

HEALTH PHYSICS OFFICE
Directorate of Technical Services

30 November 1959

ARM2.941209.133b

Report on the Investigation of an
Overexposure of an Individual to Ionizing Radiation

1. On 22 October 1959, the Health Physics Office, U. S. Army Chemical Warfare Laboratories, received a telegram (Incl 1) from Lexington Signal Depot, that a film badge worn by SP₄ Kenneth H. Kary, US 55 622 217, had been exposed to a dose of ionizing radiation of 2,500 millirems. This film badge was worn by SP₄ Kary during the period of 8 October through 14 October 1959. SP₄ Kary is employed at the Army Chemical Center in the Radiological Laboratory, U. S. Army Chemical Warfare Laboratories, as a physicist in nuclear research activities. (see Incl 2).

2. Radiological Laboratory is licensed by the U. S. Atomic Energy Commission for the use of "byproduct material" under License No. 19-1826-1A(61), and for the use of "special nuclear material" under Licenses SNM-9, and C-3654 as amended.

3. Upon receipt of the notification of overexposure, the Health Physics Office had SP₄ Kary relieved of all duties involving the use of ionizing radiation. In addition, SP₄ Kary was placed under the care of a physician at the Army Chemical Center Dispensary in accordance with TB Med-62, AFM 160-10. Under the provisions of this bulletin, when a radiation measuring device worn by an individual indicates a radiation overexposure, the individual is removed from his occupation and placed under the care of a physician who will take a history and complete blood counts on each of three days following the overexposure, and at weekly intervals for three weeks. As was anticipated, SP₄ Kary did not show any somatic effects of radiation exposure. (see Incl 3).

4. Upon investigation by the Health Physics Office, the following data on the overexposure were compiled:

a. On 8 October 1959 SP₄ Kary was involved in unpacking thirty-four (34) sulfur pellets, and fifty (50) gold foils which had been irradiated ($S^{32}(n,p)P^{32}$) and $Au^{197}(n,\gamma)Au^{198}$) at Diamond Ordnance Fuze Laboratory. The shipment was monitored by the Health Physics Office (see Incl 4) at the time of receipt. The maximum beta-gamma dose rate measured with a G-M survey meter at the surface of the package did not exceed 20 mr/hr. In addition, the unpacking operations were monitored by a Health Physics surveyor. (see Incl 5). The maximum beta-gamma dose rate was at the surface of the material and did not exceed 25 mr/hr. (No correction was made for beta response.) No airborne or removable radioactive contamination was detected during the monitoring of the unpacking operations which had a duration of approximately two (2) hours.

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b. From 9 October through 14 October 1959, SP₄ Kary spent approximately fifteen (15) hours counting the samples listed in Para 4a above, and twenty-five (25) other sulfur samples to determine their activity. On 12 October 1959, the Health Physics Office performed a routine radiation survey of the laboratory where SP₄ Kary was working. (see Incl 6). The maximum uncorrected beta-gamma dose rate detected in the laboratory was 2 mr/hr. Neither airborne nor removable radioactivity was detected during the survey.

c. Another individual who was involved in the same operations for approximately the same period of time as SP₄ Kary received a radiation dose of seven (7) millirems during 8 October through 14 October 1959.

d. From the counting data taken during these operations, it was calculated that the following amounts of activity were present in all the samples on 9 October 1959:

Radioisotope	p32	Au ¹⁹⁸
Activity per sample	2.3 to 1.8x10 ⁻⁴ uc	16.2 to 1x10 ⁻⁴ uc
Total activity	26.3 uc	100.5 uc

e. On 22 October 1959, the Health Physics Office attempted to reconstruct the counting operation in order to determine the radiation dose rate on 9 October 1959 to which SP₄ Kary had been exposed. It was impossible to determine from the data which samples had been in which locations in respect to SP₄ Kary's position. Therefore, it was assumed that the samples with the highest activity were the nearest to him. Corrected beta-gamma dose reading of the gold and sulfur samples both separately and together were taken with a G-M survey meter and an ionization chamber. After making the appropriate corrections for decay, it was estimated that the maximum radiation dose rate to which SP₄ Kary could have been exposed was 5 mrem/hr.

