



MEDICAL DEPARTMENT

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September 2, 1976

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Deputy Director  
Division of Biomedical &  
Environmental Research  
U.S. Energy Research and  
Development Administration  
Washington, D.C. 20545

Dear Bill,

With regard to the plutonium problem on Bikini we would like to bring you up to date on (1) sample collections planned for Sept.-Oct. survey in the Marshalls; (2) samples still being analyzed from previous surveys, and (3) summary Tables of previous data comparing Rongelap and Utirik findings.

Samples for Sept.-Oct. 1976: Urines 1. Bikini: 5 gal. carboys on 5 individuals (carboys distributed last June); also 5 - 5 gal. pooled samples; 2. Rongelap: 5 - 5 gal pooled samples; 3. Utirik: 5 - 5 gal. pooled samples; 4. Wotje: 5 - 5 gal. pooled samples; 5. Ebeye: 5 - 5 gal. pooled samples; 6. Majuro: 5 - 5 gal. pooled samples and samples on 50 Bikini people planning to return in the near future. You will note we are collecting samples from a number of atolls not directly involved in the 1954 fallout.

Whole body gamma spectroscopy on Bikini people (for <sup>137</sup>Cs body burdens) originally planned for October are being delayed until April in hope that the advance group of Eniwetak people will have returned to their atoll and can also be counted during that operation.

N. Greenhouse, J. Naidu and V. Nelson plan on collecting soil and plant samples in Sept.-Oct. from Wotje, Ailuk, Utirik, Rongelap and Bikini.

Samples presently being analyzed are animal samples (pig, chickens, crabs from Rongelap and Bikini, water from Bikini cisterns, soil from Rongelap. Autoradiographs for alpha tracks of animal lung and liver tissues are being run.

The enclosed Tables have been compiled by N. Greenhouse, J. Naidu and me and include data from various sources. Many of the Tables are incomplete. We are attempting to pull together in one file all available data from personnel and environmental radiological surveys on Rongelap, Utirik and Bikini atolls. When this is accomplished we should be able to make more comprehensive comparative Tables on these atolls. We hope these data will be on hand for your planned meeting of the experts.

Sincerely,



Robert A. Conard, M.D.

RAC:gc

Enc.

CC: J. Deal

T. McCraw

R. Ray

N. Greenhouse

J. Naidu

RADIOCHEMICAL ANALYSES OF URINE (DATA IN AVERAGE pCi/liter)\*

Year	No. in group	Av. vol. ml	<sup>90</sup> Sr	<sup>137</sup> Cs	<sup>239-240</sup> Pu
<u>Rongelap</u>					
1970	20	895	3.5	2700	
1971	15	534	3.7	2400	
1972	18	460	2.4	2600	
1973	11	249	6.5	4600	
1974	14	557	2.8	4500	
1975 (Mar)	14	753	4.6	2100	
1976 (Mar)	17**	679	4.6	2100	0.009 ± .002
	1	1250			0.014 ± .007
<u>Utirik</u>					
1974	11	542	1.3	1300	
<u>Bikini</u>					
1970	Pooled		1.2	1150	
	Urine G	1100	2.2		
	Urine M	930	1.9		
	HASL* control	3000	1.0	120	
	HASL control	1000	1.6		
1971	Pooled	2670	1.7	1830	
1972	Pooled	2700	4.2	0910	
1973	13	304	6.7	1300	
1974	8	165	2.3	1300	
	10	649			
1975 (Mar)	8	360	7.3	1800	
(Oct)	18	510	3.1	1300	
	Pooled	9319			0.01 ± .002
1976 (Mar)	24**	480	4.7 ± 4.6	1600 ± 800	0.009 ± .002
<u>N.Y. City</u>					
(1976)	Pooled	20,000			0.0009 ± .0004
	1	500	0.9	8.0	
	1	500	0.8	10.0	

\* Analytical error terms associated with <sup>90</sup>Sr and <sup>137</sup>Cs analyses were usually less than 10 percent.

\*\* Pooled for Pu analysis.

