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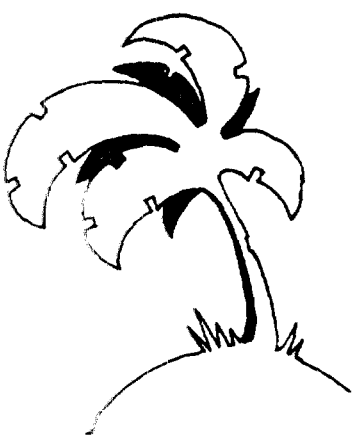
PLANNING AND OPERATIONS DIRECTIVE 1975 BIKINI RADIOLOGICAL SURVEY

JUNE 1975



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NEVADA OPERATIONS OFFICE
LAS VEGAS, NEVADA

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

PLANNING AND OPERATIONS DIRECTIVE
(NVO -- 58)

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: for C. E. Williams
Mahlon E. Gates, Manager

Date: 12 June 1975

PLANNING AND OPERATIONS DIRECTIVE

(NVO - 158)

1975 BIKINI ATOLL RADIOLOGICAL SURVEY

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

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 equipment 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 or commercial aircraft. Sample shipments will be handled by military aircraft. The field survey itself will be followed by analysis of samples by [illegible] laboratories and Lawrence Livermore Laboratory.

V. ORGANIZATION

Management of all survey operations will be the responsibility of the NV Field Survey Leader. The LLL 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

A. Department of Interior (DOI)

1. Grant 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. Assure that the Trust Territory of the Pacific Islands Administration and other appropriate agencies in organizations participate in the preparation and guidance of the survey.

B. Division of Operational Safety (DOS/HQ)

The Division of Operational Safety (DOS/HQ) is responsible for coordination with the Department of Interior and all other Washington level agencies and offices.

DOS will also be responsible for program guidance, evaluation of survey data and the preparation of reports concerning plans for further development of Bikini Atoll.

C. Nevada Operations Office

1. Assigned Duties for Operations, NV

a. Is responsible to the Manager, NV for successful accomplishment of the field phase of survey and preparation of required survey reports.

b. Is responsible for liaison with Trust Territory and Bikini Island officials and with other concerned field agencies.

c. Arrange for appropriate air, water and logistic support for the conduct of the radiological survey.

d. Will select scientific personnel to accomplish the Bikini land and water survey.

e. Arrange that the appropriate survey reports are developed and submitted to DOS/HQ as required.

2. Assistant Manager for Planning, Programming and Budget, NV

Will provide the AEC as required the details of fiscal support and survey funding.

D. Technical Director

The Technical Director will be responsible to the ANO, 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 ANO, NV, for the following.

1. Providing a Scientific Director.

2. Supporting sample collection and laboratory analysis required for dose assessment, pathway assessment and low level 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 required.

H. Brookhaven National Laboratory (BNL)

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

I. EG&G, Inc.

EG&G will provide aerial photographic mapping of Bikini and Eneu Islands to facilitate participant location in the ground survey (photographic mission completed May 25, 1978).

VII. SCHEDULE

The Schedule for the 1978 Bikini Atoll Radiological Survey is:

June 12 All survey parties at Kwajalein on location at Kwajalein.

13 Personnel and gear prepare for departure.

14 0830 MDT departure Kwajalein for Bikini.

15 1600 arrives Bikini; personnel depart Kwajalein for Majuro via C-54.

16-26 Survey conducted.

