

State of North Carolina  
Department of Environment,  
Health and Natural Resources  
Division of Radiation Protection

James B. Hunt, Jr., Governor  
Jonathan B. Howes, Secretary  
Dayne H. Brown, Director



10-21-96

R.L. Woodruff  
USNRC Region II  
Suite 2900  
101 Marietta St. N.W.  
Atlanta, GA 30323

RE: North Carolina Incident No. 96-02

Dear Mr. Woodruff:

Enclosed is a copy of correspondence between this Agency and Duke University concerning a high dosimetry report first reported to the NRC September 16, 1996. We have acknowledged Dr. Plott's report and findings. Duke University is scheduled for an inspection next week (Oct. 28), and the dosimetry program will be covered. This inspection was scheduled prior to and independent of this incident.

Should there be any questions concerning this incident please contact this off at (919) 571-4141.

Sincerely,

  
Grant Mills, HP NCDRP

9611080240 961021  
PDR STPRG ESGNC  
PDR

3825 Barrett Dr.,  
Raleigh, North Carolina 27609-7221  
Voice 919-571-4141



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Duke University  
Duke University Medical Center  
DURHAM, NORTH CAROLINA  
27710

Occupational and Environmental Safety Office  
RADIATION SAFETY DIVISION

BOX 3155  
TELEPHONE (919) 684-2194, 684-6852  
FAX (919) 684-2422

October 15, 1996

Mr. Grant Mills, Health Physicist  
Radioactive Materials Section  
NCDEHNR - Division of Radiation Protection  
3825 Barrett Drive  
Raleigh, North Carolina 27609-7221

RECEIVED  
OCT 17 1996

RADIOACTIVE MATERIALS

Subject: Report of Overexposure for License Number 032-0247-4

Dear Mr. Mills:

On September 6, 1996, a representative of Siemens Dosimetry Services contacted us regarding the results of two quarterly TLD whole body badges. For the period of April 5 through July 5, one badge (Account 78434, Badge 014) received 0 mrem deep dose, 0 mrem eye dose, and 2150 mrem shallow dose; the other badge (Account 78434, Badge 017) received 27650 mrem deep dose, 27650 eye dose, and 92440 mrem shallow dose.

We immediately identified the Authorized User for whom these employees work. (Both individuals are graduate students in the Department of Pharmacology.) The User is authorized to possess 5 millicuries (mCi) of iodine-125, 150 mCi of phosphorous-32 (P-32), 20 mCi of hydrogen-3, 1 mCi of carbon-14, and 50 mCi of sulfur-35. Because the badge results indicated high shallow doses, our investigation concentrated on P-32 as the source of exposure.

Radiation Safety records indicate that the laboratory received approximately 247 mCi of P-32 from April to July; records also indicate that approximately 133 mCi was placed in the waste collection drums during the quarter. Because P-32 is a pure beta emitter (and cannot contribute to deep dose), we contacted Siemens to request a glow curve review by a corporate health physicist.

Late in the afternoon on September 13, a Siemens health physicist confirmed the shallow dose of 92440 mrem for Badge 017. However, the raw data indicated no deep dose of that magnitude; the deep dose would be changed from 27650 mrem to 10 mrem. Nonetheless, because of the shallow dose of Badge 017, this overexposure was reported to Mr. Jerry Hightower on September 16, the day we received the Siemens Radiation Exposure Report.

The Authorized User and the employees were interviewed by Radiation Safety personnel on September 11 and September 20. Both times, the employee with the reportable exposure stated he had not worked directly with radioactive materials during the period in question. He received no exposure from dental x-rays, medical x-rays, or nuclear medicine procedures. He also stated that the badge remained in his desk drawer for almost the entire quarter; it never left the lab. (His desk is actually located in the "cold zone" of the laboratory.)

The room next door is the radioactive materials area which includes a hood, refrigerator, and waste storage containers; only quantities less than 2 mCi P-32 are used in this room. (Activities greater than 2 mCi are used in a room down the hall.) We surveyed the area, reviewed the lab's radiation safety notebook, and verified the radiation safety training records of the employees. Security of radioactive materials appeared adequate. As an added precaution, however, urine samples were collected on September 20 from the twelve staff members; no sample had detectable levels of P-32.

The Authorized User stated that two other graduate students perform most of the P-32 work in his lab. According to the Radiation Exposure Report, these two individuals received 0 and 70 mrem shallow dose during the same monitoring period.

