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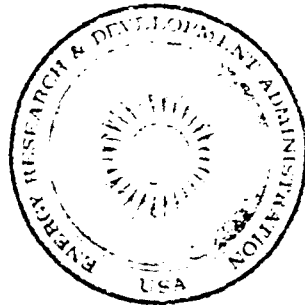
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# PLANNING AND OPERATIONS DIRECTIVE 1975 BIKINI RADIOLOGICAL SURVEY



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JUNE 1975



UNITED STATES  
 ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION  
 NEVADA OPERATIONS OFFICE  
 LAS VEGAS, NEVADA

U. S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION  
LAS VEGAS, NEVADA

PLANNING AND OPERATIONS DIRECTIVE  
(NVO - 158)

PROJECT: 1975 Bikini Atoll Radiological Survey

SPONSOR: U. S. Energy Research and Development  
Administration

TECHNICAL AGENCIES: LLL, EPA, University of Washington  
Brookhaven National Laboratory

Signed:

*M. E. Gates*  
Mahlon E. Gates, Manager

Date:

*12 June 1975*

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APPENDIX

TITLE

A.

DELEGATION OF AUTHORITY

B.

SURVEY LOCATION

C.

TECHNICAL PLAN

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PLANNING AND OPERATIONS DIRECTIVE

(NVO - 158)

1975 BIKINI ATOLL RADIOLOGICAL SURVEY

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## PLANNING AND OPERATIONS DIRECTIVE

(NVO - 158)

### I. BACKGROUND

The Bikini Atoll was extensively used during the 1950's for atmospheric nuclear testing, necessitating displacement of the Bikinians. The rehabilitation of Bikini Atoll and the resettlement of people on Bikini and Enyu Islands has been approved and the project is underway with approximately 80 people now residing on these two islands.

The need for a more comprehensive survey of Bikini Atoll was recognized in October, 1974, following a visit to the Marshall Islands by Defense Nuclear Agency, Department of Interior and ERDA representatives. ERDA became committed to the early accomplishment of this survey in a meeting with Trust Territory representatives in Anaheim, California, in January, 1975.

### II. PURPOSE

The purpose of the 1975 Bikini Atoll Radiological Survey is to conduct a Gamma Survey which will supplement Brookhaven National Laboratory data and provide information for advising the Department of the Interior on the location of Phase II homes and to conduct a soil, plant and water sampling program. This planning and operations directive provides guidance and defines responsibilities for the conduct of this survey.

### III. AUTHORITY

Authorization and guidance for the Bikini Atoll Radiological Survey was furnished NV per teletype from ERDA/HQ dated May 19, 1975, attached as Appendix A.

### IV. CONCEPT OF OPERATIONS

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The 1975 Bikini Atoll Radiological Survey will include sampling of biota, soil and ground water on Bikini and Enyu Islands (see Appendix B). Specifically, soil profile and surface samples will be taken around existing structures, proposed housing sites and in agricultural areas. Skimming wells will be dug to take soil samples at various depths and to collect water samples.

IV. CONCEPT OF OPERATIONS (Cont'd)

Initial deployment of equipment and personnel will be via commercial aircraft and military aircraft from various CONUS points to Kwajalein. Personnel and cargo will assemble at Kwajalein and continue to Bikini via Kwajalein Missile Range (KMR) C-54 and the Marshall Islands Research Vessel (Liktanur). Upon completion of the survey, personnel will return to Kwajalein via KMR C-54 chartered aircraft. Sample shipments will be handled by military aircraft. The field survey itself will be followed by analysis of samples by McClellan Laboratory and Lawrence Livermore Laboratory.

V. ORGANIZATION

Management of all survey operations will be the responsibility of the NV Field Survey Leader. The Technical Director (LLL) will advise and support the NV Field Survey Leader and has full authority and responsibility for the technical plan (see Appendix C).

The survey party is expected to include representatives of:

- A. Division of Operational Safety (DOS), ERDA/HQ
- B. Office of the Assistant Manager for Operations (AMO), NV
- C. Lawrence Livermore Laboratory (LLL)
- D. Environmental Protection Agency (EPA)
- E. Brookhaven National Laboratory (BNL)
- F. University of Washington

\* VI. RESPONSIBILITIES

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A. Department of Interior (DOI)

- 1. Grants authority for the conduct of the 1975 Bikini Atoll Radiological Survey to the Division of Operational Safety (DOS) ERDA/HQ.

VI. RESPONSIBILITIES (Cont'd)

2. Assures that the Trust Territory and Marshall Islands Administrations and other appropriate agencies or organizations are aware of the responsibilities and guidelines of the survey.

