

K. Z. Morgan  
3382

OAK RIDGE NATIONAL LABORATORY  
Health Physics Division

93 103

August 10, 1956

To: J. C. Hart  
From: L. C. Johnson  
Subject: Radiation Excursion in Building 9213

On February 1, 1956 at approximately 9:48 a.m. a large excess reactivity was introduced in one of the experimental critical assemblies using enriched uranium in solution. This was caused by the improper operation of the fill-letdown valve which allowed the reactor to rise on a prompt critical period. The protection afforded by a minimum of five feet of concrete shielding in conjunction with distance and angular distribution of "shine" prevented serious exposures to personnel in the area.

The excursion was not accompanied by a violent explosion. It appeared that a large bubble arose within the fuel solution to be sprayed in the immediate area of the reactor. Fans to the building were turned off within a few minutes after the incident and most of the personnel evacuated to Y-12 proper. The remaining personnel, wearing assault masks, obtained readings, checked for contamination, blocked off areas, and handled other problems connected with the emergency.

The irradiated solution was removed from the system to a shielded area on February 2, and access to the test cell was allowed with the wearing of expendable clothing as the only additional Health Physics requirement. The small amount of beta-gamma fallout in other parts of the building was removed without difficulty soon after the incident. Reactor experiments were resumed on February 6.

The only question of significant exposure occurred with the guard. A concrete wall is now under construction to protect the guard post, parking lot, and roads leading to the building.

Information regarding the equipment involved, energy release, fuel consumed, cause of the incident, and preventative measures are discussed in confidential report ORNL CFN 56-2-105 by Dixon Callahan and Building 9213 staff.

The following pages list personnel exposures and related information.

CMH

Air Activity Analysis : Air activity in the building soon after the incident was ten times maximum permissible concentration for continuous exposure when using an approved mask in the presence of fission mixtures.\*

By 12:20 p.m. on February 1, all exhaust fans except those in the reactor room were operating and air activity of less than  $10^{-8}$   $\mu\text{c}/\text{cc}$  for beta-gamma activity measured in the building proper. Alpha activity throughout the building, excluding the reactor room was insignificant. A few hours later, air activity in the building and reactor room was well below the MPC for both beta-gamma and alpha activity.

The wind direction in the Y-12 valley immediately following the incident was N NE at two miles per hour. A few hours later, 1:00 p.m., the direction was N NE at three miles per hour. This relieved the heavily populated Y-12 area of any airborne activity.

Two gamma energies of .5 MEV and 1.5 MEV and a beta energy of .9 MEV were detected on the samples.

