Battelle
Pacific Northwest Laboratories

409809

R

Date:

From: W. J. BAIR

To: RCT

Attached are copies of communications from Joe Tribo at HARC to Joe Maher, from me to Joe & Joe to me. Do you think we should pursue the possibility of HARC involvement? Our TTO report clearly identifies the ecological areas of concern.

REPOSITORY P.N.N.L.

COLLECTION Marshall Islands

BOX No. 5685

FOLDER Enewetak 1976

DOCUMENT **DOES NOT** CONTAIN ECI

Reviewed by [illegible] Date 4/29/97

Notes of a meeting Dr. Gilbert attended in Joe Deal's office on July 29, 1976 discussing upcoming Enewetak cleanup.

Joe Deals
Office

May 29, 1976

- [illegible] (with definitive) [illegible]
- [illegible]
- [illegible]
- Can a valid need come with P
- EPA approval of cleanup guide (provisional)
- 40 pCi based on exposure data (Exp dose estimation here

FADA Rule - may be way question to ERDA - under.

DRA see cleanup in [illegible] existing radiological

- Have detailed plans

- Problems: Natural materials - not covered in 20 years

DRA doesn't want to keep ad area not identified in 20 years

(Difference in discussing between DRA + ERDA)

- Level [In Boulder area, maybe as high as 60 pCi is higher than site permissible value]

Roger Ray: Best way to spend money on General Guidelines

EPA Guidelines → 30-40 d/m/gm (~ 10-30 pCi)

provision that it must [illegible] case

A public convenience

c) Right of value

- Don't know recommend criteria yet

Drinking water: not much information

- don't know how we're reading into criteria

Time dates should be considered in some problem (Eldfell)
(Reykjanes)
- put 4 or 6 new pegs on Eldfell
- look at residual rates
(Bill Jackson did ^{90}Sr, ^{137}Cs on Jarnet)

Uncertainties

- Tim Gerlach primary detector for Pu
- Analytical uncertainties of the isotopes

Do criteria apply to top surface only?
Less number ⇒ surface ones
(stratigraphers)

- and uncertainties are highly predictable

+ [Nancy could result in both ways criteria
- and pick up 10-15% of Pu on Hunsat

Density in Pleistocene is main factor then dist works
Recent tephra core.
- However Tephra can change rates
- People use them ones in beds, etc.

Can we use Yellowstone criteria have been met?

- use ref to standard +

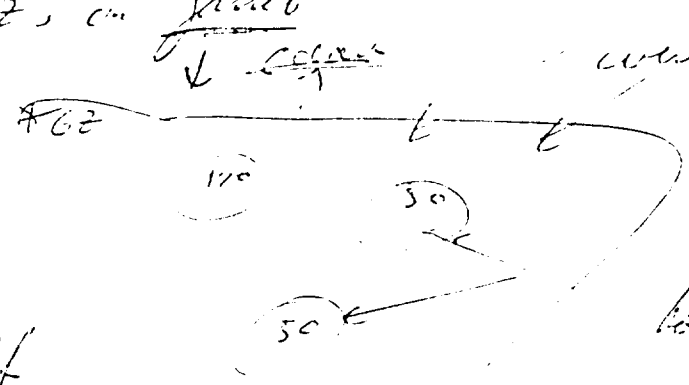
- Surface can get feist prosty
- Upper diffusion vessels Fonseca?
- Tie an example on ~~Tie~~ Jarnet

Need to determine what steps

- Lay out options for sampling

Initial material about 1"

- no identified burial grounds on Jamestown
- 3 CCZ's on Jamestown



↓ Colors ... curved

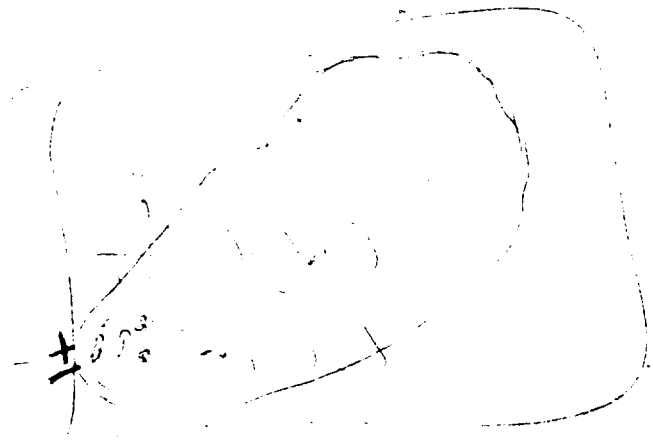
bifurcate (= 40 pieces)

3 cores left
Layer need to divide if not to go back

CCZ
CCZ Layer

---

* Need to maintain integrity of criteria specifications as chosen



11 + 3 = 14 pieces

1 = 10 pieces

- Clean up with (recommendations for clean up)
- -consulting with NVC -140 writeup
- Query not as impressive
  - based on Pam work
- Dot "Heat" (LASL) - trial vaccine model
  - used this finding
  - Transfer (dose)
  - uses 40, 400
    - ↑ goal to see bump

f 140 = nothing

40 - 400 : "grey" area - collect quantitative
- collaborative needs to be consulted
- some clients would benefit more
⇒ not the expert

- FDA + FADA
  - Confer
  - Visual
  - agree

↑ Limits for true results

Help decision explain to Dave - to help FADA decision

- Feeding on one (
- How many samples must be taken
- Process
- What will assurance, precision)

LL - Roger Ray } in Silver : probe on corn leaves
Documented : and work by ...

Dose to Dave - to help [illegible]

- [ref + accumulate data over area]
  - spectrometer
  - calibrate
  - computer
  - plotter

- combine this result with the complex
  - of Ce(IV) + with chemisorption island
  - determine

-
  DUO approved entrance
- FRDA responsible for final certification
-

Office [Joe Deal] (Assistant for Health)
Martin Biles (Dep. of Direct. of Safety, Security & Compliance)
Glenn Lynch

J114 (1st floor back of building)
- 405

(Roger Ray: ~~[illegible]~~ Environ. Impact Statements
Report of AEC Task Groups on
Recom. for Licensing and Siting
of Reactors
June 12, 1974)

[Mrs. Patrick]
Dulles for departure
[Lufthansa Terminal]

27th UA 79 Leaves 5:40 to Seattle
12:45 Lv Dulles T
San Jose 3:10 – 11:15
28. 12:10p.
Glenn U 606 9:45p

Telephone
493-2411

Additional Guidance Needed for Enewetak
Cleanup of Pu Contaminated Soil

1. Over what area or areas should Pu-in-soil measurements be averaged:
   a. In-Situ measurements?
   b. Soil sampling?
2. To what areas should the Pu cleanup criteria, 40 pCi/g and 400 pCi/g, be applied?
3. Looking at past survey results compared with the cleanup criteria, which islands need cleanup? What levels of assurance that the criteria are met without cleanup are reasonable and attainable?
4. For certification of islands for which cleanup of Pu has been performed:
   a. What data are required?
   b. How are the data to be evaluated?
   c. What are goals that are likely to be attainable in terms of the assurance that can be given that the cleanup criteria have been met?
5. For cleanup operations, is there some optimum combination of In-Situ, soil sampling, and wet chemistry measurements that yields the most relevant information to guide contaminated soil removal at the least cost? Can a generalized approach be developed for use with all islands

Table 13. Number of sample locations on each island.

Stratification	Island	Approx area, 10^5 ft^2	Assumed mean ^{239}Pu activity, pCi/g	No. of sample locations	
				Surface, 0-15 cm	Profiles
Phase I Group I	BRUCE	9	1	10	3
	REX	2	1	4	3
	GLENN	25	1	28	4
	HENRY	13	1	14	3
	IRWIN	7.5	1	9	3
	JAMES	4.8	1	6	3
	KEITH	11	1	12	3
	LEROY	7	1	8	3
Phase I Group II	DAVID	48	1	53	7
	ELMER	80	1	80	10
	FRED	140	1	64	8
Phase I Group III	SAM	0.25	1	4	1
	TOM	0.25	1	4	1
	URIAH	0.89	1	2	2
	WALT	1.74	1	4	1
	VAN	1.39	1	5	1
	ALVIN	0.61	1	4	1
	CLYDE	1.01	1	3	1
Phase II Group I	ALICE	10	50	22	4
	BELLE	20	50	33	4
	CLARA	2	50	9	3
	DAISY	6	50	15	4
	EDNA	0.3	50	6	2
Phase II Group II	KATE	8	50	22	2
	LUCY	10.5	50	22	4
	PERCY	1	50	5	1
	MARY	6	50	22	3
	NANCY	9	50	22	4
	OLIVE	14	50	23	4
	PEARL	27	50	45	4
	TILDA	15	50	33	5
	URSULA	12	50	27	4
	VERA	10	50	22	3
	WILMA	7	50	22	3
Phase III	IRENE	20	100	20	14
	JANET	120	50	132	12
	SALLY (including SALLY's CHILD)	37	50 (west end) 10 (elsewhere)	34	9
Phase IV	YVONNE (south)	18	50	51	9
	YVONNE (north)	25	Highly variable	0	46

samples.

b/^{137}Cs
0.05
0.07
0.04
0.09
0.03
0.15
0.03
0.06
0.07
0.17
0.06
0.08
0.08
0.08
0.31
0.07
0.08
0.07
0.05
0.09

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activities
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Radio-nuclide	Activity, pCi/g Mean	Range
^{90}Sr	80	14-430
^{137}Cs	36	5.6-141
^{239}Pu	12	3.9-68
^{60}Co	5.9	1.4-33

The radioactivity seems to be fairly homogeneously distributed throughout the island, even though considerable construction activities, such as the building of an airstrip along the center of the island and large-scale earth grading at

Table 15. Enewetak soil data, "northern islands" (pCi/g in top 15 cm).

		^{90}Sr		^{137}Cs		^{239}Pu		^{60}Co	
		Mean	Range	Mean	Range	Mean	Range	Mean	Range
ALICE		80	14-430	36	5.6-141	12	3.9-68 ✓	5.9	1.4-33
BELLE	Dense	123	14-670	48	14-170	26	7.2-130 ✓	10	3.1-30
	Sparse	44	35-130	8.6	3.3-44	11	5.8-26	4.6	2.4-9.6
CLARA		65	13-310	26	5.6-110	22	3.5-88 ✓	6.4	0.91-20
DAISY	Dense	190	100-380	11	3.4-33	41	22-98 ✓	11	6.4-26
	Sparse	32	16-120	3.8	0.86-9.0	15	3.8-33	0.85	0.37-7.4
ILONA		46	30-220	4.2	2.7-6.4	18	13-24	0.43	0.33-0.63
IRENE		30	5.9-570	3.2	0.22-41	11	2.4-280 ✓	5.4	0.12-520
JANET		44	1.6-630	16	0.57-180	8.5	0.08-170 ✓	1.9	0.02-33
KATE	Dense	67	37-200	24	18-37	17	8.6-50 ✓	2.7	1.6-5.8
	Sparse	11	1.6-49	4.8	1.8-16	2.3	0.17-14	0.46	0.03-3.5
LUCY		32	10-83	11	2.2-25	7.7	2.4-22	1.5	0.26-3.8
MARY		29	11-140	9.9	5.6-26	8.0	2.0-35	1.5	0.74-4.8
NANCY		36	16-110	12	6.0-28	9.1	2.3-28	1.6	0.56-5.3
PERCY		13	3.6-73	0.94	0.12-17	3.5	1.5-23	0.47	0.08-2.9
OLIVE	Dense	22	4.6-70	8.5	3.5-28	7.7	2.2-30	1.5	0.65-4.1
	Sparse	4.5	2.0-11	0.16	0.07-11	2.8	1.9-4.1	0.11	0.05-0.31
PEARL	Hot spot	62	35-140	19	7.4-55	51	15-530 ✓	12	3.6-70
	Remainder	17	3.2-61	7.6	1.2-34	11	0.85-100 ✓	4.1	0.49-49
RUBY		12	7.1-63	1.4	0.71-7.2	7.3	3.0-24	0.93	0.29-16
SALLY		8.4	0.87-140	3.0	0.03-30	4.3	0.21-130 ✓	0.54	0.05-69
TILDA	Dense	27	17-54	8.4	3.5-20	7.6	1.4-17	1.2	0.61-1.9
	Sparse	8.7	2.2-47	1.0	0.04-5.3	2.5	1.1-34	0.37	0.21-1.7
URSULA		6.8	2.0-19	1.7	0.13-7.8	1.3	0.26-7.3	0.31	0.05-1.7
VERA		6.3	1.1-68	2.0	0.03-12	2.5	0.60-25	0.30	0.02-2.2
WILMA		3.3	0.26-13	1.3	0.31-7.2	1.1	0.1-5.3	0.12	0.01-0.7
Southern YVONNE		1.7	0.09-20	0.40	0.02-3.6	3.2	0.02-50 ✓	0.64	0.01-20
Northern Beaches		6.4	1.2-30	0.30	0.03-9.0	2.7	0.34-18	0.13	0.03-1.6

YVONNE - Because of the complex distribution of activities on Northern YVONNE no single mean value for an isotope can be used for the island as a whole without being misleading. Readers should consult the YVONNE discussion in this section and the detailed data in Appendix II for information pertinent to their interests.

Table 16. Enewetak soil data, southern islands (pCi/g in top 15 cm).

	^{90}Sr		^{137}Cs		^{239}Pu		^{60}Co	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Group A (DAVID, ELMER, FRED)	0.41	0.02-4.8	0.21	0.01-2.1	0.04	0.004-0.31	0.03	0.01-0.15
Group B (All others except LEROY)[a]	0.52	0.03-3.9	0.14	0.004-1.8	0.07	0.004-1.1	0.06	0.007-63
Group C (LEROY)	11	1.6-34	3.2	0.5-10	0.63	0.02-2.0	0.58	0.04-5.0

[a]SAM, TOM, URIAH, VAN, ALVIN, BRUCE, CLYDE, REX, WALT, GLENN, HENRY, IRWIN, JAMES and KEITH.

the northeastern end, took place during the weapons-testing period. This relative homogeneity is also supported by the results of the aerial survey.

The activities as a function of depth, obtained from Locations 24, 26, and 100 within the island's interior, follow the general rule of a rapid decrease in activity within the first few centimeters of the surface (relaxation lengths of 3-5 cm) and then level off to become almost homogeneous (as demonstrated at Location 100). Profile samples collected at Locations 23 and 25, which are on or near the beaches, display essentially homogeneous activity distributions.

BELLE—As clearly indicated by the photographs, this island is so heavily vegetated that it was almost impossible to penetrate. The only exception is the northeast corner of the island, which is relatively open with sparse vegetation. Most of the soil samples were collected within the densely vegetated areas, with a few obtained within the sparsely vegetated northeast corner. The following activities resulted:

Radionuclide	Activity, pCi/g Mean	Range
Areas of dense vegetation		
^{90}Sr	123	14-670
^{137}Cs	48	14-170
^{239}Pu	26	7.2-130
^{60}Co	10	3.1-30
Areas of sparse vegetation		
^{90}Sr	44	35-130
^{137}Cs	8.6	3.3-44
^{239}Pu	11	5.8-26
^{60}Co	4.6	2.4-9.6

The mean activities exhibited by the samples from the northeast corner are roughly a factor of three smaller than those from the remainder of the island. Since only a few samples were collected within the corner area, the factor of three may or may not reflect the true difference in the mean values. The aerial survey results do not reflect this difference.

DEFENSE NUCLEAR AGENCY
FIELD COMMAND
KIRTLAND AIR FORCE BASE, NEW MEXICO 87115

2 SEP 1976

Manager
United States Energy Research & Development Administration
Nevada Operations Office
ATTN: Mr Roger Ray
P. O. Box 14100
Las Vegas, NV 89114

Dear Mr Ray:

During the 21 May 76 meeting at ERDA/NV on Enewetak Cleanup, opinions were expressed that soil Pu concentration data should be treated statistically by automatic computer contouring methods to yield concentration contours with some known level of confidence. If these methods are to be used during Cleanup, it would seem beneficial to test them at this time. The data necessary to make such a test are tabulated in Enclosure 1. They are Pu concentrations for Enjebi island from AEC/NVO-140 and corresponding sample location coordinates from the original maps used during the AEC Enewetak Survey. These sampling locations were the only ones identified precisely by engineering surveyors.

Richard Gilbert, Battelle Pacific Northwest Laboratories, is doing automatic Pu contouring as part of ongoing ERDA studies. In a recent informal discussion with Ed Bramlitt, he indicated that, if authorized, he could analyze the Enjebi data in a few work days and the effort would add to the overall understanding of Pu contouring as well as identify better the regions of Enjebi deserving more thorough sampling. Frank Markwell also expressed an interest in analyzing the Enjebi data by his contouring method in order to illustrate the need for a more extensive survey during Cleanup.

Your assistance would be appreciated in arranging for the Enjebi data to be contoured by the methods most appropriate for Cleanup.

Sincerely,

1 Encl
As stated

J. R. SCHAEFER
Colonel, USA
Director, Logistics

Copy Furnished:
Mr Richard O. Gilbert

Battelle
Pacific Northwest Laboratories
Battelle Boulevard
Richland, Washington 99352
Telephone (509) 946-2378
Telex 32-6345

October 19, 1976

Mr. E. M. Bramlitt
Defense Nuclear Agency
Field Command
Kirtland Air Force Base, NM 87115

Dear Ed:

Enclosed are the $^{239-240}Pu$ in soil contours Dr. Pam Doctor and I obtained using the data you sent us that were collected at random soil locations on the island of Enjebi (Janet) Enewetak Atoll in 1972.

The enclosure labeled "A" gives estimated contours in units of pCi/gram; in addition, the location of data points are indicated by a cross. Three contour levels in $\log_e$ scale are indicated; 2.08, 2.71 and 3.56. These are rounded from actual contour levels of 2.079442, 2.70805, and 3.555348, which when antilogs are taken, correspond to 8, 15, and 35 pCi/gram, respectively. The contours on the plot are in $\log_e$ units since the contours were obtained on the logarithms of the data. The coordinates around the plot correspond to the North and East coordinate system you supplied with the data.

Enclosure "B" gives the same contour lines as "A" and in addition plots the value of the $^{239-240}Pu$ soil concentrations (pCi/gram) at collection locations. These are the data used to estimate the contours. Enclosure "C" is identical to "B" except that Pam has roughed in the shoreline of Enjebi and colored the four bands of estimated concentrations (<8, 8-15, 15-35, >35 pCi/gram). The contour lines extending off the island should be ignored.

The estimated contours were obtained using a nearest-neighbor estimation routine on the SURFACE II Graphics System developed by the Kansas Geological Survey. This system is described in "The SURFACE II Graphics System" by R. J. Sampson, pp. 244-266 in Display and Analysis of Spatial Data (J. C. Davis and M. J. McCullogh, eds.), John Wiley and Sons, 1975. The specific subroutines used were GRID and NEAR. The basic idea is to estimate $^{239-240}Pu$ concentrations at equally spaced grid points over the island. The grid size used here was 100 feet. The estimate at each grid point was obtained as a weighted average of the eight nearest data points, where the data nearest

to the grid point are assigned the highest weights. As mentioned above, the data were transformed to logarithms before any calculations were made. Once the grid estimates are obtained the desired contour lines are drawn automatically by linear interpolation between grid estimates. We did not iterate on the residuals to produce the enclosed contours. Iteration does not seem to be required for these data, i.e. the contours obtained after iterating would, in my judgement, be about the same as those given here.

The $^{239-240}Pu$ data collected at 0-5 cm and 0-10 cm increments were adjusted to correspond more closely to the 0-15 cm increments used at most sample locations. This was done by dividing the 0-5 cm and 0-10 cm data by 1.88 and 1.26, respectively. The factor 1.88 is the median of the ratios of 0-5 cm to 0-15 cm concentrations obtained from the profile samples on Enjebi. Similarly, 1.26 is the median ratio of the 0-10 cm to 0-15 cm concentrations. The 0-5, 0-10, and 0-15 cm concentrations were weighted averages of concentrations obtained at 0-2, 2-5, 5-10, and 10-15 cm, the weights being 2/15, 3/15, 5/15, and 5/15 respectively. This is the same weighting procedure you have been using.

I have enclosed the revised list of soil Pu concentrations dated September 1976 which you sent Pam Doctor in your letter of October 8, 1976. These are the data we used except for the circled data which are for the 0-5 or 0-10 cm sample The data used for these values are indicated next to the circled concentration. Please note that the North coordinate for sample location 120 appears to be in error since this N-E location is off the island. Using Figure B.8.1.f as a guide I replaced N144480 with N144880 which puts the sample in about the right position according to the figure. Also we have switched the Pu concentrations for samples 89 and 90 and for 27 and 28 since the Am/Pu ratios then fall into line. Since samples 89 and 90 are spacially adjacent and 27 and 28 fairly near to each other I don't think the contours would change much if we hadn't switched those samples.

Now concerning the interpretation of the contour maps: It appears that the computer contouring has done a reasonably good job of automatically estimating and drawing contours around the "hot spots". A major drawback, however, is the lack of confidence statements associated with the contours. As I have noted in our phone conversations, the method of contouring we have used does not provide for estimating these confidence intervals. This is most unfortunate since we are left with a pretty map with little to guide us concerning its accuracy. We should recall, also that these contours were drawn without knowledge of the locations of detonation points, wind patterns at time of detonation, and other "subjective" data that might possibly be useful in drawing contours. I think we need to seriously face the question of whether

our automatic contouring result are an improvement over someone setting down and drawing contours by hand. What is needed are estimates of variability on the contour lines. One can get a feel for the relative accuracy of some of the contours in certain parts of the island by noting whether any data points are in the vicinity of the contour lines. In general, other things being constant, the more dense the data points, the more confident we can be of the placement of the contour lines.

We have talked some about Kriging and how this technique can give estimates of confidence limits on contours if the data are adequate. I understand you have a copy of Dr. Delfiner's report on his attempts to use Kriging to answer the question "Which hectares on Janet exceed an average Pu concentration of 40 pCi/g"? His overall conclusion was that "this question cannot be answered on the basis of the present data". He indicated that denser sampling was required in order to identify the "structure" (trends around the GZ's or across the island) of the data for spacings less than 50 meters. This structure must be identified before Kriging can be applied to the above question. Dr. Delfiner suggested that "the best that can be done is to calculate an undifferentiated global mean.

This raises the question of whether more samples could be collected around the GZ areas and/or hot spots suggested by the present data before the cleanup crew gets underway next year. These samples might allow the structure to be estimated so that Kriging could be applied. Of course, the use of In Situ devices for measuring ^{241}Am on the island is another approach for obtaining data for estimating the structure. If the In Situ devices are used, however, it is imperative that the resulting In Situ ^{241}Am data be calibrated with Pu concentrations in soil by taking a large number of soil samples close to each other and in the area "read" by the detector. This would need to be repeated at several locations on the island. This should be done before the In Situ device is used to make cleanup decisions.

Hope these comments and the enclosed plots are helpful. I'm sending copies to Tom McCall at ERDA and Bruce Church at NVO, also.

Best regards,

Pamela G. Doctor
for
Richard O. Gilbert
Senior Research Scientist
Statistics Section
Systems Department

ROG:mll

Copies with enclosures to

T. F. McCraw, ERDA Headquarters, Washington, D.C.
B. W. Church, ERDA, NVO, Las Vegas.

Battelle
Pacific Northwest Laboratories
Battelle Boulevard
Richland, Washington 99352
Telephone (509) 946-2104
Telex 32-6345

September 22, 1976

Mr. Tom McCraw
U.S. Energy Research and
Development Administration
Washington, D.C. 20545

Dear Tom:

This letter is in response to your request for guidance on the number of samples required for the proposed clean-up survey on the Enewetak atoll. I begin with some general comments then discuss specifically the questions you distributed at the meeting in Joe Deal's office on July 29, 1976. There is also an appendix to illustrate the computation of certain confidence limits using $^{239-240}Pu$ soil data from the island of Janet. This letter has benefited from comments and suggestions by other statisticians at BNW (Drs. Lee Eberhardt, Tony Olsen, and Pam Doctor).

The number of samples will depend in part on how well the portable Ge(Li) counter performs in the field, i.e. on how accurately the Ge(Li) readings relate to the amount of plutonium in soil. It will also depend on the statistical design used in the field and on whether it is decided that a contour map of plutonium concentrations is a major goal or whether probability statements about mean concentrations are preferred. Contouring calls for a systematic (uniformly spaced) sampling scheme, while probability statements require random sampling within sub-areas of an island. Probably it would be desirable to use some kind of sequential sampling scheme, in which results of an initial set of samples are used to decide whether a given area should be (a) considered "clean" (below some standard level), (b) cleaned up, or (c) whether additional samples should be taken before a decision is made. Such a scheme is likely to require continued attention by someone with statistical training, but may be expected to reduce the amount of sampling required.

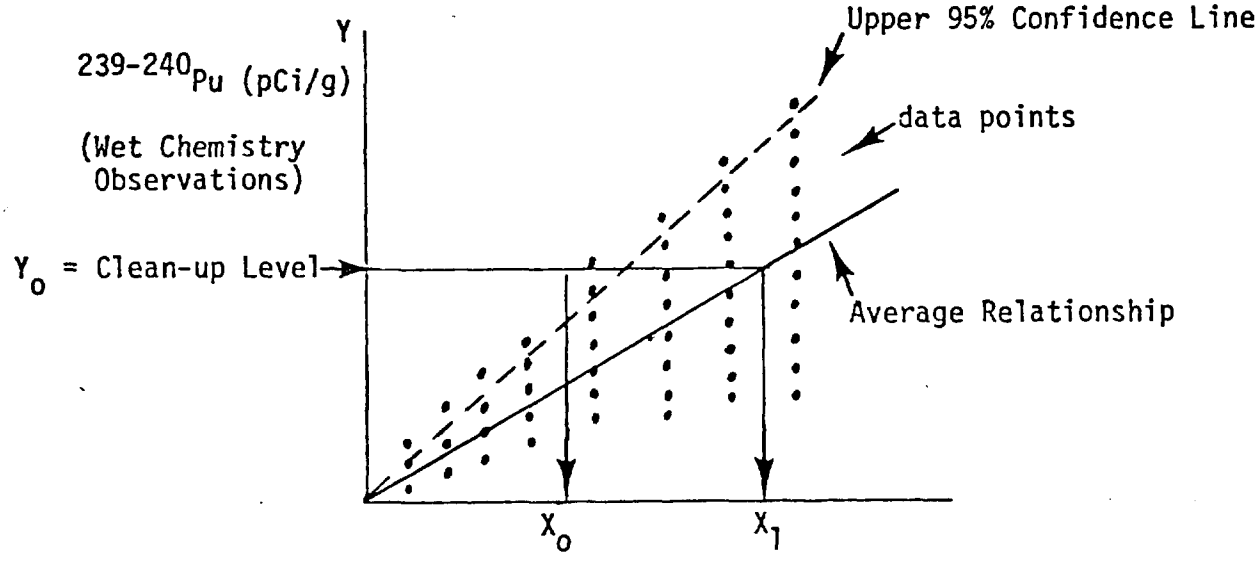
If contouring is used, Dr. Delfiner of the Centre de Morphologie Mathematique, Fontainebleau, France should be consulted on this question of the number of samples required. Dr. Delfiner is knowledgable on "kriging" (a contouring method), and he may be helping Bruce Church set up the technique for use on the islands. We understand that arrangements are being made for Dr. Delfiner to be in Las Vegas for 3 weeks in October and again in November to install his kriging routine on REECo's computer.

The question of whether In-Situ measurements, soil samples, or both should be used for deciding whether an area or island should be cleaned-up requires further discussion. To answer this question we need to know

whether In-Situ or soil sample data are more indicative of future health risk of inhabitants. Is long term health a function of an average (integrated) measure of exposure such as obtained by an In-Situ device, or is it more a function of peak plutonium concentrations from soil aliquots? Also, the use of In-Situ measurements in the cleanup determination implies we need to determine the relationship of these readings to soil concentrations. This can only be done under field conditions. I would suggest a number of In-Situ measurements be made at different locations. At each location the total soil scanned by the device should be carefully collected and mixed and a number of aliquots be analyzed for plutonium. In this way a calibration equation relating In-Situ and soil sample concentrations can be estimated. This will no doubt need to be repeated for different islands or portions of islands since the calibration relationship may not be the same for all areas. If the decision to cleanup is made primarily on the basis of In-Situ measurements then the calibration information is necessary in order to relate to the cleanup criteria which, presumably, will be stated in terms of plutonium concentrations in soil samples.

This reflects a basic decision needed before a sampling plan is selected. If clean-up decisions are to be based on wet-chemistry determinationson soil samples then the In-Situ device may serve only as a means of reducing the number of analyses needed. In any case, we suppose some chemical determination will be required for calibration of the device.

Let us assume that the In-Situ measurements are related linearly to the average Pu concentration in the surface soil scanned by the In-Situ device. For example, if the Pu/Am ratio is constant then the data should look something like a linear "average relationship" through the origin as indicated in the plot below.



IN-SITU DATA

The variability in Pu concentrations would probably be greater for high In-Situ readings than for low readings (as indicated in the diagram). If Y_0 is the level of Pu in soil signifying clean-up, this corresponds to an average In-Situ reading X_1. But the data in the diagram indicates individual Pu readings considerably greater than Y_0 for In-Situ reading X_1. Hence, if the In-Situ device is used to meet the clean-up criteria in terms of Pu concentrations, the level of In-Situ indicating clean-up should be less than X_1. One candidate is the value of the In-Situ measurement (X_0 in the diagram) such that the upper (one-sided) 95% confidence on average Pu concentration is Y_0. An alternative approach would be that level of In-Situ reading such that some large percent (P) of the Pu concentrations associated with that In-Situ level are less than Y_0 with probability $1-\alpha$. The main point here is that if clean-up is to be based on In-Situ measurements, the level of In-Situ measurement indicating clean-up should probably be lower than indicated by the average linear relationship.

In the remainder of this letter I have addressed the five questions you handed out at the meeting with Roger Ray, Paul Dunaway, and others in Joe Deal's office on July 29, 1976. Hopefully, this discussion will help clarify some of the different kinds of statistical probability statements that can be made based on sample results. I direct your attention particularly to the discussion of "acceptance sampling" for Question 3. This seems to be a much more satisfactory approach than using average Pu concentrations for deciding whether an island needs to be cleaned up. There are a good many details that would need to be worked out for actual field application in connection with kriging, but these need to be explored with someone like Dr. Delfiner. A table of sample sizes required to meet various probability criteria is included in the section dealing with Question 3 for the simplest (nonsequential) sampling design. The number of samples would probably be less for a sequential design.

Question I: Over what area or areas should Pu-in-soil measurements be averaged:

a. In-Situ measurements?
b. Soil sampling?

The answer to this question depends in part on the variability present from sample to sample, the spacing of samples, whether any trends are present and perhaps most importantly on how the health standards (cleanup criteria) are formulated. If there are no trends and the variability between samples is relatively small, then the area over which samples are averaged can be large. However, if strong trends are present (such as near GZ for example), it would be important to define these fairly precisely. In that case rather few if any areas might be averaged. Presumably In-Situ measurements would need less (if any) averaging than plutonium concentrations in soil samples since each such In-Situ measurement is itself an average of the Americium activity in the area scanned by the detector.

It is clear that averaging plutonium concentrations will tend to reduce the apparent health risk since the peak concentrations get averaged in with the lower concentrations. This is not, however, a justification for averaging. What we need to know is what average or metric is the best indicator of future health risk to persons inhabiting the area. Guidance from resuspension and radionuclide cycling studies is needed here.

Question 2: To what areas should the Pu cleanup criteria, 40 pCi/g and 400 pCi/g, be applied?

This seems to be a restatement of Question 1. Again, the answer depends on how concentrations for the various size areas are related to health. If this were known and we had some idea of trends and variability over space, we would be in a better position to answer this question.

Question 3: Looking at past survey results compared with the cleanup criteria, which islands need cleanup? What levels of assurance that the criteria are met without cleanup are reasonable and attainable?

A. There are a number of probability statements that can be made based on survey data. These include (1) a one-sided upper confidence limit on the true (unknown) average Pu concentration, and (2) a one-sided upper confidence limit on a percentile of the population. For this latter case, using the 95th percentile for $\alpha = .01$ as an example, we could construct, e.g., an upper $100(1-\alpha) = 99\%$ confidence limit on the concentration level below which 95% of the soil concentrations on the island lie. A third type of interval that appears particularly useful is a one-sided upper confidence limit on the proportion of soil concentrations that fall below the cleanup specification level (this level is denoted here by L). These three kinds of limits are illustrated in an attached supplement to this letter using the $^{239-240}Pu$ data collected on Janet during the 1972 Enewetak survey. We might say at this point, however, that confidence limits on average values (number 1 above) are usually computed on the assumption the data are themselves normally distributed or that the estimated mean is normally distributed. Since Pu concentrations tend to have skewed distributions similar to the lognormal, the usual procedures are sometimes modified by first transforming the data to logs, computing the limits in log scale, then transforming the limits back to the original scale. Alternatively, nonparametric or "distribution-free" limits can be computed. These latter limits are valid no matter what the underlying statistical distribution, but the one-sided limits will be higher (or wider for 2-sided limits) than if a specific distribution such as the normal or lognormal is assumed. We note, however, that limits on percentiles and proportions (items 2 and 3 above) do not require any assumptions about the underlying statistical distribution. The several approaches mentioned above are illustrated in the Supplement.

B. The question of whether to cleanup an island or part of an island can be put in a hypothesis testing framework. In particular, what is known as "acceptance sampling" appears to be a useful approach since there is no need to make any assumptions (normal, lognormal, etc.) about the statistical distribution of the data. The basic idea is to specify (1) an activity level, say L, above which cleanup is indicated, (2) a proportion (p_1) of samples with activities greater than L that is acceptable, (3) a proportion (p_2) of samples with activities greater than L that is not acceptable, (4) the allowable risk (α) of concluding that cleanup is necessary when it really isn't, and (5) the risk (β) of concluding that cleanup is not necessary when in fact cleanup is necessary. Once these quantities have been specified we can determine (i) the number of samples n required in order to meet these specifications, and (ii) the rejection number r. If r or more of the n samples have activities greater than L, then cleanup is required. Note that this approach assumes we are willing to tolerate a certain proportion (p_1) of samples with activities greater than L without cleaning up the area. Of course, p_1 can be specified to be as small as we choose.

The risk β should be specified as a small quantity since the consequences of not cleaning up a contaminated area could be considerable to the inhabitants of the area. $1-\beta$ is known as the "power" of the design, i.e. the probability that the area is cleaned up when the actual proportion is p_2. On the other hand we would also like α to be near zero so as to avoid unnecessary cleanup operations. In the following table we give values of n and r for various values of p_1, p_2, α, and β. These were obtained using Table 13 in Burstein, H., 1971. Attribute Sampling;Tables and Explanations, McGraw-Hill, 464 pp. These values of n and r are for a non-sequential sampling plan. A sequential plan would probably require fewer samples.

From the results in TABLE 1 we note that:

a) As α gets larger the number of samples (n) required decreases when p_1, p_2, and β remain constant. Hence, if we are willing to risk spending more money on cleanup, the number of samples we need to collect decreases.

b) As β increases (power decreases) the number of samples n also decreases when p_1, p_2, and α remain constant. Hence, if we are willing to take a higher risk of missing some areas needing cleanup, we won't need to take as many samples.

c) As p_2 increases, the number of samples (n) decreases. If our cleanup criterion is that 10% rather than 2% of the samples must be greater than L before cleanup is started, then only 113 rather than 3063 samples need be taken (assuming $p_1 = \alpha = \beta = .01$). That is it will take many fewer samples to detect a difference between $p_1 = .01$ and $p_2 = .10$ than to detect a difference between $p_1 = .01$ and $p_2 = .02$. Hence, as p_1 and p_2 are placed closer together (for given α and β), the number of samples (n) increases.

TABLE 1

Number of Samples (n) and Rejection Numbers (r) for Nonsequential Acceptance Sampling for Specified Parameters α, β, p_1, and p_2.

	α = .01											
	p_1 = .001				.01				.05			
p_2 =	.01		.10		.02		.10		.06		.10	
β	n	r	n	r	n	r	n	r	n	r	n	r
.01	1157	5	64	2	3063	45	113	5	10962	601	589	43
.05	773	4	46	2	2179	34	76	4	8091	451	448	35
.10	667	4	38	2	1782	29	52	3	7101	401	335	27
	α = .05											
.01	838	3	44	1	2263	31	81	3	8339	451	435	30
.05	628	3	29	1	1567	23	61	3	5487	301	287	21
.10	388	2	22	1	1235	19	38	2	4515	251	222	17
	α = .10											
.01	661	2	44	1	1939	26	64	2	6578	351	362	24
.05	473	2	29	1	1258	18	46	2	4614	251	227	16
.10	388	2	22	1	993	15	38	2	3647	201	175	13

The proper use of "Acceptance Sampling" requires that samples be collected at random within homogeneous areas (see, e.g., Sampling Inspection (H. A. Freeman, M. Friedman, F. Mosteller, and W. A. Wallis, eds.), Mc-Graw Hill, 1948, pages 48, 49 and 89). Concerning the homogeneity assumption, it seems advisable to divide an island into two, three, or more areas depending on general level of activity and to go through the acceptance sampling procedure in each area separately. These areas could be defined on the basis of the plutonium concentrations obtained by the 1972 survey.

The assumption of random sampling within areas is important in order to preserve the α and β risks decided on for the decision making process. The use of alternative sampling plans, such as sampling at grid nodes of a systematic grid, must be carefully evaluated and supervised to insure the integrity of the final decision. This is a most important consideration in the design of the cleanup study that requires attention to detail. Someone familiar with the statistical requirements should be in the field during the sampling process to insure fidelity to the agreed upon design.

