MALLINCKRODT
Nuclear Medicine

June 13, 1997

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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Re: Report on May 14, 1997 Re-186 Thumb Contamination/Shallow Extremity Dose Incident at the Mallinckrodt Maryland Heights Missouri Facility

Mallinckrodt Inc. hearby submits a report according to the requirements of 10 CFR 20.2203 (a) (2) (I) regarding the May 14, 1997 incident in which a Maryland Heights Radiation Worker received a localized extremity dose in excess of regulatory limits as a result of a failure to conduct proper personal contamination surveys. The failure led to subsequent off site low level contamination of his vehicle and his residence.

I. Details of the Incident

NOTE: The following accounts leading up to the notification to the Health Physics Department (HPD) on the morning of May 15, 1997, were obtained from interviews with the individual.

May 14, 1997

<u>On Site</u>

On Wednesday, May 14, 1997, the individual involved in the incident was working on a Re-186 process within the Iodine/Selenium (I/Se) Laboratory. The individual had been working on the Re-186 process throughout the day. The Re-186 process is performed within a hot cell and the majority of the process involved the use of manipulators.

The individual was not contaminated during the process since he left the lab on many occasions, conducted personal contamination survey and did not detect any personal contamination. Subsequent investigation by HPD and radiation metrology showed that the contamination monitor was calibrated and functioning normally.

At approximately 1:00 PM, the individual completed the manufacturing portion of the process, assisted with a different process in the same laboratory.

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At 3:00 the individual began the waste handling portion of the process. The waste handling portion of the process involved inserting process waste into shielded waste container (overpack) buckets from the side of the hot cell. The individual changed his gloves approximately three times during the waste handling.

At approximately 3:30 PM, the individual left the I/Se Laboratory and entered the Decon I Laboratory, which is adjacent to the main laboratory exit (air lock). The individual stated that he noticed the back end of an activity transfer cart as it was leaving the air lock. The activity transfer cart is utilized for transporting raw material to the Other Invivo Department from the Cyclotron Chemistry Laboratory. The cyclotron raw material is deposited and briefly stored in the activity transfer box which is a shielded receptacle for receipt of cyclotron raw material. The individual then exited the Decon I Laboratory and entered the air lock to conduct his personal contamination survey. The individual stated that when he removed the GM pancake probe from its shielded holder the personal contamination monitor indicated that it was detecting a source. The individual stated that he assumed that the meter reacting to the source that was just deposited into the activity transfer box and he did not realize that he had personal contamination. The individual failed to resurvey himself at another air lock check out monitor upon assuming that the meter was detecting elevated background. The individual then failed to conduct the required secondary personal contamination survey with a hallway scintillation meter. The individual stated that he was in a rush due to personal commitments and forgot to conduct the secondary personal contamination survey with the hallway scintillation probe. At approximately 3:35 PM the individual went to his office, which is an unrestricted area, and did paper work for the remainder of his time on site. At approximately 5:00 PM, the individual removed his work shoes.

Off Site

At approximately 5:30 PM, the individual left the facility and went directly to a soccer practice which he was coaching. The individual stated that he only handled a soccer ball and some boundary cones, while at the practice.

The individual left the soccer practice and drove directly to his mother's house. The individual visited briefly and spent most of his time in the kitchen and a small amount of his time in the garage obtaining a soda. The individual then went directly to his home. The individual went to the dog kennel in his backyard. He met his wife and daughter who were already in the kennel. The individual washed his hands while he was in the kennel.

The individual went into his home, washed his hands in the kitchen, and then went directly to bed.

May 15, 1997

Off Site

The individual woke up at approximately 2:30 AM, took a shower, and left for work at approximately 3:00 in the same vehicle which he had driven from work the previous evening. The individual arrived at his normal scheduled work time of 4:00 AM.

On Site

Upon entering the facility, the individual was informed, by the Security Department, that he was restricted from radiation or radioactive material areas as a result of an elevated urine analysis result. The individual had submitted a urine sample, according to normal procedure, the previous evening and HPD had informed Security of the individual's restriction. The Security Department is utilized to intercept facility employees as they come on site whenever any restriction is made. The individual submitted a second urine sample and it was analyzed at approximately 6:15 AM. The individual stated that upon notification of the second urine analysis results he became concerned [illegible]ceeded to conduct a personal contamination survey with the hallway scintillation meter in Building 600.

