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PRELIMINARY RADIOLOGICAL REPORT ON BIKINI ATOLL

Prepared by Tommy F. McCraw

Division of Operational Safety
U. S. Atomic Energy Commission
Washington, D. C.

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Enclosure 1

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RADIOLOGICAL REPORT ON BIKINI ATOLL

Introduction

Reports on this subject were prepared by Philip F. Gustafson in April and May 1968 (Attachments 1 and 2). Since that time the decision has been made that the Bikini people may be returned to their Atoll but that certain measures should be taken to further reduce radiation exposures. These measures are described in the report of the AEC Ad Hoc Committee (Attachment 3).

During 1969, cleanup of Bikini Atoll, which was one of the Ad Hoc Committee's recommendations, was accomplished through a cooperative project funded by DOD and AEC. The Atoll has now been turned back to the Office of Trust Territories of the Pacific, Department of Interior. DOI is currently conducting a program of agricultural rehabilitation that has been under way about one year and construction of housing and community facilities is to begin in the near future.

The cleanup project provided an opportunity to obtain significant additional information on the levels of environmental radiation and radioactivity in the Atoll. Enough of the results from the 1969 monitoring and sample collecting activities are now available from Allen Smith and William Moore of SWRHL and from Edward Held of the University of Washington to make preliminary comparisons with the 1967 results and to determine what if any differences the 1969 data may make in radiation exposure estimates prepared by Dr. Gustafson. Comparisons

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in this report will be directed to environment levels on Bikini and Eneu, the islands being rehabilitated by DOI.

Comparison of External Radiation Survey Results

Table I of this report is a summary of external radiation levels for Bikini and Eneu. These data indicate that the 1967 values for Bikini and Eneu were essentially correct. It is suggested that the values for 1969 are not different enough to warrant recalculating external exposures and that Dr. Gustafson's values in Table III of Attachment 1 and Table VIII of Attachment 2 still apply.

The estimates in the column labeled "Modified" in Table III of Attachment 1 are obtained by assuming that the village area or areas around homes are covered with a layer of clean coral gravel 1 to 2 inches in depth. A further reduction in external dose may be expected by a factor of two to ten for that exposure received during time spent indoors since homes are to be constructed from concrete blocks made from local materials. This reduction may be optimized by selecting sand and aggregate for making concrete from locations in the Atoll having the lowest levels of radioactivity.

The external exposure estimates in Table VIII of Attachment 2 are based on the assumption that 2 inches of clean coral gravel cover the ground around housing. However, a shielding factor for concrete block

houses has not been applied. To this extent dose estimates for these data are now expected to be more conservative than when first developed.

Internal Dose Comparisons

Table II of this report contains a comparison of 1967 and 1969 values for ^{90}Sr, ^{137}Cs, and ^{55}Fe, the radionuclides of most concern in the Bikini diet. The following comments apply to this comparison:

1. Fish - The 1969 values for eviscerated whole fish are somewhat lower than the 1967 values for muscle. However, the 1967 values for muscle would still appear to be applicable so Gustafson's intake values in the 1968 report would still apply.
2. Pandanus Fruit - The 1969 values for ^{90}Sr and ^{137}Cs are higher than the 1967 values lending even more support to the Ad Hoc Committee's recommendations for precautions to be taken in planting Pandanus.
3. Birds - The 1969 value for ^{55}Fe is in good agreement with the 1967 value. The 1969 value for ^{137}Cs in the curlew is higher than the 1967 average value for birds. However, the curlew is seldom caught. The 1969 average value of ^{137}Cs for birds eaten most often is in close agreement with Gustafson's value and his intake level would still apply.
4. Arrowroot - The 1969 values for prepared arrowroot flour (the 1967 value was for unprepared arrowroot which is inedible)

show a significant change. The ^{90}Sr value is higher by a factor of about 14 but the ^{137}Cs value is lower by a factor of 150. These new values should be used in a redetermination of internal exposures from ^{90}Sr and ^{137}Cs.

5. Coconut - The 1969 values for ^{90}Sr and ^{137}Cs in coconut are in good agreement with 1967 values and Gustafson's intake values would still apply.

