Item 1

THE GEISINGER MEDICAL CENTER
DANVILLE, PENNSYLVANIA 17821
717-275-1000

DEPARTMENT OF RADIOLOGY

DIAGNOSTIC ROENTGENOLOGY
J. L. WILLIAMS, M.D.
G. R. FUNKHOUSER, M.D.
G. A. MOLLER, M.D.
T. L. O'ROURKE, M.D.
L. C. SANTINI, M.D.

RADIOTHERAPY & NUCLEAR MEDICINE
D. D. BEILER, M.D.

RADIATION PHYSICS
J. S. KROHMER, PH.D.

GEISINGER MEMORIAL HOSPITAL
SCHOOL OF NURSING
FOSS CLINIC
FRUEAUFF RADIATION CENTER

April 27, 1968

C. W. Wallhausen, Vice President,
United States Radium Corporation,
P. O. Box 246,
Morristown, New Jersey 07960

SUBJECT: Report of investigation, recommendations, and calculations regarding Tritium releases from stacks at the Bloomsburg, Pennsylvania plant of the U.S.Radium Corp.

Dear Mr. Wallhausen:

This letter is an answer, in part, to questions raised by the Compliance and Licensing Divisions of the U.S. Atomic Energy Commission during our meeting of April 11, 1968 at Bethesda, Maryland. It answers those questions regarding release of Tritium to the atmosphere from seven (7) stacks at your Bloomsburg, Pennsylvania plant which have resulted from U.S.A.E.C. on-site inspections andsubsequent citations. It outlines a step-by-step analysis ofthe situation which has resulted in one (1) recommendation which I have informed you of on April23, 1968 and which I am certain your organization is in the process of accomplishing. This recommendation is as follows:

> THE AREA TO THE EAST OF THE MAIN BUILDING AND THE TRITIUM BUILDING AND A PORTION OF THE AREA TO THE REAR OF THESE BUILDINGS MUST BE CONVERTED INTO A RESTRICTED AREA TO WHICH ACCESS IS CONTROLLED BY THE U.S. RADIUM CORP.. THIS IS TO BE ACCOMPLISHED BY ERECTING A STURDY,STEEL, SIX-FOOT FENCE EXTENDING EASTWARD FROM THE NORTHEAST CORNER OFTHE MAIN BUILDING TO THE EAST PROPERTY LINE, THENCE FOLLOWING THE PROPERTY LINE SOUTHWARD TO THE NORTH EDGE OF THE ABANDONED CANAL, THENCE WESTERLY FOLLOWING THE LINE OF THE CANAL TO A POINT TO THE WEST OF THE WESTMOST RADIOACTIVE UNDERGROUND STORAGE VAULT, AND THEN NORTHWARD TO THE SOUTH WALL OF THE MAIN BUILDING. THE FENCE MAY HAVE ONE OR TWO SETS OF ACCESS GATES WHICH ARE TO BE KEPT LOCKED EXCEPT WHEN VEHICLE ACCESS IS REQUIRED. THE FENCE SHALL BEAR LABELS ON ITS OUTER SURFACE INDICATING THAT THE AREA WITHIN IS A "RESTRICTED AREA" AND WITH WORDING "CAUTION, AIRBORNE RADIOACTIVITY AREA". A DRAWING INDICATING THIS FENCE LINE IS INCLUDED WITH THIS LETTER.

It is my opinion that this recommendation along with the calculations included in this letter will answer in-full all questions regarding the Tritium releases and will establish that such releases in the future will be in compliance with 10 CFR 20.106 using the concentration of SOLUBLE Tritium listed in Table II, Column 1 of 10 CFR Part 20 as a MAXIMUM PERMISSIBLE CONCENTRATION. This concentration is 2×10^{-7} uCi/ml or 2×10^{-7} Ci/m^3 . This letter should be submitted with your answer to other questions and should also be a part of any license amendment applied for by your Bloomsburg Plant. It should be noted that it contains information pertaining to the future plans for theBloomsburg facility.