We note that attribute sampling is ordinarily used in situations where the "attribute" can be measured accurately for each element examined and decisions about a given population (often a quantity of manufactured product) are to be made on the basis of the sampled elements. Hence we are neglecting "counter error" here and assuming decisions are to be made on the basis of whether or not sample elements from a given area (e.g., soil aliquots) indicate that a proportion of such elements are above some set limit.

Question 4: For certification of islands for which cleanup of Pu has been performed:

a) What data are required?
b) How are the data to be evaluated?
c) What goals that are likely to be attainable in terms of the assurance that can be given that the cleanup criteria have been met?

In Question 3 we suggested acceptance sampling as a method to decide whether cleanup is necessary. Following the cleanup operation additional soil samples and In-Situ measurements must be taken for certification. Acceptance sampling as outlined above could also be used for this purpose (see TABLE 1 for number of samples required). If the certification requirement states that all collected samples must have plutonium concentrations below the critical level L, then the values of n in TABLE 2 below are appropriate (calculated using Table 12 in Burstein). If any sample has activity greater than L then the cleanup operation has not been successful and certification would not be issued. β and p_2 are defined as above in our discussion of Question 3. Note that the α risk (of concluding that cleanup is necessary when it really isn't) is not specified in TABLE 2. This risk does exist, but is ignored here on the basis that risk β (of concluding that further cleanup

is not necessary when it really is necessary) is the most crucial for certification purposes. Sampling for certification should also be done independently for homogeneous areas within islands.

TABLE 2

Number of Samples* Required to be $100(1-\beta)\%$ Sure that the True Proportion of Samples With Concentrations Greater Than L is Less Than p_2

	p_2		
β	.01	.05	.10
.01	458	90	44
.05	298	58	29
.10	229	45	22
.20	160	31	16

*Based on assumption that we will find no samples with activities greater than L.

Question 5: For cleanup operations, is there some optimum combination of In-Situ, soil sampling, and wet chemistry measurements that yields the most relevant information to guide contaminated soil removal at the least cost? Can a generalized approach be developed for use with all islands or should guidance be derived for the known conditions on each island requiring change?

The question of optimum combination of In-Situ and soil sampling needs to be addressed relative to the kriging procedure. Hence, Dr. Delfiner should be consulted on this matter. In general the optimum combination will depend in part on how well the In-Situ and plutonium concentrations from soil samples are correlated, and on the relative costs of the two procedures. Gilbert and Eberhardt (1976, "An Evaluation of Double Sampling for Estimating Plutonium Inventory in Soil", Radioecology and Energy Resources, Proceedings of the Fourth National Symposium on Radioecology, Dowden, Hutchinson and Ross, Inc.) discuss the issues involved.

The question of a generalized approach should also be taken up with Dr. Delfiner. The general level and heterogeneity of plutonium activity in soil over an island will certainly affect the total number of samples required for cleanup (if any) and certification. However, the general sampling design may be applicable to all islands.

I hope this letter will help you in planning for the Enewetak sampling and cleanup effort. Some of the ideas discussed here are in pretty rough form and would need considerable thought to develop a final plan. Hopefully my brief comments on "acceptance sampling" will serve to stimulate discussion on its merits relative to the "average concentration" approach for deciding whether cleanup is required or has been achieved.

Best regards,

Dick

Richard O. Gilbert
Senior Research Scientist
Systems Department
Statistics Section

cc: Roger Ray, ERDA, NV, Las Vegas
Bruce Church, ERDA, NV, Las Vegas
Paul Dunaway, ERDA, NV, Las Vegas
Mary White, ERDA, NV, Las Vegas

Supplement to Letter from R. O. Gilbert to T. McCraw dated September 22, 1976 Concerning Sampling Plans for Enewetak Cleanup Survey.

I. Confidence Limits on True Average (Median) Concentration.

x = Pu concentration

$y = \log_e x$

If x is distributed lognormally, then

$$\text{Prob}[\mu \leq \bar{y} + \frac{ts}{\sqrt{n}}] = 1-\alpha \quad \text{(since the } y_i \text{ are normal)},$$

where s = standard deviation of the y's.

$\bar{y}$ = mean of logs of the sample data,

μ = true (unknown) mean of logs

t = "t" value for specified α and $n-1$ degrees of freedom.

Then $\exp(\bar{y} + t_\alpha s/\sqrt{n})$ is an approximate $(1-\alpha)$% upper limit on the median of the lognormal distribution (original data). The median is that concentration above which and below which half the observations lie.

For Janet (data taken from Fig. B.8.1.i in NVO-140) we have

$n = 139$, $\bar{y} = 2.180$, and $s = 1.152$

For $\alpha = 0.01$, 0.05, and 0.10 we find:

α	t_{138}	100 $(1-\alpha)$% Upper Limit on Median
.01	2.35	11 pCi/g
.05	1.66	10
.10	1.29	10

Interpretation: For $\alpha = .01$ we state: We are 99% sure that the true (unknown) median Pu concentration on Janet is less than or equal to 11 pCi/g (if the data are lognormal).

Discussion: An alternative approach would be to assume the mean $\bar{x}$ of the Pu concentrations is approximately normally distributed. Then an upper confidence limit on the true (inknown) mean would be computed as $\bar{x} + \frac{ts}{\sqrt{n}}$, where s now refers to the standard deviation of the original untransformed observations. Since for Janet we have $n = 139$, $\bar{x} = 15.9$ pCi/g, $s = 20.9$ pCi/g we find the approximate limits:

α	t_{138}	100(1-α)% Upper Limit on True Mean
.01	2.35	20 pCi/g
.05	1.66	19
.10	1.29	18

Since the decision to cleanup may be a function more of extreme values rather than average concentrations the next section considers upper limits on percentiles.

II. Nonparametric Confidence Limits on Percentiles

Using "Practical Nonparametric Statistics" by W. J. Conover, John Wiley, 1971, page 111, we compute upper one-sided confidence limits:

> The probability is 1-α that p percent of the soil concentrations for the area from which samples were collected are less than or equal to X.

Estimated values of X for various values of p and α for the data from Janet are:

p	α	X(pCi/g)	
.50†	.01	13	
.50†	.05	11	(median = 9.8 pCi/g)
.50†	.10	11	
.50	.25	10	
.90	.01	51	
.90	.05	46	(90^{th} percentile = 37 pCi/g)
.90	.10	41	
.90	.25	41	
.95	.01	120	
.95	.05	67	(95^{th} percentile = 46 pCi/g)
.95	.10	57	
.95	.25	52	

Interpretation: For p = .90 and α = .05 we state: We are 95% sure that 90% of the soil concentrations on the island are $\leq$ 46 pCi/gm.

†These values of X for α = .01, .05, and .10 when p = .50 are nonparametric equivalents of the 100(1-α)% upper limits on the median computed in Part I above. The upper limits (X) obtained here do not require any assumption about the distribution of the observations. Note that these limits are consequently somewhat higher than the corresponding limits in Part I.

Note: These computations assume the data are homogeneous, i.e. there are no trends in the data. Since there are trends present on Janet (increasing concentrations near GZ areas) these kinds of computations should be done separately for GZ and low level areas.

III. One-Sided Confidence Limit on a Proportion

Using "Attribute Sampling" by Herman Burstein, Mc-Graw-Hill, 1971, (Table 1) we can obtain the following probability statement:

> The probability is $100(1-\alpha)$ that the proportion of soil samples with Pu concentrations greater than or equal to the cleanup Level L is less than or equal to P.

Estimates of P for various values of α for cleanup level 40pCi/g (using the 139 soil samples (0-15 cm) from Janet) are:

α	P
.01	.167
.05	.145
.10	.133

Note: Proportion of samples with Pu concentrations $\geq$ 40 pCi/g is 13/139 = .0935.

Interpretation: For α = .01;
We are 99% sure that 16.7% of the soil samples on Janet have concentrations $\geq$ 40pCi/g.

Discussion: A possible approach to deciding whether an island needs to be cleaned up is as follows: The island (or parts of the island) will be cleaned up unless P is less than, say, 5% for some specified α level, say .01. If it had happened that only 1 of the 139 samples had a Pu concentration $\geq$ 40pCi/g then we find that P = .047 (4.7%) for α = .01. Hence, in that hypothetical case we would decide not to cleanup the island if the above rule ($P \leq .05$ when α = .01) had been used. An alternative and perhaps preferable method of deciding whether cleanup is necessary is discussed under Question 3, part B.

ROUTING AND TRANSMITTAL SLIP

1 TO Dr. Richard O. Gilbert Battelle Pacific Northwest Laboratory Box 999	INITIALS DATE	CIRCULATE COORDINATION
2 Math Building, Room 1201 Richland, Washington 99352	INITIALS DATE	FILE INFORMATION
3	INITIALS DATE	NOTE AND RETURN PER CONVERSATION
4	INITIALS DATE	SEE ME SIGNATURE

ACTION

REMARKS

Do NOT use this form as a RECORD of approvals, concurrences, disapprovals, clearances, and similar actions

FROM FCDNA/FCLS	DATE 23 Nov 76 PHONE 264-6487

OPTIONAL FORM 41
AUGUST 1967

5041-101-01

FCLS-H 23 November 1976

MEMORANDUM FOR RECORD

SUBJECT: Determination of Pu in Enewetak Soil by Alpha Particle Counting

REFERRENCE: Memorandum for Record, 27 Oct 76, Same Subject

1. Ref 1 reported interim results of a study to compare alpha particle count rates of Enewetak soil samples with their total specific alpha particle activity as determined by radiochemistry and reported in NVO-140. A reasonably good correlation was determined for 11 of 13 samples investigated. Since alpha particle count rates for the two "outliers" was reproducible, and their Pu content appeared too large, both samples were reanalyzed for Pu at USAF/MCL by radiochemistry. Results are as follows:

SAMPLE NUMBER	NVO-140 Pu CONC (pCi/g)	REVISED Pu CONC (pCi/g)	NVO-140 Am CONC (pCi/g)	TOTAL SPECIFIC α ACTIVITY
5116	399	278	19.00	297.0
5196	532	65	9.65	74.7

2. Enclosure 1 tabulates the net alpha particle count rates and total specific activities for all 13 samples. The average count rate per unit specific activity was determined both as the ratio of the means, β_1, and the mean of the ratios, β_2:

$$\beta_1 \pm SE = 0.0196 \pm 0.0019 \quad \text{Relative SE} = 9.8\%$$

$$\beta_2 \pm SE = 0.0302 \pm 0.0075 \quad \text{Relative SE} = 24.8\%$$

A linear regression yielded the relationship:

$$Y(c/min) = 0.433 + 0.0169\ X(pCi/g)$$

with a coefficient of determination, $r^2 = 0.9525$. This curve is plotted in enclosure 2 as a broken line. All data points are shown in enclosure 2 within circles, and the solid line is a plot of $Y = \beta_1 X$.

3. Alpha particle counting (without chemistry) continues to look suitable as a rapid method for estimating the concentration of transuranics in Enewetak soil at concentration levels of interest to Cleanup. A possible explanation for the high Pu concentrations reported in NVO-140 for samples 5116 and 5196 is that ($\approx$10g) aliquots contained "hot particles" and the

aliquots were not representative of the entire (≈1000g) ball-milled sample. This explanation suggests that alpha particle counting (without chemistry) might also be used as a simple independent check of radiochemical analyses whenever small aliquots of large environmental samples are analyzed for transuranics.

E. T. Bramlitt

2 Encl
as

E. T. BRAMLITT
Health Physicist

Alpha Particle Counting of Enewetak Soil Samples

SAMPLE NUMBER	Y NET α COUNT RATE (C/MIN)	X TOTAL α SPECIFIC ACTIVITY (pCi/g)	Y/X cpm/(pCi/g)
3892	1.0	46.3	.022
3746	0.8	27.9	.029
3777	1.0	44.7	.022
3894	0.0	12.2	.000
3896	2.2	91.2	.024
3754	1.0	18.8	.053
5200	0.3	2.59	.116
5115	5.8	313.0	.019
5114	7.0	338.0	.021
5113	7.5	384.0	.020
5116	4.2	297.0	.014
5119	7.7	462.0	.017
5196	2.8	74.7	.037

ENCL 7

FIG. 1. Net alpha particle count rate versus [illegible]

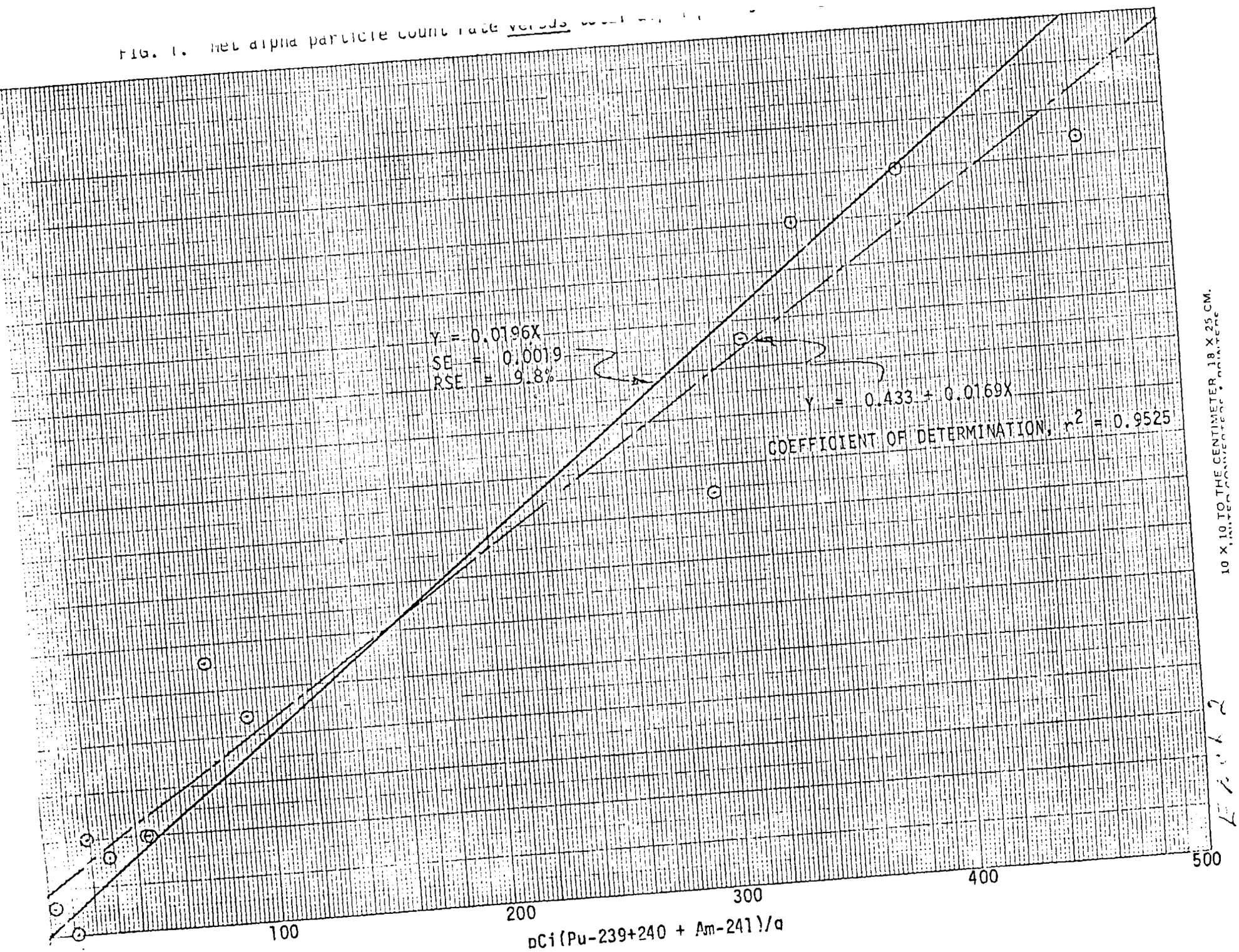
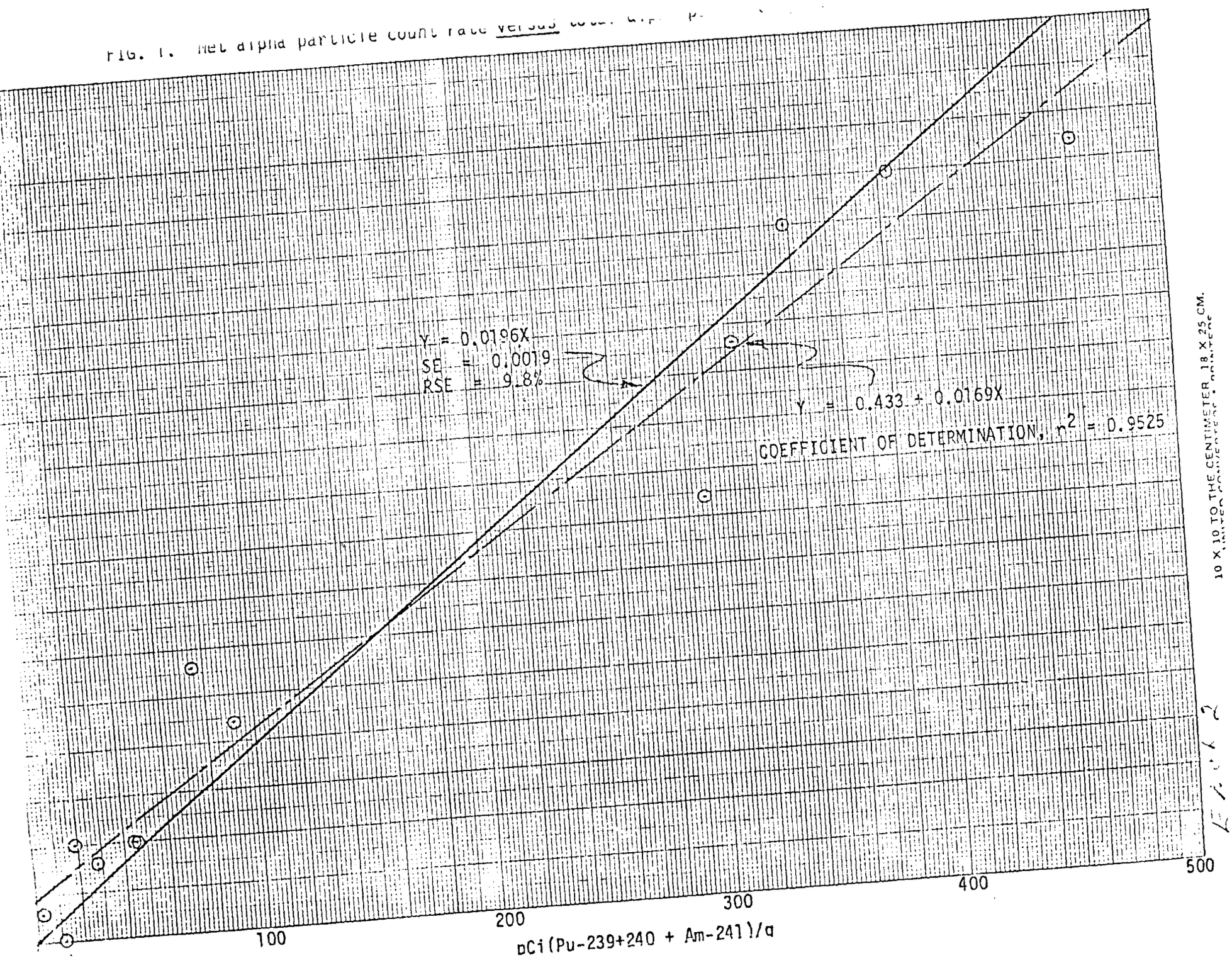


FIG. 1. Net alpha particle count rate versus [illegible]



Phone Conversation April 17, 1978

4-17-7

Questions for M. Barnes:

1.) Report on calibration of IMP
- Standards been used?
- IMP Am vs soil Am (what depth soil? Where data taken? on islands?

2). Problem areas: sample collection, quality contr

3). Averaging? What is valid method for dose assessment
- Island, ¼ hectare, ⅓ hectare?

4). Where do we need data?

5). What reports have been written that can be furnish to ~~committee~~ Advisory Group

---

No recent IMP report

Tad Tipton → IMP Am calibration
- no good liquid water
- John Tipton 739-0584 (EG+

Soil cookie cutter: 2.5cm (nominal), but ≈ 3cm due to method of operation.
actual cookie cutter has not been used since sometime in the period Oct 1 – Dec. 1, 1980. Soap has been used since then.

43/

Boeing [illegible] with IMP

- [illegible]

- [illegible]

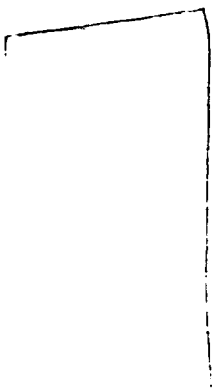
- [illegible]

1) [illegible]

2) [illegible]

3) [illegible]

4) [illegible]



ITC = Inter-trial coherence

ERSP = Event-Related Spectral Perturbation

- Event-related potentials (ERPs)
  - Sensory processing
  - Cognitive processing
- Time-frequency analysis (TFA)
  - Oscillatory activity
  - Phase-locked activity
  - Non-phase-locked activity

- Hemodynamic activity:
  - fMRI – positron emission tomography
  - fNIRS
  - EEG
  - MEG

Trig

Phone Conversation with Madeline Barnes (Gilbert)

Calibration

(a) Checks to make sure the IMP is correctly reading a known Am source at specified distance fr detector
- 4 times a day (in the field)

(b) Conversion from Am read by IMP and ~~soil~~ soil Am in top 2.5 cm (nominal) - 3 cm depth
- Call John Tipton (EG+G) (739-0584) FTS→598 for calibration information
  - M. Barnes has no paired IMP - soil Am NTS data
  - She received no ~~so~~ raw IMP values from J. Tipton. He gave her the converted values. She did kriging on these estima soil values & compared with prior kriging on ~~soil~~ actual soil values.

Averaging

For Cleanup

- Base cleanup decisions on $\frac{1}{4}$ or $\frac{1}{2}$ hectare averages

For Dose Assessment

- (1) Use highest $\frac{1}{4}$ ($\frac{1}{2}$) hectare conc. left on islan after cleanup
  - (2) average the $\frac{1}{4}$ ($\frac{1}{2}$) hectare concentrations and use the average
  - (3) Estimate the dose for <u>each</u> $\frac{1}{4}$ ($\frac{1}{2}$) hectar and combine these dose estimates depend on projected length of time spent in each $\frac{1}{4}$ ($\frac{1}{2}$) hec
    - would be easy to program on computer
  - (4) Use the ~~=~~ 40 pCi/g, 100 pCi/g, or 400 pCi/g designation for the island. A very conservative approac

since soil levels are known to be less than these limits

Reports the Advisory Group Should Receive

Everyone

1. ~~Weekly~~ Monthly situation reports (DOE)
   - Input from all groups
2. Technical reports (statistical)
3. Procedures (protocols)
   ~ 30 sets each from 2-30 pages in length
   - send stab. protocol + list of title of other protocols
4. Calibration data
5. Set of island estimates *
   a) aver. over $\frac{1}{4}$ ($\frac{1}{3}$) hectare units
   b) 2 scale plot showing locations
   c) upper bounds
   d) cross hatch areas (those above limits)
   e) Tech. report on ratio + conversion procedures
   f) subsurface data if available.
   g) cover letter
6. Subsurface data

---

* Note: 16 point averages are obtained when use 35 m grid and want $\frac{1}{4}$ hectare averages. The areas estimated actually overlap in this case

Basic Problem

- Military in Albuquerque + Washington don't have a grasp of the day-to-day problems on the islands.

Communication

- Good communication within DOE on the islands
  - R. Rez sends around messages he gets from Tato + Tesat (military) since ~~this~~ politics affects operations.
  - R.R. also sends his letter around (sometimes for comment ~~&~~ before sending them)

Health Problem

- Military requires their field people to wear anti-contamination gear (suit), which can lead to heat prostration. M. Barnes thinks it could lead to someone dying. DOE refuses to require DOE people to wear this gear.
- AFRRI (committee?) (Auxier is on it) has recommended no suits, but military does anyway.

Timetable for Island Characterization

Nov. 15 deadline for completed island characterizatio was not a realistic date. The IISP lines through island veg. weren't even finished on most islands by Nov. 15. Even by April 1, some ~~lines~~ lines were not completed. All remaining characterization should be co

hand by the military by april 28.
W. Barnes also gave the military some subsurface data on Friday (April 14)

Quality Control

FTS 474-5511 (operator)
~~[illegible]~~
~~491-3338~~
1505 345-3461

- Mike Ortiz (Eberline, Santa Fe) makes audits on analytical lab periodically
  - spiked samples
- Stat. group has quality control too
- EG+G does calibration quality control

~~Mines~~

Subsurface

On Bogon, contamination levels ~ 1000 pCi/g at 40-60 cm, but EMP didn't see it at all.

Military Command

Joe Briggs (colored) is good (easy) to work with - not a "we-you" person. He "gets the job done" but is not the commander

Mixer is the island commander (but has no day to day ~~[illegible]~~ authority.

JTG = Joint Task Group
↑
The military operation.

ERSP
↑
Enewetak Radiological Support ~~[illegible]~~ Program

eberline

April 21, 1978

EI-916124

Mr. Dick Gilbert
Battelle Northwest
P. O. Box 999
Richland, Washington 99352

Dear Mr. Gilbert:

Enclosed herewith is a copy of Quality Control Procedure regarding the Enewetak CleanUp Project. Also enclosed is a copy of the Quality Assurance Audit, Enewetak CleanUp.

If you require anything further, please contact us.

Sincerely,

Michael Ortiz for

MICHAEL A. ORTIZ
Laboratory Manager

MAO/jm

Encls.

ROG

Phone Conversation with Michael A. Ortiz

1. duplicates and spikes are, according to the "Quality Control Procedure" supposed to be run once a week. In fact, the frequency has been once a month for months aug - December.

   Reasons: a) During each months there were very few field samples collected ⇒ no use in doing duplicates. This also inhibited running of spiked samples.

   b) Procedure was not typed up and signed by DOE [illegible]

2. No interpretation or statistical analysis of QC data is done. Reports to DOE/ERSP manager consist only of lists of data with little or no comment.

3. If the difference between the "true" and observed concentrations on spiked samples is more than 20 or 25%, then all the field samples done in the same batch as the spike are reanalyzed (I presume a new aliquote is taken)

4. % errors are ?

5. [illegible]

6. Soil preparation procedure:

a) estimate volume of sample
b) wet and dry weight
c) no sieving
d) Entire sample placed in 1 gallon can with 10 one inch steel balls. Ball milled for 4 hrs
e). one Sq aliquot for wet chemistry. a separate aliquot for Ge(Li)?

7. More data are now available. These will be sent to me before June 5,6 meeting. Also, more information on procedures will be sent.

8. The alpha readings are highly variable; just a rough estimate.

9. Beta readings are no longer being taken

10. The highly variable and problem-biased 239Pu (and perhaps 241Am, wet chemistry) concentrations from spiked samples done during Sept. 1977 were not ball-milled. The poor agreement with the "true" concentration lead to the new soil procedure of ball-milling all samples.

(Don't know whether this includes unburned samples).

11. Medical artifacts will be made at LLL during late June and July.

TABLE 1. Duplicate analyses (two 5-gram aliquots) from Enewetak Atoll soil field samples.[++]

	Month	Analysis 1	Analysis 2	Percent Relative Variability[+] (%)
		pCi/g	pCi/g	
^{239}Pu	Sept.	3.1	3.4	6.5
		4.5	4.7	3.1
		12	14	10.9
		21.6	28.8	20.2
	Oct.	5.1	6.1	12.6
		6.0	6.0	0.0
		11.7	8.9	27.2
		12.7	13.0	1.6
		17.9	18.2	1.2
		19.4	21.6	7.6
		21.1	21.8	2.3
	March and April	0.58	0.62	4.7
		0.62	0.73	11.5
		2.35	1.97	12.4
		16.86	13.39	16.2
		22.95	31.42	22.0
		29.56	27.15	6.0
		38.23	36.82	2.7
		119.2	116.2	1.8
				Median = 6.0%
				Range: 0.0 to 27.2%
^{238}Pu	March and April	0.01	0.02	47.1
		0.03	0.05	35.4
		0.20	0.18	7.4
		1.89	1.57	13.1
		2.66	1.96	21.4
		4.00	3.53	8.8
		4.09	4.07	0.3
		6.66	8.82	19.7
				Median = 16.4%
				Range: 0.3 to 47.1%

[+] $100(s/\bar{x})$

[++] From Eberline Quality Assurance Reports for September 1977 through April 1978 transmitted to R. O. Gilbert in letters from Mike Ortiz (Eberline) dated April 21 and May 15, 1978.

TABLE 2. Duplicate analyses (two 5-gram aliquots) from Enewetak Atoll soil field samples.[++]

	Month	Analysis 1	Analysis 2	Percent Relative Variability[+] (%)
		pCi/g	pCi/g	
Gamma ^{241}Am	Sept.	1.1	1.1	0.0
		1.6	1.2	15.7
		9.2	8.1	9.0
		13	13	0.0
		33	30	6.7
		35	30	10.9
		44	40	6.7
	Oct.	3.0	3.0	0.0
		3.1	2.8	7.2
		3.3	3.5	4.2
		8.6	8.7	0.8
	March and April	<MDA	0.25	-
		<MDA	<MDA	-
		1.72	1.77	2.0
		5.46	5.35	1.4
		14.25	15.45	5.7
				Median = 4.9%
				Range: 0.0 to 15.7%
Chemistry ^{241}Am	Oct.	3.3	2.4	22.3
		6.5	7.7	12.0
		15.2	15.6	1.8
				Median = 12.0%
Gross Alpha	Oct.	5	25	94.3
		10	21	50.2
		16	28	38.6
		34	16	50.9
				Median = 50.5%
Beta	Oct.	24	32	20.2
		72	62	10.6
		137	132	2.6
		345	363	3.6
				Median = 7.1%

[+] $100(s/\bar{x})$

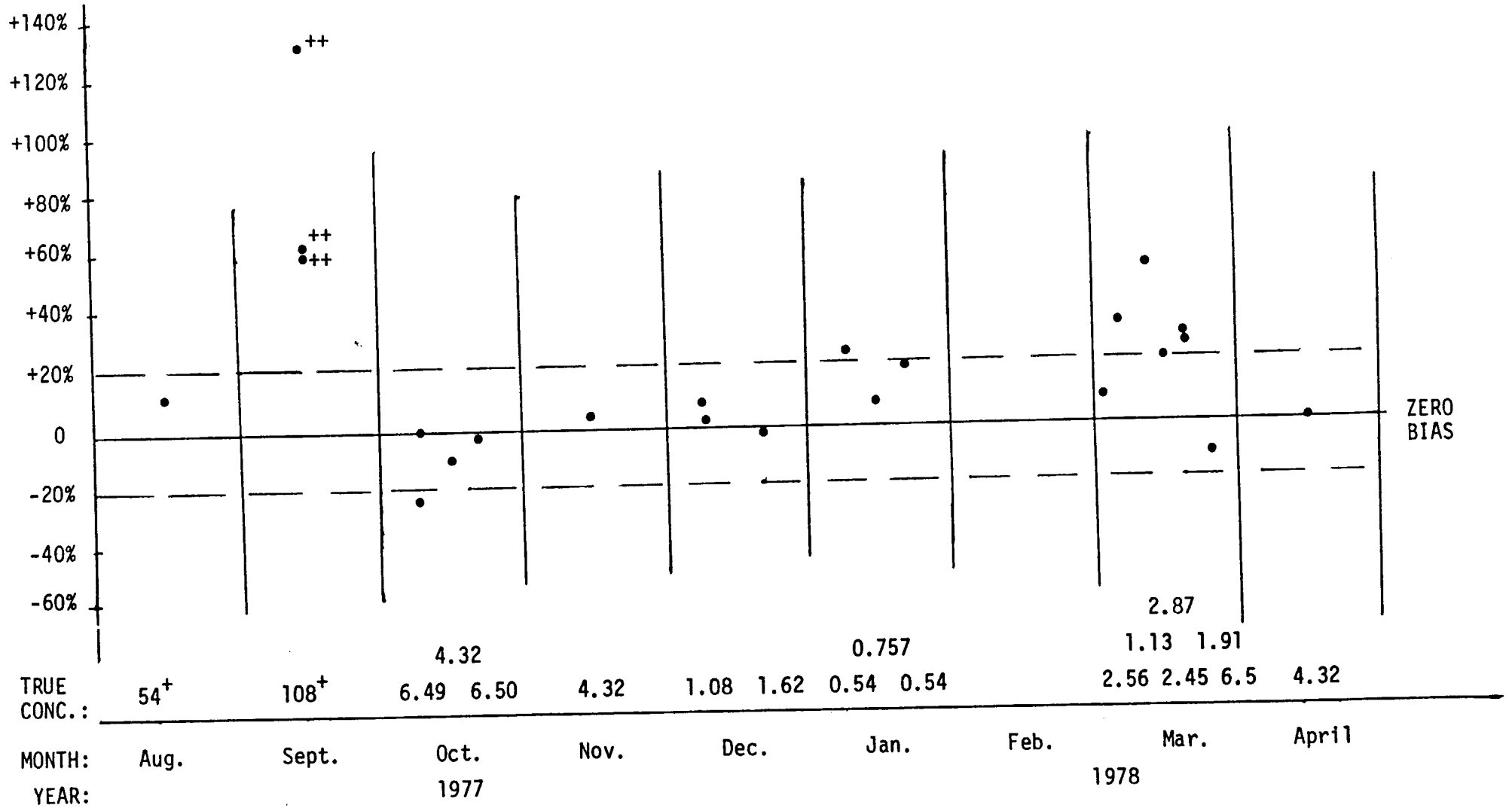
[++] From Eberline Quality Assurance Reports for September 1977 through April 1978 transmitted to R. O. Gilbert in letters from Mike Ortiz (Eberline) dated April 21 and May 15, 1978.

TABLE 3. Analyses on blank soil samples taken from Enewetak Island.[+]

	Month	Amount of Spike Added	Observed (pCi/g) ± Counting Error (2σ)
^{239}Pu	Oct.	0.0	0.08 ± 36%
		0.0	0.04 ± 42%
		0.0	0.15 ± 25%
	Nov.	0.0	0.04
	March	0.0	0.28 ± 25%
		0.0	0.25 ± 25%
		0.0	0.11 ± 32%
		0.0	0.24 ± 26%
		0.0	0.65 ± 46%
	April	0.0	0.05 ± 45%
			Median = 0.13 Range: 0.04 to 0.65 pCi/g
^{238}Pu	March	0.0	0.02 ± 52%
		0.0	0.04 ± 58%
		0.0	0.02 ± 71%
		0.0	0.03 ± 67%
	April	0.0	0.03 ± 61%
Gamma ^{241}Am	Oct.	0.0	<0.10
		0.0	0.08 ± 131%
		0.0	0.15 ± 213%
	Nov.	0.0	<0.10
	March	0.0	<MDA
		0.0	<MDA
		0.0	<MDA
Chemistry ^{241}Am	Oct.	0.0	0.04 ± 100%
	March	0.0	0.02 ± 200%
		0.0	0.53 ± 82%
		0.0	0.03 ± 100%
		0.0	0.04 ± 115%
	April	0.0	0.07 ± 67%

[+]From Eberline Quality Assurance Reports for September 1977 through April 1978 as transmitted to R. O. Gilbert in letters from Mike Ortiz (Eberline) dated April 21 and May 15, 1978.

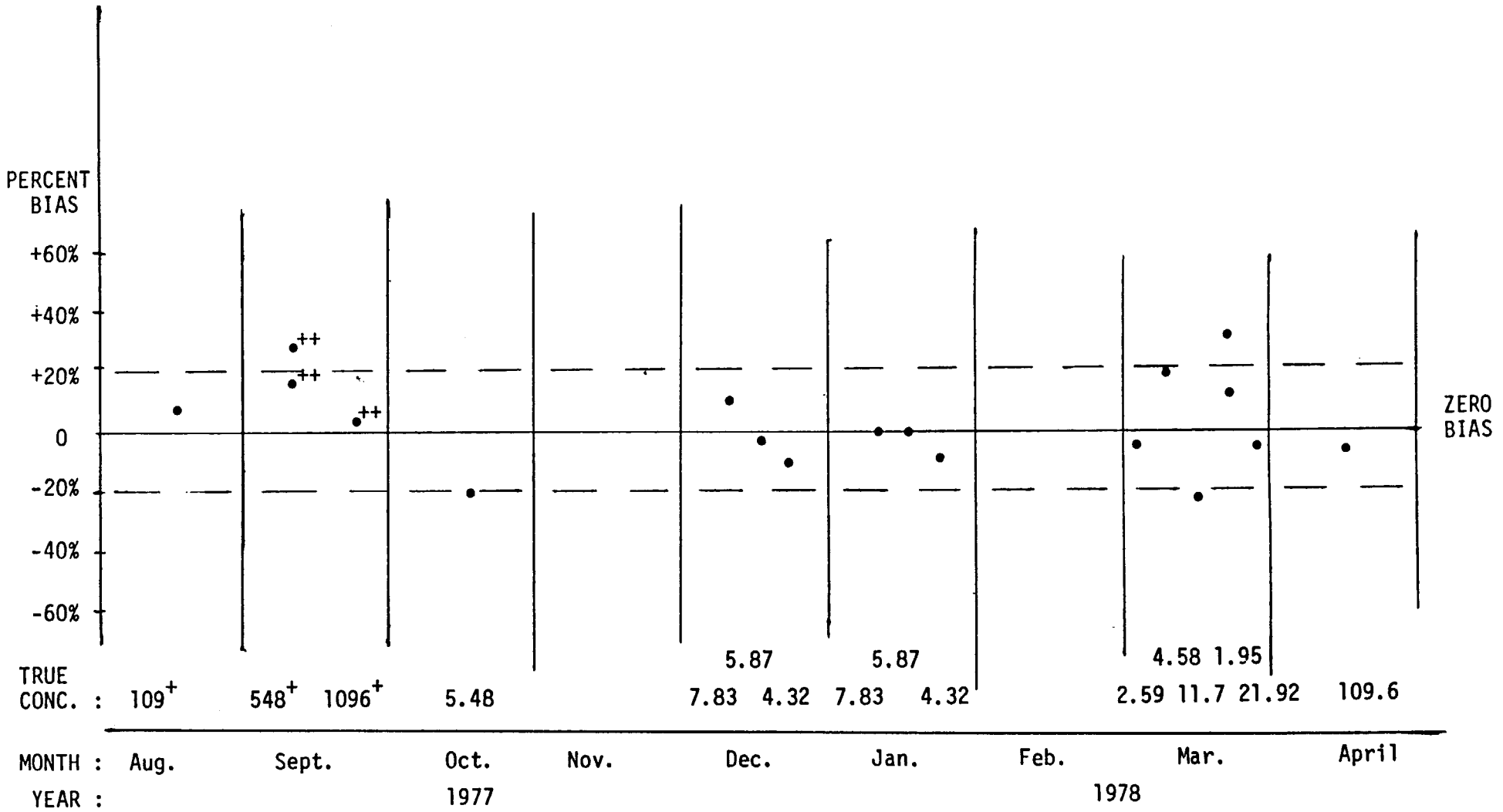
PERCENT DEVIATION FROM ^{239}Pu SPIKED SOIL SAMPLES. WET CHEMISTRY ANALYSIS BY EBERLINE ENEWETAK LABORATORY



+pCi Total. All other values are pCi/g dry (Enewetak Island) soil.