---

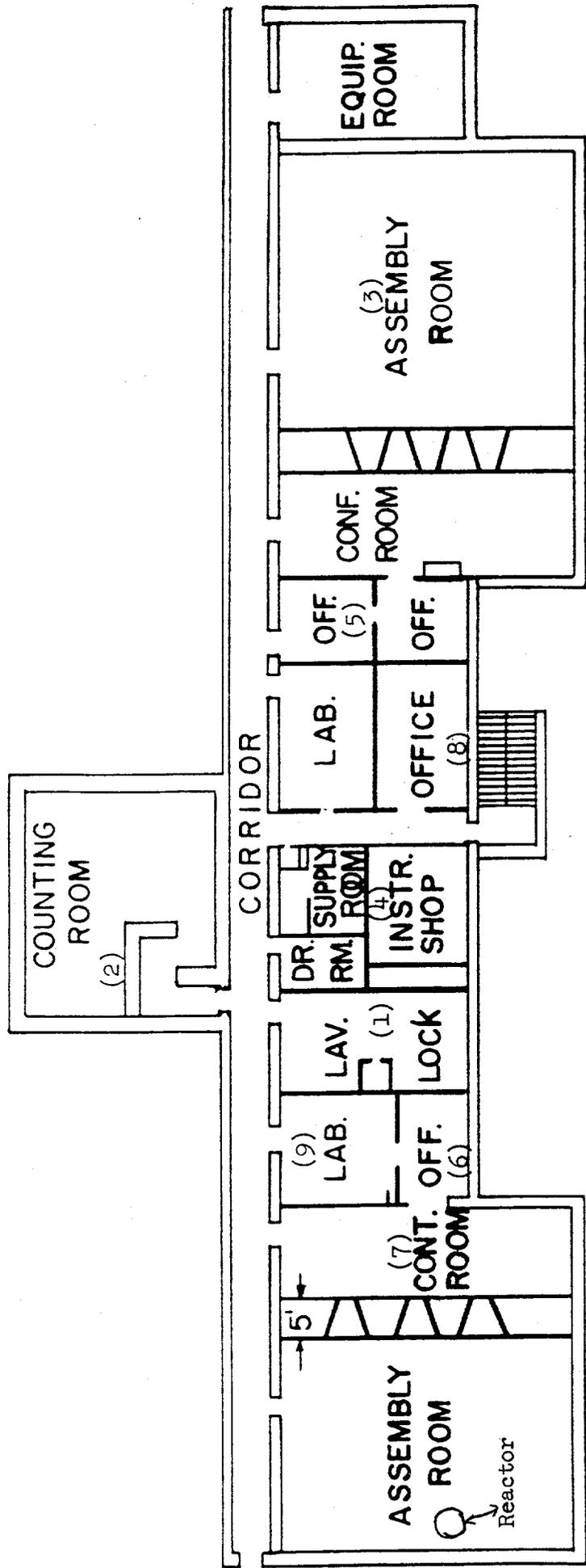
*MPC (Beta-Gamma) with approved mask . . . . .	$1 \times 10^{-6}$ $\mu\text{c}/\text{cc}$
MPC (Beta-Gamma) without mask . . . . .	$1 \times 10^{-8}$ $\mu\text{c}/\text{cc}$
MPC (Alpha) with approved mask . . . . .	$5.0 \times 10^{-9}$ $\mu\text{c}/\text{cc}$
MPC (Alpha) without mask . . . . .	$5.0 \times 10^{-11}$ $\mu\text{c}/\text{cc}$

Direct Readings ~30 Minutes After Excursion

<u>Location</u>	<u>Readings</u>
On road opposite reactor . . . . .	14 mr/hr
Outside Room 102 - door closed . . . . .	600 mr/hr
Outside reactor room South side ~ 4 feet above ground . . . . .	100 mr/hr
Inside door of Room 102 . . . . .	3400 mr/hr
Cross corridor 2nd level . . . . .	28 mr/hr
Corridor Gate (warning light) . . . . .	60 mr/hr
Open doorway to reactor room . . . . .	>6000 mr/hr
Through closed door to reactor room . . . . .	2600 mr/hr
Sight glass in control room . . . . .	3200 mr/hr*
Water filled window in control room . . . . .	2300 mr/hr*
Desk in control room . . . . .	6000 mr/hr*
<u>4:35 p.m. February 1, 1956</u>	
Sight Glass, Room 102 . . . . .	300 mr/hr
Floor, SE corner new console . . . . .	1000 mr/hr
Door, Room 203 . . . . .	100 mr/hr
Door, Room 201 . . . . .	200 mr/hr
<u>8:30 a.m. February 2, 1956</u>	
Sight glass, Room 102 . . . . .	100 mr/hr
Floor, SE corner new console . . . . .	300 mr/hr
Door, Room 203 . . . . .	30 mr/hr
Door, Room 201 . . . . .	20 mr/hr

---

\* Fuel dumped from reactor and stored in tanks beneath control floor.