CALCULATION OF MAXIMUM EXPECTED TRITIUM CONCENTRATIONS AT POINTS OF RELEASE TO UNRESTRICTED AREAS

These calculations are made using equations set forth by Sutton and included in "Meteorology and Atomic Energy," U.S.Atomic Energy Commission, GPO, July, 1955 which deal with STACK DISPERSION and ATMOSPHERIC DILUTION. The formulas which are used represent a minor modification from those of Sutton in that a factor (f) is introduced which takes into account the fraction of a year during which winds may be directed toward the point of calculation. Calculations are for a yearly average concentration unless stated otherwise. Formulas used are as follows:

ALL FOR AN ISOTROPIC CONTINUOUS-POINT-SOURCE AND ALL FOR DOWNWIND POINTS

$$X(x) = \frac{2\ Q\ f}{3.1416\ C^2\ \bar{u}\ x^{2-n}}\ e^{-(h^2/C^2\ x^{2-n})} \qquad (1)$$

$$X_{max} = \frac{Q\ f}{4.26\ \bar{u}\ h^2} \qquad (2)$$

$$d_{max} = (h^2/C^2)^{\frac{1}{2-n}} \qquad (3)$$

Where: $X(x)$ is the concentration of Tritium x meters downwind from stack in Ci/m^3 and at ground-level

X_{max} is the maximum ground-level concentration of Tritium in Ci/m^3

d_{max} is the distance from the stack in meters (m) at which X_{max} occurs

Q is the emission rate from the stack in Ci/sec and is equal to the concentration of emission in Ci/m^3 times the exhaust rate in m^3/sec

f is the fraction of a year during which the wind is expected to blow toward the point in question

n is a non-dimensional parameter associated with atmospheric stability

C is the generalized diffusion coefficient in $m^{n/2}$

$\bar{u}$ is the mean wind velocity in m/sec

h is the stack height in meters (m)

x is the distance in meters from the stack downwind to the point of calculation

Values for f, n, C, and $\bar{u}$ listed above must be estimated from available data and have in each case been estimated in a conservative fashion so as to yield values for $X(x)$, X_{max} and d_{max} which are maximal. The choices of these parameters are described below along with reasons for the choices:

u: The prevailing winds in Bloomsburg, Pennsylvania are from the West and Northwest at 5 to 11 miles/hour. Since an increased wind velocity tends to minimize $X(x)$ and X_{max}, the minimum wind velocity of 5 miles/hr or 2.2 m/sec is used in all calculations and in all directions along with appropriate values for f as described below

f: The following fractions of a year during which the wind can be expected to blow toward the point in question are used:

Point in Question	Wind Direction	f
Easterly	West	1.0
Southerly	North	0.5
Westerly	East	0.1
Northerly	South	0.1

n: The value of n according to Sutton varies from 0.2 for "Low lapse rate" conditions to 0.5 for "Large inversion" conditions. A conservative, but realistic assumption is that the condition which prevails for the Bloomsburg U.S. Radium Corp. plant is one of "Zero or small temperature gradient". Accordingly, a value of n = 0.25 is used in all calculations.

C: According to Sutton, the value of C, the generalized diffusion coefficient, is determined by the values for n and for stack height h. Extrapolated values for C (at n = 0.25) vary from 0.140 to 0.148 for stacks from 10 meters down to 4 meters high. Accordingly values for C^2 for the various stacks at the Bloomsburg plant are chosen as follows:

Stack in Question	Height	C^2 in $(meters)^n$
Gas Fill	20ft or 6.1m	0.020
Tritium Bldg.	13ft or 4.0m	0.022
Annex	20ft or 6.1m	0.020
Hand Application	30ft or 9.2m	0.020
Watch Dial	20ft or 6.1m	0.020
Exit Marker	20ft or 6.1m	0.020
Future Watch Dial & Hand Applic.	33ft or 10m	0.020

Other stack parameters which are pertinent to the use of the above equations and to the calculations are as follows:

STACK	h (m)	EXHAUST RATE (m^3/sec)	MEASURED AVE. CONCENTRATION (Ci/m^3)	Q c/sec (Ci/m^3)	HYPOTHETICAL MAX. CONC. (Ci/m^3)	Q c/sec (Ci/m^3)
Gas Fill	6.1	1.85	* 61.2×10^{-7}	113.2×10^{-7}	2×10^{-5}	3.7×10^{-5}
H-3 Bldg.	4.0	0.60	* 15.2×10^{-7}	9.1×10^{-7}	2×10^{-5}	1.2×10^{-5}
Annex	6.1	1.85	* 10.6×10^{-7}	19.6×10^{-7}	2×10^{-5}	3.7×10^{-5}
Hand App.	9.2	0.60	* 6.2×10^{-7}	3.7×10^{-7}	2×10^{-5}	1.2×10^{-5}
Watch Dial	6.1	4.25	# 5.7×10^{-7}	24.3×10^{-7}	2×10^{-6}	1.0×10^{-5}
Exit Sign	6.1	1.42	# 0.67×10^{-7}	0.95×10^{-7}	2×10^{-6}	2.8×10^{-6}
Future W. Dial & H.P.	10	0.95	-	-	2×10^{-4}	1.9×10^{-4}

