, this drug unites with the plutonium or Pu-related metal contaminant and prevents them from reaching the bone by causing them to be excreted by the kidney into the urine.
- Except for pain after intramuscular injection, DTPA is not known to have immediate after-effects in the doses prescribed.
- Since, however, less than 300 persons have ever been given DTPA in the U.S. (since 1965), it is not known for certain whether there is any chance for DTPA to cause any bad after-effects later in life.
- So even though the probability for such a happening is extremely remote, the Federal Food and Drug Agency and the Department of Energy want all persons given this drug to be followed over the course of their lives to see whether or not there are any after-effects of its use.
- In addition, the use of this drug is so uncommon clinically, no commercial drug company can afford to manufacture and distribute it; this situation forces it to be manufactured by the U.S. government contractor and supplied without cost to doctors and their patients.
- It was decided years ago that to meet all medical needs, it would be best to keep the drug in an Investigational New Drug (IND) status, approved by FDA for therapeutic use in persons contaminated by plutonium and its related metals but requiring that its use be documented.
- The "IND status" requires that the names and addresses of all such persons be kept in a central registry so the patients can be followed, and also requires that informed consent of the person be obtained before DTPA's use.
- "Informed consent" requires that the person know why the drug is being given and what consequences, if any, there may be if it is not given. A form must be signed to prove that the person was so informed.
- Because the drug works best when it is given within an hour or less of the accident in which the contamination is received, there is some haste at the time of the first treatment which has been frightening to some people.

•Some safety experts believe that this concern and confusion could be overcome by having all plutonium workers sign such a treatment permission on their being hired, but so few job categories involve running the risk of being contaminated by plutonium that this procedure is unnecessary. In plants devoted principally to handling plutonium, this procedure could be helpful.

•The data in the DTPA registry system show that: internal contamination by plutonium in our plants is extremely rare; whenever it has happened, DTPA therapy has been extremely safe and effective; and that the presently in force DOE system of using FDA's IND drug procedure to control and monitor its use promotes the safety of employees and assures their medical protection.

APPENDIX K: DTPA CONSENT FORM

(This form has been approved for use of noninstitutional physicians by the ORAU/ORNL Committee on Human Studies, Oak Ridge, Tennessee and DOE Biomedical Research Division of Safety, Standards, and Compliance.)

INFORMED CONSENT FORM
FOR USE OF CA-DTPA, AN INVESTIGATIONAL DRUG

NAME: _____ AGE: _____ DATE: _____ TIME: _____ AM/PM

I _____, hereby request and authorize
_____ M.D. to give to _____

(myself)
the drug trisodium calcium diethylenetriaminepentaacetate (CA-DTPA) in an attempt to enhance the removal of _____ from my body. I understand that I have been involved in an incident where I was exposed to radioactive _____ and may have been contaminated, to some degree, by this exposure. The above-named physician has consulted with me concerning this condition and has advised me that one method of treatment is the use of the drug CA-DTPA. I understand that I may require repeated doses of this drug several times a week and may need to get additional treatments with a drug called Zn-DTPA, depending on the level of contamination that I have experienced, should I decide to accept this method of treatment.

I understand that CA-DTPA is an investigational drug and not available for general use. The term "investigational drug" means that the drug, CA-DTPA, is undergoing investigation, under FDA control, to determine its effect on humans. It has been explained to me that this compound has the property to bind with some heavy metals, including iron, lead, plutonium, americium, and the other heavy metals within the body and helps the body to excrete them. I have been told that CA-DTPA especially when given in high doses for prolonged periods of time tends to remove zinc from the body. For this reason treatment is switched from CA-DTPA to Zn-DTPA if prolonged treatment is necessary. I understand that all risks may not be known and that unforeseen results may occur. On the other hand, it has been explained to me that the risk of developing adverse late effects from actinide incorporation is decreased with CA-DTPA followed by Zn-DTPA therapy, and I realize that this treatment is offered to me only after careful deliberation by Dr. _____ and colleagues.

I am consenting to its use for the study and treatment of my condition with the understanding that the results of this treatment may not necessarily be of benefit to me. The use of CA-DTPA in the treatment of internal radionuclide contamination is part of a national research program. I do not object if any information relating to my case is used in professional journals or medical books, or for any other purpose in the interest of medical education, knowledge, or research; provided, however, that it is specifically understood that in any such publication or use I shall not be identified in any way. I further agree that I will participate in whatever follow-up studies are deemed appropriate by my physician at whatever intervals are found suitable by the investigators. I am reserving the right to withdraw my permission at any time without prejudicing my further medical care. Dr. _____ has also offered to answer any additional questions.

Signed: _____
(patient)

Witness: _____

(continued next page)

Informed Consent Form (CA-DTPA) (continued)

Page 2

The foregoing consent was read, discussed, and signed in my presence, and in my opinion the person so signing did so freely and with full knowledge and understanding.