6. Coconut Crabs - The 1969 levels of both ^{90}Sr and ^{137}Cs in crabs from Bikini Island are higher than the 1967 average value. The edible portion of each crab will contain about 1 pound of muscle and 1 pound of liver. Therefore, the average radionuclide content for crabs will be the average value for muscle and liver. The level of ^{55}Fe in crabs is so low (the average value for muscle and liver) as not to constitute any significant intake of this radionuclide for this item of diet.

7. Clams - The levels of ^{90}Sr, ^{137}Cs, and ^{55}Fe in clams and lobster are so low that intake of these radionuclides through these items of diet may be neglected in dose calculations.

Table III of this report presents revised values of daily radionuclide intake using the Rongelap diet and updated with the 1969 monitoring results.

Table IV presents a comparison of estimated daily dietary intake values that may apply if certain items of the diet are included or excluded. A number of observations may be made:

1. Updating Gustafson's estimates with 1969 monitoring results increases the intake estimate for the total diet by about 50% for ^{90}Sr and 68% for ^{137}Cs. The items contributing most to this increase are Pandanus and Crab.
2. Updating intake estimates with 1969 data and assuming no intake of Pandanus, Arrowroot or Crab (the diet used in Gustafson's dose predictions) shows a minor change when compared with Gustafson's intake estimates.
3. Updated data indicate that including Arrowroot in the diet (no Pandanus or Crabs) increases the ^{90}Sr intake by a factor of about 2 and ^{137}Cs intake remains about the same.
4. Updated data indicate that including Arrowroot and Crab in the diet (no Pandanus) increases the ^{90}Sr intake by a factor of 6 to 7 and increases the ^{137}Cs intake by a factor of about 2.

In the section on "Summary of Radiation Exposure" in Attachment 1 there is the statement that, "It is unlikely that the whole body exposure, or the exposure to specific organs including bone, will exceed 4 rads in 5 years, 15 rads in 30 years or 30 rads in 70 years." The dose estimates

in Table V were obtained by scaling Gustafson's estimates up or down using the updated intake data in Table IV. These estimates indicate that including Arrowroot in the diet increases the dose to bone by about 0.8 rad in 5 years while whole body dose remains the same. Including Arrowroot and Crab in the diet without a dietary supplement of calcium increases dose to bone to almost 8 rads in 5 years or twice the 4 rads in 5 years mentioned above. With a calcium supplement including Arrowroot and Crab in the diet brings dose to bone very near the 4 rads in 5 years value. However, in the interest of placing only those restrictions on intake that are actually needed, it is suggested that Arrowroot and Crab can be left in the diet provided the calcium intake in the diet is brought up to 1 gram per day. There is the additional consideration that intake of Coconut Crab will probably be self limiting in that an intake of 14 grams per day by as many as 100 people would require 600 crabs per year. Large numbers of crabs have not been seen on Bikini Island and some were destroyed during the vegetation clearing operations in 1969.

Unrestricted use of local foods at an intake corresponding to the Rongelap diet could bring whole body dose up to the 4 rads in 5 year level and dose to bone up to about 50 rads in 5 years if an edible variety of Pandanus was available which is not the case. The wisdom of the Ad Hoc Committee's recommendations is that when edible Pandanus does become available on Bikini, exposures such as those above will not occur.

TABLE 1

External Radiation Levels on Bikini and Eneu Islands

μR/hour

	'67 Average	'67 Range	'69 Average	'69 Range
Bikini: Beach	12.7	5-25	< 10	≤ 10
Village	25.1	10-60	35-44*	15-80
Interior	72.7	40-120	86	20-120
Eneu:	4.3	2-10		< 10-20

*The higher value applies if it is considered the village extends 250 feet inland from the lagoon road. The lower value would apply for housing placed near the lagoon road.

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TABLE II

COMPARISON OF RADIONUCLIDE CONTENT OF BIKINI DIET

1967 VERSUS 1969

pCi/g WET WEIGHT

	^{90}Sr		^{137}Cs		^{55}Fe	
Diet Item	'67	'69	'67	'69	'67	'69
Fish	.19	.08[1]	.32	.13[1]	100	18[1]
Pandanus Fruit	19	28[3]	52	130	-	-
Birds	.13	-	26.5	28[2]	100	110
Arrowroot	.17	2.4[3]	92	.6[3,4]	-	-
Coconut	.19	.31[3]	114	120[3]	-	-
Crabs: Muscle	19	12[3]	72	181[3]	-	1.2[3]
Liver	-	62[3]	-	170[3]	-	41[3]
Clams or Lobster	.04	-	.02	nd	-	5.9