f. Another radiation survey of the laboratory and the area in which SP₄ Kary had been working was made on 22 October 1959. (see Incl 7). The results of this survey were practically the same as those from the survey of 12 October 1959. A careful examination of all the material present in the laboratory from 8 October through 14 October 1959 was made. The only source of radioactivity which might have conceivably caused the overexposure was a Sr⁹⁰ calibration source which gave a maximum beta-gamma dose of 15 mrem/hr at a distance of one (1) foot and had the highest associated dose rate of any material in the laboratory. The source was stored in a wooden cabinet about seven (7) feet above the floor and about twelve (12) feet from where SP₄ Kary was working. The maximum radiation level at the surface of the cabinet was 1.5 mr/hr. SP₄ Kary seemed reasonably certain that this source was not on the counting bench anytime while he was working and did not believe that it could have contributed to his exposure. The source was noted as being in the cabinet during the routine radiation survey of 12 October 1959. (see Incl 6).

g. Upon questioning SP₄ Kary about his activities during 8 October through 14 October 1959, he repeatedly stated that he had not worked on any other radiation project. This statement was substantiated by his immediate supervisor. A signed statement by SP₄ Kary on his actions during the period

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was obtained (Incl 8), and a signed statement of substantiation was obtained from his supervisor (Incl 9).

h. SP₄ Kary did not wear pencil dosimeters or any other type of dosimetric device during the period in question other than his film badge. Therefore, no other dosimetric data are available on the overexposure.

5. The overexposed film packet was forwarded to this office along with an evaluation of the film (Incl 10) as requested by telephone. During the telephone conversation with the individual at Lexington who developed the film, this individual stated that the photon energy involved was about 220 Kev. In addition, he stated that he suspected possible chemical damage to the film during processing, but could not be certain of this.

6. Upon inspection of the film using a densitometer, the darkening attributed to the gamma dose does not appear to be uniform, but is random and splotchy with no particular relation to the location of the gamma filters. It is believed by this office that this darkening may be the result of chemical damage. Also the photon energy of 220 Kev does not correspond to the gamma or bremsstrahlung radiation which could be expected from the radioisotopes and materials present in the area. The beta exposure appeared to be valid with a sharply defined image of the beta window. This film may be obtained for inspection upon request from Lexington Signal Depot, to which it has been returned.

7. The possibility of the badge being exposed at close range to a source of radiation while SP₄ Kary was not wearing it, was also investigated. This type of prank has been responsible for the overexposure of film badges in the past. Evidence to support this possibility was not obtained during the investigation.

8. SP₄ Kary has received the following exposure during the time he has been employed by Radiological Laboratory:

From 12 March 1958 to 11 March 1959 - 0 mrem
From 12 March 1959 to 11 September 1959 - 16 mrem
From 12 September 1959 to 10 November 1959 - 2,507 mrem
Total (from 12 Mar 58 to 10 Nov 59) - 2,523 mrem

SP₄ Kary had no occupational radiation exposure prior to employment at Radiological Laboratory.

9. From the above information, this office believes the exposure is not valid; but that either the film packet was damaged during processing or was purposely exposed to some unknown source of radiation as a prank. However, because the validity of the exposure cannot be disproved, the overexposure will be considered valid. SP₄ Kary will not be permitted to return to radiological operations until he has been cleared by the Dispensary or in nine weeks from the date of his exposure.

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10. The corrective action to be taken will be to check personnel working with irradiated samples to insure that they are wearing pencil dosimeters during all future operations of this nature. The immediate supervisor has been informed to instruct his personnel that pencil dosimeters will be worn during all future handling of irradiated material.