To date, we can offer no explanation for the high dose to Badge 017 nor for the 2150 mrem shallow dose to Badge 014. The interviews with the Authorized User and the employees have yielded no information to substantiate deliberate exposure of the dosimeters. In addition, during our visits to the lab, we saw no indication of poor radiation safety techniques or lack of administrative control of radioactive materials. The Authorized User and the two students described the dosimetry results as "incredulous."

You and Mr. Hightower visited the laboratory and interviewed the employees on September 25, 1996. To complete your files, the following information is attached to this report of overexposure:

ITEM	DATE	DESCRIPTION
Receipt/disposal forms from Authorized User	April - June 1996	Indicate lab receipt of 247 mCi and disposal of 133 mCi P-32
Letter from Inid Deneau, Siemens Health Physicist	September 13, 1996	Changes deep dose to 10 mrem and confirms shallow dose of 92440 mrem
Radiation Exposure Report from Siemens	Printed August 21, 1996 Received September 16, 1996	Laboratory personnel dosimetry results for April - July 1996
Letter from Sander Perle, Director of ICN Technical Operations	October 15, 1996	Confirms deep dose of 10 mrem and changes shallow dose to 60050 mrem

Siemens Dosimetry Services (located in Illinois) was recently purchased by ICN Biomedicals, Inc., Dosimetry Division (located in California). Technical support has been inadequate during the transition. Ms. Inid Deneau, Siemens health physicist, reviewed the data and changed the deep dose on September 13. She now works for Landauer and was unavailable to provide assistance during the later phases of our investigation.

Last week, we reported another overexposure to Mr. Hightower which he referred to the Electronic Products Section. An employee who works with a mobile C-arm fluoroscopy unit recently received approximately 30 rem deep dose during a monthly monitoring period. The Radiation Exposure Report indicated the badge had been exposed to photon energies greater than 250 keV, an impossibility for C-arm equipment. We requested another analysis of the film and Mr. Sander Perle, Director of ICN Technical Operations, confirmed the results today. Because the film had been exposed to light during processing, a dose of 0 mrem will be assigned to the employee. (A formal written report will be filed with the Electronic Product Section.)

All Siemens badges are sent to Radiation Safety from the vendor. The badges are delivered and exchanged in the laboratories by Radiation Safety personnel. The badges are then brought to our office and shipped to the vendor for processing. From now on, all badges collected by Radiation Safety for processing will be monitored for contamination before shipment to the vendor.

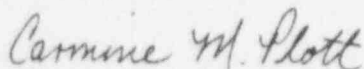
Although Mr. Perle is a welcome addition to ICN, he was unaware of the P-32 overexposure until Friday, October 11, when we called to request a second analysis of the x-ray film. At that time, we requested his review of the glow curves from Badge 017; we provided him copies of our investigation reports and the letter from Ms. Deneau. Consequently, two requests by Duke to re-analyze the glow curves of Badge 017 have yielded two changes to the assigned dose. Ms. Deneau changed the deep dose from 27650 mrem to 10 mrem; Mr. Perle changed the shallow dose from 92440 mrem to 60050 mrem.

The Siemens/ICN technical support staff should have initiated the second review of data prior to release of the Radiation Exposure Reports with the two overexposures. We have complained to Siemens/ICN about the lack of quality control. As a result of these interactions, we are confident with our decision to change vendors. By the end of the year, all participants in our personnel monitoring program will be provided Landauer badges. These badges will be shipped directly to the laboratories from the vendor. The employees will exchange their own badges and return them to Radiation Safety for shipment to the vendor for processing.

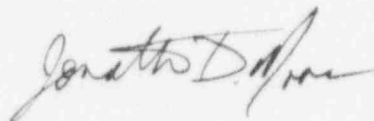
Our investigation of this incident has focused on potential willful exposure of the dosimeter in the laboratory. We cannot prove that Badge 017 was contaminated nor can we prove the reading is inaccurate. Since the employee admits he did not wear the badge regularly during the time in question, we feel the results do not reflect his true occupational exposure. However, the assigned shallow dose of 60 rem will remain in the employee's exposure history. The employee and the Authorized User will receive a copy of this letter and the letter from Mr. Perle confirming the latest assigned dose.

