APPENDIX II

DOCUMENTS EXAMINED

Appendices to the Committee Report

I. Preliminary Anthropologist's Report - Bikini Atoll Survey - 1967. Jack A. Tobin

II. Documents Examined

III. Members of Survey Team

IV. Figure 1. Bikini Atoll - Map

V. Brief Summary of the Radiological Status of the Bikini Atoll. Philip F. Gustafson

Additional Documents Examined

1. Letter of December 7, 1966, from Hon. Stewart L. Udall, Secretary of the Interior to Hon. Glenn T. Seaborg, Chairman, AEC, with paragraph deleted.

2. Letter of April 8, 1968, John R. Totter to members of the ad hoc committee of consultants.

3. Letter of April 8, 1968, John R. Totter to members of the survey team and associates.

4. Report entitled MEETING TO DISCUSS RETURN OF THE NATIVES TO THE BIKINI ATOLL, prepared by John R. Totter, DBM, Philip F. Gustafson, DBM, and Roy D. Maxwell, OS.

5. RADIOLOGICAL REPORT ON BIKINI ATOLL, April, 1968. Prepared by Philip F. Gustafson, DBM

6. ADDITIONS TO RADIOLOGICAL REPORT ON BIKINI ATOLL, May, 1968. Philip F. Gustafson, DBM

7. 1967 BIKINI RADIOLOGICAL RESURVEY--MARSHALLS. AGRICULTURE REPORT, by James T. Hiyane, District Agriculturist, Trust Territory.

8. EXTERNAL RADIATION LEVELS ON BIKINI ATOLL--May, 1967. HASL-190. December, 1967. Prepared by Harold L. Beck and Burton G. Bennett, Health and Safety Laboratory and Tommy F. McCraw, AEC/OS.

9. Letter of January 8, 1968, from Edward E. Held, with attached tables, to John N. Wolfe.

10. Letter of December 11, 1967, from Edward E. Held, with attached tables, to Edward P. Hardy, Jr.

11. Letter of December 26, 1967, from Edward E. Held to Edward P. Hardy, Jr.

12. Figure: Body Burden Gamma Emitters--Rongelap exposed group. Submitted by Robert A. Conard, Brookhaven National Laboratory.

13. Figure: Estimated Body Burdens ^{90}Sr--Rongelapese. Submitted by Robert A. Conard.

14. Table: Estimated Peak Dose Per Year--Rongelap People. Submitted by Robert A. Conard.

15. Table: Comparison of Rongelap and Bikini Food. Submitted by Robert A. Conard.

16. Table: Age Distribution of Bikinians--October, 1967.

17. THE BIKINI STORY IN BRIEF. By Leonard Mason, University of Hawaii.

APPENDIX III

MEMBERS OF SURVEY TEAM

Edward Held, University of Washington

Harold Beck, Health and Safety Laboratory

Burton Bennett, Health and Safety Laboratory

Arnold Joseph, Marine Sciences Council

Jack Tobin, Trust Territory

James Hiyane, Trust Territory
(not present at meeting)

Tommy McCraw, AEC/OS

Francis Tomnovec, U. S. Naval Radiological Defense Laboratory (not present at meeting)

