

REPORT OF PUBLIC HEALTH SERVICE OFF-SITE
RADIOLOGICAL MONITORING DATA

OPERATION HARDTACK
PHASE I
1958

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During the Spring and Summer, 1958, test series at the Pacific Proving Grounds the Public Health Service operated an off-site radiological safety program under an agreement with Joint Task Force Seven. Details of the Public Health Service operation are covered in "Manual for Public Health Service Participants - Operation HARDTACK."

PHS Officers stationed on each of the close-in populated atolls of Utirik, Ujelang, Rongelap and Wotho secured data on radiation levels and collected environmental samples for laboratory counting. In addition, data on gamma levels were obtained by weather personnel at the following locations: Kwajalein, Midway, Wake, Guam, Truk, Ponape, Tarawa, Nauru, Majuro, Kussie, and Kapinga marange. These locations cover an area of approximately one thousand mile radius from the testing area.

On each of the islands operated by PHS personnel a monitoring station was established in the camp site near the native village. At each of these stations iodine, air and rainfall fallout samples were taken as well as daily gamma readings. A continuous gamma recorder was used along with an AN/PDR 27F Radiac instrument. A high range AN/PDR 18A radiac instrument and a cutie pie for Beta measurements were provided but were not needed during the operation. In addition, approximately fifteen film-badge stations were established on each of the islands manned by a PHS Officer.

All of the sample collectors, the gamma recorders, film-badge station number one, and the location at which daily gamma readings were taken were in close proximity so that, as early as possible, these readings and samples came from the same location. Equipment on the weather islands consisted of a continuous gamma recorder and an AN/PDR 27F radiac instrument. These were operated by the weather station personnel stationed there with supervision and consultation from the PHS. Radiation exposures on these islands were negative, but the records are on file with the Public Health Service should there be any question.

During the period of the tests at Johnston Island, the Service operated monitoring stations (air sampling and continuous gamma monitor recorders) on the principle islands of the Hawaii group. This was done in conjunction with the Territorial Health Department and at their request. Data from these stations show no increase above background.

The purpose of this report is to present data from stations operated by PHS personnel. It will be subject to additional study and analyses in an attempt to further determine its significance.

data
Hardtack I

APPENDIX I
EXTERNAL GAMMA DATA

During the operation four gamma intensity readings daily were taken at the populated off-site atolls utilizing a radiac meter AN/PDR 27F, calibrated against a standard consisting of 7 micrograms of Radium. Following each test hourly readings were taken for an interval of time dependent upon fallout forecasts, wind conditions at and following test time, cloud tracking, and readings obtained at the atolls. The attached tables and charts show the weighted daily averages of these readings for the atolls at which stations were maintained.

An estimated cumulative exposure of the population of these atolls resulting from operation HAFDTACK has been computed based on the meter readings. These exposures are tabulated and are compared with a calculated 70 year dose in TABLE I. The computation for these exposures are attached. The two exposures agree quite well when one considers that one is an infinite exposure. In a further comparison, the indicated dose on the film-badges exposed for the entire operation is also included.

TABLE I.

ATOLL	CUMULATIVE EXPOSURE	CALCULATED 70 YEAR DOSE	FILM BADGE DOSE
WOTHO	142 mr	194 mr	Badge Watermarked
RONGELAP	285 mr	469 mr	393 mr
UJELANG	222 mr	251 mr	334 mr
UTIRIK	230 mr	399 mr	307 mr
PARRY IS.	2.605 μ r	3.492 μ r	-

DAILY AVERAGE READINGS
(mr/hr)

DATE	UTIRIK	UJELANG	WOTHO	RONGELAP	PARRY IS.	ENINETCK
4/11	0.01	0.02	0.02	0.02	0.02	-
5/6	0.01	0.20	0.02	0.02	0.02	-
5/7	0.01	0.25	0.02	0.02	0.02	-
5/8	0.01	0.18	0.02	0.02	0.02	-
5/9	0.01	0.15	0.02	0.02	0.02	-
5/10	0.01	0.15	0.02	0.02	0.02	-
5/11	0.01	0.13	0.02	0.02	0.02	-
5/12	0.01	0.09	0.02	0.02	0.02	-
5/13	0.13	0.08	0.02	0.02	0.02	-
5/14	1.00	0.22	0.02	1.10	19.0	-
5/15	0.80	0.30	0.16	1.20	13.0	-
5/16	0.75	0.27	0.23	0.90	9.00	-
5/17	0.45	0.25	0.20	0.70	5.00	-
5/18	0.40	0.22	0.18	0.50	3.50	-
5/19	0.35	0.21	0.14	0.35	3.40	2.90
5/20	0.30	0.20	0.11	0.27	3.10	2.40
5/21	0.28	0.20	0.06	0.25	2.50	2.10
5/22	0.22	0.17	0.05	0.22	2.30	1.90
5/23	0.20	0.17	0.05	0.18	3.00	2.20
5/24	0.19	0.15	0.04	0.17	2.40	1.60
5/25	0.18	0.15	0.04	0.16	2.10	1.50
5/26	0.17	0.12	0.03	0.15	1.80	1.30
5/27	0.17	0.12	0.03	0.14	1.70	1.20
5/28	0.10	0.12	0.03	0.13	1.50	1.10
5/29	0.10	0.12	0.03	0.12	1.40	1.00
5/30	0.10	0.11	0.05	0.12	1.30	0.90
5/31	0.13	0.11	0.05	0.14	1.20	0.90
6/1	0.11	0.10	0.05	0.13	1.30	0.90
6/2	0.10	0.10	0.05	0.12	1.10	0.80
6/3	0.10	0.10	0.03	0.11	1.20	0.80
6/4	0.10	0.10	0.03	0.09	1.10	0.70
6/5	0.10	0.10	0.03	0.09	1.00	0.70
6/6	0.12	0.10	0.03	0.09	0.80	0.60
6/7	0.13	0.10	0.03	0.08	0.80	0.60
6/8	0.18	0.07	0.03	0.08	0.80	0.60
6/9	0.12	0.07	0.03	0.08	0.70	0.50
6/10	0.12	0.07	0.03	0.08	0.60	0.45
6/11	0.10	0.08	0.03	0.07	0.60	0.35
6/12	0.09	0.06	0.02	0.07	0.70	0.35
6/13	0.07	0.07	0.02	0.07	0.60	0.40
6/14	0.06	0.09	0.02	0.07	0.60	0.40
6/15	0.06	0.08	0.02	0.07	0.60	0.35
6/16	0.06	0.08	0.02	0.07	0.60	0.35
6/17	0.05	0.07	0.02	0.06	0.43	0.30
6/18	0.04	0.06	0.02	0.06	0.42	0.25
6/19	0.04	0.05	0.02	0.06	0.38	0.25
6/20	0.05	0.06	0.02	0.06	0.36	0.25
6/21	0.05	0.06	0.02	0.06	0.30	0.25
6/22	0.04	0.06	0.02	0.06	0.27	0.20
6/23	0.04	0.06	0.02	0.06	0.29	0.20
6/24	0.05	0.06	0.02	0.06	0.28	0.20
6/25	0.05	0.04	0.02	0.05	0.25	0.20

DAILY AVERAGE READING
(mr/hr)

DATE	UTIRIK	UJELANG	WOTHO	BONGELAP	PARRY IS.	ENINETCK
6/26	0.05	0.05	0.02	0.05	0.22	0.20
6/27	0.05	0.05	0.02	0.05	0.24	0.20
6/28	0.04	0.05	0.02	0.05	0.90	0.20
6/29	0.04	0.05	0.02	0.06	0.80	0.30
6/30	0.04	0.25	0.02	0.05	1.30	0.55
7/1	0.04	0.18	0.02	0.05	0.80	0.30
7/2	0.04	0.13	0.02	0.07	0.60	0.25
7/3	0.04	0.13	1.00	0.40	0.40	0.25
7/4	0.04	0.18	0.60	0.25	0.60	0.25
7/5	0.04	0.13	0.40	0.18	0.50	0.25
7/6	0.04	0.12	0.24	0.13	0.45	0.25
7/7	0.04	0.12	0.13	0.10	0.40	0.20
7/8	0.04	0.11	0.11	0.10	0.35	0.20
7/9	0.04	0.10	0.10	0.10	0.28	0.20
7/10	0.04	0.09	0.09	0.08	0.24	0.15
7/11	0.04	0.09	0.09	0.08	0.24	0.15
7/12	0.04	0.08	0.08	0.07	-	0.15
7/13	0.04	0.08	0.08	0.07	0.08	1.00
7/14	0.04	0.07	0.05	0.07	1.30	0.30
7/15	0.04	0.07	0.05	0.04	0.80	0.20
7/16	0.05	0.06	0.04	0.04	0.70	0.15
7/17	0.07	0.06	0.06	0.04	0.60	0.15
7/18	0.05	0.06	0.09	0.04	0.50	0.15
7/19	0.05	0.06	0.08	0.04	0.35	0.15
7/20	0.05	0.06	0.08	0.04	0.25	0.15
7/21	0.05	0.06	0.08	0.04	0.28	0.15
7/22	0.06	0.05	0.07	0.04	0.24	0.15
7/23	0.06	0.06	0.07	0.04	0.23	0.15
7/24	0.04	0.05	0.06	0.04	0.22	0.10
7/25	0.04	0.06	0.06	0.04	0.21	0.10
7/26	0.04	0.06	0.07	0.04	0.19	0.10
7/27	0.05	0.06	0.06	0.04	0.20	0.10
7/28	0.06	-	0.06	0.04	0.19	0.10
7/29	0.04	0.05	0.06	0.04	0.18	0.10
7/30	-	0.05	0.05	0.04	0.17	0.10
7/31	-	0.05	0.05	0.04	0.15	0.10

70 YEAR AIR DOSE CALCULATIONS

As a consideration of the infinite doses received from operation HARDTACK on the various islands, the fallout incidents were treated separately. This assumes a background increase due to a particular detonation and the infinite dose received from that particular event is calculated. In the cases where an island received fallout on more than one occasion an attempt has been made to calculate the infinite dose for each fallout period. These values are then added together to obtain the total infinite dose received.

It should be remembered that this is an air dose and not a body dose. The calculations are based on the following equation:

According to the Empirical Relationship for Fallout $R_t = R_1 t^{-0.2}$ the expression for the gamma dose in air can be derived as:

$$D_a = 5 R_1 (1 - t_z^{-0.2})$$

Or $D_a = q R_1$

Where D_a = The gamma dose in air from H+1 to a later time t_z
 R_1 is the dose rate at H+1 and can be obtained from the equation

$$R_1 = f R_t$$

Where R_t is the dose rate at some time other than H+1 and f is a proportional factor relating the two.

Both f and q can be read from tables and graphs provided for this purpose.

70 YEAR AIR DOSE CALCULATIONS
RONGELAP

Fallout occurred on 5/14/58 at H+73. The doserate:

$$R_t = 1.10$$

$$R_1 = 190 \times 1.10 \\ = 209$$

$$D_a(H+73) = 209 \times 2.9$$

$$D_a(H+\infty) = 209 \times 5.0$$

$$DA = 209 (5.0 - 2.9) \\ = 439$$

Fallout occurred on 7/3/58 at H+12. The doserate:

$$R_t = 0.48$$

$$R_1 = 21 \times 0.48 \text{ mr/hr} \\ = 10.08$$

$$D_a(H+12) = 10.08 \times 2.0$$

$$D_a(H+\infty) = 10.08 \times 5.0$$

$$DA = 10.08 (5.0 - 2.0) \\ = 30.32 \text{ mr}$$

Total dose in Air = $439 + 30.32 = \underline{469.32}$

70 YEAR AIR DOSE CALCULATIONS
UJELANG.

Fallout occurred on 5/7/58 at H+34... The doserate

$$R_t = 0.30 \text{ mr/hr}$$

$$R_1 = 74 \times 0.30 \text{ mr/hr} \\ = 22.20$$

The Dose in Air is

$$D_a(H+34) = 2.5 \times 22.20 \\ D_a(H+00) = 5.0 \times 22.20 \\ D_a = (5.0 - 2.5) 22.20 \\ = \underline{55.5 \text{ mr}}$$

Fallout occurred on 5/16/58 at H+110. The doserate

$$R_t = 0.25 \text{ mr/hr}$$

$$R_1 = 0.25 \times 300 \\ = 75.0 \text{ mr/hr}$$

The Dose in Air is

$$D_a(H+110) = 75 \times 3.1 \\ D_a(H+00) = 75 \times 5.0 \\ D_a = (5.0 - 3.1) 75 \\ = \underline{142.5 \text{ mr}}$$

Fallout occurred on 6/30/58 at H+36. The doserate

$$R_t = 0.29 \text{ mr/hr}$$

$$R_1 = 0.29 \times 76 \\ = 22.04$$

The Dose in Air is

$$D_a(H+36) = 2.6 \times 22.04 \\ D_a(H=00) = 5.0 \times 22.04 \\ D_a = (5.0 - 2.6) 22.04 \\ = \underline{52.89 \text{ mr}}$$

The total 70 year dose delivered for the three fallout incidents on Ujelange is:

$$55.5 + 142.5 + 52.98 = \underline{251 \text{ mr}}$$

70 YEAR AIR DOSE CALCULATIONS
UTIRIK

Fallout occurred on 5/15/58 at H+75. The dose rate

$$R_t = 1.0 \text{ mr/hr}$$

$$R_1 = 190 \times 1.0$$
$$= 190 \text{ mr/hr}$$

$$D_a(H+75) = 2.7 \times 190$$

$$D_a(H+00) = 5 \times 190$$

$$D_a = (5 - 2.7) \times 190 = \underline{399 \text{ mr}}$$

70 YEAR AIR DOSE CALCULATIONS
NOTE

Fallout occurred on 5/16/58 at H+98. The doserate

$$R_t = 0.23 \text{ mr/hr}$$

$$\begin{aligned} R_1 &= f R_t \\ &= 270 \times 0.23 \\ &= 62.1 \text{ mr/hr} \end{aligned}$$

$$\begin{aligned} D_a(H+98) &= 62.1 \times 3.1 \\ D_a(H+\infty) &= 62.1 \times 5.0 \\ D_a &= 62.1 (5.0 - 3.1) \\ &= \underline{118 \text{ mr}} \end{aligned}$$

Fallout occurred on 7/3/58 at H+15. The doserate

$$R_t = 1.00 \text{ mr/hr}$$

$$\begin{aligned} R_1 &= f R_t \\ &= 27 \times 1.00 \\ &= 27 \text{ mr/hr} \end{aligned}$$

$$\begin{aligned} D_a(H+15) &= 27 \times 2.2 \\ D_a(H+\infty) &= 27 \times 5.0 \\ D_a &= 27(5.0 - 2.2) \\ &= \underline{75.6 \text{ mr}} \end{aligned}$$

$$\text{Total Dose Received} = 75.6 + 118 = \underline{193.6 \text{ mr}}$$

70 YEAR AIR DOSE CALCULATIONS
PARRY ISLAND

Fallout occurred on 5/14/58 at H+30. The doserate

$$R_t = 19.0 \text{ mr/hr}$$

$$R_1 = 164 \times 19 \\ = 1216 \text{ mr/hr}$$

$$D_a(H+55) = 2.5 \times 1216$$

$$D_a(H+\infty) = 5.0 \times 1216$$

$$D_a = (5.0 - 2.5) 1216 \\ = \underline{3,040 \text{ mr}}$$

Fallout occurred on 6/30/58 at H+30. The doserate

$$R_t = 1.08 \text{ mr/hr}$$

$$R_1 = 64 \times 1.08 = 69 \text{ mr/hr}$$

$$D_a = (5.0 - 2.5) 69 \\ = \underline{172 \text{ mr}}$$

Fallout occurred on 7/14/58 at H+50. The doserate

$$R_t = 1.06 \text{ mr/hr}$$

$$R_1 = 115 \times 1.06 \\ = 122 \text{ mr/hr}$$

$$D_a = (5.0 - 2.7) \times 122 \\ = \underline{280 \text{ mr}}$$

Total air dose delivered = 3,040 + 172 + 280 = 3,492 mr

APPENDIX II

OFF-SITE FILM BADGE SURVEY

1. A film badge survey was carried out on the four islands (Ujelang, Utirik, Rongelap, and Wotho) where RadSafe stations were maintained by PHS personnel (HQ JTF-7). This survey consisted of the setting up of about 15 film badge stations at various points on the islands. Station Number One was located at the RadSafe station at the campsite. The other stations were placed to give a complete coverage of the islands and, in particular, the native villages. The locations of the stations are recorded in the original data by description as well as island maps. The film badges were to have been placed three feet above the ground. However, this was not always followed, as in the case of Ujelang, where many film badges were placed six feet above the ground on coconut trees.