This overexposure was presented to the Duke University Medical Center Radiation Control and Radioactive Drug Research Committee on October 1, 1996. All records pertaining to the investigation are available for your review. If I may provide you with additional information at this time, please contact me at 684-2194.

Sincerely,



Carmine M. Plott, Ph.D.  
Radiation Safety Officer



Jonathan D. Moore, MS  
Dosimetry Chief

Attachments

cc: Xiang Wang, Ph.D.  
Xing Shen

## RECEIPTS (milliCuries)

Date	Isotopes				Source
	$^{32}\text{P}$	$^{35}\text{S}$	$^3\text{H}$	$^{125}\text{I}$	
4/2	0.5 /				
4/3	1.0 /				
4/9			5.0 /	1.0 /	
<del>4/11</del>		2.0 /			
4/13	50.0 /				
4/18	1.0 /			5.0 /	
Total:	54.5	2.0	5.0	6.0	

RSO WASTE COLLECTION DRUMS (milliCuries of each isotope placed in drum this month)

	Isotopes					
	$^{32}\text{P}$	$^{35}\text{S}$	$^3\text{H}$	$^{125}\text{I}$		
	0.770 + 16.5	1 + 1	0.05 + 0.055	0.41 + 945		
	+ 0.2 + 8	+ 3.5 + 0.01	+ 0.0, + 1.696	<del>0.41</del>		
	+ 8.5 + 12	Ta.001 + 6.71				
	+ 5.64 + 0.18	*				
	+ 0.24 + 0.010					
	+ 0.3.					
Total:	52.24	11.22	1.811	0.86		

OTHER DISPOSAL METHODS (milliCuries transferred to another Authorized User, gas release, etc.)

Date	Isotopes			To whom or brief description
Total:				

## SUMMARY BOX

Isotope	Previous Total on Hand	+ Receipts	- Sanitary - Sewer	- Waste - Drums	- Other	x Decay Factor	= Total on Hand (milliCuries)
<sup>32</sup> P	69.073	54.5		52.24		0.233	16.6
<sup>35</sup> S	8.37	20		11.221		0.789	13.53
<sup>3</sup> H	2.638	5.0		1.811		0.995	5.80
<sup>125</sup> I	—	6.0		0.86		0.707	3.63
<sup>14</sup> C	0.025					1.0	0.025



May 96

## RECEIPTS (milliCuries)

Date	Isotopes				Source
	$^{32}\text{P}$	$^3\text{H}$			
5/3	1.0 ✓				
5/10	25.0 ✓				
5/17	1.0 ✓				
5/21	2.0 + 1.0 + 5.0 ✓	5.0 ✓			
Total:	80	5			

## RSO WASTE COLLECTION DRUMS (milliCuries of each isotope placed in drum this month)

<del>exp</del> Isotopes					
	$^{32}\text{P}$	$^{35}\text{S}$	$^3\text{H}$	$^{125}\text{I}$	
	0.16 + 0.01	1 + 3.5	0.03 + 0.07	0.1	
	1.022 + 0.11	0.53	0.02 + 2.021		
	0.225 + 0.63		0.005 + 0.02		
	17.15 + 0.957		+ 0.05		
Total:	20.264	5.03	2.916	0.1	

## OTHER DISPOSAL METHODS (milliCuries transferred to another Authorized User, gas release, etc.)

Date	Isotopes			To whom or brief description
Total:				

## SUMMARY BOX

Isotope	Previous Total on Hand	+ Receipts	- Sanitary Sewer	- Waste Drums	- Other	x Decay Factor	= Total on Hand (milliCuries)
$^{32}\text{P}$	16.6	80 ✓		20.264		0.233	<del>13.2</del> 17.19 ✓
$^{35}\text{S}$	13.53			5.03		0.789	6.71 ✓
$^3\text{H}$	5.8	5 ✓		2.916		0.995	7.84 ✓
$^{125}\text{I}$	3.63			0.1		0.707	2.50 ✓
$^{14}\text{C}$	0.025					1.0	0.025 ✓

June 96

RECEIPTS (milliCuries)

Date	Isotopes					Source
	<sup>32</sup> P					
6/12	1.0	✓				
6/14	10.0	✓				
6/17	50.0	✓				
6/26	50.0	✓				
6/28	1.0	✓				
Total:	112					

RSO WASTE COLLECTION DRUMS (milliCuries of each isotope placed in drum this month)

Isotopes					
<sup>32</sup> P	<sup>35</sup> S	<sup>3</sup> H			
0.12 + 13	1	0.07 + 0.02			
+ 0.42 + 30.76		+ 0.015 + 0.03			
+ 16.5					
Total:	60.8	1	0.135		

OTHER DISPOSAL METHODS (milliCuries transferred to another Authorized User, gas release, etc.)