SECOND FLOOR  
WEST

SECOND FLOOR  
EAST

Nasal Smears and Pocket Chamber Readings

Nasal Smears		Pocket Chambers		Location of Person in Building (Refer to Attached Floor Plan)	
Name	Badge No.	c/m at 10% Geo.	Gamma		Neutrons Nth
[REDACTED]	[REDACTED]	2	175 - 190	200+ - 200+	1
[REDACTED]	[REDACTED]	0	200+ - 200+	200+ - 200+	9
[REDACTED]	[REDACTED]	5	200 - 180	155	7
[REDACTED]	[REDACTED]	2	--	--	3
[REDACTED]	[REDACTED]	11	20 - 20	45 - 50	3
[REDACTED]	[REDACTED]	0	25 - 25	40 - 40	3
[REDACTED]	[REDACTED]	1	5 - 10	5 - 15	3
[REDACTED]	[REDACTED]	0	--	--	5
[REDACTED]	[REDACTED]	1	140 - 140	190 - 200	4
[REDACTED]	[REDACTED]	6	140 - 200+	200+ - 200+	6
[REDACTED]	[REDACTED]	2	120 - 140	180 - 190	9
[REDACTED]	[REDACTED]	3	0 - 0	0 - 0	2
[REDACTED]	[REDACTED]	5	170 - 170	190 - 200	7
[REDACTED]	[REDACTED]	1	105 - 110	140 - 160	8
[REDACTED]	[REDACTED]	2	100 - 130	140 - 160	4
[REDACTED]	[REDACTED]	70	60 - 60	120 - 140	5
[REDACTED]	[REDACTED]	--	80 - 100	145 - 160	8
[REDACTED]	[REDACTED]	3	110 - 110	175 - 200+	4
[REDACTED]	[REDACTED]	0			

External Exposure to Personnel (Film Badges)

Name	Badge No.	Gamma mr	N <sub>f</sub> Mrep	N <sub>th</sub> /cm <sup>2</sup>	N <sub>f</sub> Dose Mrem	N <sub>th</sub> Dose	Total Dose
[REDACTED]	[REDACTED]	260	4.5	5.4 x 10 <sup>8</sup>	45	90	395
[REDACTED]	[REDACTED]	330	15.5	3 x 10 <sup>8</sup>	155	50	535
[REDACTED]	[REDACTED]	400	5.5	8 x 10 <sup>8</sup>	55	120	575
[REDACTED]	[REDACTED]	25	1.8	--	18	0	45
[REDACTED]	[REDACTED]	30	2.7	3 x 10 <sup>8</sup>	27	45	100
[REDACTED]	[REDACTED]	30	--	--	--	--	30
[REDACTED]	[REDACTED]	30	0.9	6 x 10 <sup>7</sup>	9	9	50
[REDACTED]	[REDACTED]	100	3.6	--	36	0	140
[REDACTED]	[REDACTED]	160	7	6.3 x 10 <sup>8</sup>	70	90	320
[REDACTED]	[REDACTED]	260	14.5	3 x 10 <sup>8</sup>	145	50	455
[REDACTED]	[REDACTED]	330	7	--	70	0	400
[REDACTED]	[REDACTED]	0	--	--	0	0	0
[REDACTED]	[REDACTED]	260	2.7	9.8 x 10 <sup>8</sup>	27	150	440
[REDACTED]	[REDACTED]	100	2.7	9.1 x 10 <sup>8</sup>	27	140	265
[REDACTED]	[REDACTED]	125	1	2 x 10 <sup>8</sup>	10	30	160
[REDACTED]	[REDACTED]	400	5.5	6 x 10 <sup>8</sup>	55	91	550
[REDACTED]	[REDACTED]	190	5.5	2 x 10 <sup>8</sup>	55	30	275
[REDACTED]	[REDACTED]	170	5.5	2.4 x 10 <sup>8</sup>	55	36	260
[REDACTED]	[REDACTED]	565	(1000	--	2000-10,000	300-600	11,165 <sup>(1)</sup> 2,865 <sup>(2)</sup> )*

RBE 10

(2) RBE 2

\*Taken from threshold detectors.