2. The film badges at each station were taken up every four weeks for processing and replaced by new badges. In addition to this, several badges were placed at Station Number One at start of operations that were to be collected at two-week intervals and at the end of the series to give a cumulative dose.

3. The doses listed in this summary will tend to be higher than the actual dosage received on the islands because of the exposure received from fallout on Elmer just prior to processing. This is particularly true of the May badges. For this reason one should consider the results from the cumulative badges as giving a better representation of the actual doses received.

4. The complete data are presented in tabular form accompanying this summary. A brief discussion of the results will be given here. For specific information one should consult the original data rather than this summary.

5. The results show that each station reported essentially the same dosage as others on the same island. The average total station doses received ranged from about 400 mr on Utirik and Wotho to about 900 mr on Rongelap. The average total station dose on Ujelang was about 550 mr. The cumulative dose badges at Stations Number One gave essentially the same results as the four-week badges if one considers the situation outlined in 3 above. The "ten week" and "end of series badges from Wotho appear to be watermarked, thus accounting for the abnormally high readings on these badges.

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FILM BADGE DATA - WCT.

STATION	FRGE	TO	DOSE	FRGM	TO	DOSE	FRGM	TO	DOSE	TOTAL
No. 1	4/18	5/15	147							
No. 2	4/18	5/15	130	5/15	6/24	* 50	6/24	8/1	122	302
No. 3	4/18	5/15	147	5/15	6/24	* 50	6/24	8/1	180	377
No. 4	4/18	5/15	132	5/15	6/24	* 50	6/24	8/1	148	330
No. 5	4/18	5/15	130	5/15	6/24	* 50	6/24	8/1	137	316
No. 6	4/18	5/15	123	5/15	6/24	* 50	6/24	8/1	113	286
No. 7	4/18	5/15	124	5/15	6/24	* 50	6/24	8/1	295	469
No. 8	4/18	5/15	140	5/15	6/24	* 50	6/24	8/1	-	-
No. 9	4/18	5/15	-	5/15	6/24	* 50	6/24	8/1	137	-
No. 10	4/18	5/15	129	5/16	6/24	* 50	6/24	8/1	-	-
No. 11	4/18	5/15	127	5/16	6/24	* 50	6/24	8/1	-	-
No. 12	4/18	5/15	164	5/16	6/24	* 50	6/24	8/1	193	407
No. 13	4/18	5/15	-	5/16	6/24	* 50	6/24	8/1	-	-
No. 14	4/18	5/15	127	5/16	6/24	* 50	6/24	8/1	502	679
No. 15	4/18	5/15	50	5/15	6/26	* 50				
No. 16	4/18	5/15	92	5/15	6/26	* 50				

No. 1(6) 4/17 6/3 227
 No. 1(8) 4/17 6/24 193
 No. 1(10) 4/17 8/1 757 - Badge watermarked
 No. 1(12) 4/17 8/1 805 - Badge watermarked

* Less than 50 mr.

FILM BADGE DATA - RONGELAP

STA- TION	FROM	TO	DOSE	FROM	TO	DOSE	FROM	TO	DOSE	FROM	TO	DOSE	TOTAL
No.1	4/12	5/16	160										
No.2	4/12	5/16	301	5/16	6/13	548	6/13	7/11	171	7/11	7/31	130	1150
No.3	4/12	5/16	280	5/16	6/13	418	6/13	7/11	139	7/11	7/31	117	1054
No.4	4/12	5/16	251	5/16	6/13	419	6/13	7/11	133	7/11	7/31	169	982
No.5	4/12	5/16	240	5/16	6/13	403	6/13	7/11	138	7/11	7/31	000	781
No.6	4/12	5/16	253	5/16	6/13	397	6/13	7/11	137	7/11	7/31	000	787
No.7	4/12	5/16	265	5/21	6/13	362	6/13	7/11	133	7/11	7/31	000	760
No.8	4/12	5/16	277	5/16	6/13	371	6/13	7/11	144	7/11	7/31	134	926
No.9	4/12	5/16	285	5/16	6/13	392	6/13	7/11	139	7/11	7/31	106	922
No.10	4/12	5/16	310	5/16	6/13	403	6/13	7/11	142	7/11	7/31	155	1010
No.11	4/12	5/15	263										
No.12	4/12	5/16	350	5/16	6/13	578	6/13	7/11	165	7/11	7/31	125	1218

No.1 (12) All camp end of series badge:
4/12

7/31 393 393

No.1 (8) 8 week badge:
4/12

6/6 212

No.1 (10) 10 week badge:
4/12

6/20 288

FILM BADGE DATA - UTIR

STA- TION	FROM	TO	DOSE	FROM	TO	DOSE	FROM	TO	DOSE	FROM	TO	DOSE	TOTAL
No.1	4/16	4/29											
No.2	4/16	5/13	670										
No.3	4/16			5/28	133								
No.4	4/16			6/12	121								
No.5	4/16									7/30	307		307
No.6				5/14	6/12	126	6/12	7/15	*50	7/15	7/30	83	-
No.7	4/16	5/14	122	5/14	6/12	97	6/12	7/15	*50	7/15	7/30	82	351
No.8	4/16	5/14	118	5/14	6/12	146	6/12	7/15	*50	7/15	7/30	83	397
No.9	4/16	5/14	149	5/14	6/12	59	6/12	7/15	*50	7/15	7/30	-	-
No.10	4/16	5/14	107	5/14	6/12	136	6/12	7/15	*50	7/15	7/30	87	360
No.11	4/16	5/14	114	5/14	6/12	152	6/12	7/15	*50	7/15	7/30	82	398
No.12	4/16	5/14	107	5/14	6/12	137	6/12	7/15	*50	7/15	7/30	54	348
No.13	4/16	5/14	142	5/14	6/12	149	6/12	7/15	*50	7/15	7/30	86	427
No.14	4/16	5/14	155	5/14	6/12	123	6/12	7/15	*50	7/15	7/30	96	424
No.15	4/18	5/15	183	5/15	6/12	184	6/12	7/15	*50	7/15	7/30	107	524
No.16	4/18	5/15	129	5/15	6/12	167	6/12	7/15	*50	7/15	7/30	66	412
No.17	4/18	5/15	131	5/15	6/12	168	6/12	7/15	*50	7/15	7/30	*50	399
No.18	4/18	5/15	302	5/15	6/12	-	6/12	7/15	*50	7/15	7/30	-	-
No.19	4/18	5/15	128	5/15	6/12	151	6/12	7/15	*50	7/15	7/30	73	402
No.20	4/18	5/15	125	5/15	6/12	159	6/12	7/15	*50	7/15	7/30	102	436

* Less than 50 mr

FILM BADGE DATA - UJELANG

STA- TION	FROM	TO	DOSE	FROM	TO	DOSE	FROM	TO	DOSE	FROM	TO	DOSE	TOTAL
No.1	4/18	5/16	230	5/16	6/13	*50	6/13	7/11	150	7/11	7/31	137	567
No.2A	4/18	5/16	227	5/16	6/13	*50	6/13	7/11	138	7/11	7/31	129	544
No.2B	4/18	5/16	213	5/16	6/13	*50	6/13	7/11	145	7/11	7/31	128	536
No.3	4/18	5/16	222	5/16	6/13	*50	6/13	7/11	132	7/11	7/31	-	-
No.4	4/18	5/16	223	5/16	6/13	*50	6/13	7/11	139	7/11	7/31	107	519
No.5	4/18	5/16	233	5/16	6/13	*50	6/13	7/11	168	7/11	7/31	200	649
No.6	4/18	5/16	224	5/16	6/13	*50	6/13	7/11	158	7/11	7/31	130	562
No.8	4/20	5/16	241	5/16	6/13	*50	6/13	7/11	138	7/11	7/31	141	570
No.9	4/20	5/16	268	5/16	6/13	*53	6/13	7/11	164	7/11	7/31	139	624
No.10	4/20	5/16	210	5/16	6/13	*50	6/13	7/11	149	7/11	7/31	137	546
No.11	4/20	5/16	200	5/16	6/13	*50	6/13	7/11	137	7/11	7/31	147	534
No.12	4/18	5/16	222	5/16	6/13	*50	6/13	7/11	173	7/11	7/31	130	575
No.13	4/18	5/16	195	5/16	6/13	*50	6/13	7/11	121	7/11	7/31	122	488
No.14	4/18	5/16	220	5/16	6/13	*50	6/13	7/11	171	7/11	7/31	159	600

No. 1 (2)	155
No. 1 (8)	188
No. 1 (12)	334

* Less than 50

APPENDIX III

IODINE SAMPLING PROGRAM

During the 1958 HARDTACK series at PPG a new type of sampling was introduced to study the Iodine-131 concentration in air from fallout and to determine the possibility of such sampling in off-site monitoring for a test series.

The iodine sampling program was carried out on the five populated atolls Eniwetok, Wotho, Ujelang, Utirik and Rongelap. Since iodine is gaseous and is not trapped by filter paper a low volume air pump was used which pulled air through a cartridge filled with activated charcoal which will collect gaseous iodine. The intake end of the cartridge also has a MSA filter to collect any iodine that might have been deposited as particulates and to prevent the other particulate activity from entering the charcoal filter. These cartridges are then counted by use of a single channel analyzer and the iodine concentration extrapolated back to the end of collection. The results of these data have been tabulated and are attached.

These data will be studied further to determine possible correlations between external gamma levels, gross air-borne particulate beta, and I-131 levels.

IODINE SAMPLE DATA - RONGELAP

SAMPLE NUMBER	DATE AT END OF COLLECTION	TIME AT END OF COLLECTION	SAMPLING PERIOD HOURS	SAMPLE MIC/13 AT END OF COLLECTION
1	05-04-58	1500	28	3.54
2	05-05-58	1200	21	7.00
4	05-13-58	0700	24	5.82
5	05-14-58	0700	24	7.47
6	05-16-58	0700	31	Counting invalid
7	05-17-58	0900	25	64.00
8	05-18-58	0800	25	34.40
9	05-19-58	0800	24	24.30
10	05-20-58	0800	24	125.50
11	05-21-58	0800	24	89.10
12	05-22-58	0900	25	94.10
13	05-23-58	0830	23.5	115.00
14	05-24-58	Sample Lost		
15	05-25-58	0930	23.5	85.60
16	05-26-58	1015	24.75	65.00
17	05-27-58	1000	23.75	59.50
18	05-28-58	0930	23.5	71.70
19	05-29-58	1000	24.5	66.80
20	05-30-58	0900	23	49.40
21	05-31-58	0815	23.25	35.70
22A	06-01-58	1900	24	39.00
22B	06-02-58	1900	24	43.00
23	06-03-58	1900	24	40.20
24	07-04-58	1200	24	16.10
25	07-05-58	1500	27	7.40
26	07-23-58	2020	24	2.06
27	07-24-58	2020	24	1.80
28	07-28-58	1300	24.5	Indistinguishable from Background
29	07-29-58	1500	26	3.86
30	07-30-58	1500	24	0.64
31	07-31-58	Motor Failed		

IODINE SAMPLE DATA - WOTHO

<u>SAMPLE NUMBER</u>	<u>DATE AT END OF COLLECTION</u>	<u>TIME AT END OF COLLECTION</u>	<u>SAMPLING PERIOD HOURS</u>	<u>SAMPLE MMC/M3 AT END OF COLLECTION</u>
1	05-13-58	0830	Sample lost	
2	05-14-58	0745	23.25	5.86
3	05-15-58	0745	24	21.50
4	05-16-58	0745	24	17.20
5	05-17-58	0900	25.25	12.60
6	05-18-58	0930	24.50	15.5
7	05-19-58	0800	22.50	8.30
8	05-22-58	1030	24	23.30
9	05-23-58	1030	24	24.70
10	05-24-58	1030	24	31.20
11	05-27-58	1800	24	26.80
12	05-28-58	1800	24	36.70
13	05-31-58	1800	24	21.50
14	06-01-58	1800	24	22.50
15	06-02-58	1800	24	15.30
16	06-17-58	2100	24	11.30
17	06-29-58	0930	24	6.28
18	06-30-58	0939	24	3.00
19	07-02-58	1100	24	7.10
20	07-03-58	1100	24	9.36
21	07-04-58	1100	24	17.10
22	07-05-58	1100	24	6.50
23	07-23-58	2020	24	Indistinguishable from Back-
24	07-24-58	2020	24	" " " " " ground
25	07-28-58	1230	24	0.08
26	07-29-58	1230	24	2.55
27	07-30-58	1230	24	2.25

