

D41

MARSHALL ISLAND DOSE ASSESSMENT AND ENVIRONMENTAL PROGRAM
FY1987 - 1988 - 1989

WILLIAM L. ROBISON
LAWRENCE LIVERMORE NATIONAL LABORATORY

DE
John Rudolph's files - for
Marshall Islands - Program plan

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A. United States Compact Requirements

There are three specific tasks identified in the compact which are related to dose assessments and environmental research and monitoring which LLNL performs for the DOE. These are:

A review of the Rongelap dose assessments and restoration of habitability of Rongelap if required.

A dose assessment of Enjebi Island at Enewetak Atoll and recommendations on resettlement.

Rehabilitation of Bikini Atoll (Bikini and Eneu Islands).

LLNL has a continuing effort at each of the 3 identified atolls and is prepared to respond to the requirements laid forth in the compact.

A. COMPACT REQUIREMENTS

BIKINI AND ENEU ISLAND RESETTLEMENT - BIKINI ATOLL

ENJEBI ISLAND RESETTLEMENT - ENEWETAK ATOLL

RONGELAP ISLAND DOSE ASSESSMENT AND REVIEW - RONGELAP ATOLL

B. RONGELAP DOSE REVIEW

- COMPACT REQUIREMENT: A REVIEW OF OUR DOSE ASSESSMENTS BY AN INDEPENDENT SCIENTIFIC TEAM.

- THIS WILL REQUIRE CONSIDERABLE EFFORT ON OUR PART ONCE THE INDEPENDENT SCIENTIFIC TEAM IS ESTABLISHED.

- TIME LINE
 - 1.) EXACT TIME UNKNOWN
 - 2.) UNLIKELY NOW THAT THE SCIENTIFIC TEAM WILL BE DETERMINED AND THE REVIEW PROCESS BEGIN BEFORE LATE FY1986 OR EARLY FY1987.

- OUR INVOLVEMENT SHOULD LAST ONLY A FEW MONTHS AFTER THE REVIEW PROCESS ACTUALLY BEGINS. PROBABLY COMPLETE IN FY1987.

C. Rongelap Reassessment

This reassessment is prompted by information obtained during our visit to Rongelap last month (February, 1986). Considerable quantities of "Yap variety" coconuts are being grown on Rongelap even though the majority of the coconuts on the island appear to be of the "old variety".

Why is this a concern? The reasons are the following:

1. The external gamma exposure and the soil concentration of ^{137}Cs is higher by about a factor of 2 at Rongelap than at Eneu.

	External Gamma $\mu\text{r/h}$	Decay corrected to 1987 Soil ^{137}Cs Concentration pCi/g	
		0.5cm	0-40cm
Rongelap	4.5	12	4.1
Eneu	2.3	5.9	2.9
ratio (R/E)	2	2.0	1.4

2. The ^{137}Cs concentration in coconut meat and fluid, however, is about 15 pCi/g wet weight at Eneu and about 5.5 pCi/g wet weight at Rongelap. The ratio of the ^{137}Cs concentration in coconut on Rongelap to that on Eneu is thus about 0.4.

3. This difference was assumed to be due to the 2 different varieties of coconuts on the islands, i.e. "Old Variety" on Rongelap and "Yap Variety" on Eneu. Age of the trees and ^{137}Cs distribution in the soil column could not be discounted, however.

4. This result has been confirmed by evaluating both varieties of trees that are near neighbors at Eneu and Bikini Islands. However, the effect of age cannot be discounted in this observed difference.

C. Rongelap Reassessment (Continued)

5. The importance of coconut in the diet is reflected in the maximum annual and integral doses which for Eneu are about 2 times those of Rongelap.

6. Thus, we need to determine the uptake of ^{137}Cs in "Yap Variety" coconuts on Rongelap and compare that with the uptake in young and old "old variety" coconuts.

7. The we could evaluate whether a scenario of "Yap Variety" coconut consumption on Rongelap could possibly lead to higher doses that we estimated in the NMIRS.

Our predictions of body burdens using the NMIRS data agree very well with the BNL wholebody measurements. This probably is because most of the coconut consumption is still from "old variety" trees and our sampling during the MNIRS was predominately "old variety".

However, the issue of the increased use of the "Yap Variety" coconut and the impact on doses could be raised and we need to be in a position to answer the questions.