B. Division of Operational Safety, ERDA/HQ

The Division of Operational Safety, ERDA/HQ, is responsible for coordination with the Department of Interior and all other Washington level agencies and officials.

DOS will also be responsible for program guidance, evaluation of survey data and the assessment of impact concerning plans for further resettlement of Bikini Atoll.

C. Nevada Operations Office

1. Assistant Manager for Operations, NV

- a. Is responsible to the Manager, NV, for successful accomplishment of the objectives of survey and preparation of required survey reports.
- b. Is responsible for liaison with Trust Territory and Marshall Islands officials and with other concerned field agencies.
- c. Assures the appropriate technical and logistic support for the conduct of the terrestrial survey.
- d. Will select laboratories to accomplish the laboratory analysis work.
- e. Assures that the appropriate survey reports are developed and submitted to ERDA/HQ as required.

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2. Assistant Manager for Plans, Engineering and Budget, NV

Will assist the AMO as required in matters of field support and survey funding.



D. Technical Director

The Technical Director will be responsible to the AMO, NV, for the following:

1. Preparation of a detailed technical plan.
2. Direction of the technical effort in the field.
3. Preparation of the final survey report.

E. Lawrence Livermore Laboratory (LLL)

LLL will be responsible to the AMO, NV, for the following:

1. Furnishing a Technical Director.
2. Supporting sample collection and laboratory analysis required for dose assessment, pathway assessment and lens water studies.

F. Environmental Protection Agency (EPA)

EPA, NERC/LV will participate in the conduct of this survey by assisting the Technical Director in radiation measurement, and soil sampling programs.

G. University of Washington

U of W will assist in sample collection, analysis and dose assessment as requested.

H. Brookhaven National Laboratory (BNL)

BNL will assist in sample collection, analysis and dose assessment as requested.

I. EG&G, INC.

EG&G will provide aerial photographic mapping of Bikini and Enyu Islands to facilitate position location in the ground survey (photographic mission completed May 23, 1975).

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VII. SCHEDULE

The schedule for the 1975 Bikini Atoll Radiological Survey is:

- |      |       |   |
|------|-------|---|
| June | 11    | All survey personnel and cargo on location at Kwajalein.            |
|      | 12    | Personnel and cargo prepare for departure.                          |
|      | 15    | 0800 LCU departs Kwajalein for Bikini.                              |
|      | 16    | LCU arrives Bikini; personnel depart Kwajalein for Bikini via C-54. |
|      | 16-26 | Survey conducted.   |
|      | 26    | Personnel depart Bikini via C-54; LCU depart Bikini for Roi Namur.  |
|      | 27    | Personnel depart for Honolulu.                                      |

VIII. FUNDING

Funding for this survey is the responsibility of each participant organization.

IX. REPORTS

Survey reports from field personnel will be submitted to the Technical Director in a timely fashion.

The final survey report will be published by NV and submitted to DOS, ERDA/HQ for evaluation.

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THIS CONFIRMS JOE DEAL'S MAY 16 TELECON WITH ROGER RAY ABOUT THE BIKINI SURVEY, AS FOLLOWS:

1. NVO CAN PROCEED WITH AN ALTERNATE SURVEY WHICH DOES NOT DEPEND UPON DOD SUPPORT.
2. FIRST PRIORITY IS TO CONDUCT A GAMMA SURVEY WITH HAND-HELD INSTRUMENTS WHICH WILL SUPPLEMENT BNL DATA AND PROVIDE INFORMATION FOR ADVISING DOI ON THE LOCATION FOR PHASE II HOMES.
3. SECOND PRIORITY WILL BE GIVEN TO LIMITED EFFORT FOR COLLECTING SOIL, PLANTS, AND WATER SAMPLES.
4. THE ERDA LCU WILL BE USED TO SUPPORT THE SURVEY TEAM OF ABOUT 15 PEOPLE FOR 10 TO 12 DAYS, BEGINNING AROUND JUNE 12-15.
5. A SEPARATE MESSAGE WILL BE SENT TO LLL REQUESTING THEIR PARTICIPATION.