IODINE SAMPLE DATA - UTIRIK

SAMPLE NUMBER	DATE AT END OF COLLECTION	TIME AT END OF COLLECTION	SAMPLING PERIOD HOURS	SAMPLE MMC/MS AT END OF COLLECTION
1	05-12-58	1840	24	26.00
2	05-13-58	1800	23.3	19.00
3	05-14-58	1115	Sample lost	
4	05-15-58	2045	21.4	29.90
5	05-16-58	Sampler failed		
6	05-17-58	2145	25	15.10
7	05-18-58	2100	23.3	15.23
8	05-19-58	2055	24	12.10
1B	05-22-58	1800	24	65.40
2B	05-23-58	1800	24	59.70
3B	05-27-58	2200	24	26.30
4B	05-28-58	2200	24	41.30
5B	05-31-58	0615	24	20.30
6B	06-01-58	0700	24	18.00
7B	06-02-58	0715	24.25	22.70
16	06-12-58	0930	24	11.30
17	06-13-58	0930	24	6.80
18	06-16-58	0930	24	12.70
19	06-17-58	0930	24	9.30
20	06-29-58	0930	24	4.34
21	06-30-58	0930	24	2.35
22	07-04-58	0930	24	3.97
23	07-05-58	0930	24	3.74
24	07-13-58	1930	24	Indistinguishable from Background
25	07-14-58	0930	24	" " " "
26	07-23-58	2020	24	2.83
27	07-24-58	2020	24	3.99
28	07-28-58	1230	24	Indistinguishable from Background
29	07-29-58	1230	24	1.29
30	07-30-58	0800	19.5	0.33

IODINE SAMPLE DATA - U. LANG

SAMPLE NUMBER	DATE AT END OF COLLECTION	TIME AT END OF COLLECTION	SAMPLING PERIOD HOURS	SAMPLE IINC/M3 AT END OF COLLECTION
2	05-13-58	2100	19	40.20
3	05-14-58	2300	26	35.70
4	05-15-58	2200	23	69.00
5	05-16-58	2200	24	37.90
6	05-17-58	0200	28	38.60
7	05-20-58	0800	18	51.50
8	05-21-58	0800	24	20.50
9	05-22-58	0800	24	57.70
10	05-23-58	0830	24.5	41.10
11	05-24-58	0810	23.67	27.80
12	05-25-58	0800	24	80.70
13	05-27-58	1800	24	56.10
14	05-28-58	1800	24	19.80
15	05-29-58	1200	18	33.40
16	05-31-58	1815	24	87.80
17	06-01-58	1815	24	22.10
18	06-02-58	1900	24.75	10.70
19	06-04-58	1045	24	17.40
20	06-05-58	1045	24	22.80
21	06-12-58	0930	24	11.10
22	06-13-58	0930	24	21.60
23	06-16-58	0930	24	12.90
24	06-17-58	0800	22.5	14.10
25	06-19-58	1900	24	9.03
26	06-20-58	1900	24	6.70
27	06-29-58	0930	24	5.70
28	06-30-58	0930	24	9.20
29	07-01-58	1445	29.25	7.10
30	07-03-58	1030	24	7.10
31	07-04-58	1030	24	9.20
32	07-05-58	0930	23	15.90
33	07-13-58	1930	24	1.07
34	07-15-58	0800	36.50	3.50
35	07-19-58	1530	24.33	1.73
36	07-20-58	1510	23.67	2.82
37	07-21-58	1510	24	6.34
38	07-22-58	1510	24	1.52
39	07-23-58	2020	23.67	0.69
40	07-24-58	2020	24.33	4.12
41	07-25-58	2020	24	2.13
42	07-28-58	1235	24	1.24
43	07-29-58	1235	24	2.25
44	07-30-58	1235	24	0.87

NUMBER	OF COLLECTION	OF COLLECTION	BOIERS	OF COLLECTION
1	05-16-58	1100	24.5	132
2	05-17-58	0900	21	560
3	05-18-58	0930	25.5	216
4	05-19-58	0900	23.5	205
5	05-20-58	0800	23	200
6A	05-21-58	0800	24	130
6B	05-22-58	0800	24	38.90
7	05-23-58	0830	24.5	311.00
8	05-24-58	0830	24	52.30
9	05-25-58	1330	29	35.25
10	05-26-58	0815	18.75	42.30
11	05-27-58	0845	24.50	36.60
12	05-28-58	0815	23.50	73.80
13	05-29-58	0815	24	29.90
14	05-30-58	0830	24.25	22.10
15	05-31-58	1030	26	32.80
16	06-01-58	0950	23.3	68.40
17	06-03-58	0750	22	9.90
18	06-04-58	0820	24.5	11.80
19	06-06-58	0830	49.1	4.50
20A	06-07-58	0800	23.5	6.10
20B	06-08-58	0900	25	7.50
21	06-09-58	0900	24	7.50
22	06-10-58	0900	24	6.00
23	06-11-58	0900	24	9.20
24	06-12-58	0915	24.25	9.20
25	06-13-58	0845	23.5	21.20
26	06-14-58	0945	25	13.70
27	06-15-58	1000	24.25	9.50
28	06-16-58	0845	22.75	12.40
29	06-17-58	0845	24	3.35
30	06-18-58	0930	24.75	4.90
31	06-19-58	0900	23.50	20.70
32	06-20-58	1000	25	6.10
33	06-22-58	0830	46.5	Indistinguishable from Background
34	06-23-58	0830	24	4.50
35	06-24-58	0830	24	5.50
36	06-25-58	0940	25.17	3.02
37	06-26-58	0820	22.67	3.00
38	06-27-58	0830	24.17	6.90
39	06-28-58	0810	23.70	2.03
40	06-29-58	0940	25.50	12.30
41	06-30-58	1300	27.70	Sample not counted
42	07-01-58	1145	22.25	6.40
43	07-02-58	0730	19.75	6.81
44	07-03-58	0820	24.84	6.80
45	07-04-58	1145	27.40	25.60
46	07-05-58	1100	23.25	9.30
47	07-06-58	0930	22.50	10.50
48	07-07-58	0945	24.25	10.40
49	07-15-58	0840	21.7	7.86
50	07-16-58	1140	27	1.19
51	07-17-58	0940	22	7.78
52	07-18-58	0800	22.67	8.48
53	07-19-58	0845	24.75	6.09
54	07-20-58	1800	33	Sample lost
55	07-21-58	0845	14.45	3.32
56	No Data			
57	07-22-58	1115	26.5	Sample lost
58	07-23-58	1645	29.5	Indistinguishable from Background
59	07-24-58	1345	21	2.00
60	07-26-58	0900	43.25	0.73
61	07-27-58	0920	24.33	2.25
62	07-28-58	0850	23.5	0.46

APPENDIX IV

FALLOUT AND RAIN SAMPLING PROGRAM

Precipitation was collected at six stations in and about the Eniwetok Proving Ground. Sampling stations were maintained on Parry Island, Eniwetok Island, Rongelap Island, Ujelang Island, Utirik Island and Wotho Island.

The samples were collected in weekly composites, the precipitation falling in a collector funnel of $0.4M^2$ in area and detained in a carboy of approximately 19 liters volume. The depth of precipitation is obtained by dividing the total volume of water collected by the area of the collector.

After washing the collector with approximately one liter of water to wash dry fallout into the collecting bottle and thoroughly mixing the contents in the bottle by vigorous shaking, a one liter sample of the original collection was sent to the laboratory at Parry Island. Five hundred milliliters of this one liter sample were evaporated to dryness on aluminum planchets.

These planchets were counted for gross beta activity in the central laboratory of the Public Health Service Radiation Surveillance Network in Washington, D.C. The counting was performed in a NRC $7\frac{1}{2}$ Proportional Chamber using P-10 as the counting gas. This equipment operates with an efficiency of about 35% for Strontium-Yttrium⁹⁰ beta particles. The samples were counted twice approximately 7 days apart. Assuming the Way-Wigner Relation for the decay of fission products of U^{235} by slow neutrons ($A_1T_1^{1.2} = A_2T_2^{1.2}$) the activity of the sample was extrapolated to the time of end of collection. The results of these water samples have been tabulated and are attached.

As an additional project many of these samples were counted daily and the decay curves run to check the type of decay. They were found to agree quite closely with the Way-Wegner "1.2 law." A plot of one of these samples is attached as an illustration of this.

SAMPLE NUMBER	COLLECTION		MM RAIN	/DAYS AFTER COLLECTION	LABORATORY MEASUREMENT		AGE DAYS
	FROM	TO			MMC liter	MMC x 10 ⁵ M ²	
ELMER							
1							
2							
3							
4	5/12	5/23	11.25	*	2,320,000	261.0	10
5	5/23	5/30	18.75	*	468,000	87.7	11
6	5/30	6/6	11.0	18	88,532	9.74	-
7	6/6	6/15	42.5	*	33,800	14.36	17
8	6/18	6/28	13.25	*	5,400	0.71	22
9	6/28	7/5	38.75	*	135,000	52.3	15
10	7/5	7/14	46.25	8	137,100	63.4	-
11	7/14	7/21	-	23	4,826	-	-
FRED							
1							
2							
3	5/3	5/14	7.50	20	308,864	23.2	-
4	5/14	5/26	10.0	*	3,520,000	352.0	14
5	5/26	6/9	31.25	*	126,200	39.4	10
6	6/10	6/26	38.70	*	35,500	13.7	17
7	6/26	7/11	29.4	*	112,000	44.1	12
8	7/11	7/15	35.0	29	15,668	5.48	-
9	7/15	7/16	70.8	*	6,300	4.46	10
10	7/16	7/23	50	21	2,064	1.03	-
11	7/23	8/9	28.7	*	5,640	1.62	35
12	8/9	8/11	47.5	*	2,140	1.01	25
WOTHO							
1							
2							
3							
4	5/4	5/11	4.38	23	736	0.03	-
5	5/11	5/18	62.5	16	10,918	6.82	-
6	5/18	5/25	-	*	1,570,000	-	11
7	5/25	5/31	5.6	*	84,400	4.75	13
8	5/31	6/7	17.5	17	12,376	2.16	-
9A	6/8	6/15	47.5	23	2,386	1.13	-
9B	6/16	6/22	2.50	*	11,180	0.26	23
10	6/22	6/29	23.7	*	5,600	1.33	23
11	6/29	7/6	96.2	*	132,000	127.0	12
12	7/6	7/13	75	31	3,472	2.6	-
13	7/13	7/20	87.5	*	14,800	12.95	11
14	7/20	7/27	100	*	4,260	4.26	32
15	7/27	8/3	42.5	*	4,680	2.04	41
UJELANG							
3	5/2	5/9	3.13	25	15,880	0.50	-
4	Missing						
5	5/17	5/24	13.5	*	390,000	52.6	8
6	5/24	5/30	2.0	*	250,000	5.16	8
7	5/30	6/6	47.25	*	13,700	6.47	15
8	6/6	6/13	63.2	*	8,700	5.5	14
9	6/13	6/20	20.0	*	13,840	2.77	10
10	6/21	6/28	19.2	*	26,600	5.12	11
11	6/29	7/4	20	18	22,390	4.40	-
12	7/4	7/11	47	*	14,300	6.76	17
13	7/11	7/18	47	*	7,000	2.21	15
14	7/18	7/25	94.5	*	2,960	2.80	36
15	7/25	8/1	54.5	*	10,000	54.5	10

SAMPLE NUMBER	COLLECTION		MM RAIN	/DAYS AFTER COLLECTION	LABORATORY MEASUREMENT		AGE DAYS
	FROM	TO			MIC liter	MIC x10 ⁵ M ²	
UTIRIK 4	5/7	5/13	5.00	*	72,000	3.6	45
5	5/13	5/20	3.25	14	487,212	15.8	-
6	5/20	5/27	6.75	21	66,430	4.48	-
7	5/27	6/3	53	14	53,450	28.30	-
8	Missing						
9	6/11	6/18	9.15	*	12,800	1.17	26
10	6/18	6/25	10.75	*	8,100	0.87	31
11	6/25	7/2	13	*	19,900	2.59	16
12	7/2	7/9	55	13	10,566	5.81	-
13	7/9	7/16	71	28	2,100	1.49	-
14	7/16	7/22	57.5	29	4,318	2.48	-
RONGELAP							
2							
3	4/29	5/6	7.5	42	96,870	7.27	-
4	Missing						
5	5/13	5/20	3.75	14	94,996	3.56	-
6	Missing						
7	5/30	6/5	10	*	104,000	10.4	-
8	6/5	6/12	14.25	*	13,600	1.93	23
10	6/20	6/27	8.7	*	4,960	0.43	26
11	6/27	7/4	50	18	40,882	20.4	-
12	7/4	7/11	72.5	*	16,700	12.1	12
13	7/11	7/18	60	*	8,600	5.16	9
14	7/18	7/25	120	*	4,500	5.4	15
15	7/25	8/1	5.75	*	4,160	0.24	19

NOTES:

1. If marked * sample was followed for decay and reported activity was extrapolated to time of end of collection, assuming $A_1 T_1^{1.2} = A_2 T_2^{1.2}$
2. Assumption is made that 2.22 Beta particles per minute = 1.0mC.
3. Activity is measured in comparison with a Sr-Y⁹⁰ standard source.

<u>RATE (mr/hr)</u>	<u>DAYS</u>	<u>HOURS</u>	<u>DOSE (mr)</u>
0.03	13	312	9.36
0.04	3	72	2.88
0.05	10	240	12.00
0.06	7	168	10.08
0.07	3	72	5.04
0.08	5	120	9.60
0.09	3	72	6.48
0.10	1	24	2.40
0.11	2	48	5.28
0.13	1	24	3.12
0.14	1	24	3.36
0.16	1	24	3.84
0.18	1	24	4.32
0.20	1	24	4.80
0.23	1	24	5.52
0.24	1	24	5.76
0.40	1	24	9.60
0.60	1	24	14.40
1.00	1	24	24.00
		TOTAL	<u>141.84</u>

* Above preoperational level of 0.02 mr/hr.