* Average for 1967
\# Average of small number of 1968 readings

Individual Stack Calculations:

Gas Fill Stack:

Assumed values: $Q = 113.2 \times 10^{-7}$; $h = 6.1$; $\bar{u} = 2.2$; $n = 0.25$; $\sigma^2 = 0.020$; x to fence on East = 104 meters; f as stated above

$X_{max} = 0.33 \times 10^{-7}$ Ci/m^3 (East)
$= 0.17 \times 10^{-7}$ Ci/m^3 (South)
$= 0.33 \times 10^{-8}$ Ci/m^3 (West & North)

$d_{max} =$ 72.5 m or 238ft

$X(104) = 0.28 \times 10^{-7}$ Ci/m^3 at East fence

Assumed (Hypothetical) values: $Q = 3.7 \times 10^{-5}$ (Stack conc. = 100 x MPC); Other values as above.

$X_{max} = 1.07 \times 10^{-7}$ Ci/m^3 (East)
$= 0.54 \times 10^{-7}$ Ci/m^3 (South)
$= 0.11 \times 10^{-7}$ Ci/m^3 (West & North)

$d_{max} =$ 72.5 m or 238ft

$X(104) = 0.92 \times 10^{-7}$ Ci/m^3 at East fence

Tritium Building Stack:

Assumed values: $Q = 9.1 \times 10^{-7}$; $h = 4.0$; $\bar{u} = 2.2$; $n = 0.25$; $\sigma^2 = 0.022$; x to fence on East = 64 meters; f as stated above

$X_{max} = 0.06 \times 10^{-7}$ Ci/m^3 (East)
$= 0.03 \times 10^{-7}$ Ci/m^3 (South)
$= 0.06 \times 10^{-8}$ Ci/m^3 (West & North)

$d_{max} =$ 42.8 m or 140ft

$X(64) = 0.05 \times 10^{-7}$ Ci/m^3 at East fence

Assumed (Hypothetical) values: $Q = 1.2 \times 10^{-5}$ (Stack conc. = 100 x MPC); Other values as above.

$X_{max} = 0.80 \times 10^{-7}$ Ci/m^3 (East)
$= 0.40 \times 10^{-7}$ Ci/m^3 (South)
$= 0.08 \times 10^{-7}$ Ci/m^3 (West & North)

$d_{max} =$ 42.8 m or 140ft

$X(64) = 0.69 \times 10^{-7}$ Ci/m^3 at East fence

Individual Stack Calculations (con't):

Annex Stack:

Assumed values: Q - 19.6×10^{-7}; h - 6.1; ū - 2.2; n - 0.25; C^2 - 0.020; x to fence on East - 90 meters; f as stated above

X_{max} = 0.06×10^{-7} Ci/m^3 (East)
= 0.03×10^{-7} Ci/m^3 (South)
= 0.06×10^{-8} Ci/m^3 (West & North)

d_{max} = 72.5 m or 238ft

X(90) = 0.05×10^{-7} at East fence

Assumed (Hypothetical) values: Q - 3.7×10^{-5} (Stack conc. - 100 x MPC); Other values as above.

X_{max} = 1.07×10^{-7} Ci/m^3 (East)
= 0.54×10^{-7} Ci/m^3 (South)
= 0.11×10^{-7} Ci/m^3 (West & North)

d_{max} = 72.5 m or 238ft

X(90) = 1.00×10^{-7} Ci/m^3 at East fence

Hand Application Stacks:

Assumed values: Q - 3.7×10^{-7}; h - 9.2; ū - 2.2; n - 0.25; C^2 - 0.020; x to fence on East - 107 meters; f as stated above

X_{max} = 0.05×10^{-7} Ci/m^3 (East)
= 0.03×10^{-7} Ci/m^3 (South)
= 0.05×10^{-8} Ci/m^3 (West & North)

d_{max} = 102 m or 324ft

X(107) = 0.05×10^{-7} Ci/m^3 at East fence

Assumed (Hypothetical) values: Q - 1.2×10^{-5} (Stack conc. - 100 x MPC); Other values as above.