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INDIVIDUAL RADIOLOGICAL MONITORING DATA - BIKINI

(Urine Levels - amt/1; <sup>137</sup>Cs Body Burdens - 1974, nCi)

No.	Age	Sex	1973				1974				1975 (Mar.)				1975 (Oct.)				1976 (Mar.)				1976 (Oct.)				
			90 Sr pCi	137 Cs nCi	Yrs. Bik.		90 Sr pCi	137 Cs nCi	137 Cs nCi	** Yrs. Bik.	90 Sr pCi	137 Cs nCi	Yrs. Bik.		90 Sr pCi	137 Cs nCi	Yrs. Bik.		90 Sr pCi	137 Cs nCi	Yrs. Bik.		90 Sr pCi	137 Cs nCi	Yrs. Bik.		
B1	46	F				<0.1	0.5	58	1.5																		
B2	20	F												2.2	2.0	1											
B3			5.5	2.6	?			72																			
B4	62	M						78	2	4.5	2.1	3					4.8	2.9	4								
E			18.9	1.3																							
B6			2.0	0.4																							
B7	24	M						95	1																		
B8	31	F						108	3																		
B9	16	F												8.2	2.9	1											
10	26	M								4.7	1.9	1.5															
11	32	M				3.2	1.7	156	6																		
12	51	M						290	0.5	12.0	2.1	1.5		2.9	0.9	2											
13	32	M	2.2	0.6	1			81	2					2.1	0.8	3.5											
14	24	M				<0.2	1.5		2					5.7	2.1	3											
15	57	M						51	2								2.3	0.3	4								
1	25	F																									
17	56	F												4.8	2.5	1											
18	47	F						116	2																		
19		M				2.4	0.8		3																		
20	25	F						73	3								2.4	1.2	5								
21			5.7	1.1																							
22	32	M						103	4																		
23	24	M								6.6	1.5	1.5															
24	41	M	7.8	2.0	1			122	2	18.0	3.0	3															
25	44	M								2.4	0.4	2.5		1.9	2.0	3		6.8		4							

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INDIVIDUAL RADIOLOGICAL MONITORING DATA - BIKINI

(Urine Levels - amt/1; <sup>137</sup>Cs Body Burdens - 1974, nCi)

No.	Age	Sex	1973			1974				1975 (Mar.)				1975 (Oct.)			1976 (Mar.)			1976 (Oct.)			
			90 Sr pCi	137 Cs nCi	Yrs. Bik.	90 Sr pCi	137 Cs nCi	137 Cs ** nCi	Yrs. Bik.	90 Sr pCi	137 Cs nCi	Yrs. Bik.	90 Sr pCi	137 Cs nCi	Yrs. Bik.	90 Sr pCi	137 Cs nCi	Yrs. Bik.	90 Sr pCi	137 Cs nCi	Yrs. Bik.		
B26	32	F						7.8	3.0	2				1.6	1.2	2.5	4.0	1.4	3				
B27	18	M																					
B28	15	F																					
B29	56	M																					
B30	33	F															9.6	1.4	3				
B31	46	M												2.3	1.5	1	1.6	1.1	1.5				
B32	59	M												0.6	0.5	1	1.1	0.9	1.5				
B33	44	F												5.1	1.6	2.5	5.4		3				
B34	49	F												3.9	1.9	1							
B35	27	M				1.2	1.0	93	3								10.1	3.0	5				
B36	17	F						36	3					1.9	0.6	4.5							
B37	22	F						29	0.5								3.4	0.5	2.5				
B38	16	F						96	1					1.9	1.2	2.5							
B39	49	M	6.2	0.9	1			402	2					4.5	1.1	3.5							
B40			4.8	1.2																			
	62	F						33	0.5														
B42	56	F						30	0.5														
B43	16	F						90	1								8.4	2.6	3				
B44	30	F	11.6	2.1	1	3.8	3.2	92	2														
B45	44	M	5.4	0.5	1	4.6	1.6	168	2								5.5	0.9	4				
B46			1.9	0.4																			
B47	29	F						107	2														
B48	37	M																					
B49	45	M	8.9	2.1	1			56	2														
B50	47	F						18	0.5														

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INDIVIDUAL RADIOLOGICAL MONITORING DATA - BIKINI

(Urine Levels - amt/l; <sup>137</sup>Cs Body Burdens - 1974, nCi)

No.	Age	Sex	1973			1974				1975 (Mar.)			1975 (Oct.)			1976 (Mar.)			1976 (Oct.)		
			<sup>90</sup> Sr pCi	<sup>137</sup> Cs nCi	Yrs. Bik.	<sup>90</sup> Sr pCi	<sup>137</sup> Cs nCi	<sup>137</sup> Cs nCi	** Yrs. Bik.	<sup>90</sup> Sr pCi	<sup>137</sup> Cs nCi	Yrs. Bik.	<sup>90</sup> Sr pCi	<sup>137</sup> Cs nCi	Yrs. Bik.	<sup>90</sup> Sr pCi	<sup>137</sup> Cs nCi	Yrs. Bik.	<sup>90</sup> Sr pCi	<sup>137</sup> Cs nCi	Yrs. Bik.
B51	33	M				3.0	0.6	222			2				6.8	2.8	4				
B52	19	M						77			1										
B53	46	M						156			1	0.5	0.5	2	2.3	1.4	3				
B54	51	M						72			5										
B55	56	M													2.8	1.1	3				
B56	54	F													5.1	3.2	6				
B57	24	M													3.0	1.0	3				
B58	22	F													7.6	0.9	4				
B59	20	M													4.3	1.9	3				
B60	24	M													1.5	1.6	2				
B61	30	M													5.5	1.1	3				

\*\* Gamma Spectrographic analyses - body burdens.