CUMULATIVE EXPOSURE COMPUTATIONS
RONGELAP

<u>*RATE (mr/hr)</u>	<u>DAYS</u>	<u>HOURS</u>	<u>DOSE (mr)</u>
0.04	17	408	16.32
0.05	6	144	7.20
0.06	9	216	12.96
0.07	10	240	16.80
0.08	6	144	11.52
0.09	3	72	6.48
0.10	3	72	7.20
0.11	1	24	2.64
0.12	3	72	8.64
0.13	3	72	9.36
0.14	2	48	6.72
0.15	1	24	3.60
0.16	1	24	3.84
0.17	1	24	4.08
0.18	2	48	8.64
0.22	1	24	5.28
0.25	2	48	12.00
0.27	1	24	6.48
0.35	1	24	8.40
0.40	1	24	9.60
0.50	1	24	12.00
0.70	1	24	16.80
0.90	1	24	21.60
1.10	1	24	26.40
1.20	1	24	28.80
		TOTAL	<u>285.36</u>

* Above preoperational level of 0.02 mr/hr

CUMULATIVE EXPOSURE COMPUTATIONS
UTIFIK

<u>*RATE (mr/hr)</u>	<u>DAYS</u>	<u>HOURS</u>	<u>DOSE (mr)</u>
0.04	26	624	24.96
0.05	13	312	15.60
0.06	6	144	8.64
0.07	2	48	3.36
0.09	1	24	2.16
0.10	8	192	19.20
0.11	1	24	2.64
0.12	2	48	5.76
0.13	4	96	12.48
0.17	2	48	8.16
0.18	2	48	8.64
0.19	1	24	4.56
0.20	1	24	4.80
0.22	1	24	5.28
0.28	1	24	6.72
0.30	1	24	7.20
0.35	1	24	8.40
0.40	1	24	9.60
0.45	1	24	10.80
0.75	1	24	18.00
0.80	1	24	19.20
1.00	1	24	24.00
		TOTAL	230.16

* Above preoperational level of 0.01 mr/hr

CUMULATIVE EXPOSURE COMPUTATIONS

UJELANG

<u>*RATE (mr/hr)</u>	<u>DAYS</u>	<u>HOURS</u>	<u>DOSE (mr)</u>
0.04	1	24	0.06
0.05	10	240	12.00
0.06	17	408	24.48
0.07	7	168	11.76
0.08	5	120	9.60
0.09	4	96	8.64
0.10	8	192	19.20
0.11	3	72	7.92
0.12	6	144	17.28
0.13	4	96	12.48
0.15	4	96	14.40
0.17	2	48	8.16
0.18	3	72	12.96
0.20	3	72	14.40
0.21	1	24	5.04
0.22	2	48	10.56
0.25	3	72	18.00
0.27	7	24	6.48
0.30	1	24	7.20
		TOTAL	<u>221.52</u>

* Above preoperational level of 0.02 mr/hr

CUMULATIVE EXPOSURE COMPUTATIONS
PARRY ISLAND

<u>RATE (mr/hr)</u>	<u>DAYS</u>	<u>HOURS</u>	<u>DOSE (mr)</u>
0.15	1	24	3.60
0.17	1	24	4.08
0.18	1	24	4.32
0.19	2	48	9.12
0.20	1	24	4.80
0.21	1	24	5.04
0.22	2	48	10.56
0.23	1	24	5.52
0.24	4	96	23.04
0.25	2	48	12.00
0.27	1	24	6.48
0.28	3	72	20.16
0.29	1	24	6.96
0.30	1	24	7.20
0.35	2	48	16.80
0.36	1	24	8.64
0.38	1	24	9.12
0.40	2	48	19.20
0.42	1	24	10.08
0.43	1	24	10.32
0.45	1	24	10.80
0.50	2	48	24.00
0.60	8	192	115.20
0.70	3	72	50.40
0.80	7	168	134.40
0.90	1	24	21.60
1.00	1	24	24.00
1.10	2	48	52.80
1.20	2	48	57.60
1.30	4	96	124.80
1.40	1	24	33.60
1.50	1	24	36.00
1.70	1	24	40.80
1.80	1	24	43.20
2.10	1	24	50.40
2.30	1	24	55.20
2.40	1	24	57.60
2.50	1	24	60.00
3.00	1	24	72.00
3.10	1	24	74.40
3.40	1	24	81.60
3.50	1	24	84.00
5.00	1	24	120.00
9.00	1	24	216.00
13.00	1	24	312.00
19.00	1	24	456.00
		TOTAL	2,605.44

* Above preoperational level of 0.02 mr/hr

APPENDIX V.
AIR SAMPLING PROGRAM

Air samplers were operated on eight populated islands during operation HARDTACK. These included the six major sampling stations on Wotho, Utirik, Ujelang, Rongelap, Parry, and Eniwetok plus the island of Japtan just north of Parry and Kwajalein. Samples were taken daily during the first part of the operation, but due to equipment failures this was abandoned and samples were taken for a period of 48 hours after each shot.

The samples were taken with a standard Staplex air sampler employing a four inch head. For processing, the samples were sent to the AEC field office in Las Vegas, Nevada. A gross beta count was taken and this compared to a Sr-Y⁹⁰ standard source to obtain the concentrations in air a certain number of days after collection. These data have been tabulated and are attached.

Since the samples were only counted once, no attempt has been made to assign an age to them. However, activity values determined at the count time were extrapolated to the end of the collection. The assumptions made in the extrapolations were that the activity decay rate followed the $t^{-1.2}$ law; that the activity of each air sample was entirely due to the preceding detonation; that residual activity from detonations other than the preceding one was regarded as having been formed by the preceding one. Extrapolated values for samples collected on a shot day were determined at the (H+1 day) level as it was not practical to extrapolate beyond this point. All other samples were extrapolated at the actual time interval from the preceding shot to the end of collection time.

Example of extrapolation method:

Conditions: At the first count, the activity of the sample was equal to 30 mmc/m³. The time elapsed from the end of the collection to the first count was 23 days. The sample was collected 2 days after a detonation.

Solution: Days from shot day to first count equal 25. Using the "Radiation Dosage Calculator," set 25 days opposite 30 on the outer dial. Read activity at end of collection on outer dial opposite 2 days which equals 625 mmc/m³.

About 85 air samples were followed for decay and absorption over a two months period. However, the raw data has not yet been analyzed and no significant conclusions can be drawn at this time.

AIR SAMPLING DATA - FRED

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/M ³ AT 1st COUNT	uuc/M ³ AT END OF COLLECTION
Fred 21	5-13	29.2	1.0	
22	5-14	28.1	0.88	
23	5-15	27.1	620	
24	5-16	26.1	124	6200
25	5-17	25.1	54.7	2800
26	5-18	24	50.2	1200
27	5-19	23	-	Motor Failure on Sampler
28	5-20	21.9	38.1	380
29	5-21	20.9	18.4	770
30	5-22	19.9	18.9	725
31	5-23	18.9	100	3700
32	5-24	18	24.4	400
33	5-25	16.5	15.7	160
34	5-26	16	15.2	450
35	5-27	14.9	21.9	590
36	5-28	41.1	24.7	2500
37	5-29	40	12.3	550
38	5-30	40.2	83.5	7200
39	5-31	39.1	53.1	4600
40	6-1	38.6	12.9	1150
41	6-2	37.1	3.42	130
42	6-3	36.1	11.7	920
43	6-4	35.1	4.4	300
44	6-5	34	3.2	95
45	6-6	33	2.56	50
46	6-7	32.1	2.19	28
47	6-8	30.9	2.16	22
48	6-9	24	3.02	140
49	6-10	29.1	4.77	300
50	6-11	28.2	2.29	120
51	6-12	27.1	15.5	1600
52	6-13	25.8	3.59	82
53	6-14	25.2	9.0	140
54	6-15	24.1	44.2	2000
55	6-16	23.1	-	Air Sampler Failure
56	6-17	22.2	3.16	60
57	6-18	21.1	3.68	140
58	6-19	21.8	4.68	210
59	6-20	19.3	4.58	80
60	6-21	19.8	4.98	58
61	6-22	18.4	4.46	32
62	6-23	17.7	7.0	45
63	6-24	16.8	5.58	28
64	6-25	15.4	3.6	15
65	6-26	14.4	4.81	17
66	6-27	25.8	6.27	32
67	6-28	24.7	6.32	295
68	6-29	-	-	Instrument Failure
69	6-29	24.1	13.9	680

AIR SAMPLING DATA- FRED

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/m ³ AT 1st COUNT	uuc/m ³ AT END OF COLLECTION
Fred 70	7-1	21.6	11.0	200
71	7-2	20.9	6.5	250
72	7-3	19.9	11.0	410
73	7-4	18.5	39.6	1500
74	7-5	17.9	19.9	330
75	7-6	18.0	12.5	390
76	7-7	17.8	22.1	730
77	7-8	17.0	32.4	490
78	7-9	16.0	26.1	240
79	7-10	14.8	919	65
80	7-11	13.9	12.8	62
81	7-12	13.1	10.0	220
82	7-13	30	76.2	4800
83	7-14	29	6.65	420
84	7-15	28	6.47	400
85	7-16	27	5.8	150
86	7-17	26	8.70	140
87	7-18	25	29.5	1400
88	7-19	24	14	680
89	7-20	23	13.1	270
90	7-21	22	5.80	280
91	7-22	21	6.44	240
92	7-23	33	3.58	240
93	7-24	32	4.18	260
94	7-25	31	-	Instrument failure
95	7-26	30	3.83	72
96	7-27	29	8.65	550
97	7-28	28	17.6	1000
98	7-29	27	12.0	260
99	7-30	26	10.2	150
100	7-31	25	14.3	150

AIR SAMPLE DATA - ELMER

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/M ³ AT 1st COUNT	uuc/M ³ AT END OF COLLECTION
Elmer 20	5-13	28.9	2.05	
21	5-14	27.9	210	
22	5-15	27	695	
23	5-16	25.9	131	6500
24	5-17	25	92.5	4800
25	5-18	23.9	47.6	1050
26	5-19	23	48.3	630
27	5-20	22	34	350
28	5-21	21	14	560
29	5-22	20	10.5	380
30	5-23	19	49.6	1900
31	5-23	17.7	2.28	Filter Failure
32	5-25	16.8	8.15	80
33	5-26	16	12.2	300
34	5-27	15	26.4	700
35	5-28	14	53.2	1450
36	5-29	13	28.9	330
37	5-30	14.9	125	3200
38	5-31	13.8	155	3600
39	6-2	12.8	66.7	730
40	6-3	11.9	26.1	520
41	6-4	21.1	3.85	160
42	6-6	19.1	2.32	23
43	6-7	18.1	2.24	16
44	6-8	17.1	22.1	25
45	6-9	16.1	5.1	140
46	6-10	14.1	4.76	125
47	6-11	23	3.3	125
48	6-12	21	18.2	880
49	6-13	21.1	14.1	275
50	6-14	19	1.1	12
51	6-15	19.1	5.85	210
52	6-16	18.1	18	620
53	6-17	17.1	5.76	90
54	6-18	16.1	5.9	160
55	6-19	15.1	10.4	275
56	6-20	25	9.65	220
57	6-22	23.1	7.76	85
58	6-23	22.1	27.1	Filter Failure
59	6-24	21.1	2.91	18
60	6-25	20	2.06	10
61	6-26	19.1	2.88	13
62	6-27	18.1	5.15	18
63	6-28	17.1	5.63	160
64	6-29	16.1	11.9	310
65	6-30	19.6	105	4200

AIR SAMPLE DATA - ELMER

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/m ³ AT 1st COUNT	uuc/m ³ AT END OF COLLECTION
Elmer 66	7-1	9.8	2.97	25
67	7-2	8.9	6.25	88
68	7-3	7.8	8.99	110
69	7-4	11.7	135.5	2800
70	7-5	10.7	108.5	1050
71	7-6	9.8	7.58	125
72	7-7	15.8	10.9	325
73	7-8	16.3	10.75	140
74	7-9	7.9	9.42	48
75	7-10	12.9	7.95	45
76	7-11	11.7	4.7	20
77	7-14	9.9	101	1600
78	7-15	7.7	12.2	150
79	7-16	8.75	5.42	37
80	7-17	7.9	6.35	30
81	7-18	7.0	56.6	600
82	7-19	13	4.51	100
83	7-20	12	10.5	110
84	7-21	11	1.96	13
85	7-22	10	3.38	55
86	7-23	20	2.2	72
87	7-24	19	3.25	110
88	7-26	17	4.07	39
89	7-27	16	6.26	175
90	7-28	15	9.0	250
91	7-29	-	-	Filter - Failure
92	8-5	7	29.4	65
100	8-5	20	3.85	18

AIR SAMPLING DATA - KWAJALEIN

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/Li ³ AT 1st COUNT	uuc/m ³ AT END OF COLLECTION
Kwajalein				
20	5-23	27.8	4.65	260
21	5-24	26.8	8.75	230
22	5-25	25.8	2.42	37.
23	5-26	24.9	6.90	350
24	5-27	23.8	193	9000
25	5-28	22.6	105	4600
26	5-29	40.7	27	1100
27	5-30	39.7	8.7	800
28	5-31	38.7	5.58	430
29	6-1	37.7	1.97	160
30	6-2	36.7	1.23	35
2 dif. sample (31	6-3	35.7	1.43	75
(31	6-4	34.7	9.1	680
32	6-5	33.7	10.1	325
33	6-6	32.7	15.6	300
34	6-7	31.7	9.05	130
35	6-8	30.7	0.77	8
36	6-9	29.7	2.82	160
37	6-10	28.8	1.61	95
39	6-12	26.7	0.63	30
40	6-13	26.7	1.09	25
41	6-14	25.8	0.73	12
42	6-15	24.8	-	Air Sample Failure
43	6-18	22.8	0.38	17
44	6-19	20.8	0.82	32
45	6-20	19.8	1.38	25
46	6-21	18.8	1.96	21
47	6-22	17.8	3.12	22
48	6-23	16.8	-	Air Sample Failure
49	6-24	15.8	-	-
50	6-25	14.8	2.06	8
51	6-26	27.3	2.1	12
52	6-27	26.3	1.17	6
53	6-28	25.3	0.188	42
54	6-29	-	-	Air flow guage failed
55	6-29	-	-	" " " "
56	6-30	-	-	" " " "
Thru 68	7-14	-	-	" " " "

AIR SAMPLE DATA - DAVID

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/M ³ AT 1st COUNT	uuc/M ³ AT END OF COLLECTION
David 18	5-12	31.6	1.98	-
19	5-13	30.6	1.31	-
20	5-14	29.6	847	-
21	5-15	28.6	153	-
22	5-16	27.6	60.2	3200
23	5-17	26.6	47.1	2600
24	5-18	29.2	27.6	720
25	5-19	24.6	35.3	525
26	5-20	23.6	12.4	125
27	5-21	22.6	18.8	830
28	5-22	21.6	10.3	400
29	5-23	21.5	40.3	1800
30	5-24	20.5	10.3	190
31	5-25	19.5	10.1	120
32	5-27	17.5	37.3	1300
33	5-28	16.5	34.5	450
34	5-31	13.7	79.3	1900
35	6-1	11.3	54	1200
36	6-2	31.7	4.2	130
37	6-3	30.7	3.4	225
38	6-4	29.7	2.86	195
39	6-12	21.9	12.2	500
40	6-13	21	12.5	230
41	6-16	26	8.95	500
42	6-17	25	5.88	140
43	6-19	22.7	3.0	140
44	6-20	21.7	3.35	60
45	6-29	57	4.15	550
46	6-30	56	21.2	2700
47	7-1	55	0.8	110
48	7-3	53	1.57	155
49	7-4	52	5.26	700
50	7-7	49	4.89	560
51	7-8	48	3.25	150