Witness: _____

Date: _____

Addendum:

Dr. _____ has explained to me the possible effects to fetus that may occur from prolonged treatment with Cs-DTPA.

Signed: _____
(patient)

Witness: _____

**APPENDIX L: OPERATING PROCEDURES AND SAFETY RULES
FOR THE TRU ANALYTICAL LABORATORY, BUILDING 7920**

OPERATING PROCEDURES AND SAFETY RULES FOR THE
TRU ANALYTICAL LABORATORY, BUILDING 7920

J. H. Cooper and J. M. Peele

1. General

1. All rules for general laboratory safety as presented in the *ORNL Master Analytical Manual*, Method 9 0055, shall be observed.

2. *Safety Rules for Radiochemistry Laboratories*, Sect I-II, written by E. I. Wyatt, shall be observed.

3. In addition, the special rules for the TRU Analytical Laboratory given below shall be observed. These rules shall also be kept in compliance with TRU operations safety rules.

2. Zoning

1. Clean zone. All of the TRU office addition is a clean zone, and no contamination or radioactive material is allowed. The hall immediately inside the north entrance to the TRU facility is a clean zone. The women's rest room and office 103 are clean zones.

2. Regulated zones. Certain zones are classified as regulated zones in which either street clothing or contamination clothing (free of contamination) may be worn. These areas are office 204, the operating area in front of the cells, laboratories 110 and 210, corridors, counting room 205, and elevator. Before going from a regulated zone to a clean zone (in street clothing only), hands and shoes must be monitored.

3. Contamination zone. Alpha labs 108 and 208, the transfer area, and the area behind the cells are contamination zones, and protective clothing (described below) must be worn therein. (Permission of the Chemical Technology shift supervisor must be obtained before going behind cells.) Upon going from a contamination zone to a regulated zone, shoe covers must be removed; and shoes, hands, and clothing must be monitored for activity.

3. Clothing

1. Coveralls. All personnel working in the contamination zone shall wear coveralls marked "CONTAMINATION" across the back.

2. Gloves. Whenever working in hoods or open-faced glove boxes, rubber gloves shall be worn. Wear surgical gloves under regular rubber gloves. Never touch anything inside a hood or box without gloves. Once gloves have touched anything inside a hood or box, do not allow them to

touch any uncontaminated equipment or apparatus outside the hood or box. When working in a glove box, wear surgical gloves to protect hands in case of a failure in the box gloves. Use tape to fasten gloves to sleeves of coveralls. Monitor them frequently. Disposable polyethylene gloves may be worn when working with low-level radiation, such as slightly contaminated equipment or sample bottles.

3. Shoes. Yellow shoes shall be worn in the contamination zone and may be worn (if uncontaminated) in the regulated zone. Personnel working in glove-box labs must wear shoe covers. An uncontaminated area will be maintained at the entrance to each lab where personnel may stand after removing shoe covers. Never place shoe covers in this transition area.

4. Visitors' clothing. The above regulations pertain to personnel working in the building. However, visitors are required to wear contamination smocks and shoe covers, being careful to change shoe covers when entering or leaving glove-box labs.

4. Monitoring

1. Personnel. Scintillation alpha monitors will be provided at the exits from each lab and at exits from regulated zones. Personnel must monitor themselves (especially shoes after removing shoe covers) before leaving any lab. Before leaving the building through the change room, all persons should be thoroughly monitored. Frequent monitoring of hands and arms (gloves and sleeves) while working in the glove-box areas will help detect sources of contamination and check its spread.

2. Equipment. All equipment leaving the labs shall be monitored. Frequent checks of the glove-box areas (especially glove ports, bag ports, filter connections, drain lines, and the floor) will be necessary to check sources and spread of contamination.

3. Waste. All solid waste material shall be sealed in polyethylene and monitored for alpha, beta-gamma, and neutron radiation before leaving the work area. Packages which measure greater than 200 mR beta-gamma are too hot for the stainless steel waste drums. Bottles of contaminated liquid waste are also sealed in polyethylene and monitored before being sent to room 212 for disposal.

5. Special Procedures

1. Sample transportation. Any radioactive sample that is moved from one location to another (except within hoods, cells, or boxes) shall be doubly contained and sealed in heavy-duty polyethylene. Plates for alpha counting shall be carried in the regular Lucite boxes which must be monitored before leaving the laboratory.

2. Transfer from Bldg. 7920, cell area. Place all paper, glass, and other waste in prenumbered paint cans that are equipped with a bail. When full, install lids and retain until Operations has made arrangements for removal. If longer than one week, notify Operations supervision in addition to Analytical Chemistry supervision. Assistance will be expected on operating conveyor and placing buckets in conveyor.