Edward F. Williams Jr.
EDWARD F. WILLIAMS JR.
Ass't Chief, Health Physics Office

10 Incl

1. Telegram (6 cys)
2. Test Program (6 cys)
3. Blood Rpt (6) (6 cys)
4. Diamond Ord Fuze Lab Rpt (6 cys)
5. Surveyor's Rpt (6 cys)
6. Rpt of Rad Survey (6 cys)
7. Rpt of Rad Survey (6 cys)
8. Indiv Statement (6 cys)
9. Supervisor's Statement (6 cys)
10. Ltr fm Lex Sig Dep, 23 Oct 59 (6 cys)

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ET048 ORA160

PP RUETLE

DE RUETDA 98

ZNR

P M 211330Z

FM CO LEXINGTONSIGDEP LEXINGTON KY

OCT 21 4 11 PM '59
22
21 Oct 59

TO RUETLE/ CO US ARMY CHEMICAL WAREFARE LABORATORIES ARMY CHEMICAL
CENTER MD

ACTION: CWLABS

CALLED: MRS LEWIS
0025

KKFG RUEPC/TSG DA WASHDC

DA GRNC

BT

UNCLAS LX 19397 FOR CHEF HEALTH PHYSICS OFFICE INFO MEDCE
FROM SIGDL-800 FILM NR OFL045 WORN BY KENNETH KARY WK OF
OCT 59 INDC DOSAGE OF 2500 MILLIREMS/2.500 REMS/

RECEIVED
SIGDL-800
OCT 21 1959
4 11 PM '59

OCT 21 8 55 AM '59

RECEIVED

BT

CFN LX 19397 SIGDL-800 OFL045 8-14 59 2500 /2.500 REMS/

21/1819Z

Incl 1

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TEST PROGRAM

Receipt and Handling of S and Au Samples from the Field

It is anticipated that the sulfur and gold samples will be sent to ACC for counting. The following procedures will be followed:

Gold: The gold will be received in lucite boxes ready for counting. These foils, 1/2" diameter and 18 mil thick, mint gold, have been irradiated in the field and Au¹⁹⁸ produced (Au¹⁹⁷ (n, γ) Au¹⁹⁸). This isotope has a half-life of 2.70 days and decays with the emission of a beta particle and a gamma in cascade. The activity should be about 20 mr/hr on arrival. There should be no smearable contamination. These samples will be taken to Room 1A, Area 11, for counting on the scintillation assemblies there. The samples will be kept in lucite boxes when not being counted. The gold foils will be handled by tweezers only; lab coats will be worn.

Sulfur: The sulfur will be received in the form of molded pellets approximately 1-1/2" diameter and 3/8" thick. These pellets have been irradiated in the field and P³² formed. If the counting rate is sufficiently high they will be transferred to Room 1A for counting. If the counting rate is too low the bulk of the inert S³² will have to be reduced. This will either be done by burning away the S³² or chemically combining it. These two methods are now being studied (as covered by Health Physics TP 170) and it has not been decided which would be more feasible.

The burning method is simply a matter of placing the pellet in an aluminum weighing cup, igniting it, and burning away the S³² and leaving the P³² in the cup ready to be counted. This would have to be performed in a fume hood with care since it seems an amount of the active phosphorus will escape. Our results are not reproducible with the accuracy desired. If this method is used, lab coats and rubber gloves will be worn by participating personnel. The work will be confined to the fume hoods in Lab 8, Area 11.

The alternate method, i.e., the chemical combination of the S³², has not yet been proven of value for this work. It is thought that the sulfur pellet could be dissolved in carbon disulfide, CS₂, and the solution filtered. The filtrate containing the P³² will be allowed to evaporate. The residue will be counted. A study of this work is presently progressing under the amendment of Health Physics TP 170. This will be done in a fume hood in Lab 8, with personnel wearing lab coats and rubber gloves.

These treated pellets will then be transferred to Room 1A for counting. The anticipated counting rate on the sulfur is 10,000 to 20,000 c/m/sample at the time received.

Project No: 4-12-10-007-02

Project Officer: David L. Rigotti

Responsible Supervisor: David L. Rigotti

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RADIOLOGICAL BLOOD REPORT

Name Kary, Kenneth Film Badge No. _____ ~~OK~~ *
MIL *
Station: Army Chemical Center, Maryland. Date 22 Oct 1954 *(delete one)

RBC 5.25 WBC 6,800 HB 15.2 gms

DIFFERENTIAL: Neutrophils 57 Lymphocytes 36

Monocytes 5 Eosinophis 1 Basonphils 1

Reticulocytes _____

OTHER DATA (If indicated) _____

REMARKS:

Incl 3 (1)