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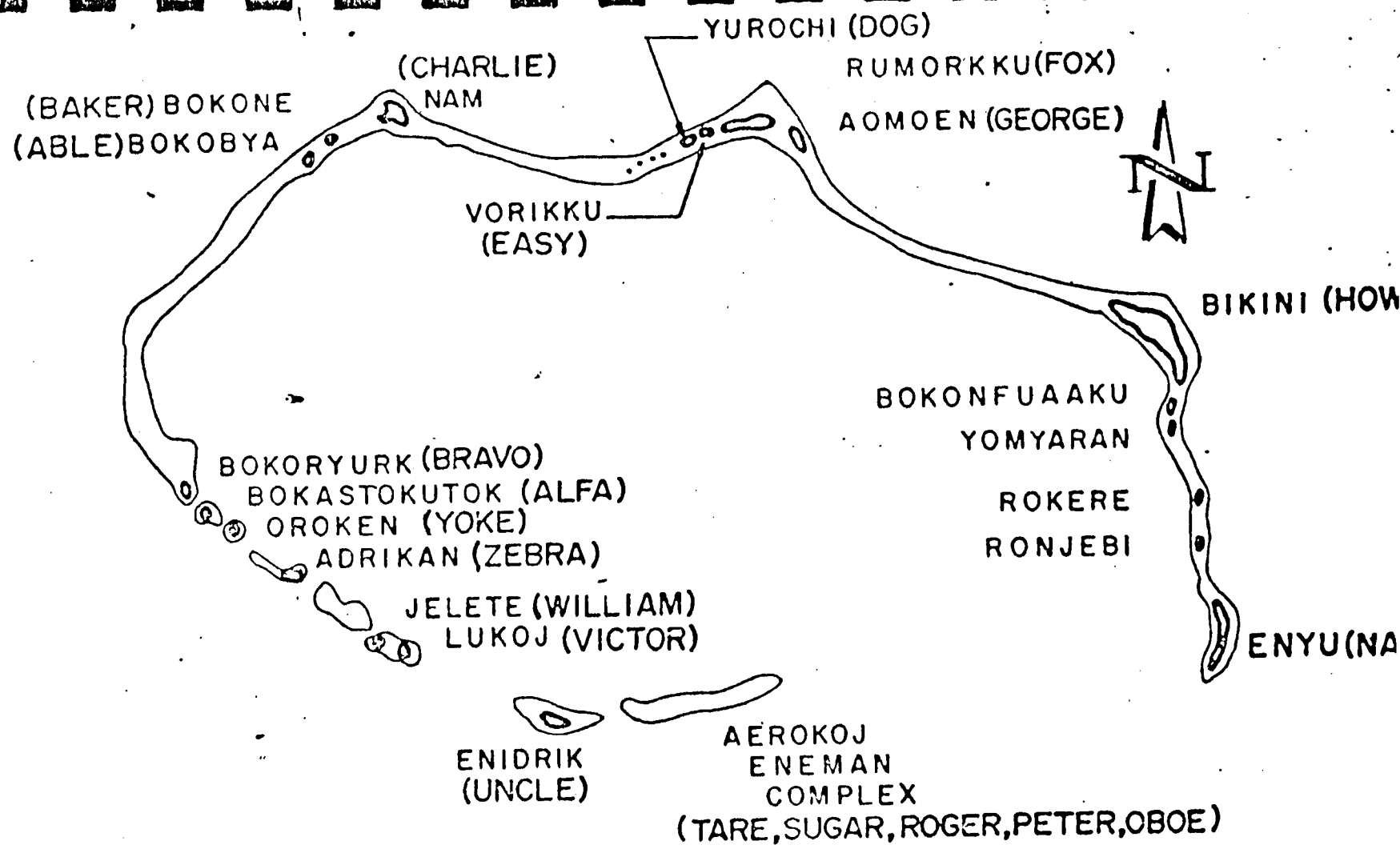
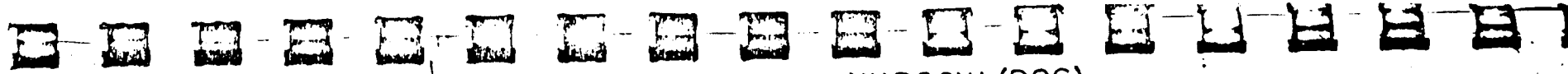
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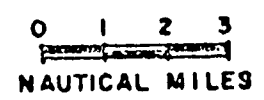
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**BIKINI ATOLL**



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Table 1. Number of soil sample locations on each island (continued).

	<u>No. of Sample Locations</u>	
	<u>Surface (0-15 cm)</u>	<u>Profiles (0-90 cm)</u>
<u>Eneu</u>		
North of airstrip	60	2
South of airstrip	40	2
TOTAL	350	12 (6 samples each)

The exact soil sampling locations will actually be determined by a random selection process to obtain statistically meaningful and unbiased results. Special samples will also be collected within "hot spot" areas or other areas of specialized interest. The samples will be placed in plastic bags with appropriate identification tags and readied for shipment to LLL, where they will undergo preprocessing and gamma-spectral analysis. It is anticipated that analyses for other radionuclides of interest, such as plutonium-239 and strontium-90, will be performed at a contractor laboratory.