C. RONGELAP ASSESSMENT

- COMPACT REQUIREMENT: RESTORE HABITABILITY OF RONGELAP ISLAND AND REVIEW DOSE ASSESSMENT.
- EXTERNAL DOSE AND ^{137}CS SOIL CONCENTRATION AT RONGELAP IS HIGHER THAN AT ENEU.
- TOTAL DOSE AT RONGELAP IS ABOUT ONE HALF THAT OF ENEU BECAUSE THE ^{137}CS CONCENTRATION IS LESS IN RONGELAP COCONUT THAN IN ENEU COCONUT.
- RESULT WAS CONSIDERED DUE TO DIFFERENCE IN UPTAKE OF ^{137}CS IN DIFFERENT VARIETY OF COCONUT AT THE TWO ATOLLS.
- NEW "YAP VARIETY" HAS ABOUT THREE TIME THE UPTAKE OF THE "OLD VARIETY". MOST OF RONGELAP IS PLANTED WITH "OLD VARIETY".
- DIFFERENCE IN ^{137}CS UPTAKE BETWEEN THESE 2 VARIETIES WAS CONFIRMED AT BIKINI ATOLL. HOWEVER, WE COULD NOT FACTOR OUT THE EFFECT OF AGE BECAUSE OF "OLD VARIETY" TREES ON BIKINI ARE VERY OLD AND AT THE END OF THEIR LIFECYCLE.
- FOUND IN FEBRUARY, 1986 THAT "YAP VARIETY" HAS BEEN PLANTED ON RONGELAP. APPEARS TO BE SLOWLY REPLACING "OLD VARIETY".
- NEED TO EVALUATE DIFFERENCE IN UPTAKE AT RONGELAP BETWEEN "OLD VARIETY" COCONUTS AND "YAP VARIETY" COCONUTS.
- NEED TO EVALUATE THE DIFFERENCE IN UPTAKE BETWEEN OLD "OLD VARIETY" COCONUTS AND YOUNG "OLD VARIETY" COCONUTS.
- SAMPLING CAN BE DONE IN AUGUST OF 1986.
- PROCESSING AND ANALYTICAL COULD BE COMPLETED IN FY1987.
- A REASSESSMENT OF THE ESTIMATED DOSES AT RONGELAP BASED ON THIS INFORMATION COULD BE COMPLETED IN FY1987 OR EARLY FY1988.

D.

ENEWETAK DOSE ASSESSMENT

- COMPACT REQUIREMENT: DOSE ASSESSMENT FOR ENJEBI ISLAND IN 1 YEAR. ONE YEAR FROM WHEN? ONE YEAR REQUIREMENT COULD BE AS LATE AS EARLY FY1988.
- CURRENT DATA FOR ^{137}Cs CONCENTRATION IN COCONUT, BREADFRUIT AND PANDANUS ARE AVAILABLE FROM OUR TEST PLOTS ESTABLISHED IN 1974 ON ENJEBI ISLAND.
- THESE DATA WILL PROVIDE THE BASIS FOR THE UPDATED DOSE ASSESSMENT.
- DATA FROM 1976 AND 1977 FOR PAPAYA, BANANA, SWEET POTATO, SQUASH, ETC. ARE AVAILABLE.
- THESE DATA PROBABLY SHOULD BE UPDATED TO AVOID CRITICISM THAT WE DON'T HAVE CURRENT DATA ON ANNUAL CROPS.
- * ● THIS PROJECT COULD BE STARTED IN AUGUST OF 1986. RESULTS WOULD BE AVAILABLE IN FY1987.
- THE UPDATED DOSE ASSESSMENT FOR ENJEBI ISLAND SHOULD BE COMPLETED IN LATE FY1987 OR EARLY FY1988.
- REMEDIAL MEASURES EVALUATED AT BIKINI ATOLL WILL BE APPLICABLE IF NECESSARY AT ENJEBI ISLAND.

E 1 Excavation Experiment

The object of this experiment is to demonstrate the effectiveness of soil removal on reducing the concentrations of ^{137}Cs in the soil, and thus plants, at Bikini Island and whether crops could be grown on the remaining nutrient deficient soil.