++Samples not ball-milled.

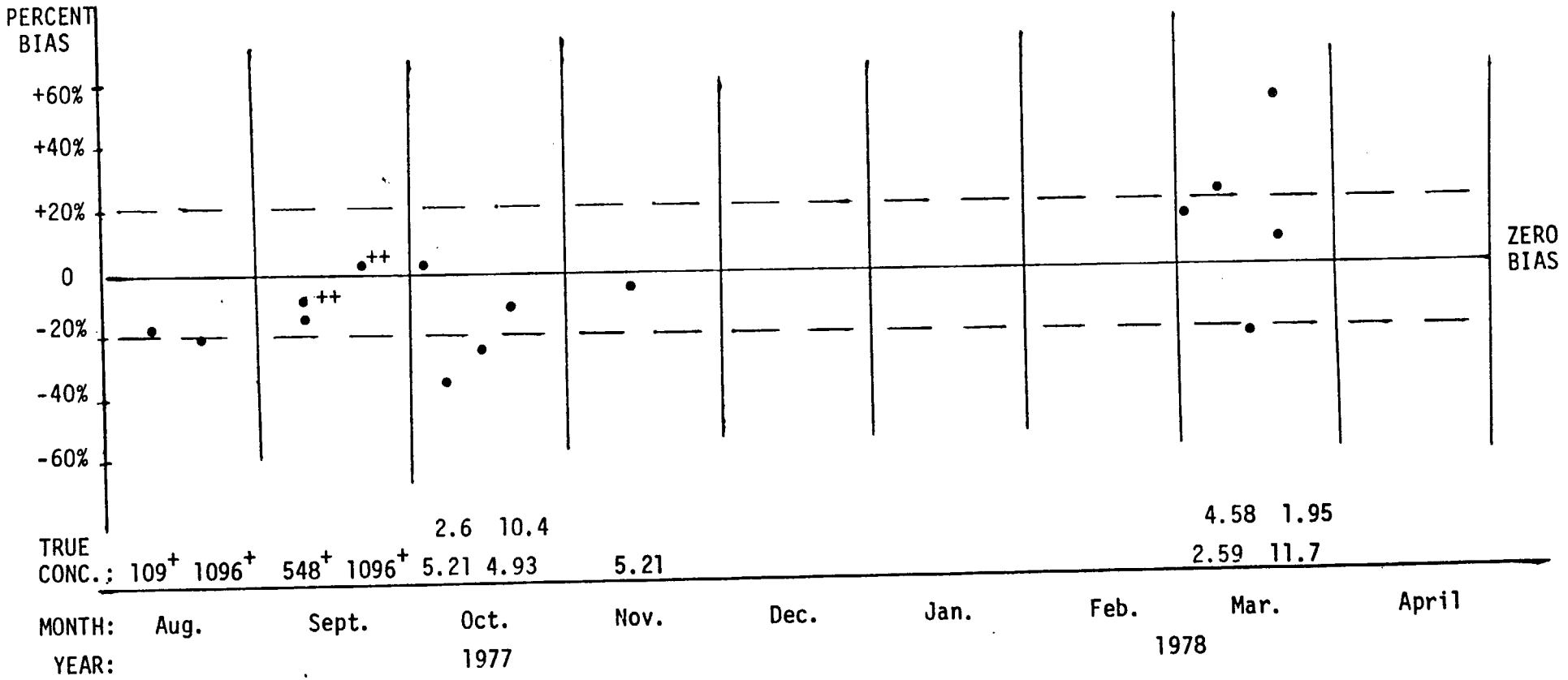
PERCENT DEVIATION FROM ^{241}Am SPIKED SOIL SAMPLES. WET CHEMISTRY ANALYSIS BY EBERLINE ENEWETAK LABORATORY.



+pCi Total. All other values are pCi/g dry (Enewetak Island) soil.

++Sample not ball-milled.

PERCENT DEVIATION FROM ^{241}Am SPIKED SOIL SAMPLES. GAMMA SPECTROMETRY ANALYSIS BY EBERLINE ENEWETAK LABORATORY.



+pCi Total sample. All other values are pCi/g dry (Enewetak Island) soil.

++Sample not ball-milled.

Phone Conversation with Madeline Barnes
(May 3 and 5, 1978)

1. The profile samples transmitted to the Advisory Group for the April 26 and 27, 1978 meeting by Madeline Barnes are not representative of "typical" profile evolution on the islands of the atoll. These profiles were taken in areas where it was suspected that untypical conditions might exist.

The only profile information that might be useful for use in LLL's dose model are the 0-5, 10-15, 20-25 (could be 0-3, 10-13 and 20-23) cuts taken at each sampling site for location spot. These were analyzed for wet chemistry, but the field sampling procedures were "sloppy" (my term) in the sense that depths of samples were crudely measured, and some core contamination from depth intervals may have occurred. These data will be organized and transmitted to me by M. Barnes. Bruce Church has put a halt to the collection of the 10, 20, and 30 cm profile samples.

The Advisory Group may want to consider whether additional profile samples should be

taken

2. Main purpose of the 0, 10, 20 cm profile samples was to see whether Pu/Am ratio changes with depth (apparently they do not).

3. What has been done to summarize profile data?
   a) listings of whole profiles that showed concentrations (at any depth?) > 50 pCi/g
   b) maps (location of profile samples)
   c) narrative
   d) "witnessing" at each depth (Church)
      · M. Barnes doesn't feel these criteria are worth much. Not enough data!

4. Information from phone conversation with M. Barnes on 5-3-78:

   M. Barnes had nothing to do with the decision to use 1/2 σ, i.e. the 50% confidence limit for determining cleanup areas. Site preferred to use 1 σ, but was told in no uncertain words that 1/2 σ was to be used. M. Barnes thinks the decision to use 1/2 σ was made at an Albuquerque meeting to which one DRI people were invited.

M. Bernier notes that on most islands the same damage would occur whether 1 or 5 or is used, i.e. the units are either "cold" or "very hot". Even 20 would not change that drastically if very much. The exception is the island of Janet, where 1 would increase the area to be cleared.

54-3000-101 (9-59)

DON'T SAY IT --- *Write It!*

DATE _____

TO _____ FROM _____

- H 50 pts = initial word count
- flag
- narrative
- contouring at each depth (chunk)

** { something (color/BB pics) }
- don't have "average player" stuff

{ 0, 10, 30 } a little spelling sometimes } no subtleties

demo

Hole

Brent saw this

Correlation and Mitigation Planning Site Surface Clearing

"pockets"

1.

Don't guess it - just get yes-no.

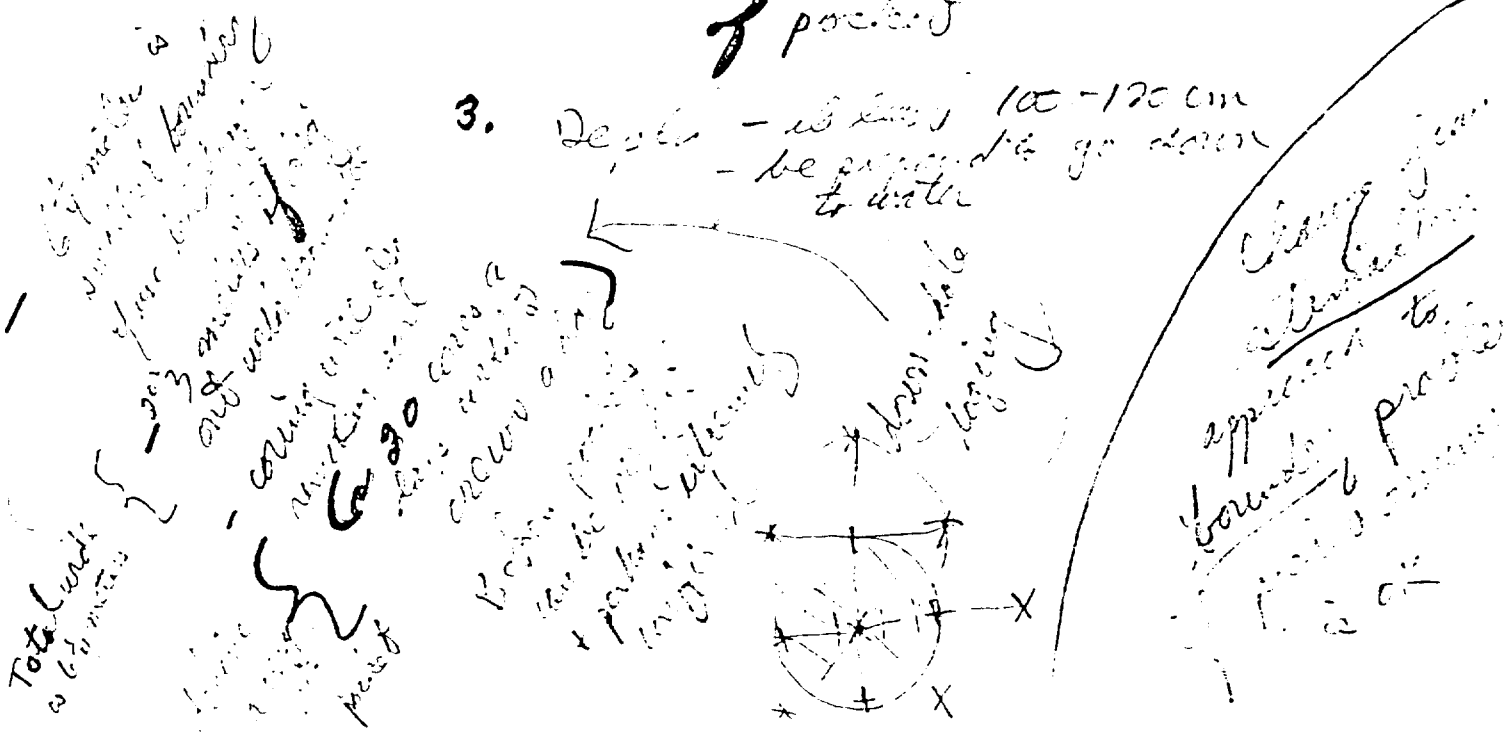
Borer (unit) pockets over-all the 1/4 ha.

no over. just yes-no

- continue with next one
- is it inside the perimeter

faster to use binoculars (very far) + simple 30 cm

1. look for good spot (unmistakable. ~ 25 or 10 m apart)
2. From center to proposed (unexpected) boundary of pocket
3. Depth - at least 100-120 cm
   - be prepared to go deeper if water



Boken point go down ≈ 100 cm (perhaps)

- Get condition D repetition

[personal opinion] } - Use lower than 160 because it's on point ✗ samples as variable.

Ex: vicinity of — a volcano

boreal area

Alice

					8.6	7.4	7.2	8.4	
		9.4	7.2	7.2	6.2	5.6	5.4	5.6	6.2	9.8
		6.2	5.6	5.6	5.6	6.2	7.2	8.4	
	7.0	6.2	7.2	7.2	8.4				
9.8	9.0								

Bella

			13.6	11.4	11.6	11.6	13.4	
		11.2	9.0	8.8	8.8	8.8	9.2	15.4
	11.0	9.0	8.8	8.8	8.8	9.0	11.0	
13.6	9.2	8.8	8.8	8.8	9.2	11.2		
11.4	8.8	8.8	8.8	9.0	11.0			
11.4	8.8	8.8	9.0	11.2				
11.4	9.0	10.0	13.4					
14.4	13.2							

Coeff. of Variation (%) $(s/\bar{x})$ ← ratio of standard deviation to $\bar{x}$.

alice

					18	16	26	80	
		24	23	20	14	13	13	21	61	290
		13	14	15	17	30	31	117		
	19	20	33	33	41					
58	69									

eberline

May 10, 1978

EI-916144

Mr. Dick Gilbert
Battelle Northwest
P. O. Box 999
Richland, Washington 99352

Dear Mr. Gilbert:

Enclosed herewith is a revised copy of the Quality Control Procedure regarding the Enewetak CleanUp Project.

If you have any comments or require any further information, please contact us.

Sincerely,

MIKE ORTIZ
Laboratory Manager

MO/jm

Encl.

PLEASE REPLY TO: ALBUQUERQUE LABORATORY P.O. BOX 3874, ALBUQUERQUE, NEW MEXICO 87110 TELEPHONE (505) 345-341

EBERLINE INSTRUMENT CORPORATION P.O. BOX 2108 SANTA FE, NEW MEXICO 87501. TELEPHONE (505) 471-3232. TWX 910-985-067

eberline

May 15, 1978

EI-916149

Mr. Dick Gilbert
Battelle Northwest
P. O. Box 999
Richland, Washington 99352

RE: Enewetak Clean-Up Project

Dear Mr. Gilbert:

Enclosed herewith is a copy of the "QA" report for March, April, 1978 for the Enewetak Clean-Up Project.

If you require anything further, please contact us.

Sincerely,

MICHAEL A. ORTIZ
Laboratory Manager

MAO/jm

Encls.

PLEASE REPLY TO: ALBUQUERQUE LABORATORY P.O. BOX 3874 ALBUQUERQUE, NEW MEXICO 87110 TELEPHONE (505) 345-3

EBERLINE INSTRUMENT CORPORATION, P.O. BOX 2108 SANTA FE, NEW MEXICO 87501. TELEPHONE (505) 471-3232. TWX 910-985-0

Phone Conversation with Jodi — May 30, 1972

Re- IMP-ing

Sally was re-IMP-ed and a correction factor of 1.6 was found necessary, i.e. old IMP readings should be multiplied by 1.6

The factor of 1.6 is not correct for alice. The old alice IMP readings were given incorrect for the water problem and the (corrected (for voltage)) readings were sent to me in the data packet from Mukabira and Jodi on May 8(?).

The factor of 1.6 (voltage correction) may be ok for Lucy, but this trend should be re-IMP-ed.

Field Activities

- Inspection visit to area by [illegible]
- Perhaps should get FG+G maps to tell us about [illegible]

Routine Activities (Operations Maintenance Activities)

a) Requisitions (per ZDK) for average use + [illegible] areas to meet recommendations [illegible]

Quantities are already available on [illegible]. The damages on 1/2 hectare areas cannot be kept [illegible] over 1/2 hectare areas

b). Records to be maintained on daily [illegible] over the [illegible] blocks and [illegible]

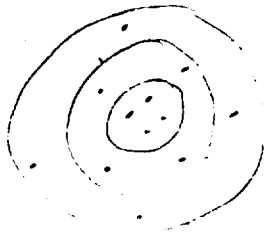
Planning

DDA wants to do the planning exercise
DCF wants to start off on the right foot with [illegible] get a set of methods (common [illegible] planning) [illegible]

- No protocol yet. Modeling + [illegible] have documents [illegible]. This must be part of the [illegible]

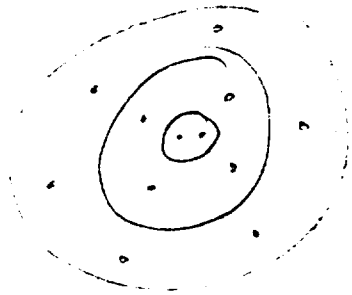
Soil Petition

Presently used Method



2, 2, 2

"Correct" petition



1, 3, 3

Sally <-- 1.6

RE IMP

1.7 voltage

1.6 not connected for arcs

Lucy = 1.6 Proton on (P)

should go back

Spot: chair/arms ? → Bob Behind

{ Burstein (5-6+6)
black & Jones 2, 5 }

Work Tuesday

- 50 cents good work for 1/4 [illegible]
- work 1/2 hour on Tuesday

DNA work

2nd, 30 [illegible]

Picture: [illegible]

{ 1, 2, 3
2, 2, 0 }

DETERMINATION OF TRANSURANIC CONCENTRATIONS IN SURFACE SOIL AT ENEWETAK

The concentrations of transuranic radionuclides (Plutonium-238, -239, -240 and Americium-241) in surface soils are determined using a sequence of procedures involving instrumental surveys, radiochemical analyses of soil samples, and statistical analysis of the data to estimate the average concentrations of transuranics in the soil.

An in-situ radiometric survey of the area under investigation is performed using a unique, self-propelled instrument system called an "IMP" (named for the small tracked vehicle that carries the system). Gamma radiation from the ground is detected by a planar intrinsic germanium detector suspended from the end of a retractable boom on the IMP. Gamma spectra from the detector are analyzed and recorded. From the 60 keV gamma, the average concentration of Am-241 in the top 3 cm of soil within the detector's field of view (a 21-meter diameter circle) is determined.

Soil samples are taken and radiochemically analyzed in the Enewetak Radiation Laboratory. The concentrations of Plutonium and Americium are determined. Conversion factors are derived from these data which allow estimates of the total transuranic concentrations in soil to be calculated from the Am-241 measurements of the IMP.

To survey a large area, the IMP travels from point-to-point along a surveyed grid, making a measurement at each grid intersection. Data from the entire survey field are statistically analyzed and isopleths are drawn of the estimated average concentrations of total transuranics in the surface soil. The isopleths are based on the 70% upper bound, i.e. the probability is at least 0.7 that the true average concentration is no greater than the upper bound. If soil is removed, this process is repeated to ascertain the concentration values of newly exposed surfaces.

WATER RESOURCES CENTER
Desert Research Institute — University of Nevada System

4582 Maryland Parkway
Las Vegas, Nevada 89109
(702) 736-2293

June 21, 1978

Dr. Richard Gilbert
Batelle-Pacific Northwest Lab.
P.O. Box 999
Richland, WA 99352

Dear Dick:

I finally received the Janet (Enjebi) map with the results recorded. Only the 70% upper bound numbers are given and not the estimates themselves. Putting all those numbers on a map is not a fun task. The intensity map indicating areas where the total transuranics is greater than 40 pCi/g is just a rough sketch I did but does give a general overview of the island. Also enclosed are the estimates and 70% upper bounds for Olive (Aej) and Vera (Alembel). This should complete the set of initial results for all the major northern islands. There may be some small islands that have not been sent but the results have not yet arrived.

The other papers enclosed are some requested from Bruce Church by you. He asked me to mail them to you.

If you have any questions or requests please call. Hopefully, I can be of more assistance than I was this morning concerning Tech Note #1.

Sincerely,

Jo J. Giacomini
Research Statistician

JG:cm

ENCL: As stated above

comments From Madalene

- drill very many places left to do more IMP-soil studies. Need labor to remove veg. in vegetated areas.

Department of Energy
Enewetak Radiological
Support Project
APO San Francisco 96333

4 August 1978

Col. Robert W. Bauchspies
Commander, JTG
Enewetak Atoll
Marshall Islands

SUBJECT: Results of Experiments Conducted on the DOE Test Plot on Island Bijire (Tilda)

Transmitted with this cover letter is Tech Note #8.0, "Field Investigation of Soil Sample Result to IMP," which presents the reasons for the experiments, describes how the experiments were conducted, lists all the raw data and analysis thereof, and states several conclusions and recommendations.

JOHN STEWART
ERSP Manager

JS:sas

Encl: As above

cc: J2, JTG
J3, JTG
W. J. Stanley, DOE/PASO, Honolulu, HI
DOE/PASO Site Rep.
ERSP Tech Advisor
ERSP File
DRI
Roger Ray, DOE-NV
Bruce Church, DOE-NV
Dr. Richard Gilbert, Battelle, Richland, WA

Notes on Plowing Study. Dr. Gilbert was sent the technical notes describing the study and the results.

Consultation with M. Bowen — 6/5

1. Stakes set by eye and hand compass
2. Pre-ploughing work by Dale Dewham (Tech. Note 7.0,
   - "Before" IMP readings (part of regular survey in Jan-Feb,
   - Profiles at IMP locations
3. Planning ploughing
   - Profiles taken at preplowing locations
   - Plowed - horizontal (to IMP and more around)
   - Ranked
   - "after" IMP readings at 8 locations (Control)
   - Profiles taken at post-plowing locations (note that a slightly different set of locations was done). ← done to avoid confounding of plowing and [illegible] effects

Time of [illegible] Depth of [illegible] pre-studies

- 0-5 cm
- 5-10
- 10-15
- 15-20

} more detailed than the layers

Root zone? →
- 30
- 40
- 50

} [illegible] (5 cm depths)

Perhaps should have sampled further down but knew where deep the plow would go.

Lab work: do more than 3 samples/profile.

Note: Took pre-plowing IMP data. need calculated one pre-plowing values.

Canonical Correlation — Factor 1: 30, 16

Quantitative Stratigraphy — 4, 5

ROG

Plowing

1. Need tight control on plowing technique to achieve desired and uniform (consistent) type of mixing and turning.

2. The layering of overturned soil raises sampling design questions. Need to know what the layering effect is if want to sample the different layers. Sampling different layers may be important if work are limited to certain layers. If we sample from top through all layers then need to adequately mix the column of soil before subsampling.

3. Sampling will need to take into account the pattern of attainment left by plow & operator

4. Are soils being measured for particle size distribution, organic matter content, cation exchange capacity, pH, and available plant nutrients?

Plowing Study (notes from M. Barnes)

1). Hot spots (~25 to 40% of surface values before plowing ← 30 cm depth
exist after plowing

2). Tech. notes may not be finished by time of our visit to Enewetak. Rough drafts are in files on Enewetak

3). Tech note 9.0 that discuss preparatory sampling (before plowing) down to 140 cm may be finished by that time.

Department of Energy
Washington, D.C. 20545

JAN 16 1979

Dr. E. M. Morimoto
Division Leader
Environmental Sciences
Lawrence Livermore Laboratory
Livermore, California 94550

Dear Ed:

During your December visit we agreed to detail what is needed in the next round of dose estimates for Bikini. As you know, it is our commitment to conduct a program of radiological follow-up and to periodically reassess radiological conditions at Bikini. LLL dose estimates along with the Brookhaven, PNL, whole body measurements are the end products of this followup. These measurements and predictions are key elements in developing advice for Department of the Interior, DOI, and Department of Defense, DOD. With the recent evacuation of Bikini Island last August, the next question is whether or not Eneu Island can be used as a village island and still maintain exposures of residents within the acceptable standards. Past data has not provided any optimism on the answer to this question. DOI is anxiously awaiting the new information. We are committed to providing this information and subsequent advice to DOI by the end of January 1979.

We have listed and enclosed suggested options relative to the assessment of Eneu as a village island. Any suggestions you have would be most welcome. We would of course be pleased to discuss this with you and Bill Robison.

Sincerely,

L. Joe Deal, Assistant Director
Division of Operational
and Environmental Safety

cc: R. J. Catlin, OECO
W. W. Burr, OHER
W. Weyzen, OHER
W. Bair, PNL
B. Wachholz
R. Ray, NV

STAFF COMMENTS

It is expected that the results of dose estimates for use of Eneu as a village island will depend to a considerable degree on the assumptions regarding land use and diet. The task of providing additional advice to DOI is further complicated by observing that while we have a chance to correct past mistakes, the problem of limiting exposures in an atoll environment is more difficult than recognized earlier.

Though the residency limitations of the return to Bikini Atoll were never well understood by the Bikinians and any understanding they may have had has been further dimmed by time, the fact is that the AEC recommendation to President Johnson for their return to the atoll and the subsequent plans for cleanup and rehabilitation of the atoll, were based primarily upon radiological considerations. First, that the U.S. radiation protection standards for exposures of individuals will be used to determine what is "safe."* Second, that any restrictions to limit exposures be simple and easily understood by the Bikinians, and three, that all involved parties maintain a spirit of cooperation to achieve the goal of the Bikinians again living in safety on their atoll. These parties include the people, their advisors, the Trust Territory Government, and agencies of the Federal Government.

In addition, past judgements and recommendations have been based on dose estimates using the average contamination level of land and food as opposed to "worst case" conditions. We believe this approach is still valid.

---

*There is no documentation that a numerical balance or trade-off was made between the benefits of the Bikinians return and the risks of radiation exposure. As stated in 1968, the predicted exposures "do not offer a significant threat to health and safety." In our strict application of Federal radiation standards for a similar decision to return the Enewetakese to their atoll, EPA considered the numerical values of these standards as upper limits.

Since then, however, we have learned that:

1. The restrictions on the location of the first village and of food crops were not followed.

2. The precautions the people needed to take to keep exposures down were neither simple to understand nor easy to apply.

3. The effort to provide alternate foods to reduce use of locally grown foods, (to keep radiation standards from being exceeded) was not successful.

4. The level of the people's understanding of precautions needed to reduce and control exposures is not well known but in view of their actions we assume it is very poor. If food is locally grown and available it will be eaten by some persons in spite of restrictions against its use.

5. The consumption of certain locally grown foods will be determined in part by local conditions. For instance, the amount of coconut milk used may be influenced by the adequacy of fresh water supplies (where there is a shortage of water, people will drink more coconut milk). Storm damage can place coconuts or other terrestrial grown foods in short supply thereby changing the diet, kind (source), and amount of food consumed.

As for the intended purpose and use of the next round of Bikini dose estimates, these will be used as the basis for advice on whether or not the Bikini people should return to live on Eneu Island. Predicted doses, expressed as the highest annual whole body and bone marrow doses for individuals and 30-year whole body doses for the population, from all contributing radionuclides, will be evaluated using current radiation standards. As at Enewetak, 50 percent of annual and 80 percent of 30-year standards will be used in evaluating resettlement options. Doses from transuranium elements will be compared with the 1 mRad/yr to lung and 3 mRad/yr to bone as presented in EPA's proposed guidelines. If the radiological data base is adequate it would be most helpful to have dose estimates for the three options listed below. Among these, results for option I are essential to providing additional advice to DOI. Therefore option I should be given highest priority.

I. Live on Eneu Island - all food grown on Eneu plus fish from lagoon:

   a. plus imported food

b. no imported food

c. no imported food plus water shortage

II. Live on Eneu Island - all food grown on Eneu except not all coconut from Eneu (plus imported food):

a. 10 percent Bikini Island coconut and coconut milk

b. 50 percent Bikini Island coconut and coconut milk.

III. Live on Bikini Island - all food grown on Bikini plus fish from lagoon (plus imported food).

The age group in the population receiving the highest annual dose should be used. Average values should be used for external radiation levels (by island) as well as for contamination levels of items of the diet. The diet used for previous Bikini estimates should be updated for these predictions where needed. The aerial radiological survey data from the Bikini portion of the Northern Marshalls survey should be used.

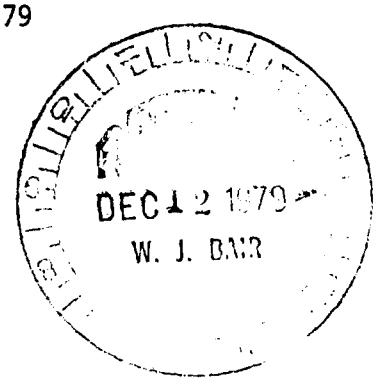
If for Options I, II, and III above there are any significant differences in the dietary intake within the population that could cause a few individuals (as opposed to consideration of differences among age groups) to receive higher doses, these should be evaluated. Annual whole body and bone marrow doses (in the highest year) for such individuals would be predicted.

Finally, the exposure history for those who have already lived on Bikini Island must not be overlooked. In calculating 30-year exposures for all three options, this past exposure must be included. Since the standard applies to the average exposure of a population, it is suggested that an average value be developed for those who lived on Bikini Island. This value will be included in all 30-year dose estimates.

ENCLOSURE A

Department of Energy
Washington, D.C. 20545

September 28, 1979



Mrs. Ruth Van Cleve
Director, Office of
Territorial Affairs
Department of Interior
Washington, D. C. 20240

Dear Mrs. Van Cleve:

The following is in response to your verbal request that the Department of Energy assess for you the radiological consequences which might accrue to the people of Enewetak assuming that they reside only on the islands of Enewetak, Medren and Japtan, and assuming that coconut trees are planted on the northeastern islands of the Enewetak Atoll, specifically the islands of Lujor, Lojwa, Aomon, Bijire, Aej and Alembel.

In what follows we are concerned only with potential health consequences to the people of Enewetak and not with the question of the acceptability or marketability of copra produced from the coconut trees on the world market or at specific processing facilities, nor with any possible U.S. involvement with respect to the acceptability or marketability of the copra. Information regarding the distribution or binding properties of radionuclides of concern in coconuts is not yet available, and the commercial implications of same is an issue not addressed in this letter.

The exposure estimates below are based upon preliminary information analyzed by the staff of the Lawrence Livermore Laboratory and included in their draft report entitled, "Preliminary Reassessment of the Potential Radiological Doses for Residents Resettling Enewetak Atoll." It must be emphasized that while these values are best estimates, they are only estimates and could be in error by a factor of 2 or more. Furthermore, they are based upon average values (e.g., average diets, average island contamination values, average uptake of radionuclides by food plants, etc.), and individuals will depart from the average--in either direction--to varying degrees depending upon personal lifestyles, proclivities, and diet preferences. Nor do the exposure estimates consider those individuals who might, for whatever reason, engage in practices which could lead to excessive exposures.

Although the data base for the potential exposure estimates is not yet complete (e.g., the island of Lujor had not yet been factored into the dose calculations), it is not expected that additional information will substantively alter the exposure estimates; should this occur, however, we will immediately inform you.

The calculated radiation exposure levels for living only on Enewetak, Medren and Japtan islands are:

	Maximum Individual	30-Years
with imported food	11 millirem/year	100 millirem-bone marrow 69 millirem-whole body
without imported food	24 millirem/year	220 millirem-bone marrow 120 millirem-whole body

If it is assumed that 15% of their time is spent on the northern islands, and that 10% of their total intake of coconut meat/milk originates from the coconut trees of the northeastern islands, the calculated radiation exposure levels are:

	Maximum Individual	30-Years
with imported food	28 millirem/year	250 millirem-bone marrow 200 millirem-whole body
without imported food	51 millirem/year	460 millirem-bone marrow 270 millirem-whole body

For purposes of reference, it may be recalled that U.S. exposure criteria are:

Maximum exposure to an individual in any one year: 500 millirem

Integrated 30-year exposure level: 5000 millirem

Because of the uncertainties and assumptions which are inherent in deriving radiation exposure estimates of this nature, the Atomic Energy Commission Task Group report recommended the following exposure limits for planning and cleanup purposes:

Maximum exposure to an individual in any one year: 250 millirem

Integrated 30-year exposure level: 4000 millirem

Given the assumptions and limitations stated, it is apparent that all of the radiation exposure estimates are below both the U.S. exposure guidance and the AEC recommendations.

I hope that this information is helpful to you and responsive to your request.

Sincerely,

Bruce W. Wachholz

Bruce W. Wachholz, Ph.D.
Office of Environment

Enclosure B

Honorable Sidney R. Yates
Chairman, Subcommittee on Interior
Committee on Appropriations
House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

As promised in my progress report of July 3, 1979, on Enewetak Rehabilitation and Resettlement Project to your Committee, I am submitting this followup report on recent developments.

The Department of Energy during March and April of this year conducted a new soil survey of Engebi Island and other northern islands of Enewetak Atoll, and the results were analyzed by the Lawrence Livermore Laboratory. A draft report entitled, "Preliminary Reassesment of the Potential Radiological Doses for Residents Resettling Enewetak Atoll" was issued by DOE on July 23, 1979. This preliminary report has not yet been released because survey results on one additional northeASTERN island, Lujor, AND ALL OF THE ISLANDS IN THE NORTHWEST still have to be factored into the dose calculations. It is not expected that the additional information will substantially alter the exposure estimates FOR THE LIFESTYLES CONSIDERED, HOWEVER. Copies of the final reassessment report will be provided to the Committee as soon as it is released by the Department of Energy.

discussion of decision based upon risk vs. standards?

The preliminary assessment report, however, enabled actions to take place on a number of pending items, and it is on these that I report.

Planting of the Northern Islands

You will recall from my July 3, 1979, progress report, that planting of the six northern islands of Enewetak (exclusive of Engebi Island) had been held up pending the results of the new soil analysis. The planting of these six northern islands was part of the Enewetak Rehabilitation Master Plan. The Enewetak Rehabilitation Master Plan, as funded by appropriations through your Committee, called for residence only on the three southern islands of the Atoll, Enewetak, Medren, and Japtan. Coconut and other agricultural planting was to confined to the southern islands and certain of the northern islands. The people of Enewetak agreed to these stipulations.

The exposure analyses in the "Preliminary Reassessment Report" demonstrated that, under certain assumptions and limitations, all of the radiation exposure estimates would be below the U.S. exposure guidance and A.E.C. recommendations. The potential situation is outlined in a September 28, 1979, letter from the Department of Energy to the Director of the Office of Territorial Affairs. A copy of that letter is enclosed for your information.

On the basis of the DOE analysis, the decision was made in September to proceed with the planting of coconut trees on these six northern islands and the planting program on these islands now is underway.

Dose Assessment Meeting

The "Preliminary Dose Reassessment Report" also permitted the "Dose Assessment" meeting that the people of Enewetak had requested in December 1978, to take place. This meeting with the people of Enewetak originally had been scheduled for May 1979. For various reasons, it had to be rescheduled and the meeting was held on Ujelang Island on September 19 and 20. The ~~bulk~~ MAJORITY of the people of Enewetak still reside on Ujelang pending a return to Enewetak Atoll. The Department of the Interior was represented at the September meeting on Ujelang by the Solicitor of the Department, Mr. Leo Krulitz.

At the December 1978 meeting, the Department of Energy had been requested to give a risk assessment review to the people of Enewetak. Subsequently, in July 1979, the Legal Advisor for the people of Enewetak, Mr. Theodore Mitchell, Micronesian Legal Services Corporation, informed the Department of Energy that he had retained scientific consultants and he would not need to rely upon the Department of Energy for that type of information. The Department of Energy and this Department believes, however, that the United States

executive branch also had a responsibility to report on conditions at Enewetak Atoll to the people. The Department of Energy, accordingly, prepared a presentation which was given to the people of Enewetak at the meeting on Ujelang. The presentation was given in Marshallese, slides were shown, and a booklet describing the conditions on Enewetak Atoll was distributed to the people. The booklet, entitled "Enewetak Atoll Today", is in Marshallese and English and copies were provided ~~for~~ TO all ~~adults~~ MEMBERS of the community. A copy of "Enewetak Atoll Today" is enclosed for the Committee's information.

The Legal Counsel for the people of Enewetak and the independent consultants presented a risk assessment to the people at a closed session to which government representatives were not invited. Copies of the presentation given by scientists retained by the Micronesian Legal Services Corporation will be provided as soon as they are received from the Legal Advisor for the people of Enewetak.

Engebi Resettlement

The consultants for the Micronesian Legal Services Corporation contend that the risks from living on Engebi Island are so small as to be essentially insignificant. In their estimation, only approximately one additional cancer death in the lifetime of the population would result, and they believe that it might take five generations before even one

extra case of a birth defect would appear.

The Department of Energy and its scientific advisors agree, in general, with this interpretation of the risk analysis. The DOE risk analysis for living on Engebi Island under varyin conditions are shown in the diagrams and explanations on pages 22-24 of the Booklet, "Enewetak Atoll Today".

This Department, however, holds that as long as the United States retains a trust responsibility for the people of Enewetak, and so long as the United States is potentially liable for erroneous decisions, there will be some issues relating to Enewetak Resettlement that cannot be decided by vote of the Enewetakese. It is our opinion that, even though the risk of living on Engebi Island appears to be slight, and even though the people of Engebi have expressed a strong desire to live on Engebi, a final decision cannot be made without further study.

It should be noted that when the Cleanup Program was authoriz and funded by the Congress, the Armed Services Committee made clear that there was to be no resettlement permitted in Enewetak Atoll unless the RECOMMENDED radiation EXPOSURE LIMITS ~~standards~~ established by the Energy Research and Development Administration were met.

Senate Armed Services Committee Report 94-157 of May 22, 1975 page 10, on the Enewetak Cleanup funding by the Department of Defense stated: (Underlining ours)

"The Committee agreed to a one time authorization of $20 million to accomplish the cleanup. The Department is charged to accomplish the cleanup within that amount using every possible economy measure. The Committee insists that radiation standards established by the Energy Research and Development Agency be met before any resettlement be accomplished."