ASSOCIATES OF SURVEY TEAM

Philip Gustafson, AEC/BM

Joseph Rivera, Health and Safety Laboratory

APPENDIX IV

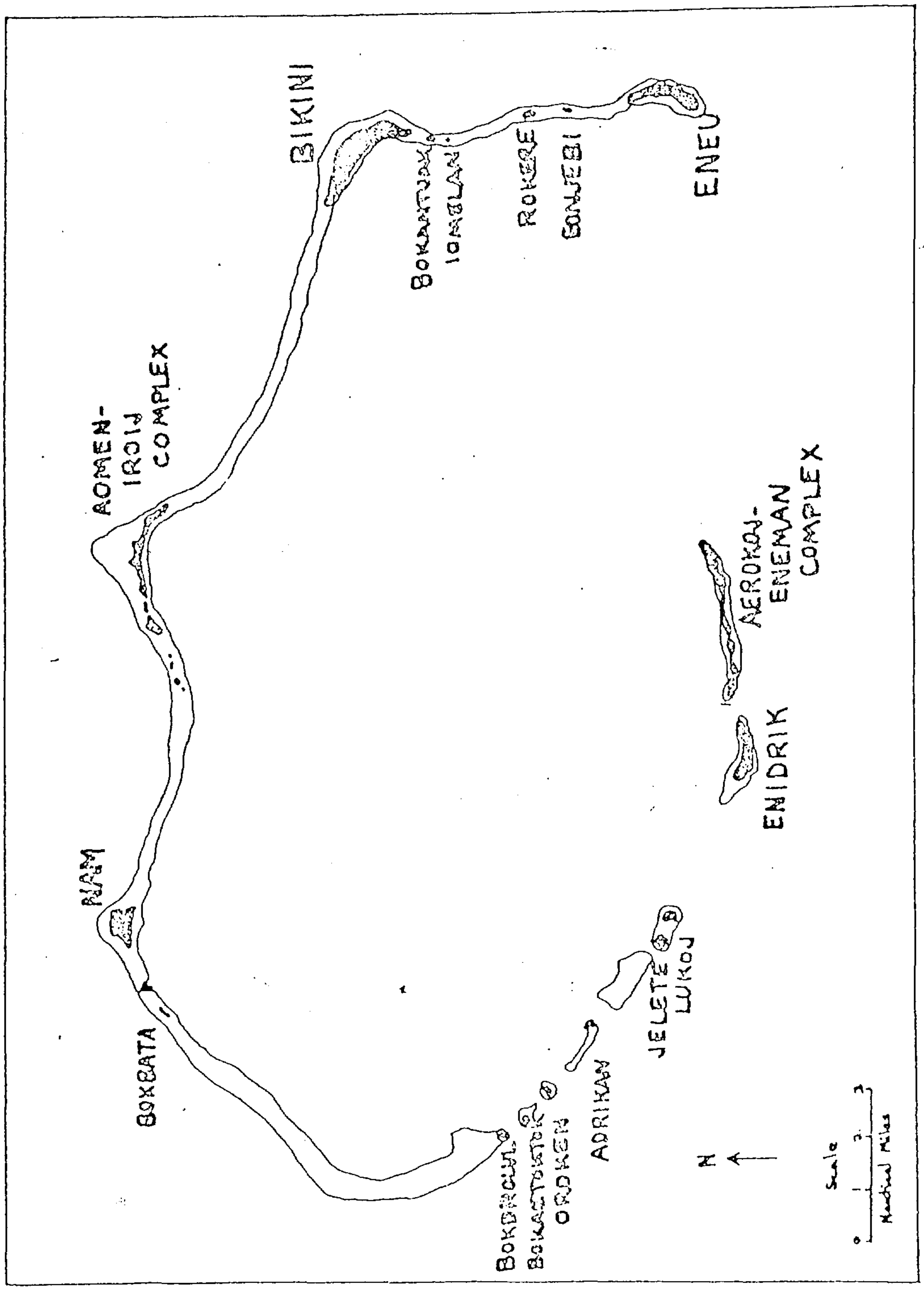

Figure 1. Bikini Atoll

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APPENDIX V

Brief Summary of the Radiological Status of the Bikini Atoll

Philip F. Gustafson
Fallout Studies Branch
Division of Biology and Medicine
May 1968

A number of radiological surveys of Bikini Atoll have been made since 1946. The most recent survey was conducted in April and May 1967. The main effort was devoted to the measurement of ambient radiation levels using several types of detectors. The external radiation field was mapped in considerable detail on Bikini and Eneu Islands, and less thoroughly on the remainder of the atoll. The various radionuclides and their concentrations which gave rise to the observed radiation field were determined from field gamma-ray spectrometry. Representative samples of local plants and animals which might be eaten by the returning natives were collected and have been analyzed for radioactivity.

The results of the 1967 survey provide a basis for making reasonable estimates of the total (external plus internal) radiation exposure which the Bikinians might receive over the coming years, if they return to the atoll. Background radiation on the atoll is due almost exclusively to cosmic radiation, and there are only trace amounts of the naturally occurring radioelements in the area. Except in the immediate vicinity of nuclear detonations, the composition of the residual gamma-ray radioactivity was similar throughout the atoll, consisting of about 70% ^{137}Cs, 20% ^{60}Co, and 10% ^{125}Sb. Variations in intensity were observed from place to place; Eneu was the least contaminated, followed by Bikini Island itself. A dose gradient existed across Bikini, with lowest levels on the beach areas, and highest values in the heavily overgrown interior.

The external dose received by the returned Bikinians will depend upon where various people are located, and for what periods of time, within the island complex. Location in turn depends upon whether they are men, women, or children. The returnees (see Age Distribution table) will probably consist of about equal numbers of men and women. The amount of time likely to be spent in the four radiation domains (village area, beach, interior, and lagoon) by the various groups within the population are shown in Table 1. Probably the most time will be spent in the village area, where the dose rate is intermediate between beach and interior levels. The dose rate may be reduced one half by covering the ground with an inch of clean sand or soil. This in essence will be done in the village area through the custom of covering the dirt floor and the yard with several inches of polished coral pebbles. The expected integral dose to the population over various time intervals starting in 1970 is shown in Table 2.