AIR SAMPLING DATA - UTRICK

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END COLLECTION TO 1st COUNT	uuc/m ³ AT 1st COUNT	uuc/m ³ AT END OF COLLECTION
Utirik	28A	5-13	30.1	7.18
	28B	5-14	29	200
	29	5-15	28	34.1
	30	5-16	27	59
	31	5-17	25.9	21.9
	32	5-18	-	- Air sampler failure
	36	5-21	21.9	6.59
	37	5-22	20.9	6.56
	38	5-23	19.9	6.55
	39	5-27	19	95.8
	40	5-28	22.8	70.2
	41	5-31	20.6	3.65
	42	6-1	19.5	2.58
	43	6-2	18.5	1.99
	44	6-10	29.7	1.21
	45	6-10	29.5	1.66
	46	6-12	28.1	1.16
	47	6-13	27.0	0.97
	48	6-16	24.0	0.76
	49	6-17	23.1	1.39
	50	6-29	16.8	2.22
	51	6-30	15.8	1.58
	52	7-4	18.9	1.42
	53	7-5	17.9	1.79
	54	7-13	11.6	4.2
	55	7-14	10.7	3.4
	56	7-23	20	2.94
	57	7-24	19	1.71
	58	7-28	15	2.46
	59	7-29	14	3.94
	60	7-30	13	4.6

AIR SAMPLING DATA - RONGELAP

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END COLLECTION TO 1st COUNT	uuc/m ³ AT 1st COUNT	uuc/ft ³ AT END OF COLLECTION
Rongelap				
17	5-6	36.8	1.06	
18	5-7	25.8	1.32	
25	5-17	26	28.5	1650
26	5-18	25	3.88	95
27	5-19	24	8.75	130
29	5-22	20.9	3.54	140
30	5-23	19.9	2.75	110
31	5-24	19	10.3	175
32	5-25	18	14.5	160
33	5-26	16.9	3.58	100
34	5-27	15.9	51.3	1450
35	5-28	15	198	5500
36	5-29	14	44.7	580
37	5-30	13	1.04	Air Sample Failure
38	5-31	39.8	20.8	1800
39	6-1	38.4	2.2	165
40	6-2	36.4	2.63	88
41	6-3	35.4	1.81	140
41	6-10	29.3	0.89	55
42	6-11	28.5	2.08	120
43	6-12	27.5	1.37	72
45	6-17	25.1	1.52	35
46	6-19	22.7	2.58	120
47	6-20	21.7	2.9	58
48	6-29	24.8	2.8	150
49	7-4	11.7	65.3	1600
50	7-5	17.7	5.78	98
51	7-23	20	20.1	750
52	7-24	19	6.16	225
53	7-28	15	1.74	9.5
54	7-29	14	4.27	17
55	7-30	13	5.73	22
56	7-31	12	6.58	18

Two dif.
samples

AIR SAMPLE DATA - UJELANG

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/M ³ AT 1st COUNT	uuc/M ³ AT END OF COLLECTION
Ujelang 24	5-13	30.8	0.3	
25	5-13	30	0.9	
26	5-14	29	13.7	
27	5-15	28	41.2	
28 - 29	5-17	-	-	Sampler Failure
30	5-22	22	11.1	480
31	5-23	21	49.4	2100
33	5-27	17.5	26.2	850
34	5-28	16.5	76.6	2500
35	5-29	14.8	22.7	310
36	5-31	39.5	206	18000 ↗
37	6-1	38.5	48.1	4000
38	6-2	37.5	2.07	72
39	6-4	35.9	1.45	120
40	6-5	34.9	0.57	17
41	6-10	29.7	0.99	62
42	6-11	28.7	1.04	62
43	6-12	28	7.05	400
44	6-13	27	2.55	60
45	6-16	26	2.08	110
46	6-17	25.1	1.26	23
47	6-19	22.7	2.91	140
48	6-20	21.7	4.85	100
49	6-29	17.9	2.58	88
50	6-30	16.8	5.55	190
51	7-1	15.6	73.5	1050
52	7-3	13.8	12.1	310
53	7-4	12.8	54.1	480
54	7-5	11.9	141	1500
55	7-13	19	8.31	300
56	7-15	17	4.5	155
57	7-19	24	9.8	500
58	7-20	23	12.7	260
59	7-21	-	-	Air Sampler Failure
60	7-22	21	2.09	80
61	7-23	20	2.69	90
62	7-24	19	5.05	180
63	7-25	18	8.15	135
64	7-28	15	28.7	800
65	7-29	14	19.1	210
66	7-30	13	8.18	60

AIR SAMPLING DATA - WOTHO

AIR SAMPLE	DATE AT END OF COLLECTION (PPG DATE)	DAYS FROM END OF COLLECTION TO 1st COUNT	uuc/l ³ AT 1st COUNT	uuc/l ³ AT END OF COLLECTION
Wottho 18	5-11	32.8	0.82	
19	5-12	31.8	0.69	
20	5-13	30.9	0.19	
21	5-14	29.9	0.74	
22	5-15	28.9	19	
23	5-16	27.9	79.5	3800
24	5-17	26.9	42.8	1150
25	5-18	25.9	22.4	325
26	5-19	24.9	19.7	225
27	5-22	23.9	4.42	180
28	5-23	22.8	72.2	3500
29	5-24	21.8	5.32	225
30	5-27	17.5	72.3	2400
31	5-28	16.5	71	2400
32	5-31	13.5	27.8	700
33	6-1	12.5	3.61	90
34	6-2	37.7	1.61	72
35	6-10	29.9	1.33	65
36	6-11	29.5	2.43	150
37	6-12	28.5	1.64	90
39	6-29	11.8	3.6	90
40	6-30	10.8	5.6	100
41	7-2	14.8	2.51	65
42	8-3	13.8	9.0	220
43	7-4	12.8	114	2900
44	7-5	11.8	7.25	72
45	7-23	19	3.63	135
46	7-24	18	5.02	170
47	7-28	14	2.54	65
48	7-29	13	6.95	80
49	7-30	12	8.5	62

Am. English Notes

Our samples were reported on eight isolated islands during operation Hardback. These included the six major sampling stations on Uotaka, Uink, Ujelang, Rongelap, Rongerik, and Eniwetok plus the island of Fajou just north of Rongelap and Rongerik. Samples were taken daily during the first part of the operation, but due to equipment failures this was abandoned and samples were taken for a period of 48 hours after each shot.

The samples were taken with a standard Geiger counter employing a 4 inch pad. The samples were sent to the AEC for analysis in San Diego, Nevada. A grain beta count was taken and this compared to a 5000 ± 90 standard source to obtain the concentration in $\mu\text{Ci/g}$ of certain number of days after collection. These data have been tabulated and are attached.

Since the samples were a by counted only, no attempt has been made to assign an age to them. ~~with the exception of the~~ ~~concentration at the end of collection.~~



activity values determined at the count time were left plotted
at the end of collection. The assumptions made in the extrapolation
was that the activity decay rate followed the $t^{-1.2}$ law,
that the activity of each air sample was entirely due to
a preceding detonation; that residual activity from
detonations other than the preceding one was regarded
as having been formed by the preceding one. Extrapolated
values for samples collected on a shot day were
determined at the (H + 1 day) level as it was not
practical to extrapolate beyond this point. All other
samples were extrapolated at the actual time interval
from the preceding shot to the end of collection time.

Example of extrapolation method:

At the first count, the activity of the sample
was equal to 30 $\mu\text{mc}/\text{M}^3$. The time elapsed from the
end of collection to the first count was 23 days.
The sample was collected 2 days after a detonation.
23 days from shot day to first count equal 25. Using
"Fission Dose Calculator", at 25 days opposite 30 on
the outer dial. Read activity at end of collection on
the inner dial opposite 2 days which equals 675 $\mu\text{mc}/\text{M}^3$.

(OVER)

2
About 85 air samples were followed over a
two month period. for decay and absorption
However, the raw data had not yet been
analyzed and no significant conclusions can
be drawn at this time.

DATE	DATE AT OF COUN	Days From End Coun To 1st Co	Am/1st 1st Co	Days At 5 No?	Days Fro N-DAY 1st Co	Am/1st END OF COLLECT	TABLE 1 DAVID
DAVID - 18	5-12	31.6	1.98				
19	13	30.6	1.31				
20	14	29.6	847				
21	15	28.6	158				
22	16	27.6	622	⊙-I	27.6	321(400)	
23	17	26.6	47.1	1	27.6	2600	
24	18	25.6	29.2	2	27.6	720	
25	19	24.6	35.3	3	27.6	525	
26	20	23.6	12.4	4	27.6	125	
27	21	22.6	18.8	⊙-II	22.6	820(400)	
28	22	21.6	12.8	⊙-III	21.6	400(400)	
29	23	21.5	42.3	1	22.5	1800	
30	24	20.5	19.3	2	22.5	190	
31	25	19.5	10.1	3	22.5	120	
32	26	-	-	⊙-IV	-	-	
33	27	17.5	37.3	⊙-V	17.5	1300(400)	
34	28	16.5	34.5	1	17.5	1150	
35	29	-	-	⊙-VI	-	-	
36	30	13.7	79.3	⊙-VII	13.7	1700(400)	
37	31	11.3	54	1	12.3	1200	
38	6-1	31.7	4.2	2	33.7	130	
39	2	30.7	3.4	⊙-VIII	30.7	235(400)	
40	3	29.7	2.86	3	32.7	195	
41	4	29.7	2.86	⊙-IX	32.7	195	
42	5	21.9	12.2	1	22.9	50	
43	12	21	12.5	2	23	230	
44	13	-	-	⊙-X	-	-	
45	15	26	2.95	1	27	500	
46	16	25	5.88	2	27	140	
47	17	-	-	⊙-XI	-	-	
48	19	22.7	3.0	1	23.7	170	
49	20	21.7	3.35	2	23.7	60	
50	21	-	-	⊙-XII	-	-	
51	23	57	4.15	⊙-XIII	57	50(400)	

DATE	DATE ATC OF SCHEDULE	CHRG DO	Days From Base Count To ATC	Amplifier 12" Cou	Days Ret SMOT	Days Fro M-day T. 12" Cou.	Amplifier Base Count	
1118-46	6-30	56	21.2	1	57	2700		
47	7-1	55	0.8	2	57	110		
48	7-4	53	1.57	② - VII	53	1250		no sample
49	7-4	52	5.2	1	53	700		
50	7-7	49	4.89	② - VII	50	560		no sample
51	8-8	48	3.25	2	50	150		

1118 2
DAVID

AIR SAMPLE	DATE AT	DEGREE OF CLOUD (%)	TEMPERATURE OF CLOUD (°C)	WIND VELOCITY (MPH)	WIND DIRECTION (°)	WIND VELOCITY (KNOTS)	WIND DIRECTION (°)	WIND VELOCITY (KNOTS)	WIND DIRECTION (°)
FLM62-20	5-13		28.9	205					
21	14		27.9	210					
22	15		27	675					
23	16		25.9	181	⊙-I	25.9	650		
24	17		25	92.5	1	26	4800		
25	18		23.9	42.6	2	25.9	1050		
26	19		23	42.3	3	26	670		
27	20		22	38	4	26	350		
28	21		21	14	⊙-II	21	560		
29	22		20	14.5	⊙-III	20	350		
30	23		19	49.6	1	20	1900		
31	24		17.7	2.20	1	17.7	-		
32	25		16.3	8.15	3	17.3	80		
33	26		14.2	14.2	⊙-II	16	300		
34	27		15	26.4	⊙-I	15	700		
35	28		14	52.2	1	15	1450		
36	29		13	28.9	2	15	350		
37	30		15.9	12.5	⊙-II	15.9	3200		
38	31		13.3	15.5	⊙-III	13.3	3600		
39	6-2		12.8	66.7	2	14.8	750		
40	3		2.9	26.1	⊙-III	11.9	520		
41	4		21.1	3.25	1	22.1	160		
42	6		19.1	2.32	3	22.1	23		
43	7		12.1	2.24	4	22.1	16		
44	8		17.1	4.04	5	22.1	25		
45	9		16.1	5.1	⊙-III	12.1	1450		
46	10		14.1	4.76	1	15.1	125		
47	11		23	3.3	⊙-I	23	1250		

7100 feet

Air Sample	DATE AT OF CALLS (PAC-DAY)	Days From OF CALLS TO 1ST C	mic/m ³ 1ST Col.	Days n SHOT	Days F. H-DAY 1ST Col.	mic/m ³ END OF
48	6-12	21	19.2	1	22	380
49	13	21.1	15.1	2	23.1	275
50	14	19	11	3	22	12
51	15	19.1	5.85	⊕-XI-III	19.1	210.4
52	16	18.1	18	1	19.1	670
53	17	17.1	5.76	2	17.1	90
54	18	16.1	5.9	⊕-III	16.1	160
55	19	15.1	16.4	1	16.1	275
56	20	25	9.65	2	27	220
57	22	23.1	7.76	4	27.1	85
58	23	22.1	-	5	22.1	-
59	24	21.1	2.91	6	27.1	18
60	25	20	2.16	7	27	10
61	26	19.1	2.88	8	27.1	13
62	27	18.1	5.15	9	27.1	18
63	28	17.1	5.63	⊕-III	17.1	160
64	29	16.1	11.9	⊕-III	16.1	260
65	30	19.6	10.5	1	20.6	4200
66	7-1	9.8	2.97	2	11.8	25
67	2	8.9	6.25	⊕-III	8.9	80
68	3	7.8	2.97	⊕-III	7.8	110
69	4	11.7	135.5	1	12.7	2800
70	5	10.7	108.5	2	12.7	1050
71	6	9.8	7.58	⊕-III	9.8	125
72	7	15.8	10.9	1	16.8	325
73	8	8.25	16.3	2	10.75	140
74	9	2.9	9.42	3	10.9	48
75	10	12.9	7.95	4	16.9	45