A 1.5 acre plot was cleared of all trees and excavated to 40 cm depth. A control plot of the same size, where only trees were removed and no excavation occurred, was established immediately adjacent to the excavation site.

In-situ gamma spectroscopy measurements were made prior and subsequent to excavation. Soil profiles were also taken before and after excavation. About 30 different plant species were planted in the excavation and control plots.

All plants in the excavation plot received micro-nutrients and N,P,K with the exception of one row of various plants which received only micro-nutrients. All plants were carefully irrigated and fertilized as required.

The plants generally did very well with this careful attention to nutrient and water supply. The unfertilized row is vastly inferior to the fertilized rows. Thus, plants can be grown on the nutrient deficient soil if adequate nutrient and water are applied correctly. This requires a significant commitment for a long period of time if excavation is the selected clean-up option.

The in-situ gamma measurements and the analysis of samples from the excavation and control plots show a significant decrease in ^{137}Cs to levels at or below that of Eneu Island.

E 1. EXCAVATION EXPERIMENT - BIKINI ISLAND

- COMPACT REQUIREMENT: REHABILITATION OF BIKINI ATOLL.
- EXCAVATION COMPLETED FEBRUARY, 1985.
- CROPS PLANTED IN FEBRUARY, MAY AND JULY OF 1985.
- LIMITED ANALYTICAL RESULTS NOW
- PROCESSING AND ANALYSIS OF ABOUT 200 ANNUAL CROP SAMPLES WILL CONTINUE INTO MID-FY 1987.
- PROCESSING AND ANALYSIS OF PERENNIAL CROPS, (PAPAYA, BANANA AND CITRUS) WILL CONTINUE THROUGH FY1987 AND PERHAPS INTO FY1988.
- PROCESSING AND ANALYSIS OF LONG TERM FOOD CROPS (COCONUT, BREADFRUIT AND PANDANUS) WILL NOT BEGIN UNTIL FY1988; THIS WILL NOT INCLUDE EDIBLE FRUIT.
- BASIC RESULTS WILL BE AVAILABLE IN FY1987 FROM ANNUAL AND SOME PERENNIAL CROPS TO SHOW THAT EXCAVATION WILL INDEED REDUCE THE ¹³⁷CS IN PLANTS TO CONCENTRATIONS AT OR BELOW THOSE OF ENEU ISLAND.
excavation 4/5 Feb 85
- DEMONSTRATION OF ABILITY TO GROW PLANTS AFTER EXCAVATION WILL BE COMPLETE IN FY1987.

*Projection of ¹³⁷Cs
similar to what
Lass and her found*

*¹³⁷Cs accounts
for 95% of dose
either thru
ingestion or
absorption acc'ts
for am. unit*

E 1. EXCAVATION EXPERIMENT - BIKINI ISLAND

IN-SITU GAMMA SPECTROSCOPY RESULTS

EXCAVATION SITE	BEFORE EXCAVATION	AFTER EXCAVATION	BEFORE/AFTER RATIO
		68	5

= MICRO R/hour
μR/H

137Cs from
137CS PCI/G WET WEIGHT

<u>PLANT TYPE</u>	<u>EXCAVATION SITE</u>	<u>EXCAVATION CONTROL SITE</u>
CORN	4	29
WINGED BEAN	1.8	
ZUCCHINI	2.1	

E 2. N, P, K Experiment

The purpose of this experiment is to determine under field conditions whether significant additions of potassium (K) to the atoll environment would reduce the uptake of ^{137}Cs into a major food crop such as coconut.

Three separate experiments are underway. Results from the first two indicate that the uptake of ^{137}Cs is definitely reduced by adding K at rates of about 600 lbs per acre per year. The ^{137}Cs concentration in coconut on Eneu Island has been reduced below the natural ^{40}K concentration in coconut. It is still to be determined how long this effect will last. In other words, the frequency of application and the rate of application to produce and maintain the effect must still be evaluated and will take 2-3 years.

In addition, we still do not know to what level we can reduce the ^{137}Cs concentration on Bikini Island where concentrations are 10 times those on Eneu Island. A continued sampling over the next 2 years will resolve this issue.

The field trial to demonstrate the K effect on a large scale and to evaluate the effectiveness of one large annual application of K will have to be monitored over the next two years.