1. Values for 1969 are eviscerated whole reef fish.

2. Average for four species.

3. Values for Bikini only used for this data point.

4. Value applies to arrowroot flour prepared by grinding, rinsing three times with salt water and once with fresh water (Marshallese method of preparation).

nd - not detectable

TABLE III

ESTIMATED DAILY RADIONUCLIDE INTAKE FOR BIKINI DIET

UPDATED WITH 1969 MONITORING RESULTS

pCi/day

Food Item	Daily Intake (gms)	^{90}Sr	^{137}Cs	^{55}Fe
Fish	554	105	177	55,400
Pandanus	164	4,594	21,320	-
Birds	41	5	1,086	4,510
Arrowroot	41	98	25	-
Coconut	9	2	1,026	-
Crabs	14	518	2,450	-
Clams	45	-	-	-
Imports*	32	-	-	-
	900	5,322	26,084	59,500

*Intake for imports is negligible compared with intake from local products.

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TABLE IV

COMPARISON OF RADIONUCLIDE DIETARY LEVELS

1967 VERSUS 1969

pCi/day

Assumption	^{90}Sr	^{137}Cs	^{55}Fe
1964 and 1967 data, all items	3,496	15,570	59,500
1964 and 1967 data, no Pandanus, Arrowroot, or Crabs*	114	2,290	59,500
1964 and 1967 data updated with 1969 results, all items	5,322	26,084	59,500
Updated data, no Pandanus, Arrowroot, or Crabs	112	2,289	59,500
Updated data, no Pandanus or Crabs	210	2,314	59,500
Updated data, no Pandanus	728	4,764	59,500

*These values were used in Gustafson's dose estimated, Table VIII, Attachment 2.

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TABLE V

IMPACT OF 1969 MONITORING RESULTS ON EXPOSURE ESTIMATES

(rads)

CHILDREN

	Bone ^{90}Sr	Whole Body (^{137}Cs & ^{55}Fe)[1]	External[2]	Total Whole Body	Total Bone
5 year exposure, Gustafson's estimates for no Pandanus, Arrowroot, or Crab and 0.42 gm/day calcium intake	.98	.28	.75	1.03	2.01
		(Note: the above values also apply to the 1969 data)			
5 year exposure, updated data, no Pandanus or Crab, 0.42 gm/day Calcium intake	1.80	.28	.75	1.03	2.83
5 year exposure, updated data, no Pandanus, 0.42 gm/day calcium intake	6.25	.58	.75	1.33	7.58
5 year exposure, updated data, no Pandanus, 1 gm/day calcium intake	2.63	.58	.75	1.33	3.96
5 year exposure, updated data, no precautions with intake	45.74	3.19	.75	3.94	49.68

1. These dose estimates revised to the extent of assuming 10% instead of 100% ~~retention~~ absorption for ^{55}Fe.
2. Assumes covering village area with 1 to 2 inches of uncontaminated coral gravel. This value does not include the consideration that concrete block houses will provide additional exposure reduction during that time spent indoors.

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RADIATION SAFETY CONSIDERATIONS AT BIKINI ATOLL

MAY 1970

In response to an inquiry by the High Commissioner of the Trust Territory of the Pacific, the following general statement is provided regarding radiation safety of Bikini Atoll:

On Tuesday, August 27, 1968, the ship James M. Cook arrived at Kili Island bringing the High Commissioner, then Mr. William Norwood, representatives of the U. S. Department of Interior, Atomic Energy Commission, and Department of Defense, and members of the press. A primary purpose of the visit was to discuss with the Bikini people the recent decision that they be returned to their Atoll and to answer questions regarding conditions in the Atoll. At that meeting there were questions on whether the islands were safe and whether food was safe to eat.

With Mr. Chutaro acting as interpreter, the AEC representative told the Bikinians that the question of safety of returning to the Atoll and using foods found there had been carefully studied. A Committee of experts meeting in Washington, D. C. had concluded that returning the people to Bikini Atoll would not offer a significant threat to their health and safety but certain simple measures should be taken to further reduce radiation exposure. The recommendations of this Committee of experts were summarized. The people were told that for the present, only the Bikini-Eneu complex is to be rehabilitated. While they may go any-

where in the Atoll for purposes such as fishing and food collection, homes and community facilities are to be built only on Eneu and Bikini. In answer to a question, the Bikinians were told that food from the lagoon would be safe to eat. Certain precautions were to be taken in planting Pandanus, and radioactive scrap metal was to be removed from the islands.