Summary of Cassette Film Readings in mr

Location	Film No.	OW	S
New Guard House	100-1	900	645
Old Guard House	100-0	195	165
Room 101	101-1	> 20,000	> 20,000
Room 101	101-2	> 20,000	> 20,000
Room 102	102-1	> 20,000	13,150
Room 102	102-2	> 20,000	12,350
Room 103	103-1	295	245
Room 104	104-1	50	60
Room 107	107-1	50	< 30
Room 107	107-2	25	< 30
Room 108	108-1	3,925	6,650
Room 108	108-2	5,500	9,250
Room 108	108-3	4,875	7,450
Hallway West	200-1	145	245
Hallway East	200-0	395	555
Room 201	201-1	> 20,000	> 20,000
Room 201	201-2	> 20,000	> 20,000
Room 201	201-3	> 20,000	> 20,000
Room 202	202-1	1,360	1,410
Room 202	202-2	665	750
Room 203	203-1	450	620
Room 210	210-1	195	310
Room 211	211-1	195	180
Room 212	212-1	195	180
Room 215	215-1	70	60
Room 216	216-1	120	180
Room 216	216-2	120	180

Final Values of Dose as Calculated From the Neutron Threshold Detectors

Location of Threshold Detectors

Dose in rep's

Room 201  
Guard Shack  
Room 202  
Corridor

100  
1  
Insignificant  
Insignificant

Urinalysis Results

Name	Badge No.	Period Covered by Specimen	Analyzed For	Per Cent MPC	Estimated Total Dose
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	*10.8% < 5.0%	< 5 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	*28.4% 23.2%	9.6 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	17.6% 11.5%	5.5 mr
[REDACTED]	[REDACTED]	2-1 to 2-2	Sr	*14.8%	< 5 mr
[REDACTED]	[REDACTED]	2-1 to 2-2	Sr	*24.7%	8.1 mr
[REDACTED]	[REDACTED]	2-1 (Samples taken after shower) 2-6 to 2-7 2-11 to 2-12 2-20 to 2-21	Sr Sr Sr	533.3% 44.9% 17.9% < 5.0%	83 mr
[REDACTED]	[REDACTED]	2-1 to 2-2	Sr	644.8%	105 mr (Indications of sample carton contamination)
[REDACTED]	[REDACTED]	2-3 to 2-4 2-11 to 2-12 2-20 to 2-21	Sr Sr Sr	80.7% 18.7% < 5.0%	
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7 2-10 to 2-11 2-20 to 2-21	Sr Sr Sr Sr	339.0% 13.1% 7.9% < 5.0%	43 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	*70.09% < 5.0%	13.8 mr
[REDACTED]	[REDACTED]	2-1 to 2-2	Sr	*123.4%	15.6 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	*45.3% < 5.0%	9.0 mr
[REDACTED]	[REDACTED]	2-1 to 2-2	Sr	*24.7%	8.1 mr

Urinalysis Results (Cont'd)

Name	Badge No.	Period Covered by Specimen	Analyzed For	Per Cent MPC	Estimated Total Dose
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	13.8% <5.0%	< 5 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	* 8.6% 16.8%	< 5 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	*194.6% <5.0%	24.5 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7	Sr Sr	*99.0% 17.0%	12.6 mr
[REDACTED]	[REDACTED]	2-1 to 2-2 2-6 to 2-7 2-12 to 2-13 2-20 to 2-21	Sr Sr Sr Sr	*427.6% <5.0% <5.0% <5.0%	54 mr
[REDACTED]	[REDACTED]	2-1-56	Sr	10.4%	< 5 mr
[REDACTED]	[REDACTED]	2-1 to 2-2	Sr	8.6%	< 5 mr

Samples were analyzed for uranium content and in all cases were less than 10% of MPC.

MPC values are based on continuous exposures. Since these readings are the result of a single exposure incident, the first samples reported are probably too high by at least a factor of ten.

\*Samples analyzed for Strontium contained approximately 25% Strontium<sup>89</sup>.

## February Incident in ORNL Critical Experiments Laboratory

A power excursion occurred in an assembly of  $U^{235}$  accidentally made prompt critical by the over-addition of solution to the reactor on February 1, 1958. Although the safety devices operated automatically, thus terminating the reactors, energy was nevertheless released and occurred in unmeasured times. The complexity of the mechanism causing the accident precluded even a qualitative study.