We have also implemented a small scale study on the effect of several rates of K on ^{137}Cs uptake in garden vegetables. These results will be complete in mid-FY1987.

It might be prudent to demonstrate the effect of added K on ^{137}Cs uptake in breadfruit which is perhaps the second most important local food. We have several breadfruit trees available on Bikini which we have been sampling for several years. This could be accomplished by FY1989.

E 2.

N, P, K EXPERIMENT - BIKINI AND ENEU ISLANDS

- COMPACT REQUIREMENT: REHABILITATION OF BIKINI ATOLL.
- PRELIMINARY EXPERIMENT STARTED ON ENEU ISLAND - JANUARY, 1981 - 4 TREES.
- EXPERIMENT EXPANDED ON ENEU ISLAND AND BIKINI ISLAND - MAY, 1983 - 5 TREES ON ENEU AND 5 TREES ON BIKINI.
- LARGE SCALE FIELD TRIAL STARTED WITH BARC ON BIKINI ISLAND - FEBRUARY 1985. FACTORIAL EXPERIMENT WITH N, P AND 2 RATES OF K. 120 TREES IN EXPERIMENT.
- RESULTS FROM PRELIMINARY AND EXPANDED EXPERIMENTS (SEE VIEW GRAPHS).

QUESTIONS AND IMPLICATIONS

1. ENEU COCONUT UPTAKE OF ^{137}Cs REDUCED BELOW NATURAL LEVELS; BUT HOW LOW CAN WE GET BIKINI ^{137}Cs COCONUT CONCENTRATIONS?
2. DURATION? TIME DEPENDENT. IT WILL TAKE 2 TO 3 Y TO COMPLETE EVALUATION OF THE FIELD TRIALS TO DETERMINE THE EXTENT OF REDUCTION AND THE DURATION OF THE EFFECT.
3. * IF REDUCED UPTAKE PERSISTS THROUGH FY1988, THE IMPLICATION IS THAT THE TREATMENT WITH K WOULD HAVE TO BE DONE AT MOST EVERY 3 Y.

last application of potassium was in '84 - ~~potassium~~ ^{137}Cs levels have stabilized at the reduced rate below ^{or at} normal levels reduced effect of ^{137}Cs seen at 1 1/2 yrs

Continue to add potassium at Bikini, may take several trees & stop application of potassium to determine what will happen there

E 3. IRRIGATION/LEACHING EXPERIMENT - BIKINI ISLAND

PHASE I

- COMPACT REQUIREMENT: REHABILITATION OF BIKINI ATOLL.
- PREMISE: IRRIGATION WITH SEA WATER WILL REMOVE ¹³⁷Cs FROM THE SOIL COLUMN AND ROOT ZONE OF THE PLANTS INTO THE GROUNDWATER.
- CONDITIONS: ACTIVE ROOT ZONE REMOVED. THUS, IN THE INITIAL EXPERIMENT (PHASE I) THE TREES WERE CLEARED FROM THE 1 HECTARE (2.5 ACRE) TEST PLOT.
- SHORT IRRIGATION: STARTED - JUNE 1982 (4 DAYS)
SHORT IRRIGATION: CONTINUED - DECEMBER 1982 (8 DAYS)
FEBRUARY 1983 (9 DAYS)
MAY 1983 (7 DAYS)
DECEMBER 1983 (14 DAYS)
- LONG IRRIGATION: STARTED - FEBRUARY 1984
STOPPED - APRIL 1984 (44 DAYS)
- COCONUT AND PANDANUS TREES PLANTED - MAY AND AUGUST, 1984.
- OTHER FOOD CROPS PLANTED - FEBRUARY, MAY AND JULY, 1985.

E 3. IRRIGATION/LEACHING EXPERIMENT - BIKINI ISLAND (CONTINUED)

PHASE I

- APPROXIMATELY 3 TO 5% OF INVENTORY WAS MOVED TO THE GROUNDWATER.
- PRELIMINARY RESULTS FOR THE 2.5 ACRES CLEARED OF VEGETATION SHOW A REDUCED UPTAKE OF ¹³⁷CS, BY PLANTS GROWN SUBSEQUENT TO IRRIGATION.
- RESULTS FROM FEBRUARY AND MAY 1985 COLLECTIONS.