Purpose: Gamma-Exposure Rate Survey

The gamma-ray exposure measurements program conducted on the ground is designed to provide detailed examination of the geographical variability of the exposure rates on Bikini and Eneu Islands, and to provide overall verification of exposure rate measurements made during previous visits.

Methods and Measurements

The program utilizes the Baird-Atomic scintillation detector which consists of a 2.5-cm-diam x 3.9-cm-long NaI crystal with ratemeter readout. The instrument is calibrated with a <sup>137</sup>Cs point source on the primary calibration range of the National Environmental Research Center, Las Vegas, Nevada. While the response of this instrument is energy-dependent, our experience at Enewetak showed that this was not a serious limitation because of the dominance of <sup>137</sup>Cs in the radiation background on the Atoll. We will also utilize the Reuter-Stokes high pressure ionization chamber. The current produced by the radiation induced ionization within the chamber is measured by a sensitive electrometer with digital readout. The instrument exhibits a flat energy response over all gamma-ray energies of interest to this survey. It is capable of measuring exposure rates from about 1 µR/hr to 200 µR/hr with an accuracy of about 5%. Thus, the results derived from this instrument may be chosen as a reference to which measurements obtained by other techniques can be compared.

## 1975 BIKINI SURVEY PROGRAM

### Bikini Soil and Gamma Exposure Rate Survey Program

#### Purpose: Soil Survey

The soil sampling program is designed to identify the primary radionuclides contributing to the external gamma exposure and to determine the geographical distribution of these radionuclides in the soil on Bikini and Eneu Islands of the Bikini Atoll. Every possible effort will be made to integrate this sampling program with previous programs to avoid undue duplication of effort. The actual number of samples and their specific collection sites will be a function of (1) the expected activity levels, (2) future home-construction plans, (3) future agricultural plans, and (4) the number and locations of recent soil samples collected by other programs.

#### Methods and Measurements

Two types of soil samples will be collected for analysis: (1) a 15-cm-deep surface core sample of 60 cm<sup>2</sup> area, and (2) a profile collection based upon sidewall sampling in a trench in which samples of 100 cm<sup>2</sup> area are collected at 15-cm depth increments to a total depth of 90 cm. For purposes of planning the survey, Bikini Island may be divided into the north, central, and south sections along the respective second baseline roads. Eneu may be divided into the north and south sections divided by the airstrip. The approximate numbers of surface and profile samples to be collected within these sections are shown in Table 1. Note that a major fraction of the surface samples will be collected within the central section of Bikini Island. This is due to the relatively higher and more variable gamma exposure rates in this area and to the fact that a major fraction of the returning Bikinians will most likely reside within this section. Only a few profile samples are planned in this area because several samples have already been collected during previous surveys. The north and south sections of Bikini Island and all of Eneu exhibit relatively lower contamination levels; hence, the sampling density is lower. Special emphasis, however, will be given to the lagoon side of both islands since future homes may be erected in these areas.

Table 1. Number of soil sample locations on each island.

	<u>No. of Sample Locations</u>	
	Surface (0-15 cm)	Profiles (0-90 cm)
<u>Bikini</u>		
North of second Baseline N	25	2
Central Section	200	4
South of second Baseline S	25	2

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Measurements of the exposure rate at 1 m above the ground will be made with the NaI scintillator at each of the soil sampling locations on both islands. The ionization chamber will be primarily used for measurements within the central section of Bikini Island with additional measurements to be made at selected areas. Thus, from this program a comprehensive picture of the gamma-ray exposure rates will be available for both islands.

#### Bikini-Ground Water Program

Purpose: To establish a network of well locations on Bikini and Eneu Islands in order to assess the ground water quality and to systematically study the hydrology and geochemistry of radionuclides, major and trace elements in the ground water system. Water movement and residence times will be assessed to deduce the transport rates and mechanisms for radionuclides deposited in the soil zone or taken up by vegetation.

#### Methods and Measurements

Approximately 7 holes will be drilled with a ground power auger at selected locations along the centerlines of Bikini and Eneu Islands. Pits will be dug with a backhoe to a maximum depth since the ground water reservoir surface will be approximately 2 meters below the ground surface. We must emphasize that the progress of this program will be seriously hampered if a backhoe is not available to support our effort. The auger will penetrate the ground water lens to a depth of approximately 3 to 5 feet. Each hole will be cased with slotted 2" diameter PVC pipe and the pipe will be extended to the soil surface. The pit will be back-filled to essentially provide no environmental impact on the area.