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RADIOLOGICAL BLOOD REPORT

Name Kary, Kenneth Film Badge No. _____ ~~OTI~~ *
MIL *
Station: Army Chemical Center, Maryland. Date 23 Oct ~~(delete one)~~ 1959

RBC 5.56 WBC 5,500 HB 14.5 gm
DIFFERENTIAL: Neutrophils 61 Lymphocytes 34
Monocytes 5 Eosinophis _____ Basophils _____
Reticulocytes _____

OTHER DATA (If indicated) _____

REMARKS:
Incl 3 (2)

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RADIOLOGICAL BLOOD REPORT

Name Kary, Kenneth

Film Badge No 24

~~XRAY~~ *
MIL *

Station: Army Chemical Center, Maryland.

Date 7 19

*(delete one)
19

RBC 5.12

WBC 9,400

HB 15.2 gm

DIFFERENTIAL: Neutrophils 61

Lymphocytes 37

Monocytes 1

Eosinophis 1

Basonphils _____

Reticulocytes _____

OTHER DATA (If indicated) _____

REMARKS:

D, 10 3' (3)

A Cml C 6-20 (16 Jun 50)

ARMY - A CML C. MD.

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RADIOLOGICAL BLOOD REPORT

Name Kary, Kenneth Film Badge No. _____
Station: Army Chemical Center, Maryland. Date 2 Mar 59 19____
XXXX *
MIL *
*(delete one)

RBC ~~5.25~~ 5.09 WBC 5,250 HB 15 gms
DIFFERENTIAL: Neutrophils 51 Lymphocytes 41
Monocytes 3 Eosinophis 5 Basophilis _____
Reticulocytes _____

OTHER DATA (If indicated) _____

REMARKS: _____

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RADIOLOGICAL BLOOD REPORT

Name Kary, Kenneth Film Badge No. _____ ~~CIX*~~
 MIL *
 Station: Army Chemical Center, Maryland. Date 9 Jun 19 59 *(delete one)

RBC 5.35 WBC 5000 HB 14.3 gms

DIFFERENTIAL: Neutrophils 6.8 Lymphocytes 30

Monocytes 1 Eosinophis 2 Basonphils _____

Reticulocytes _____

OTHER DATA (If indicated) _____

REMARKS: _____

A Cml C 6-20 (16 Jun 50)

ARMY - A CML C. MD.

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Box #:

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File:

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RADIOLOGICAL BLOOD REPORT

Name Kary, Kenneth Film Badge No. _____ ~~XIXI~~ *
 MIL *
 Station: Army Chemical Center, Maryland. Date 16 Nov 19 59 *(delete one)

RBC 11.75 WBC 5,300 HB 14.5 gm

DIFFERENTIAL: Neutrophils 49 Lymphocytes 50

Monocytes 1 Eosinophis _____ Basophilis _____

Reticulocytes _____

OTHER DATA (If indicated) _____

REMARKS: _____

A Cml C 6-20 (16 Jun 50)

ARMY - A CML C. MD.

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DIST: Orig to Health Physics
1 cc to Transferor
1 cc to Receiver

H.P. Number 986
Posted By [Signature]

REPORT OF RECEIPT OR TRANSFER OF RADIOACTIVE MATERIAL
AT ARMY CHEMICAL CENTER, MARYLAND

1. The following radioactive material was received on 8 OCT 59
 transferred (day month year)

Isotope: Au¹⁹⁸ B³² No. of Packages: 1
(element, mass no.) Units per Package: 54 Au
2715

From: Diamond Ordnance Test Lab
(Shipper's or Transferor's Name and Address)

Via: _____ Carrier's Receipt No. _____
(Carrier) Bill of Lading No. _____

2. Max. mr/hr at Package Surface: 20 Meter Used: BECKMAN MX-5

PROTECT YOURSELF FROM EXCESS RADIATION, INHALATION, OR INGESTION

Monitor will open package, note whether contents are intact or damaged.
If damaged, reseal at once, hold in safe place, notify Chf, Health Physics.
If intact, monitor inner container.