X_{max} = 0.15×10^{-7} Ci/m^3 (East)
= 0.08×10^{-7} Ci/m^3 (South)
= 0.15×10^{-8} Ci/m^3 (West & North)

d_{max} = 102 m or 324ft

X(107) = 0.15×10^{-7} Ci/m^3 at East fence

Industrial Stack Considerations (cont'd):

Present Watch Dial Stack:

Assumed values: $Q = 2.43 \times 10^{-6}$; h - 6.1; $\bar{u}$ - 2.2; n - 0.25; C^2 - 0.020; x to property line on West - 2 meters; f as stated above x to fence on East - 208 meters; x to fence on South -134 m

$X_{max} = 0.07 \times 10^{-7}$ Ci/m^3 (East)

$= 0.04 \times 10^{-7}$ Ci/m^3 (South)

$= 0.07 \times 10^{-8}$ Ci/m^3 (West & North)

d_{max} = 72.5 m or 238ft

X(208) = 0.02×10^{-7} Ci/m^3 at East fence

X(134) = 0.04×10^{-7} Ci/m^3 at South fence

X(2) at stack height = 0.57×10^{-7} Ci/m^3 at stack height at West prop. line

Assumed (Hypothetical) values: $Q = 8.92 \times 10^{-6}$ (Stack conc. - 10 x MPC); Other values as above.

$X_{max} = 0.11 \times 10^{-7}$ Ci/m^3 (East)

$= 0.06 \times 10^{-7}$ Ci/m^3 (South)

$= 0.11 \times 10^{-8}$ Ci/m^3 (West & North)

d_{max} = 72.5 m or 238ft

X(208) = 0.03×10^{-7} Ci/m^3 at East fence

X(134) = 0.06×10^{-7} Ci/m^3 at South fence

X(2) at stack height = 2×10^{-7} Ci/m^3 at stack height at West prop. line

Exit Marker Stacks:

Assumed values: $Q = 0.95 \times 10^{-7}$; h - 6.1; $\bar{u}$ - 2.2; n - 0.25; C^2 - 0.020; x to property line on West - 1 meter; x to fence on East - 210 meters; x to fence on South - 116 meters; f as st. abo

NOTE: Since the maximum measured concentration from this stack is below MPC, and since the maximum hazard will occur in the event of Exit Marker tube breakage, this situation will be analyzed.

In 1967, one tube containing 5 curies of Tritium was broken and presumably released through the stack. With an exhaust rate of 1.42 m^3/second this would result in the following average concentrations:

$Conc._{day} = 4.06 \times 10^{-5}$ Ci/m^3 or 203 x MPC at stack exhaust

$Conc._{year} = 1.11 \times 10^{-7}$ Ci/m^3 or 0.6 x MPC at stack exhaust which results in a Q = 1.59×10^{-7} Ci/sec

Individual Stack Calculations (con't):

Exit Marker Stacks (con't):

Using this latter value of Q, the following result:

X_{max} = 0.05×10^{-8} Ci/m^3 (East)
= 0.02×10^{-8} Ci/m^3 (South)
= 0.05×10^{-9} Ci/m^3 (West & North)

d_{max} = 72.5 m or 238ft

X(210) = 0.02×10^{-8} Ci/m^3 at East fence

X(116) = 0.04×10^{-8} Ci/m^3 at South fence

X(1) = 0.11×10^{-7} Ci/m^3 at stack height at West property line

Assumed (Hypothetical) values: Q - 2.86×10^{-6} Ci/sec(Results from hypothetical breakage of Exit Markers containing 90.0 curies during year; this would yield stack exhaust average concentrations of:
$Conc._{day}$ = 8.2×10^{-5} Ci/m^3 or 410 x MPC
(Assumes max. release of 10.0 Ci/day)

$Conc._{year}$ = 2.00×10^{-6} Ci/m^3 or 10.0 x MPC

Using Q - 2.86×10^{-6} Ci/sec, the following result:

X_{max} = 0.03×10^{-7} Ci/m^3 (East)
= 0.04×10^{-7} Ci/m^3 (South)
= 0.08×10^{-8} Ci/m^3 (West & North)

d_{max} = 72.5 m or 238ft

X(210) = 0.03×10^{-7} Ci/m^3 at East fence

X(116) = 0.06×10^{-7} Ci/m^3 at South fence

X(1) = 2.00×10^{-7} Ci/m^3 at stack height at West property line

Future Watch Dial & Hand Application Stack (New Building to East of Main Bldg.):

Assumed values (Hypothetical): Q - 1.89×10^{-4} Ci/sec (Stack conc. -1000xMPC)
h - 10; $\bar{u}$ - 2.2; n - 0.25; C^2 - 0.020;
x to property line on East - 80 meters;
f as stated above

X_{max} = 2.00×10^{-7} Ci/m^3 (East)
= 1.00×10^{-7} Ci/m^3 (South)
= 0.20×10^{-7} Ci/m^3 (West & North)

d_{max} = 129 m or 423ft

NOTE: Since at this future time, this will be the only stack operating, all unrestricted area concentrations will be below MPC.