Radiation samples are frequently sent to other laboratories at the ORNL plant. These laboratories include Bldg. 3019, Bldg. 9735, and Bldg. 2026. Both liquid and solid samples are contained in polyethylene or flint glass bottles with polyethylene insert screw caps. The sample bottles are then hermetically sealed in a polyethylene bag and placed in an unbreakable container, such as an ice cream carton or paint bucket. All packaged samples must be inspected and tagged by Health Physics personnel before leaving the building.

3. Sample receiving from processing cells.

a. Samples shall go into cell 8 from processing cells, and request sheets shall be given to the Analytical Chemistry shift supervisor.

b. Supervisor shall make out work sheets, indicating dilutions required and procedures to be followed.

c. Samples and/or dilutions from the cell area will be brought out twice during a shift unless a rush sample is being handled.

d. All sample portions brought out will be put into clean bottles before bringing to transfer area glove box.

e. Samples will not be handled with gloves directly. Use tongs to manipulate any item that has been in the cell. Place all items in a plastic bag, and bag it out using the routine bagging procedure.

f. Sample bottles are then transferred to the special glove box also located in the transfer area. Here all sample solutions are transferred into clean bottles. This box is equipped with a special entry chute to facilitate this operation. No sample bottles that have been in the cell bank shall pass this point. Exceptions to the rule are special samples that go to Bldg. 2026 and are introduced into the cell bank there. Sample solutions in clean and properly labeled bottles are bagged out and transferred to the appropriate work area.

g. If it is necessary to use shielded waste disposal system, aid the Chemical Technology operators in monitoring and sample removal in decontamination box. Do not do any of the bagging or physical handling of the samples and/or plastic buckets under any circumstances. (1) Process samples must be shielded to less than 1 R/h before removal from the cell area. In special cases, sample reading greater than 1 R/h can be removed with direct Health Physics surveillance. (2) Process samples which activate an alpha probe through the plastic bag must be shielded to <100 mR/h neutrons before transfer from the cell area. (3) Do not forget to monitor gloves before and after use and to post readings on the log sheet.

h. High levels of alpha activity must be handled in the glove boxes in rooms 108 or 208. Samples or dilutions that need to go into the open glove box in room 208 for alpha plating must be less than 10^8 alpha c/m/mL.

i. Sample preparations for other analyses, which include gross gamma, gamma scans, and neutron counting on solutions greater than 10^6 alpha c/m/mL, must be labeled HIGH ALPHA. These solutions are to be returned to the glove box for disposal as soon as the analysis is completed.

4. Waste Disposal.

a. *Cell area.* Place all paper, glass, and other waste in pre-numbered paint cans with bails. When full, install lids and retain until Operations has made arrangements for removal. If longer than one week, notify Operations supervisor in addition to Analytical Chemistry supervision. Assistance will be expected in operating conveyor and placing buckets in conveyor.

b. *Glove boxes and hoods.* All contaminated solid waste is separated into burnable and nonburnable material. The waste is then sealed in heavy-duty polyethylene and transferred to one of the appropriate stainless steel drums labeled either "burnable" or "nonburnable," which are located in lab 108. These waste packages are monitored before being placed in the drum because the maximum permissible radiation is 200 mR per drum. Waste packages that are too hot for these drums are put in fiber drums and placed at the entrance to the limited access area (LAA) for disposal by TRU operations. Notify the TRU shift supervisor when there is a package to be handled.

c. *Garbage cans.* All large cans shall be lined with plastic bags. Only compactable waste that may be slightly contaminated, such as shoe covers or surgical gloves, may be placed in these cans. When the cans are full, tape seal the bags, identify with proper label giving name, date, and location, and place bag in yellow dumpster.

d. There is a drum located near the yellow dumpster for non-compactable waste material. Seal the material in polyethylene bags and also label with name, date, and location.

e. There is a drum for disposal of noncontaminated glassware which is located near the elevator on the first floor.

f. *Contaminated liquid waste.* The hot drain line that services the glove boxes and hoods in labs 108 and 208 is permanently out of service, and all radioactive liquid waste is bagged out in suitable containers (such as 2-gallon plastic bottles) and carried to room 212. The waste is then bagged into a glove box equipped with a hot drain that leads to F-115 waste tank. After the liquid waste is poured down the drain, flush with copious quantities of water. The TRU shift supervisor must be notified before any waste material is added to the waste tank. The empty containers are then flushed with water and bagged out for reuse.

5. Changing Gloves on Boxes. Remove clamp holding glove, and push O-ring off glove. Turn new glove inside out and place cuff on port over old glove cuff. Pull O-ring onto new glove and slip old glove off port into box. Replace clamp and tighten. Monitor glove port and surrounding area for activity. Clean up if any activity is detected.