At approximately 6:20 AM, the individual detected significant external contamination on his left thumb. He stated that he had attempted to decontaminate his finger but was not successful. He then reported to the HPD Laboratory.

II. Response to the Incident

On Site

At approximately 6:30 AM, an HPD representative conducted additional personal contamination surveys on the individual when he arrived at the HPD Laboratory. A thorough whole body contamination survey was conducted. They discovered that there was significant skin contamination on the individual's left thumb. Please refer to Attachment I for additional details.

The Radiation Safety Officer was notified at approximately 6:45 AM. Upon notification of the individual's contamination, the RSO instructed the HPD representative to begin assessment of all the areas which the individual had been during the past day for contamination surveys.

At approximately 7:00 AM HPD began to interview the individual regarding the processes he was had been working and the areas he had been in during the past day.

At 7:30 the personal contamination survey of the individual was completed for dose assessment. At approximately 7:30 AM, HPD representatives were dispatched to investigate possible spread of contamination to individuals who were either with or near the area which the individual had worked. Contamination investigation was also being conducted upon the hot cell and laboratory areas where the individual had worked. HPD wipes and surveys indicated that there were no cross contamination concerns on the hot cell or the laboratory work area. There were no individuals who reported external contamination to HPD before or after the incident was discovered.

The individual then escorted HPD to the office and vehicle. The HPD conducted contamination wipes and surveys in the office area and completed the survey at approximately 8:30 AM. HPD also conducted contamination wipes and surveys on the individuals vehicle. The vehicle surveys were completed at approximately 9:00 AM. There was low level contamination detected in the office and the vehicle. Please refer to Attachment I for additional details.

The individual's personal contamination was not removable with soap and water. A bleach and water solution was then used successfully, to significantly reduce the contamination on the individual's thumb. Although the bleach solution ultimately reduced the skin contamination levels, it required repeated applications.

At approximately 10:00 AM the individual's wife, who also is employed as a radiation worker at the Maryland Heights facility, was contacted and a thorough external personal contamination survey was conducted. At approximately 2:30 PM a urine sample from the individual's wife was analyzed. External contamination surveys and urine analysis showed that the individual's wife was not contaminated.

During the following few hours HPD was involved with conducting additional interviews with the individual, verification of contamination survey data, informing management of the incident, conducting dose calculations, and conducting off site low level decontamination.

At 1:30 PM, CT Mallinckrodt calculated that the approximate shallow dose equivalent-maximal extremity, in excess of 250 Rads and therefore required immediate notification to the NRC.

At approximately 4:20 PM, Mallinckrodt contacted Region III to inform them of the incident. At 4:34 PM CT, Mallinckrodt reported the incident to the NRC Operations Center according to the requirements of 10 CFR 20(a) (1) (.

Off Site

The HPD interviewed the individual regarding all the areas which he had been and all other individuals with whom he came in contact with between leaving work on May

14, 1997 and returning to work on May 15, 1997. The individual stated that he had gone directly to a soccer practice after leaving work.

The individual stated that he did not have any contact with individuals during his soccer practice. The individual stated that he only handled the soccer ball and the boundary cones while he was at soccer practice. The soccer ball and boundary cones were in the individual's vehicle when the incident was discovered. HPD contamination surveys showed that the soccer ball and the boundary cones were not contaminated. Please refer to Attachment I for additional details.

The HPD then proceeded to conduct an off site contamination investigation using a portable wipe counter, and a portable contamination survey meter. At approximately 11:00 AM, the HPD representative and the individual went to the individual's residence. Wipes and contamination survey, with a GM pancake probe, showed that there was some minor contamination in the kitchen, bathroom, and kennel. The contamination was removed with damp towels. Subsequent contamination surveys showed that the contamination was removed. The clean up materials were all retained and brought back to the facility. The wipes were eventually counted in the HPD Laboratory upon return to verify that all contamination had been removed.

At approximately 1:00 PM, the HPD representative and the individual went to the individual's mothers residence. Contamination wipes and surveys were conducted. Survey results showed that there was no contamination at his mother's residence.