Summary of Concentrations at Boundaries of Unrestricted Areas:

Concentrations based upon measured stack concentrations:

At fence to East: Total X = 0.47×10^{-7} Ci/m^3 = 0.24 x MPC
At Fence to South: Total X = 0.30×10^{-7} Ci/m^3 = 0.15 x MPC
At West Property Line: Total X = 0.62×10^{-7} Ci/m^3 = 0.31 x MPC
(At stack Height)
At Front of Plant: Total X = 0.06×10^{-7} Ci/m^3 = 0.03 x MPC

Concentrations based upon hypothetical stack concentrations:

At fence to East: Total X = 2.82×10^{-7} Ci/m^3 = 1.41 x MPC *
At fence to South: Total X = 1.66×10^{-7} Ci/m^3 = 0.83 x MPC
At West Property line: Total X = 2.32×10^{-7} Ci/m^3 = 1.16 x MPC *
(At stack height)
At Front of Plant: Total X = 0.34×10^{-7} Ci/m^3 = 0.17 x MPC

* NOTE: Although these values are above MPC's, in view of the unlikely possibility of reaching the hypothetical values, it is unlikely that these concentrations will ever be realized.

Concentrations based upon Future New Watch Dial Plant hypothetical stack concentration

At Fence to East: Total X = 2.00×10^{-7} Ci/m^3 = 1.00 x MPC
At Fence to South: Total X = 1.00×10^{-7} Ci/m^3 = 0.50 x MPC
At West Prop. Line: TotalX = 0.20×10^{-7} Ci/m^3 = 0.10 x MPC
At Front of Plant: TotalX = 0.20×10^{-7} Ci/m^3 = 0.10 x MPC

Additional Recommendation:

Owing to the fact that the third floor womens lounge is an unrestricted area, and since the present Hand Application stacks exhaust in the near vicinity, the following is recommended:

THE PRESENT HAND APPLICATION STACKS SHOULD BE EXTENDED UPWARD SIX (6) FEET AND THE WINDOWS ON THE EAST WALL OF THE WOMENS LOUNGE SHOULD BE PERMANENTLY SEALED UNTIL THESE STACKS GO OUT OF OPERATION DUE TO FUTURE PLANS.

Respectfully submitted,

Jack S. Krohmer, Ph.D.,
Certified Radiological & Health Physicist

Feb. 1968

Date	No	Hrs	x MPC	MPC Hrs
2-1-68	128	14.5	5.0	72.5
		8.8	38.8	341.5
		15.1	2.6	39.2
		8.1	1.4	11.3
		15.0	1.2	18.0
	135	8.2	3.5	28.7
		40.8	0.8	32.7
		8.0	8.1	64.8
		17.1	2.2	37.6
		7.0	0.9	6.3
	146	17.2	1.2	20.6
	142	7.0	7.4	51.8
	144	15.6	3.0	46.8
	145	8.0	5.6	44.8
		16.0	3.9	62.4
		8.0	6.8	54.4
		14.9	4.4	65.6
		8.2	10.6	86.9
	150	42.0	2.0	84.0
	154	25.7	1.1	28.3
	155	5.5	168.0	924.0
		15.6	8.7	135.8
		8.2	15.6	128.0
		16.2	90.5	1465.0
		6.8	26.0	176.8
	160	16.2	10.4	168.3
		8.5	3.2	27.2
		63.5	1.7	107.9
		8.5	1.0	8.5
		15.2	1.0	15.2
2-20-68	165	11.5	43.0	497.5
	166	12.0	2.6	31.2
		12.0	70.0	840.0
		11.8	13.2	155.9
		11.9	17.1	203.5
	170	13.0	3.8	49.4
		8.3	12.8	106.3
		14.7	4.3	63.2
		7.8	18.8	146.7
		41.7	1.0	41.7
	175	9.0	2.3	20.7
		16.0	1.6	25.6
		7.0	2.9	20.3
		17.0	3.0	51.0
		7.5	3.3	24.7
	180	14.2	1.6	22.7
2-29-68	181	12.0	12.2	146.5
		696.5		6541.8

