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ESTIMATED FALLOUT IN 1963 FROM NUCLEAR WEAPONS TESTS

DELETED VERSION ONLY

Sections

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NOV 1 5 1962

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FISSION YIELDS FOR UNITED STATES, UNITED KINGDOM AND USSR TESTS

The attached data is forwarded in response to your query regarding comparative yields from United States, United Kingdom and Soviet tests to date.

It is noted that the analyses have not yet been completed on the 1962 Soviet test series.

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In view of the White House restrictions on the dissemination as well as public release of information on Soviet tests, it is requested that no dissemination be made of this data outside the AEC and that no public release be made without authorization from the appropriate authority through the Division of Intelligence.

Enclosure:
Table

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TABLE I

ATMOSPHERIC NUCLEAR TEST YIELDS

November 15, 1962

(Megatons)

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	US	UK	USSR	ALL NATIONS
Through November 3, 1958				
Total	120* (US and UK combined)		50*	170*
Fission	65* (US and UK combined)		25*	90*
1961 Series				
Total	Nil	Nil	120*	120*
Fission	Nil	Nil	25*	25*
1962 Series	(As of ~~Oct. 30~~) 15 Jan		(As of ~~Nov. 4~~) 15 Jan	
Total	36	.11	~~150~~ 182	~~186~~ 220
Fission	16	Nil	~~20-30~~ 65-70	~~36-66~~ 71-76
Totals				
Total	143	8.5	~~300~~ 352	~~476~~ 506
Fission	74	6.5	~~90-100~~ 105-110	~~150-180~~ 186-190

* Denotes unclassified values.

DOE ARCHIVES

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II.

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STRONTIUM-90

Table I summarizes total and fission yields from all past tests. The total yield from all past USSR tests is a little more than double those from U. S. tests (320 vs. 145 MT). The fission yield from all past USSR tests is ~~slightly~~ more than from the U. S. tests (70-100 vs. 74 MT). In 1962, the total yield from the USSR tests was 150 MT and from the U. S. tests 38 MT; the fission yield for USSR was 20-30 MT and for U. S. 16 MT. It should be noted that the Soviet yields are estimates, and that, particularly, the 1962 total yields and fission yields are preliminary estimates based on assumptions derived from incomplete data.

By the end of 1962, it is estimated that there will be a deposition of 100 millicuries per square mile (mc/mi^2) of strontium-90 (from all past tests) in the wet eastern part of the United States (40 mc/mi^2 in dry western U. S.). Data on strontium-90 in milk in 1962 indicate that deposition of strontium-90 in some areas in the wet eastern part of the United States varied as much as a factor of two from other areas in the same general location and by as much as a factor of ten from dry sections of the country. The annual (1963) deposition may be 37-60 mc/mi^2 additional for wet eastern U. S. (15-24 mc/mi^2 for dry western U. S.). ~~Roughly, then,~~ the accumulated Sr-90 will increase ~~about~~ 50 per cent by the end of 1963 over that at the end of 1962. Of the total amount of Sr-90 deposited the end of 1963, about ~~60~~ 58 per cent will have come from all past USSR tests and ~~40~~ 39 per cent from all past U. S. tests. (Possibly 50 per cent more Sr-90 will be deposited in the United States from USSR tests held at Novaya Zemlya from megaton detonations when the cloud height is about 80,000 feet or less, than from a similar U. S. test in the equitorial region -- because of the meteorological factors.)

3. The annual rate of deposition may be as high as ~~60~~ 64 mc/mi^2 for wet eastern United States, with ~~30-33~~ 33-35 mc/mi^2 occurring in the quarter April-June 1963. Heretofore, the highest annual deposition rate has been about 25-30 mc/mi^2. (1959 + 1962)

4. Using estimates developed by the United Nations Scientific Committee on the Effects of Atomic Radiation for Worldwide Fallout, the peak values of Sr-90 in 1963 averaged over the U. S. might approach 25 strontium units in milk and about 35 strontium units in the total diet in late spring or early summer of 1963. (A strontium unit is one micromicrocurie Sr-90 per gram of calcium; for milk, a micromicrocurie of Sr-90 per liter is approximately one strontium unit.) The annual average for milk might approach 20 strontium units and for the total diet 28 strontium units. The highest national average of Sr-90 in milk for any 12 month period, for which data are available, has been 12 micromicrocuries per liter (uuc/l) for the year ending in September 1962, with the peak month showing 17 uuc/l in June 1962. During the month of June

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1962, the highest monthly average for any station was 40 μμc/l at Rapid City, South Dakota, while the lowest average was 3 μμc/l at Phoenix, Arizona.

Evaluation

The Federal Radiation Council's guide for daily intake of Sr-90 (for measurements based on a suitable sample of the population) for normal peacetime operations is 200 micromicrocuries. If the population of a major milkshed could be considered a "suitable sample" for application of the guide, the daily intake of Sr-90 by any such population sample would be unlikely to approach the guide in 1963. It should be noted that the daily intake corresponding to the accepted FRC Radiation Protection Guide (RPG) is 600 micromicrocuries, but the FRC stated ". . . There is currently no known operational requirement for an intake value as high as the one corresponding to the RPG. Hence, a value estimated to correspond to doses to the critical organ not greater than one-third of the RPG has been used. . . ."

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SHORT-LIVED RADIONUCLIDES

An analysis of radiation levels from the short-lived radionuclides will require additional study. The topic is introduced here, however, to point out that based on the strontium-90 rates of deposition, the amount of associated short-lived activities may be sufficient to produce external dose rates comparable to background levels in some areas of the country. This could create some public reaction.

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IODINE-131

General

". . . Doses to the thyroid from the major past tests were estimated to have ranged from 100 to 200 millirems per year during and immediately following periods of testing. These values apply only to individuals who were infants at the time of highest concentration of radioactive iodine. The average value for all age groups was about a tenth as much. Although data from which thyroid doses during 1957-58 can be estimated are limited, it is likely that there was much geographic variation, and in some limited areas of the United States the average thyroid doses were probably many times the national average. . . ."[1.]

". . . At the present time, the monitoring programs indicate that I-131 levels accumulated during the past year to a value such that the estimated radiation dose to the thyroid" (of young children) "is about 1-1/2 times the annual background from naturally occurring materials, as a national average, and about 5 times the annual background in a few areas . . .", i.e. 0.15 and 0.5 rads. . . ."[2.]

Yearly Averages

Table I lists the yearly averages since the start of nuclear weapons tests in September 1961. (Public Health Service network.) There were only two stations above a yearly average of 100 micro-microcuries of I-131 per liter of milk ($\mu\mu c/l$); Palmer, Alaska (109) and Salt Lake City, Utah (102).

[redacted]

Specific Events

Fall 1961 - There was a relatively large rise of I-131 in milk in the mid-west in the fall of 1961. (See Table II.) This probably resulted from the U.S.S.R. shots on September 10, 1961.[3] The ensuing trajectory was unique -- curling around the North Pole, passing down the U. S. eastern coast, turning westward along the Gulf coast states and hence up the mid-west. The fallout was principally in the form of dry deposition from the cold polar air mass (as contrasted with the more usual method of "rainout").

Spring 1962 - There was also a relatively large rise of I-131 levels in milk in the mid-west in the spring of 1962. (See Table III.) This could have resulted from the U. S. tests at Christmas Island. There were severe thunderstorms over the mid-west, reaching into the lower stratosphere.[4]

Salt Lake City and Environs July 1962 - There were relatively large rises in the I-131 in milk at Salt Lake City and its environs[5] due principally to Small Boy (July 14, 1962) and to a lesser extend by Johnie Boy (July 11, 1962) and Sedan (July 6, 1962). (See Table IV.) The peak value for any sample was 9,000 micro-microcuries per liter (a grab sample from a herd near Salt Lake City; not a composite sample).

Des Moines Event - On June 13, 1962, Des Moines underground shot released a substantial amount of radioactive debris; i.e., considerably greater amount than if it had just vented. The trajectory was northerly for a few hundred miles, then toward the west and finally curled down the west coast. The highest recorded amount of I-131 in milk was 1,240 micromicrocuries per liter at Spokane, Washington, on June 21, 1962.

Evaluation

The top of Range II of the Federal Radiation Council Guides for normal peacetime operations is a daily intake of 100 micromicrocuries of I-131. These intake values may be averaged over periods up to one year. The Federal Radiation Council is currently working on Guides appropriate to nuclear weapons testing.