Mr/hr at Inner Container Surface: 20 Meter Used: BECKMAN MX-5
Monitored by: N. T. Deed

3. Remove packing slip and record the following:

Compound: Au¹⁹⁸ and S¹⁰⁵ Solid
(Chem. name or formula) Liquid _____
 Gas (Activity per unit volume) _____

Total Quantity: 0.1 millicuries. Container(s) Returnable? No
Shipper's Measurement Yes
of Radiation: _____ at _____ on _____
(Rate) (Distance) (Date)

4. Requisition No. _____ Requested by: Kinch
Other Reference Nos. _____ For use in HP Test Program No. 176

5. Receipts for above material:

a. INITIAL RECEIPT:
0.1 mc at Bldg 716 by [Signature]
(Quantity) (Signature, Organization)

b. TRANSFER: (RECEIVERS WILL NOTE SECTION 2 ABOVE AND ASSUME RESPONSIBILITY
FOR COMPLIANCE WITH SEC. 2.24 IN HEALTH PHYSICS SOP)
0.1 mc to Bldg. 716.
(Quantity) Room 1A Received by _____
(Signature, Organization)

c. STORAGE:
(Quantity) at Bldg 3013 until _____
(Date, If indefinite, so state)

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8 OCT. LAB 1A. CHECKED OUT GOLD^{AND SULFUR} SHIPMENT FOR KINCH -
EXTERNAL READING OF MATERIAL AT SURFACE - 25 MR -
UNPACKING & WORKING TIME - 2 HRS (MAX.) - RAN
30 MIN AIR SAMPLE + SMEARED WORKING AREA -
DOSE RATE @ AREA OF INDIVIDUALS WORKING - 10-15
MR/HR - *air sample & smear OK! WTD.*

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REPORT OF RADIOLOGICAL SURVEY

DATE: 12 Oct. 59

Laboratory 1A, Bldg 716 was surveyed on the above date by a Health Physics monitoring team. The results of this survey are as follows:

MEASURABLE CONTAMINATION:

None

EXTERNAL DOSE RATE:

Source cabinet on safe reads 1.5 mr.
Counting area of personnel reads 2.0 mr.

AIRBORNE ACTIVITY:

None

VIOLATIONS OF HEALTH PHYSICS PROCEDURES:

None

Any discrepancies should be remedied as soon as possible. A recheck will be made by the Survey Section of the Health Physics Office.

Mr. David Rigotti
Area Supervisor

W.T. O'Connell
Chief, Survey Section
Health Physics Office

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HEALTH PHYSICS AREA SURVEY PLOT