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Mean Cesium-137 Levels Obtained by Whole Body Counting - 1974

	Male			Female		
	No.	nCi	nCi/kg body wt.*	No.	nCi	nCi/kg body wt.*
Bikini	8	128	1.84 (0.43-5.11)	13	73	1.15 (0.22-3.26)
Utirik	9	262	4.05 (2.64-6.84)	13	133	2.13 (0.96-3.85)
Rongelap	22	475	7.76 (4.37-16.3)	24	304	5.13 (2.71-13.46)
BNL med. team	4	2.93	0.0352(0.0134-.0791)			

\* MPC 43 nCi/kg

Estimated Dose to Bone Marrow (mrem/yr)\*

SOURCE	BIKINI	ENUE	RONGELAP	UTIRIK	USA	
					DENVER	LONG ISLAND
Natural	80	80	80	80	325	190
Medical Dental	0	0	10	10	70	70
Contamination Gamma	165	7	20	7		
Internal	21	21	68	31		
TOTAL	266	108	178	128	395	260

\* Dose on Marshall Islands based on personnel and environmental data.

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ANIMAL DATA  
COCONUT CRABS

Island	Year	Part	$^{90}\text{Sr}$	$^{137}\text{Cs}$	$^{239-240}\text{Pu}$
			nCi/kg	nCi/kg	pCi/kg
Rongelap	1964	edible	4.0 - 9.0		
"	1969	whole	53.0	8.5	
"		"	34.0	7.0	
"	1972	"	56.0	13.0	
		"	28.6	5.0	
		"	39.0	6.1	
		"	31.0	6.8	
		"	23.0	5.1	
	1974	"	18.0	5.0	
		"	40.0	8.2	
		"	18.0	4.8	
	1975	{ edible	0.4	2.7	1.9
" Arbur Is.		{ skeleton	26.4	1.4	8.3
" Kabelle		{ edible	2.4	21.3	8.2
Island		{ skeleton	0.1	8.8	14.8
"		{ edible	0.8	14.6	5.1
		{ skeleton	24.1	5.0	2.2
Bikini		whole	23.3	11.8	1.5
	1970	"	24.8	14.8	0.07
	1971	"	132.0	11.4	
		"	412.0	8.6	
	1973	"	45.7	9.3	
	1974	muscle	16.0	380.0	18.0
		hepatopancreas	36.0	93.0	25.0
		skeleton	160.0	70.0	21.0
Enue	"			0.3	

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## ANIMAL DATA (1974)

## OTHER THAN CRABS

Atoll	Sample	$^{90}\text{Sr}$ pCi/kg*	$^{137}\text{Cs}$ nCi/kg*	$^{239-240}\text{Pu}$ pCi/kg*
	Pig			
Rongelap (Kabelle)	{ meat	10	11.0	
	{ organs	5	3.4	2.2
	{ bones	11,000	6.0	7.0
" Rongelap Island	Pig			
	{ meat	1.5	2.0	
	{ bones	1,600	0.9	0.4
"	chicken { meat	4	0.7	
	{ bones	480	0.6	0.8
"	" { meat	36	1.1	
	{ bones	3,500	0.6	0.6
Bikini Island	chicken { meat	8	0.7	
	{ bones	750	0.8	0.9
Rongelap Island	Rat 1	350	3.6	
	" 2	280	4.2	
	" 3	540	4.3	
Bikini Is.	Rat 1	6,000	8.1	6.7
	Fish	60		4.0
	(dry wt.)	240		20.0
		180		45.0
	" surgeon muscle			<.001 dpm/g

\* Wet weight except dry wt. for fish.