Based on the usual assumptions, the highest recorded stations (Palmer, Alaska and Salt Lake City, Utah) would correspond approximately to a 0.5 rad dose to the thyroid of children. The National Academy of Sciences - National Research Council report, Pathological Effects of Thyroid Irradiation, stated in part ". . . There is no evidence at hand, except for one doubtful case in a child, that any of the treatments for hyperthyroidism has produced a thyroid cancer, although doses have ranged from a few thousand rad upward. . . ."

TABLE I

Yearly Averages of Iodine-131 in Milk
(Micromicrocuries per liter)

	Sept. 1961-Aug. 1962	Oct. 1961-Sept. 1962
Alabama, Montgomery	12.5	12.2
Alaska, Palmer	65.8	109.0
Arizona, Phoenix	23.2	19.2
Arkansas, Little Rock	40.7	32.8
California, Sacremento	13.0	13.2
California, San Francisco	12.6	12.8
Colorado, Denver	26.5	23.5
Connecticut, Hartford	17.1	18.9
Delaware, Wilmington	20.9	22.7
District of Columbia, Washington	15.5	17.9
Florida, Tampa	15.4	12.6
Georgia, Atlanta	25.2	19.6
Hawaii, Honolulu	12.2	12.4
Idaho, Idaho Falls	45.1	37.5
Illinois, Chicago	40.2	40.7
Indiana, Indianapolis	24.7	25.6
Iowa, Des Moines	89.7	77.4
Kansas, Wichita	73.3	66.4
Kentucky, Louisville	29.6	26.0
Louisiana, New Orleans	28.0	20.1
Maine, Portland	20.0	24.1
Maryland, Baltimore	19.5	19.4
Massachusetts, Boston	30.0	26.0
Michigan, Detroit	48.9	41.3
Michigan, Grand Rapids	26.5	25.7
Minnesota, Minneapolis	87.8	69.5
Mississippi, Jackson	34.4	22.6
Missouri, Kansas City	92.2	85.5
Missouri, St. Louis	52.2	42.2
Montana, Helena	49.2	44.7
Nebraska, Omaha	70.0	63.1
Nevada, Las Vegas	6.1	8.1
New Hampshire, Manchester	25.6	22.8
New Jersey, Trenton	21.6	19.0
New Mexico, Albuquerque	20.3	19.7
New York, Buffalo	23.7	25.0
New York, New York	29.0	26.1
New York, Syracuse	33.3	30.4
North Carolina, Charlotte	12.5	9.7
North Dakota, Minot	27.4	41.2
Ohio, Cincinnati	33.9	33.4
Ohio, Cleveland	25.4	24.9

TABLE I (cont.)

Yearly Averages of Iodine-131 in Milk
(Micromicrocuries per liter)

	Sept. 1961-Aug. 1962	Oct. 1961-Sept. 1962
Oklahoma, Oklahoma City	52.4	46.9
Oregon, Portland	32.8	30.8
Pennsylvania, Philadelphia	22.4	21.5
Pennsylvania, Pittsburgh	25.2	23.5
Puerto Rico, San Juan	13.4	12.2
Rhode Island, Providence	22.8	21.0
South Carolina, Charleston	19.8	13.2
South Dakota, Rapid City	9.3	21.7
Tennessee, Chattanooga	23.6	18.9
Tennessee, Memphis	40.8	29.6
Texas, Austin	14.1	12.9
Texas, Dallas	22.1	20.9
Utah, Salt Lake City	101.5	93.9
Vermont, Burlington	24.9	22.5
Virginia, Norfolk	20.8	16.2
Washington, Seattle	30.9	33.6
Washington, Spokane	70.1	66.0
West Virginia, Charleston	18.5	16.3
Wisconsin, Milwaukee	40.2	38.6
Wyoming, Laramie	57.0	57.5

[redacted]

TABLE II

Some High Levels of Iodine-131 in Milk
Fall 1961
(Micromicrocuries per liter)

Locality	Date	Concentration
Nebraska, Omaha	October 2	730
Louisiana, New Orleans	September 25	530
Missouri, St. Louis	September 27	500
New York, New York	September 30	440

[redacted]

TABLE III

Some High Levels of Iodine-131 in Milk
Spring 1962
(Micromicrocuries per liter)

Locality	Date	Concentration
Kansas, Wichita	May 13	670
Iowa, Des Moines	May 16	300
Kansas, Kansas City	May 18	605
Kansas, Kansas City*	June 1	780
Nebraska, Omaha*	June 1	340

*Probably the result of earlier fallout in mid-May, plus a mixture of debris, principally from the U. S. tests at Christmas Island.

[redacted]

TABLE IV

Samples From Salt Lake City Milk Pool

Date Collected	µµc I-131/Liter
June 20, 1962	Not detectable
July 3,	" "
6	" "
10	20
11	60
12	30
13	300
14	250
15	390
16	410
17	160
18	450
20	1660
21	1190
22	450
22	1390
25	2050
26	1960
27	1290
28	960
29	730
31	570
August 2	640
3	590
4	370
5	410
6	520

[redacted]

[redacted]

REFERENCES

1. Federal Radiation Council, Health Implications of Fallout from Nuclear Weapons Testing through 1961, Report No. 3, (May 1962).

2. Prediction Panel of Congressional Hearings on Radiation Standards, Including Fallout, (June 1962).

3. "A Survey of Radioactive Fallout from Nuclear Tests", Machta, L.; List, R. J. and Telegadas, K., Journal of Geophysical Research, Vol. 67, No. 4, (April 1962).

4. Memorandum for the record, "Remarks on I-131 Fallout in Midwestern U. S. in Mid-May 1962", by Lester Machta. Reproduced in Congressional Hearings, Radiation Standards, Including Fallout, p. 776, (June 1962).

5. Memorandum for Commissioner Haworth, D. A. Ink, E. J. Bloch and others, "Meetings in Utah Re High Iodine Levels in Milk", Gordon Dunning, (August 13, 1962).

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FALLOUT FROM NUCLEAR WEAPONS TESTS AT NEVADA TEST SITE

Summary Statements

1. With the resumption of nuclear tests in Nevada on September 15, 1962, the U. S. Atomic Energy Commission has detonated 52 nuclear devices in underground chambers which were designed to contain the radioactivity. In addition, six devices were detonated either in the atmosphere or at a shallow depth underground. These six devices were detonated only under conditions that would minimize exposures to populated off-site areas. A summary of the data on fallout from the nuclear detonations at the Nevada Test Site since September 15, 1961, is attached.

2. The highest exposure to any off-site person (as recorded on personnel film badges) was 438 milliroentgens. The Federal Radiation Council's Guide for normal peacetime operations is 1500 milliroentgens per year to individuals, and 500 milliroentgens per year when the technique is used of measuring a suitable sample of the population. An operational guide of 3.9 roentgens was used by the Test Organization in the following context: AEC Staff Paper 604/65, dated June 12, 1962, entitled OFF-SITE RADIATION EXPOSURE CRITERIA FOR NEVADA TEST SITE, recorded "the clarification of a basic guide of 3.9 roentgens estimated dose per year to off-site populations for nuclear weapons tests at the Nevada Test Site; every reasonable effort should be made to keep

[redacted]

the radiation exposures as low as possible, but for planning purposes, if unanticipated yet cridible circumstances could result in estimated doses in excess of 3.9 roentgens per year, then the detonations should be postponed until more favorable conditions prevail. Any past radiation exposures, from either nuclear weapons tests or other activities at the Nevada Test Site, would be included in estimating the total potential exposure from any given detonation."

3. The highest gross beta activity in the air was measured at Alamo, Nevada, on July 14, 1962, amounting to 140,000 micromicrocuries per cubic meter. Such activity in the air has no direct interpretation in terms of radiation doses to persons but serves to act as an alert for additional monitoring.

4. Drinking water supplies showed no signficant increases above those generally throughout the country.

5. Detailed information on milk monitoring is contained in a separate section.

[redacted]

FALLOUT FROM ATMOSPHERIC NUCLEAR WEAPONS TEST IN PACIFIC AREA
OPERATION DOMINIC
April-July 1962

Summary Statements

1. Documentation of radioactive contamination resulting from the U. S. tests at Christmas Island was conducted jointly by Joint Task Force Eight (JTF-8) Radiation Safety personnel and University of Washington personnel under AEC contract. The off-site area covered was approximately 2000 miles in radius, measured from Christmas Island. All populated islands in this area were monitored.