¹³⁷CS RATIO, CONTROL SITE/IRRIGATION SITE

PLANT SPECIES	PCI/G WET WEIGHT CONTROL/PCIG WET WEIGHT IRRIGATION
GRASS	256
MORNING GLORY	26
MESSERSCHMIDIA	20
CORN	27

25-30 x lower than non-control group

- INTERPRETATION - EXCHANGEABLE POOL OF ¹³⁷CS.
- DURATION? TIME DEPENDENT; ONE YEAR EVALUATION SO FAR. WE WILL NEED TO EVALUATE THE UPTAKE IN VARIOUS PLANTS IN THE IRRIGATION PLOT (I.E. COLLECT SAMPLES FOR PROCESSING AND ANALYSIS) OVER THE NEXT 2-3 Y.
- THE DURATION OF THE EFFECT WILL DICTATE THE USEFULNESS OF THIS METHOD AS A CLEAN-UP OPTION AND THE NEED FOR N,P, K APPLICATION AS THE CONTINUING TREATMENT SUBSEQUENT TO IRRIGATION.
- ADDITIONAL FIELD AND LABORATORY EXPERIMENTS ARE REQUIRED TO ESTABLISH THE BASIS OF THE OBSERVED EFFECT AND FOR PREDICTING THE POSSIBLE DURATION BEYOND THE NEXT 3 YEARS.
- BOTH THE FIELD AND LABORATORY EXPERIMENTS ANTICIPATED NOW WILL BE COMPLETED IN FY1987. IT IS POSSIBLE THAT SOME CARRY OVER COULD OCCUR IN FY1988.

E 3. IRRIGATION/LEACHING EXPERIMENT - BIKINI ISLAND

PHASE II

- PREMISE: 1. IRRIGATION WITH SEA WATER WILL REMOVE EXCHANGEABLE ¹³⁷CS WITH ACTIVE ROOT ZONE OF TREES IN TACT.
- 2. COCONUT TREES AND MOST VEGETATION OTHER THAN BREADFRUIT WILL SURVIVE THE REQUIRED IRRIGATION.
- TEST PLOT CLEARED - FEBRUARY 1986.
- EXPERIMENT TO START - MAY 1986 *2 plot, one treated w/ 1 meter of water the other w/ 2 meters*
- SAMPLE COLLECTIONS (COCONUT, GROUNDWATER) WILL CONTINUE THROUGH FY1988.
- SAMPLE PROCESSING AND ANALYTICAL WORK WILL CONTINUE THROUGH FY1988 AND INTO FY1989.
- INITIAL RESULTS WILL BE OBTAINED IN FY1987 BUT THE TOTAL EFFECT MAY NOT BE OBSERVED UNTIL FY1988.
- DURATION OF ANY OBSERVED EFFECTS WOULD HAVE TO BE EVALUATED THROUGH FY1988-1989.

E 4. Eneu Island Dose Assessment

Plans are already under way for the Bikinians to establish a presence on Eneu Island. Thus, an updated dose assessment for Eneu Island is needed.

The 1981 assessment was based on limited data and a 1981 settlement date. We now have a much more extensive data base for Eneu Island as a result of our continuing program at Bikini Atoll. Also, major resettlement will not occur before 1988.

Other refinements will be made in the new assessment. For example, open air gamma exposure rates were used to estimate wholebody external doses in 1981. In the new assessment we will account for shielding by houses and by crushed coral put around the houses. Data for some food items are now available which were estimated, and estimated high, in the 1981 assessment.

The end product will be a more realistic estimate of the doses a returning population might receive at Eneu Island.

E 4. ENEU ISLAND DOSE ASSESSMENT

- COMPACT REQUIREMENT: REHABILITATION OF BIKINI ATOLL
- RESETTLEMENT OF ENEU ISLAND IS THE LIKELY FIRST STEP IN THE BIKINI ATOLL REHABILITATION.
- THE LAST DOSE ASSESSMENT (1981) WAS BASED ON LIMITED DATA AND A RESETTLEMENT IN 1981.
- SIGNIFICANTLY MORE DATA FOR ENEU ISLAND ARE NOW AVAILABLE FROM OUR CONTINUING PROGRAM AT BIKINI ATOLL AND RESETTLEMENT OBVIOUSLY WILL NOT OCCUR BEFORE ABOUT 1988.
- THUS, AN UPDATED AND REFINED DOSE ASSESSMENT OF ENEU ISLAND IS NEEDED.
- THE DATA ARE AVAILABLE AND THE DOSE ASSESSMENT CAN BE COMPLETED IN FY1987.