On the evening of May 15, 1997, the HPD conducted personal contamination surveys on the individual's two year old daughter. There was no external contamination detected. The child's diapers were also saved for two weeks following the incident. Assays of the contents of the diapers with gamma spectroscopy showed that there was no internal contamination in the child. Also, additional contamination surveys were conducted at the individual's mother's residence and the individuals residence. There was no contamination detected at either of the locations.

May 16, 1997

At approximately 7:00 AM, two NRC Region III inspectors arrived at the Maryland Heights Facility to inspect the response to the incident, off site decontamination efforts, and Mallinckrodt's skin dose calculations.

The RSO and the inspectors discussed the details of the incident. The inspectors were then escorted to the I/Se Lab and reviewed the details of the process.
The NRC inspectors and a group of Mallinckrodt personnel went to the individual's home, conducted confirmatory surveys and interviewed the individual.

The NRC inspectors then returned to the facility, conducted additional interviews, and held a close out meeting with HPD staff members and Mallinckrodt management representatives present. The NRC inspectors stated that they felt the Mallinckrodt response to the incident was satisfactory, and noted that all off site contamination was successfully controlled.

III. Cause of the Incident

The results from the investigations showed that the personal contamination and the off site low level contamination were not a result of deliberate or intentional action.

A. Personal Contamination/Skin Dose

It was estimated that the individual became contaminated at approximately 3:00 PM on May 14, 1997. The exact cause of the personal contamination is uncertain. The personal contamination may have occurred while taking off his contaminated gloves or as a result of a pin hole sized puncture within one of the pairs of gloves.

Glove Removal

The individual stated that he remembered taking off his left glove first and the individual had contamination on his right wrist. It is conceivable, but impossible to substantiate, that the individual could have contaminated his left thumb from his right glove while taking off his right glove. The presence of the contamination on the right wrist would indicate that there could have been contamination present on the top opening of the glove.

Hole in the Glove

The individual changed gloves approximately three times while handling the waste. The individual disposed of all but one pair of his used gloves into a shielded waste container ("overpack"); the one pair of gloves which were not thrown in the overpack were placed into the hot cell. These gloves were discovered during the beginning of the investigation. They were taken from the hot cell and tested for leaks on a later date, after the Re-186 on the gloves decayed to lower activity levels. Two separate leak tests were conducted. The gloves were first filled with water and there were no leaks observed. Secondly, the gloves were filled with nitrogen gas and submersed under water. There were no leaks observed.

B. Inadequate Personal Contamination Survey/Off Site Low Level Contamination

The off site, low level contamination occurred because:

1. The individual did not survey himself properly upon leaving the I/Se Lab.
2. The individual failed to conduct a secondary personal contamination survey with the hallway scintillator.

As a result of this failure, the individuals personal contamination was undetected and low level off site contamination of the individual's vehicle and residence occurred.

IV. Dose to the Individual

Dose estimates were conducted using the Varskin Mod 2 software program. A consultant was utilized for a second independent calculation of the skin dose.

During the May 29, 1997 NRC incident inspection close out meeting at the Maryland Heights Facility, the NRC and Mallinckrodt discussed the fact that the skin thickness, where the contamination/dose was located, was significantly greater, approximately 30 mg/cm^2, because the location was on a callus area of skin. The preliminary extremity dose value for both a 7mg/cm^2 or a 30 mg/cm^2 are as follows:

Mallinckrodt	7mg/cm^2=609 Rads	30mg/cm^2=290 Rads
Mallinckrodt Consultant	7mg/cm^2=467 Rads	30mg/cm^2=241 Rads

Mallinckrodt believes a more accurate extremity dose estimate may be obtained using a 30 mg/cm^2 instead of 7 mg/cm^2 since the location of the dose was located in a callus area. The absence of any observed biological effects, such as erythema, support the dose estimates which are indicative of dose to a higher thickness of skin. The individual has been under the supervision of a nuclear medicine physician since the incident occurred. The physician has stated that there will likely be no short term effects as a result of the exposure since there have been no observable effects as of yet. Please refer to Attachment I for the factors used for the dose estimate calculation.