2. Bio-environmental samples were taken on Christmas Island in April 1962, before testing began and in the same locations in August 1962, after testing had ceased. Preliminary evaluation of available data on foodstuffs revealed little change in the levels of radioactive contamination between these two sets of measurements. During the operational period, transient increases of beta activity were detected in air and precipitation samples at some off-site stations. Film badge readings indicated no radiation exposures from fallout to any JTF-8 personnel or native populations above normal background radiation levels. The film badges used are ineffective at radiation exposures of less than 30 milliroentgens.

3. With completion of the testing program at Johnston Island in early November, bio-environmental sampling in the vicinity is planned for the near future. This program will be accomplished by personnel of the University of Washington, under AEC contract.

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DRAFT

VII.

FALLOUT FROM NUCLEAR TESTS AT NEVADA TEST SITE

Since the resumption of nuclear tests on September 15, 1961, the United States Atomic Energy Commission had detonated 58 nuclear devices at the Nevada Test Site as of October 27, 1962. Fifty-seven of these were weapons tests, and one was a cratering experiment in the Plowshare program. Of the weapons tests, 52 detonations were in underground chambers which were designed to contain radioactivity, and five were detonated either in the atmosphere or at a shallow depth below the surface. The five latter detonations and the cratering experiment, in which the detonation occurred at a depth of 635 feet, were conducted under conditions in which exposures to populated off-site areas were minimized.

INDIVIDUAL EXPOSURES OFF-SITE

As a part of the AEC's over-all monitoring program conducted in the area surrounding the Nevada Test Site, more than 260 persons have been issued film badges since the resumption of underground testing in September 1961. The recorded radiation exposure received by these personnel is maintained as a permanent record by the AEC, and each individual is informed of his exposure record. Table I summarizes the highest exposures received by off-site individuals since September 15, 1961, at NTS until about September 4, 1962. These records have been corrected for natural background radiation exposure, which is approximately 0.5 mr/day for the general area. Table II lists the locations and number of people wearing film badges that recorded no identifiable radiation exposure above natural background.

ENVIRONMENTAL CONTAMINATION

General

Since September 15, 1961, most of the nuclear test detonations at the Nevada Test Site have been conducted in underground chambers. This technique was used in an attempt to prohibit the release of radioactive material off the test site. As indicated in Table III, of the 52 underground nuclear detonations held in Nevada, eight have released some gaseous radioactivity measurable off-site.

The physical characteristics and relative amounts of various isotopes released by these tests vary somewhat from those released by past tests at NTS. Although there have been four surface or near surface detonations, plus one cratering shot giving off-site fallout resembling that from past test series, the major portion of the activity in the remainder of the series has been contained on-site or underground. Minimal amounts of gaseous activity, along with small quantities of particulate material containing activity, have been released to the atmosphere through venting of underground detonations.

In test series prior to 1961, nuclear devices were airdropped or were detonated on steel towers, balloons or in uncovered shallow holes; thus, fallout particles contained many kinds of debris in addition to the radioactivity. Induced activity in the debris contributed little to the total radioactivity in the fallout. As much as 25 to 50 per cent of the total radioactivity returned to the earth within a few hours.

During the present series, the nature of the releases of gaseous material is such that the clouds formed do not rise to altitudes such as those from surface or near surface detonations, but linger near the surface and are acted upon by the lower tropospheric and surface winds. Normally, these clouds are so dispersed by the time they reach off-site populated areas that they are difficult to detect with portable monitoring equipment. However, in a few events, clouds have passed over areas where people were located; hence, there have been some off-site radiation exposures. These exposures are documented on film badges furnished to these people by AEC. The highest exposure from fallout recorded for an off-site individual was 438 mr at Nyala, Nevada.

Due to the gaseous nature and rapid movement of these clouds, stringent requirements are placed on the off-site monitors, who must intercept the clouds and record radiation intensities during passage of the clouds. Airborne monitors locate and track the radioactivity and direct the mobile ground monitors into the path of the clouds. Unless there is a continuous recording air or background radiation instrument or a mobile ground monitor in an area when a radioactive cloud passes, passage of the cloud can be estimated only by predicting the cloud trajectory to determine whether the cloud has passed a specific area. There is generally little residual radioactivity deposited on the ground from these clouds. Records of cloud passage are obtained by mobile ground monitors in addition to routine monitoring of large off-site areas near the test site.

Milk

Milk collections have been made in the vicinity of NTS, and the samples analyzed by the U. S. Public Health Service, under contract with AEC. Tables IV, V, VI and VII present the highest concentrations of I-131 detected in milk during the indicated time periods.

In July 1962, the wind trajectories of radioactive clouds from five nuclear tests passed over the Salt Lake City area. Three of these clouds are known to have deposited residual fallout activity in this area. Iodine-131 was detected in milk supplies for a short period of time. The tables show that while the peak value of I-131 in milk in the Salt Lake City area was relatively high, the average levels over a period of time were considerably below those considered to constitute a health hazard, based upon previous studies of effects of I-131 upon human thyroids. For example, the station showing the highest yearly average (Salt Lake City with 102 micromicrocuries of I-131 per liter of milk) might result in a one-half roentgen exposure to the thyroid of young children and lessor amounts to adult thyroids.

Gross Beta Air Activity

At the present time, there are 28 permanent air sampling stations in operation surrounding NTS. The data recorded by these air samplers is used by the off-site monitoring group as an indicator of the presence of airborne radioactivity in that area. These data indicate the presence of radioactivity and the need for further monitoring but are of no direct value in assessing radiation doses. For purposes of illustration, the ten highest levels found in the area are listed in Table VIII.

Isotopic Air Results

The relative quantities of various isotopes in air are obtained from isotopic analysis of samples taken by prefilters and charcoal cartridges. Some of the highest values determined for I-131, I-133 and I-135 are shown in Table IX.

Water Supplies

Gross beta water monitoring is conducted for water supplies used by people in the off-site area around NTS. All sources monitored are subsurface supplies, except for Lake Mead. There are no known surface water supplies for human use in the nearby off-site area. The highest levels of gross beta activity in water supplies during the period of October 1961 to October 1962 are listed in Table X. For comparison, there has been selected some other high level data from the U. S. Public Health Service on radioactivity in raw surface water in the United States.

Isotopic analysis was conducted on many of these NTS samples, and the results show that levels of cesium-137, barium-140, zirconium-95, ruthenium-103, cerium-141, cerium-144 and iodine-131 were below the levels of detection. Levels of strontium-89 and strontium-90 were less than 5 μμc/l and 1 μμc/l respectively.

[redacted]

TABLE I

Highest Exposures Received by Off-Site Individuals at NTS September 15, 1961 - September 4, 1962

Location*	Period of Time In Which Exposure Occurred**	Total Exposure (mr)	Exposure From Fallout (mr)
Caliente	1/31/62 - 8/28/62	245	141
Casey Ranch	5/16/62 - 8/8/62	230	188
" "	" "	260	218
" "	" "	285	243
Diablo	5/15/62 - 8/16/62	265	220
"	2/7/62 - 8/16/62	330	285
Nyala	5/16/62 - 8/8/62	290	248
"	" "	435	393
"	6/20/62 - 8/8/62	310	285
"	5/16/62 - 8/8/62	480	438
Penoyer Ranch	3/5/62 - 8/16/62	260	178
Pine Creek Ranch	5/24/62 - 8/8/62	345	307
" " "	" "	255	217
Twin Springs	5/15/62 - 8/16/62	290	245
" "	2/13/62 - 8/16/62	265	173
Blue Eagle Ranch	6/12/62 - 9/5/62	205	161
" " "	5/9/62 - 9/5/62	200	140
" " "	6/11/62 - 8/10/62	255	225
" " "	5/16/62 - 9/6/62	285	229
Duckwater	5/19/62 - 9/4/62	215	161
Gardner Ranch	2/14/62 - 9/5/62	395	294
Hiko	2/20/62 - 9/3/62	340	243
Lockes	2/6/62 - 9/4/62	215	110
Manzonie Ranch	2/13/62 - 9/4/62	280	179
" "	" "	210	109

*Each entry represents a different individual.