or $6541.8 / 696.5 = 9.4$ x MPC for Feb. 1968

March 1968

Date	No	Hrs	x MPC	MPC Hrs	Date	No	Hrs	x MPC	MPC Hrs
3-1-68	182	14.0	2.0	28.0	3-19-68	211	16.5	4.4	72.6
		7.5	19.0	142.7			10.2	75.5	77.0
		14.5	2.6	37.7			11.5	3.4	39.1
	185	8.0	19.8	158.3			12.1	9.1	111.1
		40.8	1.7	69.4		215	12.8	3.7	47.4
		9.0	1.0	9.0			9.0	6.5	58.5
		14.2	1.2	17.0			15.0	4.1	61.5
		11.8	18.1	213.9			8.5	23.5	199.7
	190	12.0	1.2	14.4			14.9	4.6	68.5
		12.0	15.0	180.0		220	8.0	10.3	82.4
		13.0	2.0	26.0			40.9	1.5	61.4
		8.2	17.9	146.9			8.2	7.0	57.4
		15.8	3.2	50.6			16.8	0.9	15.1
	195	9.0	7.0	63.0			8.8	5.6	49.3
		14.2	4.7	66.7		225	13.2	2.0	26.4
		7.8	13.5	105.3			23.8	8.2	195.1
		41.3	1.4	56.8			10.0	8.4	84.0
		8.0	6.5	52.0			15.2	1.6	24.3
	200	15.3	1.8	27.6			8.2	8.6	70.5
		9.0	8.9	80.1		230	14.7	1.7	25.0
		16.0	4.5	72.0	3-30-68		8.3	11.1	92.3
		8.0	2.0	16.0			715.9		3945.2
		14.0	1.2	16.8					
	205	25.0	10.6	265.0			or $3945.2/715.9 = 5.5$ x		
		8.6	12.9	111.0			for March 1968		
		14.5	5.8	84.1					
		8.0	10.4	83.2					
		40.8	3.4	138.6					
	210	9.0	10.5	94.5					

42-383

April 1968

Date	No	Hrs	x MPC	MPC Hrs	Date	No	Hrs	x MPC	MPC Hrs
4-1-68	232	40.8	2.4	93.0	4-23-68	261	15	3.1	46.5
		8.2	13.8	113.1	Sub Total		545.2		2,589.0 4.
		14.6	5.0	73.0					
	235	12.2	5.8	70.8					
		11.9	5.1	60.7					
		12.2	7.2	87.8					
		11.8	6.4	75.5					
		12.2	5.9	71.9					
	240	12.7	24.2	307.5					
		8.3	4.4	36.5					
		65.1	1.2	78.1					
		22.6	1.4	31.6					
		8.8	6.6	58.1					
	245	16.2	1.0	16.2					
		8.0	6.8	54.4					
		15.0	1.2	18.0					
		8.4	10.9	91.6					
		87.8	1.3	114.0					
	250	8.8	11.5	10.0					
		15.5	1.0	15.5					
		8.0	27.1	216.8					
4-17-68	253	14.5	2.0	29.0					
Sub Total		423.6		1,723.1	4.1 x MPC				
	254	10.0	7.6	76.0					
	255	14.0	1.6	22.4					
	256	12.3	17.8	216.5					
	257	11.8	2.3	26.1					
4-19-68	258	10.0	16.9	169.0					
4-22-68	259	63.0	1.8	113.2					
	260	9.0	21.8	196.2					

Hand Painting Stack - 14

Date	Time	Mins.	MPC	OPS
12-19-67	0934-1625	411	.046	Painting, 12 Ci
12-19/20-67	1645-0815	930	.044	O/N none
12-20-67	0845-1612	447	.249	Painting, 12 Ci
12-20/21-67	1637-0812	935	.005	O/N none
12-21-67	1125-1610	285	.307	Painting, 12 Ci
12-21/22-67	1653-0815	922	.061	O/N none
12-26-67	0829-1507	398	.001	Painting, 12 Ci
12-26/27-67	1600-0810	970	.000	O/N none
12-27-67	0831-1515	404	.000	Painting, 12 Ci
12-27/28-67	1538-0821	1003	.018	O/N none
12-28-67	0847-1512	385	.078	Painting, 14 Ci
12-28/29-67	1542-0832	1010	.005	O/N none
1-29-68	0905-1547	402	34.109	Painting, 16 Ci
1-29/30-68	1622-0805	943	12.084	O/N none
1-30-68	0847-1545	418	19.200	Painting, 16 Ci
1-30/31-68	1619-0814	955	8.785	O/N none
1-31-68	0855-1550	415	7.293	Painting, 16 Ci
1-31/2-1-68	1615-0815	960	8.195	O/N none
2-1-68	0850-1554	424	37.357	Painting, 16 Ci
2-1/2-68	1624-0809	945	14.014	O/N none
2-2-68	0905-1512	367	37.097	Painting, 16 Ci
2-5-68	0842-1512	390	48.779	Painting, 20 Ci
2-5/6-68	1541-0812	991	11.737	O/N none
2-6-68	0912-1550	398	5.516	Painting, 16 Ci
2-6/7-68	1619-0810	941	12.994	O/N none
2-7-68	0850-1555	425	50.712	Painting, 18 Ci
2-7/8-68	1626-1255	1229	3.860	Ops, O/N