26 Personnel depart Bikini via C-54, LCU depart Bikini for Ebeye.

27 Personnel depart for Honolulu.

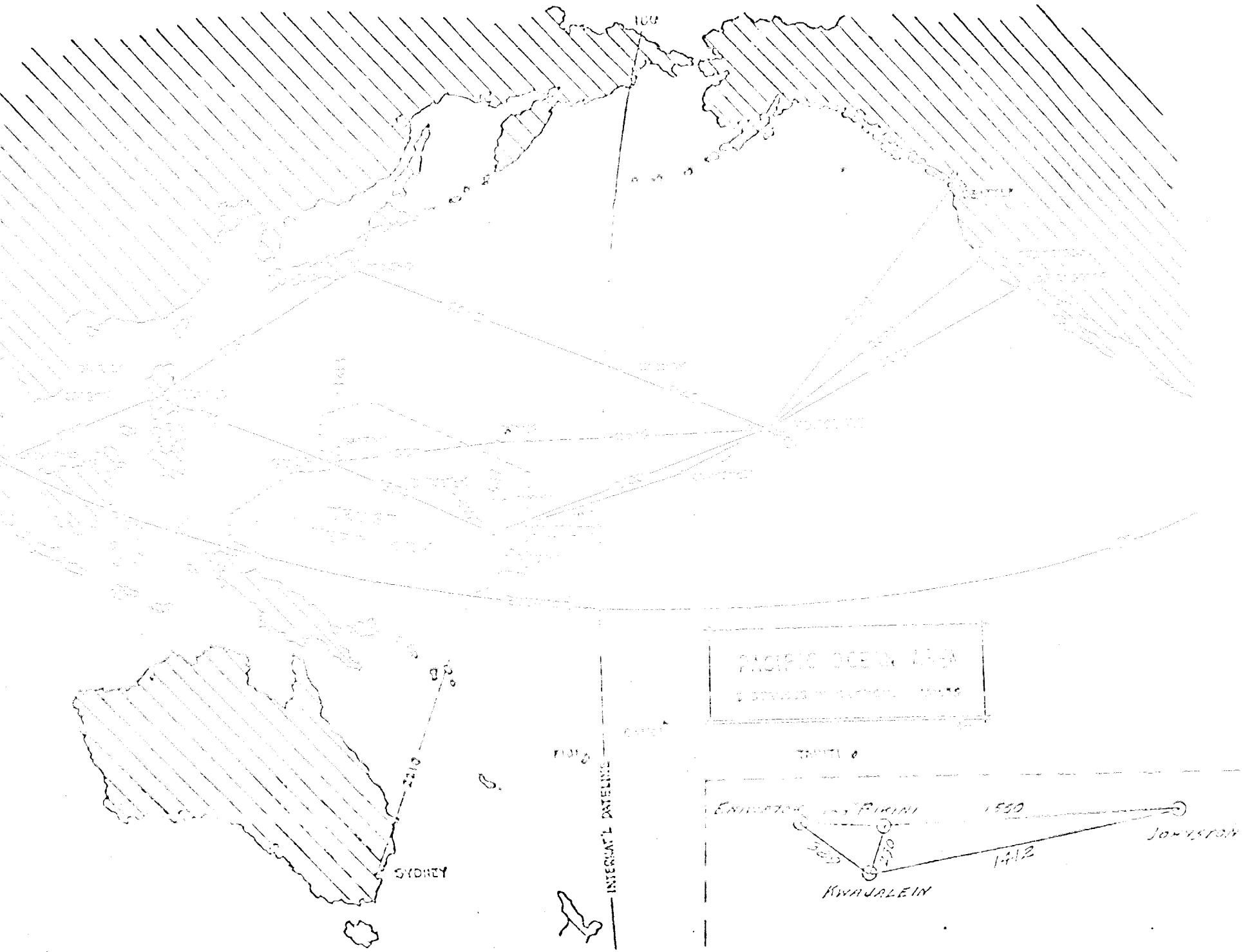
VIII. FUNDING

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

IX. REPORTS

Survey reports from ERDA personnel will be submitted to the Technical Director for Marshall Islands Programs.

The final survey report will be prepared by EV and submitted to DOE, HQ/NV for evaluation.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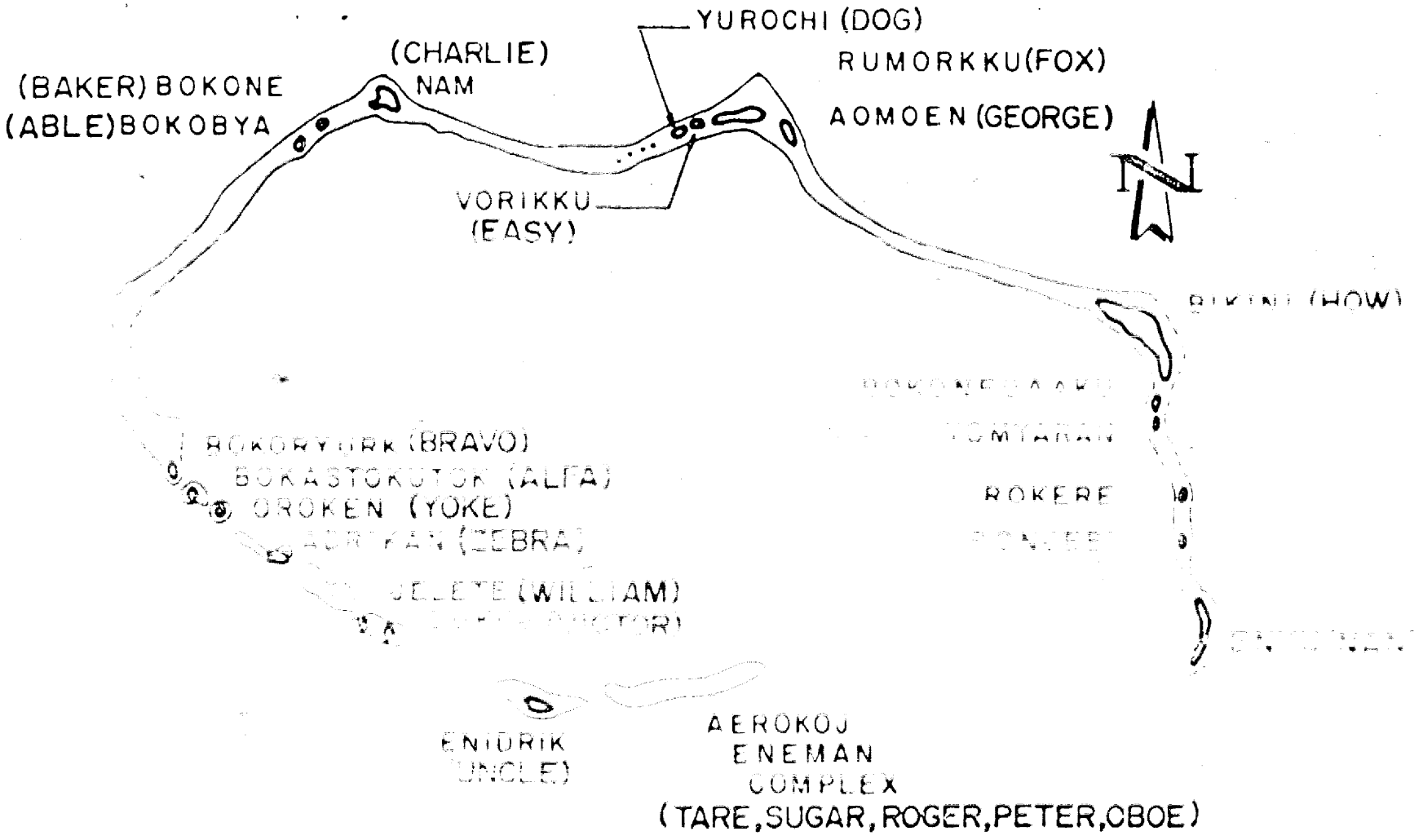