The average fast neutron reading obtained was  $< 10^8/cm^2$ . The highest thermal neutron reading was  $2.23 \times 10^{10}/cm^2$ . The highest gamma reading taken was 515  $\mu$ /cm. The gamma readings were taken from films worn by workers in the building. Neutron results were obtained from the activities induced in plutonium, in gold, and in cadmium-covered gold foils.

The fact that the Laboratory was isolated and the presence of a favorable wind made it possible to purge the test cell in which the accident occurred. Ventilating fans, installed for just this reason, were used to do the evacuation of contaminated air.

FEB 19 1956

# INTER-COMPANY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

Operated By

CARBIDE AND CARBON CHEMICALS COMPANY

Post Office Box P  
OAK RIDGE, TENN.

(INSERT  
NAME)

COMPANY \_\_\_\_\_

LOCATION \_\_\_\_\_

TO K. Z. Morgan  
LOCATION Bldg. 2001

DATE February 9, 1956

ANSWERING LETTER DATE

ATTENTION  
COPY TO A. M. Weinberg

SUBJECT Cooperation of Health Physics

*2/11/56*

It is the purpose of this note to express our appreciation of the interest and effort of members of your Division and yourself in the aftermath of the power excursion experienced in Building 9213 on February 1. The cause of the excursion is believed to have been an over filling of the test vessel with solution due, in turn, to the failure of the pressure of the transporting air in the reservoir to be reduced sufficiently rapidly. The operation of this transfer system has not been entirely satisfactory for some time and remedial measures were begun several months ago. Replacement parts are scheduled for delivery within the next few weeks.

With the multiplicity of critical assemblies which we test, the real probability of subsequent excursions must be recognized without complacency and every effort must be made to insure that all personnel are always in their appointed positions. Under these conditions it is believed that the consequences of excursions, although distasteful, are not catastrophic.



Dixon Callihan

DC:mlr

SERIAL PER AREA/FACILITY DATE TIME OCCURRED DURATION 005D 0948 02-01-56 9213 00247  
 NUMBER ORIE NUMBER OCCURRED DURATION 005D 0948 02-01-56 9213 00247  
 WORK AREA OR PART FURTHER DEFINED DESCRIPTION OF INCIDENT RADIATION EXCURSION-PROMPT CRIT REACTION

RADIATION ENCOUNTERED MATERIALS INVOLVED (SPEC SERV)(MAX CON OF PERS C/M,D/M \*) (EXT DOS MAX MR)\* (MED O  
 A B G NF NI NT ENRICH U IN SOL FP SR BIOASSA 1 1.0 5 M0&6 RM&6  
 (AIR ACTIVITY ) RAD B/G (MAX PROBE READING ) TACTILE CONTAMINATION DATA  
 (MAX UCI/CC \*) (MAX HND) (MAX C/M) (MAX D/M) (MAX S/M) (MAX T/M) (MAX W/M) (MAX X/M) (MAX Y/M) (MAX Z/M)  
 (CF 10(-X) MR/H \* ALP((C/M)/(D/M)) B-G(C/M) ALP((D/M) B-G(D/

ID	N A M E	EX RA	CL CO	PE CO	WB TR	NE LG	HA AR	RE OR	SK VIA	SM CT	OB ME	PE SKIN	SMER NASL	HND	TRNK	WHOL	DOSE	IR ER
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	395	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	535	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	575	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	45	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	30	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	50	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	140	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	320	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	455	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	400	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	440	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	265	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	160	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	550	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	275	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	260	
[REDACTED]	[REDACTED]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	2865	

\*\* N O T E S  
 A-NO ACTION REQUIRED D-ALL WORK STOP G-AREA NORM C MAX.  
 B-ENTIRE AREA ZONED E-NORMAL WORK CONT. H-CLEANUP REQUIRED J-SURFACE CONTAMINATION PRESENT  
 C-AREA PART ZONED F-AREA NORM C MIN. I-AIR ACTIVITY PRESENT K-PERSONNEL EXPOSURE LIST

\* H = 100X, M = 1000X, R = MR/HR, WHERE C/M, D/M, UCI/CC ARE SHOWN IN COLUMN HEADINGS