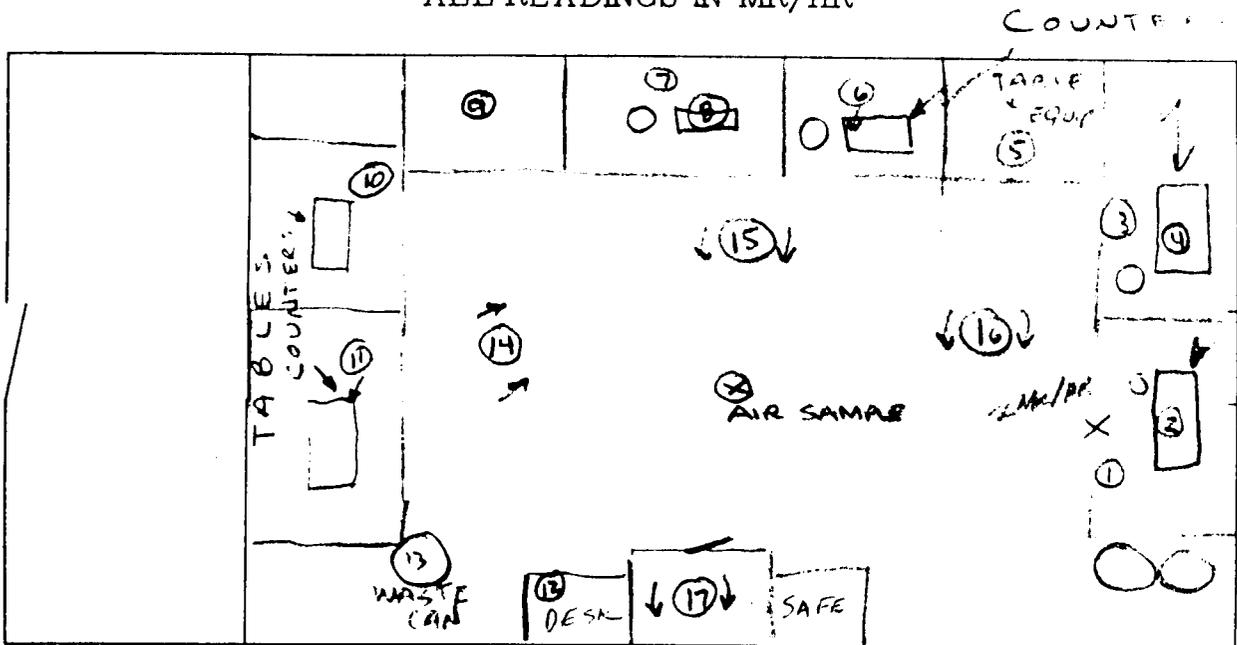
AREA 1A BLDG. _____

SURVEY MADE 10-12-59 BY OCEL-FANELLI

COPY RECEIVED FOR AREA SUPERVISOR BY _____

INSTRUMENT THYAC NO. 389C

ALL READINGS IN MR/HR



ROOM _____

SURVEYOR'S REMARKS

SOURCE CABINET ON SAFE - 1.5 MR/HR

X READING OF 2 MR/HR NEAR COUNTING AREA

SMEAR COUNTED
11/14/59 OK

AIR SAMPLE OK!

PAGE 1 of 2 PAGES

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REPORT OF RADIOLOGICAL SURVEY

DATE: 22 Oct 59

Laboratory 1A, Bldg 716 was surveyed on the above date by a Health Physics monitoring team. The results of this survey are as follows:

VISIBLE CONTAMINATION: None

EXTERNAL DOSE RATE: No readings above bkg.

ALPHA ACTIVITY: None

VIOLATIONS OF HEALTH PHYSICS PROCEDURES: Cardboard box used as "hot" waste can. This should be remedied.

Any discrepancies should be remedied as soon as possible. A recheck will be made by the Survey Section of the Health Physics Office.

Mr. David Rigotti
Area Supervisor

W.T. O'Connell
Chief, Survey Section
Health Physics Office

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HEALTH PHYSICS AREA SURVEY PLOT