E 5. ESTIMATED COST FOR CLEAN-UP OPTIONS

<u>METHOD</u>	<u>COST \$M</u>	<u>SOURCE</u>	<u>It would be habitable</u>
SCRAPE AND DUMP (~2Y)	60	BARC	10Yrs w/
N, P, K (~10Yrs) <i>application for</i>	<3	LLNL/BARC	immed.
SALT WATER LEACHING (~1Y) <i>can.</i>	6 <i>very rough if \$4.6M</i>	SPECTRUM ENGINEERING	immed. local food program scare w/ supply mental program

E 6. Significance of Options

There are two major categories to evaluate when comparing the potential remedial options. One is the environmental consequences of each action and the other is the dollar cost.

The scrape and dump option which has been highly publicized creates a major adverse environmental impact and costs about \$60M. As a result, the potential use of methods currently being evaluated in the ongoing LLNL/DOE projects at Bikini Atoll become very significant.

Preliminary results from both salt water leaching and high potassium experiments indicate that there may be ways of accomplishing the desired dose reduction without the severe environmental impacts of the scrape and dump option and at a lot less cost.

For example, the estimated difference in cost between the scrape and dump option and the leaching and K options could be as much as \$58M. In addition, both the leaching and K would be much easier to implement. Thus, completion over 2-3y of the experiments currently under way is essential for selecting the appropriate method or combination of methods and for reducing the potential cost to the U.S. Government by very significant amounts.

E 6. SIGNIFICANCE OF OPTIONS

A. SCRAPE AND DUMP (EXCAVATION)

1. POSITIVE EFFECTS

A.) ¹³⁷CS REDUCED TO ACCEPTABLE LEVELS.

2. NEGATIVE EFFECTS

A.) LOSS OF ALL VEGETATION INCLUDING 40,000 COCONUT TREES, BREADFRUIT AND PANDANUS.

B.) LOSS OF TOP SOIL AND THUS MOST OF THE ORGANIC MATTER AND NUTRIENTS BUILT UP OVER SEVERAL HUNDRED YEARS.

C.) LOSS OF MOISTURE RETAINING CAPACITY IN THE SOIL.

D.) NEED FOR RE-VEGETATION OF THE ISLAND AND ALL THE ASSOCIATED REQUIREMENTS; NOT TRIVIAL.

E.) RELATIVELY DIFFICULT TO IMPLEMENT.

3. ESTIMATED COST - \$60M.

B. N, P, K TREATMENT

1. POSITIVE EFFECTS

A.) REDUCED UPTAKE OF ¹³⁷CS IN PLANTS TO ACCEPTABLE LEVEL.

B.) INCREASED GROWTH AND PRODUCTIVITY OF ALL PLANTS DUE TO N, P, K.

C.) SIMPLE TO IMPLEMENT.

E.) ALL CURRENT VEGETATION SURVIVES AND FLOURISHES.

2. NEGATIVE EFFECTS

A.) EXTERNAL WHOLEBODY EXPOSURE UNCHANGED. ESTIMATED DOSES WILL BE BELOW THE CURRENT FEDERAL GUIDELINES.

3. ESTIMATED COST - < \$3M OVER 10 Y. PERHAPS MUCH LESS *(depends upon rate studies over next few years)*

C. IRRIGATION/LEACHING WITH SALT WATER.

1. POSITIVE EFFECTS

A.) REDUCED UPTAKE OF ¹³⁷CS IN PLANTS TO ACCEPTABLE LEVEL.

B.) SIMPLE TO IMPLEMENT.

C.) NO MAJOR ENVIRONMENTAL IMPACT. NO LOSS OF SURFACE SOIL.

2. NEGATIVE EFFECTS

A.) EXTERNAL WHOLEBODY EXPOSURE UNCHANGED. ESTIMATED DOSES WILL BE BELOW THE CURRENT FEDERAL GUIDELINES.

B.) WOULD PROBABLY KILL THE BREADFRUIT TREES AND PERHAPS THE PANDANUS.

