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Environmental Aspects of the June 16, 1995 Tritium Release from the Savannah River Site

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EXECUTIVE SUMMARY

On June 16, 1995 approximately 10,700 Ci of elemental tritium (HT) were released through a 200 ft stack during a welding operation in H-area while stainless steel containers were being prepared for burial. The workers immediately evacuated the room and H-area personnel were instructed to remain indoors for 30 minutes.

The dose at the site boundary was calculated with the WINDS system atmospheric transport model to be 3×10^{-6} mrem, a value one-hundred million times smaller than the yearly average dose for SRS area (300 mrem). The plume moved in a west south-west direction and crossed the Savannah River into Georgia about 11:00 EDT.

The Environmental Technology Section (ETS) and Environmental Monitoring Section (EMS) dispatched teams to collect air, air-moisture, water and vegetation samples on-site and near the Georgia communities of Waynesboro and Louisville. The TRAC (Tracking Radioactive Atmospheric Contaminants) vehicle was also mobilized to monitor atmospheric tritium concentrations in near real time.

The samples were analyzed and revealed the presence of predominantly elemental tritium in quantities consistent with the 10,700 Ci reported by the stack monitors. The maximum measured HT concentration was 1348 pCi/m³. The samples also confirmed the calculated direction, speed, and size of the plume.

The samples also contained trace amounts of HTO in the plume path. The maximum HTO measured concentration was 6.57 pCi/g. This HTO could have been produced by oxidation during the initial welding incident or by subsequent conversion. The trace HTO distribution was in good agreement with the predicted plume path.

INTRODUCTION

Approximately 10,700 Ci of tritium was inadvertently released into the atmosphere from the H-area tritium facility between 9:33 EDT and 10:03 EDT on June 16, 1995. The 10,700 Ci were determined to be predominately elemental (HT) based on the facility stack forms monitor data at the time of the release.

The release was below emergency reporting levels and federal safety limits, but as a precaution, workers in the area were instructed to remain indoors for 30 minutes after the release.

The estimated dose at the site boundary was calculated with the WINDS system Puff/Plume model to be 3.4×10^{-6} mrem, which can be compared to an average daily dose from natural phenomena in the SRS area of approximately 1 mrem.

After the release, the Environmental Technology Section (ETS) and Environmental Monitoring Section (EMS) collected air, air-moisture, water and vegetation samples on site and off site, downwind of the release. The data collected by ETS and EMS is summarized in this report.

RELEASE DESCRIPTION

The incident occurred in the H-area tritium facility when stainless steel containers were being welded before burial. During the process, elemental tritium was discharged through the 200 ft stack from 09:33 EDT to 10:03 EDT.

The tritium forms monitor indicated that all of the 10,700 Ci were elemental HT rather than oxide HTO. However, since the forms monitor obtains the HTO amount by subtracting the HT amount from the total released, the possibility of a very small HTO release can not be excluded.

METEOROLOGY ON JUNE 16, 1995

June 16 was a cool dry summer day. The weather was dominated by high pressure centered over the Washington DC area which produced fair weather and light northeasterly winds. (Fig. 1). The Southeast had

mostly sunny skies (Fig. 2). The high and low temperatures in Augusta for the day were 85° F and 58°F respectively.

The winds during the day were from the northeast and steady. At 9:30 EDT the Site Area Mean (SAM) wind was from the east-north east (62 degrees) at 6.5 mph. By 14:30 EDT the SAM wind speed had increased to 8.5 mph but the wind direction had changed little (from 67 degrees). After 14:30 EDT the wind shifted to a more easterly direction (from 80 degrees).

The atmosphere was unstable during the release (stability class A or B) which resulted in substantial dilution of the plume.

EMERGENCY RESPONSE AND PLUME DISPERSION

The amount of tritium released was not sufficient to require the declaration of an Alert or activation of the Emergency Operations Center. Protective action included the evacuation of the room where the incident occurred and personnel in H-area were instructed to remain indoors for 30 minutes.

The WSRC Emergency Duty Officer in the Emergency Operations Center (EOC) used the Puff/Plume dispersion model to calculate a site boundary dose of 3.4×10^{-6} mrem. This value was confirmed with Puff/Plume calculations by ETS personnel in the WCAL (Weather Center) (See Fig. 3).

Because the EOC was not activated, no formal notification was transmitted to the ETS or EMS. ETS learned of the event at approximately 10:15 EDT, and sampling teams and the TRAC vehicle were organized at approximately 10:45 EDT. Air sampling was possible in Georgia only because of the late notification and the time required to assemble sampling teams.

EMS was notified of the incident at 11:45 EDT. Sampling teams collected silica gel, atmospheric moisture, water and vegetation samples on the SRS between 12:35 and 16:15 EDT. Locations were selected based on Puff/Plume dispersion predictions.