Date	Isotopes			To whom or brief description
Total:				

SUMMARY BOX

Isotope	Previous Total on Hand	+ Receipts	- Sanitary - Sewer	- Waste Drums	- Other	x Decay Factor	= Total on Hand (milliCuries)
<sup>32</sup> P	17.79	112		60.8		0.233	16.075
<sup>35</sup> S	6.71			1		0.789	4.505
<sup>3</sup> H	7.84			0.135		0.995	7.666
<sup>125</sup> I	2.50					0.707	1.768
<sup>14</sup> C	0.025					1.0	0.025



# Dosimetry Service

H.E. Division (Formerly SIEMENS Dosimetry Service)

September 13, 1996

Ms. Carmine Plott  
Duke University  
Enviro/Rad Safety  
Research Drive  
Durham, NC 27710

Cust #78434 (9645)

Dear Ms. Plott:

Badge numbers 014 and 017, both type 013's with April 5, 1996 wear dates, reported exposure readings of 2150 mrem shallow and 27560 mrem deep, 92440 mrem shallow respectively. Attached are the glow curves showing that valid radiation exposures do exist. Badge 014 is accurate as reported. Badge #017 indicated a high deep dose exposure along with an even higher shallow dose. The shallow dose is valid as you can see from the glow curve. The deep dose, however, is not. As you can see from the glow curves that a wrong path in the calculation was taken since the raw data indicates no deep dose of that magnitude. At the most, the deep dose may have been 10 mrem. The necessary subtraction will be made to the exposure history reflecting a dose of 10 mrem deep for the April wear period. No changes will be made to the shallow dose.

Please contact me if you have any questions.

Sincerely,

Inid S. Deneau  
Health Physicist



# GROUP FILE SELECTION

6-17879.018

Group #70000000

Page 1

Date Time TID Code ID Group #  
08/14/1996 00:28:19 3 200500 00000000

14.10

0.952 ECC  
2.241 NA

1217.90

High

0.241 ECT  
0.883 ECC  
104.7 NA

Open window  
(Shallow Edge)

Badge # 014

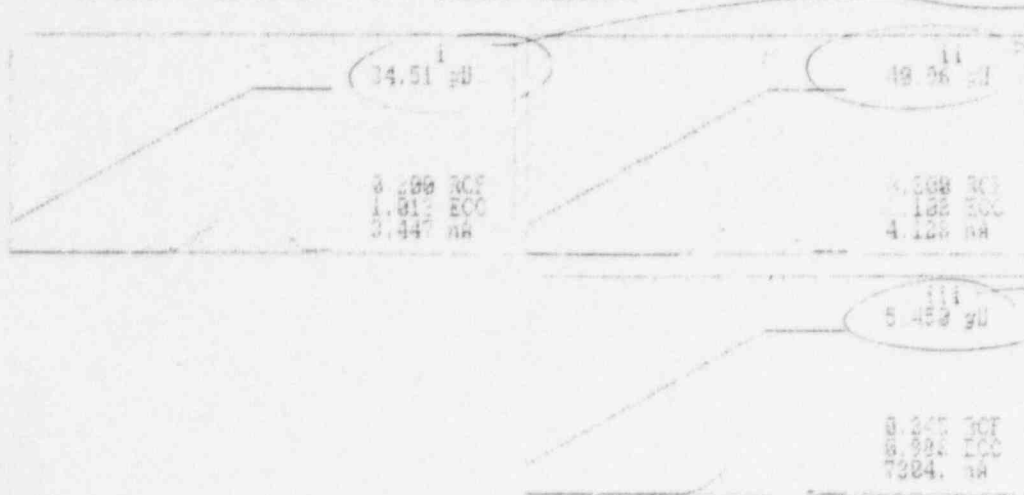
GROUP FILE SELECTION

E-03679.008

Group #0009647 Reader #

Page No. 1

Date 08/14/1996 20:05:45 3 166098 #0009645



Not high enough for min of a deep dose

Very high  
Open window (Shallow Dose)