**These dates vary because all individuals were not residing in the area during the entire testing period.

[redacted]

[redacted]

TABLE II

Locations and Number of People Wearing Film Badges
That
Recorded No Identifiable Radiation Exposure* Above Natural Background
September 15, 1961 - August 25, 1962

St. George, Utah	15 people
Littlefield, Arizona	2 people
Beatty, Nevada	26 people
Furnace Creek, Nevada	8 people
Lathrop Wells, Nevada	16 people
Pahrump, Nevada	10 people
Rhyolite, Nevada	2 people
Springdale, Nevada	1 person
Tonapah, Nevada, Area	32 people

*Exposures less than 30 mr cannot be determined accurately from these film badges.

[redacted]

[redacted]

TABLE III

Nuclear Events at Nevada Test Site
September 15, 1961 - December __, 1962

Date	Type Shot[7]	Footnotes
15 Sept. '61	Low Yield - Underground	2, 3
16 Sept. '61	"	1, 4
10 Oct. '61	"	2, 3
29 Oct. '61	"	2, 4
3 Dec. '61	"	1, 4
13 Dec. '61	"	1, 4
17 Dec. '61	"	1, 4
22 Dec. '61	"	2, 4
9 Jan. '62	"	1, 4
18 Jan. '62	"	2, 4
30 Jan. '62	"	2, 4
8 Feb. '62	"	1, 4
9 Feb. '62	"	2, 4
15 Feb. '62	"	2, 4
19 Feb. '62	"	2, 4
19 Feb. '62	"	2, 4
23 Feb. '62	"	1, 4
24 Feb. '62	"	2, 4
1 Mar. '62	"	2, 3
5 Mar. '62	Shallow depth, Low yield, Underground	5, 3
6 Mar. '62	Low yield, Underground	1, 4
8 Mar. '62	"	2, 4

[redacted]

[redacted]

TABLE III (cont.)

Date	Type Shot[7]	Footnotes
15 Mar. '62	Low yield, Underground	1, 4
28 Mar. '62	"	1, 4
31 Mar. '62	"	1, 4
5 Apr. '62	"	1, 4
6 Apr. '62	"	1, 4
12 Apr. '62	"	1, 4
14 Apr. '62	"	1, 4
21 Apr. '62	"	5, 3
27 Apr. '62	"	1, 4
7 May '62	"	1, 4
12 May '62	Intermediate yield, Underground	1, 4
19 May '62	Low yield, Underground	1, 4
25 May '62	"	5, 3
1 June '62	"	1, 4
6 June '62	"	1, 4
13 June '62	"	1, 4
21 June '62	"	5, 3
27 June '62	Intermediate yield, Underground	1, 4
28 June '62	Low yield, Underground	2, 4
30 June '62	"	2, 3
6 July '62	Plowshare cratering experiment	1, 4
7 July '62	Low yield slightly above ground	5, 6, 3
11 July '62	Shallow depth low yield	5, 4
13 July '62	Low yield, Underground	5, 3
		1, 4

[redacted]

[redacted]

(This table will be updated with additional shots to be added.)

TABLE III (cont.)

Date	Type Shot[7]	Footnotes
14 July '62	Low yield few feet above ground	5, 3
17 July '62	Low yield slightly above ground	5, 3
27 July '62	Low yield, Underground	2, 4
24 Aug. '62	"	1, 4
24 Aug. '62	"	1, 4
14 Sept. '62	"	1, 4
20 Sept. '62	"	1, 4
29 Sept. '62	"	1, 4
5 Oct. '62	Intermediate yield, Underground	1, 4
12 Oct. '62	Low yield, Underground	1, 4
19 Oct. '62	"	5, 3
27 Oct. '62	"	1, 4

TABLE III (cont.)

Footnotes:

1. No release of radioactivity occurred.
2. Release of small quantities of steam and/or a gaseous cloud contain ing small quantities of radioactivity.
3. Some activity detected off-site.
4. No activity detected off-site.
5. A radioactive cloud produced.
6. 635 feet underground-cratering shot - less than 30 KT fission.
7. Low yield - 20 KT or less.

   Intermediate yeidl - between 20 KT and 1 MT.

[redacted]

TABLE IV

Highest Concentrations of I-131 in Individual Samples of Milk in Nevada September 1, 1961 - July 1, 1962

Location	Date	Levels ($\mu\mu c/l$)
Hiko, Nevada	11/ 2/61	720
Elko, Nevada	6/21/62	610
Robbins Ranch, Nevada	6/22/62	520
Austin, Nevada	6/30/62	180
Carlin, Nevada	6/22/62	160
Eureka, Nevada	6/23/62	110
Fallini's Ranch, Nevada	11/29/61	90
Wendover, Nevada	6/29/62	90

10 other measurements between 10 and 80 $\mu\mu c/l$

26 other measurements less than 10 $\mu\mu c/l$

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TABLE V

Highest Concentrations of I-131 in Individual Samples of Milk in (a) Nevada and (b) Utah July 1962

(a) Nevada - (Based on 66 samples from 23 sources)

Location	Date	Levels (μμc/l)
Caliente, Nevada	7/19/62	6,900
Caliente, Nevada	7/23/62	3,500
Fallini's Ranch, Nevada	7/23/62	3,200
Ely, Nevada	7/24/62	2,800
Alamo, Nevada	7/17/62	2,300
Ely, Nevada	7/26/62	2,000
Caliente, Nevada	7/25/62	1,800

(b) Utah - (Based on 53 samples from 9 sources)

Location	Date	Levels (μμc/l)
Snyderville, Utah	7/20/62	9,000
Snyderville, Utah	7/20/62	5,400
Snyderville, Utah	7/25/62	4,400
Oakley, Utah	7/25/62	4,400
Oakley, Utah	7/25/62	4,200
Snyderville, Utah	7/27/62	3,000
Kamas, Utah	7/27/62	2,600
Oakley, Utah	7/27/62	2,600
Oakley, Utah	7/30/62	2,200

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TABLE VI

**Highest Concentrations of I-131 in Milk in (a) Nevada and (b) Utah
August 1962**

(a) Nevada

Location	Date	Levels (μμc/l)
Caliente, Nevada	8/ 1/62	1,000
Pioche, Nevada	8/ 8/62	1,000
Alamo, Nevada	8/ 2/62	420
Ely, Nevada	8/ 2/62	410
Lund, Nevada	8/10/62	400
Panaca, Nevada	8/ 6/62	370
Las Vegas, Nevada	8/ 1/62	260

(b) Utah

Kamas, Utah	8/ 3/62	1,500
Kamas, Utah	8/ 6/62	1,500
Oakley, Utah	8/ 3/62	1,200
Snyderville, Utah	8/ 9/62	880
Snyderville, Utah	8/ 3/62	740
Vernal, Utah	8/21/62	570
Ogden, Utah	8/ 2/62	260
Logan, Utah	8/ 1/62	130

[redacted]

[redacted]

TABLE VII

Highest Concentrations of I-131 in Milk in Nevada and Utah
September 1962

Location	Date	Levels (μμc/l)
Blue Eagle Ranch, Nevada	9/12/62	130
Blue Eagle Ranch, Nevada	9/ 6/62	90
Logan, Utah	9/ 4/62	70
Logan, Utah	9/ 6/62	60
Caliente, Nevada	9/ 6/62	60
White River Valley, Nevada	9/ 7/62	60
White River Valley, Nevada	9/13/62	60

[redacted]

TABLE VIII

Highest Gross Beta Air Activity for Off-Site Communities in Nevada

	Location	Concentration ($\mu\mu c/M^3$)	Time	Date
1.	Diablo	13,000	0905-1637	7/ 6/62
2.	Diablo	33,000	1645-2000	7/ 6/62
3.	Ely	7,300	2000-0800	7/ 6/62-7/ 7/62
4.	Peyonor Ranch	8,800	1105-0245	7/ 6/62-7/ 7/62
5.	Warm Springs	7,800	0600-1545	7/10/62-7/11/62
6.	Alamo	140,000	1445-1900	7/14/62
7.	Alamo	24,000	0630-1100	7/14/62-7/15/62
8.	Caliente	9,300	1400-1500	7/14/62-7/15/62
9.	Diablo	10,000	1000-1600	7/14/62
10.	Lund	10,000	1745-1855	7/14/62

TABLE IX

Highest Isotopic Air Results for Off-Site Communities in Nevada

Characoal Cartridges

Location	Collection Period Time	Collection Period Date	($\mu\mu c/M^3$) Midcollection or Cloud Peak Time I-131	I-133	I-135
Diablo	0905-1637	7/ 6/62-7/ 6/62	267	13,500	61,400
Ely	2000-0800	7/ 6/62-7/ 7/62	72	2,550	ND*
Penoyer	1105-0245	7/ 6/62-7/ 7/62	70	3,950	9,200
Diablo	1000-1650	4/14/62-4/15/62	55.3	762	2,800
Lockes	1315-1315	7/ 6/62-7/ 7/62	49	202	ND*

Prefilters

Location	Collection Period Time	Collection Period Date	I-131	I-133	I-135
Diablo	0905-1637	7/ 6/62-7/ 6/62	3,560	ND*	ND*
Diablo	0840-1925	6/13/62-6/13/62	190	2,700	20,000
Currant	0800-0800	4/14/62-4/15/62	400	2,100	ND*
Diablo	1000-1650	4/14/62-4/14/62	525	2,700	2,000
Caliente	1400-1500	7/14/62-7/15/62	1,100	ND*	ND*

*ND means "not detectable".