Photos of the individual's thumb are being taken on a frequent basis. The photos do not indicate the presence of any adverse reaction as a result of the skin dose.

V. Corrective Actions

The intent of the corrective actions is to address the root cause of the personal contamination and enhance systems to significantly reduce the likelihood of similar occurrences in the future.

Corrective actions currently under investigation by Mallinckrodt are focused on methods to either eliminate direct handling waste/glassware or to avoid direct handling of the waste/glassware by use of tools. Although there are other processes in which waste handling with gloved hands does not occur, the evaluation has also included the review of all batch sheets and SOP's which involve the handling of radioactive material. The purpose of this review is to insert any steps regarding reminders for the selection and type of remote handling tools and protective clothing. Please refer to Attachment II for additional details regarding the corrective actions.

We are also investigating solutions which include fewer administrative controls and an increase in engineering controls. The facility is currently evaluating the possibility of a site wide portal monitoring system as an engineering control to address the issue of possible off site contamination.

VI. Conclusion

This incident was very serious. The plant has placed evaluation of system and their enhancement and review at a high priority. Additional training and reminder sessions related to personal contamination surveys have already occurred. All facility personnel have been made aware of the incident.

There does not appear to be any short term effects to the individual's skin as a result of the dose. The individual has been under the constant examination of a nuclear medicine physician and photographs of the individual's thumb have been taken frequently.

The plant personnel have been working openly with each other to communicate, evaluate and possibly enhance safety and expectations regarding personal contamination survey techniques and protective clothing.

The facility has placed priority and resources into the issue of radioactive contamination prevention. Mallinckrodt has written a reference SOP for selection and use of personal protective equipment for radioactive contamination protection at the Maryland Heights Facility. The facility is the process of reviewing, for possible enhancement, SOP's and batch sheets which involve the use of radioactive material. The facility intends to incorporate additional engineering controls into the personal contamination survey process.

Please contact me at (314) 770-7981 if you wish to discuss this matter or if you would like to schedule a meeting to discuss this matter further.

Sincerely,

Daniel Riemer
Radiation Safety Officer
Mallinckrodt Inc.,
Maryland Heights Facility

Attachments

cc: Mr. Roy Caniano
Acting Deputy Director of Division of Materials Safety
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Chair, Maryland Heights Radiation Safety Committee
Mallinckrodt Inc.

Maryland Heights Radiation Safety Committee

Radiation Worker Re-186 Shallow Extremity Dose Assessment

June 13, 1997

Calculations were performed by Mallinckrodt, Inc. and by an independent consultant retained by Mallinckrodt, Inc. A preliminary shallow extremity dose value has been determined. This dose will be finalized when our consultant provides Mallinckrodt, Inc. with a final report. The dose was calculated using a skin depth of 30 mg/cm^2 as well as 7 mg/cm^2. The thumb area where the contamination was most prominent is a callus area. A dose calculated at a depth of 30 mg/cm^2 is a more accurate measure of dose to biologically sensitive tissue.

Facts:

1. Worker stated that he left the lab area at 1530 instead of 1730, on 14MAY97, which was the original calculation time. Worker actually began handling Re-186 wastes at 1500. This 1500 time will be used to be the most conservative time at which the contamination could have occurred.

2. He had 500,000 cpm, at ½", on his left thumb at 0730 on 15MAY97.

3. The summation of the activities are based upon measured count rates at his home and were measured at a distance of ½" from the contaminated surfaces using an HP-260 GM probe.

4. Contamination in his vehicle was measured with a Ludlum 44-21 probe on contact with the surfaces in question. Vehicle was not used after ~0600 on 15MAY.

5. The shoe laces were measured with a 44-21 probe at ½" from the surface. The shoes were removed by the worker at ~1700 on 14MAY97 and not handled again prior to survey.

6. Worker left home and did not handle any items at his residence after ~0300 15MAY97.

Calculation of Efficiency Factors

A Re-186 source was manufactured to use in calculation of efficiency factors. The activity was determined by gamma spectroscopy to be 1.345 µCi on 21MAY97 at 1200.

On 21MAY97 @1525, contact readings were taken in air and with a 1" acrylic backing for an estimation of the backscatter contribution.