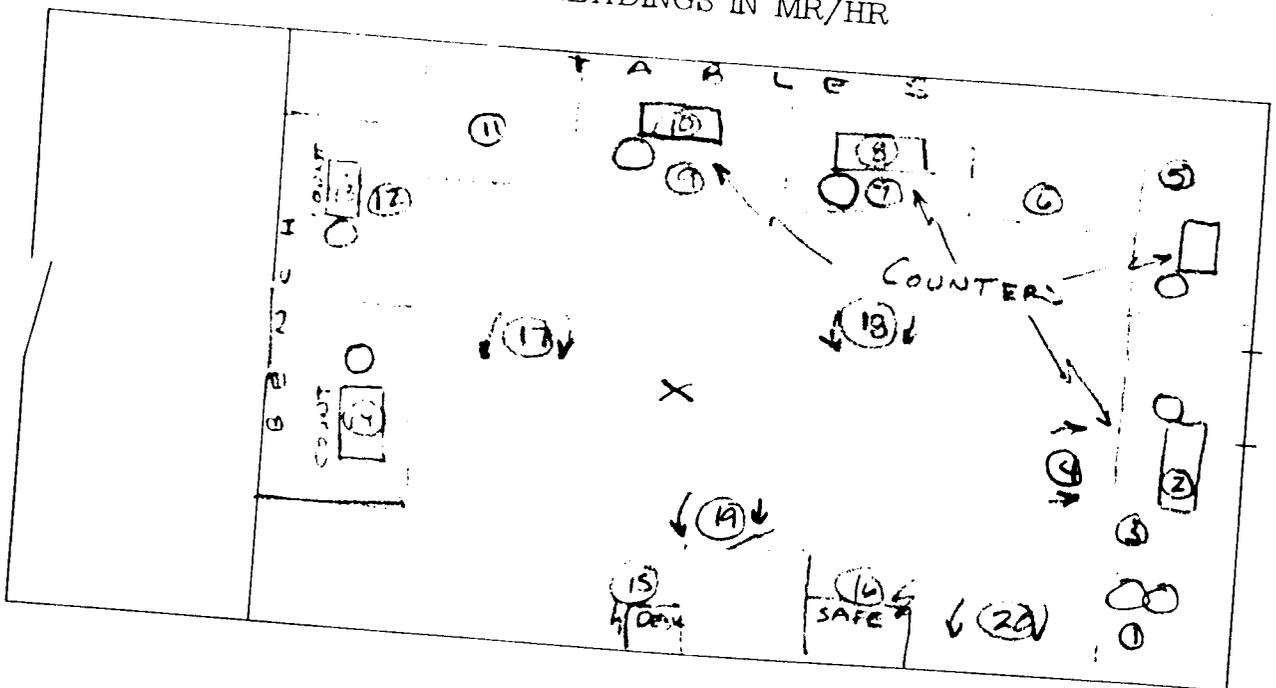
AREA 1A BLDG. 716

SURVEY MADE 10-22-57 BY CEL - FANELL

COPY RECEIVED FOR AREA SUPERVISOR BY _____

INSTRUMENT THYAC NO. 389C

ALL READINGS IN MR/HR



ROOM _____

SURVEYOR'S REMARKS

NO READINGS ABOVE BKG. (0.03MR)

X-AIR SAMPLE

"HOT" WASTE BASKET MISSING - USING BOX

IN AREA OF
AIR SAMPLE UNIT

10-22-57

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S T A T E M E N T

To the best of my knowledge, this report covers my activities during the period of 8 October through 14 October 1959.

I counted thirty-four (34) sulfur pellets that had received a neutron irradiation forming phosphorous-32. The activity of these pellets ranged in value from approximately 2.0×10^2 CPM to approximately 1.3×10^6 CPM. This included ten (10) samples whose activity ranged from 1.0×10^5 - 1.3×10^6 CPM. The closest that I came to these samples was about six (6) inches. During the period in question, I spent from 12 - 15 hours counting these samples.

I spent approximately two (2) hours unpacking fifty (50) gold and twenty-five (25) sulfur samples. The activity of the sulfur in this case ranged from background to 3.5×10^5 CPM. The activity of the gold ranged from background to approximately 9.0×10^6 CPM.

In both cases Health Physics personnel monitored the samples in question. I did not wear pocket chambers at any time during this period.

I cannot remember coming contact with any other source of radiation during this period.

In my opinion the exposure reported was not a valid exposure to me.

Kenneth H. Kary

KENNETH H. KARY

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S T A T E M E N T

To concur with the statements made by Sp4 Kary in the attached statement. To the best of my knowledge they are correct and complete.

I know of no source of radiation with which Sp4 Kary was working which could have accumulated the reported exposure in the period of time involved.



JOHN W. KINCH
Ch, Radiation Measurements Section

Incl 2

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LEXINGTON SIGNAL DEPOT

LEXINGTON, KENTUCKY

IN REPLY REFER TO:
SIGDL-800

23 October 1959

SUBJECT: Processed Film

TO: Chief, Health Physics Officer
Directorate of Technical Services
U. S. Army Chemical Warfare Laboratories
Army Chemical Center, Maryland
ATTN: Mr. Edward F. Williams Jr.

1. Film number OFLO45 is inclosed as requested by Mr. Williams in telephone conversation, 22 October 1959 with Mr. R. C. Layson, this depot.

2. The film badge apparently was exposed to beta and high energy gamma radiation. The beta dosage as indicated by the darkening in the open window area is 2000 millirems. The gamma dosage as indicated by the remainder of the film is 500 millirems.

3. Film number OFLO50 worn by David M. Kilminster indicated no darkening. Film number OFLO87 worn by Norris Smith indicated slight darkening in all areas; however, this darkening is not visible to the eye.

FOR THE COMMANDER:

1 Incl
Processed film packet

George L. Guller
for K. J. HOLMES
Major, SigC
C, Depot Maint Div

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