Questions have since been asked as to how one can interpret the conclusions of the experts. As to whether certification can be given that Bikini is radiation free, the answer is that this cannot be done. Such a certification could not be given for any location in any country since there is radioactivity everywhere. Levels of radioactivity vary from place to place. Some occur naturally and some are man made. The levels of man-made radioactivity in Bikini Atoll are higher than in the U. S. due to tests conducted in the Atoll, but these levels are slowly declining. The radiation which comes from this radioactivity can be measured with instruments and the radioactivity in foods can be measured in the laboratory. Such measurements have been made for Bikini Atoll, the levels are known, and additional measurements will be made in the future.

Since the levels of radioactivity in Bikini Atoll are not zero, the question comes as to how much radioactivity or radiation is acceptable from a health viewpoint and do the levels expected for Bikini residents fall within the acceptable range. The answer from the Committee of

experts is that exposures at Bikini Atoll are expected to be acceptable. Predicted exposures are well within the radiation safety standards set by national and international bodies of experts provided certain precautions are taken. The Committee of experts who evaluated the safety of returning to Bikini Atoll recommended measures that should reduce radiation exposures and insure that exposures remain acceptable for all future time.

One recommendation is that periodic resurveys of Bikini Atoll should be conducted that will provide a continual check on the radiation status of the people and the environment and that will help form the basis for decision as to the time of rehabilitation of islands outside of the Bikini-Eneu complex. This continuing monitoring of the environment at Bikini Atoll is no different than the monitoring conducted throughout the United States wherein measurements of radiation and radioactivity in foods are made. It would be unusual not to make such measurements for the Bikini people considering such measurements are made for the people in the U. S.

As to levels of radioactivity in foods in Bikini Atoll, two foods should be mentioned, namely, coconut crab and Pandanus. The Committee of experts did not recommend that eating coconut crab be prohibited. Rather, coconut crab should not be eaten in such quantity that it forms a major part of the diet to the exclusion of other foods which generally

contain lower levels of radioactivity than coconut crab. The Committee's recommendation that the population of coconut crabs be sharply reduced was directed to this end but there was no intent that the crabs be entirely removed from the Atoll. Some reduction occurred during cleanup operations on Bikini Island and coconut crabs are not now seen there in large numbers. Coconut crabs may be included in the diet when the population returns but this recommendation is subject to continuing review.

For Pandanus, the Committee recommended removal of two inches of topsoil over an area covered by the crown of mature trees for plantings on Bikini. If this is not done on Bikini, the fruit produced may not be acceptable. Fruit produced by Pandanus trees planted on Bikini will be analyzed to insure that it is acceptable for food.

The Committee has recommended that no precautions are needed on Eneu and coconut crabs found there may be eaten in any quantity. Pandanus may be planted there without soil removal.

While the Committee's recommendations for achieving lower radiation exposure are all beneficial, there is one very important recommendation requiring the cooperation and participation of the Bikini people. This concerns insuring an adequately nutritious diet for those living in the Atoll. Use of a dietary supplement of powdered milk has been suggested which will relieve the calcium deficiency usually associated with the Marshallese diet.

In addition to the general statement above, there has been a request for answers to specific questions which may be asked. A list of questions and answers is provided below:

1. Q. HOW DID THE COMMITTEE OF EXPERTS DECIDE BIKINI IS SAFE?

   A. They reviewed measurements and data that had been accumulated during past surveys, then met with the 1967 survey team. Predictions were made of the total radiation exposure expected to occur from all possible sources if the natives were returned. In their opinion this exposure does not offer a significant threat to health and safety.

2. Q. DOES THE REPORT OF THE COMMITTEE OF EXPERTS MEAN THAT THERE IS NO RADIATION ON THE ISLANDS?

   A. No. It means that in the opinion of the AEC and the Committee of experts the type and level of radiation do not offer a significant threat to health and safety.