BIKINI ATOLL

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NAUTICAL MILES

1975 [illegible] STUDY PLAN

Technical Director	[illegible]
Soil/Water Program	T. E. [illegible]
Ground Water Program	V. [illegible]
Plant/Soil Program	J. [illegible]

June 3, 1975

19[illegible] BIKINI SURVEY PROGRAM

Bikini [illegible] and [illegible] Soil 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 Procedures

Two types of soil samples will be collected for analysis: (1) a 15-cm-deep surface core sample of 60 cm² area, and (2) a profile collection based upon sidewall sampling from trench in which samples of 100 cm² 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 can be divided into the north and south sections divided by the airstrip. The approximate number 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 found there and to the fact that a major fraction of the returning Bikini people will most likely reside within this section. Only a few profile samples are planned in this area because several profiles have already been collected during previous surveys. The north and south sections of Bikini as well as 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.

	No. of Sample Locations	
	Surface (0-15 cm)	Profiles (0-90 cm)
Bikini		
North of Second Baseline Rd	25	2
Central Section	200	4
South of Second Baseline Rd	25	2

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

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

The exact position of 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 special interest. The samples will be placed in plastic bags with appropriate identification tags and readied for shipment to LLL where they will undergo preparation 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 geographic 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 will utilize the [illegible] scintillation detector which consists of a [illegible] NaI [illegible] crystal with [illegible] readout. The instrument is calibrated with a ^{137}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 ^{137}Cs in the radiation field found on the Atolls. 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 recording exposure rates from about 1 μR/hr to 200 μR/hr with an accuracy of about [illegible]. Thus, the results derived from this instrument can be used as a reference to which measurements obtained by other techniques can be compared.

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 portion 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 examined to define the transport processes and mechanisms for radionuclides deposited in the soil zone and for uptake by vegetation.

Methods and Materials

Approximately 7 holes will be drilled with a manual power auger at selected locations along the center lines of Bikini and Eneu Islands. Pits will be dug with a backhoe to a depth near the ground water reservoir which occurs approximately 2 meters below the ground surface. We must emphasize that the purpose 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 prevent any 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 electrical 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 where the freshest indicated ground water; then will be chosen the smallest number of well sites having the freshest water for sampling and analysis. Water will be pumped from the wells, filtered, and sampled. Radionuclides, major elements, nutrients, and bacteriological 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 regularly 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 reservoirs for agriculture, domestic, or drinking purposes. Two closely spaced wells, located in Plot C-17 (enhanced soil program) on the local ground water quality. Soil leaching and lysimeter experiments are also planned. The well locations, drilling, and sampling, however, are our final goals during the two weeks allotted for this program.

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 and off Bikini, species available at [illegible]. A transect sampling program which will be based upon a widely available species, probably *Messerschmidia* or [illegible], will also be conducted to determine the intra-island variation in the uptake of radioactivity. These data will be valuable in assessing [illegible] and to correlate with the broad soil radioactivity survey from the aerial survey.

An attempt will be made to correlate the sampling sites with the ground water survey to provide data on leaching 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/site) will be obtained in the root zone of the trees sampled to determine the concentration of radioactivity in the soil, the soil water, and the organic fraction. A large sample of soil (5 kg.) from the organic zone of the soil (0-30 cm depth) will be taken to make a leaching measurement of soil retention radioactivity. Both leaves and fruit will be sampled to permit leaf-to-fruit transfer coefficients to be calculated. Nonfood species will also be collected 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 [illegible] 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 rehabitation of the atoll and introduction of coconut, pandanus fruit, breadfruit, bananas, and papayas to the diet.

Filtered 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 delay in fielding the present survey, there will be no attempt to establish an air sampling program during this survey.

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 radio chemical 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 rehabiliation of the atoll.