In hearings that gave rise to that report, Mr. Mitchell, then as now counsel for the people of Enewetak, supported the above result, at hearings of May 7, 1975 on H.R. 5210 before the Subcommittee on Military Installations and Facilities (page 162 - 165), stated:

" . . . . ERDA has been, I think wisely conservative in the standards that they have set.

So that the ultimate objective, the premise of the clean-up program, is that when it is done, there will not be a danger, a risk, for these people, for the entire atoll.

. . . . I don't want these people to be endangered at all.

. . . . No danger to the people."

Similarly, when the Department of Interior's request for rehabilitation and resettlement funds was under consideration before your Subcommittee on March 17, 1977, there was

strong reiteration that Federal Radiation standards would be followed. General Warren D. Johnson, then Director of DNA, was a backup witness at this hearing and testified: (p. 768)

" . . .The Department of Defense is committed to clean the island up to the standards established by ERDA, and ERDA is committed to assure we have reached those standards, so this is a coordinated effort. In other words, we cannot move anybody back until ERDA says, "You have done what we have said has to be done."

The Master Plan for the Enewetak Rehabilitation and Resettlement Program that was submitted to your Committee for funding in 1977 was developed around the radiation standard stipulations set forth by the Department of Energy and by Congress when it approved the cleanup funding. As noted earlier in this report, the Master Plan called only for the rehabilitation and resettlement of the three southern islands, Enewetak, Medran, and Japtan, and for the planting of only certain of the northern islands as well as the southern islands. Engebi Island was not to be used for the next 35-50 years, i.e., until natural decay of strontium AND cesium elements in the soil had ~~brought about acceptable levels~~ RESULTED IN POTENTIAL RADIATION EXPOSURE LEVELS WHICH WOULD BE WITHIN THE APPLICABLE STANDARDS. The people of Enewetak agreed to these stipulations and had a major role in the development of the approved Master Plan. Thus, in addition to the radiation risk elements still unresolved, resettlement of the Engebi people on Engebi

Island at this time would be a major change in the cleanup and rehabilitation plan. Congress also has not authorized funds, as yet, to provide for housing and community facilities on Engebi.

Nonetheless, given the present desire of the people of Engebi, that in spite of the risk elements involved they wish to reside on Engebi Island , this Department has indicated that it would study the matter further with knowledge of the people's preference. This study now is underway.

Irrespective of the final decision with respect to Engebi, of which we will advise you when it is made, additional funding for the Enewetak Project would appear to be necessary. Should it finally be decided that housing and community facilities should be built at this time on Engebi, funding for these facilities will be required. Conversely, if the decision is that Engebi should remain "off-limits" for residential and other purposes for another 35-50 years, it is our belief that the U.S. Government has a moral and legal obligation to provide, before termination of the trusteeship, a suitable financial arrangement that would insure the ability of the people of Engebi to build appropriate housing and community facilities on Engebi at a period in the future when the ~~reduced~~ BE REDUCED TO SUCH A LE radiation levels of the island will ~~not pose a risk hazard to them~~ THAT APPLICABLE STANDARDS WOULD NOT BE EXCEEDED. This matter also is under study and we will keep the Committee informed of developments.

Sincerely,

UNDER SECRETARY

Enclosures.

Enclosure
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Department of Energy
Washington, D.C. 20545

OCT 29 1979

J. BAIR

Mr. John E. DeYoung
Territorial Officer, Trust Territory
of Pacific Islands and Guam
Department of the Interior
Room 4308
18th & C Streets, N.W.
Washington, D.C. 20240

Dear John:

Enclosed are our comments on your draft letter to Representative Yates.

We appreciate the opportunity to offer comments on this letter, and we trust that they will be helpful to you.

Sincerely,

Bruce W. Wachholz, Ph.D.
Office of Environment

Enclosure

Comments on Draft Letter from Department of Interior to Representative Yates

Major Comments

1. The primary point of the letter seems to be a discussion of the possible resettlement of Enjebi. It would seem appropriate, therefore, for this issue to be discussed at the beginning of the letter rather than at the very end.

2. The space devoted to discussion of coconut planting and of the Ujelang conference seem disproportionately large compared to the primary purpose of the letter (i.e., the possible resettlement of Enjebi).

3. There seems to be an imbalanced discussion of the two alternate ways of approaching the question of Enjebi: cost-risk-benefit evaluation versus strict application of radiation exposure limits. The discussion of the "Enjebi Resettlement" does not clearly or adequately address the subject of U.S. radiation exposure limits. The first two paragraphs of this section discuss risk, the third addresses Interior's position, while those following state what various opinions (e.g., Congress, Mr. Mitchell) were on the AEC/ERDA recommended exposure limits at the time of the authorization. Either prior to or following the third paragraph (i.e., Interior's position), it would be helpful to clarify the background of radiation exposure limits: FRC guidance, AEC/ERDA recommendations to Interior (and why they differed from the FRC), and the recent EPA position (although this also might logically come later in the discussion). The two philosophies (risk vs. exposure level) should be understood by the reader. (A restructuring of this

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section - e.g., FRC, AEC/ERDA recommendations, Mr. Mitchell's and Congress' opinion, cleanup plan, risk and the peoples' preference, Interior's position, then the current last paragraphs might be more informative. With the "Ujelang Conference" immediately preceding this section, however, the paragraphs on risk do follow naturally.)

4. Using FRC guidance as the exposure limit (rather than the AEC/ERDA recommendations) which was endorsed by the EPA, the length of elapsed time until potential radiation exposures on Enjebi Island would be within the FRC guidance varies according to the assumed living pattern:

A. Live on Enjebi
   Imported food available and a daily part of the diet
   Coconuts available only from the southern islands
   Waiting period - 0 years

B. Live on Enjebi
   No imported food available
   Coconuts available only from the southern islands
   Waiting period - 10-15 years

C. Live on Enjebi
   Coconuts grown in north
   Waiting time - 30-70 years depending upon
   a) Whether or not food is imported
   b) Whether coconuts are grown on Enjebi, and/or
   c) Whether coconuts are grown on the other six northeastern islands

If the decision already has been made to plant coconuts on the six northeastern islands, then options A and B above become academic, and the waiting period becomes 30 to about 65 years depending upon the availability and use of imported foods. Of course, use of the AEC/ERDA/DOE recommendations would extend this time period.

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-5. It should be made clear that the decision to plant the coconut trees on the six northeastern islands was based solely upon the additional potential radiation exposure to people assumed to reside on Enewetak, Japtan, and Medren Islands. More specifically, presumably the decision did not consider the acceptability or unacceptability of copra from these coconut trees at processing plants or on the world market. This should be clarified. The following sentence, inserted after the first sentence of the last paragraph on the bottom of page 2, would be appropriate: "The Preliminary Reassessment Report does not address the issue of the acceptability on the world market of copra obtained from coconut trees planted on those six islands, however, and the implication of this issue, particularly in view of the experience of copra from trees planted on Bikini Island, has yet to be resolved." The decision to plant the trees, and the bases for it, are recognized to be Interior's responsibility, however.

Additional Comments

Page 1, Paragraph 2

We have no problem with the two sentences beginning "This preliminary..." being omitted. If they are retained, however, "northern" should be replaced by "northeastern," and the words "and all of the islands in the northwest" should be inserted before the word "still." Furthermore, after "exposure estimates" please insert the words "for the lifestyles considered, however."

Page 2, Paragraph 3

The terms "all of the radiation exposure estimates..." should be clarified that the statement pertains only to the living conditions identified in the preceding paragraph.

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Page 3, Line 12

Replace "bulk" with "majority."

Page 3, Line 18

Insert "by Mr. Mitchell" between "requested" and "to."

Page 3, Line 25

Typo - "believed"

Page 4, Line 7

Omit comma after "entitled."

Page 4, Line 9

Replace "for" with "to," and replace "adults" with "members."

Page 5, Line 20

Replace "...the radiation standards established by..." with "...the radiation exposure limits recommended by..."

Page 6, Line 8

Insert "to" between "rise" and "that."

Page 7, Line 15

Typo - "earlier"

Page 7, Line 20, and Page 8, Line 17

"30-50 years" should be "30-65 years"

Page 7, Line 20

"...strontium and cesium"

Page 7, Line 21

Suggest "...soil had resulted in potential radiation exposure levels which would be at least within the U.S. exposure limits."

Page 8, Line 23

Omit "reduced"

Page 8, Lines 23-24

Replace "...not pose a risk to them." with "...be reduced to such a level that applicable exposure limits would not be exceeded."

Enclosure 1

Draft #2
12/3/79

Mrs. Ruth G. Van Cleve, Director
Office of Territorial Affairs
U. S. Department of the Interior
Office of the Secretary
Washington, D.C. 20240

Dear Mrs. Van Cleve:

Reference is made to your letter of October 22, 1979, in which you state that the Department of the Interior is considering the agricultural redevelopment of Enjebi Island and the reestablishment of a community on that island for the Enjebi people. As part of this consideration you requested estimates of the time which must elapse before exposure levels on Enjebi Island would meet exposure limits.

Current estimates of the number of years which must pass if exposure limits are to be adhered to are based upon the potential dose estimates provided in the Preliminary Dose Assessment Report prepared by the staff of the Lawrence Livermore Laboratory (LLL). These dose estimates have been compared to the exposure guidance, and, based upon known radioactive decay rates of the radionuclides involved, time intervals have been calculated. U. S. Federal Radiation Council recommended exposure levels (adopted also by the Environmental Protection Agency) are 500 mrem to the maximum exposed invididual in any one year (and assumes that the maximum exposed individual does not vary from the average population exposure by more than a factor of 3, resulting in a recommended average population exposure level of 170 mrem per year) and 5000 mrem over a 30 year period. Atomic Energy Commission recommendations, recognizing the uncertainties inherent in such dose estimates, were one-half of the FRC guidance for the maximum

individual, or 250 mrem in any one year and eighty per cent of the 30 year exposure value, or 4000 mrem over 30 years.

Several different scenarios and living patterns and conditions were examined assuming that people would be living on Enjebi:

Living Pattern	Potential Exposure(mrem)	Years to Meet FRC Guidance
a. Local and imported food consumed Coconuts only from southern islands	300	0
b. No imported food available Coconuts only from southern islands	560	10-15
c. Local and imported food consumed Coconuts only from Enjebi	975	35-40
d. Local and imported food consumed Coconuts from Enjebi to Billae	900	30-35
e. No imported food available Coconuts only from Enjebi	2000	65-70
f. No imported food available Coconuts from Enjebi to Billae	1860	60-65

(The assumptions underlying these estimates are identified in the LLL preliminary report and should be recalled, e.g., time spent on islands other than Enjebi, coconuts consumed from other islands, etc.)

If the AEC recommendations are applied, the time intervals increase by about 30 years. For example, category "c" above would be about 65-70 years, category "d" would be 60-65 years, category "e" would be about 95-100 years, and category "f" would be about 90-95 years.

Presumably this decision was based at least in part upon our letter to you of September 28, 1979, in which we estimated the potential additional radiation exposure to people assumed to live on Enewetak,

Japtan and Medren islands, should the six islands be planted with coconut trees. The assumptions inherent in those dose estimates were identified in that letter. As we pointed out in that letter, however, the dose estimates do not account for those individuals who might, for whatever purpose, engage in activities and practices which would lead to greater exposures than those indicated.

Furthermore, we stated in that letter that the acceptability of copra from those coconut trees at processing facilities or its marketability in world commerce was not being addressed. At present there is no basis for encouraging the expectation that "science" will find a way to reduce the uptake of radionuclides, particularly cesium and strontium, by coconut trees. While studies to modify this uptake continue to be in progress, currently there is no justification for optimism on this matter.

An additional question is the administrative mechanism by means of which decisions will be made in the years to come should the concentration of radionuclides in the coconuts be unacceptable on the world market. Based upon the experience at Bikini Island, and in view of Mr. Deal's letter of September 29, 1978, to Admiral Monroe, the unacceptability of these coconuts on the world market would appear to be a very real possibility. In view of the changing relationships in the Marshall Islands, it is not clear where responsibility and authority may reside should this matter need to be addressed in the future.

Enclosed are 20 copies of the book "Enewetak Today," which was presented to and discussed with the Enewetak people at Ujelang. These may help to supplement those which you previously received directly from Dr. Bair.

I hope that this information is responsive to your request. Please let me know if we can be of further assistance.

Sincerely,

Bruce W. Wachholz, Ph.D.
Office of Environment

20 Enclosures

bcc: McCraw, Deal, Burr, Hollister, Clusen

Concurrence: McCraw, Deal, Burr, Hollister, Watters, McCammon

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Department of Energy
Washington, D.C. 20545

DEPARTMENT OF ENERGY

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FROM: Bruce Wachholz NAME
DOE, GTN LOCATION
233-4365 TELEPHONE NR

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DEC 21 1979
W. J. BAIR

December 21, 1979

J. A. Auxier, ORNL
W. J. Bair, PNL
C. W. Francis, ORNL
R. O. Gilbert, PNL
J. W. Healy, LASL
R. O. McClellan, ITRI
C. R. Richmond, ORNL
W. L. Templeton, PNL
R. C. Thompson, PNL

4416
- 1 -

SUBJECT: Calibration, Certification and Congress

Several things suggest that it might not be useful to meet during the week of January 7.

1. Roger Ray will be at Enewetak that week for previously scheduled meetings.

2. Roger Ray feels that the calibration information analysis will not be completed by that time, primarily because "not much will be done in the next two weeks."

3. Certification documents need to be revised prior to April, but there is no more restrictive time constraint.

4. Senate hearings are postponed to February 13-14 in Honolulu.

The above suggest that some date in February might be more appropriate for the above subjects. Furthermore, I am hopeful of scheduling a BNL program review in February. Will solicit your availability re dates as soon as possible.

Met December 17 with staff of Senate Committee on Energy and Natural Resources. Day 1 of the hearings will feature up to 4 hours of Executive Branch (DOI, DOE, DNA, EPA) testimony on the background and history of Bikini and Enewetak, how we got to where we are today, plus current conditions and differences between atolls (Enewetak/Bikini) and islands (Kneu/Enjebi). Day 2 will feature what options and directions exist for the future. Second day participants will be DOI (with DOE and EPA support), representatives/members of the Government of the Marshall Islands, members of the Bikini council and their legal counsel (Weisgall), and members of the Enewetak council and their legal counsel (Mitchell) and advisors (Brill, Bender and Kiste).

Since the agencies are to integrate their testimony, and since there appears to be more than a little confusion and uncertainty as to how this is to be handled, it seems inappropriate to tie up your time early in January. In view of the above, therefore, I would suggest that it would be useful to meet on the January 9-11 dates discussed last week. If a meeting re the hearing testimony would be beneficial, I will contact you. We should, however, plan to meet in February re calibration, certification and BNL.

Thank you for your time and comments last week.

Bruce W. Wachholz

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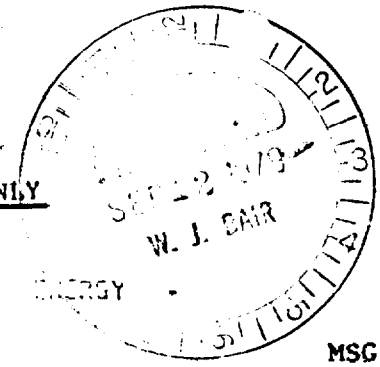

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Washington, D.C. 20545

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TO: William Bair NAME — PNL; Richland, Wash. LOCATION — 509-946-2431 TELEPHONE NR.

FROM: B. Wachholz NAME — DOE, Germantown LOCATION — 233-4365 TELEPHONE NR.

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9358

Would you please consider and comment upon the following revised letter to Interior re. coconuts on the northeastern islands of Enewetak:

The following is in response to your verbal request that the Department of Energy assess for you the radiological consequences which might accrue to the people of Enewetak assuming that they reside only on the islands of Enewetak, Medren and Japtan, and assuming that coconut trees are planted on the northeastern islands of the Enewetak Atoll, specifically the islands of Lujor, Lojwa, Aomon, Bijire, Aej and Alembel.

In what follows we are concerned only with potential health consequences to the people of Enewetak and not with the question of the acceptability or marketability of copra on the world market or at specific processing facilities, nor with any possible U.S. involvement with respect to the acceptability or marketability of the copra. Information regarding the distribution or binding properties of radionuclides of concern in coconuts is not yet available, and the commercial implications of same is an issue not addressed in this letter.

The exposure estimates below are based upon preliminary information analyzed by the staff of the Lawrence Livermore Laboratory and included in their draft report entitled, "Preliminary Reassessment of the Potential Radiological Doses for Residents Resettling Enewetak Atoll." It must be emphasized that while these values are best estimates, they are only estimates and could be in error by a factor of 2-3. Furthermore, they are based upon average values, and individuals could depart from the average -- in either direction -- to varying degrees depending upon personal lifestyles, proclivities, and diet preferences. Nor do the exposure estimates consider those individuals who might, for whatever reason, engage in practices which could lead to excessive exposures.

Although the data base for the potential exposure estimates is not yet complete (e.g., the island of Lujor had not yet been factored into the dose calculations), it is not expected that additional information will substantively alter the exposure estimates; should this occur, however, we will immediately inform you.

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-2

The calculated radiation exposure levels for people living only on Enewetak, Medren and Japtan islands are:

	Maximum Individual	30-Years
with imported food	11 Millirem/Year	100 Millirem-Bone Marrow 69 Millirem-Whole Body
without imported food	24 Millirem/Year	220 Millirem-Bone Marrow 120 Millirem-Whole Body

If it is assumed that 15% of their time is spent on the northern islands, and that 10% of their total intake of coconut meat/milk originates from the coconut trees of the northeastern islands, the calculated radiation exposure levels are:

	Maximum Individual	30-Years
with imported food	28 Millirem/Year	250 Millirem-Bone Marrow 200 Millirem-Whole Body
without imported food	51 Millirem/Year	460 Millirem-Bone Marrow 270 Millirem-Whole Body

For purposes of reference, it may be recalled that U.S. exposure criteria are:

Maximum exposure to an individual in any one year: 500 mrem

Integrated 30-Year exposure level: 5000 Millirem

Because of the uncertainties and assumptions which are inherent in deriving radiation exposure estimates of this nature, the Atomic Energy Commission Task Group report recommended the following exposure limits for planning and cleanup purposes

Maximum exposure to an individual in any one year: 250 Millirem

Integrated 30-Year exposure level: 4000 Millirem

Given the assumptions and limitations stated, it is apparent that all of the radiation exposure values are compatible with both the U.S. Exposure Guidance and the AEC Recommendations.

I hope that this information is helpful to you and responsive to your request.

DOE Form AD-321
(6-78)
Exception to SF 14, Approved by NARS, June 1976

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6. FROM DR. BRUCE WACHHOLZ
OFFICE OF ENVIRONMENT
DEPARTMENT OF ENERGY
WASHINGTON, D. C. 20545

7. [signature] (Signature of authorizing official)

8. DATE SEPTEMBER 7, 1979

9. TO BAIR COMMITTEE (ATTACHED LIST OF ADDRESSEES)

COMMUNICATION CENTER ROUTING 69 69

THE DEPARTMENT OF INTERIOR RECENTLY REQUESTED A DOE OPINION RE THE RADIOLOGICAL CONSEQUENCES OF PLANTING THE NORTHEASTERN ISLANDS WITH COCONUT TREES IF THE ENEWETAK PEOPLE ARE RELOCATED SOLELY ON THE SOUTHERN ISLANDS OF ENEWETAK, MEDREN AND JAPTAN. THIS ALTERNATIVE WAS INCLUDED BY LLL IN THEIR DRAFT DOSE ASSESSMENT, WHICH IS THE BASIS FOR THE PROPOSED RESPONSE. IT WOULD BE MUCH APPRECIATED IF YOU COULD REVIEW THIS DRAFT LETTER AND COMMUNICATE ANY COMMENTS/SUGGESTIONS TO ME BY COB MONDAY, SEPTEMBER 10. DRAFT LETTER FOLLOWS:

THE FOLLOWING IS IN RESPONSE TO YOUR VERBAL REQUEST THAT THE DEPARTMENT OF ENERGY ASSESS FOR YOU THE RADIOLOGICAL CONSEQUENCES WHICH MIGHT ACCRUE TO THE PEOPLE OF ENEWETAK ASSUMING THAT THEY RESIDE ONLY ON THE ISLANDS OF ENEWETAK, MEDREN AND JAPTAN, AND ASSUMING THAT COCONUT TREES ARE PLANTED ON THE

Elite Pica

Sept 7 [illegible]

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NORTHEASTERN ISLANDS OF THE ENEWETAK ATOLL, SPECIFICALLY THE ISLANDS OF LUJOR, LOJWA, AOMON, BIJIRE, AEJ AND ALEMBEL.

IN ADDITION TO THE ABOVE ASSUMPTIONS, IT MUST BE STATED THAT THE FOLLOWING DOES NOT CONSIDER THE CONSEQUENCES OF COMMERCIAL QUANTITIES OF COCONUT TREES WITH RESPECT TO THE ACCEPTABILITY OR MARKETABILITY OF THE COPRA ON THE WORLD MARKET OR AT SPECIFIC PROCESSING FACILITIES. NOR DOES THE FOLLOWING CONSIDER ANY SUBSEQUENT U.S. INVOLVEMENT WITH RESPECT TO A COPRA YIELD WHICH IS UNACCEPTABLE TO PROCESSORS OR TO THE WORLD MARKET.

FURTHERMORE, THE EXPOSURE ESTIMATES BELOW ARE BASED UPON PRELIMINARY INFORMATION ANALYZED BY THE STAFF OF THE LAWRENCE LIVERMORE LABORATORY AND INCLUDED IN THEIR DRAFT REPORT ENTITLED, "PRELIMINARY REASSESSMENT OF THE POTENTIAL RADIOLOGICAL DOSES FOR RESIDENTS RESETTLING ENEWETAK ATOLL." WHILE THIS INFORMATION IS NOT YET COMPLETE (E.G., THE ISLAND OF LUJOR HAS NOT YET BEEN FACTORED INTO THE DOSE CALCULATIONS), IT IS NOT EXPECTED THAT ADDITIONAL INFORMATION WILL SUBSTANTIVELY ALTER THE EXPOSURE ESTIMATES; SHOULD THIS OCCUR, HOWEVER, WE WILL IMMEDIATELY INFORM YOU.

THE CALCULATED RADIATION EXPOSURE LEVELS FOR PEOPLE LIVING ON ENEWETAK, MEDREN AND JAPTAN ISLANDS ARE:

	MAXIMUM INDIVIDUAL	30-YEARS
WITH IMPORTED FOOD	11 MILLIREM/YEAR	100 MILLIREM - BONE MARROW 69 MILLIREM - WHOLE BODY
WITHOUT IMPORTED FOOD	24 MILLIREM/YEAR	220 MILLIREM - BONE MARROW 120 MILLIREM - WHOLE BODY

IF IT IS ASSUMED THAT 15% OF THEIR TIME IS SPENT ON THE NORTHERN ISLANDS, AND THAT 10% OF THEIR TOTAL INTAKE OF COCONUT MEAT/MILK ORIGINATES FROM THE COCONUT TREES OF THE NORTHEASTERN ISLANDS, THE CALCULATED RADIATION EXPOSURE LEVELS ARE:

	MAXIMUM INDIVIDUAL	30-YEARS
WITH IMPORTED FOOD	28 MILLIREM/YEAR	250 MILLIREM - BONE MARROW 200 MILLIREM - WHOLE BODY
WITHOUT IMPORTED FOOD	51 MILLIREM/YEAR	460 MILLIREM - BONE MARROW 270 MILLIREM - WHOLE BODY

FOR PURPOSES OF REFERENCE, IT MAY BE RECALLED THAT U.S. EXPOSURE CRITERIA ARE:

MAXIMUM EXPOSURE TO AN INDIVIDUAL IN ANY ONE YEAR: 500 MILLIREM

INTEGRATED 30-YEAR EXPOSURE LEVEL: 5000 MILLIREM

BECAUSE OF THE UNCERTAINTIES AND ASSUMPTIONS WHICH ARE INHERENT IN DERIVING RADIATION EXPOSURE ESTIMATES OF THIS NATURE, THE ATOMIC ENERGY COMMISSION TASK GROUP REPORT RECOMMENDED THE FOLLOWING EXPOSURE LIMITS FOR PLANNING AND CLEANUP PURPOSES:

MAXIMUM EXPOSURE TO AN INDIVIDUAL IN ANY ONE YEAR: 250 MILLIREM

INTEGRATED 30-YEAR EXPOSURE LEVEL: 4000 MILLIREM

GIVEN THE ASSUMPTIONS STATED, IT IS APPARENT THAT ALL OF THE RADIATION EXPOSURE VALUES ARE COMPATIBLE WITH BOTH THE U.S. EXPOSURE GUIDANCE AND THE AEC RECOMMENDATIONS.

I HOPE THAT THIS INFORMATION IS HELPFUL TO YOU AND RESPONSIVE TO YOUR REQUEST.

Addressees:

Dr. William J. Bair
Manager, Environment, Health
and Safety Research Program
Battelle-Pacific Northwest Laboratory
P. O. Box 999
Richland, Washington 99352

Dr. Chester W. Francis
Environmental Sciences Division
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830

Dr. Richard O. Gilbert
Energy Systems Department
Battelle-Pacific Northwest Laboratory
P. O. Box 999
Richland, Washington 99352

Dr. John W. Healy
H Division - Health Research
Los Alamos Scientific Laboratory
P. O. Box 1663
Los Alamos, New Mexico 87545

Dr. Roger O. McClellan
Director, Lovelace Inhalation
Toxicology Research Institute
P. O. Box 5890
Albuquerque, New Mexico 87115

Dr. Chester R. Richmond
Associate Director, Biomedical and
Environmental Sciences
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830

Dr. William L. Templeton
Associate Manager, Ecosystems Dept.
Battelle-Pacific Northwest Laboratory
P. O. Box 999
Richland, Washington 99352

Dr. Roy C. Thompson
Biology Department
Battelle-Pacific Northwest Laboratory
P. O. Box 999
Richland, Washington 99352

Dr. John A. Auxier
Director, Health Physics Division
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830

Dr. William Robison
Terrestrial & Atmospheric Sciences
University of California
Lawrence Livermore Laboratory
P. O. Box 808
Livermore, California 94550

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Washington, D.C. 20545

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FROM: B. Wachholz (NAME) DOE, Germantown (LOCATION) 233-4365 (TELEPHONE NR.)

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2. Jack Healy, LASL		
3. Bill Robison, LLL		
4.		
5.		

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As Requested	For Correction	Prepare Reply
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REMARKS

Attached are notes taken by John DeYoung, Dept. of Interior, during the meeting they had with Ted Mitchell and Mitchell's consultants regarding the Enewetak Dose Assessment document. The notes are for your information.

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Notes on Meeting of Monday, August 13, 1979, with T. L. Mitchell and His Consultants, Dr. W. Ogle, Mr. Michael Bender, and Dr. R. Brill

Dr. Ogle (Environmental Aspects)

1. This informal meeting was opened by Dr. William E. Ogle, Energy Systems, Inc. (formerly associated with the Los Alamos Project) who explained briefly how the radiation dose was computed. He noted that the "direct path" radiation was not very significant but that the "food chain" aspect was the important aspect to be considered. Marine food chain with respect to Enewetak is "clean" and presents no problem.

2. Dr. Ogle limited his comments to "Engebi" Island. He commented that the Livermore Report was a good one-that a fine job had been done, although he noted that over 50 years you might find a 50% uncertainty.

3. Using Engebi Island and the worst example, i.e., taking all 454 people and assuming "famine condition" (i.e., no imported foods) but all food from Engebi or the N.E. islands, after 8 years of living on Engebi, the dose assessment which would be received by the people would be 200-250 miligram per year at the peak.

4. Over a 30-year period, this would result in exposure of 4-7 R. Fed. Standards in USA for a 30-year period would be 5 R.

5. Ogle raised a question as to how uncertain is the 4-7 R estimate. He noted that a year ago the estimate without the benefit of the recent "dose assessment study" was twice as high, i.e., 8-14 R over a period of 30 years.

Summary of Dr. Ogle's opinion:

1. No problem at all with respect to return of people of Engebi.

2. If there is concern for "any risk", you could decrease the 4-7 R range by increasing amount of imported food brought in, or by delaying use of consumption of local food, i.e., coconuts for another stated period.

3. He further noted that only 15% of food now consumed (3/10 of a daily 2 pound diet) is locally grown in any event.

Dr. R. Brill (Cancer Risk)

1. Dr. Brill described what the dose assessment meant in terms of effect on the people. He noted that there is 2-3% chance of increase in cancer risk to people exposed to 1/rem per year. You cannot tell which might be radiation induced or natural. Also in the U.S. there is a 15% chance of anyone getting cancer.

2. He also used the "worst" situation, i.e., taking all of the Enewetak population (454), assuming that they would all live on Engebi, would eat local foods under "famine" conditions.

   Under this situation, dose would be 360 r/yr. This would result in .84 cases of radiation cancer above the 68 natural ones expected during this 30 yr period. For a small group, then, the risk is 0-1, i.e., only 1 more cancer than would normally be expected would occur and you couldn't "pick" this case out. in essence, "risk would be zero".

3. Dr. Brill commented that the greatest hazard is that increased medical attention which will identify more cancer cases. But there would be no way to tell whether any of these were radiation induced. He noted that radiation is a low factor of risk. As an example, he cited that a "smoker" subtracts 225 days from life whereas radiation at the Engebi level would subtract only 16 days.

Dr. M. Bender (Genetic Effects)

1. He pointed out that cancer and genetic effects are the only ones known to occur from levels of radiation as found at Engebi.

2. Studies at Hiroshima produced no hard evidence of genetic effects in man.

3. For "Engebi" he maximized the risk... took a presumed 7.5 dose (i.e., constant famine situation, etc., and assumed 7.5 R exposure to each child). Since there would be a 10-11% chance, in any event, that a child would be born with some abnormality, the additional exposure risk at Engebi would add only .0004 to .0006 added risk, less than one-half of a percent. This would be a very small risk.

4. Could expect 1 extra abnormality in each of 3 generations exposed to 1 rad/year.

5. In short, if all the Enewetak population were to live on Engebi, under the worst conditions, radiation would induce "one" additional defect every 83 years. These would not be "monsters" but variety of "defects".

6. Dr. Bender also stressed that the Federal Radiation Guides are "guides" only, not mandatory rules for people to follow. He noted that people in Denver receive higher annual exposures than would the people at Engebi.

7. He stressed the exaggerated "fear" of radiation risk and stated that in his opinion there had been too much explanation and warning about hazards of radiation given to the people of the Marshalls and this has blown the situation out of proportion.

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A brief discussion of Federal Standards followed with comparison of "occupational standards", etc.

1. Dr. Brill noted that many people in the U.S. accept a much higher rate of exposure in certain jobs, etc., than the Federal standards.

2. Dr. Ogle stated that U.S. standards were not intended to apply to an individual or to a small group.

3. Dr. Bender stressed that the Federal Radiation Guides are not "rules" but simply guidelines that set arbitrary levels.

4. Dr. Bender also stressed that the "guidelines" do not take into consideration doses people receive from medical x-rays, etc. This is estimated to be about 80 milirem a year. If you add this to an average of 100 normal (direct) rad radiation, an individual in the U.S. regularly receives about 180 R a year. This is not much different than the 250 people would receive on Engebi.

5. Dr. Bender also said that the normal dose in the Marshalls (direct) is about 50 milirem per year. He would have no hesitation about living on Engebi himself.

6. Dr. Ogle stated that in his opinion the real issue is emotional and political. In his opinion, there are no physical radiation hazards that can be measured at Engebi, and probably none at all exist there.

Comparison with Bikini situation

High Commissioner Winkel asked how the "Engebi" situation compared to the Bikini situation

1. Dr. Brill, after stating that he had not investigated the Bikini situation in any depth, believed that the Bikini situation clearly was of a different order of magnitude. Dr. Bender concurred. Both, though, would defer to analysis of more detailed data on Bikini.

2. Dr. Ogle was of the opinion (again qualified by stating that he had not examined the Bikini data) tht there was appreciably more fallout at Bikini and the situation might be significantly different there.

SUMMARY

In short, these three experts appeared to be saying that there is no "danger" at present or in the "future" at Engebi and that no ill effects would result if the people were allowed to return to live there.

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TO: Bill Bair (NAME) PNL Richland (LOCATION) 509-946-2421 (TELEPHONE NR.)

FROM: B. Wachholz (NAME) DOE Germantown (LOCATION) 233-9365 (TELEPHONE NR.)

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-1-

ENJEBI

Age	Male	Female	Total
0-5	27	17	44
6-10	16	23	39
11-15	14	11	25
16-20	14	10	24
21-25	12	6	18
26-30	4	6	10
31-35	5	4	9
36-40	11	4	15
40 and above	7	7	14
TOTAL	110	88	198

ENEWETAK

Age	Male	Female	Total
0-5	35	24	59
6-10	16	18	34
11-15	18	20	38
16-20	18	14	32
21-25	10	9	19
26-30	11	7	18
31-35	6	9	15
36-40	8	5	13
40 and above	15	11	26
TOTAL	137	117	234

8/8 179
12/3 179

List of Addressees

Dr. John A. Auxier, ORNL
Dr. William J. Bair, PNL
Dr. Chester W. Francis, ORNL
Dr. Richard O. Gilbert, PNL
Dr. John W. Healy, LASL
Dr. Roger O. McClellan, ITRI
Dr. Chester R. Richmond, ORNL
Dr. William L. Templeton, PNL
Dr. Roy C. Thompson, PNL

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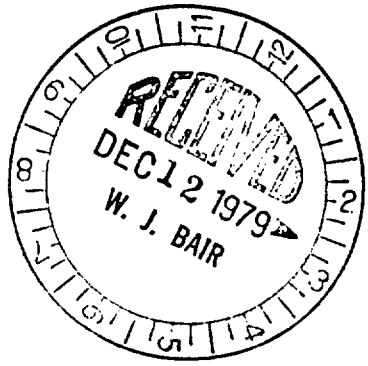

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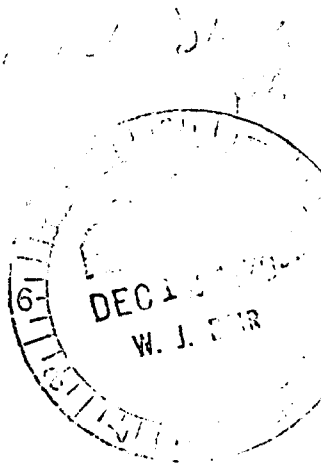

December 3, 1979

Those on Attached List

Gentlemen:

It has been some time since I last updated you on activities re the Marshall Islands. Inasmuch as several matters have occurred during that time, I shall try to briefly identify recent events. These may be the subject of further discussion at the next meeting.

I. General

1. I have been relocated within the Office of Health and Environmental Research as a program manager responsible to Dr. Burr. Mr. Tommy McCraw likewise has been transferred to OHER. A full time secretary and a 3rd staff person are in the process of being obtained.

2. Three projects funded by OES (the LLL Dose Assessment project, the BNL whole body counting activites, and the Univ. of Washington studies) also are being transferred to OHER beginning in FY 81. Thus all funding re the Pacific will originate from OHER with the exception of the 13 atoll survey and the Enewetak support programs, both of which are scheduled to terminate in CY 1980.

3. Mrs. Linda Hurley, who since 1974 has assisted me in secretarial matters (and who also was Dr. Carter's secretary), has since early October lived at the NIH hospital where her son is undergoing diagnostic tests and treatment. She has not been available during that time, nor is it likely that she will return to full time work for some weeks to come. Consequently, correspondence and other office activities have slowed down considerably.

II. Enewetak

1. Several of you have commented upon the observation that "planning and preparation have begun for northern island planting." Also, by letter of October 12, 1979, Dr. Bair

requested an update on this issue. By telephone the Department of Interior (DOI) requested an estimate of the potential radiation exposure contribution to Enewetak people assuming that they live on Japtan, Medren and Enewetak islands, and that they visit the six northeastern islands solely to tend coconut trees and harvest copra, particularly under the assumptions of time and ingestion given in the LLL dose assessment. It was pointed out to DOI that there also was the question of the marketability of the copra, but they were interested primarily in the potential exposure to people under the stated conditions. A copy of the response to them has already been sent to you (Enclosure A). Based upon this information DOI decided to approve the planting of coconut trees on the six northeastern islands. This matter subsequently has been discussed with the Office of Territorial Affairs and with the Soliciter General of DOI. Their position is that a) the potential exposures are within both FRC guidance and AEC recommendations, b) to plant the islands is in keeping with the master plan, and c) they have 6-8 years to consider the issue of marketability - if in fact they are contaminated. On several occasions I have told DOI that a) at present we have no basis on which to offer any hope that "science" will find a way to reduce or eliminate the uptake of radionuclides, especially of Cs and Sr, in coconuts, b) work is continuing in an effort to identify the location of radionuclides in the coconut, and c) once the Trust Territory Agreement ends, who will be responsible for decisions? (For example, if in 3-5 years it becomes apparent that the copra is not marketable, who will decide what, if anything should be done, e.g., to destroy the crop? Will this be the responsibility of the Marshall Islands Government, the Enewetak Council, Mr. Mitchell, or who? This is of particular importance since there will be no Trust Territory of the Pacific Islands, no High Commission and no Department of Interior presence.) DOI's informal response was that even if the coconuts are not saleable, they will only rot on the islands and the people are no worse off then if they never were planted.

On this and other matters DOI recently sent us a draft letter to Congressman Yates for comment. A copy of their draft and our comments are enclosed. (Enclosures B and C).