The first hole will be located near the island center. The salinity of the water will be measured with an in-situ conductivity probe. Two holes will then be drilled to bracket the center hole and the salinity will be measured in each. We will continue drilling up to 7 holes on each island proceeding in the direction toward the freshest indicated ground water; this will provide the maximum number of well sites having the freshest water for potential utilization. Water will be pumped from the wells, filtered, and sampled. Radionuclides, major elements, nutrients, and bacteria measurements will be made at the laboratory to provide data for water quality. Specific wells (to be defined in the field) will be pumped continuously over a day and serially sampled to follow the changes in water quality as a function of usage. Recommendations will be made on the potential usefulness of the ground water reservoir for agriculture, household, or drinking purposes. Two closely spaced wells, located in high Cs137 disturbed soil columns on the local ground water quality. Soil leaching and lysimeter experiments are also planned. The well locations, drilling, and sampling, however, are our first priorities during the two weeks allotted for this program.



Assessment of the fresh water residence time will be made from the data. The well network, once established, will be available for resampling on subsequent trips we plan to the atoll to thoroughly assess the dynamics of radionuclide cycling in the ground water reservoir and to maintain a surveillance on the water quality. The program operation will be fashioned after our Enewetak ground water study and comparison of the data from both atolls should be especially valuable for predicting the mechanism and rates of constituents in ground water at Pacific atolls. The U. of Hawaii (Dr. R. Buddemeier) will have the analytical responsibility for major element analysis and LLL (V. E. Noshkin) will have the responsibility for radionuclide assessment. We will determine the concentrations of Cs137, Sr90, and plutonium in all samples by radiochemical techniques. Gamma emitters present in a ferric hydroxide precipitate will be identified and the levels assessed from the spectrometry data. Tritium will be measured on selected samples.

#### Plant/Soil Sampling Program

Purpose: The main thrust of the program will be to determine radionuclide concentrations in food species, to correlate these with soil concentrations at various depths, to determine nuclide availability to plants in the coral soils, and to relate the food-species radioactivity to other indigenous nonfood species which may have indicator species potential. The unique information that this survey will provide is:

1. Soil-to-plant and soil-to-fruit concentration factors for detectable radionuclides.
2. The relationship between food species and nonfood species at the same location.
3. The relationship between total soil radioactivity and the radioactivity which is available to the plant in the soil solution at the time of sampling.
4. The relationship of vegetation, soil, soil water, litter, and humus in the overall cycling of radionuclides in mature food crops.
5. The relationship of lens water radioactivity to that in soil water and plants growing above the lens zone in order to determine the rate of loss (time dependent information) from the coral atoll environment.
6. Intra-island variability in vegetation radionuclide concentrations.
7. Supply the data base for assessment of terrestrial food chain transfer of radioactivity from the soil to man for long-term dose evaluation upon rehabilitation of the atoll.

## Methods and Measurements

The sampling program will therefore consist of integrated sample series composed of food species and soil profile samples which will be obtained on an ad hoc, species available basis. A broader sampling program which will be based upon a widely available species, probably Messerschmidia or Scaevola, will also be carried out to determine the intra-island variations in vegetation radioactivity. These data will be valuable in recommending future agricultural sites and to correlate with the broad soil radioactivity survey and the aerial survey.

An attempt will be made to correlate some sampling sites with the ground water survey to provide data on the cycling of radionuclides at the given site. All food species presently growing and fruiting on Bikini will be sampled in triplicate if the quantity of material permits. Soil profiles (2/tree) will be obtained in the root zone of the tree sampled to determine the concentration of radioactivity in the soil, the soil water, and the organic fraction. A large sample of soil (3 kg.) from the organic zone of the soil (1-30 cm. depth) will be taken to make a leaching measurement of soil solution radioactivity. Both leaves and fruit will be sampled to permit leaf-to-fruit transfer coefficients to be calculated. Nonfood species will also be sampled in the vicinity of the food species to provide information on species variation in radionuclide uptake, and to evaluate the use of nonfood species concentrations in predictive assessment of human intake when no food products are available for analysis. This approach was used in the Enewetak survey because of the paucity of food species on the atoll.

This program along with the ground water program will supply the data base for assessing the long-term dose commitment via food chains upon rehabilitation of the atoll and inclusion of coconut, pandanus fruit, breadfruit, bananas, and papayas in the diet.

### Bikini Air Sampling Program

Due to limited support facilities, manpower, and time, and due to other program demands for air sampling equipment as a result of the delays in fielding the present survey, there will be no attempt to establish an air sampling program during this survey.

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