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TABLE 4

RADIOCHEMICAL ANALYSES OF WELL WATER (pCi/liter) AND SLUDGE FROM WATER  
CISTERNS (pCi/g. dried sludge) FROM BIKINI

Year	Sample	Vol.,ml	$^{90}\text{Sr}$ *	$^{137}\text{Cs}$ **	$^3\text{H}$	$^{239-240}\text{Pu}$ ***
1971	"good well"	1830	6.0 ± 17%	600 ± 1%	770 ± 40%	0.04 ± 25%
	"bad well"	1830	25 ± 3%	850 ± 1%	1040 ± 30%	0.05 ± 20%
	"good well" (closed)	1810	103 ± 2%	1044 ± 1%		0.058 ± 15%
	"good well" (opened)	1980	125 ± 3%	818 ± 1%		5.76 ± 6%
	drinking water (camp area)	3580	0.46 ± 4%	1.53 ± 8%		0.004 ± 100%
1972	well water	1000	15.4 ± 9%	800 ± 1%		
	drinking water	1960	0.61 ± 6%	1.8 ± 8%		
1973	new well	60	52	600		0.38 ± 40%
	B-1 well	225	11	724		0.08 ± 50%
1975	Sludge from water cisterns (6 samples)					2.91-4.02 $\bar{x}$ 3.06

\* MPC  $4 \times 10^3$  pCi/l

\*\* MPC  $2 \times 10^5$  pCi/l

\*\*\* MPC  $3 \times 10^5$  pCi/l

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PLANTS

Year	Atoll/Island	Tissue	<sup>90</sup> Sr		<sup>137</sup> Cs		<sup>239</sup> Pu		<sup>241</sup> Am	
			Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.
<u>1. Bread Fruit (pCi/g dry)</u>										
74										
75	Bikini	leaves	251 - 446	332	29 - 95	53	.043-.148	.10		
74	Rongelap	leaves	23		27					
75	Wotho	leaves	.21		.35					
		fruit	<.08		1.7					
75	Bigej		- no data -							
<u>2. Pandanus (pCi/g dry)</u>										
74										
75	Bikini	leaves	41 - 402	170	37 - 1035	508	.031-.20	.087		
		fruit	34 - 255	138	3524 - 3665	3591	.001-.01	.005		
74	Rongelap	leaves	11		13					
		fruit			- no data -					
75	Wotho	leaves			- no data -					
75	Bigej	leaves	<.10		.92					
		fruit	.15		.55 - 1	.78				
<u>3. Coconut (pCi/g dry)</u>										
74										
75	Bikini	leaves	5.2 - 35	15.7	58 - 649	154	.018-.96	.205		
74	Rongelap	leaves	2.1		4.2					
75	Bigej	meat	<.15		1.2-2.3	1.75				
75	Wotho	leaves	.10		.70					
<u>4. Messerschmidia (pCi/g dry)</u>										
74	Bikini	leaves	235		305					
75		leaves	15 - 384	102			.07 -.985	.478		
74	Rongelap	leaves			- no data -					
75	Bigej	leaves	.16		2.3					
75	Wotho	leaves			- no data -					

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Year	Atoll/Island	Tissue	PLANTS							
			<sup>90</sup> Sr Range	Avg.	<sup>137</sup> Cs Range	Avg.	<sup>239</sup> Pu Range	Avg.	<sup>241</sup> Am Range	Avg.
<u>5. Scaveola (pCi/g dry)</u>										
74	Bikini	leaves	33		110					
75		leaves	31 - 169	92			.07-.931	.252		
74	Rongelap	leaves	3.0		27					
75	Bigej	leaves	<.17		.95					
75	Wotho	leaves	- no data -							
<u>6. Papaya (pCi/g dry)</u>										
74	Bikini	fruit	81		1050		<.002			
75		fruit	74 - 79	76			.001-.009	.005		
75	Wotho	fruit	<.15		0.32					
		rind	<.14		15					
		seeds	<.14		12					
<u>7. Squash (pCi/g dry)</u>										
74	Bikini/	fruit	10		794					
	Bikini	fruit	5				.003			
<u>8. Banana (pCi/g dry)</u>										
74	Bikini	fruit	7.9		16					
75		fruit	9.33				.002			
		skin	90				.18			
<u>9. Arrowroot (pCi/g dry)</u>										
75	Bikini	tubers					.239			

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SOIL, AIR AND HOUSE DUST

Atoll/Island	Year	<u>SOIL</u>							
		<sup>90</sup> Sr Range	pCi/g. dry Average	<sup>137</sup> Cs Range	pCi/g. dry Average	<sup>239</sup> Pu Range	pCi/g. dry* Average	<sup>241</sup> Am Range	pCi/g. dry Average
Bikini/Bikini	1970	-	-	27 - 955	199	7 - 140	43	5 - 45	17.5
	1972	-	-	-	-	2.5 - 132	21	.85 - 8.7	3.8
	1974	5.8 - 370	130.6	-	-	.44 - 9.3	3.7		
	1975	18 - 432	127	14.9 - 250	24.5	.55 - 73	23	.24 - 17	6.5
		14 - 578	202	-	-	-	-	-	-
Kwajalein/Bigej	1975	.4	-	-	-	-	-	-	
Wotho/Wotho	1974	.3	-	-	-	-	-	-	
	1975	-	-	1.1	-	-	-	.08	

\*MPC for Pu established by Eniwetak Task Group is 40 pCi/g.