Air 390,000 cpm, Ludlum 44-21 probe, absolute efficiency is 0.134
Acrylic 400,000 cpm, Ludlum 44-21 probe, absolute efficiency is 0.138

Difference of ~2.5%.

On 21MAY97 @ 1645, readings at a distance of ½" were taken with an acrylic backing with the Ludlum 44-21 probe.

Air calculation based upon the 2.5% difference outlined above, absolute efficiency is 0.064
Acrylic 190,000 cpm, absolute efficiency is 0.066

Acrylic was used to simulate the backscatter encountered from the body area. Assessments were compared to measurements made with the source in air. It was found that the backscatter was 2.5% higher from the acrylic source compared to measurements taken in air and on the table surface. Allowances will be made for the change in efficiency based upon what was measured; i.e. skin versus a door handle.

The ratio of efficiency for the HP-260 to Ludlum 44-21 probes at a ½" distance was 1.875 with the HP-260 probe being more efficient.

All values below are absolute efficiency.

1.	HP-260 =	0.120 @ ½" w/o acrylic
2.	44-21 =	0.066 @ ½" with acrylic
3.	44-21 =	0.064 @ ½" w/o acrylic
4.	44-21 =	0.138 contact with acrylic
5.	44-21 =	0.134 contact w/o acrylic

These values are slightly higher (better efficiency) than was first reported to the NRC due to a more accurate determination of the activity in a point source geometry versus the original 5 ml geometry.

Summary of all activities found. Refer to efficiency numbers above. All cpm values are net cpm.

Worker's Office

1.	3000 cpm, shoe laces, Eff. 3	46875 dpm at 0830 15MAY97
	Applied activity from 1500 to 1700 on 14MAY97	53586 dpm at 1500 14MAY97

Worker's Vehicle

1.	2000 cpm, steering wheel, Eff. 5	14925 dpm at 0900 15MAY97
2.	800 cpm, shift knob, Eff. 5	5970 dpm
3.	500 cpm, head light switch, Eff. 5	3731 dpm
	Total	24627 dpm at 0900 15MAY97
	Applied activity from 1500 14MAY97 to 0600 15MAY	28260 dpm at 1500 14MAY97

Worker's house

1.	3200 cpm, kitchen sink faucet handle, Eff. 1	26667 dpm at 1200 15MAY97
2.	3900 cpm, kitchen towel, Eff. 1	32500 dpm
3.	2100 cpm, hot faucet handle hall bath, Eff. 1	17500 dpm
4.	200 cpm, toothpaste container hall bath, Eff. 1	1667 dpm
5.	17000 cpm, bath towel hall bath, Eff. 1	141667 dpm
6.	220 cpm, kennel sink handle, Eff. 1	1833 dpm
7.	4680 cpm, clothing worn by Jeff, Eff. 1	39000 dpm
	Total	260833 dpm at 1200 15MAY97
	Applied activity from 1500 14MAY97 to 0300 15MAY	306262 dpm at 1500 14MAY97
	Total Found on Items	388108 dpm at 1500 14MAY97

Worker's skin contamination at 0730 15MAY97.

1.	500000 cpm, left thumb, Eff. 2	7575758 dpm at 0730 15MAY97
2.	60000 cpm, right wrist, Eff. 2	909091 dpm
3.	7000 cpm, neck area below left ear, Eff. 2	106061 dpm
	Total	8590909 dpm at 0730 15MAY97
	Decay Corrected Total	9746005 dpm at 1500 14MAY97
	with the added 388108 dpm, Grand Total	10522221 dpm at 1500 14MAY97
		4.73974 μCi at 1500 14MAY97

3.98% of the total activity remaining on his thumb was found on various items during surveys. From this assessment, we believe that the contamination was relatively fixed to his skin based upon the low levels of contamination found on items he had handled and the great effort required for decontamination of the skin. To be conservative, we have doubled the amount of contamination found at his home, vehicle and office and add this amount to the total activity found. An additional 388108 dpm, at 1500 14MAY97, was added to the total activity.

Chronology of activity on worker's skin.

Starting at 1500 on 14MAY97. Determined to be the time of the contamination event. Activity on thumb calculated to be 4.73974 uCi.