TABLE X

Gross Beta Water Results

Nevada Test Site Area

Location	Date	Levels (μμc/l)
Diablo	February 1962	51
Furnace Creek	August 1962	32
Ash Meadows	July 1962	70
Lathrop Wells	November 1961	68
Tonopah Test Range	May 1962	98

*U. S. Public Health Service Data (March 1962)

Coolidge, Kansas	74
Page, Arizona	43
Peoria, Illinois	58
Cape Girardeau, Missouri	45
Kansas City, Kansas	47

*These levels are some of those recorded for March 1962. The data presented is activity associated with dissolved solids in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. The comparison is made, therefore, between the gross beta activity found in subsurface water supplies which generally are untreated and the gross beta activity in surface water supplies associated with dissolved solids which are not removed by water treatment. They should not be interpretated as average values because levels at many other locations were much lower. (For more complete data, see "Radiological Health Data", Vol. III, No. 9, September 1962.)

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DRAFT

FALLOUT FROM ATMOSPHERIC NUCLEAR WEAPONS TEST IN PACIFIC AREA OPERATION DOMINIC

During 1962, there were 35 nuclear devices detonated in the atmosphere above the Pacific Ocean near Christmas Island and Johnston Island. The yield of these devices ranged from low kiloton to the megaton range. The height of burst for all detonations was sufficient to negate local radioactive fallout. The devices were delivered to the point of detonation by either manned aircraft or surface-to-air missiles.

In addition to the atmospheric tests, there was one underwater test, a low yield nuclear device, detonated in the Eastern Pacific Ocean several hundred miles from the closest land area and remote from any commercial fishing areas. This underwater test deposited all of the fission product radioactivity in the ocean where it decayed and was mixed and diluted by sea water.

The radiological safety program for the test series was a joint effort among the Joint Task Force Eight (JTF-8) personnel, U. S. Public Health Service personnel assigned to JTF-8 for the test and personnel from the University of Washington, Seattle, Washington, under contract to the U. S. Atomic Energy Commission.

The on-site program consisted primarily of air and background monitoring and personnel and equipment monitoring on Christmas Island and Johnston Island. The off-site program consisted of a series of cruises by the C. H. Gilbert for collecting environmental samples in the Central Pacific area and a network of 19 monitoring

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stations established on islands within a radius of 2,000 miles of Christmas Island. In the island network, four were primary stations located on populated islands, manned by officers of the U. S. Public Health Service; six were secondary stations located on more distant islands and populated mainly by JTF-8 personnel who operated the monitoring equipment; nine were background stations located on islands at a considerable distance from the test area. The equipment at the background stations consisted primarily of continuous background recording equipment operated by weather groups or scientific personnel already on the island. Figure 1 shows the location and level of effort of the stations of the network.

Environmental samples were collected routinely by JTF-8 personnel during the period of April 12-August 15, 1962. Scientific personnel aboard the C.F. Gilbert participated in this environmental sampling program on three cruises, April 24-May 12, 1962, June 4-June 25, 1962, and July 23-August 15, 1962. Approximately 8,000 samples were collected, most of which were returned to the University of Washington, Seattle, Washington, for complete analysis. Data from these examinations will not be available until after January 1, 1963.

Preliminary data from beta and gamma radiation scanning of the environmental samples were obtained from the laboratory on Christmas Island. The Hawaiian Surveillance Network (a U. S. Public Health Service activity) collected environmental samples on

[redacted]

[redacted]

the Hawaiian Islands during the entire period. Analysis of these samples was accomplished at the Public Health Laboratory, Honolulu, Hawaii.

Preoperational Samples

Radioactivity was detected in samples collected during the preoperational period. Representative findings are presented in Table I for water, milk and food samples.

Operational Samples

Samples collected during the operational period were for the most part from the sampling stations established on the various islands of the area. Tables II and III summarize findings for gross beta air activity, precipitation and drinking water. It can be seen that gross beta activity in air was low during the entire period of the operation. However, samples of precipitation gave relatively high gross beta readings which are reflected in the drinking water samples.

The levels of radioactivity in native foodstuffs during the test operational period were found to be about the same as that in preoperational samples. Samples of grass and scavola were found to contain high levels of fission product activity. The highest level of gross beta activity detected in grass was 135,000 μμc/kg for a sample obtained on July 11, 1962, at Rarotonga. Since the gross beta activities in both the grass and drinking water samples were the result of fresh fission product fallout, the activities decreased rapidly with time.

[redacted]

[redacted]

Average gamma radiation levels were taken routinely at all JTF-8 radiological safety stations. Normal background for the islands in the Central Pacific is 0.01 to 0.03 milliroentgens per hour (mr/hr). The greatest increases in gamma background were recorded on Fanning Island on May 6, 1962, on Palmyra Island on June 12, 1962, and on Washington Island on July 14, 1962, with all stations showing a rise to 0.04 mr/hr. Tabulated data indicate that there was no significant change in background in the Central Pacific area as a result of Operation Dominic.

The total radiation exposure due to fallout as recorded by film badges from Operation Dominic, was essentially zero on Christmas Island. The maximum infinity dose on both Penrhyn Island and Washington Island, as calculated by external gamma radiation measurements, was less than 10 mrem. This is below the level of detection of film badges.

Summary of Results During Test Operations

Fanning Island

No significant fallout occurred. An increase in air concentration to 20 $\mu\mu c/M^3$ occurred on May 24, 1962. Fission product activity was detected also in scavola and grass samples.[1/] The highest precipitation deposition occurred during the period of June 26-July 8, 1962. However, levels of radioactivity detected

1/ Since there are few grazing animals present on these islands, levels of contamination of grass and scavola are only indicative of some fallout.

[redacted]

in drinking water and food samples collected during and after this period were not significantly different from the levels detected in preoperational samples.

Washington Island

On May 7 and 21, 1962, fission products were detected in precipitation samples. The presence of this radioactivity was reflected also in scavola and grass samples.[1] Levels of fission products in precipitation samples indicated an increase to about 8,700 μμc/l gross beta on May 14, 1962. However, on the 15th, this activity was decreasing rapidly. Drinking water collected at this time showed 650 μμc/l gross beta activity, of which 25 μμc/l was I-131. This is far below the level at which the water would be unsafe to drink.

Palmyra Island

The highest air concentration was 58 $\mu\mu c/M^3$, observed on June 25, 1962. Other peaks of air activity were 43 $\mu\mu c/M^3$ on May 17, 1962, and 39 $\mu\mu c/M^3$ on June 21, 1962.

Penrhyn Island

On May 13, 1962, the level of I-131 detected in precipitation was 3,600 μμc/l. This was attributed to rain-out involving fresh fission products. If an adult had drunk one liter of this water

1/ Since there are few grazing animals present on these islands, levels of contamination of grass and scavola are only indicative of some fallout.

[redacted]

per day until all of the I-131 activity had decayed away, the total dose to his thyroid would have been less than one rad. However, heavy rains continued in the area for four more days with the precipitation after the first day containing essentially no additional I-131. This, of course, diluted the iodine activity found on May 13, to the point where the integrated dose to the adult's thyroid would have been less than 50 mrads. Similar calculations of dose to a child's thyroid would have resulted in higher values than for adults, but children on Penrhyn drink much less water.