ELMER

Field Station

Page 3
ELMER

AIR SAMPLE	DATE AT END OF COUNT (APR DATE)	DAYS FROM END OF COUNT TO 1ST COUNT	Ampl/100 AT 1ST COUNT	DAYS FROM 1ST COUNT	DAYS FROM 1ST COUNT TO 1ST COUNT	Ampl/100 AT END OF COLLECTION
ELMSR-76	7-11	11.7	4.7	5	16.7	20
77	14	9.9	101	①-III	9.9	1600 (1000)
78	15	7.9	14.5	①-III	8.9	1150 (11)
79	16	8.75	5.42	2	10.75	37
80	17	7.9	6.35	3	10.9	30
81	18	7.0	56.6	①-III	7.0	600 (100)
82	19	13	4.51	1	14	100
83	20	12	10.5	2	14	110
84	21	11	1.96	3	14	13
85	22	10	3.38	①-III	10	55 (100)
86	23	20	2.2	①-III	20	72 (100)
87	24	19	3.25	1	20	110
88	26	17	4.03	3	20	39
89	27	16	6.26	①-III	16	175 (100)
90	28	15	9.0	1	16	250
91	29	-	-	-	-	-
92	8-5	7	29.4	2	15	65
100	5	20	3.85	2	28	18

Field failures

MC January	Days F of Cal.	Days F of Cal. 75 125	Days F of Cal. 125 150	Days DM	Days F M-Day 125 Co	Days F of Cal. 125 Co	Days F of Cal. 125 Co
FRED-21	5-13	29.2	1.0				
22	14	27.1	0.88				
23	15	22.1	6.20				
24	16	26.1	12.4	⊙-I	26.1	6200 (over)	
25	17	25.1	57.7	1	26.1	2500	
26	18	24	50.2	2	26	1200	
27	19	23	-	3	26	-	Notes: Fishes or samples
28	20	21.9	38.1	4	25.9	350	
29	21	20.9	18.4	⊙-II	20.9	770 (over)	
30	22	19.9	18.9	⊙-III	19.9	725 (over)	
31	23	18.9	100	1	19.9	3700	
32	24	18	24.4	2	20	400	
33	25	16.5	15.7	3	19.5	160	
34	26	16	15.2	⊙-IV	16	420 (over)	
35	27	14.9	21.9	⊙-V	14.9	570 (over)	
36	28	41.1	24.7	1	42.1	2500	
37	29	40	12.3	2	42	550	
38	30	40.2	83.5	⊙-VI	40.2	720 (over)	
39	31	39.1	53.1	⊙-VII	39.1	4600 (over)	
40	6-1	38.6	12.9	1	38.6	450	
41	2	37.1	3.42	2	37.1	130	
42	3	36.1	11.7	⊙-VIII	36.1	220 (over)	
43	4	35.1	4.9	1	36.1	300	
44	5	34	3.2	2	36	25	
45	6	33	2.56	3	36	50	
46	7	32.1	2.19	4	36	28	
47	8	30.9	2.16	5	35.9	22	
48	9	24	3.02	⊙-IX	24	140 (over)	

FRKO

AIR SAMPLE	DATE OF CHRG. OR CHRG. DATE	DRY BULB T° 15' C.	WET BULB T° 15' C.	WIND DIRECTION	WIND SPEED	DRY BULB T° 15' C.	WIND DIRECTION
FRKO - 49	6-10	29.1	4.77		1	301	310
50	11	28.2	2.29	⊙-I		253	130
51	12	27.1	15.5		1	28.1	1600
52	13	25.8	3.59		2	27.8	82
53	14	25.2	9.0		3	28.2	140
54	15	24.1	44.2	⊙-III		24.1	200
55	16	23.1	-		1	-	-
56	17	22.2	3.16		2	24.2	60
57	18	21.1	3.68	⊙-XII		21.1	140
58	19	21.8	4.68		1	22.8	210
59	20	19.3	4.58		2	21.3	80
60	21	19.8	4.98		3	22.8	58
61	22	18.4	4.46		4	22.4	32
62	23	17.7	7.0		5	22.7	45
63	24	16.8	5.58		6	22.8	28
64	25	15.4	3.6		7	22.4	15
65	26	14.4	4.81		8	22.4	17
66	27	25.8	6.27		9	24.8	32
67	28	24.7	6.32	⊙-IV		24.7	215
68	29	24.1	13.9	⊙-VII		24.1	680
69	29	-	-		-	-	-
70	7-1	21.6	11.0		2	23.6	200
71	2	20.9	6.5	⊙-VIII		20.9	250
72	3	19.9	11.0	⊙-IX		19.9	440
73	4	18.5	39.6		1	19.5	1500
74	5	12.9	19.9		2	19.9	330
75	6	18.0	12.5	⊙-XA		18.0	392
76	7	17.8	22.1		1	18.8	730

Air Sample Failure

Instrument Failure

FRED

AIR SAMPLE	DATE TIME OF COLL. (P.M. OR A.M.)	DRY FLUX OF COLLEC. TB / ST. Co	WIND / M ² / ST. Co	DAYS A. S.M. 7	DAYS TO N-DAY T / ST. Co	WIND / M ² / ST. Co
FRED - 77	7-8	17.0	32.4	2	19.0	490
78	9	16.0	26.1	3	19.0	240
79	10	14.8	9.9	4	18.8	65
80	11	13.9	12.8	5	18.9	62
81	12	13.1	10.0	②-VI	13.1	220
82	13	30	76.2	1	31	4800
83	14	29	6.65	①-VII	29	470
84	15	28	6.47	1	29	400
85	16	27	5.8	2	29	150
86	17	26	8.70	3	29	140
87	18	25	29.5	①-VIII	25	1400
88	19	24	14	1	25	680
89	20	23	13.1	2	25	270
90	21	22	5.80	3	25	430
91	22	21	6.44	①-IX	21	240
92	23	33	3.58	①-X	33	240
① 93	24	32	4.18	1	33	260
94	25	31	-	2	-	-
95	26	30	3.83	3	33	72
96	27	29	8.65	①-XI	29	550
97	28	28	17.6	1	29	1000
98	29	27	12.0	2	29	260
99	30	26	10.2	3	29	150
100	31	25	14.3	4	29	150

Instrument failure

Year	Days of Cal	Days of Cal to 1st	Time/1st	Days	Days of M-day 1st	Time/1st	End	Collect
1941	22	-	-	⊕-II	-	-	-	-
1941-20	5-23	27.8	4.65	1	28.8	260		
21	24	26.8	8.75	2	28.8	230		
22	25	25.8	2.42	3	28.8	27		
23	26	24.9	6.90	⊕-II	24.9	350		
24	27	23.8	1.93	⊕-II	23.8	900		
25	28	22.6	1.05	1	23.6	4600		
26	29	40.7	2.7	2	42.7	1100		
27	30	39.7	8.7	⊕-II	39.7	810		
28	31	38.7	5.58	⊕-VII	38.7	430		
29	6-1	37.7	1.97	1	38.7	160		
30	2	36.7	1.23	2	38.7	35		
Two samples	31	35.7	1.43	⊕-VII	35.7	75		
	31	4	34.7	9.1	1	35.7	680	
32	5	33.7	10.1	2	35.7	325		
33	6	32.7	15.6	3	35.7	300		
34	7	31.7	9.05	4	35.7	130		
35	8	30.7	0.77	5	35.7	8		
36	9	29.7	2.82	⊕-IX	29.7	160		
37	10	28.8	1.61	1	29.8	95		
38	11	-	-	⊕-IX	-	-		
39	12	26.7	0.63	1	27.7	30		
40	13	26.7	1.09	2	28.7	25		
41	14	25.8	0.73	3	28.8	17		
42	15	24.8	-	⊕-IX ⊕-VII	-	-		
43	18	22.8	0.38	⊕-VII	22.8	17		
44	19	20.8	0.82	1	21.8	32		
45	20	19.8	1.38	2	21.8	25		
46	21	18.8	1.96	3	21.8	21		

KWJ

~~Two samples~~

air sample failure

Air	SAMPLE	DATE AT OF COLL.	(PAG. DI.)	DAYS FR OF COLL. TO /ST C	Time/ST 12 C	DAYS ST.	DAYS + H-DAY 12 C	Time/ST END O COLLSE	KWAS
KWAS	-47	6-22		17.8	3.12	4	21.8	22	
	48	23		16.8	-	5	21.8	-	Air sampler failure
	49	24		15.8	-	6	21.8	-	" " "
	50	25		14.8	2.06	7	21.8	8	
	51	26		27.3	2.1	8	35.3	12	
	52	27		26.3	1.17	9	35.3	6	
	53	28		25.3	0.88	$\frac{210}{10}$	25.3	42.4	
	54	28		-	-	-	-	-	air flow gauge failure
	55	29		-	-	-	-	-	" " "
	68	7-14		-	-	-	-	-	" " "

DATE AT	OF CALL	1946	Days From	END Call	T. 1st C.	Days	1st C.	Days	M-Day	1st C.	END	Call	ROUNDS LAP
3-17	5-6	36.8	1.06										
18	7	35.8	1.32										
25	17	26	28.5	Ⓢ-I		1	27		27	1650			no sample
26	18	25	3.88			2	27		27	95			
27	19	24	2.75			3	27		27	130			
29	22	20.9	3.54	Ⓢ-III			20.9		20.9	140			no sample
30	23	19.9	2.75			1	20.9		20.9	110			
31	24	19	10.3			2	21		21	175			
32	25	18	14.5			2	21		21	160			
33	26	16.9	3.58	Ⓢ-IV			16.9		16.9	100			
34	27	15.9	51.3	Ⓢ-V			15.9		15.9	140			
35	28	15	19.8			1	16		16	5500			
36	29	14	44.7			2	16		16	580			
37	30	13	1.04	Ⓢ-VI			13		13	-			^{air} samples taken
38	31	39.8	20.8	Ⓢ-VII			39.8		39.8	1800			
39	6-1	32.4	2.2			1	39.4		39.4	165			
40	2	36.4	2.63			2	38.4		38.4	88			
41	3	35.4	1.81	Ⓢ-VIII			35.4		35.4	140			no sample
41	10	29.3	0.89	Ⓢ-IX		1	31.3		31.3	58			
42	11	28.5	2.08	Ⓢ-X			28.5		28.5	110			
43	12	27.5	1.37			1	28.5		28.5	72			no sample
45	17	25.1	1.52	Ⓢ-XII		2	27.1		27.1	35			no sample
46	19	22.7	2.58			1	23.7		23.7	120			
47	20	21.7	2.9			2	23.7		23.7	58			no sample
48	29	24.8	2.8	Ⓢ-XIV			25.8		25.8	150			no sample
49	7-4	14.7	65.3	Ⓢ-XV		1	12.7		12.7	1600			
50	5	12.7	5.78			2	19.7		19.7	98			
				Ⓢ-I									} no sample
				Ⓢ-II									
				Ⓢ-III									

Two diff samples with same number

AIR SAMPLE	DATE EN OF CONC. (MS OR DAYS F)	END CONC. TO 1210	μmcf/MS 1 ST. CO.	DAYS H JMO?	DAYS F H-DAY 1 ST. CO.	μmcf/MS END O CALC	RONGELAP
-	23	-	-	(M) - XXIV	-	-	To Sample
RONGELAP-51	23	20	20.1	(M) - XXV	20	750.1	
52	24	19	6.16	1	20	225	
53	28	15	1.74	5	20	9.5	
54	29	14	4.27	6	20	19	
55	30	13	5.73	7	20	22	
56	31	12	1.58	8	20	18	

AIN	Sample	DATE R	End of C	Days From	OF Cause	To 1st	Days From	1st C	Days From	5 mo	Days From	N-Day	1st C	Days From	End of	Collect	UJELANG
UJELANG-24		5-13		30.8		0.3											
	25	13		30		0.9											
	26	14		29		13.7											
	27	15		28		41.2											
		16		-		-				⊕-I							no sample
	28-29	17		-		-				-							sample failed
		18		-		-				⊕-II							no sample
	30	22		22		11.1				⊕-III	22		480				
	31	23		21		49.4				1	22		2100				
		24		-		-				⊕-IV							no sample
	33	27		17.5		26.2				⊕-I	18.5		850				
	34	28		16.5		76.6				1	17.5		2500				
	35	29		14.8		22.7				2	16.8		310				
		30		-		-				⊕-VI							no sample
	36	31		39.5		206				⊕-VII	39.5		1800				
	37	6-1		38.5		48.1				1	39.5		4000				
	38	2		37.5		2.07				2	39.5		72				
		3		-		-				⊕-VIII							no sample
	39	4		35.9		1.45				1	36.9		120				
	40	5		34.9		0.57				2	36.9		17				
		6		-		-				⊕-IX							no sample
	41	10		29.7		0.99				1	30.7		62				
	42	11		24.7		1.04				⊕-I	28.7		62				
	43	12		28		7.05				1	29		400				
	44	13		27		2.55				2	29		60				
		14		-		-				⊕-XIII							no sample
	45	16		26		2.08				1	27		110				
	46	17		25.1		1.26				2	27.1		23				
		18		-		-				⊕-XIII							no sample
	47	19		22.7		2.91				1	23.7		140				
	48	20		21.7		4.85				2	23.7		100				
		21		-		-				⊕-XIV							no sample
	49	24		17.9		2.58				⊕-XIV	18.9		89				
	50	30		16.8		5.55				1	17.8		180				
	51	7-1		15.6		73.5				2	17.6		1050				
		2		-		-				⊕-XVIII							no sample
	52	3		13.8		12.1				⊕-XIX	13.8		310				
	53	4		12.8		54.1				1	13.8		480				

N/A SAMPLE	DATE AT L.	OF COLLECT (PAG. DAT.)	Days from COLLECTIO 1st Col.	Time/mi 1st Conn.	Days Air Shot	Days Fri M-Day To 1st Col.	mic/m ³ Erio Correct	CASE 2 UJELANG
UJELANG-54	7-5		11.9	141	2 ② - $\frac{2}{37}$	13.9	1500	3 no sample
55	13		19	8.21	1 ② - $\frac{1}{37}$	20	300	
56	15		17	4.5	1 ② - $\frac{1}{37}$	18	155	
57	17		24	9.8	1	25	500	57 no sample
58	20		23	12.7	2	25	260	
59	21		-	-	-	-	-	Air sample taken
60	22		21	2.09	② - $\frac{2}{37}$	21	80	
61	23		20	2.69	② - $\frac{2}{37}$	20	90	
62	24		19	5.05	1	20	180	
63	25		18	8.15	2	20	135	
64	27		-	-	② - $\frac{2}{37}$	-	-	no sample
64	28		15	28.7	1	16	810	
65	29		14	19.1	2	16	210	
66	30		13	8.18	3	16	60	