3. Q. HOW MUCH RADIATION WILL THE BIKINIANS BE EXPOSED TO?

   A. That will depend on whether or not the recommendations from the Committee of experts are followed. Under the worst conditions, with all of the recommendations ignored that are intended to minimize intake of radioactivity in food, the exposure in the first five years from internal and external radiation sources still would be within acceptable limits set by the Federal

Radiation Council for individuals not engaged in atomic energy work. However, the recommended actions to minimize exposure from radionuclides in food will be needed to insure that the Pandanus may be eaten when it becomes available and that exposures over longer times such as 30 and 70 years remain within acceptable levels. The calculated figures for accumulated whole body doses are:

ADULTS	CHILDREN
5 years - 1 rad	1 rad
30 years - 6 rads	5 rads
70 years - 10 rads	10 rads

The Federal Radiation Council's radiation protection guide for the whole body of the individuals amounts to:

Individuals in a Population	
1 year	0.5 rad
5 years	2.5 rads
30 years	15 rads
70 years	35 rads

The general philosophy, based on both experience and research, is that 0.5 rad per year provides an acceptable level of whole body exposure for individuals. This value may be used where sufficient monitoring is performed so that radiation exposures are known.

4. Q. WHAT ABOUT THE RATE OF ACCUMULATION OF RADIATION EXPOSURE?

A. The rate for external radiation will be higher in the first few years but will decline steadily with time. Initially the accumulation will be about twice that for the average person in the U. S. Reduction to the U. S. average will occur in about 30 to 50 years. When the Bikini people first return, the doses to whole body from external and from internal radioactivity will be about equal. When more of the locally produced foods such as Pandanus begin to become available, the contribution from internal radioactivity may increase. The recommendations of the Committee of experts are intended to insure that such exposures in the future remain within an acceptable range.

5. Q. WHERE DOES THE RADIATION IN THE ATOLL COME FROM?

A. Primarily from radionuclides in soil. The levels vary considerably from one island to another. It is for this reason that Eneu and Bikini were suggested as village sites since these two islands have lower levels.

6. Q. WHY ARE THE ISLANDS NOW CONSIDERED ACCEPTABLE FOR HABITATION WHEN THEY WEREN'T SOME YEARS AGO?

A. Radioactivity decreases with the passage of time. Some radionuclides disappear faster than others. Altogether it is a combination of the passage of time and the work of nature in diffusing and dispersing the radionuclides. Readings taken in 1964, for instance, were higher than those of 1967.

7. Q. WHY MUST PRECAUTIONS BE TAKEN IN PLANTING PANDANUS TREES ON BIKINI?

A. Pandanus fruit is a native diet staple, supplying certain needed vitamins. While there are no Pandanus of edible variety now on Bikini Island, samples from a nonedible variety have been found to contain a higher level of both strontium-90 and cesium-137 than other plants grown in the same soil. The Committee of experts have made a recommendation for reducing these levels in the fruit of trees to be planted on Bikini Island by removing the top two inches of soil which contains most of the radionuclides. On Eneu there is no need for such precautions since the soil there contains only a very small amount of radionuclides.

8. Q. WHY WAS IT SUGGESTED THAT THE COCONUT CRAB POPULATION SHOULD BE REDUCED IN NUMBER?

A. The coconut crab is a native favorite. However, it is not desirable that this food be a major part of the diet since the levels of radioactivity in the crab are somewhat higher than some other food items. This consideration is the basis for the recommendation on crab population reduction.

9. Q. WHAT ABOUT COCONUTS? ARE THEY RADIOACTIVE?

A. Coconuts have been observed to contain some amounts of radioactivity but much less than Pandanus fruit. Suitable planting and fertilizing procedures are expected to reduce even these amounts. There are

not many mature coconut trees on the atoll now. On some of the islands the tops of the coconut trees were snapped off by the force of the test blasts. On the islands most affected by the tests, the trees were burned or washed away. Many new coconut trees are being planted on the islands of Eneu and Bikini.

10. Q. WILL THE BIKINIANS BE ABLE TO FISH IN THE LAGOON?

A. Yes. The survey team reports the lagoon contains a large quantity of fish. Marine life is low in radioactivity.

11. Q. IS THERE ANY RADIOACTIVITY IN THE BIRDS AND FISH?

A. Some fish and birds contain measurable amounts of radionuclides which they have retained from what they've eaten, but the amount is not large enough to cause concern.