Figure 1. Surface weather map for June 16, 1995 at 8:00 EDT

Figure 2. Satellite cloud depiction for June 16, 1995 at 8:00 EDT

june 16-5

12:13 EDT 16-JUN-95

CIRCLES INDICATE
PUFF LOCATIONS
EVERY 30.0 MINUTES

RELEASE DATE AND TIME
09:33 EDT 16-JUN-95

RELEASE TOTAL
IS 1.07E+04 Ci.

Dist. (miles)	Dose (mrem)	Arrival Time	
2.7	1.2E-05	10:03	DT
5.4	5.5E-06	10:33	DT
8.4	2.8E-06	11:03	DT
11.4	1.9E-06	11:33	DT
15.5	1.1E-06	12:03	DT
19.6	1.0E-06	12:33	DT
23.7	9.5E-07	13:03	DT
27.8	8.9E-07	13:33	DT
31.9	8.4E-07	14:03	DT
36.0	8.0E-07	14:33	DT
40.1	7.6E-07	15:03	DT
44.2	7.3E-07	15:33	DT

*
Doses are ground-level
50 year whole body
equivalent dose
commitment in mrem.

SRL ENVIRONMENTAL TECHNOLOGY SECTION

PUFF/PLUME PROGRAM

Figure 3. Plume path and HT concentrations from Puff/Plume model.

ENVIRONMENTAL SAMPLES AND ANALYSIS

Air Samples

ETS collected 24 air grab samples at six different locations in Georgia between 13:15 and 15:21 EDT. The locations of these samples are shown in Fig. 4 and Table 1. These samples were collected on specially-prepared molecular sieves to distinguish between elemental (HT) and oxide (HTO) forms of tritium. They were then returned to the laboratory in building 735-A processed, and counted by liquid scintillation. An analysis of these samples revealed the presence of HT above background levels. Very low concentrations of HTO were also detected with maximum values near the plume centerline.

ETS also collected air-moisture samples with the TRAC vehicle. The location of these samples is shown in Fig. 4 and Table 2. These samples were analyzed for HTO in real time on the TRAC vehicle and then reanalyzed on June 19 in the Low-Level Counting Facility. The real-time analysis indicated no HTO with a detection level of 2.4 pCi/gm. However, the re-analysis in the much more sensitive Low-Level Counting Facility, revealed trace amounts of HTO in 3 of 4 samples (1.2 - 2.2 pCi/gm) with a 95% confidence level of ± 0.4 pCi/gm.

Off-Site Vegetation Samples

The ETS sampling teams collected several vegetation samples for laboratory analysis by EMS. The sample locations and analyzed values are given in Table 3. The measured concentrations range from 0.02 pCi/gm to 0.91 pCi/gm. The low values are consistent with normal background values but the larger ones, which occurred along the plume path, are higher than normal background and indicate the presence of small amounts of HTO in the plume.

On-Site Vegetation Samples

Vegetation samples were collected by the EMS at 30 on-site locations. The sample locations are shown in Fig. 5 and HTO concentration in the samples are listed in Table 4. Also given in Table 4 are ranges in HTO concentrations from various site locations for 1994. These background values are less than 1 pCi/gm which indicates that the large HTO values given in Table 4 are due to the June 16 release.

Table 1: ETS grab-air samples.

Map Location	Sample Location	Time Begin	Duration	Volume m3	HTO pCi/g	HT pCi/m3
1	Hwy 25 - Hepzibah-McBean	13:17	0:30	1.5	0.50	1.08
2	Hwy 25 - Brier Creek	13:15	0:30	1.5	6.57	257.80
2	Hwy 25 - Brier Creek	13:54	0:30	1.5	3.39	50.36
2	Hwy 25 - Brier Creek	14:35	0:30	1.5	4.06	39.77
3	Hwy 25 - Waynesboro	13:17	0:30	1.5	1.00	5.38
3	Hwy 25 - Waynesboro	13:56	0:30	1.5	1.03	4.39
3	Hwy 25 - Waynesboro	14:31	0:30	1.5	0.82	1.75
4	Hwy 25 - 4mi S. Waynesboro	13:29	0:18	0.9	0.85	4.08
5	Hwy 1 - 2mi S. Louisville	14:32	0:30	1.5	3.02	1347.60
5	Hwy 1 - 2mi S. Louisville	15:04	0:30	1.5	0.64	12.51
6	Hwy 1 - 5.3mi S. Louisville	14:49	0:30	1.5	0.25	8.82
6	Hwy 1 - 5.3mi S. Louisville	15:21	0:30	1.5	0.38	2.98

Table 2: ETS TRAC samples. The column labeled 735-A analysis is a re-analysis of the TRAC samples in the ETS' low-level counting facility.