Last week DOI also wrote us on another matter (to be discussed below), and it is our intention to address the coconut issue again in our reply to this letter.

2. In response to a request from Mr. Mitchell that DOE present dose assessments and risk assessments to the people of Enewetak, and in fulfillment of a commitment made by Joe Deal in December, 1978, to do so, a number of people traveled to Ujelang on September 18-20 to do so. DOE was represented by Hal Hollister, Tommy McCraw, Bill Brown, Roger Ray, Harry Brown and me; Leo Krulitz (Soliciter General) represented DOI; Allen Richardson represented EPA; Alice Buck, John Iaman, John Healy and Bill Bair also attended at our request. Mr. Mitchell was accompanied by Randy Brill, Mike Bender and Bill Ogle. The Deputy High Commissioner also attended, as did the Chief Secretary of the Marshall Islands and the CBS "60 Minutes" camera crew. I will be pleased to discuss the trip in detail at your convenience.

The primary DOE contribution to the meeting was the presentation and explanation of the book "Enewetak Today," which has already been sent to you. The President of the Marshall Islands also sent an open letter to the people of Enewetak (Enclosure D). Following our meeting with the people, their Council met with Mr. Mitchell and his advisors; this meeting resulted in a petition to DOI to reconsider the resettlement to Enjebi (Enclosure E).

A personal note - the generosity and hospitality of the people were overwhelming.

3. DOE has discussed the desirability, if not necessity, of preparing a supplemental EIS to consider the resettlement of Enjebi. Mr. Mitchell has challenged the need for this, as well as the relevance of Radiation Protection Guides and Protection Action Guides (see Enclosure F, see also previously sent EPA letter to Mrs. Van Cleve). Upon receipt of the letter, DNA indicated that they wanted a meeting with Krulitz and staff, Clusen and staff, and EPA staff to discuss the necessity of a supplemental EIS, DNA's interest presumably based upon the fact that DNA prepared the original EIS. This meeting has not yet been scheduled, however.

4. LLL is recalculating the dose assessment in the light of a) additional information now available from the remainder of the islands, and b) in conformance of ICRP-30. While the specific numbers will change, the changes are not expected to be sizeable ones.

5. In reviewing the LLL preliminary dose assessment, Ed Bramlitt, DNA Field Command, questioned the calibration procedures used in the IMP's, specifically the soil composition used in calibration vs. the soil composition at Enewetak. (You may recall that the general issue of calibration is one which you have raised in the past). Indications from Las Vegas are that Mr. Bramlitt is correct, and that errors of 20-25% may have been introduced, the readings being lower than actual radioactivity levels. Until this is clarified and the extent of revisions is assessed, LLL revised dose assessments are on "hold." Perhaps more important is the possibility that island certification documents may have to be revised and that island usage reconsidered per the guidelines for TRU levels. Roger Ray's only communication on this subject is enclosed (Enclosure G). A team has gone out to Enewetak to make additional measurements for calibration.

6. With LLL in the process of writing a "final" dose assessment, any comments, suggestions, criticisms, etc., which you may have should be transmitted to Dr. Robison as soon as possible.

7. The Corps of Engineers asked DNA what plans were made for continuing monitoring of the structural integrity of the crypt. DNA replied that they end their involvement on April 15, 1980, and that DOE will monitor lagoon water, fish, etc. Presumably the direct question was not answered, although I have not seen DNA's response.

8. Except for a request for additional copies of the book "Enewetak Today," we have not heard from Mr. Mitchell since the meeting with the Enewetak people. He is, however, attempting to rally Congressional support for resettlement of Enjebi.

9. It is reasonable to assume that Congressional hearings may be held on this subject sometime within the next few months.

10. DOI recently requested the number of years before exposure on Enjebi would be within U.S. exposure limits. Their letter and a draft of our reply are enclosed (Enclosures H and I), the latter addressing several other issues as well. Any comments would be appreciated ASAP.

11. Whole body counting of the Enewetak people at Ujelang and at Japtan is scheduled tentatively for January-February, 1980. This will give us baseline data prior to their return to the Atoll in April, 1980.

12. Formal ceremonies are being planned by DNA for return of the Enewetak people to the Atoll on April 8, 1980.

III. Bikini

1. En route to/from Ujelang, DOI (Krulitz) and DOE (Hollister) stated to Bikini representatives that if requested we would prepare a book for the similar to "Enewetak Today" and would meet with them sometime in 1980, presumably no later than September, 1980. (Any comments or recommendations which any of you might wish to make regarding the content and effectiveness of the book "Enewetak Today" would be most welcome so that they might be considered prior to the preparation of a book for the Bikinians.)

2. The Bikinians are seriously considering relocating on Wake Island.

3. On November 20, Tommy McCraw and I met with DOI, representatives of the Bikini Council and the Council's legal counsel, Mr. Jonathon Weisgall. Their concerns were several:

a. Comparison of Eneu with Enjebi and the southern islands of Enewetak.

b. Potential effectiveness of scraping the surface of Eneu.

c. Potential exposure levels of a rotating Bikini population living on Eneu for a period of 6 months at a time roughly once every 4-5 years.

d. Comparison of Eneu with U.S. exposure levels (radiological maps of continental U.S. and of Marshall Islands/Eneu/Bikini were provided).

4. LLL is about 2 months away from a final dose assessment for Eneu and Bikini. Pending another meeting with Mr. Weisgall, LLL may be asked to include potential doses:

a. With and without imported food,

b. Resulting if the top 6 inches of soil were removed from Eneu,

c. If families lived on Eneu for 6 months at a time at 4-5 year intervals,

d. With varying amounts of time spent on Bikini.

5. The Bikinians and their legal counsel do not seem to challenge the applicability of U.S. exposure limits to their situation (although Mr. Mitchell does).

6. The Bikinians, should they decide to return to Eneu regardless of circumstances, might be willing to sign statements releasing the U.S. from liability for future related health consequences. The value of such a release is unknown. (Mr. Mitchell takes the position that should people return to Enjebi, the U.S. must share in that increased risk by accepting continued liability for any radiological consequences).

7. LLL would very much like to hire a Marshallese to tend the garden plot on Eneu. Roger Ray wrote to the Marshall Islands Government re this, with a copy to DOI and, subsequently, to DOE. DOI asked DOE if we concurred in this request (which we had not) and expressed concern that the Bikini people would interpret this as discrimination (i.e., if "he" can live there, why can't we?). Discussions are continuing and the issue is not yet resolved.

IV. The Burton Bill

1. On October 10 the Senate held hearings on the Burton Bill. While Mr. Mitchell and DOI were invited to testify, DOE was not asked for comments. Their formal statements are enclosed, including both DOE testimony and written reply (Enclosures J, K, and L).

2. Prior to the hearing, OMB was concerned about these items: that the open-ended health care plan be modified to periodic examination for radiation related effects and treatment if necessary, and that DOE responsibilities be funded directly rather than through DOI. These concerns are reflected in DOI's statement.

3. The presiding Senator, Matsunaga of Hawaii, apparently offered two opinions: that since DOI is the lead agency covering a broad scope of programs in the Pacific, funding and responsibility should be located in DOI rather than fragmented among departments, and that a comprehensive program plan would seem desirable. No requests were made or directives given, however.

4. The bill currently is under study with the Senate subcommittee.

V. Office of Micronesian States Negotiation

DOE continues to be actively involved in the interagency discussions and activities, particularly re nuclear claims.

VI. Brookhaven National Laboratory

A number of issues have been raised addressing personnel, financial and programmatic matters. A number of these issues are directly linked to NVOO and PASO interactions and activities. I will be pleased to discuss them in more detail should you so desire.

VII. Hearings

The Senate Energy and Natural Resources Committee (including Senators Jackson, Johnston and Matsunaga) is expected to hold 2 days of hearings re Bikini and Enewetak resettlements during the week of January 21 in Honolulu.

VIII. Palomares

I had the opportunity to accept Dr. Iranzo's kind invitation to visit Palomares with him. I will be pleased to discuss this matter with you if you wish, and to share photographs with you.

Sincerely,

Bruce W. Wachholz, Ph.D.
Office of Environment

12 Enclosures

WATER RESOURCES CENTER
Desert Research Institute — University of Nevada System

4582 Maryland Parkway
Las Vegas, Nevada 89109
(702) 736-2293

February 3, 1980

Dr. Richard O. Gilbert
Battelle Pacific Northwest
Laboratory
P.O. Box 999
Richland, WA 99352

Dear Dick:

In order to give you a better idea of the ranges and distributions of the various kinds of errors that affected the Enewetak data, I am enclosing a short writeup on that subject. I am also enclosing my draft of a proposed Tech Note describing how we propagated errors during the cleanup. If that sounds familiar, it's because you asked me to write it about two years ago, and I've just now gotten around to doing it.

My understanding is that this information on errors will be presented to the Marshall Islands Advisory Group ("Bair Committee") at the same time as John Tipton's new information on the soil mass attenuation coefficient. I believe the idea is to provide a comparison between the bias due to using the wrong attenuation, and the random errors that are present. Please look this material over, and if you have questions or comments, of if you want more information before the committee meets to hear Tipton, call me at (702) 736-2293.

Sincerely,

Madaline Barnes

Madaline Barnes
Research Statistician

MB:ds

Encl.

WATER RESOURCES CENTER
Desert Research Institute — University of Nevada System

4582 Maryland Parkway
Las Vegas, Nevada 89109
(702) 736-2293

February 11, 1980

Dr. Richard O. Gilbert
Energy Systems Department
Battelle-Northwest Laboratory
P.O. Box 999
Richland, WA 99352

Dear Dick:

Sorry to be so long in sending references on the shrinkage estimator (James-Stein). The theoretical work is in a paper by Stein in the 3rd Berkeley Symposium on Prof. and Stat. in 1955, 197-206, and in a paper by James and Stein in the 4th Berkeley Symposium in 1961, 361-379. A good introduction is an article by Efron and Morris in Scientific American of May, 1978. Some other articles are:

Efron and Morris	JASA 68(1973) 117-130
Efron and Morris	JASA 70(1975) 311-319
Efron and Morris	Ann. Stat. 4 (1976) 11-21
Efron and Morris	Ann. Stat. 4 (1976) 22-32
Moore and Brook	Ann. Stat. 6 (1978) 917-919

As I mentioned, there are practical advantages to using this estimator in that the shrinkage toward the mean may have the effect of eliminating quarter hectare averages above 40 pCi/gm. On the other hand there may be philosophical objections.

Sincerely,

Forest L. Miller, Jr.
Research Professor

FLM:ds

DOE F 1325.8
(7-79)

U.S. DEPARTMENT OF ENERGY

memorandum

DATE August 19, 1980

REPLY TO ATTN OF EV-30

SUBJECT Marshall Islands

TO R. Clusen, ASEV
H. Hollister, DASEV/R
W. W. Burr, D/OHER
J. Deal, OES
J. Blair, HHAD
T. McCraw, OHER
R. Ray, NVOO
V. Bond, BNL
W. Robison, LLL
W. Bair, PNL

Attached are the latest musings from Interior and others. They include

1. Interior's RFP for health care under the Burton Bill. We did not see a final draft prior to release.

2. Letter of August 8, 1980, plus attachments, from Charles Domnick, Deputy Secretary of Foreign Affairs, Government of the Marshall Islands, to Wallace Green.

3. Interior's letter of August 13, 1980, to Charles Domnick. We were not consulted on this response even though Interior committed us to attend meetings.

These are for your info only. Please return or discard if you do not wish to retain.

Bruce W. Wachholz, Ph.D.
Office of Health and Environmental
Research, Office of Environment

Attachments

RECEIVED
AUG 25 1980
W. J. BAIR

Department of Energy
Washington, D.C. 20545

JUN 26 1980

Mr. Wallace O. Green
Acting Deputy Assistant Secretary
Territorial and International Affairs
U.S. Department of the Interior
Washington, D.C. 20240

Dear Mr. Green:

As requested in your letter of May 20, 1980, to Mrs. Ruth C. Clusen, and per Mr. Copaken's verbal request following a meeting of April 23, 1980, at his office attended by Mr. Copaken and several of his consultants, the Department of Energy (DOE), Brookhaven National Laboratory (BNL), and the Department of Interior, which was represented by Mr. John DeYoung, the Department of Energy is pleased to elaborate upon its proposed agreement as appended to my letter of March 25, 1980, to Mrs. Ruth Van Cleve.

It was clear during this meeting that Mr. Copaken, perhaps, did not fully understand the substance of our offer of March 25, 1980, or the reasons behind it. Discussions on April 23, 1980, between our medical personnel (Department of Energy and Brookhaven National Laboratory) and Mr. Copaken's medical consultant, Dr. Robert G. Loeffler, were most helpful in clarifying many of these issues, however. It presumably is a consequence of these discussions that Mr. Copaken verbally requested us to amplify upon our offer of March 25, 1980.

This amplification basically consists of a detailed identification of the laboratory tests to be included under the general term "biochemical screening profile" which was included in paragraph 1 of the proposed agreement appended to my letter of March 25, 1980. The identification of specific tests included under that term is appended to this letter. You will note that it includes hematological, biochemical and urological analyses, plus other indicators, which would clearly identify, among other things, any evidence of thyroid dysfunction or of blood dyscrasias.

Clearly, any possible radiation exposure of the people of Likiep Atoll has been considerably less than that experienced by the people of Rongelap and Utirik, and, at this time, after 26 years of medical follow-up, we have no reason to believe that diseases which have not appeared among the Rongelap and Utirik populations would appear among any other populations in the Marshall Islands as a consequence of any possible lower levels of radiation exposure (e.g., bone cancer or opthalmic effects).

Except for the enclosed clarification of the first paragraph as indicated, the proposed agreement included in my letter to Mrs. Van Cleve of March 25, 1980, remains valid.

We hope that this will clarify our previous proposal and will be responsive to your request and that of Mr. Copaken.

Sincerely,

/s/

Bruce W. Wachholz, Ph.D.
Office of Health and Environmental Research, Office of Environment

Enclosure

bcc: OHER Reading File
Wachholz's Reading File
L. Brothers, DASEV/P, EV-2

CONCURRENCES

RTG. SYMBOL	INITIALS/SIG.	DATE
BWachholz		6/ /80
TMcCraw		6/ /80
JViren		6/ /80
JBlair		6/ /80
WWBurr		6/ /80
HHollister		6/ /80
RCClusen		6/ /80
		6/ /80

STUDIES TO BE INCLUDED PER THE PROPOSED AGREEMENT OF MARCH 25, 1980

I. Medical History

II. Clinical Studies

III. Laboratory Tests

A. Hematological Analyses

1. White Blood Cell
2. Red Blood Cell
3. Hematocrit
4. Hemoglobin
5. Platelet
6. Differential Count
7. Computation of Cell Indices
8. Cellular Morphology

B. Biochemical Analyses

1. T_4
2. TSH
3. HTG

} As indicated to follow thyroid carcinoma

4. SMA-20, including
   a. Sugar
   b. Electrolytes
   c. Lipids
   d. Serum protein
   e. Uric acid
   f. Blood urea nitrogen

g. Creatinine

h. LDH

i. CPK

j. And such other tests as may be indicated by disease patterns (e.g., alkaline phosphatase, cholesterol, etc.)

C. Urinalysis, Including Routine Microscopic Analysis

IV. Other

Where confirmatory evidence is indicated (e.g., gamma camera imaging, biopsies), such tests would be recommended on a case-by-case basis.

DOE F 1325.8
(7-79)

RECEIVED
AUG 18 1980
W. J. BAIR

U.S. DEPARTMENT OF ENERGY

memorandum

DATE August 6, 1980

REPLY TO ATTN OF EV-30

SUBJECT Unfolding Events re the Marshall Islands and Public Law 96-205

TO Attached List

Knowing of your continuing interest in events re the Marshall Islands even though the "cleanup" of Enewetak has been concluded, attached are a number of documents which give some idea of the way events are moving. To refresh your memory of who's who:

Mitchell represents the Enewetak people. He no longer represents the Utirik people, and there seems to be some question whether he represents the Rongelap people.

Weisgall represents the Bikini people.

Copaken represents the Government of the Marshall Islands.

Bruce W. Wachholz, Ph.D.
Office of Health and
Environmental Research

17 Attachments

10/12/79 Bender/Brill Assessment of Radiation Health Effects of the Resettlement of Enewetak Atoll
03/12/80 P.L. 96-205
03/28/80 ltr - Kabua to Burton/Yates
03/28/80 ltr - Kabua to President Carter
04/15/80 ltr - Weisgall to Van Cleve
04/21/80 ltr - Copaken to Green
04/25/80 ltr - Copaken to Wachholz
05/20/80 ltr - Green to Clusen
06/24/80 ltr - Alcalay to Sloan
06/26/80 ltr - Wachholz to Green
07/01/80 ltr - Wachholz to Copaken
07/18/80 ltr - Copaken to Wachholz
07/18/80 ltr - Alcalay to Green w/encl:
  06/06/80 ltr - Bertell to Sloan and
  06/23/80 K.Z. Morgan review
07/23/80 ltr - Mills to Mitchell
07/23/80 ltr - Loeffler to Copaken
07/25/80 ltr - deBrum to Green
08/04/80 DOI Discussion Paper

Addressees:

J. Auxier, ORNL
W. J. Bair, PNL
C. Francis, ORNL
D. Gilbert, PNL
J. W. Healy, LASL
R. O. McClellan, ITRI
C. Richmond, ORNL
W. L. Templeton, PNL
R. Thompson, PNL

Department of Energy
Washington, D.C. 20585

AUG 19 1980

Mr. Jonathan M. Weisgall
Ginsburg, Feldman, Weil and Bress
1700 Pennsylvania Avenue, N.W.
Washington, D.C. 20006

Dear Mr. Weisgall:

The Department of Energy agrees in principle to the proposal set forth in your letter-proposal of May 26, 1981, which will settle the litigation in People of Bikini v. Seamans, et al, Civil No. 76-348 (D-Ha.). Final approval of your proposal is contingent upon reaching agreement on the following:

1. Technical procedures covering such matters as sampling techniques, sample storage and transportation, sample processing, analytical procedures, a defined level of acceptability of sample variance between Epidemiology Resources, Inc. samples and Lawrence Livermore National Laboratory samples, splitting samples for confirmatory analyses by Epidemiology Resources, Inc. and by Lawrence Livermore National Laboratory, etc.

2. The taking and handling of any environmental samples by Epidemiology Resources, Inc. will be jointly supervised by one person designated by Epidemiology Resources, Inc. and one person designated by the Department of Energy.

3. Since the Department of Energy laboratory personnel periodically visit Bikini Atoll on a ship chartered by the Department, we would expect that Epidemiology Resources, Inc. sampling at Bikini Atoll could be conducted in conjunction with a visit by our laboratory personnel. If this is done, we will deduct an appropriate portion of transportation expense from our contract payment. If such coordination is clearly impractical, then you may proceed as indicated in the proposal.

4. Should Epidemiology Resources, Inc. base its dose calculation upon any dietary assumptions other than those used by the Lawrence Livermore National Laboratory, parallel calculations using the Lawrence Livermore National Laboratory dietary assumptions also should be included so that the source of any differences due to the assumed diet is clear.

We must observe that it is our belief that obtaining 40 environmental samples from Bikini Atoll is not required by the court agreement and, further, is of dubious scientific or technical merit. Nevertheless, we are sensitive to the desire of the Bikini people for site confirmation and we therefore agree to accommodate their perceived needs.

We must observe also that the court agreement requires review by a single scientist. Because you believe that a small team is required to comprehensively review the data, and perform related tasks, we have agreed to your request so that there will be absolutely no question of our having provided every resource needed to perform this task. Please understand that if you wish to alter the distribution of time among the three principal investigators (without exceeding the total amount allotted to them by contract) this would be acceptable to us.

As stated in previous letters dated January 22, 1981 and March 31, 1981, the Bikini people must formally acknowledge that execution of this contract with Epidemiology Resources, Inc. constitutes full and complete compliance by the Department of Energy in fulfilling the Department's sole outstanding obligation under the terms of the Memorandum Agreement settling the litigation.

Inasmuch as this contract will be between the Department of Energy and Epidemiology Resources, Inc., and since your letter-proposal of May 26, 1981, is neither on Epidemiology Resources, Inc. letterhead nor signed by an authorized Epidemiology Resources, Inc. officer, a proposal from Epidemiology Resources, Inc. addressed to the Department of Energy and signed by an Epidemiology Resources, Inc. official will be needed in order to comply with Departmental procurement requirements. We look forward to receiving a proposal from Epidemiology Resources, Inc. Written agreement on the conditions and procedures set forth above can be either incorporated directly into the proposal or set forth in a letter which will become part of any signed agreement.

Please call us if you have any questions.

Sincerely,

Stephen H. Greenleigh
Acting Deputy Assistant Secretary
for Environment, Safety and Health
Environmental Protection, Safety and
Emergency Preparedness

cc: W. Robison, LLNL
S. Gottlieb, DOE/OGC
R. Ray, NVOO
B. Wachholz, DOE/EP
H. Gill, DOE/OGC

bcc: Wachholz Rdr, EP-32 GTN
ESH/OOS Rdr
W. Bair, PNL ✓
J. Healy, LANL

CONCURRENCES

RTG SYMBOL	INITIALS/SIG.	DATE
EP-32	Wachholz	8/12/81
EP-32	McCraw	8/12/81
EP-34	JDeal	8/ /81
EP-32	Patters	8/ /81
OGC-34	SGottli	8/ /81
EP-30	SGreenl	8/11/81
RTG. SYMBOL	INITIALS/SIG.	DATE
RTG SYMBO	INITIALS/SIG	DATE
RTG. SYMBO	INITIALS/SIL	DATE

DOE F 1325.10

OFFICIAL FILE COPY

October 28, 1980

J. Deal, EV-131
T. McCraw, EV-30

Attached is a letter from Jonathan Weisgal. He raises the issue of why Eneu was not considered "safe" at the time of the '78 hearings, whereas in 1980 it is conditionally okay. (The content of the May, 1979, letter to which referral is made is nearly identical with our current position, and I will respond to that portion of his letter). Since you were involved at that time (1978), could you provide a response for that portion of the letter?

Please let me know ASAP.

Thank you.

Bruce W. Wachholz, EV-30

cc: W. Bair, PNL
W. Robison, LLNL
R. Ray, NVOO

LAW OFFICES
GINSBURG, FELDMAN, WEIL AND BRESS
1700 PENNSYLVANIA AVENUE, N. W.
WASHINGTON, D. C. 20006

CABLE: "LEGIS" TELEX 89-2422

TELEPHONE
(202) 637-9000

DAVID GINSBURG
MYER FELDMAN
J. W. ROSENTHAL
FRANK A. WEIL *
E. WILLIAM HENRY
LEE R. MARKS
JOHN H. ZENTAY
MARTIN JACOBS
JAMES E. WESNER
FRED W. DROGULA
MICHAEL I. SANDERS, P.C.
JOEL S. BURTON
JAMES HAMILTON
ALFRED J. EICHENLAUB
RICHARD P. SILLS, P.C.
PETER H. RODGERS
ALAN S. WEITZ

DAVID G. BRESS (1908-1976)

*ADMITTED IN NEW YORK ONLY

ANDREA JILL GRANT
JACOB DWECK
MARTHA JANE SHAY
BRUCE H. RABINOVITZ
ROBERT W. HAWKINS
JOSEPH E. RESENDE
DAVID J. FREEMAN
CELIA ROADY
GARY J. KLEIN
PHILIP M. BATTLES, III
LAWRENCE P. KELLER
SCOTT W. STUCKY
PATRICIA N. BLAIR
GAYLE FORST
RICHARD A. COHN
G. STEPHEN SAUNDERS
ALAN R. YUSPEH
SUSAN A. COBB
IRA T. KASDAN
JONATHAN M. WEISGALL
JUDITH ANN JACOBSON
PETER A. CASCIATO
SUSAN BANES HARRIS
EDWARD J. TOLCHIN

WRITER'S DIRECT DIAL NUMBER

(202) 637-9104

October 16, 1980

Mr. Hal L. Hollister
Acting Deputy Assistant
Secretary for Research
Office of Assistant Secretary
for Environment
U.S. Department of Energy
EV-3 Forrestal Building
Washington, D.C. 20585

Dear Mr. Hollister:

As you may recall from the dose assessment meeting on Kili last week, Senator Henchi Balos, the Bikinians' elected representative to the Marshall Island Nitijela, asked DOE scientists why they now believe that people can live on Eneu Island in light of the fact that government officials just two years ago stated that Eneu Island would have to remain off-limits for 20-25 years, due to unexpectedly high levels of radiation on the island. You and Dr. Wachholz replied that DOE had no knowledge of such statements.

Senator Balos was referring to testimony on May 22 and June 19, 1978 before the House Appropriations Committee Sub-committee on the Interior. At the May 22 hearing, for example, Ruth Van Cleve, Director of the Office of Territorial Affairs, stated that her expectation that the Bikinians could be moved to Eneu had been changed by recently-released DOE data declaring Eneu off-limits:

> "I must tell you ... that we have suddenly been required to recast our preliminary plans in a very major way. The committee will recall that when we testified before you a month ago, we anticipated, on the basis of the best information then available to us from the Department of Energy, that if it were necessary to move the people of Bikini Island to an alternative,

> safe site, we could expect that the nearby island of Eneu would be available for the purpose.
>
> Last Thursday we learned that tests of a limited sample of food-stuffs growing on Eneu showed an uptake of radionuclides much in excess of those predicted on the basis of the known cesium and strontium content of the soil. Accordingly, we have concluded that we must eliminate Eneu as an alternative site, and we have thus revised substantially the plans for temporary settlement."

Hearings on 1978 Second Appropriations Bill Before the Subcommittees of the House Committee on Appropriations, 95th Cong., 2d Sess. at 866 (1978) (hereinafter "Hearings"). See also High Commissioner Winkel's statement, id. at p. 889.

Following Mrs. Van Cleve's remarks, Joe Deal of DOE submitted data showing that cesium levels on Eneu were 5 to 6 times the previous estimates. He also stated that radiation measurements in six salt water wells on Eneu may have exceeded EPA standards. Hearings at 877.

At the June 19 hearing, High Commissioner Winkel reported that he had met with the people living on Bikini Island and "explained to the people ... that Eneu Island ... was not considered safe enough to allow their living on it at this time...." Hearings at 913. The Statement of Understanding signed by the U.S. Government on Kili on August 16, 1978 reflects this view: "...[o]n the basis of the most recent scientific information, it appears that Eneu Island ... will ... be unavailable for settlement."

Eight months later, by letter dated May 15, 1979, Ruth Clusen, DOE Assistant Secretary for Environment, wrote to Under Secretary of the Interior Joseph stating unequivocally that Eneu could not be resettled for 20-25 years even with imported food:

> "The degree of uncertainty in estimating doses on Eneu Island is similar to that for Enewetak Atoll. Assuming, therefore, that Enewetak criteria are applicable to other similar situations

in the northern Marshall Islands, the dose estimates for return of the Bikini people to Eneu Island would be compared to the Enewetak criteria as described above rather than to the FRC guidance. When this is done, it is found that even with imported food the radiation doses to the people on Eneu would not be expected to be in compliance with the Enewetak criteria for about 20-25 years." (Emphasis supplied)

I am enclosing copies of Mrs. Clusen's May 15, 1979 letter as well as cited pages from the hearings, the August 16, 1978 Statement of Understanding, and various newspaper articles that reported at the time that a move to Eneu would not be possible.

In light of the above testimony, I believe it would be appropriate to review this matter, and I request that you provide Senator Balos, through me, with a thorough answer to his question. It may be that these 1978 and 1979 statements were based on incomplete data, but this matter should be cleared up.

I look forward to hearing from you soon.

Sincerely,

Jonathan Weisgall

Jonathan M. Weisgall

JMW:cmf

Enclosures

cc: Henchi Balos (w/enc.)
Ruth Clusen (w/enc.)
Steve Gottlieb, Esq.
Gordon Law (w/enc.)

there is an immediate danger, then we can pause until the radiological surveys reveal whether the move to Eneu can be made or whether we have to move to a less attractive site.

As we informally advised the committee staff last week, the results of the very recent tests of the body burdens of the people living on Bikini Island show a significant increase in such burdens. While it may be arguable whether the test results show "an immediate danger," we in the Department of the Interior are satisfied that the people should be moved from Bikini Island as soon as it is possible to do so.

We have asked the representatives of the Department of Energy to discuss with you the radiological situation on Bikini and its implications for the people on Bikini Island, and they will do so in a moment. Then the High Commissioner and I want to discuss with you our plans for the move of the people from Bikini Island.

NEED TO RECAST BIKINI REHABILITATION PLANS

I must tell you now, however, that we have suddenly been required to recast our preliminary plans in a very major way. The committee will recall that when we testified before you a month ago, we anticipated, on the basis of the best information then available to us from the Department of Energy, that if it were necessary to move the people of Bikini Island to an alternative, safe site, we could expect that the nearby island of Eneu would be available for that purpose.

Last Thursday we learned that tests of a limited sample of foodstuffs growing on Eneu showed an uptake of radionuclides much in excess of those predicted on the basis of the known cesium and strontium content of the soil. Accordingly, we have concluded that we must eliminate Eneu as an alternative site, and we have thus revised substantially the plans for temporary settlement. We will outline those plans to you after the Energy Department discussion of the radioactivity situation on Bikini and Eneu.

To assist us in our discussion of our relocation plans, there are present with me this morning, in addition to High Commissioner Winkel, his District Administrator for the Marshall Islands District, Oscar

Is there anything else contaminated that they eat besides coconuts?

Mr. O. DEBRUM. Pandanus and other local subsistence crops.

Mr. YATES. Are those infected too?

Mr. O. DEBRUM. We are told they are infected also.

Mr. YATES. All right, go ahead, Mr. Deal.

Mr. DEAL. The last slide, you asked us to tell you the status of what we knew of Enen Island.

Mr. YATES. We would like to know what the status of Bikini is as well.

[The charts follow:]

MEASURED RADIATION DOSE—BIKINI ISLANDERS

[REM per year]

	1974	1977	1978
External	0.200	0.200	0.200
Internal	.003 to .067	.088 to .538	.070 to .980
Total	.203 to .267	.288 to .738	.270 to 1.180

Note: Federal standard for individuals equals 0.5 REM per year.

STATUS—ENUE ISLANDS

External radiation: 12 rem/year.

Coconut (16 trees): Cs measurements 5 to 6 times previous estimates.

Other food crops: Samples now being analyzed.

Six water wells: 3 not potable (high salt); 3 may be potable but; radiation measurements may exceed EPA standards.

Mr. YATES. Have you decided that from now on you are not going to permit people to live on Bikini any more? Obviously they can't live there if they are going to continue to be infected, right?

Mr. DEAL. Right, yes, sir.

Mr. YATES. So as far as you know, Bikini Island is through as an area for living.

Mr. DEAL. Yes, sir, probably until we get another 30 years. The half life of cesium is 30 years, so at the end of 30 years there would be one-half the amount of cesium remaining. For every 30-year period thereafter, the cesium decays to one-half its value.

BASIS OF 1968 DECISION ON BIKINI

Mr. YATES. Why were people allowed to go back there in 1972? Who made that decision?

Mrs. VAN CLEVE. Mr. Chairman.

Mr. YATES. Your friend in Interior?

Go ahead, please, Mrs. Van Cleve.

Mrs. VAN CLEVE. The President of the United States made the decision in August 1968.

Mr. YATES. Acting upon whose advice?

Mrs. VAN CLEVE. He announced that the people of Bikini could return on the basis of advice received from experts hired by the Atomic Energy Commission who said that Bikini was safe for human habitation.

STATEMENT OF HIGH COMMISSIONER ADRIAN P. WINKEL BEFORE THE INTERIOR AND RELATED AGENCIES SUBCOMMITTEE, COMMITTEE ON APPROPRIATIONS, HOUSE OF REPRESENTATIVES, CONCERNING RESETTLEMENT OF THE PEOPLE OF BIKINI, MAY 12, 1978

Mr. Chairman, Members of the Committee

The preceding statements of Mrs. Van Cleve and the presentation of the Department of Energy clearly demonstrate the dilemma we face in dealing with the immediate and longer-range futures of the people now living on Bikini Island.

Until last week, it had been a reasonable presumption based on predictions by the Department of Energy that Eneu in the Bikini Atoll would be a satisfactory place to which the Bikini people could be moved in the immediate short-run period and that it would also serve as a permanent location for the bulk of the larger group still on Kili.

We now know that this is not the case.

We thus have the necessity of a temporary move to a location that most likely will not be the permanent home for these people.

At this point let me say that there are no uninhabited islands or atolls on which these people might make a permanent settlement. Uninhabited islands in the Marshalls are uninhabited because they are incapable of sustaining human life to any extent, particularly the numbers of people we are talking about.

going to say any-

ank you for com-

our statement and record.

STATEMENT OF HIGH COMMISSIONER ADRIAN P. WINKEL BEFORE THE INTERIOR AND RELATED AGENCIES SUBCOMMITTEE, COMMITTEE ON APPROPRIATIONS, HOUSE OF REPRESENTATIVES, CONCERNING RESETTLEMENT OF THE PEOPLE OF [illegible] JUNE 19, 1978

Mr. Chairman, Members of the Committee

In accordance with the decisions made at your May 22nd meeting, I discussed with the people of Bikini Island their forthcoming move from that island and their preference as to relocation sites. These meetings were held over a period of 24 hours, on Thursday and Friday, June 1 and 2, with virtually all of the people of the Island--men, women, and children--in attendance at the first meeting, and 35 to 40 people (the adult male population) at the succeeding two meetings.

Subsequently, on Monday, June 5, a meeting was held with the people of Kili Island for the same purposes, with about 100 people in attendance.

In the opening remarks at Bikini I explained to the people that I was there to inform them it was necessary that they move from Bikini Island, that Eneu Island also was not considered safe enough to allow their living on it at this time, and that four relocation sites were suggested for their consideration and decision.

At the second meeting on Friday, June 2, various spokesmen outlined the preferences of the people as follows:

1) Stay on Bikini Island until further information is available about Eneu food and its levels of radioactivity. The people reasoned that they would have to

Department of Energy
Washington, D.C. 20585

May 15, 1979

Honorable James A. Joseph
Under Secretary of the Interior
Washington, D. C. 20240

Dear Mr. Joseph:

I am pleased to reply to your letter of April 12, 1979, regarding the possible return of the Bikini people to Eneu Island.

This response will address both of the issues you raise:

1. Your understanding of previous statements by my staff.

2. More detailed information on estimated dose assessments for people living on Eneu Island, including various assumed living and eating patterns.

With respect to the first point, your understandings are, in general, correct. The more detailed information addressing the second point is included as an enclosure to this letter.

If the guidance of the Federal Radiation Council (FRC) (500 mrem/yr to individuals, and 170 mrem/yr and 5000 mrem/30 yrs to a population) is to be complied with, the people could return to Eneu only if it is assured that adequate imported food would be available to and used by the people for approximately 20 years, that food grown on Bikini Island is not a part of the diet, that residence is restricted to Eneu Island, and that visitation to Bikini Island is effectively controlled.

Since the FRC guides were originally formulated, an Environmental Impact Statement (EIS) was prepared for the resettlement of Enewetak Atoll. In the EIS, recommended criteria which are one-half of the FRC guidance for individuals and 80 percent of the 30-year FRC guidance for populations were proposed for evaluating land use options for use in planning the cleanup and rehabilitation of Enewetak Atoll. These criteria were recommended because of uncertainties in estimating future doses to the people at Enewetak Atoll. However, following the return of people to the Islands, direct radiation exposure measurements would

be available and compared with the full FRC guidance of 500 mrem/yr to individuals and 5000 mrem/30 yrs to the population. These criteria for Enewetak were reviewed by interested Government agencies; no objections to these criteria were raised. One of the reviewing agencies, the Environmental Protection Agency (EPA), found the criteria acceptable, but considered them to be "... upper limits ..." and that "... any proposed guideline or numerical values for the dose limits are only preliminary guidance and that a cost-benefit analysis must be undertaken to determine whether the projected doses are really as low as readily achievable and practical before proceeding with the relocation project. On the basis of such analysis it may be prudent to lower dose guidelines for this operation."

The degree of uncertainty in estimating doses on Eneu Island is similar to that for Enewetak Atoll. Assuming, therefore, that Enewetak criteria are applicable to other similar situations in the northern Marshall Islands, the dose estimates for return of the Bikini people to Eneu Island would be compared to the Enewetak criteria as described above rather than to the FRC guidance. When this is done, it is found that even with imported food the radiation doses to the people on Eneu would not be expected to be in compliance with the Enewetak criteria for about 20-25 years.

Several basic combinations of residence and food constraints are discussed in the enclosed, and are illustrated and summarized in the attachments to the enclosed. Other considerations also are addressed. If any further refinement of the data changes these estimates in a significant way, we will immediately inform you.

We trust that this is helpful to you in resolving the issue of the acceptability of Eneu Island as a residence island.

Sincerely,

Ruth C. Clusen
Assistant Secretary for Environment

Enclosure

cc: Dr. William Mills, EPA

RADIOLOGICAL IMPLICATION FOR RESETTLEMENT OF ENEU ISLAND

SUMMARY

Unless imported food is a substantial and continuing part of the diet of the Eneu population for about 20 years, unless access to Bikini Island can effectively be controlled for several years, and unless access to food from Bikini Island is restricted, it is unlikely that radiation doses to people living on Eneu Island would be in compliance with federal radiation protection guidance.[1] Based upon previous experience and past practices, however, it is doubtful whether imported food will be a significant part of the daily diet. It can also be questioned whether or not access to Bikini Island can be controlled. Therefore, a return to Eneu Island should be delayed for close to 20 years if radiological dose is the only governing factor unless a firm commitment can be made which will guarantee that adequate imported food will be available and used by the people, and that residence can be restricted to Eneu Island. If the Enewetak radiation exposure criteria[2] are to be applied to the Eneu population, it is unlikely that the radiation doses to the people would be in compliance with the criteria for approximately 20 years, even if imported food is available and if mobility is restricted. Under either criteria, a return to Bikini Island would be delayed even longer because of the higher levels of radionuclides in the soil.