AIR SAMPLES

(pCi/M<sup>3</sup>)

Bikini/Bikini	1972	0.06 x 10 <sup>-4</sup>	0.12 x 10 <sup>-4*</sup>
		to 0.2 x 10 <sup>-4</sup>	

\*MPC is 6 x 10<sup>-3</sup> pCi/M<sup>3</sup> (ICRP, Pub. 2, 1959).

HOUSE DUST

(pCi/g)

Bikini/Bikini	1975	1.97 - 3.3	2.2
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BODY BURDENS - STRONTIUM-90  
(BASED ON RADIOCHEMICAL URINE ANALYSES)

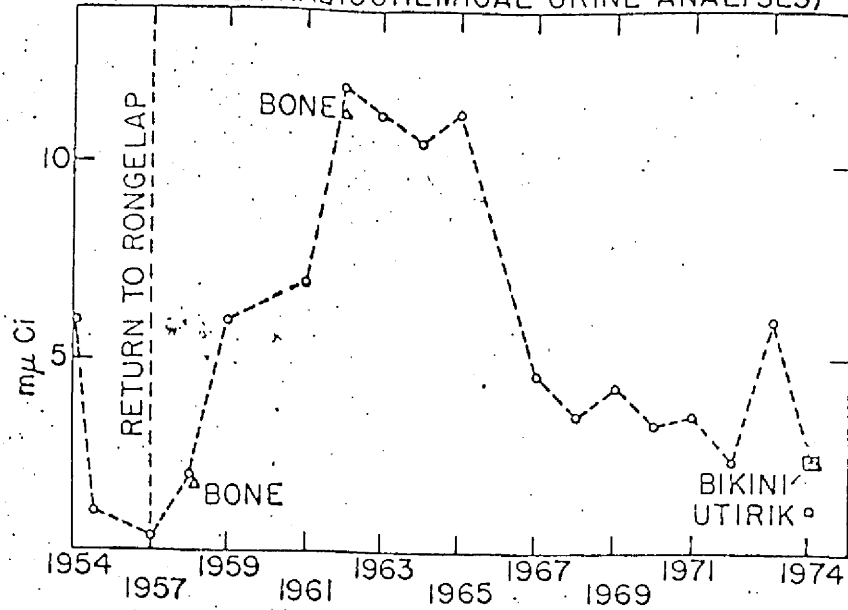


Fig. 1

BODY BURDEN GAMMA EMMITERS -  
WHOLE BODY GAMMA SPECTROSCOPY

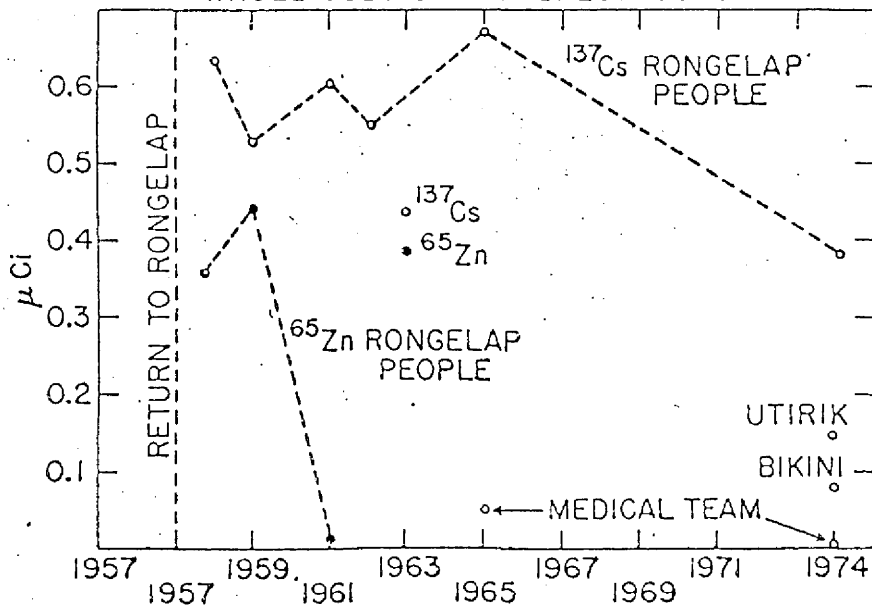


Fig. 2