Samoa Island

Except for the possibility of some fresh fission debris in grass,[1/] no fission products identifiable as resulting from Operation Dominic were detected.

Rarotonga Island

Except for the possibility of some fresh fission debris in grass[1/] and precipitation, no fission products identifiable as resulting from Operation Dominic were detected.

Nuka Hiva

On July 14, 1962, air concentration increased to 26 $\mu\mu c/M^3$ gross beta activity. No other identifiable fission products were detected during the testing period.

1/ Since there are few grazing animals present on these islands, levels of contamination of grass and scavola are only indicative of some fallout.

[redacted]

[redacted]

Johnston Island

Postoperational monitoring is in process at the time of writing this report. No fission products were identifiable as resulting from the Christmas Island portion of Operation Dominic. It is not expected that there will be more fission products at Johnston Island than at Christmas Island.[2/]

Other Islands

Traces of radioactivity were detected in air samples and in precipitation in Hawaii, on Christmas Island and Malden Island. No radioactive fallout identifiable from Operation Dominic events was detected on Canton Island, Tongatabu Island, Tahiti, Wake Island, Midway Island, French Frigate Shoals and Kwajalein Island.

Postoperational Samples

Data on the levels of radioactivity found in selected samples collected during the postoperational period are presented in Tables IV and V. The gross beta activity level in food is relatively unchanged from the level in the preoperational samples.

2/ The launching pad on Johnston Island (approximately 1000 foot radius) was contaminated by scattered fissionable material, following the destruction of a device after a missile malfunction on July 25, 1962. The levels of alpha contamination in this area exceeded the permissible limits; thus, cleanup of the area was required. Cleanup consisted of decontaminating equipment, scraping the top layer of soil of the areas which were highly contaminated and sealing the contamination on buildings with layers of concrete or paint. The decontamination was completed by mid-August.

[redacted]

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Levels of activity in samples of well water in the postoperational period were relatively unchanged from the preoperational samples. The gross beta levels of activity of grass samples in Table IV are lower than those found during the operational phase, as will be noted on the sample from Rarotonga. During the test period, the activity level found was 135,000 μμc/kg; whereas, the level in the postoperational period was reduced to 15,000 μμc/kg.

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[redacted]

TABLE I

JTF-8 Off-Site Surveillance Network, Preoperational Samples
Christmas Island - Water Samples

Type	Date	Location	Gross Beta (μμc/l)	I-131 (μμc/l)	Sr-90 (μμc/l)
Well water	4/24/62	Bamboo Waterhole	4	ND*	0.7
Well water	4/20/62	London	9	ND*	-
Well water	4/20/62	London	22	ND*	0.3
Well water	4/20/62	London	17	ND*	0.5

Christmas Island - Environmental and Food Samples

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Type	Date	Location	Gross Beta (μμc/kg) wet weight	Other Specific Isotopes; i.e. Ce-141, Ce-144, I-131, Ba-140, Cs-137, Zr-Nb-95, Zn-65, Ru-103-106
Bonefish liver	4/20/62	London Reef	-	ND*
Hermit crab	"	London	2800	ND*
Coconut milk	"	JOC	900	only trace of Cs-137
Bonefish muscle	"	London Reef	3000	"
Langusta muscle	"	London Reef	1500	"
Langusta shell	"	London Reef	-	ND*
Coconut (green)	"	London	-	ND*
Soil	"	London	-	ND*
Bonefish muscle	"	Y-Site	-	ND*
Jackfish liver	"	Y-Site	-	ND*
Jackfish muscle	"	Y-Site	4000	ND*

*ND means "not detectable".

[redacted]

[redacted]

TABLE I (cont.)

Oahu, Hawaiian Islands - Water, Milk and Food Samples

Type	Date	Location	Sr-89 (μμc/l)	I-131 (μμc/l)	Ba-140 (μμc/l)	Cs-137 (μμc/l)	Zr-95 (μμc/l)	Ru-103-1 (μμc/l)
Well water	4/10/62	Wahiawa	-	ND*	30	ND*	45	-
Well water	4/10/62	Kaneohe	-	25	ND*	ND*	10	-
Milk	4/ 5/62	Oahu	-	ND*	ND*	10	-	-
"	4/24/62	"	40	ND*	ND*	25	-	-
			-----------------	μμc/kg - wet weight	-----------------			
String beans	4/11/62	"	[illegible]	ND*	ND*	15	90	465
String beans	"	"	-	ND*	ND*	15	20	115
Pineapple	"	"	4	ND*	ND*	ND*	140	255
Green onion	"	"	-	140	ND*	ND*	270	240
Green onion	"	"	-	ND*	ND*	ND*	85	165
Sweet potato	"	"	8	ND*	ND*	15	10	115
Sweet potato	"	"	-	ND*	ND*	15	ND*	ND*
Papaya	"	"	-	ND*	ND*	25	60	140
Papaya	"	"	-	ND*	ND*	35	50	115
Banana	"	"	-	ND*	ND*	ND*	ND*	ND*
Water cress	"	"	-	15	ND*	65	135	290
Water cress	"	"	3	ND*	ND*	ND*	285	285

*ND means "not detectable".

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TABLE I (cont.)

Fanning Island - Water and Food Samples

		Gross Beta ($\mu\mu c/l$)	Gross Beta ($\mu\mu c/kg$) Wet Weight	Concentrations $\mu\mu c/kg$ wet wt. Other Isotopes
Well water	4/21/62	85	-	ND*
Coconut	4/23/62	-	3000	ND*
Papaya	4/22/62	-	2300	100 - Zr-95
Pandanas	4/22/62	-	1200	450 - Cs-137
Hermit Crab	4/21/62	-	-	trace of Cs-137 and Zn-65
Lobster Tail	4/22/62	-	6100	ND*
Bonefish	4/22/62	-	-	ND*

Washington Island - Water and Food Samples

Roof water	4/23/62	32	-	not measured
Well water	4/23/62	6	-	not measured
Breadfruit	4/22/62	-	1590	430 - Cs-137
Papaya	4/22/62	-	1580	150 - Cs-137
Pandanas	4/22/62	-	3200	220 - Cs-137
Coconut (ripe)	4/22/62	-	2710	410 - Cs-137
Coconut (grn)	4/22/62	-	180	59 - Cs-137 67 - Zr-95
Lobster	4/24/62	-	2300	190 - Zr-95 320 - Zn-65
Octopus	4/28/62	-	2900	250 - Zr-95

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American Samoa - Food Samples

Tuna muscle	4/24/62	-	2900	ND*
Tuna muscle	4/24/62	-	3000	ND*
Tuna muscle	4/24/62	-	2800	ND*

*ND means "not detectable".

[redacted]

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TABLE II

JTF-8 Off-Site Surveillance Network - Operational Samples
Gross Beta Air Activity ($\mu\mu c/M^3$)

Location	May 1-30, 1962	June 1-30, 1962	July 1-15, 1962
Christmas Island (JOC)	Avg. - 3.7 Max. - 11 (5/20)	Avg. - 4 Max. - 12 (6/9)	Avg. - 2.1 Max. - 12.5 (7/1
Christmas Island (London)	Avg. - 5.3 Max. - 17 (5/19)	Avg. - 3.5 Max. - 12.5 (6/9)	Avg. - 0.9 Max. - 1.4 (7/3
Christmas Island (A-Site)	Avg. - 4 Max. - 15 (5/18)	Avg. - 3.5 Max. - 12 (6/9)	Avg. - 0.5 Max. - 1.0 (7/3
Fanning Island	Avg. - 5.4 Max. - 20.5 (5/24)	Avg. - 4.4 Max. - 14.5 (6/3)	Avg. - 1.0 Max. - 2.7 (7/1
Washington Island	Avg. - 3.5 Max. - 13.5 (5/18)	Avg. - 2.7 Max. - 13 (6/10)	Avg. - 1.1 Max. - 4.5 (7/1
Honolulu, Hawaii	Avg. - 2 Max. - 4.4 (5/17)	Avg. - 1.9 Max. - 3.5 (6/2)	Avg. - 1.6 Max. - 3.5 (7/2
Palmyra Island	Avg. - 4.7 Max. - 43 (5/17)	Avg. - 8 Max. - 39 (6/21) Max. - 57.7 (6/25)	Avg. - 2 Max. - 7 (7/1
Malden Island	Avg. - 5.4 Max. - 19 (5/15)	Avg. - 3.9 Max. - 11.2 (6/10)	Avg. - 1 Max. - 2 (7/1
Penrhyn	No Data	Avg. - 2.4 Max. - 7 (6/28)	Avg. - 3.4 Max. - 13.5 (7/1
Canton Island	Avg. - 5.5 Max. - 19 (5/17)	Avg. - 5.5 Max. - 24.5 (6/2)	Avg. - 3.3 Max. - 6.8 (7/1
Johnston Island	No Data	Avg. - 1.4 Max. - 2.5 (6/11)	Avg. - 3 Max. - 10.5 (7/1
Wake Island	No Data	Avg. - 1.5 Max. - 3 (6/14)	Avg. - 1.1 Max. - 3.4 (7/
Midway Island	No Data	Avg. - 1.5 Max. - 3.7 (6/13)	Avg. - 1 Max. - 2.3 (7/
French Frigate Shoals	No Data	Avg. - 2 Max. - 4.6 (6/22)	Avg. - 2.1 Max. - 4.8 (7/

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TABLE II (cont.)