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[1] The Federal Radiation Council (FRC) recommended exposure limits of 500 mrem/yr to individuals, 170 mrem/yr to average population groups, and 5000 mrem/30 yrs to the average population of the U.S.

[2] Enewetak criteria are one-half of the FRC exposure limit for individuals and 80 percent of the FRC 30-year exposure limit.

BACKGROUND

In August 1978 the residents of Bikini Island left their Atoll because measurements of radiocesium made in April 1978 showed accumulations in the bodies of 13 out of 101 people such that if this level were maintained for one year, it would result in an annual radiation dose equal to or greater than the 500 mrem/yr federal radiation protection criteria for exposure of individuals. The dose rate might have increased further had those people continued to live on Bikini Island. At that time the question was raised about whether or not the Bikini people could relocate on Eneu Island. Information then available on the radionuclide content of test plantings of food crops on Eneu was inadequate, and there were insufficient samples of coconuts grown on Eneu Island to answer the question. In the Congressional Committee hearings[3] held on July 25, 1978, it was agreed that priority would be given to collecting and analyzing available data to update radiation exposure estimates for use by those who are considering whether the Bikini people should return to live on Eneu Island. In early 1979, new information was obtained so that dose predictions for residence on Eneu Island could, for the first time, be based upon data from analysis of actual food items of the diet grown on the island rather than on theoretical predictions derived from soil concentrations.

RADIATION SOURCES

People living on Eneu Island receive radiation exposure from two sources: 1) external irradiation from natural background radiation

[3]Interior and Related Agencies Subcommittee, Committee on Appropriations, House of Representatives.

(which is very low) and from radionuclides remaining in the soil from nuclear tests at Bikini Atoll; 2) internal irradiation from radionuclides deposited in the body as a consequence of eating foods from the island area (including foods grown in the contaminated soil and marine life from the lagoon) and from inhaling airborne radionuclides. Because of the metabolic characteristics of the predominant radionuclides (cesium-137 and strontium-90) at Eneu, bone marrow doses are expected to be slightly greater than whole body doses, and will be the limiting exposure.

The external radiation dose rate has been determined from data obtained during a recent aerial radiological survey. The external doses to whole body and bone marrow for Eneu residents were calculated using measurements of external radiation and estimates of time spent in various areas of the island (e.g., village, island interior, on the lagoon, etc.).

The internal radiation doses were calculated from estimates of the amounts and kinds of food in the diet (with and without imported foods) and from measurements of the radionuclide content of these foods and of drinking water (see Attachments 1, 2, 3, and 4). Levels of radioactivity in food shown in these attachments were obtained from analysis of samples collected on Eneu Island, except for pandanus which was not yet available. Since pandanus would be a diet constituent, the contributed dose is calculated from uptake coefficients and soil concentrations of radionuclides. The 30-year dose commitment is calculated assuming only radioactive decay with no reduction from other possible mechanisms.

It is expected that some individuals on Eneu Island will receive doses higher or lower than the predicted average dose. This may result from: 1) eating a larger or smaller quantity of food than that shown in the assumed diet, 2) eating more or less of certain foods containing the highest radioactivity levels, and 3) eating foods grown from areas on the island having soil concentrations higher or lower than the average. In this regard it should be noted also that the former "...Federal Radiation Council suggests the use of the arbitrary assumption that the majority of individuals do not vary from the average by a factor greater than three."[4] This factor of three is used in establishing and distinguishing between guidance for the maximum annual dose to the average individual within that population and guidance for the potentially highly exposed individual within that population.[5]

FEDERAL GUIDANCE

Radiation Protection Guides for the U.S. were approved by the President and are used by federal agencies in their radiation protection activities. These guides specify the radiation dose that should not

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[4]Report No. 1, Background Material for the Development of Radiation Protection Standards, Staff Report of the Federal Radiation Council, U.S. Department of Health, Education and Welfare, May 13, 1960, pg. 27.

[5]The "maximum annual dose" refers to the dose in that year in which the exposure of the average individual is greatest, taking into account the buildup and the removal and decay of radionuclides in the body. The majority of the highly exposed individuals within this population are assumed not to receive an annual exposure more than a factor of three greater.

be exceeded without careful consideration of the reasons for doing so,[6] and that every effort should be made to encourage the maintenance of radiation doses as far below these guides as practicable. To comply with these standards, certain conditions must be met. First, the basic FRC recommendation is "...that the yearly radiation exposure to the whole body of individuals in the general population...should not exceed 0.5 rem."[7] The FRC recognized, however, that exposure of individuals may be difficult to monitor under some circumstances; thus they suggested that the limit to individuals may be met by the use of average limits to the popualtion. Second, therefore, the FRC indicated that: "Under certain conditions, such as widespread radioactive contamination of the environment, the only data available may be related to average contamination or exposure levels. Under these circumstances, it is necessary to make assumptions concerning the relationship between average and maximum doses. The Federal Radiation Council suggests the use of the arbitrary assumption that the majority of individuals do not vary from the average by a factor greater than three. Thus, we recommend the use of 0.17 rem for yearly whole-body exposure of average population groups... It is critical that this guide be applied with reason and judgment. Especially, it is noted that the use of the average figure, as a substitute for evidence concerning the dose to individuals, is permissible only when

[6]The Federal Radiation Council, in Report No. 1 (see footnote 4, pp. 26-27), stated that the guidance should not be exceeded unless "...a careful study indicates that the probable benefits will outweigh the potential risk."

[7]See Note 4, p. 26.

there is a probability of appreciable homogeneity concerning the distribution of the dose within the population included in the average."[8] Third, "When the size of the population group under consideration is sufficiently large, consideration must be given to the contribution to the genetically significant population dose. The Federal Radiation Council...recommends the use of the Radiation Protection Guide of 5 rem in 30 years...for limiting the average genetically significant exposure of the total U.S. population. The use of 0.17 rem per capita per year, as described (above) as a technique for assuring that the basic Guide for individual whole body dose is not exceeded, is likely in the immediate future to assure that the gonadal exposure Guide is not exceeded."[9] Therefore, the whole body dose is considered to be the equivalent of the genetically significant dose.

Because of the absence of radiation protection guides specific for the Marshall Islands, criteria were developed from the basic Federal guidance for evaluating land use options for use in planning the cleanup and rehabilitation of Enewetak Atoll.[10] These criteria are presented here since they were developed subsequent to the decision regarding the cleanup and rehabilitation of Bikini Atoll. It was

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[8] See Note 4, p. 27.

[9] See Note 4, p. 27.

[10] Cleanup, Rehabilitation, Resettlement of Enewetak Atoll - Marshall Islands, Environmental Impact Statement, Defense Nuclear Agency, April 1975.

recognized that decisions on land use involve consideration of predicted radiation doses which have inherent uncertainties. To make allowance for this, radiation criteria were chosen that are 50% of the annual Federal guidance for individual whole body and bone marrow doses and 80% of the 30-year whole body dose for population exposures. Therefore, the Enewetak criteria limits the dose to the whole body or the bone marrow of individuals to 250 mrem/yr and the dose to the average individual within the population to 4000 mrem/30 yr. (It should be noted that use of a percentage of the FRC values was not an attempt to establish new guidance, but was considered to be a necessary precaution in the application of the FRC values.[11] The adoption of limits for Enewetak equal to one-half the FRC guide for individuals and 80 percent of the FRC guide for 30-year limits is a result "... of the uncertainty concerning dose estimates which depend greatly on the foods people will choose to eat and the way they will choose to live."[12] While dose estimates are to be compared to these percentages of the FRC guides, actual exposure levels monitored after the people return should be compared to the 100 percent values of the FRC guides.[13])

CALCULATED DOSES LIVING IN ENEU

The calculated doses[14] shown below are for three living patterns and for two assumed diets. The diets are based on the recent experience

[11] See footnote 10, Vol. II., Sec. B, p. III-10.

[12] See footnote 10, Vol. I., Sec. 5, p. 5-7.

[13] See footnote 10, Vol. I., Sec. 5, p. 5-7 and Vol. II., Sec. B, p. III-11.

[14] All dose estimates are rounded off and are based upon information contained in "An Updated Radiological Dose Assessment of Eneu Island at Bikini Atoll," Robison, W. L. and Phillips, W. A., UCRL-52775, 1979, in draft.

and observations of the scientific teams who have been working on Bikini Atoll.[15]

Calculated Maximum Annual Dose (Average for Population)

(Federal guidance is 170 mrem/yr)

A. People live 100% of the time on Eneu Island.

	With Food Imports	Without Food Imports
Whole Body	120 mrem/yr	210 mrem/yr
Bone Marrow	140 mrem/yr	260 mrem/yr

B. People live 90% of the time on Eneu Island and visit Bikini Island 10% of the time, or 80% of the time is spent on Eneu Island and 20% of the time is spent on Bikini Island, and assuming that no food from Bikini Island is eaten.

	With Food Imports		Without Food Imports	
	90-10	80-20	90-10	80-20
Whole Body	150 mrem/yr	170 mrem/yr	240 mrem/yr	260 mrem/yr
Bone Marrow	170 mrem/yr	190 mrem/yr	280 mrem/yr	300 mrem/yr

NOTE: On attachments 7-8 it is assumed that the maximum exposed individuals would be three times these values as per the FRC guidance.

Calculated 30-Year Dose (Average Whole Body)

(Federal guidance is 5000 mrem/30 yrs)

A. People live 100% of the time on Eneu Island.

With Food Imports	Without Food Imports
2700 mrem	4700 mrem

B. People live 90% of the time on Eneu Island and visit Bikini Island 10% of the time, or 80% of the time is spent on Eneu Island and 20% of the time is spent on Bikini Island, and assuming that no food from Bikini Island is eaten.

With Food Imports		Without Food Imports	
90-10	80-20	90-10	80-20
3200 mrem	3700 mrem	5200 mrem	5700 mrem

NOTE: People who recently lived on Bikini Island already have received a dose of about 1000 mrem. This has not been included in the above estimate

[15]The dietary parameters are important factors in the calculation of dose estimates, and the diet is continually being refined as additional informatio becomes available. To the extent that the diet used in this document (Attachment 1) may be refined, or that dietary practices may change, the dose estima may also change accordingly.

If there is increased utilization of Bikini Island, the projected doses can be estimated by applying the finding that the respective Bikini doses would be about eight to ten times the doses for Eneu residence shown above (maximum annual and 30-year doses).[16]

If return to Eneu and Bikini is delayed, the above dose estimates would be reduced by a factor of two for every 30-year period the return is delayed. This is due to the fact that the radioactivity of the two radionuclides (cesium-137 and strontium-90) that contribute most to whole body and bone marrow doses, decays in the environment with an effective half-time of 30 years.

Attachments 5 and 6 present estimates of the maximum annual whole body and bone marrow doses for the average population if, starting with 1979 as the zero time, a return to live on Eneu Island (the six lower curves) or on Bikini Island (the two highest curves) is delayed. Attachments 7 and 8 present similar information for the individuals receiving the highest doses. Attachment 9 shows the predictions for 30-year doses.

DISCUSSION

The predicted maximum annual whole body and bone marrow doses for the average Eneu Island population in Attachments 5 and 6 can be compared with the 170 mrem/yr federal guidance. If a monitoring program

[16]The basis for this estimate is that the concentrations of radionuclides in the soil and in coconuts on Bikini are about eight to ten times greater than those on Eneu. Therefore, consumption of foods grown on Bikini Island would increase the annual dose rate estimates significantly, the increase depending upon the type and quantity of food eaten. Estimates based upon assumed combinations of Eneu and Bikini foods, and imported foods, other than those included herein, can be provided if needed.

is in place, doses to the highest individuals can be compared with the standard for individuals which is 500 mrem/yr (see Attachments 7 and 8). Doses for the highest individuals can also be compared with the Enewetak criterion which is 250 mrem/yr.

Whether annual doses (for the population or for individuals) and 30-year doses for people living on Eneu or Bikini Islands meet or exceed federal guidance and/or the recently developed Enewetak criteria depends upon the amount, kind, and source of local foods that are eaten, the availability of imported foods, the proportion of residence time on Eneu Island and on Bikini Island, and the time interval between now and the date of rehabitation.

Attachments 5 through 9 illustrate the estimated dose (vertical axis) to the population or to an individual in the population if the people are returned to Eneu or to Bikini in any particular year (horizontal axis, beginning in 1979). Moreover, the attachments illustrate estimated doses for eight separate living patterns as identified on Attachment 5. Federal guidance and Enewetak criteria levels also are indicated. If any particular curve does not go above the guidance or criteria level, a return of the people could be accomplished that year without expecting to exceed the guidance or criteria, providing residence conforms to the conditions upon which the doses are estimated. If a curve goes above the guidance or criteria, the point at which it crosses the guidance or criteria, as read from the horizontal axis, is the approximate number of years that return should be delayed so that the radiation dose would not be expected to exceed the guidance or criteria.

For example, if the Bikinians returned in 1979 to Eneu, if the diet consists of both local and imported foods as shown in Attachment 1, and if they spend no time on and consume no food from Bikini Island, (Attachments 5-9, Curve 1) their predicted maximum annual whole body and bone marrow doses and their 30-year whole body doses (average for the population) would be within the federal guidance of 170 mrem/yr and 5000 mrem/30 yr. Under these same conditions, exposures of the highest individuals would be within the 500 mrem/yr federal guidance for whole body and bone marrow but would exceed the 250 mrem/yr Enewetak criterion. Without imported food (Attachments 5-9, Curve 4) both predicted average population and highest individual doses exceed the 170 and 500 mrem/yr federal guidance, while the 30-year estimate of 4700 mrem/30 yr just meets the 5000 mrem/30 yr federal guidance but exceeds the 4000 mrem/30 yr Enewetak criterion.

Furthermore, it must be recognized that there is a significant degree of uncertainty in the dose estimates because of the need to predict lifestyles of peoples. For most situations it is estimated that these values may be realistic to within a factor of two; under unusual circumstances they may be within a factor of three.[17] These, then, would be the approximate error bands associated with the curves in Attachments 5-9.

A summary comparison of these curves with the federal guidance and with the Enewetak criteria is given in Attachment 10.

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[17] Robison, W.L. and Phillips, W.A., "An Updated Radiological Dose Assessment of Eneu Island at Bikini Atoll, UCRL-52775, 1979, in draft.

OTHER CONSIDERATIONS

In evaluating radiological conditions on Eneu and Bikini Islands, there are certain other factors which should be taken into account:

1. Exposure to any radiation is believed to involve some risk which is proportionally greater as the radiation exposure increases; therefore, any unnecessary radiation exposures should be avoided and all exposures kept as low as is reasonably achievable.

2. The benefits and risks inherent in the Federal guidance are those applicable to persons living outside of restricted access areas in the U.S. under normal peacetime operations.

3. There appear to be difficulties associated with the practicality and reliability of applying administrative controls over long periods of time with the intent to limit exposure.

4. The need to apply a safety factor where there are uncertainties in the predicted dose estimates, resulted in the use of a factor of 2 in applying Federal guidance to the Enewetak situation.

5. The marketability for copra produced from coconuts grown on Bikini and Eneu Islands is questionable at the present time.

There are also nonradiological factors which have not been considered. Among these are:

1. The benefits to be derived by the Bikini people in returning to their Atoll according to their own decisions and preferences.

2. Resettlement options at locations other than Bikini Atoll.

3/21/79

DIETS

FOOD ITEM	ENEU ISLAND FOODS ONLY INTAKE G/DAY	ENEU ISLAND AND IMPORTED FOODS INTAKE G/DAY
FISH	600	300
DOMESTIC MEAT	50	20
PANDANUS FRUIT	75	15
BREADFRUIT	200	100
WILD BIRDS	10	-
BIRD EGGS	5	-
COCONUT FLUID	300	200
COCONUT MEAT	100	50
CLAMS	25	15
GARDEN FRUITS AND VEGETABLES	50	30
TOTAL	1415	805
IMPORTED FOODS		825
TOTAL		1630

Attachment 1

CONCENTRATION OF ^{137}Cs IN SUBSISTENCE CROPS AND FISH AT ENIU ISLAND

Attachment 2

FOOD PRODUCT	NO. OF SAMPLES	AVERAGE CONCENTRATION PCI/G WET WEIGHT	RANGE OF CONCENTRATION PCI/G WET WEIGHT
COCONUT MEAT (GREEN)	6	22.7	3.5-48
COCONUT MEAT (INTERMEDIATE)	9	16.5	4.8-32
COCONUT MEAT (MATURE)	31	30.9	5.3-117
COCONUT MEAT (SPROUTED, SPRINGY)	8	27	16-52
ALL COCONUT MEAT	54	27	3.5-117
COCONUT FLUID	28	13.5	1.2-44
BREADFRUIT	2	6.5	5.2-7.8
SQUASH	12	8.5	1.6-20
PAPAYA	18	14	1.6-31
BANANA	3	0.92	0.54-1.3
SWEET POTATO	2	3.6	2.3-5
WATERMELON	17	2.6	0.26-7.2
GARDEN FRUITS AND VEGETABLES (AVERAGE OF SQUASH, PAPAYA, BANANA, SWEET POTATO, WATERMELON)		5.9	
FISH (MULLET)+	6	0.026+	
DOMESTIC MEAT		15*	

\+ FROM V. NOSHKIN

* ESTIMATED FROM BIKINI PIG DATA

CONCENTRATION OF ^{90}Sr IN SUBSISTENCE CROPS AND FISH AT ENEU ISLAND

FOOD PRODUCT	NO. OF SAMPLES	AVERAGE CONCENTRATION PCi/G WET WEIGHT	RANGE OF CONCENTRATION PCi/G WET WEIGHT
COCONUT MEAT	9	0.021	0.0033 - 0.052
COCONUT FLUID*	-	0.021*	-
BREADFRUIT	2	1.9	0.47 - 3.4
WATERMELON	8	0.031	0.012 - 0.053
SQUASH	6	0.054	0.024 - 0.15
PAPAYA	5	0.29	0.052 - 0.39
SWEET POTATO	1	0.13	-
GARDEN FRUITS AND VEGETABLES (AVERAGE OF WATERMELON, SQUASH, PAPAYA, SWEET POTATO)		0.13	
FISH (MULLET)		0.076+	
CLAMS		0.005+	
DOMESTIC MEAT		0.011**	

* ASSUMED TO BE THE SAME AS COCONUT MEAT

\+ FROM V. NELSON AND B. SCHELL

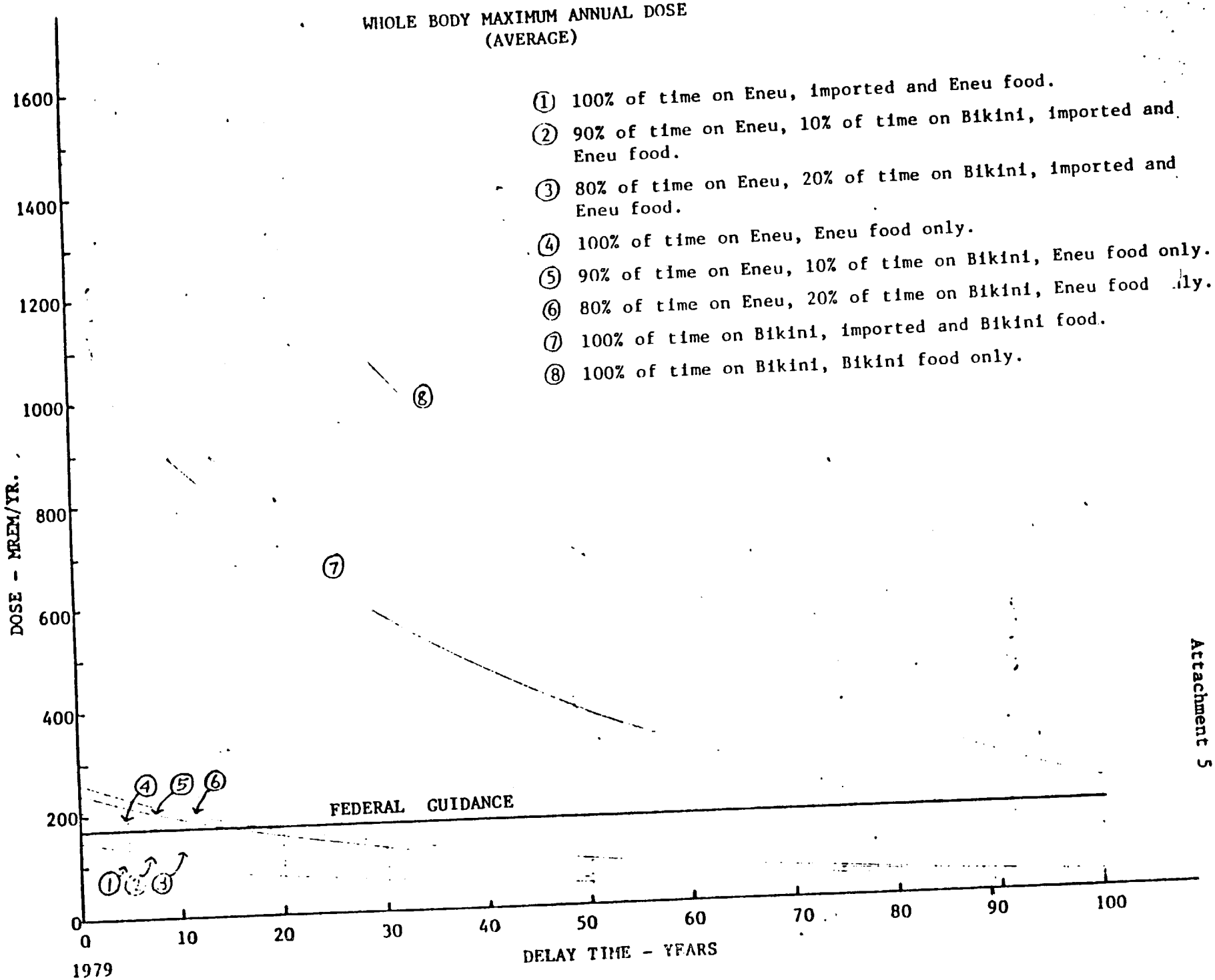
** FROM 1975 BIKINI DOSE ASSESSMENT

CONCENTRATION OF $^{239+240}Pu$ IN SUBSISTENCE CROPS AND FISH AT ENEU ISLAND

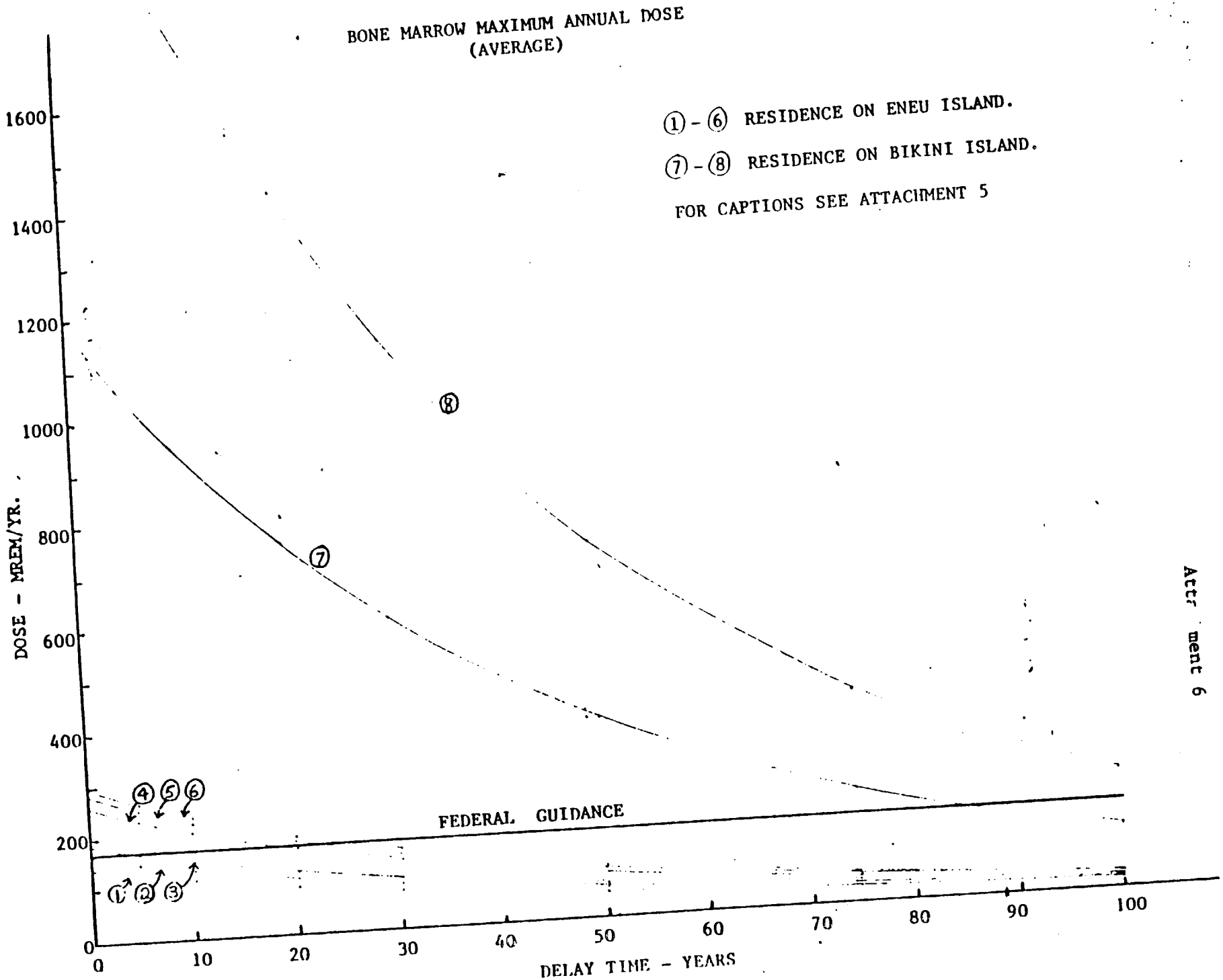
FOOD PRODUCT	NO. OF SAMPLES	AVERAGE CONCENTRATION PCI/G WET WEIGHT	RANGE OF CONCENTRATION PCI/G WET WEIGHT
COCONUT MEAT	9	2.8×10^{-5}	4.1×10^{-6}-5.3×10^{-5}
COCONUT FLUID	-	2.8×10^{-5}*	-
BREADFRUIT	1	1.7×10^{-5}	-
WATERMELON	8	1.3×10^{-5}	4.4×10^{-6}-2.0×10^{-5}
SQUASH	6	8×10^{-6}	3.5×10^{-6}-1.9×10^{-5}
PAPAYA	3	8.3×10^{-6}	6.5×10^{-6} - 1.1×10^{-5}
GARDEN FRUITS AND VEGETABLE (AVERAGE OF WATERMELON, SQUASH, PAPAYA)		9.8×10^{-6}	
FISH (MULLET)+	6	1.3×10^{-4} +	

* ASSUMED TO BE THE SAME AS COCONUT MEAT

\+ FROM V. NOSHKIN



Attachment 5



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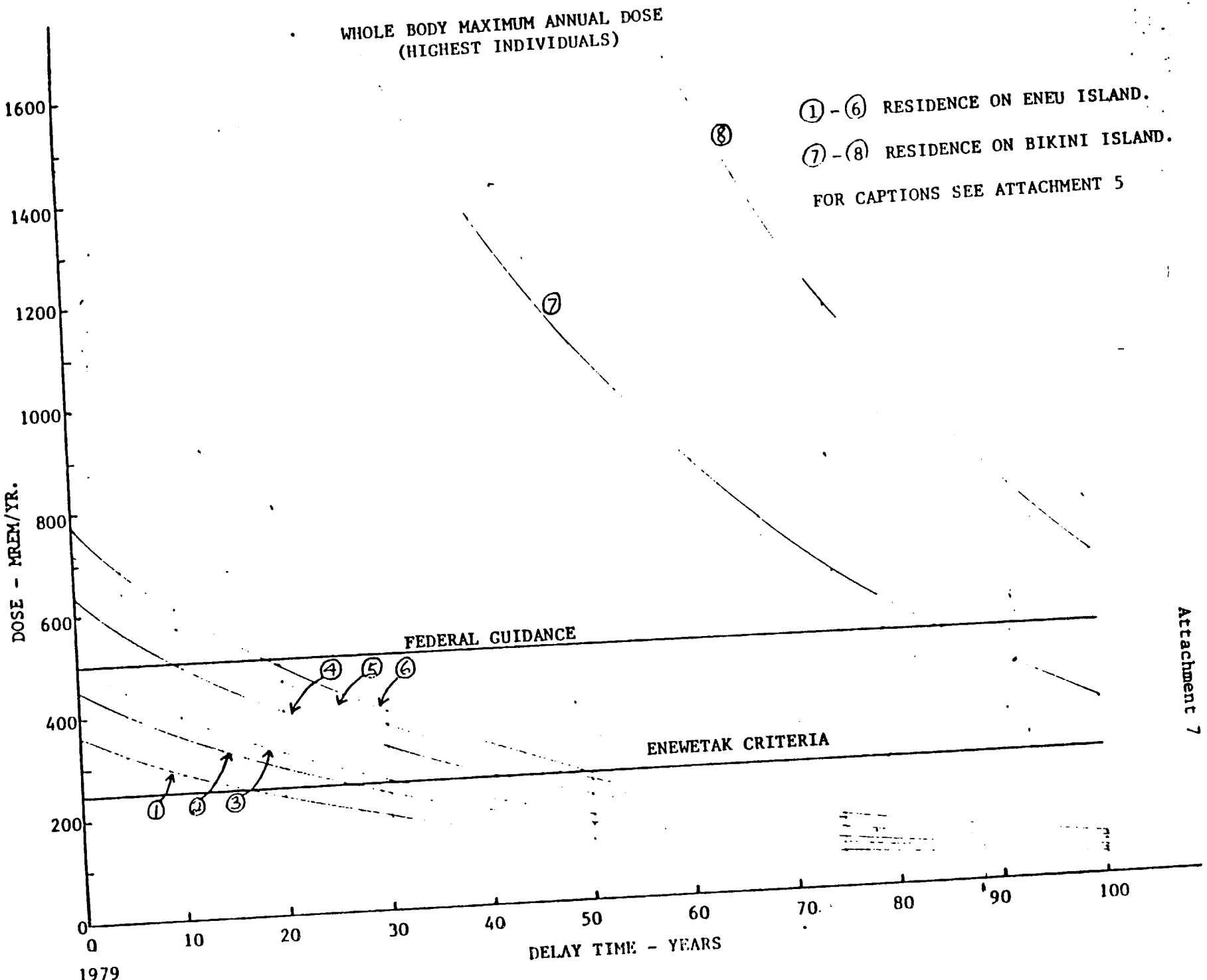

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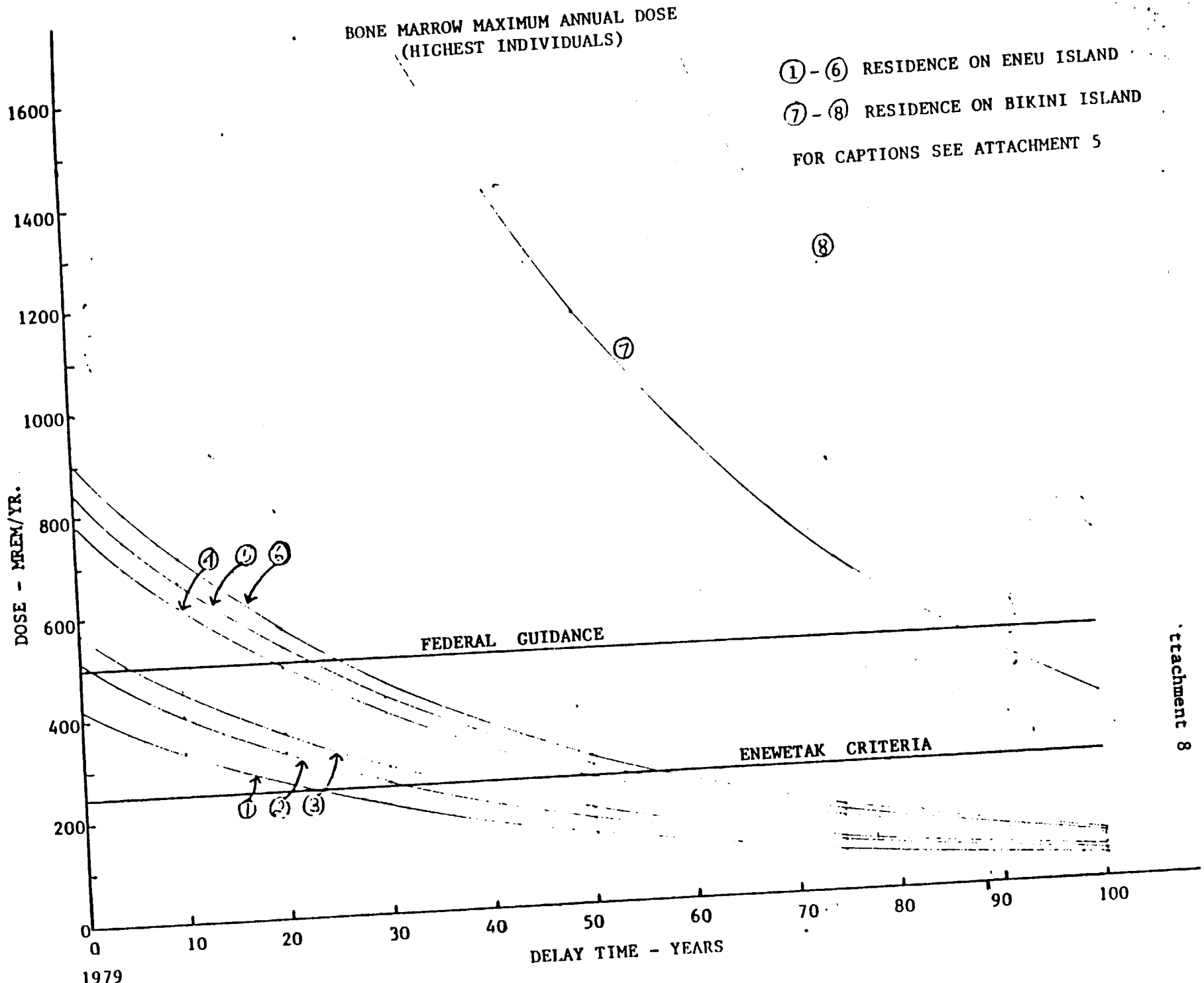

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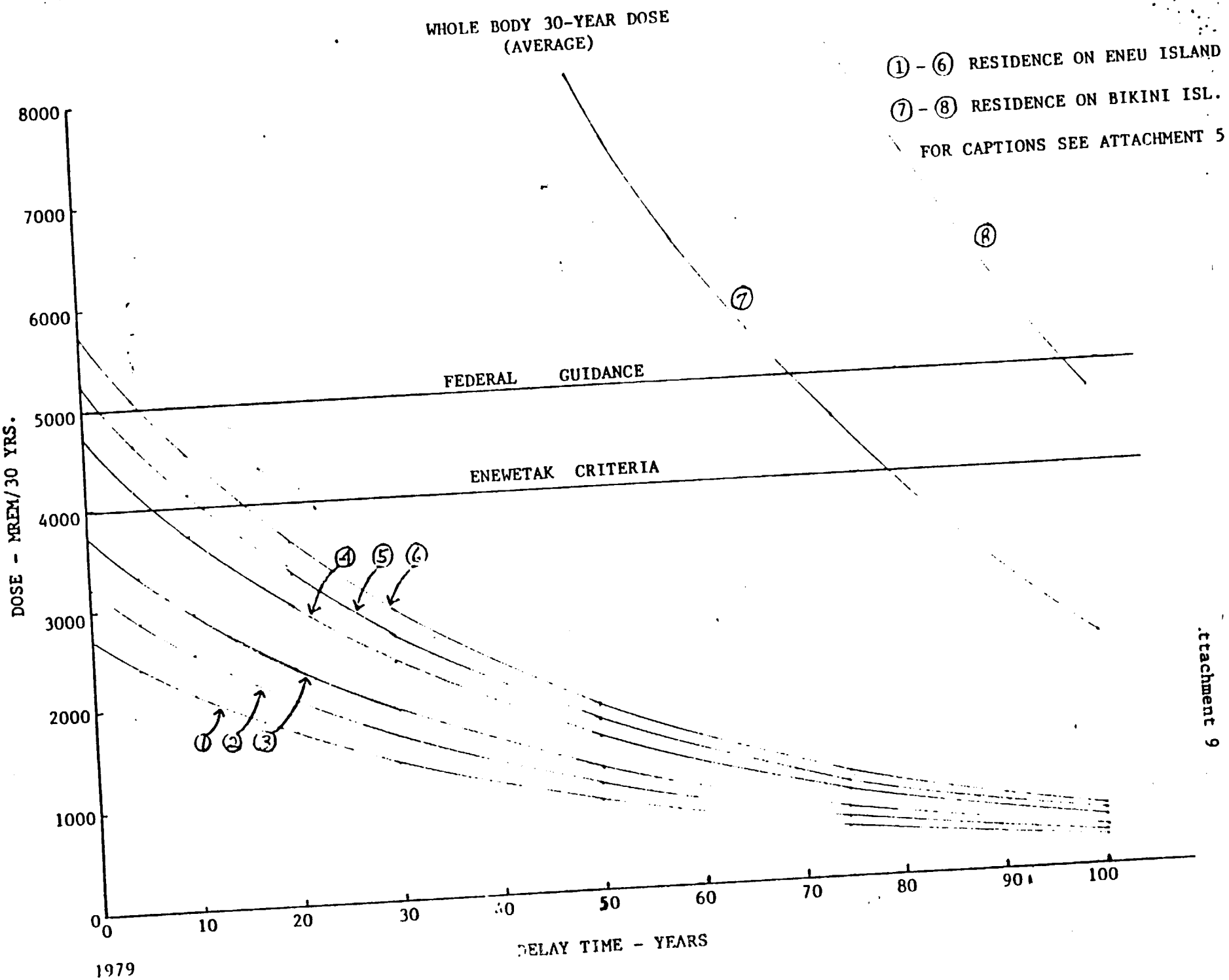

Attachment 9

STATEMENT OF UNDERSTANDING

ON THE PART OF THE

GOVERNMENT OF THE UNITED STATES

AND THE GOVERNMENT OF THE TRUST TERRITORY OF THE PACIFIC ISLANDS

CONCERNING THE

MOVE OF THE PEOPLE OF BIKINI ISLAND, AUGUST, 1978

On August 11, 1978, the Undersecretary of the Department of the Interior, James A. Joseph, the Deputy Undersecretary, Wallace Green, and the Director of the Office of Territorial Affairs, Ruth G. Van Cleve, journeyed to Bikini Island to meet with its current residents. The purpose of their meeting was to convey information on the subject of the forthcoming move by the people of Bikini Island to Kili Island, and to respond to questions and hear concerns put to them by the people of Bikini Island. They had earlier, on August 7, held a similar meeting with former residents of Bikini who now reside on Kili. The High Commissioner of the Trust Territory of the Pacific Islands, Adrian P. Winkel, had been prevented by bad weather in Saipan from joining in the visit to Bikini Island, but he had earlier met with the people of Bikini, as well as with other Bikinians on Kili.

in decrease in the radionuclide body burden. The Department of the Interior decided, in the light of the evidence presented by the Department of Energy, that the people living on Bikini should be moved at the earliest [illegible] date. An aerial/radiological survey currently underway and other radiological tests on Bikini being conducted by the Department of Energy will determine whether Bikini atoll can, in the foreseeable future, be considered as a home for the Bikini people.