Badge #017

Siemens Medical Systems Inc.  
Dosimetry Service  
2501 Barrington Road, Hoffman Estates, IL 60195  
Phone 800-888-1936 Fax (847) 304-7723

Accredited By  
The National Institute of Standards  
Through

Process Number	Customer Number	SHIP TO	Dosimeter Read	Report Printed	ALARA 13	Notice
5945	15455	78434	08/14/96	08/21/96		DEFP SHEP

DUKE UNIVERSITY  
WANG  
RESEARCH DE  
GUJAHAN NC

DUKE UNIVERSITY/HA  
ATTN DAVID JORGENSEN  
ENVIRO/RAD SAFETY  
RESEARCH DR  
DURHAM NC

27713

[illegible]

You should keep this Report !

*Cm Plott*  
10-15-96

October 15, 1996

Carmine Plott, Ph.D.  
DU/DUMC Radiation Safety Officer  
Director, OESO Radiation Safety Division  
DUMC Box 3155  
Durham, North Carolina 27710

Subject: Dose Evaluation of TLD Number 17 and Film Badge Number 20

Dear Dr. Plott,

Per our conversation yesterday regarding the re-assessment of TLD Number 17, wear date of April 5 to July 5, 1996, I have reassessed the final dose and am providing the following information:

Original dose report information

The following information was reported to Duke University in a report processed on August 21, 1996, Customer Number 15255 Process Number 9645.

1. DDE reported as 27.556 Rem
2. SDE reported as 92.443 Rem
3. LDE reported as 27.560 Rem

Dose Reassessment

After reviewing the dose report and raw data, it was obvious that the algorithm misidentified the energy path and therefore applied incorrect corrections in the various dose determinations. This was primarily due to the extremely high element response ratios. The data demonstrated that there should be very little DDE and LDE and the predominant exposure should have been in the SDE due to an exclusive exposure to beta radiation. During our conversation you mentioned that the only radionuclides the individual could have come in contact with were P-32, S-35, C-14 and I-125. The only radionuclide that would be capable of the high beta dose is most likely P-32.

ICN Dosimetry - the only way to know



ICN Dosimetry Division  
ICN Biomedicals, Inc.  
P.O. Box 13536  
Irvine, California 92713  
Tel: 1-800-251-3331, Nationwide  
714-545-0113

Carmine Plott, Ph.D.

Page 2

Assumptions used

1. TLD exposed to P-32
2. Fade Factor of 45 days applied to the TLD response (this is the middle of the wear period since the actual date of exposure is not known, and, this is industry standard in dosimetry practicing) If the maximum Fade Factor is used the total dose reassessed would increase by 5.16%.
3. The doses were assessed manually using the algorithm published by Harshaw/Bicron-NE Technology.
4. SDE was assessed using the NVLAP Category V using Sr-90/Y-90 (response used for assessing exposures to P-32).
5. DDE was assessed using the NVLAP Category IV using Cs-137.

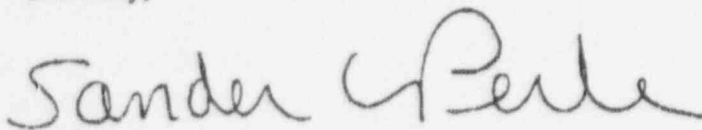
Dose Re-assessment

1. DDE is 12.7 mrem which would be reported as 10 mrem
2. SDE is 60.052 Rem which would be reported as 60.050 Rem
3. LDE is 12.7 mrem which would be reported as 10 mrem

I have enclosed an evaluation of Film Badge Number 20, type 11 with a July 1, 1996 wear date, conducted by Scott Kohlman. As you will note, the film was damaged during processing.

If you require further information or clarification, please contact me at (800) 548-5100 Ext. 2306.

Sincerely,



Sander C. Perle  
Director, Technical Operations

cc: S. Nemecek  
T. Ohlhaber  
L. Biacchi



**EVENT REPORT COVER PAGE**

**AGREEMENT STATE**

**EVENT REPORT NO.** NC- 96- 02

**DATE:** Oct. 21, 1996

**TO:**

**Deputy Director  
Office of State Programs**

**SUBJECT:** Possible Overexposure at Duke Univ.  
Medical Center, April - July 1996

**STATE:** North Carolina

**Signature and Title:** Grant Mills, NC/HP

080057

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