Starting at 1700 on 14MAY97. 10522221 dpm - 53586 dpm = 10468635 dpm corrected to 1700 = 4.64404 uCi

Starting: 0300 on 15MAY97. 10468635 dpm - 306262 dpm = 10162373 dpm corrected to 0300 = 4.17635 uCi

Starting: 0600 on 15MAY97. 10162373 dpm - 28620 dpm = 10134113 dpm corrected to 0600 = 4.07030 uCi

He was found to have 500000 cpm, at ½", on left thumb and lesser amounts on right hand and left shoulder on 15MAY97 at 0730. 3.41250 uCi on the left thumb. The maximally exposed extremity was due to the dose received on the left thumb. All calculations are based upon activity from the left thumb measurements.

All of the following readings were contact readings.

15MAY97 @ 1000, Left thumb ~25000 cpm>bkg, right wrist ~60000 cpm, 0.081603 uCi

16MAY97 @ 1000, Left thumb ~19000 cpm>bkg, right wrist ~40000 cpm, 0.062019 uCi

19MAY97 @ 0830, Left thumb ~1900 cpm>bkg, right wrist ~400 cpm, 0.0062019 uCi

20MAY97 @ 1000, Left thumb ~1500 cpm>bkg, right wrist ~300 cpm, 0.0048962 uCi

21MAY97 @ 0530, Left thumb ~1000 cpm>bkg, right wrist ~300 cpm, 0.0032641 uCi

21MAY97 @ 1850, Left thumb ~400 cpm>bkg, right wrist ~bkg, 0.0013057 uCi

22MAY97 @ 1200, Left thumb ~400 cpm>bkg, 0.0013057 uCi

27MAY97 @ 1000, Left thumb ~250 cpm>bkg, 0.00081603 uCi

28MAY97 @ 0930, Left thumb ~250 cpm>bkg, 0.00081603 uCi

29MAY97 @ 0730, Left thumb ~200 cpm>bkg, 0.00065283 uCi

30MAY97 @ 1000, Left thumb ~200 cpm>bkg, 0.00065283 uCi

02JUN97 @ 1200, Left thumb ~bkg

Dose Calculations for Various Time Periods from VARSKIN MOD2 Output: 7 and 30 mg/cm^2 Skin Depth

Note: All of these dose values were generated with VARSKIN MOD2 witnout any modification to the dose calculation algorithm. Mallinckrodt's consultant has indicated that corrections need to be made to the VARSKIN MOD2 output for this isotope and his final dose assessment will include these modifications. The dose values below include all conversion electrons above 65 keV.

TIME PERIOD	NUMBER OF MINUTES	DOSE IN RADS 7 mg/cm^2	DOSE IN RADS 30 mg/cm^2
14MAY97 @1500 to 14MAY97 @ 1700	120	64.2	30.5
14MAY97 @1700 to 15MAY97 @ 0300	600	314	150
15MAY97 @0300 to 15MAY97 @ 0600	180	84.8	40.4
15MAY97 @0600 to 15MAY97 @ 0730	90	41.3	19.7
15MAY97 @0730 to 15MAY97 @ 1000	150	57.8	27.5
15MAY97 @1000 to 16MAY97 @ 1000	1440	13.3	6.31
16MAY97 @1000 to 19MAY97 @ 0830	4230	29.6	14.1
19MAY97 @0830 to 20MAY97 @ 1000	1530	1.07	0.509
20MAY97 @1000 to 21MAY97 @ 0530	1170	0.646	0.308
21MAY97 @0530 to 21MAY97 @ 1850	800	0.295	0.140
21MAY97 @1850 to 27MAY97 @ 1000	8110	1.20	0.569
27MAY97 @1000 to 29MAY97 @ 0730	2730	0.251	0.120
29MAY97 @0730 to 02JUN97 @ 1200	6030	0.444	0.211
	Total =	608.906	290.367

A. Completed Corrective Actions

1. Restriction of the worker from radioactive material areas

On May 15, 1997, as a result of receiving a localized radiation dose to the extremity in excess of the annual limit, the worker involved in this incident was restricted from working with or around radioactive materials for the remainder of the calendar year.