Among the requests of the people of both Bikini and Kili was a request for a statement in writing of the understandings that the representatives of the United States conveyed during those meetings and of the commitments that those representatives were willing to make. The following are intended to respond to the principal concerns then and there expressed.*

Mr. Joseph and Mrs. Van Cleve, on behalf of the Government of the United States, and Mr. Winkel, on behalf of the Government of the Trust Territory, offered the following assurances:

I. The Government of the United States considers itself generally responsible for the well being of the Bikini people and their descendents and, following consultation with them, the Government of the United States will seek to arrange their relocation, permanently, in the most satisfactory manner possible. The Department of the Interior will undertake to obtain such authority and such resources as may be required in order to meet and

*On August 14, 1978, [illegible] the Bikini and Kili meetings, the four officers referred to above were involved in a major airplane accident off the coast of Guam. Although they were among the survivors, their

discharge this responsibility. The Department of the Interior will call upon other agencies of the United States Government to assist it, particularly the Department of Energy, so as to assure that, among other things, the medical needs of the current residents of Bikini Island continue to be met.

II. Because Kili Island has, until recent weeks, been regarded as solely a temporary relocation site for the people of Bikini, the Governments have never undertaken to construct permanent facilities there, nor to improve significantly any of the existing Kili facilities. It is now known that Bikini Island will not be fit for human habitation for decades to come, and on the basis of the most recent scientific information, it appears that Eneu Island, in the Bikini Atoll, will also be unavailable for settlement. In the circumstances, the Governments understand that some of the Bikini people will choose to remain on Kili indefinitely, and the Governments will accordingly undertake a program for the permanent rehabilitation of Kili.

III. It is not yet possible to develop a permanent relocation plan for the people of Bikini. That plan must await completion of the aerial/radiological survey that is now underway, and that is expected to be completed no later than the early weeks of 1979. When those survey results are available and evaluated, and when any remaining scientific tests found necessary are also completed, all of which developments are expected to occur in the first months of 1979, it will be possible to identify safe relocation sites. The Governments will then, following full consultation with the people of Kili (including the current residents of Bikini Island who will by then have relocated there), plan in detail for the relocation of such Kili residents as choose to move elsewhere, affording to them a choice among the possible relocation sites. Those who choose to remain on Kili will be accommodated there.

Bikinians Must Quit Island for at Least 30 Years, Hill Told

By Walter Pincus
Washington Post Staff Writer

The 139 Marshallese living on Bikini Island will have to leave their home atoll within three months and not return for at least 30 years because of radiation remaining from a 1954 U. S. hydrogen bomb test, a House Appropriations subcommittee was told yesterday.

An earlier plan to move them from Bikini Island to Eneu, another island in the atoll, was dropped, the subcommittee was told, because Eneu's coconuts were showing radioactivity readings five to six times higher than government scientists had previously expected.

As a result, Interior Department officials said yesterday, they could not say where the Bikini residents would eventually end up.

The people now living on Bikini were the first ones to return after a 1969 determination by the Atomic Energy Commission that the atoll was safe from radiation contamination. From 1946 through 1968 it had been the site of 23 U.S. nuclear weapons tests.

Subcommittee Chairman Sidney Yates (D-Ill.) asked witnesses from the Departments of Interior and Energy, "Why were these people allowed to go back?"

"There was no hint in 1969 that there would be a problem with coconuts, vegetables and water," he was told by Ruth G. Van Cleve, director of Interior's Office of Territorial Activities.

Joe Deal, of Energy's safety branch, said, "There were no coconuts to test and no foodstuff growing . . . We used the best instruments available at that time."

Deal outlined to the subcommittee how last month's medical examination showed the Bikini residents had taken radioactive cesium into their bodies at levels up to twice the accepted U.S. standard for the general population.

Dr. Walter Wyzen, also of DOE, told the subcommittee that the 139 men, women and children who have been living on Bikini for the past several years and eating its radioactive coconuts and other foods would have to undergo medical examinations for the next year and perhaps the rest of their lives to keep track of the radioactive matter they have ingested.

It was the finding of high concentrations of radioactive cesium and strontium—above U.S. standards—in the bodies of the Bikini residents last month that convinced Interior officials the people had to be moved.

Van Cleve told the subcommittee that although "the tests [last month] do not reveal an immediate danger" the move from the atoll should be made within 90 days—the time needed to pick a temporary place to live and build plywood homes there with aluminum roofs.

Adrian P. Winkel, high commissioner of the U.S. Trust Territory, told the subcommittee he would fly to Bikini next week and tell the residents "the need for the move and determine their preferences for a place to settle."

At that point, Rep. Frank Evans (D-Colo.) raised the question of what would be done if they did not want to leave Bikini.

"We have no choice but to require them to move," Winkel responded.

The high commissioner added, however, that it might be difficult to make the older people move because they still might prefer to remain.

Two aging Marshallese who own major pieces of land on Bikini Island are patriarchs of the two family groups that make up most of the people now living on the island.

Marshall Islanders who attended yesterday's subcommittee meeting were not sure Winkel could convince them to leave.

Illustrative of the problem was the exchange that took place when a question was asked why the people on Bikini kept eating coconuts after they had been warned they were dangerous and supplied with other food and water from outside the island.

Oscar DeBrum, the district representative of the Trust Territory government said, "Coconuts are treasured by the people. They would drink coconut milk even in the face of the warnings."

DeBrum then noted that when the medical team arrived last month on Bikini, the people offered them the radioactive coconuts as a sign of friendship.

"Either move the people or cut down the coconut trees," DeBrum suggested.

Representatives of the approximately 400 former Bikini people who now live on Kili Island told the subcommittee "we see ourselves as the victims of bureaucratic incompetence."

It was questioning by the Kili group about the safety of Bikini four years ago that first raised the possibility that dangerous radiation levels might still exist on the island.

At the time, U.S. officials were preparing to return the entire group to Bikini.

The Kili spokesman, Tomaki Juda, reminded the subcommittee that in 1946, a Navy officer told the Bikinians they had to leave their atoll so "it could be used for the good of mankind and to end all world wars."

The officer compared the Bikinians "to the children of Israel whom the Lord saved from their enemy and led into the Promised Land."

"We are," Juda said, "sadly more akin to the Children of Israel when they left Egypt and wandered through the desert for 40 years. We left Bikini and have wandered through the ocean for 32 years and we will never return to our Promised Land."

LOS ANGELES TIMES
July 23, 1978

See page 5
re Eren

U.S. ERRED

Bikini Island: Lost Again to Radiation

When the atomic bomb dropped, I thought Bikini would disappear completely. It would have been better, maybe, if it had. . . . Then we wouldn't have all these troubles.

—Nathan Note, scribe of the Bikini people, 1978

BY JERRY BELCHER
Times Staff Writer

BIKINI, Marshall Islands—When the Americans made him leave Bikini for the first time, in 1946, Andrew Jakeo was 34 years old.

When, after using the fragile Pacific atoll for 23 nuclear test blasts, the Americans in the person of President Lyndon B. Johnson assured him, his fellow islanders and the rest of the world that Bikini once again was safe for human life, Andrew Jakeo was 56.

Now Andrew Jakeo is 66 and, above all else, he wants to live out the days that remain to him on this tiny curve of coral, sand and coconut palms with his family and friends.

Then, when his time comes, he wants to be buried here among his ancestors.

But the old man will not be permitted to end his days where he wishes.

For one day next month—federal officials say about Aug. 22, although official plans dealing with this place and these people seem to go awry more often than not—the Americans will remove Andrew Jakeo and the 140 others living on 449-acre Bikini Island, largest of the 26 islets that make up Bikini Atoll.

They will be transported to "temporary" quarters in Kili, a single island with a land area one-sixth that of their 2.2-square-mile home atoll. Kili, without a lagoon, lies nearly 500 miles southeast. It is an island some Bikinians habitually refer to as "the prison."

The Bikinians must leave their ancestral home and its beautiful, fish-teeming lagoon because the Americans, as they themselves now admit, made a regrettable error 10 years ago.

Despite what the scientists and the President said—despite an investment of $3.25 million for cleanup and rebuilding—Bikini is not safe after all.

Andrew Jakeo and the others living on Bikini Island are being subjected to unacceptably high doses of radiation left behind by atomic and hydrogen bomb blasts that scared the atoll during 12 years of testing.

Some younger Bikinians may live to see their homeland again, but Andrew Jakeo will not. It may be 50 years before Bikini is fit for human habitation.

Andrew Jakeo is bitter and angry, although like most Marshallese he veils his emotions from outsiders.

"The Americans told us in 1946 that they had come to test a bomb," he said not long ago. "They told us they did not know how much the bomb would hurt Bikini. They told us that after they tested the bomb, and Bikini is good again, they will bring us back. They did not say how long it would be."

But Andrew—Marshallese address one another by first names and expect outsiders to do the same—believed, along with the 165 others the U.S. Navy removed in 1946, that they would be back within a year or so.

Meantime, he was convinced, the Americans would provide for him and the other people of Bikini.

Please Turn to Page 3, Col. 1

Bikini Islanders Lose Again to Radiation

Continued from First Page

Andrew finally came back about eight years ago. He was among the first to return. It was 24 years after the Navy had taken him away, two years after President Johnson's announcement that Bikini was safe.

From the front porch of his concrete block house overlooking Bikini lagoon, the old man recalled the long years between departure and return. There was near starvation, much privation. There was shuttling from one alien island to another and another and yet another. There was scattering of family and friends, dislocation, nearly total disruption of a hitherto quiet, untroubled way of life.

"Maybe there were some times when I was *not* unhappy," he admitted. "But . . . every day I remembered Bikini. And every day I wanted to come back because it is my homeland, because Bikini is a beautiful place."

He was quiet, deferentially polite. But at last, in reply to the stranger's question, Andrew dropped the emotional veil slightly.

How, the stranger asked, will he react when he leaves Bikini once again and forever?

"I will weep," he said. "I will feel anger. . . . I will not go. I will sit here. They will have to carry me away."

'You'd have to say the removal was the right of the conqueror.'

He said he also believed some of the others would do the same as he, feel the same as he.

And how, after all that had happened to him and his people since 1946, did he feel now about the Americans?

The old man laughed, perhaps embarrassed by the question and by the fact that the questioner was an American.

Then he leaned close, staring through thick green-tinted glasses that made his dark eyes seem enormous.

"The American is a liar-man," he said. "His promise is not kept."

The first American promise to the Bikini people was made by the U.S. Navy after President Harry S Truman had, on Jan. 10, 1946, at the recommendation of the Joint Chiefs of Staff, given the go-ahead for Operation Crossroads, the first post-World War II test of nuclear weapons.

In simplest terms, the promise went something like this: We have decided to use your atoll to test a powerful new weapon. For your own safety, Charter of 1945.

Specifically, it was designated a "strategic trust," which permitted the United States to set aside certain areas of the former Japanese mandate territory for military security purposes.

Bikini seemed a logical choice geographically, too. The idea of Operation Crossroads was to see what the atomic bomb would do to a naval fleet. The three A-bombs of World War II had been exploded in the New Mexico desert and over the Japanese cities of Hiroshima and Nagasaki.

Other sites were considered. But according to Crossroads historian Neal Hines, "Bikini fulfilled all the conditions of climate and isolation. It was . . . 2,500 miles west southwest of Honolulu . . . but it also was accessible. . . . Its inhabitants, who then numbered 162, could be moved to another atoll."

(Most other sources say the population then was 166. Since then there has been a population explosion. Today 860 persons claim land rights in Bikini Atoll—140 now living on Bikini Island, 450 on Kili, and the others scattered throughout the Marshalls.)

There was concern on the part of the U.S. fishing industry that the test blasts might hurt the rich commercial fishing grounds. There also were so many complaints from animal lovers that plans to use dogs as test animals were canceled. But there is no recorded protest against removing the Bikinians from their ancestral homeland.

"In retrospect . . . you'd have to say the removal was the 'right of the conqueror,'" said Jim Winn, a transplanted Kansan who is district attorney of the Pacific Trust Territory's Marshall Islands District.

"Our attitude must have been that we, at the cost of several thousand American lives, took the Marshalls . . . took this whole area of the Pacific from the Japanese. And . . . part of it was the attitude, 'Well, they (the Bikinians) are just little brown people anyway. They don't need their atoll. We'll just move 'em off someplace else.' "

Certainly the Bikinians were in no position to seriously oppose the Navy when, on Feb. 10, 1946, Commodore Ben Wyatt, then the military governor, arrived by seaplane and announced that they must go elsewhere.

In effect, the islanders then and there adopted the United States as their *iroij alap*—their paramount chief, the power over and beyond their local island chief, Juda. And, in Marshallese tradition, this meant that henceforward the United States was responsible for the protection and well-being of the Bikini people.

Although to American eyes the atolls of the Marshalls look much the same, the removal was deeply painful

'HOT BREW'—Jeladrick Jakeo checks sap from coconut palm. He lets it ferment into jakauru, a midly alcoholic drink. While coconuts are forbidden, Jakeo says no one has ever banned jakauru.

Islands Lost Again to Radiation

Continued from Third Page

man and his land overrides the concept of nationality.

"To say, 'I'm Marshallese,' that is a foreign concept," Kiste said. "Westerners named those islands the Marshalls. So 'Marshallese' has less meaning than 'I'm Bikinian.' And among themselves, they speak not of being Bikinians, but say, 'I'm a person of *this* particular piece of land.' Land is an expression of who I am—of individual identity."

Or, as fellow anthropologist Jack Tobin, another academic expert with long experience in the Marshalls, expressed it:

"In those islands, a man without land is no man."

By a split vote of the atoll's leaders, the Bikinians chose to go to Rongerik Atoll, 128 miles east of their home atoll. The Navy, which put out press releases at the time indicating that "the natives were delighted" by the move, was only slightly more restrained a year later in its official history of Crossroads, "Bombs at Bikini."

"The Bikinians, convinced that the (A-bomb) tests would be a contribution to world peace, indicated their willingness to evacuate," the Navy historian wrote.

It wasn't quite that way, according to Tobin, emeritus professor of anthropology at University of Hawaii.

"They did not go willingly," Tobin said. "They were forced to go. . . . They agreed because they had to, just as they had agreed to do things when the Japanese had bayonets in the background.

"Put yourself in their shoes: You've been told what to do by the Japanese for a quarter-century . . . and told by the Japanese military the Americans were weak. So when the Americans wiped out the Japanese . . . all those American ships appearing, the natural reaction . . . would be to go along with what they are told."

On the afternoon of March 7, 1946, the 166 men, women and children of Bikini were loaded aboard Navy LST 1108. As the awkward landing craft backed off the beach at Bikini Island and churned out of the blue-green lagoon, the people gathered on the main deck to sing traditional songs of farewell. The next morning they were unloaded at Rongerik.

On the morning of July 1, a B-29 bomber called Dave's Dream dropped a "nominal yield" 20-kiloton (the equivalent of 20,000 tons of TNT) atomic bomb over the fleet of 70 obsolete U.S. and captured Japanese and German warships moored just off Bikini Island. It exploded 500 feet above the fleet, sinking five ships, twisting and crushing others like cheap toys—and initiating the radiation poisoning of Bikini.

Among the 42,000 observers of the awesome blast was Chief Juda, watching as a guest of the Navy from the deck of the amphibious command

They thought they could bear up under the hardships of Rongerik.

ship Mt. McKinley, several miles away. The Navy used more than 10,000 instruments to record test data.

Chief Juda's reaction was not recorded. The next day he rejoined his people at Rongerik.

Rongerik was a disaster. It was too small. There was too little food. And, according to legend, it was haunted by an evil witch named Liborka, who poisoned the fish of the lagoon. In fact, certain fish of the lagoon were poisonous which was why Rongerik had been uninhabited for years.

But it was close to Bikini and the people had chosen it for that reason. They thought they could bear up under the hardships until they went back to their home atoll. That, they were convinced, would be in a couple of years at most.

Chief Juda had returned from the first bomb test (the second, an underwater shot, was held July 25, 1946) to tell his people that while there had been great damage to the ships, there seemed to be little to Bikini itself. The trees were still standing, still bearing coconuts. But the radiation, invisible, was not something he could understand.

Severe food shortages developed during the winter of 1946-47. In spring of 1947, fire destroyed a third of Rongerik's coconut trees. The people pressed for a return to Bikini, but a radiological survey indicated that it was too "hot" for permanent occupancy and would be for many years.

In October, the Navy announced that the Bikinians would be relocated on Ujelang. But two months later, the Pentagon announced a new series of nuclear tests would be held, this time at Eniwetok, another atoll in the Marshalls. The Eniwetok people would go to Ujelang instead of the Bikinians. The Bikinians had to wait.

Andrew Jakeo remembered the Rongerik period well. "I was a big man then," he said, "but I got skinny." He held up the little finger of his left hand. "Skinny like this. One old woman died from hunger. . . . For a year and a half, we did not have enough food, (sometimes) got our food by cutting open the coconut tree and eating the heart of the tree. This killed the tree."

Jeladrik Jakeo, Andrew's 48-year-old brother, was a teen-ager on Rongerik. "It was terrible," he remembered. "We ate things that were not good, gathered coconuts that floated in from the sea. Bad food; we got sick. Arms and legs swelled up, and we got blisters on the arms and we had diarrhea."

Late in January, 1948, the Navy dispatched anthropologist Leonard Mason, now of the University of Hawaii, to investigate. He found the exiles at the point of starvation, living on raw flour diluted with water.

In strong terms, Mason recommended that the people be removed from Rongerik as soon as possible. He also recommended Kili Island, although he admitted it had many disadvantages, as the best available place to relocate the Bikinians.

In March, 1948, they were moved to a tent camp at Kwajalein. In September, the Bikinians voted to resettle on Kili, and in November, they were finally settled on Kili and began building a new and bigger village than they had had on Bikini.

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than at Bikini. Supply ships could neither land food nor take away copra—dried coconut, the only cash crop—for months at a time because of the heavy surf. Sometimes six months passed before a ship could unload.

In an attempt to relieve the isolation, the Navy turned over a 40-foot

and the problems of the Bikinians—to the civilians. A high commissioner was appointed by the President to work with and through the U.S. Department of the Interior.

Matters did not improve right away. But under pressure from the United Nations, the high commission-

file

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509) 375-2421
Telex 15-2874

December 1, 1980

Mr. Scott Stege
TTPI LNO Kwajalein
P.O. Box 1748
APO San Francisco, CA 96555

Dear Scott:

Enclosed is a "cleaned up" two paragraphs from page 5 of your Record of the meeting at Kili. Only a few minor corrections are required.

Your Record of the meeting is very well done. I haven't compared it with the tapes, but it probably compares quite well.

Sorry to be so slow in returning this, but I have been away much of the past two weeks.

Sincerely yours,

for W. J. Bair, Ph.D.
Manager
Environment, Health and
Safety Research Program

WJB:lm

Enclosure

MEMORANDUM FORM TT-570G

TRUST TERRITORY OF THE PACIFIC ISLANDS *Office of the High Commissioner, Saipan*

TO : High Commissioner DATE: 29 October 1980

FROM : TTPI LNO Kwajalein

SUBJECT: Kili Dose Assessment Trip - October 5-9
(Majuro/Saipan dates used throughout this memo)

Background -- While on Saipan in early September I was requested by the High Commissioner to accompany the U.S. delegation on its dose assessment trip to Kili in early October. That trip resulted from a request by Bikinians, who had attended the Ujelang Dose Assessment Conference in September of 1979, for a similar presentation covering Bikini Atoll. The following individuals comprised the U.S. delegation:

Hal Hollister-DOE
Bruce Wachholz-DOE
Tommy McCraw-DOE
Steve Gotlieb-DOE legal counsel
Roger Ray-DOE
Bill Robison-Lawrence Livermore Laboratory
Dr. Bill Bair-Pacific Northwest Laboratory
Reynold deBrum-DOE Majuro representative
Gordon Law-DOI
Gary Boehlke-DOI legal counsel (NEPA)
Alice Buck-DOE (translator)

Also accompanying the delegation were Marshall Islands Government Chief Secretary Oscar deBrum and aid to the MIG Foreign Affairs Secretary, Edinal Jorkan. Judy Knape, at the request of Ted Mitchell, and Jeff Jefferson of the Marshall Islands Atomic Litigation Project as Henchi Balos' special observer, also accompanied the group.

Cost of Transportation -- The Marshall Islands Government assigned the Micro Palm as the charter vessel for the trip to Kili. The ship was in exceptionally clean condition, had just been repainted and was commanded by the redoubtable Captain Moses, in the opinion of most, the finest sea captain working in the Marshalls. The only mechanical problem experienced was with the outboard motor on the Palm's small boat which malfunctioned as we arrived at Kili, requiring the captain to borrow a 25 horsepower motor from a Kilian, "Captain Samuel". The borrowed motor fell off the Palm's small boat during landing efforts our first day at Kili. Having had his motor fully immersed, Captain Samuel asked Oscar deBrum for a replacement motor (the life of a motor is reputedly diminished by one-fourth following a dunking). Additionally, the three Bikinians who used the Palm's and their own boats to ferry people on and off Kili requested pay for their labor and $50.00 per person was fixed upon. The Department of Energy will verify these costs, plus the cost of chartering the Micro Palm, to the High Commissioner

after the Marshall Islands Government sends its bill to DOE/PASO. The onl other anticipated costs relating to Majuro/Kili/Kwajalein/Majuro transport involve meals authorized for all Ejit passengers (there were twenty who finally went to Kili) plus about 100 Kilians who traveled Majuro/Kili and about fifty who traveled Kili/Majuro. I have requested DOE's Harry Brown to route through me at Kwajalein all trip costs which are being submitted to the High Commissioner for payment.

The Dose Assessment Conference -- Presentation of the booklet, "The Meanin of Radiation at Bikini Atoll", by Alice Buck in Marshallese and responses to the questions it generated formed the nucleus of the Dose Assessment Co ference October 7 and 8 on Kili at the church. Gordon Law, however, fielded questions and offered statements which expanded the meetings beyon the factual presentation of the DOE/Lab group. In order to develop the mo complete version of the two day sessions attended by from about 50 to 150 Bikinians, I have asked Jonathan Weisgall, Dr. Bill Bair, and Tommy McCraw to send me copies of their cassettes of the proceedings. What follows is a consolidation of Judy Knape's and my own handwritten notes. When and if cassettes are received I may develop a verbatim transcript if it would sig nificantly improve on these summarized exchanges.

Opening remarks and the presentation began at 2:00 PM October 7. Que tioning began after about ten pages of the booklet had been presented by Alice Buck in Marshallese, with slides.

Jibas,senior : It's very sad to talk about land in the way described on page 10 of alab) the booklet. The United States should just give me a million dollars. Wh does Bikini Island have so much radiation when tests were performed else- where?

Bill Robison): Winds carried fallout to Bikini and, to a lesser extent, to Eneu. Th winds were going east and a little south. The main part of the cloud hit Bikini Island, but an edge touched Eneu Island.

Jibas): Can people live on islands which are shown in light pink at page 11 i the book?

This will be answered later in the book; i.e., the amount of radiatic which will be received in these islands would be below current Federal gui lines.

Would you (Robison) consider it safe for you and your family to live Eneu?

(B. Robison): I would have no hesitation because of radiation considerations to liv there as a family.

tatement: I wish the United States and its allies would remove the soil from (Bikinian) Bikini, but I see it goes down far, and would not like to see that.

omment(Woman): Until the atoll has been cleaned, my family won't want to go back.

At this point, the presentation continued on until page 18 in the boo let before further questions were raised.

Why would they monitor people on Eneu if Eneu is safe?

Predictions are estimates which may vary from person to person. To ensure that people are not getting too much, we will monitor and see if estimates are accurate.

Johnny Johnson) : Suppose I lived at Eneu and abided by all the regulations, will there be a reason to come and monitor and study me?

Hal Hollister): It's always good to have checkups to know whether you are healthy. We would not force monitoring, but it will be available.

atement(Jibas): If it's fine at Eneu, I'd like to go.

If Interior says it's safe, it seems that DOE doesn't need to bother me to check on anyone.

B. Robison): There is a risk, a small risk, in returning to Eneu even though it's below the Federal guidelines.

Tomaki Juda): Since we just received the book, can we meet with our advisors and then ask questions again?

(Andrew Jakeo): I lived on Bikini for 7 years. Can you tell me how much radiation I have?

(Bruce Wachholz): Yes, we know and can tell you if you have been whole body-counted. don't have that answer with us, but can get it and pass it to you through your legal counsel.

(Tomaki Juda): If people could go to Eneu, some of the people would request the Department of Energy to clean up Eneu so that the level of radiation would be even lower.

(J. Weisgall): Would a cleanup effectively reduce the exposure level?

(B. Robison): To reduce the dose, we would have to remove soil and particles all th way down so we would have to take a lot of soil. This might have serious effects on agriculture.

(Tomaki Juda): There is lots of soil there and if you took some, tree and plant roo would be closer to water.

(B. Robison): I don't know what the effect would be.

(Teacher): Is it 100 percent safe to live on Eneu?

(Dr. Bair): It's never 100 percent safe to live anywhere. On Eneu, even if you don't eat any food, you will inhale radioactive particles from the air and dust in very small amounts. It is an additional small risk.

(To B. Robison): You feel it would be safe for your family, but the book says there ar diet restrictions and other restrictions. Do you still feel good about being there?

(B. Robison): The diet restriction is that a portion of the food people would eat would have to be imported, and that people can live at Eneu continuously but could not go to Bikini Island.

Comment (Bikinian): The restrictions imposed are very tough. It would be better to either say "You can go and there are no restrictions" or to say "Don't go, because it's contaminated".

The first day's presentation ended at about 5:00 PM October 7, before the entire booklet could be translated. The next day the conference resumed.

Statement(Hal Hollister): We are here at your request for information. We were requested at the Ujelang meeting to present to the Bikinians a book which gives facts about radiation doses. We feel it's important to stress a few things in order to help you better understand the facts being presented. The Department of Energy is not here to either make decisions or to recommend a decision about whether you should return to Bikini. Rather we are here to present facts about radiation levels and standards; facts with which you can decide for yourselves. The Department of Energy is acting as an information resource just as they do for the Department of Interior. We sympathize with the expressed desire of the Bikini people for us to say more than the facts and standards of comparison, but we can't stand in your shoes. You must make the decision. However, we can't assure absolute safety in deciding. Remember we speak only of radiation dangers, and there are other factors that only you are in a position to consider. As the book explains, we have used radiation standards, as in the United States and around the world. We have used them so you would have some way of examining radiation levels.

Statement(G. Law): What Department of Energy has explained is factual. Based on whatever decision you make, it will not detract from what Department of Interior is committed to do for all of the people of Bikini. The same facilities will be built here (Kili) as on Eneu and Ejit; however, participation by the Bikinians is necessary to ensure their promise for the future. Robert Kennedy quote: "The future is not a gift; it is an achievement."

Q: Explain why the Bikinians were allowed to return earlier; compare Bikini and Enewetak and tell us why Enewetak was cleaned up.

The answer is provided in the booklet; it was explained, and Alice Buck went through those answers on pages 30 and 31, pages which had not been cover the previous day, when time ran short.

Q(Johnny Johnson): Since three islands were destroyed (see map on page 9) does the United States intend to pay for them?

A(Gordon Law): That answer is not for the Department of Interior, but I am certain your legal counsel will ensure your interests in this regard are protected and advanced. This is what we call in the States "passing the buck".

Comment(J. Weisgall): I believe the people are entitled to compensation for the islands which were vaporized, for damage to other islands, for loss of crops, damage to people, and other damages. There are two approaches, one through the

United States Congress, and the other through the courts. DOE and DOI won't say, "Here is the money." We must pursue, for ourselves, with the U.S. Congress, and the courts if necessary, this matter.

Q(Johnny Johnson): There appears to be a discrapancy between the graphs on page 5 and page 29 on the rate of decay of cesium.

A(B. Robison): Cesium in the ground (graph, page 5) decays at the rate of one-half its amount after 30 yars. Cesium in the body is eliminated at the rate of one-third in 100 days. So the body eliminates cesium much faster than it decays on its own.

Q(Johnny Johnson): Do those Bikinians who left Bikini two years ago have any cesium in their bodies?

A(B. Robison): Their cesium level has dropped very quickly, and there is very little left.

Q: Of those who have cesium left in their bodies, is there any harm or danger in their bodies now? Is there sickness in their bodies now?

A(B. Robison): There is no immediate sickness, but there is a small risk over a long period of time. There is no sickness in people we have seen, and the risk of harm is very small.

A(Dr. Bair): The number of people in the Marshalls has increased three times in the last thirty years. We believe that the population will increase another three times in the next thirty years. If there were 550 Bikinians now, there would be 1700 in thirty years. 1300 births would occur in the next thirty years, and about 160 deaths from all causes. One of the diseases causing death is cancer. 24 of the deaths will result from cancer. In Kili, ~~you'll~~ get about 20 millirems of natural radiation per year. In thirty years, that amounts to 600 millirems. Living on Kili ~~would~~ result in 0.06 to 0.2 ~~more~~ cancer deaths caused by ~~cancer~~. This figure ~~needs to be~~ included in the ~~figure~~ of 24 cancer-related deaths overall. If ~~500 persons~~ lived in the United States and received United States background radiation over thirty years, there ~~would~~ be 0.3 to 1.0 ~~additional~~ cancer deaths ~~based on~~ the United States average rate, which is much higher than Kili's.

If people had remained on Bikini, ~~the~~ radiation ~~dose~~ would have continued, and the risk of cancer would have increased. If people ~~over thirty years~~ receive 5000 millirems (and this is the U.S. Government standard) 0.5 to 2.0 additional cancer deaths could be expected. Even the radiation standard is not 100 percent safe, there is a risk. ~~If an individual~~ receives 15,000 millirems in thirty years, the risk increases by 1.4 to 7.0 additional cancer deaths. And if ~~one were to receive~~ 50,000 in thirty years, the risk would increase to 5.0 to 23 additional deaths from cancer. What this means is that ~~while the standard per year is 500 millirems, the U.S. standard~~ for thirty years total intake ~~is~~ 5000 millirems. For if a person were to receive 15,000 ~~millirems~~ over thirty years, the increased risk would be 1.4 to 7.0. Scientists feel it is ~~not acceptable~~ to receive 500 millirems every year, but that it is OK to receive 500 millirems some years.

: If allowed to return to Bikini Atoll, what things could be done to help reduce dose intake?

: Stay off of Bikini Island, and do not eat any local foods.

(Henchi Balos): Provide us the comparison of radiation dose at Kili and the dose at Eneu.

: Net background exposure at Kili is 20-25 millirems per year, while at Eneu it would average 170 to a maximum of 390 millirems per year. This assumes imported foods are available and are combined with about one-half local food diet.

(Henchi Balos): Why is there such a difference between Kili and Eneu?

: Fallout remains in the soil at Eneu, which is not present here at Kili.

: If there is a small risk by living at Eneu and we are unable to deter our children from eating local foods and increasing their risk, will the United States take responsibility? If the diet is augmented and people depend primarily on imported food, will the United States Government be liable if children were to receive a larger dose because an acceptable standard still cannot be maintained?

(Hal Hollister): Under the "Burton Bill", responsibility to monitor the risk lies with the United States and we would hope that the people would take advantage of that bill, for it will provide health care and monitoring. The requirement for imported food is not perpetual. As the radiological level goes down via decay, eventually imported foods will no longer be required to stay within the guidelines.

(Henchi Balos): In 1978 DOE said Bikini Island would be off-limits for 60 to 100 years and Eneu would be off-limits for 20 to 30 years. Why are you not saying this now?

(Roger Ray): I don't remember any such statement by the United States.

Comment(J. Weisgall): These were statements made in the U.S. Congressional testimony by Department of Energy. Bruce Wachholz, you were there.

(Hal Hollister): We will follow up on this question and find out the information for you.

(Johnny Johnson): See paragraph 3 on page 28. Why was the mistake made which resulted in President Johnson approving the return of Bikinians to Bikini Atoll? Was the information they had in error?

(B. Robison): Scientists in 1967 and 1968 had very little information and data. They didn't know much about radiation in the soil and plants and about dietary habits. Since that time we have monitored Bikini and Eneu and collected thousands of samples of food, soil, water, and fish. As a result we have much more information now than we did in 1968. With this additional information we can now estimate much more precisely the dose to be expected. We don't think these conclusions of today will change. However, we will continue to study and will pass on our findings and understandings to the Bikini people.

Q(Johnny Johnson): Will you give us all reports from 1967 and 1968 up through the present?

A(B. Robison): All reports are either published and available or are in the process of being made available.

Statement(Jibas): (Having walked to the front of the church so that he was face to face with Gordon Law) I want to say to Law, I'm ready to return to Eneu. I want to go to Eneu with others of my family. I understand you will provide food.

A(Gordon Law): If that is your decision this venerable gentleman will be returned and food will be provided; I will help you do it and help you with the restrictions.

Statement(Jibas): (To the gathering of Bikinians) Those who wish to follow me raise your hands.

About five, mostly old people, raised their hands, according to Judy Knape's count. Scott Stege counted about ten, including Andrew Jakeo.

Statement (Young man): We wish to meet further among ourselves and consider the information you have given us.

Q(Gordon Law): There are fifty-six Bikini people here in this church now. While I have no intent nor desire to do anything to divide or question the authority of your representatives, are these fifty-six people assembled in the church here truly representative of all 900 Bikinians?

A(Henchi Balos): My opinion is that there are perhaps fifty heads of families qualified to speak for their families among the Bikinians. I don't know how many of those fifty family heads are here. A few women are here. I think there are enough here to speak but I would ask Tomaki Juda to respond also.

A(Tomaki Juda): I feel that the representation that is here, all of the Council being present, are those who are authorized to make community decisions. We also have other family heads and others sufficient to make decisions for the 900 Bikinians.

Statement (Henchi Balos): Jibas is a respected elderly gentleman and I support him and recognize him as a spokesman. As representative of the entire Bikini community I must be in the middle and not support any one position, but I want both sides to be recognized and am in the middle. I think this would be a good time to have our legal counsel speak.

Comments(J. Weisgall): It is difficult for me to speak on behalf of the Council. It is quite obvious that there are divergent views. However, based on my discussions with the Council, I'm certain that the Bikinians want an independent scientist to confirm DOE's assessments and only at that time can the Bikinians' decision be made. Assuming that the independent scientist would confirm DOE's assessments, then at least one-half of the population will want to return to Eneu. So we should proceed on the assumption that the independent scientist will confirm DOE's dose assessment and we should talk about resettlement on that basis.

Statement(G. Law): From a personal perspective, I certainly have no intent to contest or dispute the will of the Council. However, the monumental decision you are about to undertake is now being left to an individual we don't even know and that doesn't help us decide today. You have twice rejected the scientist proposed to you. I want to act now. Obviously, this is your decision, so I must make two decisions: (1) If your scientist says the DOE report is bad, then I must plan accordingly. (2) If your scientist says the DOE report is OK, I plan accordingly, although I don't know what that will be. My responsibility is to do something for you as soon as possible. In closing, if it is your desire to take advantage of my time here, I am willing to work with Senator Balos, Magistrate Tomaki, High Commissioner's Representative Scott Stege, and Chief Secretary Oscar deBrum of the Marshalls Government to discuss these problems.