3. ESTIMATED COST

A.) \$6M

D. Possible option which would start w/ option (c), followed up w/ (B)

F. ENVIRONMENTAL HALF-LIFE OF ^{137}Cs

- COMPACT REQUIREMENT: ALL DOSE ASSESSMENTS AND RESETTLEMENT ISSUES (I.E. BIKINI, ENEWETAK AND RONGELAP ATOLLS).
- CURRENT DOSE ESTIMATES ARE BASED ONLY ON RADIOLOGICAL DECAY ($T_{1/2}=30.1\text{Y}$ FOR ^{137}Cs).
- ENVIRONMENTAL PROCESSES DO ELIMINATE ^{137}Cs FROM THE ECOSYSTEM TO THE GROUND WATER. EFFECTIVE HALF-LIFE $\lambda_E = \lambda$ RADIOLOGICAL + λ ENVIRONMENTAL.
- AS AN EXAMPLE, IF T_E IS ABOUT 30Y THE ESTIMATED DOSES WOULD BE HALF OF THE CURRENTLY ESTIMATED DOSES. THUS, T_E IS A VERY IMPORTANT PARAMETER TO KNOW.
- NO HISTORICAL DATA TO EVALUATE λ_E (OR T_E).
- T_E IS A TIME DEPENDENT PROCESSES; THUS, EVALUATING T_E TAKES TIME.
- CURRENT EXPERIMENTS
 - 1.) SIX TREES ON ENEWETAK ATOLL FIRST SAMPLED IN 1973. SAMPLED PERIODICALLY SINCE THEN. LAST SAMPLED IN FEBRUARY, 1986.
 - 2.) APPROXIMATELY 30 TREES ON BIKINI ATOLL FIRST SAMPLED IN 1978-1979. SAMPLED AT LEAST ANNUALLY SINCE THEN.
 - 3.) ABOUT 8 SITES FIRST SAMPLED IN 1959 BY THE UNIVERSITY OF WASHINGTON HAVE BEEN RE-SAMPLED IN FEBRUARY OF THIS YEAR. THUS, WE COULD GAIN 27 YEARS, RETROSPECTIVELY.

F. ENVIRONMENTAL HALF-LIFE OF ^{137}Cs (CONTINUED)

● SIGNIFICANCE

- 1.) CAN GREATLY ALTER THE PREDICTED DOSES OVER 30, 50 OR 70 Y AND THE MAXIMUM ANNUAL PREDICTED DOSE.
- 2.) COULD ALTER THE SCOPE OF CLEAN-UP ON SOME ISLANDS AND ELIMINATE OTHERS FROM CONSIDERATION.
- 3.) THIS $T_{1/2}$ EFFECT WOULD BE APPLICABLE TO ALL 3 ATOLLS CALLED OUT IN THE COMPACT.

● TIME-LINES AND MILESTONES

- | | | |
|--|---|-----------|
| $T_{1/2}$ BASED ON ENEWETAK TREES | - | FY1987 |
| $T_{1/2}$ BASED ON RONGELAP HISTORICAL SITES | - | FY1987 |
| $T_{1/2}$ BASED ON BIKINI TREES | - | FY1988-89 |

G. SUMMARY OF REMEDIAL OPTIONS

<u>PROJECT</u>	<u>ENVIRONMENTAL IMPACT</u>	<u>TIME FOR COMPLETION</u>	<u>COST AS A CLEAN-UP OPERATION</u>
BIKINI EXCAVATION	EXTREME	FY1987	\$60M
BIKINI IRRIGATION LEACHING	MINIMAL	2-3Y	\$6M
BIKINI N, P, K	NONE	2-3Y	<\$3M
BIKINI-ENEWETAK ENVIRONMENTAL T _{1/2}	NONE	2-3Y	REDUCES CLEAN-UP REQUIREMEN