2. Meetings and communications regarding the incident

On May 15, 1997, there were one on one discussions between the individual's supervisor and the individual's coworkers.

Beginning on May 16, 1997, the RSO conducted ongoing small group discussions with plant personnel regarding the incident. The RSO walked throughout the plant and approached some plant personnel and discussed aspects of the incident. Proper personal contamination survey techniques and appropriate protective clothing were also discussed with many of these individuals.

On May 19, 1997, the Health Physics (HP) Department reviewed the root cause of the incident and discussed proper personal contamination survey techniques to be communicated to plant staff in the event that questions were asked.

On May 20, 1997, the Maryland Heights Radiation Safety Committee (RSC) reviewed the root cause and discussed corrective actions for this incident. The cause of the incident as well as short term corrective actions (i.e. relocation of the activity transfer box, review of plant wide Standard Operating Procedures (SOP's) and batch sheets) and long term corrective actions (i.e. evaluation of site wide portal monitors) were discussed.

On May 22, 1997, distribution of a site wide memo to all plant employees, with copies to the Corporate Director of Regulatory Compliance and the General Manager of Nuclear Medicine, regarding details of the incident and reminders for proper personal contamination survey techniques was initiated.

On June 3, 1997, during the monthly supervisor safety meeting, a presentation of the details of the incident was made and instructions for the review of Standard Operating Procedures (SOP's) were given.

3. Relocation of the cyclotron raw material activity transfer box

On May 28, 1997, the cyclotron raw material activity transfer box was relocated to the inside of the lab from the air lock area. At the time of the incident, when the individual was exiting the lab, there was activity present in the transfer box. The individual observed the activity transfer cart leaving the area. After removal of the detector from its shield, an observed increase in count rate was assumed to be caused by the activity in the transfer box instead of possible personal contamination.

4. Suspension of the Re-186 process

On May 22, 1997, the Re-186 research project was temporarily suspended until enhancements on existing waste disposal procedures could be implemented/evaluated. Health Physics will review this enhanced SOP and batch sheet prior to reinstating the process.

Departments which handle radioactivity will also be evaluating enhancements to existing waste disposal procedures for their departments during the SOP review.

5. Relocation of the hallway scintillation contamination monitor

On May 16, 1997, the secondary survey station, utilizing a scintillation contamination monitor, was relocated to the hallway between the lab exit and the front door and front office area from the lunchroom hallway. This will act as a visual reminder for people to conduct their secondary personal contamination survey after conducting a primary contamination survey.

6. Specific written communications

On June 3, 1997, HP began distribution of information regarding reminders for the use of protective clothing and remote handling tools for handling contaminated items (i.e. glassware).

Also, this document mentioned the requirements of double gloving and the use of thick gloves and sleeve guards.

Additional memos will be forthcoming.

7. Engineering team

The Manufacturing Department has a team of personnel, including Health Physics staff, assembled to evaluate engineering controls for the purpose of dose reduction. On June 5, 1997, the manager of the Manufacturing Department instructed the team to add contamination protection to their mission.

B. Corrective Actions Which are In-Progress

1. Site wide evaluation of SOP's

On June 3 and June 4, 1997, the RSO held a meet with facility supervisors and managers to discuss the importance of proper selection and use of protection clothing and remote handling tools. The RSO instructed the attendees that they were to evaluate all options so that personal contamination could be reduced or eliminated. (i.e. possible one time use of glassware.)

2. Site wide contamination protection SOP

HP is currently compiling all existing contamination protection procedures into a site wide Contamination Protection SOP. This will be a document which all existing and future SOP's will reference, if appropriate.

3. Evaluation of a portal type monitoring system

On May 20, 1997, the RSO recommended, and the RSC supported, the evaluation of a portal monitor system at the facility. Currently HP, with the assistance of plant supervisors and management, is evaluating the available portal type monitoring units and their optimum location. The site wide portal monitoring system proposal will be presented to upper management by the end of July, 1997.

4. Posting of reminders by lab exits

The Manufacturing Department will be posting signs at lab exits which will remind workers to performing personal contamination surveys when exiting radioactive materials work areas. The posting will be completed by the end of June, 1997