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RADIOACTIVITY IN COPRA

The decision to return the Bikinians to their home Atoll was based in part on the consideration of radiation exposures of those who will reside in homes on the islands of Bikini and Eneu and who will consume locally produced foods. The health of the people was the primary consideration. Several simple measures have been recommended which are expected to insure that exposures of Bikini residents remain within acceptable levels.

In addition to insuring that radiation exposures are at acceptable levels, there are other considerations. People along with some quantities of goods, household possessions, and food will come to the Atoll. At least two important materials will go from the Atoll, e. g., scrap metal and copra. Any radioactivity associated with metal scrap would appear not to be a problem if this scrap is monitored before shipment from the Atoll. Although sale of scrap metal will be an important source of income for the returning population, copra is the money crop and the chief source of income.

The Trust Territory agriculturist estimates that with the replanting now under way, the Bikinians can produce as much copra in a month as they once produced in a whole year. This earlier annual production has been reported to be about 80,000 pounds or 40 tons. Future production

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may then be about 480 tons per year. If the copra produced through the agricultural rehabilitation program contains as much ^{137}Cs as in the 1967 and 1969 samples, i.e., 114 to 120 pCi/gm, and considering that in producing copra, coconut meat is reduced in weight by the sun drying process by as much as 50%, the copra may contain up to 240 pCi/gm. The fertilizing of the new plants which is being done in the agricultural rehabilitation program may reduce the ^{137}Cs levels in the copra.

The relationship between ^{137}Cs in coconut meat and in soil where coconut trees are growing is not known. Available soil samples have come from one place and coconuts from another on Bikini. It would be desirable to have samples of coconut and soil from the same place and to fertilize an existing tree to see what change in radioactivity content in the coconut there may be compared to unfertilized trees. Also, it would be desirable to have samples from trees wherein 2 inches of top soil were removed as suggested by the Ad Hoc Committee for Pandanus and from trees where both fertilizer and top soil removal were used.

It would be desirable to sample coconut meat and coconut frond for ^{137}Cs from existing trees on Bikini. If levels in frond and meat are related in some way, then predictions of coconut meat ^{137}Cs could

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be made using results of analysis of frond from young trees, years before these trees produce coconuts.

An indication of the significance of radioactivity in coconut meat can be seen by reviewing the production and use of copra. The natives harvest the coconuts which have taken about a year to mature and extract the coconut meat from the shell and husk. The shells are sometimes used by the natives for eating utensils and such shells may find their way into commerce in the form of charcoal. Husks are used in cooking fires and as a mulch in planting crops including coconut trees. Cord and rope are also made from husk fiber. Sleeping mats are made from coconut palm frond along with other items of handicraft such as hats and handbags. The "Kili Bag," which is a handbag manufactured by the Bikinians, is made from palm frond and Pandanus leaf and is widely known in the Pacific.

Pieces of coconut meat are sun dried, bagged, and stored under cover (warehouse) until picked up by a copra boat which may visit an Atoll two or three times a year. Collection of 25 to 50% of a years copra production in a warehouse would accumulate a sizable quantity of ^{137}Cs at the 1969 levels. Fresh coconut meat is about 50% water, 30-40% oil, and 10-20% copra meal by weight.

Copra processing plants which process copra from islands of the western Pacific are in the Philippines and Japan. The copra is washed and run through a press which extracts the coconut oil leaving a residue which is called copra meal. The oil is used in foods and cosmetics. The oil is reported to have a low mineral content and very low levels of radioactivity. Radioactivity such as ^{137}Cs in the processed copra ends up in the copra meal which contains about 20% protein and 5% oil. This meal is a good quality animal feed and is used for dairy cows. On a gram basis the level of ^{137}Cs in copra meal can be expected to be 5 to 10 times the level in fresh coconut meat. In the case of coconuts from Bikini, if the levels of ^{137}Cs in future crops are as high as found in the 1969 samples, the copra meal may contain 600 to 1,200 pCi/g.

Measures recommended by the Ad Hoc Committee for minimizing levels of radioactivity in Pandanus (removing 2 inches of soil at the planting site over an area covered by the crown of mature trees) may also be needed for planting coconut trees on Bikini. Whether this is needed cannot be determined with present information. If needed, the justification would not be so much the protection of the Bikini people but rather to minimize the level of ^{137}Cs in the copra meal that is a byproduct of production of coconut oil.