6. Changing Filters. Since the roughing filters are changed within the boxes, the only special precaution to be observed is to use care not to puncture the gloves. All building service and maintenance, including changing absolute filters to the glove boxes, is done through the building operations engineer at the TRU facility.

7. Analytical Boxes (general).

a. Any box with a background through the gloves of 10 mR/h requires the wearing of an ORNL film ring for work requiring more than 4 hours exposure.

b. Radiation background at the surface of the box must be kept below 200 mR/h. Act reading on a cutie pie. A radiation background within 3 ft of the box of approximately 3 mR/h must have a radiation hazard sign posted.

c. Any neutron background of 2.5 mR/h must be cleaned to below this level.

8. Shift Instructions for Contamination Control.

a. *Plating box.* At the beginning of every shift or before using during a shift, all red gloves will be turned inside out and dropped into a clean plastic bag. All finished samples should be disposed of by pouring liquid into a plastic waste bottle; the empty sample bottles are to be bagged out and placed in a waste container. Remember that plastic bottles are burnable waste and glass bottles are nonburnable and must be separated. Replace aluminum foil used for cooling plates and damp wipe the floor of the box.

b. *Plating box.* At end of every shift, smear the face of the glass around each port and the floor in front of the box. Check smears with the count rate meter in room 208. Use X 0.5 scale and integrating "time-sec" of 11. A reading of 20 cpm (red line) equals 50 d/m. Clean each area until the smears do not exceed this rate.

c. *Cell area.* At the end of every shift, log in samples and store completed samples.

d. Every Sunday afternoon before 1600, damp mop both rooms 208 and 108.

e. Every 4-12 shift will check counter gas cylinders and note in the log book if more are needed.

f. Every 12-8 shift will empty waste cans in labs and in front of cells.

g. Every 8-4 shift will bag out liquid waste from the plating box.

9. Counting Room.

a. All alpha boxes and gamma tubes will be probed for alpha activity before leaving room 208.

b. All cards and tubes will be labeled with sample number and whether it is gross, Pu, etc.

c. Use count rate meter on all stainless steel plates. If the count rate needle indicates (1) over 300,000 c/m, reduce aliquot size by at least 10; (2) from 40,000 to 300,000, count one minute and run a one-minute background immediately after the sample duplicates; or (3) from 0 to 40,000, count four minutes.

d. For tantalum plates, the count rate meter may be used or a regular alpha counter. See (c) above for time.

e. If total counts check within 5%, calculate; if not, recheck by replating two more aliquots.

f. If a pulse is required, leave the plate and the sheet in the counting room. Do not post the results until after the work sheet is completed.

g. After completion of a series of alpha plates, check for contamination in the counting chamber by running a one-minute background. If background has increased, change the aluminum foil and try again. If this does not help, label instrument contaminated and leave for the day crew. (Also, make a note in the log.)

h. Be sure to throw out all plates when the work sheet is completed.

i. All gamma tubes will be transported in a wooden block to and from room 208 and placed in the "counting room" block. Do not leave the transporting block in the counting room.

j. All gamma tubes should be returned to room 208 immediately after the completion of the work sheet.

k. When reporting data on the counting sheet, be sure to include the calendar date and the hour in their respective places.

l. Do not forget the absorber factor on gross-gamma calculations.

m. Samples which require a gamma scan should be run in duplicate for better results from the computer program.

PROCEDURE FOR PACKAGING RADIOACTIVE SAMPLES
FOR SHIPMENT OUT OF BUILDING 7920

Samples that are shipped from Analytical Chemistry to facilities outside of Bldg 7920 must be packaged in such a manner as to completely contain the radioactivity. Operating Procedures and Safety Rules for the TRU Analytical Laboratory, Building 7920 (June 1980) describes the routine procedures for preparing samples for shipment. Special handling is needed for samples that are contained in lead shielding carriers. Please observe the following procedure:

1. Place proper amount of sample in a flint glass bottle with plastic-lined screw cap.
2. Transfer bottle to transfer cubicle.
3. Place a lead shielding carrier on the shelf of the lazy susan and rotate to in-cell position. Carrier should be in a plastic bag to keep it clean.
4. Place sample vial in carrier and rotate to glove-box position. Tape the top onto the carrier with plastic tape. Make a "pull tab" on tape to facilitate removal with manipulators.
5. With usual precautions, bag carrier out of glove box, keeping plastic bag with as little free air space as possible.
6. Immediately place bagged carrier into another polyethylene tube and heat seal completely.
7. Place double bagged carrier in a paint can with cushioning material to prevent tipping or upsetting of carrier.
8. Tape lid on can and attach label with sample code and necessary information for recipient.
9. Fill out radiation tag and take to Health Physics Office for check-out.

October 1, 1981