2-8/9-68	1403-0825	1102	17.894	Ops, 18 Ci, O/N
2-9-68	0853-1510	377	17.972	Painting, 16 Ci
2-12-68	0837-1513	426	10.037	Painting, 20 Ci
2-12/13-68	1630-0812	942	-	sample lost
2-13-68	0912-1610	418	-	sample lost
2-13/14-68	1630-0808	938	13.030	O/N none
2-14-68	0902-1603	421	38.710	Painting, 16 Ci
2-14/15-68	1633-0812	939	.960	O/N none
2-15-68	0859-1459	360	55.107	Painting, 16 Ci
2-15/16-68	1533-0815	1002	3.397	O/N none
2-16-68	0847-1455	368	2.227	Painting, 16 Ci
2-19-68	0855-1509	374	49.514	Painting, 24 Ci
2-19/20-68	1553-0819	986	35.897	O/N none
2-20-68	0928-1509	341	98.037	Painting, 16 Ci
2-20/21-68	1542-0820	998	22.243	O/N none
2-21-68	0855-1510	375	54.757	Painting, 16 Ci
2-22-68	0834-1504	390	59.074	Painting, 16 Ci
2-23-68	0841-1507	386	45.259	Painting, 16 Ci

Tritium Releases from
Various Stacks

^{3}H Building Stack - 10

Date	Time	Mins.	MPC	OPS
11-19-67	0948-1710	442	1.75	None
11-20-67	0910-0820	1390	2.03	423 Ci resin solv. and O/N
11-21-67	0820-1605	465	2.282	419 Ci cmpdg.
11-22-67	0910-1625	435	2.056	None
11-24-67	0918-1607	409	1.781	None
11-30-67	0834-1636	482	3.475	90 Ci Foil cut
12-1-67	0829-1647	486	1.707	90 Ci Foil cut
12-4-67	0833-1620	467	4.493	90 Ci Foil cut
12-4/5-67	1654-0814	800	1.475	O/N None
12-5-67	0900-1544	404	2.237	Foil impreg prep
12-5/6-67	1610-0813	843	3.485	O/N None
12-6-67	0842-1549	427	3.285	1300 Ci Foil
12-6/7-67	1617-0814	957	4.757	O/N none
12-7-67	0848-1605	437	130.778	1300 Ci foil
12-7/8-67	1645-0810	925	17.299	O/N none
12-8-67	0844-1512	388	5.591	meas. Foil 1300 Ci
12-11-67	0902-1620	438	2.410	meas. Foil 1300 Ci
12-11/12-67	1648-0820	932	2.526	O/N none
1-15-68	1146-1509	203	2.379	Resin solv. 450 Ci
1-15/16-68	1607-0818	971	1.746	O/N none
1-16-68	0843-1506	383	2.403	Cmpdg. 450 Ci
1-16/17-68	1608-0815	967	2.106	O/N none
1-17-68	0914-1535	380	1.904	Cmpdg. 205 Ci
1-17/18-68	1612-0822	970	1.197	O/N none
1-18-68	0855-1652	477	3.581	None
1-18/19-68	1609-0826	977	1.229	O/N None

continued

^{3}H Building Stack - 10 continued

Date	Time	Mins.	MPC	OPS
1-19-68	0856-1505	369	2.381	None
2-5-68	1149-1512	203	3.848	Resin Solv. 420 Ci
2-5/6-68	1541-0812	991	3.510	O/N none
2-6-68	0912-1550	398	9.214	cmpdg. 970 Ci
2-6/7-68	1619-0810	941	5.478	O/N none
2-12-68	0837-1543	426	8.511	Blend 248 Ci
2-12/13-68	1630-0813	942	.047	O/N none
2-13-68	0912-1610	418	.050	Foil cut 10 Ci
2-13/14-68	1630-0808	938	2.988	O/N none
2-14-68	0902-1603	421	2.548	None
2-14/15-68	1633-0812	939	4.447	O/N none
2-15-68	0859-1459	360	2.831	Foil cut 34 Ci
2-15/16-68	1533-0815	1002	15.304	O/N none
2-16-68	0847-1455	368	4.062	None
2-19-68	0855-1509	374	9.028	Cut-blend 148 Ci
2-19/20-68	1553-0819	986	.532	O/N none
2-20-68	0928-1509	341	2.927	Cut-blend 598 Ci
2-20/21-68	1542-0820	998	1.979	O/N none.
2-21-68	0855-1510	375	2.004	Cut-mix 100 Ci
2-22-68	0834-1504	390	2.440	51 Ci
2-26-68	1150-1509	199	3.539	Cmpd. 3 Ci
2-27-68	0817-1635	498	12.025	Cmpd. 425 Ci