H. MILESTONE TIME LINE SUMMARY: COMPACT REQUIREMENTS

<u>PROJECT</u>	<u>SAMPLING</u>	<u>PROCESSING</u>	<u>ANALYTICAL</u>	<u>PRODUCT</u>
RONGELAP DOSE REVIEW	-	-	-	FY1987
RONGELAP REASSESSMENT	FY86	FY87	FY87	FY87-88
ENJEBI DOSE ASSESSMENT	FY87	FY87	FY87-88	FY87-88
BIKINI EXCAVATION	FY86-87	FY86-87	FY86-87-88	FY87-88
BIKINI N,P,K (14 TREES)	FY86-87-88	FY86-87-88	FY-86-87-88	FY-87-88-89
BIKINI N,P,K (FIELD TRIAL)	FY86-87-88-89	FY86-87-88-89	FY-87-88-89	FY-88-89
BIKINI IRRIGATION (PHASE I)	FY86-87-88	FY86-87-88-89	FY-87-88-89	FY-87-88-89
BIKINI IRRIGATION (PHASE II)	FY86-87-88	FY87-88-89	FY87-88-89	FY87-88-89
FIELD/LABORATORY EXP.	FY86-87	FY87	FY87-88	FY87-88
ENVIRONMENTAL T _{1/2} (RONGELAP)	FY86	FY86-87	FY87	FY87
ENVIRONMENTAL T _{1/2} (ENEWETAK)	FY86-87	FY86-87	FY87	FY87
ENVIRONMENTAL T _{1/2} (BIKINI)	FY86-87-88	FY86-87-88	FY87-88	FY88
ENEU DOSE ASSESSMENT	CONTINUOUS	CONTINUOUS	CONTINUOUS	FY87
UPDATED DOSE ASSESSMENTS (ENEU, ENJEBI, NMIRS)	BASED ON T _{1/2} DATA			FY88-89 (SOONER IF POSSIBLE)

I. BUDGET

	FY1986	FY1987, FY1988	FY1989
MANPOWER	\$1.2M	\$1.2M	\$0.8M
9.0 FULL TIME 1.5 PART TIME OF SEVERAL PEOPLE ^A 7 CONTRACT ^A			
DIVISION & DIRECT OVERHEAD	\$0.4M	\$0.3M	\$0.2M
ANALYTICAL	\$0.5M	\$0.1M	\$0.1M
LOGISTICS - <i>AcW</i> <i>comp - absolutely essential</i>	\$0.3M	\$0.3M	\$0.2M
S&E AND MISC.	\$0.2M	\$0.1M	\$0.1M
TOTAL	\$2.5M (DOE & BARC)	\$2.0M <u> </u>	\$1.4M

^A REDUCED IN FY1989.

2600 - 3000 samples per year - potential to cut back ~~here~~

M. PROSPECTS FOR RMI BUYBACK (FY1989-FY1995)

- MONITORING OF ^{137}Cs UPTAKE IN COCONUTS ON 6 NORTHERN ISLANDS PLANTED IN 1979 (MIGHT POSSIBLY BE A U.S. COMMITMENT UNDER THE COMPACT.)
- ENEU DOSE ASSESSMENT BY WETO ^{direct family holding} PRIOR TO MAJOR RESETTLEMENT. — *Robson thinks is ridiculous*
- DOSE ASSESSMENTS AND/OR EXPERIMENTS FOR ENJEBI ISLAND, AOMON ISLAND AND ANY OTHER ISLANDS AT ENEWETAK ATOLL.
- MONITORING OF RADIONUCLIDES IN THE ENVIRONMENT AT BIKINI, ENEU AND ENJEBI ISLANDS AFTER RESETTLEMENT.
- DOSE ASSESSMENTS AND/OR MONITORING OF RONGELAP ISLAND OR ANY OTHER ISLANDS AT RONGELAP ATOLL (ARBAR, ENEWETAK, KABELLE, MELLU, ETC.)
- DOSE ASSESSMENT, PROSPECTIVE OR RETROSPECTIVE, AT ANY ATOLLS OTHER THAN BIKINI, ENEWETAK AND RONGELAP.
- CONTINUATION AFTER FY1989 OF EXPERIMENTS OR DATA ACQUISITION NEEDED AT BIKINI AND ENEWETAK ATOLLS.

US Program Outside of Compact

- MI databank — imp for US to have record *imp for essential section also which is off if one city. assumptions were wrong*
- monitoring of radionuclides in enviro. after resettlement of Bikini, Enjebi & Eneu

U.S. Program outside of Compact

1. Marshall Island Data Bank
2. Monitoring of Radionuclides in the environment after resettlement at Bikini, Eneu and Enjebi.