JTF-8 Off-Site Surveillance Network - Operational Samples
Gross Beta Air Activity ($\mu\mu c/M^3$)

Location	May 1-30, 1962	June 1-30, 1962	July 1-15, 196
Kwajelin Island	No Data	Avg. - 1.9 Max. - 4 (6/27)	Avg. - 0.9 Max. - 3.2 (7/7
Tahiti	No Data	Avg. - 0.65	Avg. - 0.9 Max. - 4.5 (7/1
Nuku Hiva	No Data	Avg. - 1 Max. - 3 (6/13)	Avg. - 2 Max. - 26 (7/1

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TABLE III

JFT-8 Off-Site Surveillance Network
Operational Precipitation Samples

Location	Date	Gross Beta (μμc/l)	Iodine-131 (μμc/l)
Honolulu, Hawaii	4/26/62	410	--
" "	5/21/62	1,400	--
Kaneohe, Hawaii	7/ 5/62	700	--
Christmas Island	5/ 9/62	5,100	--
" "	6/ 1/62	670	ND*
" "	7/19/62	800	40
(JOC)			
Christmas Island (London)	6/11/62	920	25
Christmas Island (A-Site)	6/ 1/62	580	ND*
Fanning Island	5/ 7/62	1,200	--
" "	5/21/62	2,000	19
" "	7/ 8/62	14,000	ND*
Washington Island	5/ 7/62	3,700	ND*
" "	5/21/62	1,200	90
" "	7/14/62	8,700	37
" "	7/15/62	4,900	113
Malden Island	6/ 9/62	550	51
Penrhyn Island	5/13/62	257,000	3,600
Canton Island	5/31/62	310	ND*
Nuka Hiva	6/16/62	25	ND*
Tahiti	6/30/62	69	31
Viti Levu	7/20/62	420	ND*
Samoa	6/30/62	2,900	ND*
Tongatabu	7/13/62	103	ND*
Roratonga	6/30/62	6,700	ND*

Operational Drinking Water Samples

Location	Type	Date	Gross Beta (μμc/l)	I-131 (μμc/l)	Sr-90 (μμc/l)
Christmas Island	well	4/28/62	150	--	--
" "	"	6/24/62	16	23	--
Penrhyn Island	cistern	6/ 8/62	330	18	--
" "	"	6/ 9/62	470	20	0.4
Tongatabu Island	"	7/13/62	103	ND*	--
Rarotonga	"	7/11/62	128	ND*	--

*ND means "not detectable".

[redacted]

[redacted]

TABLE IV

JTF-8 Off-Site Surveillance Network
Postoperational, Environmental and Food Samples by Island

Location	Type	Date	Radionuclide Concentration µµc/kg of wet weight						
			Gross Beta	Ce-141,144*	I-131	Ba-140	Cs-137	ZrNb-95	Ru-103,106*
Christmas Island	Scavola	7/16/62	4,300	3,600	nd	5,200	nd	-	-
Christmas Island	Ripe Coconut	7/16/62	4,300	nd	nd	nd	nd	nd	nd
Christmas Island	Green Coconut	7/16/62	1,800	nd	nd	nd	nd	nd	nd
Christmas Island	Soil	7/16/62	nd	2,100	nd	nd	nd	2,600	400
Hawaii (Oahu)	Pineapple	7/31/62	nd	-	nd	nd	110	30	nd
Hawaii (Kauai)	Lettuce	7/31/62	820	-	nd	nd	nd	Trace	nd
Hawaii (Oahu)	Lettuce	7/31/62	Incomp	-	-	-	-	-	-
Hawaii (Oahu)	Milk	7/31/62	-	-	nd	nd	35	-	-
Fanning Island	Scavola	7/13/62	27,800	8,600	500	3,400	nd	8,000	1,100*
Fanning Island	Coconut	7/13/62	1,800	nd	nd	nd	230	nd	nd
Fanning Island	Coconut Milk	7/13/62	789	nd	nd	nd	nd	nd	nd
Fanning Island	Soil	7/13/62	-	1,400	nd	nd	nd	2,250	2,500
Washington Island	Ripe Coconut	7/13/62	1,800	Trace	nd	nd	280	nd	nd
Washington Island	Green Coconut	7/13/62	1,100	Trace	nd	nd	110	nd	nd
Washington Island	Scavola	7/15/62	11,000	8,500*	900	4,000	nd	6,000	1,200*
Washington Island	Soil	7/15/62	6,500	1,400	nd	870	nd	1,350	580
Washington Island	Eggs	7/15/62	980	nd	nd	nd	nd	nd	nd
Penrhyn Island	Soil	7/19/62	1,800	11,850	nd	nd	nd	3,810	480
Viti Levu, Fiji	Soil	7/25/62	nd	nd	nd	nd	Trace	340	nd
Viti Levu, Fiji	Grass	7/25/62	30,000	6,300*	nd	2,400	nd	16,000	4,900

*If Ru and Ce activities are marked with an asterisk (*), the activity reported is assumed to be from the shorter lived isotopes Ru-103 and Ce-141. Otherwise the activity is assumed to be due to the longer lived isotopes Ru-106 and Ce-144.

Trace - Insufficient to quantitate.

nd - No detectable activity.

Incomp - Analysis in process, results to follow.

[redacted]

[redacted]

TABLE IV (cont.)

JTF-8 Off-Site Surveillance Network
Postoperational, Environmental and Food Samples by Island

Location	Type	Date	Radionuclide Concentration μμc/kg of wet weight						
			Gross Beta	Ce-141,144*	I-131	Ba-140	Cs-137	ZrNb-95	Ru-103,106*
Tutuila, Samoa	Soil	7/21/62	nd	nd	nd	nd	nd	650	2,100
Tutuila, Samoa	Grass	7/31/62	35,000	19,000*	nd	9,000	nd	47,000	7,500*
Tongatubu	Soil	7/24/62	nd	nd	nd	nd	Trace	Trace	nd
Tongatubu	Grass	7/24/62	7,500	2,600	nd	1,000	nd	24,000	1,000*
Tongatubu	Milk	7/24/62	-	nd	10	42	20	190	nd
Rarotonga	Soil	7/21/62	nd	55	nd	nd	nd	72	23
Rarotonga	Grass	7/21/62	15,000	nd	nd	Trace	nd	25,000	2,000
Canton Island	Soil	7/20/62	-	600	nd	nd	nd	1,100	580

*If Ru and Ce activities are marked with an asterisk (*), the activity reported is assumed to be from the shorter lived isotopes Ru-103 and Ce-141. Otherwise the activity is assumed to be due to the longer lived isotopes Ru-106 and Ce-144.
Trace - Insufficient to quantitate.
nd - No detectable activity.