Annex Room 4, Stack 2

Date	Time	Mins.	MPC	OPS
1-4-68	1018-1457	279	.831	None
1-4/5-68	1540-0812	992	.839	O/N None
1-5-68	0900-1510	370	1.399	None
1-8-68	0834-1510	396	1.033	None
1-8/9-68	1617-0820	943	.741	O/N None
1-9-68	0847-1605	438	.817	None
1-9/10-68	1642-0856	974	1.810	O/N None
1-10-68	0938-1546	368	3.420	Scrub maint.
1-10/11-68	1635-0805	930	.893	O/N None
1-11-68	0902-1556	409	2.052	Resin 500 Ci
1-11/12-68	1645-0820	935	.191	O/N None
1-12-68	0854-1521	387	1.735	Resin 530 Ci
1-15-68	0834-1144	190	.797	Resin transfer
2-2-68	0905-1512	367	1.514	Resin 530 Ci
2-5-68	0842-1143	181	.282	Resin transfer
2-23-68	0841-1507	386	1.341	Resin 500 Ci
2-26-68	0848-1145	177	.996	Resin transfer

Tritium Gas Fill System Stack-9

Date	Time	Mins.	MPC	OPS
1-4-68	1021-1457	276	4.876	Transfer 10,000 Ci
1-4/5-68	1540-0812	992	1.945	O/N none
1-5-68	0900-1510	370	3.016	2 x 0.8 Ci
1-8-68	0902-1510	368	6.330	Transfer 10,000 Ci
1-8/9-68	1617-0820	943	.722	O/N none
1-9-68	0847-1605	438	15.906	78T, 32 Ci
1-9/10-68	1605-0856	1011	5.228	O/N none
1-10-68	0938-1546	368	13.579	33T, 13 Ci
1-10/11-68	1635-0805	930	16.903	O/N none
1-11-68	0907-1556	409	46.352	78T, 32 Ci
1-11/12-68	1645-0820	935	22.502	O/N none
1-12-68	0854-1521	387	64.601	50T, 20 Ci
1-16-68	0843-1506	383	16.986	None
1-16/17-68	1608-0815	967	9.584	O/N none
1-17-68	0914-1535	381	5.975	None
1-17/18-68	1612-0822	970	.369	O/N none
1-18-68	0855-1552	417	8.911	125T, 392 Ci
1-18/19-68	1609-0826	977	20.121	O/N none
1-19-68	0856-1505	369	16.141	40T, 124 Ci
1-29-68	0905-1547	402	5.880	None
1-30-68	0847-1545	418	1.804	None
1-30/31-68	1619-0814	955	1.526	O/N none
1-31-68	0855-1550	415	45.156	70T, 28 Ci
1-31/2-1-68	1615-0815	960	3.173	O/N none
2-1-68	0850-1554	424	27.681	34T, 14 Ci
2-1/2-68	1624-0809	945	2.015	O/N none
2-7-68	0850-1555	425	6.084	73T, 38.5 Ci
2-7/8-68	1626-1255	1229	4.545	54T, 21.5 Ci, O/N
2-8/9-68	1403-0825	1102	7.011	O/N, as above
2-9-68	0853-1510	377	22.689	67T, 34.5 Ci

Date	Time	Mins.	MPC	OPS
2-13-68	1000-1530	330	168.0	Reported/DBC
3-18-68	0827-1514	407	11.327	80T, 320 Ci
3-18/19-68	1535-0816	1001	3.041	O/N none
3-19-68	0834-1515	401	37.684	30T, 104 Ci, 22 Ci release
3-19/20-68	1525-0811	1006	9.415	O/N none
3-20-68	0825-1505	400	8.883	99T, 390.6 Ci
3-20/21-68	1530-0819	1009	5.088	O/N none
3-21-68	0847-1505	378	7.777	60T, 240 Ci
3-27-68	0852-1535	403	.858	125T, 500 Ci