Statement(J. Weisgall): It has been difficult in the past working with the independent scientist concept, and the Bikinians haven't been certain what kind they wanted. Two Americans were picked, but some felt they wanted a Japanese. Meeting last night, there was an overwhelming vote to have an American scientist review and assess survey results, so shortly I, Henchi, etc., will meet in Washington and review. If the scientist reviews and agrees and recommends you can return, how many would want to go back?

Q(Gordon Law): If six weeks from now your independent scientist agrees that returning is OK and Jibas asks "how many will go with me", how many wish to go? I, myself, believe in my colleagues' information and assume your scientist will agree as well. If so, how many will want to follow Jibas?

Q(Taro Lokobol): If we go back and we or our children are harmed in thirty years or whenever, can we look to the United States to compensate us?

A(Gordon Law): Okay. (Stege notes) Yes, you can look to us for aid. (Judy Knape notes)

Q(Taro Lokobol): Could we have the signature of the U.S. President or a memorandum of understanding?

A(Gordon Law): A memorandum of understanding binds two parties. I believe if people follow the restrictions set forth in the book I don't have to worry about your children, and won't need to help.

Q: Please explain further what is meant by the memorandum binding two parties. Are there rules for us to abide by?

A(Gordon Law): I would like them to follow rules, but I can't enforce that. There is legislation that covers your children and future generations, known as the Burton Bill.

Q(Tomaki Juda): I would like to ask DOE if it is true that when you monitor and take blood from a person you pay them $10.00 per person each time?

A(Roger Ray): Yes, in the past we have paid individuals for the inconvenience of going from their home elsewhere to be examined, but that payment was not for blood samples, it was for the inconvenience and food and taxis, etc.

Q(Tomaki Juda): If payment is not for samples, is there a value to the samples, and could you consider paying for persons who give their life's blood?

(Roger Ray): While it could be considered, we haven't seen any reason before to do it. The program was developed to benefit people and we have not considered it necessary to pay for participation, which is on a voluntary basis. I see no justification to pay for participating if a person is on his home island.

(Tomaki Juda): If people return to Eneu and monitoring occurs (before no one had taken blood samples), the blood sampling is new and is a vital issue. We're giving something from our body. Can this be compensated?

(Roger Ray): We don't have any new program of taking blood. If taken it is for general health examinations. Radiological tests are done by whole body count and urine analysis. Blood, if taken, is for general health and for your benefit. It might be used to test for diabetes, etc. I see no reason for compensation, but if it is a concern of yours, we will relate it to the proper authorities.

(To Gordon Law): When can we leave?

(Gordon Law): When people make the decision they want to leave, it's my job to make that as soon as possible. To do it right, it has to be planned with the people's help and cooperation, and they need to tell us what they want.

(Older man): America brought us here. I cannot leave without America saying for us to move. Ididn't ask to come here, I stay here where you put me until you tell me to move. I don't discredit the book. I feel it's accurate. Even if my atoll is contaminated, I'll go back if you tell me to go. I await your telling me. If you tell me to stay here for thirty years or one hundred years I will. You tell me. It's not satisfactory for you to tell me to tell you.

Statement(G. Law): An historical perspective of today's situation is important. This man was told to come here and was brought here to Kili. Agreement is made among people here that democratic government should prevail. It's not the same but not dissimilar to the United States. So recently you have decided to have representation in Washington, D.C. through legal counsel, in Majuro through your Senator, and in Saipan through the Trust Territory. You have decided that you're comfortable with representation. Democracy says the majority is to be served by representatives. I need representatives to tell me the number who wish to return, and I want to support your freedom to make that choice which is best for you. I don't want to rule you.

Q(Older man): I compare today's meeting to the meeting we had when we were asked to leave Bikini originally. We were told by a person representing a country of great power to leave so testing could be done. We were afraid we would die if we didn't leave. We were told we would be taken care of and watched over. We would be your children, and the U.S. would take responsibility. We went to Rongerik and were poisoned by fish. We then went to Kwajalein and were asked to choose, and didn't know what to choose. We ended up here on Kili and were told we would be here until Bikini was safe and we would be told to return. We were brought here to Kili. We are not happy here. We were shown other places (Wake for example). Nothing else looks good. You brought this book, I throw it down. Half of it's good, half is not. I don't understand it. How can you ask me to decide? We want you to say it's OK to return. It's too much responsibility for us to decide. We want the biggest U.S. bank to come here and be emptied. That's the only to make a help. The only thing that will help.

Statement(G. Law) : We have guilt. Here, and at home with the Indians. Permit me the analogy. There are inequities in a free society, but on balance of good and bad, the American Indians have achieved a lot. And through representation you have representatives to bring problems to me, to the United States, to President Kabua. Reasonable men can sit down and discuss and try to solve problems together. I don't want to tell you what to do. You have a simple problem to solve. The book tells you that in order to return you would have to follow certain restrictions. Through your democratic framework you must decide if you want to go, and how many will go. Historically money ruins societies, it does not do good.

Statement (Bikinian) : If we're not returned to Eneu, please don't put a helicopter pad here (at Kili). If they don't follow me don't give them a helicopter.

Q(Bero Joel from Ejit): We were assured help from the United States when we moved off of Bikini and went to Ejit. I can't put my finger on any help we have received.

A(Gordon Law): What help have you specifically requested? I think of houses, food. I don't think you've been denied help, though perhaps some requests haven't reached us.

Statement(Bero Joel) : I've made my needs known, and haven't seen the results.

A(Gordon Law): If you give me specific items and dates, I will check them out within 24 hours.

Comment(Bero Joel) : I thought we would get kerosene and matches and soap, and all we got were houses. (The following list was provided to Scott Stege by the people on Ejit, through Bero Joel:

1. Gas
2. Kerosene
3. Soap
4. School building
5. Dispensary
6. Power plant/electrical delivery system
7. Matresses, sleeping mats
8. Copra cart
9. Majuro/Ejitwalkie talkie system)

Statement(J. Weisgall) : In summary, it is clear that for several years and still today Bikini people are divided. Some want to go to Eneu today, and others want to stay on Kili regardless of safety. There are some who desire Eneu if the results of DOE are confirmed. Others want to stay on Ejit. We want to proceed on the following assumptions: (1) That some people want to return, and that it will be helpful to get actual numbers. These numbers may not be available until after the independent scientist evaluates DOE's assessments. (2) We need to look at anticipated master planning while Gordon Law is here. (3) We should also discuss what's involved in making permanent plans for Eneu and Kili as to timing.

At this point Gordon Law asked that we take a break and come back and talk about master planning. When the group returned, Gordon Law listed on large pieces of paper his concept of planning with the Bikinians.

Chart by Gordon Law:

	Ejit	Bikini	Kili
Health			
Education			
Transportation			
Communications			
Housing			
Church			
Council Hall			
Added by Bikinians from the floor. Warehouse			
Typhoon shelter			
School			
Food support			
Walk-in freezer			

Gordon Law stated that his rough estimate for facilities on Kili and Eneu came out to $18.5 million. Questions were asked whether this dollar figure in any way represented claims settlements, and Gordon Law stated absolutely not. Oscar deBrum translated into Marshallese the items and dollar figures which comprised Gordon Law's conceptual outline.

Q(Gordon Law): What would the preference of the Bikinians be for building an airstrip? Should it be done throught the High Commissioner by contract, or through the Marshall Islands Government's Department of Resources and Development?

A(Tomaki Juda): Whatever is most safe, sound, and expeditious. We would depend on Mr. Law to work with the High Commissioner and our legal counsel to choose an independent contractor.

Statement(G. Law): A public bid process may be slow and the negotiations with the Marshall Islands Government might be much quicker.

Q(Johnny Johnson): Could the CAT (Civic Action Team) unit be used to build the airstrip?

A(Gordon Law): The CAT teams run about 1.2 million for a calendar year and it would probably be more expensive to use them, although we can consider this.

Statement(T. Juda): We will entrust this matter to Mr. Gordon Law, expecting that speed and quality will guide your selection of the appropriate method in coordination with the High Commissioner and our attorney. Mr. Law, with all of the trees that must be removed for a 4,000 foot by 150 foot runway, what compensation can we look for as a result of this tree removal?

A(Gordon Law): The benefits brought to Kili and to the Bikinians by the air runway will far outstrip the productivity of the trees, which we looked at yesterday and are in many cases old and not productive.

Statement(H. Balos): In conclusion, it won't be too long before we will be able to make a decision based on the independent scientist's evaluation. Two additional items should be added to Gordon Law's list of facilities, and they are (1) airport renovation for Eneu and (2) Ejit dock repair.

The Dose Assessment Conference concluded with closing remarks by the principals Hal Hollister, Gordon Law, Tomaki Juda, Henchi Balos, Nathan Note (representing the Kili community), and Andrew Jakeo (representing the Ejit community).

The Micro Palm departed Kili following a difficult boarding from Kili's oceanside, at about 5:00 PM the evening of October 8 and reached Kwajalein October 9 at 9:00 PM.

Scott H. Stege

file

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509) 375-2421
Telex 15-2874

December 29, 1980

Dr. Bruce W. Wachholz
Department of Energy
Office of Health and Environmental
Research, EV-21
GTN, E-201
Washington, DC 20545

Dear Bruce:

I have just read Tommy's letter to Bill Robison giving his concern about the diet assumptions used in the dose assessment. I share Tommy's concerns. The actual diets of the people under conditions of imported food and no imported food are indeed vague because they have never been determined in a scientific way. This could cause eventual problems with the dose assessments and the Bikini experience could be repeated.

Knowing Mitchell's interests I think use of his diet values could be difficult to defend.

If Bill revises the dose estimates based on new information or assumptions about diets or using some of Tommy's suggestions, the dose assessment pages of the Enewetak and Bikini books could and should be revised.

With best regards,

Bill

W. J. Bair, Ph.D.
Manager
Environment, Health and
Safety Research Program

WJB:lm

Department of Energy
Washington, D.C. 20545

FEB 26 1981

Mr. Jonathan M. Weisgall
Ginsburg, Feldman, Weil and Bress
1700 Pennsylvania Avenue, N.W.
Washington, D.C. 20006

Dear Mr. Weisgall:

Mr. Hollister requested that I respond to your letters of October 16, 1980, and of November 3, 1980. Please excuse the unusual delay in responding.

As you know, the information we presented at Kili Island in the book, "The Meaning of Radiation at Bikini Atoll," indicated that the people could return to Eneu Island with the expectation that the resulting radiation doses would be within the United States Federal standards if (a) residence was restricted to Eneu Island, (b) at least 50% of their diet would consist of food from outside the atoll (imported food), (c) that time spent on Bikini Island would be controlled and minimized (10%), and (d) that no food from Bikini Island would be eaten. (Since these estimates were based upon the averaged values of a number of parameters, the individual with unusual personal habits and lifestyles may vary -- in either direction -- from these estimates.) It also was stated at Kili that without imported food it would be about 20-25 years before the people could return with the expectation of living within United States radiation exposure limits.

This information is consistent with the information provided by the Department of Energy (DOE) to the Department of the Interior (DOI) in a letter dated May 15, 1979, from Ruth C. Clusen, Department of Energy Assistant Secretary for Environment, to Mr. James Joseph, Under Secretary of the Department of the Interior. That letter contains the following paragraph:

> "If the guidance of the Federal Radiation Council (FRC) (500 mrem/yr to individuals, and 170 mrem/yr and 5000 mrem/30 yrs to a population) is to be complied with, the people could return to Eneu only if it is assured that adequate imported food would be available to and used by the people for approximately 20 years, that food grown on Bikini Island is not a part of the diet, that residence is restricted to Eneu Island, and that visitation to Bikini Island is effectively controlled."

The information therefore contained in the letter of May, 1979, was identical to the information given on Kili in October, 1980.

The letter of May 15, 1979, then proceeds to explain, however, that if the radiation exposure criteria recommended by the Atomic Energy Commission in the Environmental Impact Statement for the cleanup, rehabilitation and resettlement of Enewetak Atoll (250 millirem per year to the individual and 4,000 millirem over 30 years) were to be applied also to resettlement at the Bikini Atoll (i.e., Eneu Island), the situation would warrant deferral of resettlement at Eneu for some years. This was stated in the following paragraph from that letter, which you also quoted:

> "The degree of uncertainty in estimating doses on Eneu Island is similar to that for Enewetak Atoll. Assuming, therefore, that Enewetak criteria are applicable to other similar situations in the northern Marshall Islands, the dose estimates for return of the Bikini people to Eneu Island would be compared to the Enewetak criteria as described above rather than to the FRC guidance. When this is done, it is found that even with imported food the radiation doses to the people on Eneu would not be expected to be in compliance with the Enewetak criteria for about 20-25 years."

The content of this paragraph remains valid.

However, since the Enewetak criteria (which were conservative values based upon uncertainties with respect to data and to personal living habits) were recommendations by a Task Group of the Atomic Energy Commission to the Department of the Interior with respect to Enewetak Atoll resettlement, and since these recommendations were not based upon any regulatory authority, they were included in the letter as a point of information to the Department of the Interior so that, if they consider it appropriate, a consistent policy could be established. Furthermore, the implications of such a policy also were identified. Because the recommendations carry no regulatory authority, however, the comparison of dose estimates for the return of the Bikini people to Eneu or Bikini Islands with the recommended criteria for Enewetak was omitted from the book, "The Meaning of Radiation at Bikini Atoll," as it was omitted from the book, "The Enewetak Atoll Today," prepared in 1979.

The paragraph in Mrs. Ruth Van Cleve's letter of June 1, 1979, to Magistrate Tomaki Juda, to which you make reference in your letter of November 3, 1980, presumably was based upon the assumption that it would be unrealistic to anticipate that the four conditions referred to above (i.e., in our letter of May 15, 1979) could be assured for the next 20-25 years, particularly in light of the immediate past experiences at Bikini Island.

With respect to the testimony presented by the Department of Energy in May and June, 1978, we are unable to confirm that the Department of Energy made references at that time ". . . that Eneu Island would have to remain off-limits for 20-25 years . . ." While both Mr. Hollister and I were aware of the subject being discussed at the hearings in question, we were not aware of the above statement being made. Even if such a statement had been made at that time, however, presumably the additional information and analyses which have become available during the past 2 1/2 years would permit revision of opinion expressed on the basis of information available at that time.

The Department of Energy did testify that the cesium concentration in coconut on Eneu Island was 5-6 times higher than was anticipated from the very limited amount of relevant information that was available prior to 1978. The data reported at the hearing was the first "new" data which had just become available in early May, 1978; this limited "new" information raised questions as to the suitability of Eneu Island as a site of residence.

The Department of Energy also testified that some of the water wells may have been in excess of Environmental Protection Agency standards. This statement was based on the fact that during different years the radionuclide content of the water varied from being above Environmental Protection Agency standards to being below Environmental Protection Agency standards. The implication of this was unknown at the time, but since then has been determined to be a relatively minor contributing factor with respect to the overall potential radiation doses.

To my knowledge, the above is the extent to which the Department of Energy testified. However, given the facts as known in mid-1978 that (a) the cesium levels in coconuts were higher than expected, (b) an imported food supply system had just demonstrated its lack of effectiveness, and (c) subsistence foods were available on Bikini Island but, except for coconut trees, not on Eneu Island, it seems a reasonable assumption for the Department of the Interior to have made at that time that relocation from Bikini Island to Eneu Island was not advisable.

The more recent dose estimates include a considerably expanded data base compared to that which was available in past years. These data have resulted from the continuing Department of Energy environmental studies at the Bikini Atoll, and in part from information obtained through the Northern Marshall Islands Radiological Survey. Nevertheless, our recent radiation dose estimates confirm the above conclusions in showing that without a diet consisting of approximately 50% imported foods, plus other restrictions as identified above, United States radiation standards would be exceeded by residents on Eneu Island for approximately 20 years.

I hope that the above is responsive to inquiries by you and by Senator Balos.

Sincerely,

Bruce W. Wachholz

Bruce W. Wachholz
Office of Health and Environmental Research, Office of Environment

cc: R. Van Cleve, DOI

bcc: Wachholz Rdr
T. McCraw, EV-30
J. Deal, EV-131
S. Gottlieb, OGC-34
H. Hollister, EV-4
W. W. Burr, EV-3
W. Robison, LLNL
W. Bair, PNL

CONCURRENCES

RTG. SYMBOL	INITIALS/SIG.	DATE
EV-30	BWWachho	2/ 9 /81
EV-30	TMcCraw	2/ /81
EV-131	JDeal	2/ /81
OGC-34	SGottlieb	2/ /81
EV-4	HHolliste	2/ /81
EV-3	WWBurr	2/ /81
EV-30	CWEdingto	2/ /81
EV-1	AGFremlin	2/ /81

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J. W. ROSENTHAL
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ANDREA JILL GRANT
PATRICIA N. BLAIR
RICHARD A. FRANK

DAVID G. BRESS (1908-1976)

*ADMITTED IN NEW YORK ONLY

LAW OFFICES
GINSBURG, FELDMAN, WEIL AND BRESS
1700 PENNSYLVANIA AVENUE, N. W.
WASHINGTON, D. C. 20006

TELEX 89-2422 | CABLE "LEGIS" | TELECOPIER (202) 637-9195

TELEPHONE (202) 637-9000

JACOB DWECK
MARTHA JANE SHAY
BRUCE H. RABINOVITZ
ROBERT W. HAWKINS
JOSEPH E. RESENDE
DAVID J. FREEMAN
CELIA ROADY
GARY J. KLEIN
PHILIP M. BATTLES, III
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ROBERT L. DEITZ

April 16, 1981

RECEIVED
MAY 1 1981

WRITER'S DIRECT DIAL NUMBER

(202) 637-9104

Mrs. Alice Buck
Box 1711
APO San Francisco 96555

Dear Alice:

As you may recall when we met last October, I discussed with you the possibility of serving as a translator for (1) a lay paper on the recent DOE-sponsored radiological survey of Bikini, to be prepared by an independent scientist selected by the people of Bikini, and (2) a meeting on Kili to discuss the paper.

The Memorandum Agreement of October 27, 1978 settling the litigation in People of Bikini v. Seamans, et al., Civ. No. 75-348 (D-Ha.), a copy of which is attached, provides (¶ 10) that the people of Bikini may select "a qualified scientist having generally accepted scientific training and experience to participate in the process of analysis of [the] survey results . . . . " The people of Bikini have selected Epidemiology Resources, Inc. (ERI) of Boston, Massachusetts. Two of ERI's leading senior advisers who would work on certain aspects of this project are Dr. Henry I. Kohn, Professor Emeritus at Harvard Medical School (who will assist in health risks), and Dr. John Harley, former Director of the U.S. Government's Environmental Measurements Laboratory (who will assist in dosimetry). The director of ERI is Dr. Nancy A. Dreyer, who co-authored "The Feasibility of Epidemiologic Investigations of the Health Effects of Low-Level Ionizing Radiation," which was recently prepared on contract to the U.S. Nuclear Regulatory Commission.

I hope to complete contractual arrangements with the U.S. Government within the next few weeks regarding ERI's work.

If you are still interested in serving as a translator in this project, I would like to know what arrangements you would deem acceptable. Obviously, any final contract would be negotiated directly between you and the U.S. Government or the Trust Territory Government.

Without committing you or ERI to a timetable, I would imagine that ERI could first send you the lay booklet (hopefully no more than 10 or 15 pages), at which point you and ERI could schedule a meeting to discuss the translation. I would estimate that the trip to Kili would be similar in length and substance to the one last October and would probably require several days of background meetings and preparation with ERI (perhaps to be held on Kwajalein). I assume that, in light of your work for DOE last year, you would need less preparation for this work than you needed for the DOE project.

I hope that the booklet will be ready for translation by July or August and that a trip to Kili can be planned for September or early October at the latest.

Please write to me at your earliest convenience. Everyone involved in last year's project, most especially the Bikinians, was very pleased with the job you did, and I hope you will be able to help us out once again.

Sincerely,

Jonathan M. Weisgall

Jonathan M. Weisgall

JMW/dmk
Enclosure
cc: Bikini/Kili Council (w/o encl.)
Mr. Billy Lee Hart, Acting Deputy
Assistant Secretary - Operations
Territorial and International Affairs (w/o encl.)
Dr. Bruce Wachholz (w/o encl.)

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RENEE J. SILVER
DANA H. FOX
ROBERT L. DEITZ

WRITER'S DIRECT DIAL NUMBER

(202) 637-9104

September 14, 1981

Mr. Stephen H. Greenleigh
Acting Deputy Assistant Secretary
for Environment, Safety and Health
U.S. Department of Energy
Washington, D.C. 20585

Dear Mr. Greenleigh:

Pursuant to your letter to me of August 19, enclosed is a proposal from Epidemiology Resources, Inc. (ERI) concerning the independent radiological assessment of Bikini Atoll.

With respect to the statement at page 2 of your August 19 letter, please be advised that, as counsel to the People of Bikini, I have been authorized to acknowledge that execution of a contract with ERI will constitute full and complete compliance by the Department of Energy in fulfilling its obligations under the terms of the Memorandum Agreement settling People of Bikini v. Seamans, et al., Civil No. 75-348 (D-Ha.).

I look forward to working with you and other members of the Department of Energy in expediting all necessary departmental procurement requirements so that the attached proposal can be implemented promptly.

I look forward to hearing from you soon.

Sincerely,

Jonathan M. Weisgall

Jonathan M. Weisgall

JMW/dmk
Enclosure
cc: Bikini Council (w/encl.)
Dr. Nancy Dreyer (w/o encl.)
Dr. Bruce Wachholz (w/encl.)

Washington D.C. (Joe Deal's office)

Cleanup (will definitely go) July 28, 1976

- not simple decontamination falls short
(a) - Does an island need more work? "provisional"
- EPA approval of cleanup guide
- 40 pCi based on resuspension data (keep doses within limits)

ERDA Role: day to day guidance to ERDA — leader.

DNA: see cleanup as ~~zero~~ engineering rather than radiological

- Have detailed plans

- Problems: buried material - not sampled in 72 survey

DNA doesn't want to look at areas not identified in 72 survey

(difference in philosophy between DNA + ERDA)

- Janet [on Bikini where samples are a factor of 10 higher than lab personnel on island]

Roger Ray: Best way to spend money on Janet

Guidelines

EPA Guidelines → 30-40 d/m/gm (~ 10-20 pCi)

provision will be made for resuspension & public assistance & degree of control

- don't know reassessment criteria yet

Drinking water: not much information

- dust blowing into roofs + washing into cisterns

Time factor hasn't been considered in entire problem. (Elmer)

(Roger Ray)

- put 4 or 6 new pigs on Bikini
- look at resident rates

(Bill Jackson died ^{90}Sr, ^{137}Cs on James)

Onsite work

- Then Germanium detector primary detector for Pu?
- Analytical lab could be set up on the islands

Do criteria apply to top surface only?

Really number ⇒ surface cores.
(resuspension)

- wind conditions are highly predictable

* [Most of doses result from levels below cleanup criteria]
- could pick up 10-15% of Pu on Runit

Danaway: If Resuspension is main factor then don't worry about depth core.
- However Typhoons can bring up contam.
- People eat from pits, site.

Certification that Clean-up Criteria have been met?

- use set the standard +

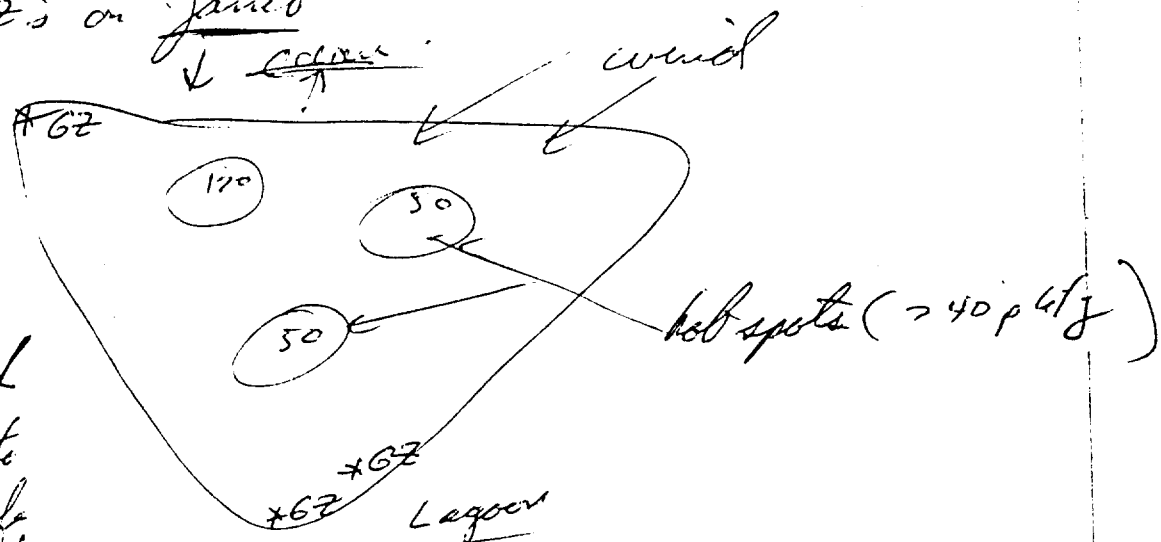
- Surface core get field priority
- Ignore all islands except Runit?
- No air samples on ~~Eng~~ James

Need to determine when it is safe

- Lay out options for sampling

Onsite measures about top 1"

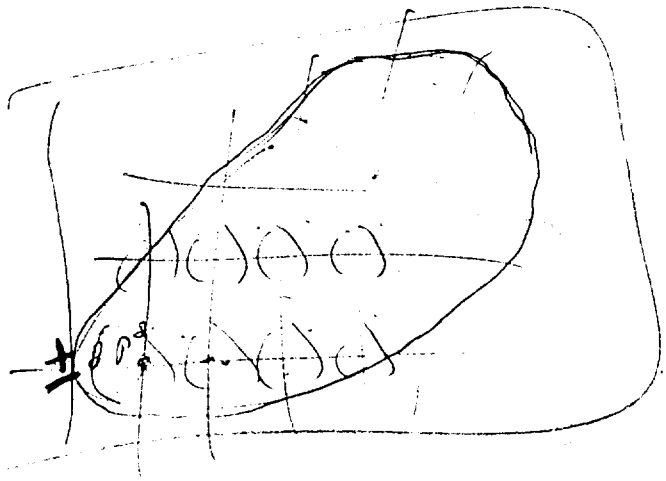
- no identified burial grounds on Jarvis
- 3 GZ's on Jarvis

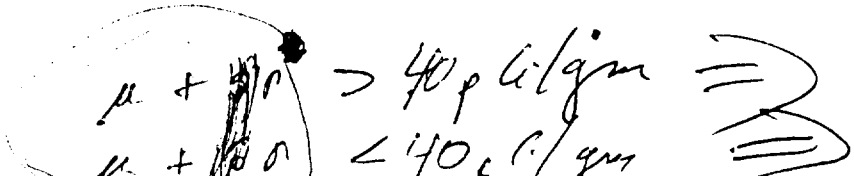


3 years left before need to decide if safe to go back

---

* { Must document why the criteria specifications are chosen





Conversation with Tom McCraw (Wash. D.C. ERDA) — July 26, 77

- clean-up criteria (recommendations for clean ups)
  - concurrently work NVO-140 writeup
- Guides not as compliance
  - levels of Pu in soil
- Jack Healy (LASL) - trust resuspension models
  - transfer (done)
  - used his findings
  - uses 40, 400.
    - ↑ job to be cleanup
    - If <40 ⇒ nothing
    - 40 - 400 : "grey" area - taller guesstimate
      - intended use needs to be considered
      - some islands too small timeled resources ⇒ not worth effort

- DNA + ERDA
  - defer Russell agency
  - ↑ Provide full time member

Help develope a plan for cleanup - to help ERDA advise

- How big an area (.
- How many samples must be taken
- How an area.
- What sort of assurance / precision)

LLL ~ Roger Ray } in Situ : probe on boom looks downward : good search technique

---

Jack Corbin (Hanford W) - Irish Am (3-3" soil depth)

- for accumulated data [over area]
  - spectrometer
  - calculator
  - computer
  - plotter

- Combine this result with soil sampling
  - do Ge(Li) + wet chemistry on islands
  - determine

-
  NVO open ended contract
- ERDA responsible for final certification
-

[Germantown]

office [Joe Deal] (assistant for Health)
Martin Biles (Dir. of Bureau of Safety Standards & Compliance)
Glenn Lynch

J114 (lab bldg back of building)
- 4 or 5.

(Roger Ray: ~~Memo~~ Environ Impact Statement
Report of AEC Task Group on
Recom for cleanup and Restoration
of Environ
June 19, 1974)

[Wa. National]
Dulles for departing
[Las Vegas tomorrow]

27th NW 79 Leaves 5:40 to Seattle

12:45 Las Vegas Flamingo Motor Lodge
493-2411
San Fran 3:10 - 11:15

28. 12:10p ~~[illegible]~~ U 742
~~[illegible]~~ Denver U 606 9:45p

Gilbert

Handout Jan 29 from Tom Wheeler in Joe Beall's office, Wash. D.C. ERDA

Additional Guidance Needed for Enewetak Cleanup of Pu Contaminated Soil

1. Over what area or areas should Pu-in-soil measurements be averaged:
   a. In-Situ measurements?
   b. Soil sampling?
2. To what areas should the Pu cleanup criteria, 40 pCi/g and 400 pCi/g, be applied?
3. Looking at past survey results compared with the cleanup criteria, which islands need cleanup? What levels of assurance that the criteria are met without cleanup are reasonable and attainable?
4. For certification of islands for which cleanup of Pu has been performed:
   a. What data are required?
   b. How are the data to be evaluated?
   c. What are goals that are likely to be attainable in terms of the assurance that can be given that the cleanup criteria have been met?
5. For cleanup operations, is there some optimum combination of In-Situ, soil sampling, and wet chemistry measurements that yields the most relevant information to guide contaminated soil removal at the least cost? Can a generalized approach be developed for use with all islands or should guidance be derived for the known conditions of each island requiring change?

Table 13. Number of sample locations on each island.

Stratification	Island	Approx area, 10^5 ft^2	Assumed mean ^{239}Pu activity, pCi/g	No. of sample locations: Surface, 0-15 cm	No. of sample locations: Profiles
Phase I Group I	BRUCE	9	1	10	3
	REX	2	1	4	3
	GLENN	25	1	28	4
	HENRY	13	1	14	3
	IRWIN	7.5	1	9	3
	JAMES	4.8	1	6	3
	KEITH	11	1	12	3
	LEROY	7	1	8	3
Phase I Group II	DAVID	48	1	53	7
	ELMER	80	1	80	10
	FRED	140	1	64	8
Phase I Group III	SAM	0.25	1	4	1
	TOM	0.25	1	4	1
	URIAH	0.89	1	2	2
	WALT	1.74	1	4	1
	VAN	1.39	1	5	1
	ALVIN	0.61	1	4	1
	CLYDE	1.01	1	3	1
Phase II Group I	ALICE	10	50	22	4
	BELLE	20	50	33	4
	CLARA	2	50	9	3
	DAISY	6	50	15	4
	EDNA	0.3	50	6	2
Phase II Group II	KATE	8	50	22	2
	LUCY	10.5	50	22	4
	PERCY	1	50	5	1
	MARY	6	50	22	3
	NANCY	9	50	22	4
	OLIVE	14	50	23	4
	PEARL	27	50	45	4
	TILDA	15	50	33	5
	URSULA	12	50	27	4
	VERA	10	50	22	3
	WILMA	7	50	22	3
Phase III	IRENE	20	100	20	14
	JANET	120	50	132	12
	SALLY (including SALLY's CHILD)	37	50 (west end) 10 (elsewhere)	34	9
Phase IV	YVONNE (south)	18	50	51	9
	YVONNE (north)	25	Highly variable	0	46

Radionuclide	Activity, pCi/g Mean	Range
^{90}Sr	80	14-430
^{137}Cs	36	5.6-141
^{239}Pu	12	3.9-68
^{60}Co	5.9	1.4-33

The radioactivity seems to be fairly homogeneously distributed throughout the island, even though considerable construction activities, such as the building of an airstrip along the center of the island and large-scale earth grading at

Table 15. Enewetak soil data, "northern islands" (pCi/g in top 15 cm).

		^{90}Sr		^{137}Cs		^{239}Pu		^{60}Co	
		Mean	Range	Mean	Range	Mean	Range	Mean	Range
ALICE		80	14-430	36	5.6-141	12	3.9-68 ✓	5.9	1.4-33
BELLE	Dense	123	14-670	48	14-170	26	7.2-130 ✓	10	3.1-30
	Sparse	44	35-130	8.6	3.3-44	11	5.8-26	4.6	2.4-9.6
CLARA		65	13-310	26	5.6-110	22	3.5-88 ✓	6.4	0.91-20
DAISY	Dense	190	100-380	11	3.4-33	41	22-98 ✓	11	6.4-26
	Sparse	32	16-120	3.8	0.86-9.0	15	3.8-33	0.85	0.37-7.4
EDNA		46	30-220	4.2	2.7-6.4	18	13-24	0.43	0.33-0.63
IRENE		30	5.9-570	3.2	0.22-41	11	2.4-280 ✓	5.4	0.12-520
JANET		44	1.6-630	16	0.57-180	8.5	0.08-170 ✓	1.9	0.02-33
KATE	Dense	67	37-200	24	18-37	17	8.6-50 ✓	2.7	1.6-5.8
	Sparse	11	1.6-49	4.8	1.8-16	2.3	0.17-14	0.46	0.03-3.5
LUCY		32	10-83	11	2.2-25	7.7	2.4-22	1.5	0.26-3.8
MARY		29	11-140	9.9	5.6-26	8.0	2.0-35	1.5	0.74-4.8
NANCY		36	16-110	12	6.0-28	9.1	2.3-28	1.6	0.56-5.3
PERCY		13	3.6-73	0.94	0.12-17	3.5	1.5-23	0.47	0.08-2.9
OLIVE	Dense	22	4.6-70	8.5	3.5-28	7.7	2.2-30	1.5	0.65-4.1
	Sparse	4.5	2.0-11	0.16	0.07-11	2.8	1.9-4.1	0.11	0.05-0.31
PEARL	Hot spot	62	35-140	19	7.4-55	51	15-530 ✓	12	3.6-70
	Remainder	17	3.2-61	7.6	1.2-34	11	0.85-100 ✓	4.1	0.49-49
RUBY		12	7.1-63	1.4	0.71-7.2	7.3	3.0-24	0.93	0.29-16
SALLY		8.4	0.87-140	3.0	0.03-30	4.3	0.21-130 ✓	0.54	0.05-69
TILDA	Dense	27	17-54	8.4	3.5-20	7.6	1.4-17	1.2	0.61-1.9
	Sparse	8.7	2.2-47	1.0	0.04-5.3	2.5	1.1-34	0.37	0.21-1.7
URSULA		6.8	2.0-19	1.7	0.13-7.8	1.3	0.26-7.3	0.31	0.05-1.7
VERA		6.3	1.1-68	2.0	0.03-12	2.5	0.60-25	0.30	0.02-2.2
WILMA		3.3	0.26-13	1.3	0.31-7.2	1.1	0.1-5.3	0.12	0.01-0.7
Northern YVONNE		1.7	0.09-20	0.40	0.02-3.6	3.2	0.02-50 ✓	0.64	0.01-20
Northern beaches		6.4	1.2-30	0.30	0.03-9.0	2.7	0.34-18	0.13	0.03-1.6

YVONNE - Because of the complex distribution of activities on Northern YVONNE no single mean value for an isotope can be used for the island as a whole without being misleading. Readers should consult the YVONNE discussion in this section and the detailed data in Appendix II for information pertinent to their interests.

Table 16. Enewetak soil data, southern islands (pCi/g in top 15 cm).

	^{90}Sr		^{137}Cs		^{239}Pu		^{60}Co	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Group A (DAVID, ELMER, FRED)	0.41	0.02-4.8	0.21	0.01-2.1	0.04	0.004-0.31	0.03	0.01-0.15
Group B (All others except LEROY)[a]	0.52	0.03-3.9	0.14	0.004-1.8	0.07	0.004-1.1	0.06	0.007-63
Group C (LEROY)	11	1.6-34	3.2	0.5-10	0.63	0.02-2.0	0.58	0.04-5.0

[a]SAM, TOM, URIAH, VAN, ALVIN, BRUCE, CLYDE, REX, WALT, GLENN, HENRY, IRWIN, JAMES and KEITH.

the northeastern end, took place during the weapons-testing period. This relative homogeneity is also supported by the results of the aerial survey.

The activities as a function of depth, obtained from Locations 24, 26, and 100 within the island's interior, follow the general rule of a rapid decrease in activity within the first few centimeters of the surface (relaxation lengths of 3-5 cm) and then level off to become almost homogeneous (as demonstrated at Location 100). Profile samples collected at Locations 23 and 25, which are on or near the beaches, display essentially homogeneous activity distributions.

BELLE—As clearly indicated by the photographs, this island is so heavily vegetated that it was almost impossible to penetrate. The only exception is the northeast corner of the island, which is relatively open with sparse vegetation. Most of the soil samples were collected within the densely vegetated areas, with a few obtained within the sparsely vegetated northeast corner. The following activities resulted:

Radionuclide	Activity, pCi/g Mean	Range
Areas of dense vegetation		
^{90}Sr	123	14-670
^{137}Cs	48	14-170
^{239}Pu	26	7.2-130
^{60}Co	10	3.1-30
Areas of sparse vegetation		
^{90}Sr	44	35-130
^{137}Cs	8.6	3.3-44
^{239}Pu	11	5.8-26
^{60}Co	4.6	2.4-9.6

The mean activities exhibited by the samples from the northeast corner are roughly a factor of three smaller than those from the remainder of the island. Since only a few samples were collected within the corner area, the factor of three may or may not reflect the true difference in the mean values. The aerial survey results do not reflect this difference.