[redacted]

[redacted]

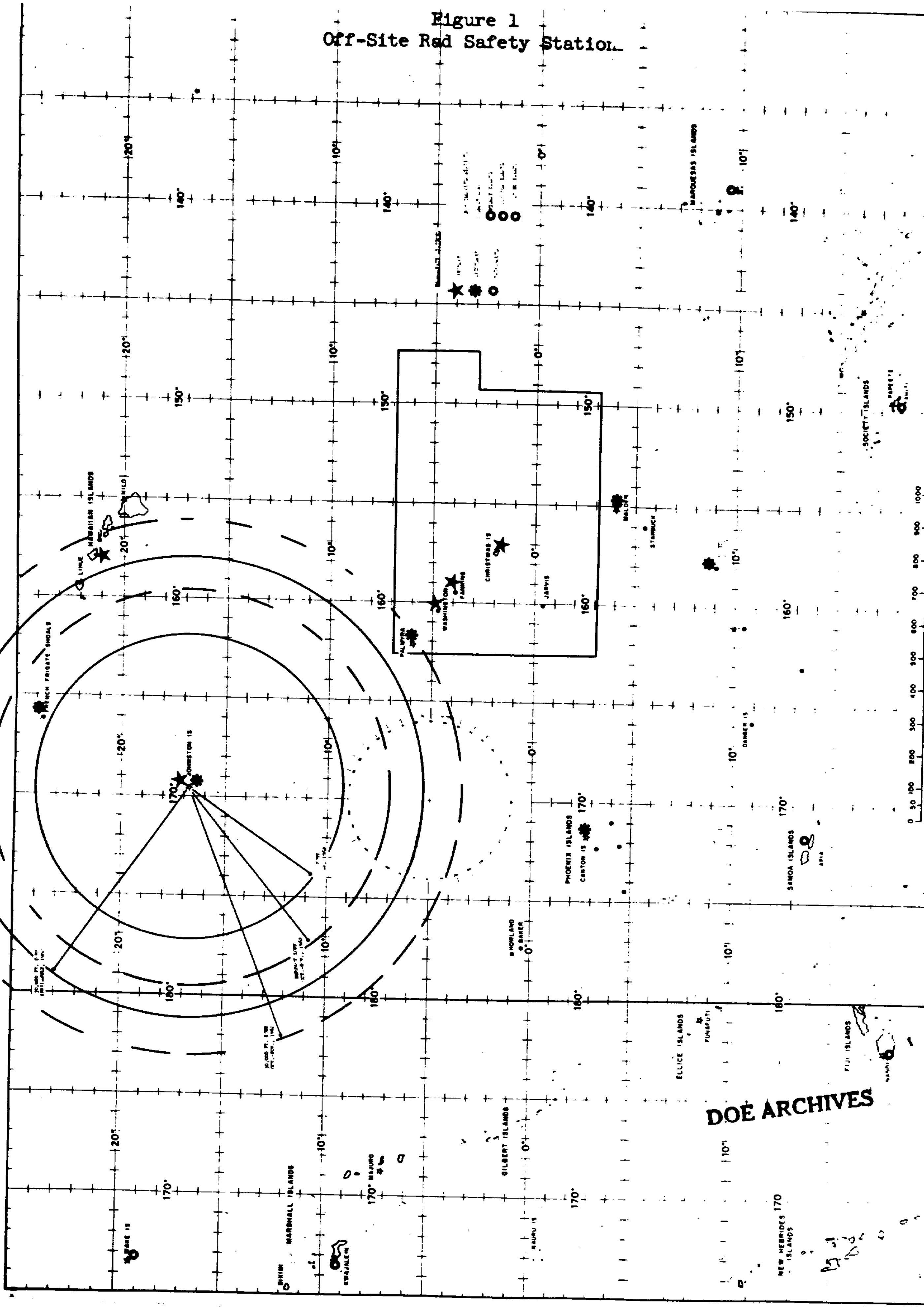
TABLE V

JTF-8 Off-Site Surveillance Network
Postoperational Water Samples by Island

Location	Type	Date	(μμc/l) Gross Beta
Christmas (Bamboo)	Well	7/15/62	10
Christmas (Decca)	Well	7/15/62	10
Christmas (Banana)	Well	7/15/62	20
Oahu (Wahiawa)	City	7/31/62	13
Oahu (Kaimuki)	City	7/31/62	10
Oahu (Honolulu West)	City	7/31/62	10
Oahu (Kaneohe)	City	7/31/62	10
Fanning Island	Well	7/11/62	10
Washington Island	Well	7/13/62	35
Washington Island	Cistern	7/15/62	650
Penrhyn Island	Cistern	7/19/62	320
Canton Island	Cistern	7/20/62	23
Tutuila Samoa	City	7/21/62	10
Tongatabu	Cistern	7/24/62	20
Rarotonga	Cita	7/22/62	10

[redacted]

Figure 1
Off-Site Rad Safety Station



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DRAFT

RADIOACTIVITY RELEASED BY UNDERGROUND EXPERIMENT NEAR CARLSBAD, NEW MEXICO

The first nuclear detonation in the Commission's Plowshare program to develop peaceful uses for nuclear explosives was Project Gnome, a multipurpose experiment in a salt bed 25 miles southeast of Carlsbad, New Mexico. The nuclear device, with a yield of about three kilotons, was detonated at 12:00 noon, MST, on December 10, 1961, 1,200 feet underground.

The detonation raised a small cloud of dust from the surface. Shortly, thereafter, a white vapor was seen issuing from the mouth of the 1,200 foot vertical shaft. This vapor, holding close to the ground, was blown north-northwest, to the east of the city of Carlsbad. There was no evidence of venting in the vicinity of surface ground zero.

Monitoring results demonstrated that the cloud was largely gaseous in nature. Although every effort had been made to minimize the deposition of radioactivity in any inhabited off-site area, small amounts of short-lived radioactivity were deposited in the path of the cloud for the first ten miles or so.

The following is a summary of the data obtained by the U. S. Public Health Service Off-Site Radiological Safety Organization of the Office of Field Operations, now the Nevada Operations Office, AEC, in the vicinity of the test site.

[redacted]

External Gamma Exposure

Monitors conducted a film badge program to give an account of accumulated radiation doses off-site. Three hundred and thirty film badges were placed on individuals and structures within a one hundred mile radius of the test site. These badges were left out for about 30 days. Six badges recorded radiation exposure. The highest film badge exposures were from Hudson Farm. A badge located outside recorded 165 mr, while a badge worn by a person at the farm recorded 140 mr. Film badges placed on two houses on the east and north sides of Illinois Camp recorded 80 mr and 50 mr respectively. The occupant of the second wore a film badge that recorded 40 mr. These doses measured by film badges have not been corrected for natural background radiation exposure, which is approximately 0.5 mr/day.

Milk

Milk samples were collected from eight producer dairies in the vicinity of the Gnome site. Results indicate that no increase of radioactivity was detected in the milk supplies from the Gnome event.

Mine Surveys

Eight mines located within a 30 mile radius from the Gnome site were monitored for external beta-gamma levels before and after the shot event. The two sets of readings remained the same within the tolerance of the instruments used.

[redacted]

Air Sampling

Of the 20 air samplers in operation, only a few filters showed any appreciable increase of gross beta activity, with the highest reading 160 $\mu\mu c/M^3$ for a 16 3/4 hour sampling period. The highest iodine concentrations found in air were 1.7 $\mu\mu c/M^3$ of I-13 and 18 $\mu\mu c/M^3$ of I-133 on December 11, 1961, and 3.5 $\mu\mu c/M^3$ of I-135 on December 10, 1961. All of the above were well below permissible levels for the general population.

Water Sampling

Fourteen water sampling points were selected in the vicinity of the Gnome event. No significant difference was found between the post-test and the pre-test water samples collected and analyze for radioactive content.

Animal Sampling

Five cattle were slaughtered prior to the Gnome event and five more about a month after the detonation, for radiochemical analysis of their body tissues and organs. All the radioactive concentrations were found to be comparable for pre and post-shot samples.

DOE

Surface Contamination

Although the radioactivity released following this test was largely gaseous in form, there was some particulate fallout in the local area. Some vehicles passing along Highways 31 and 128 (about nine miles from ground zero) were contaminated, with the

[redacted]

highest readings being about 200 milliroentgens per hour around the radiator and 150 milliroentgens per hour around the tires at about one hour after shot time. The highest reading inside of the cars was 15 milliroentgens per hour. Seven cars were washed with the results that the highest reading was 15 milliroentgens per hour around the radiator and eventually background inside the car. Two individuals were found to have slight amounts of contamination (one on the hand and one in the hair), i.e., less than 1 milliroentgen per hour (beta plus gamma). This contamination was removed by washing.