Sample Location	<u>HTO Concentration (pCi/m3)</u>	
	TRAC analysis	735-A analysis
Brier Creek to Waynesboro 12:15-12:30 EDT	0.8 ±1.8	2.2± 0.2
US 25 (N Waynesboro) 13:12-13:24 EDT	1.1±1.2	1.5±0.2
Vidette to 2mi west of Louisville on GA 24 14:57-15:25 EDT	1.1±1.2	1.2±0.2
2 mi west of Louisville 15:30-15:56 EDT	1.1±1.4	0.24±0.12

Table 3: Off-site vegetation samples.

Sampling Location	H-3 concentration (pCi/m3)
Brier Creek, US 25	0.91 ±0.04
McBean Creek, US25	0.58 ±0.03
2 mi south of Louisville	0.20 ±0.04
5.3 mi south of Louisville(2' from road)	0.02 ±0.06
5.3 mi south of Louisville(25' from road)	0.04 ±0.02
5.3 mi south of Louisville	0.02 ±0.04
16 mi from Bobby Jones	Insufficient sample
North edge of Waynesboro	0.40 ±0.05
Louisville/Barton	0.02 ±0.03
Downtown Waynesboro	0.39 ±0.05

Table 4: On-site vegetation samples.

#	Sampling Location	Tritium Concentration	
1	H-Area 614 Building	1.98	+/- 0.033
2	Burial Ground North (614 Building)	3.62	+/- 0.061
3	Burial Ground South (614 Building)	113.	+/- 1.07
4	SRS Road C, mile 0	0.300	+/- 0.037
5	SRS Road C, mile 0.25	0.239	+/- 0.034
6	SRS Road C, mile 0.5	0.390	+/- 0.048
7	SRS Road C, mile 0.75	0.979	+/- 0.051
8	SRS Road C, mile 1.0	4.49	+/- 0.061
9	SRS Road C, mile 1.25	9.36	+/- 0.085
10	SRS Road C, mile 1.5	44.9	+/- 0.258
11	SRS Road C, mile 1.75	40.4	+/- 0.246
12	SRS Road C, mile 2.0	2.96	+/- 0.043
13	SRS Road C, mile 2.25	0.758	+/- 0.029
14	SRS Road C, mile 2.5	0.689	+/- 0.044
15	SRS Road C, mile 2.75	0.835	+/- 0.056
16	SRS Road A, mile 0.0	0.087	+/- 0.014
17	SRS Road A, mile 0.5	0.278	+/- 0.035
18	SRS Road A, mile 1.0	0.203	+/- 0.037
19	SRS Road A, mile 1.5	0.460	+/- 0.042
20	SRS Road A, mile 2.0	0.245	+/- 0.040
21	SRS Road A, mile 2.5	0.559	+/- 0.041
22	SRS Road A, mile 3.0	0.900	+/- 0.046
23	SRS Road A, mile 3.5	0.514	+/- 0.036
24	SRS Road A, mile 4.0	6.71	+/- 0.086
25	SRS Road A, mile 4.5	7.99	+/- 0.102
26	SRS Road A, mile 5.0	6.71	+/- 0.093
27	SRS Road A, mile 5.5	3.79	+/- 0.069
28	SRS Road A, mile 6.0	0.320	+/- 0.033
29	SRS Road A, mile 6.5	0.147	+/- 0.028
30	SRS Road A, mile 7.0	0.258	+/- 0.034

Range of 1994 Vegetation Averages: 0.09 (Jackson) - 0.73 (Hwy 39)

Range of 1994 Vegetation Maxima: 0.15 (Jackson) - 3.38 (A-14)

NOTES:

Vegetation tritium levels are in pCi/g.

SRS Road C locations are in miles from the Upper Three Runs bridge.

SRS Road A locations are in miles from the SRS Road 6 intersection.

Table 5: On-site atmospheric moisture (silica gel) samples.

<u>Sampling Location</u>	<u>Tritium Concentration</u>	<u>1993 Average</u>	<u>1993 Maximum</u>
Burial Ground North	(1.92 +/- 0.11)E-4	2.92E-4	1.31E-3
Burial Ground South	(3.21 +/- 0.13)E-4	3.64E-4	1.94E-3
D-Area	(3.85 +/- 0.75)E-5	6.03E-5	1.61E-4
H-Area	(4.11 +/- 0.15)E-4	1.06E-3	5.26E-3
West Jackson	(1.54 +/- 0.53)E-5	2.67E-5	1.06E-4

NOTES:

Tritium concentrations are in pCi/cc.

1993 results are used because 1994 results are not available.