The actual internal dose derived from eating native foods is somewhat more difficult to assess. However, three points should be borne in mind. (1) As in the past, the natives will doubtless take much of their sustenance from the lagoon and ocean. (2) Edible land plants will be severely limited, at least at first, due to the sparcity of fruit-bearing coconut, pandanus, etc. (3) The Bikinians have become accustomed to eating new foods, and will probably continue to eat such things as rice, flour, canned meat, and powdered milk. The only radionuclides of biological importance found in foodstuffs collected at Bikini were ^{90}Sr, ^{137}Cs and ^{55}Fe. Other nuclear species were either lacking or present in very low concentration. A notion of the possible daily intake of the above three radionuclides may be obtained by taking the diet eaten by the Rongelapese as a guide, and using the observed concentrations of radioactivity in the same food items collected on Bikini. The resultant daily intakes are shown in Table 3, and are compared with the daily intakes which will lead to acceptable body burdens for individuals and a suitable sample of the population. Special procedures which will greatly reduce the ^{90}Sr content of the fruit can be undertaken at planting when edible pandanus is re-introduced to the Atoll. Edible fruit would be available about five years after planting. The fact that edible pandanus fruit will not be available for several years removes what might have been the major source of ^{90}Sr intake and materially reduces the ^{137}Cs intake as well. Removal also of land crab meat from the diet seems advisable, and such restrictions bring the ^{90}Sr intake down to 115 pCi/day or 270 pCi/g Ca. The corresponding ^{137}Cs intake is 2290 pCi/day.

Doses to the whole body from ^{137}Cs and ^{55}Fe were calculated assuming that the reduction of radioactivity in the diet occurs only from radioactive decay. Doses to bone from ^{90}Sr were also computed. Because of marked differences in metabolism, adults and children were considered separately for internal dose purposes. The total doses to whole body and to bone for children and adults from internal and external radiation over 5-, 30- and 70-year intervals starting in 1970 are indicated in Table 4. The doses acceptable for individuals and for a suitable sample of the population during the same time intervals are also indicated.

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The estimated ^{90}Sr dose to bone is maximal because additions of calcium to the diet could readily reduce ^{90}Sr uptake.

It appears unlikely that, with moderate restrictions on living and eating habits, the dose to the whole body or to bone will reach 2 rads in 5 years, 10 rads in 30 years or 16 rads in 70 years.

TABLE 1

Population and Time Breakdowns

Population	Breakdown (%)	Estimated Time Breakdown (%)			
		Village	Beach	Interior	Lagoon
Children (0-15 yrs)	50	70	20	10	--
Women	25	65	15	20	--
Men	25	60	10	20	10

TABLE 2

Integral External Doses Starting in 1970

Time Interval (years)	Integral Dose (mrads)
5	752
10	1391
20	2455
30	3332
50	4711
70	5743

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TABLE 3

Estimated Daily Intake of ^{90}Sr, ^{137}Cs, and ^{55}Fe from Bikini Foods, (pCi/day)

Food Item	Weight consumed per day (g)	^{90}Sr	^{137}Cs	^{55}Fe
Fish	554	105	178	55,400
Birds	41	5.3	1,080	4,100
Arrowroot*	41	--	--	--
Coconut	9	1.7	1,030	--
Clams	45	1.8	1.0	--
Imports	32	.5	1.0	--
Total**	782****	115	2,290	59,500
*** Acceptable intake for suitable sample		600 pCi/g Ca	7,000	87,000
*** Acceptable intake for individuals		1,800 pCi/g Ca	21,000	200,000

* ^{90}Sr and ^{137}Cs are removed in the processing of arrowroot to make flour

** This diet contains 0.42 g calcium per day

*** Calculated in the following way:

$$\text{Daily intake} = \frac{\text{MPL}}{1.44 \times T_{1/2}\ \text{(biological)}}$$

where the value of the MPL for individuals is 1/10, and for suitable sample is 1/30 of the value for radiation workers

****Other foodstuffs, (free from radioisotopic contamination) necessarily will supplement this diet.

TABLE 4

Summary of Radiation Exposure (rads)

Years	Bone (^{90}Sr)*	Internal Whole body (^{137}Cs & ^{55}Fe)	External Whole Body	Total: Whole Body	Total: Bone	Reference Values**: At .17 rad/year	Reference Values**: At .5 rad/year
Adults							
5	.09	.68	.75	1.43	1.52	.85	2.5
30	1.37	2.68	3.33	6.01	7.38	5.1	15.0
70	3.10	4.20	5.74	9.94	13.04	11.9	35.0
Children							
5	.98	.41	.75	1.16	2.14	.85	2.5
30	4.06	1.99	3.33	5.32	9.38	5.1	15.0
70	6.16	4.00	5.74	9.74	15.90	11.9	35.0

* Initial ^{90}Sr intake of 115 pCi/day or 270 pCi/g Ca by both children and adults.

** Acceptable exposure for individuals is .5rad/year. Acceptable exposure for suitable sample of the population is .17rad/year.