AIR SAMPLE	DATE AT OF COLLECT (APR MAY)	Days From END COLLECT TO 15°C	μmole/m ³ 15°C	Days at 5°C	Days From 15°C	μmole/m ³ END COLLECT	UTIRICK
288	5-13	30.1	7.18	↓	↓	↓	
29	14	29	200	↓	↓	↓	
30	15	28	34.1	↓	↓	↓	
31	16	27	59	⊙-I	27	350	
32	17	25.9	21.9	1	26.9	1200	
36	18	-	-	-	-	-	Air sampler failure
37	21	21.9	6.59	⊙-II	21.9	290	
38	22	20.9	6.56	⊙-III	20.9	250	
39	23	19.9	6.55	1	20.9	260	no sample
40	24	-	-	⊙-II	-	-	
41	27	19	95.8	⊙-I	19	350	
42	28	22.8	70.2	1	22.8	3200	no sample
43	29	-	-	⊙-II	-	-	no sample
44	31	20.6	3.65	⊙-III	20.6	140	
45	6-1	19.5	2.58	1	20.5	98	
46	2	18.5	1.99	2	20.5	32	} no sample
47	3	=	=	⊙-III	=	=	
48	10	29.7	1.21	1	30.7	70	
49	10	29.5	1.66	1	30.5	95	no sample
50	11	-	-	⊙-IV	-	-	
51	12	28.1	1.16	1	29.1	62	
52	13	27.0	0.97	2	29.0	25	no sample
53	14	-	-	⊙-IV	-	-	
54	16	24.0	0.76	1	25.0	38	
55	17	23.1	1.39	2	25.1	32	} no sample
56	18	=	=	⊙-V	=	=	
57	27	16.8	2.22	⊙-IV	16.8	62	
58	30	15.8	1.58	1	16.8	45	} no sample
59	31	=	=	⊙-IV	=	=	
60	4	18.9	1.42	1	19.9	52	
61	5	17.9	1.79	2	19.9	30	} no sample
62	6	=	=	⊙-V	=	=	
63	13	11.6	4.2	1	12.6	85	
64	14	10.7	3.4	⊙-III	10.7	65	} no sample
65	15	=	=	⊙-III	=	=	
66	23	20	2.94	⊙-IV	20	112	
67	24	19	1.71	1	20	62	

VTIRICK

AL	DATE	DE L	Days	Case	1/ST	Days	SA	Days	M-Da	1/ST	Days	EMD	Case
VTIRICK-58	7-27	28	15	2.48	1	16	70						
	59	29	14	3.94	2	16	50						
	60	30	13	4.6	3	16	35						

~~VTIRICK-58~~

Yr	Month	DATE H OF Cal	CP&S	Days F of Cal To 12	Amount / ST	Days SH	Days H-DA / ST	Amount END Col
18	5	11	32.8		0.82			
		12	31.8		0.69			
		13	30.9		0.19			
		14	29.9		0.74			
		15	28.9		19			
		16	27.9		29.5	ⓐ - I	27.9	388.1
		17	53.4		1.65	1	54.4	250
		18	76.9		42.8	2	28.9	1150
		19	25.9		22.4	3	28.9	375
		20	24.9		19.7	4	28.9	225
		21	23.9		4.42	ⓐ - II	23.9	180
		22	22.8		72.2	ⓐ - III	22.8	3500
		23	21.8		5.32	1	22.8	225
		24	17.5		72.3	ⓐ - IV	17.5	2460
		25	16.5		71	1	17.5	2400
		26	15.5		27.8	ⓐ - V	13.5	700
	6	1	12.5		3.61	1	13.5	90
		2	37.7		1.61	2	39.7	72
		3	29.8		1.33	ⓐ - VI	30.8	65
		4	24.5		2.43	ⓐ - VII	29.5	150
		5	28.5		1.64	1	29.5	90
		6	11.8		3.6	ⓐ - VIII	11.8	90
		7	10.8		5.6	1	11.8	100
	7	2	14.8		2.51	ⓐ - IX	14.8	65
		3	13.8		9.0	ⓐ - X	13.8	220
		4	12.8		114	1	13.8	2900
		5	11.8		7.25	2	13.8	72
		6	19		3.63	ⓐ - XI	19	135

DATE	OF C.	CPAC	Days of Cal. To 12	amc/ft 12' C	Days SMC	Days H-DAY 12' CO	amc/ft 6' CO	Conc.	WOTH0
W.T.H0-46	7-24		18	5.02	1	19	170		
	29		1		②-521				
47	28		14	2.54	1	15	65		
48	29		13	6.95	2	15	80		
49	30		12	8.5	3	15	62		

MEMO ROUTE SLIP
Form AEC-93 (Rev. May 1 1957)

See me about this. For reference. For action.
Note and return. For signature. For information.

TO (Name and unit)	INITIALS	REMARKS
	DATE	
TO (Name and unit)	INITIALS	REMARKS
	DATE	
TO (Name and unit)	INITIALS	REMARKS
	DATE	
FROM (Name and unit)	REMARKS	
PHONE NO.	DATE	

MARINE BIOLOGY SURVEY PROGRAM 40 (Continued)
Dated September 15, 1958
Distribution as per buck slip:

Dr. Lauren R. Donaldson
Laboratory of Radiation Biology
University of Washington
Seattle, Washington

cc: Dr. C. L. Dunham
Dr. C. W. Shilling
Dr. A. H. Seymour

REWB
Michael L. Felt

5086 9/15/58

MARINE BIOLOGY SURVEY PROGRAM 40
(Continued)

September 1958

Counting Date	COORDINATES		WATER SAMPLES					PLANKTON dpm/cc	External γ mr/hr
	N Deg-Min	E Deg-Min	Surface	25m	50m	100m	300m		
8 Sept. 58	13-53	145-06	0	0	0	0	0	130	-
	12-14	145-32	84	1800	84	0	0	490	-
9 Sept. 58	11-14	146-35	56	530	56	0	70	340	-
10 Sept. 58	10-15	147-35	0	0	0	0	0	810	-
	10-50	148-34	4600	2100	0	660	0	1200	-
	11-20	149-20	910	1100	4000	850	100	970	-
	11-57	150-18	560	11000	4600	1200	0	4400	-
	11-00	151-20	2300	2100	0	0	0	1600	-
11 Sept. 58	10-00	152-20	5300	4400	2000	0	7	1400	-
	9-09	153-30	70	0	0	0	0	1900	-

From:

Alfred W. Klement, Jr.
Radiation Effects of Weapons Branch
Division of Biology and Medicine
U. S. Atomic Energy Commission
Washington 25, D. C.

September 15, 1958

W. Klement
19

62

MARINE BIOLOGY SURVEY PROGRAM 40
(Continued)

Station at 14°25'N 157°01'E (7 Sept.)

Co⁵⁸, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰, Zr⁹⁵.

Station at 14°55'N 156°24'E - Same as above. (7 Sept.)

Station at 14°20'N 155°45'E - Same as above. (7 Sept.)

Station at 13°14'N 151°05'E (9 Sept.)

Co⁵⁸, Co⁵⁷, Co⁶⁰, Zn⁶⁵, Ba¹⁴⁰, Zr⁹⁵.

From:

Alfred W. Klement, Jr.
Radiation Effects of Weapons Branch
Division of Biology and Medicine
U. S. Atomic Energy Commission
Washington 25, D. C.

September 15, 1958

cc
L.S.

63

MARINE BIOLOGY SURVEY PROGRAM 40

(Continued)

September 1958

Counting Date	COORDINATES		WATER SAMPLES					PLANKTON dpm/cc	External γ mr/hr
	N Deg-Min	E Deg-Min	Surface	25m	50m	100m	300m		
8 Sept. 58	13-53	145-06	0	0	0	0	0	130	-
	12-14	145-32	84	1800	84	0	0	490	-
9 Sept. 58	11-14	146-35	56	530	56	0	70	340	-
10 Sept. 58	10-15	147-35	0	0	0	0	0	810	-
	10-50	148-34	4600	2100	0	660	0	1200	-
	11-20	149-20	910	1100	4000	850	100	970	-
	11-57	150-18	560	11000	4600	1200	0	4400	-
	11-00	151-20	2300	2100	0	0	0	1800	-
11 Sept. 58	10-00	152-20	5300	4400	2000	0	7	1400	-
	9-09	153-30	70	0	0	0	0	1900	-

From:

Alfred W. Klement, Jr.
 Radiation Effects of Weapons Branch
 Division of Biology and Medicine
 U. S. Atomic Energy Commission
 Washington 25, D. C.

September 15, 1958

F

64

MARINE BIOLOGY SURVEY PROGRAM 40
(Continued)

Station at 14°25'N 157°01'E (7 Sept.)

Co⁵⁸, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰, Zr⁹⁵.

Station at 14°55'N 156°24'E - Same as above. (7 Sept.)

Station at 14°20'N 155°45'E - Same as above. (7 Sept.)

Station at 13°14'N 151°05'E (9 Sept.)

Co⁵⁸, Co⁵⁷, Co⁶⁰, Zn⁶⁵, Ba¹⁴⁰, Zr⁹⁵.

From:

Alfred W. Klement, Jr.
Radiation Effects of Weapons Branch
Division of Biology and Medicine
U. S. Atomic Energy Commission
Washington 25, D. C.

September 15, 1958

f

65-

LTR. MEMO. TELETYPE. OTHER. x FAX	
TO: Mr. Element	ORIG. <input checked="" type="checkbox"/> CC: OTHER:
CLASSIF. 000	POST OFFICE REG. NO.
DESCRIPTION: (Must Be Unclassified) Regarding average half life in Plankton, etc.	REPLY NECESSARY <input type="checkbox"/> DATE ANSWERED: BY: NO REPLY NECESSARY <input checked="" type="checkbox"/> FILE CODE:
ENCLOSURES: None	REFERRED TO: Mr. Element DATE: 9/25 RECEIVED BY: <i>[Signature]</i>
REMARKS:	RETAINED: RELE 9/3/58 RM Filed: Hardtack - Disestablishment

1958 AUG 25 AM 3 07

EUA002HUB025HEA035VAB028

U.S. ATOMIC ENERGY COMM.
TWX UNIT

RR RUEPAE

DE RUHEAB 22A

R 250430Z

OFFICIAL USE ONLY

FM USAEC ENIWETOK MI

TO MR ALFRED W KLEMENT JR, DIV OF BIOLOGY & MEDICINE, USAEC WASHDC

AEC GRNC

BT

/OFFICIAL USE ONLY/LOWMAN SENDS. FOURTEEN DAYS AVERAGE HALF LIFE
IN PLANKTON BETWEEN AUG 9 AND AUG 19. CITE: TEE:FGL.

BT

CFN 9 19 TEE:FGL

25/0444Z

*File
Dissemination*

008966

NNNNNT

*lita
c/c*

OFFICIAL USE ONLY

Dr. Allyn H. Seymour, Environmental Sciences
Branch, Division of Biology and Medicine

September 8, 1958

Alfred W. Klement, Jr., Radiation Effects of Weapons Branch
Division of Biology and Medicine

RESULTS OF MARINE BIOLOGY SURVEY OF THE EPG DANGER AREA - OPERATION HARD

SYMBOL: BMREW:AWK

Attached is a consolidated report of the data obtained at EPG during the marine biology survey of the danger area for your information. I am also receiving data from the "Guam" survey which I will forward upon completion of the survey. In the meantime I will pass the daily reports to you informally.

Enclosure:
Results of Marine Biology Survey of the
EPG Danger Area - OPERATION HARDTACK

*Disestablishment
File*

data
cc

BMREW
AWKlement:mf
9/8/58

OFFICIAL USE ONLY

STA NR.	COORDINATES		WATER SAMPLES					PLANKTON dpm/cc	External* Gamma mr/hr	Date of Counting Samples
	N	E	Surface	25m	50m	100m	300m			
34	10-50	161-50	255	801	96	-	331	13000	0.14	8 Aug. 5
33	10-50	161-00	1252	234	931	4560	0	2600	0.11	"
35	11-40	161-00	9218	1617	11383	8474	365	15693	0.06	9 Aug. 5
36	12-30	161-00	44400	46800	15700	-	9180	125000	0.15	"
3	13-20	161-00	33100	53100	20300	15400	3190	851000	0.22	"
38	13-20	160-10	75500	101000	47400	1690	7110	213000	0.25	"
39	12-30	160-10	59800	69800	23000	6260	28000	310000	0.21	10 Aug. 5
32	11-40	160-10	5500	4970	26300	13700	8300	18700	0.21	"
31	10-50	160-10	2490	9040	11300	2190	3760	3550	0.30	"
29	10-00	161-00	130	0	0	0	0	5650	0.175	11 Aug. 5
28	10-00	161-50	160	65	0	0	0	5110	0.08	"
27	10-00	162-40	130	0	0	0	-	410	0.12	"
13	10-50	162-40	72	0	0	0	180	2560	0.12	"
1	11-40	162-40	1300	1100	52300	0	370	3320	0.30	"
37	11-50	161-50	37000	35600	42400	3900	3900	27100	0.34	"
2	12-30	161-50	53400	50500	157300	5400	6000	34900	0.27	"
4	13-20	161-50	218000	202000	85000	1740	4300	190000	0.20	"
5	13-20	162-40	18300	16300	710	97	5700	21900	0.15	12 Aug. 5
7	12-30	162-40	13200	17900	1460	1040	3330	17600	-	"
8	12-30	163-30	3830	3510	851	1610	2050	9110	0.22	"
6	13-20	163-30	72	460	460	1610	1870	7110	0.43	"
9	13-20	164-20	1700	640	1180	130	460	1070	0.45	"
11	12-30	164-20	237	0	0	0	772	1060	0.16	"
16	12-30	165-10	4950	1800	1360	805	2630	4670	0.22	"
10	13-20	165-10	65	0	0	0	0	1580	0.20	13 Aug. 5
17	13-20	166-00	770	620	0	97	0	1270	0.13	"
18	12-30	166-00	194	0	0	0	0	1740	0.15	"
22	11-40	166-00	497	0	90	0	720	1600	0.24	"
19	11-40	165-10	6710	6840	9440	9010	2460	8320	0.70	"
15	11-40	164-20	1210	4290	695	920	2720	4060	-	"
20	10-50	164-20	0	0	0	0	0	1510	0.14	"
21	10-50	165-10	319	0	60	0	0	1770	0.18	14 Aug. 5
23	10-50	166-00	0	0	0	0	0	293	0.16	"
24	10-00	165-10	252	97	130	0	0	3410	0.20	"
25	10-00	164-20	178	0	0	0	0	6780	0.17	"
26	10-10	163-30	0	463	0	0	0	5060	0.22	"
14	10-50	163-30	0	0	0	0	198	1940	0.10	"
12	11-40	163-30	640	1030	1930	0	360	5410	0.18	15 Aug. 5

NOTE: All dpm gross beta.