Table 6: On-site water samples.

<u>Sampling Location</u>	<u>Tritium Concentration</u>	<u>1994 Average</u>	<u>1994 Maximum</u>
H-Area North gate	7.35 ± 0.60		
H-Area 614 Building	14.3 ± 0.65	55.5	181.0
Burial Ground North 614 Building	33.0 ± 0.88	6.7	41.6
Burial Ground South 614 Building	49.4 ± 1.05	8.9	54.8
H-Area Main Gate	2.37 ± 0.57		
SRS Roads 4 & E	11.8 ± 0.62		
SRS Road C and Burma Rd	1.42 ± 0.42		
SRS Road C, mile 0.5	0.98 ± 0.31		
SRS Road C, mile 1.75	10.7 ± 0.59		
SRS Road C, mile 2.75	1.75 ± 0.48		
SRS Roads A & 3	3.48 ± 0.52		
SRS Road A, mile 3.0	3.50 ± 0.48		

Range of 1994 Rainwater Averages: 0.29 (Allendale) - 1.30 (D-Area)

Range of 1994 Rainwater Maxima: 1.30 (Hwy 21/167) - 7.59 (Aiken Barricade)

Results are in pCi/ml.

SRS Road C locations are miles from the Upper Three Runs bridge.

SRS Road A locations are miles from the Road 6 intersection.

Of the three close-in samples (V1-3, Table 4), only the one at the BGS 614 building contained an elevated tritium concentration. This high tritium concentration (113 pCi/gm) is attributed to the sample's location directly in the path of the plume (Fig. 5).

Further evidence for this conclusion is presented in Figs. 6 and 7 which show the HTO concentration in vegetation along roads C and A. Also shown is the air concentration of HT calculated with Puff/Plume (scaled so that the maximum value equals the maximum in the vegetation samples). The good agreement in plume location and shape indicate that the large values seen in the vegetation are indeed due to HTO released from the H-area facility.

Silica Gel Samples

Table 5 shows EMS' silica gel samples results. This table shows concentrations less than normal background level. For example, the value measured at H-area was 4.11×10^{-4} pCi/cc which is less than the 1993 average of 1.06×10^{-3} pCi/cc. Since the silica gel absorb moisture over an extended period, the concentrations cannot be attributed exclusively to the June 16 release. Thus, it not surprising that the HTO concentrations are not elevated.

Water Samples

The EMS water samples are given in Table 6. The concentrations range from 1 to 49 pCi/ml. Of particular interest are the samples at SRS roads 4 and E, on Road C, 1.75 miles south of the Upper Three Runs bridge, and at the Burial Ground South (614 Building). These samples are located in the plume path and have elevated HTO concentrations.

CONCLUSIONS

Data and model predictions of HT and HTO from the inadvertent release of tritium from H-area on June 16 are presented. The movement, width, and speed of the plume were found to be consistent with predictions of the Puff/Plume dispersion model. The data are also consistent with the measured release amount of 10,700 Ci of HT.

The measurements also confirm the presence of trace amounts of HTO in air-moisture, water, and vegetation samples on and off site.

Figure 4. Location of ETS air and TRAC samples (see Tables 1 and 2). The TRAC samples T2 and T4 were collected while the vehicle was moving along the path shown.

Figure 5. Location of EMS vegetation samples. The dashed lines denote samples collected along SRS Roads C (V4-V15) and A (V16-V30). The arrow shows the path of the plume.

Figure 6. Vegetation sample results on Road C, compared with the Puff/Plume prediction (scaled so the maximum equals the maximum vegetation sample).

Figure 7. As in Fig. 6 but for Road A

**Environmental Aspects of the June 16, 1995 Tritium Release
from the Savannah River Site**

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Distribution List (60)

F. B. Davis, 703-A
L. M. Papouchado, 773-A
A. L. Boni, 773-A
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W. H. Carlton, 773-A
J. E. Halverson, 735-A
J. D. Heffner, 735-16A
K. J. Hofstetter, 735-A
R. Maher, 703-A
L. H. Sain, 235-H
D. L. Hayes, 703-H
W. P. Mayson, 235-H
M. A. Schmitz, 235-H
D. D. Wilhelm, 235-H
D. J. Green, 235-H
R. L. Rabun, 235-H
J. S. Roberts, 742-A
W. G. Winn, 735-A
J. R. Cadieux, 735-A
C. R. MacDonald, 703-A
B. M. Cadotte, 719-12A
C. E. Murphy, Jr, 773-42A

S. R. Wright, 703-41A
E. Goodson, 703-47A
J. D. Arnett, 703-47A
C. T. Edwards, 703-47A

SRTC Records (2), 773-52A
ETG(31) 773-A