* Measured 3 ft. above water surface.

Gamma Spectra Station No. 2: Co⁵⁸, 60, 57, Zn⁶⁵, Ba¹⁴⁰ in order of abundance found.
Station No. 4: Same.

One fish found between stations 10 and 17: liver 45000 dpm/g, muscle 1480 dpm/g wet.
Gamma activity in muscle is approx. 50% Zn⁶⁵, remainder Co⁵⁷, 58, 60; in liver about
25% is Zn⁶⁵ and about 75% Co⁵⁷, 58, 60.

Between 9 and 19 August plankton average half life found to be 14 days.

CONFIDENTIAL

September 9, 1958

MEMO:AMK

*Secretariat
file*

Dr. Lauren R. Donaldson
Laboratory of Radiation Biology
University of Washington
Seattle, Washington

Dear Lauren:

As you know by now the EPC danger area has been disestablished. The efforts of you and your group were certainly appreciated in this respect, especially in view of the added load placed on the laboratory. The marine survey appeared to be wholly successful. It was a pleasure for me to be able to work with Frank Lowman's group. I would also like to mention the outstanding work of Jim Conrill and Bill Champion in preparation for the survey.

Before I left EPC Frank arranged to send further data to me at Washington which I am now receiving during the present survey. Since I am not sure that you are getting this data, I will forward it to you from here. The data received so far are enclosed.

Thanks again for the cooperation you gave us. I am looking forward to making a visit to the laboratory there as soon as I have the opportunity.

Sincerely yours,

Alfred W. Klement, Jr.
Radiation Effects of Weapons Branch
Division of Biology and Medicine

Enclosure:
Marine Biology Survey Program 40

cc: Dr. C. L. Dunham
Dr. C. W. Shilling
Dr. A. H. Seymour

MEMO

AMK:erent:mf

9/9/58

MARINE BIOLOGY SURVEY PROGRAM 40

September 1958

Counting Date	COORDINATES		WATER SAMPLES					PLANKTON dpm/liter cc	External 7 mr/hr
	N Deg-Min	E Deg-Min	Surface	25m	50m	100m	300m		
3 Sept. 58	12-30	161-50	0	0	0	0	0	250	-
"	13-20	161-50	0	0	0	0	0	700	-
"	14-10	161-50	0	1000	0	0	0	560	-
"	15-00	161-45	290	2200	3400	84	490	4400	-
"	15-51	161-39	7000	6200	11000	870	0	6600	-
"	16-40	161-39	920	90	1100	0	0	610	-
5 Sept. 58	14-26	158-22	14000	12000	8700	720	100	7400	-
	13-47	158-41	14000	11000	22000	850	-	-	-
	14-25	157-01	26000	17000	1100	70	570	4900	-
	14-55	156-24	17000	15000	12000	0	0	4400	-
	14-20	155-45	15000	11000	1500	0	0	5000	-
6 Sept. 58	13-35	154-58	250	5600	8100	540	0	2700	-
	12-52	154-14	9000	3300	2700	0	1200	2000	-
	12-03	153-18	0	740	5500	1700	100	270	-
5 Sept. 58	13-16	158-09	8200	6300	9100	950	0	5200	-
6 Sept. 58	12-46	152-35	17000	13000	14000	1100	0	2500	-
	13-28	151-51	4300	2800	3100	430	0	2400	-
	14-14	151-05	3900	3900	3900	2100	500	3500	-
5 Sept. 58	13-44	157-38	5700	5000	5000	970	0	3100	-
7 Sept. 58	15-00	150-16	1200	950	980	0	0	750	-
	14-00	149-15	2300	2200	1400	0	0	1600	-
	13-00	147-55	800	640	7700	0	0	2200	-
	13-56	146-57	0	740	0	0	0	480	-
	14-45	146-08	2100	1900	220	0	0	900	-
4 Sept. 58	17-00	160-44	1700	9200	7800	0	0	5000	-
	16-05	160-21	3600	1600	2100	0	0	630	-
5 Sept. 58	15-00	160-00	11000	12000	2000	420	0	6300	-

MARINE BIOLOGY SURVEY PROGRAM 40

(Continued)

Station at 15°51'N 161°39'E Gamma spectra (3 Sept.) in order of abundance

Co⁵⁸, Co⁵⁷, Ba¹⁴⁰, Co⁶⁰, Zr⁹⁵.

Station at 14°26'N 159°22'E γ spectra (5 Sept.)

Co⁵⁸, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰, Zn⁶⁵ (trace).

Station at 13°16'N 158°09'E (6 Sept.)

Co⁵⁸, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰, Zr⁹⁵

Station 12°46'N 152°35'E fish (total) 8300 dpm/g wet gross β and

water samples Co⁵⁸, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰ (6 Sept.).

Station at 13°44'N 157°38'E (7 Sept.)

Co⁵⁸, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰, Zr⁹⁵.

Station at 14°00'N 149°15'E (7 Sept.) fish liver 1100 dpm/g wet gross β ;

muscle 87 dpm/g wet gross β .

Station at 15°00'N 161°45'E (4 Sept.)

Co⁵⁸, Zn⁶⁵, Co⁵⁷, Co⁶⁰, Zr⁹⁵, Ba¹⁴⁰ (trace).

Station at 17°00'N 160°44'E (4 Sept.)

Co⁵⁸, Ba¹⁴⁰, Zn⁶⁵, Co⁵⁷, Co⁶⁰, Zr⁹⁵.

Station at 15°00'N 160°00'E (5 Sept.)

Co⁵⁸, Ba¹⁴⁰, Zn⁶⁵, Co⁵⁷, Co⁶⁰, Zr⁹⁵.

DATA FROM MARINE SURVEY OF DANGER AREA DURING
OPERATION HARDTACK-AUGUST 1958 (Report #5-Final)

STATION NR	GEOGRAPHICAL COORDINATES		WATER SAMPLES-dpm/liter					PLANKTON dpm/cc	EXT. CALIPA lcr/hr
	Y Deg-Min	E Deg-Min	Surface	25m	50m	100m	300m		
25	10-00	164-20	178	0	0	0	0	6780	0.17
26	10-00	163-30	0	463	0	0	0	5060	0.22
24	10-50	163-30	0	0	0	0	0	1940	0.10
12	11-40	163-30	640	1030	1930	0	360	5410	0.18

Counted 14 Aug 58: Station Nos 26, 26, 24. 15 Aug 58: Sta Nr 12.

NOTE: Data are preliminary and unevaluated. All above dpm gross beta.
Station Nr 12 is last station of survey.

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OPERATION HARDTACK-AUGUST 1958 (Report #4)

STATION NR	GEOGRAPHICAL COORDINATES		SURFACE	WATER SAMPLES dpm/liter				PLANKTON dpm/cc	EXT. CAMA mc/hr
	Deg-Min N	Deg-Min E		25m	50m	100m	300m		
6	13-20	163-30	78	460	460	1610	1870	7110	0.43
22	11-40	166-00	497	0	90	0	720	1600	0.24
19	11-40	165-10	6710	6840	9440	9010	2460	8320	0.70
	11-40	164-20	1210	4290	695	920	2720	4060	-
20	10-50	164-20	0	0	0	0	0	1510	0.14
21	10-50	165-10	319	0	60	0	0	1770	0.18
23	10-50	166-00	0	0	0	0	0	293	0.16
24	10-00	165-10	252	97	130	0	0	3410	0.20

Counted 12 Aug 58: Station Nr 6. 13 Aug 58: Station Nrs 22, 19, 15, 20, 14 Aug 58: Station Nrs 21, 23, 24.
 Note: Data are preliminary and unevaluated. All above dpm Gross beta.
 Station Nr 2: Gamma spectra add Zn⁶⁵ before Ba¹⁴⁰

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DATA FROM MARINE SURVEY OF DANGER AREA DURING
OPERATION HARDACK-AUGUST 1958 (Report #2)

STATION IN	GEOGRAPHICAL COORDINATES		SURFACE	WATER SAMPLES				PLANKTON dpm/co	EXT. CALCIA wt/hr
	DEG-MIN N	DEG-MIN E		25m	50m	100m	300m		
13	10-50	162-40	72	0	0	0	180	2560	0.12
1	11-40	162-40	1900	1100	52,300	0	370	3320	0.30
37	11-40	161-50	37,000	35,600	42,400	3900	3900	27,100	0.34
2	12-30	161-50	53,400	50,500	157,300	5400	6000	34,900	0.27
4	13-20	161-50	218,000	202,000	85,000	1740	4300	190,000	0.20
5	13-20	162-40	18,300	16,300	710	97	5700	21,900	0.15
7	12-30	162-40	13,200	17,900	1460	1040	3300	17,600	-
8	12-30	163-30	3830	3510	851	1610	2050	9110	0.22

Counted 11 Aug 58: Station Nos 13, 1, 37, 2, 4. 12 Aug 58: Station Nos 5, 7, 8.

NOTE: Data are preliminary and unevaluated. All above are dpm Gross beta.

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DATA FROM MARINE SURVEY OF DANGER AREA DURING
OPERATION HARDT-CG- AUGUST 1958

STATION: HR	GEOGRAPHICAL COORDINATES		Surface	WATER SAMPLES				PLANTON dpm/co	EXT. GAMMA * mr/hr at 3' above water
	W Deg-Min	E Deg-Min		25 m	dpm/liter 50 m	100 m	300 m		
34	10-50	161-50	255	801	96	-	331	13,000	0.14
33	10-50	161-00	1250	234	931	4560	0	2,600	0.11
35	11-40	161-00	9220	1620	11,400 0	8,470	365	15,700	0.06
36	12-30	161-00	44,400	46,800	157,000	-	9,180	125,000	0.15
3	13-20	161-00	33,100	53,100	20,300	15,400	3,190	851,000	0.22
38	13-20	160-10	75,500	101,000	47,400	1,690	7,110	213,000	0.25
39	12-30	160-10	59,800	69,600	23,000	6,260	28,000	310,000	0.21
32	11-40	160-10	5,500	4,970	28,300	13,700	8,300	18,700	0.21
31	10-50	160-10	2,490	9,040	11,300	2,190	3,760	35,500	0.3
29	10-00	161-00	130	0	0	0	0	5,650	0.175
28	10-00	161-50	160	65	0	0	0	5,110	0.08
27	10-00	162-40	130	0	0	0	0	410	0.14

Counted 8 Aug 58: Sta Nos 33,34. 9 Aug 58: Sta Nos 35,36, 3, 38. 10 Aug 58: Sta Nos 39,32,31. 11 Aug 58: Sta Nos 29,28,27.

NOTE: Data are preliminary and unevaluated. All above are dpm gross beta.

* External gamma readings probably contain at least about 0.10 mr/hr contamination in and around the ship so that readings are probably not indicative of water contamination.

Gamma spectra indicate the presence of Be¹⁴⁰-Ia¹⁴⁰ and ¹⁰³Pd¹⁰³, a small amount of Co⁶⁰,58 and ⁶³7, and traces of Zn. Stations 33,34, and 38 show some Zr⁹⁵-Nb⁹⁵.

MARINE BIOLOGY SURVEY PROGRAM 40
(Continued)

September 1958

Counting Date	COORDINATES		WATER SAMPLES					PLANKTON cpm/cc	External γ mr/hr
	N Deg-Min	E Deg-Min	Surface	25m	50m	100m	300m		
11 Sept. 58	10-02	154-22	1100	1100	740	0	0	2200	-
	11-01	155-04	2200	1600	3600	0	0	1200	-
	11-57	155-45	14000	12000	14000	100	0	6000	-
	13-00	156-25	4400	4700	9100	0	5600	2900	-
12 Sept. 58	12-03	156-56	3900	5400	670(?)	2300	0	2400	-
	11-01	157-28	0	0	0	0	90	180	-
	10-03	158-00	0	0	0	56	0	230	-
	11-00	159-06	1800	2100	2200	4400	1400	640	-
	10-22	159-56	0	0	0	24	170	270	-
	09-46	160-46	640	420	0	0	0	120	-
	10-30	161-43	0	0	0	0	70	150	-

END OF SURVEY

Station at 11°57'N 150°18'E (11 Sept.)

Co⁵⁸, Zn⁶⁵, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰, Zr⁹⁵.

Station at 11°57'N 155°45'E (11 Sept.)

Co⁵⁸, Co⁵⁷, Co⁶⁰, Ba¹⁴⁰, Zr⁹⁵.

NOTE: All gamma emitters determined from gamma spectrometer data at stations indicated are in order of abundance (highest listed first).

From:

Alfred W. Klement, Jr.
Radiation Effects of Weapons Branch
Division of Biology and Medicine
U. S. Atomic Energy Commission
Washington 25, D. C.

September 16, 1958

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MARINE BIOLOGY SURVEY PROGRAM 40
(Continued)

September 1958

Counting Date	COORDINATES		WATER SAMPLES					PLANKTON cpm/cc	External γ sr/hr
	N Deg-Min	E Deg-Min	Surface	25m	50m	100m	300m		
11 Sept. 58	10-02	154-22	1100	1100	740	0	0	2200	-
	11-01	155-04	2200	1600	3600	0	0	1200	-
	11-57	155-45	14000	12000	14000	100	0	6000	-
	13-00	156-25	4400	4700	9100	0	5600	2900	-
12 Sept. 58	12-00	156-56	3900	5400	670(?)	2300	0	2400	-
	11-01	157-28	0	0	0	0	90	180	-
	10-03	158-00	0	0	0	56	0	230	-
	11-00	159-06	1800	2100	2200	4400	1400	640	-
	10-22	159-56	0	0	0	84	170	270	-
	09-46	160-46	640	420	0	0	0	120	-
	10-30	161-43	0	0	0	0	70	150	-

END OF SURVEY

Station at 11°57'N 150°18'E (11 Sept.)

Co⁵⁸, Zn⁶⁵, Ba¹⁴⁰, Co⁵⁷, Co⁶⁰, Zr⁹⁵.

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NOTE: All gamma emitters determined from gamma spectrometer data at stations indicated are in order of abundance (highest listed first).

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Division of Biology and Medicine
U. S. Atomic Energy Commission
Washington 25, D. C.

September 16, 1958

September 16, 1958

ALFRED W. KLEMENT, JR.
RADIATION EFFECTS OF WEAPONS BRANCH
DIVISION OF BIOLOGY AND MEDICINE
U. S. ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

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INTERESTING END BMREW-AWK



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