[redacted]

it would be best to present the adult mean body burden as done in the January 18 correspondence between N. A. Greenhouse and yourself.

If further information is required, please contact me at FTS 666-2503 or -4207.

Sincerely,

Edward T Lessard

Edward Lessard

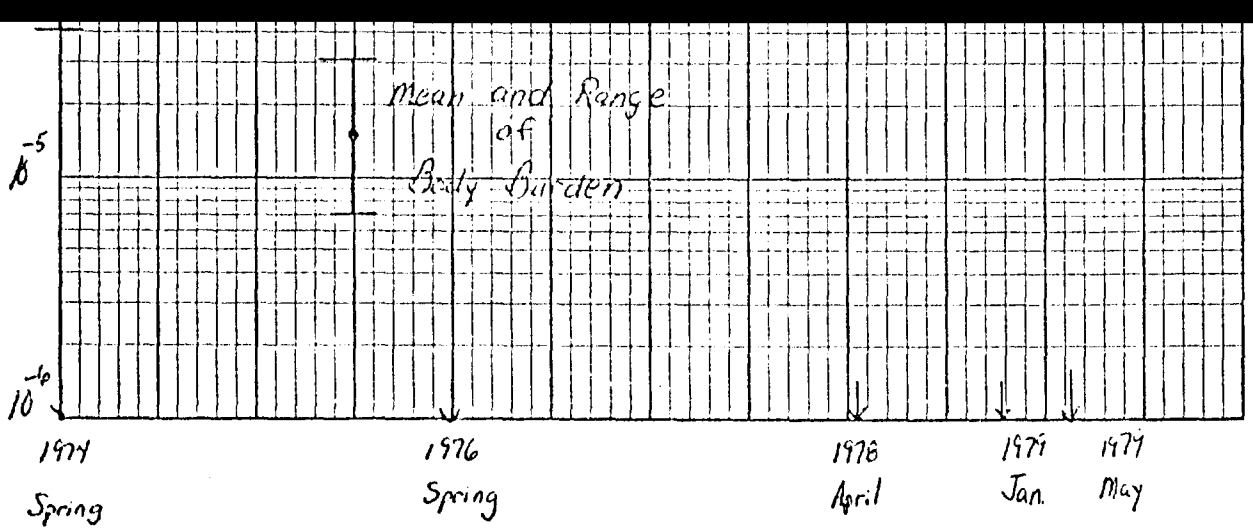
EL/slg

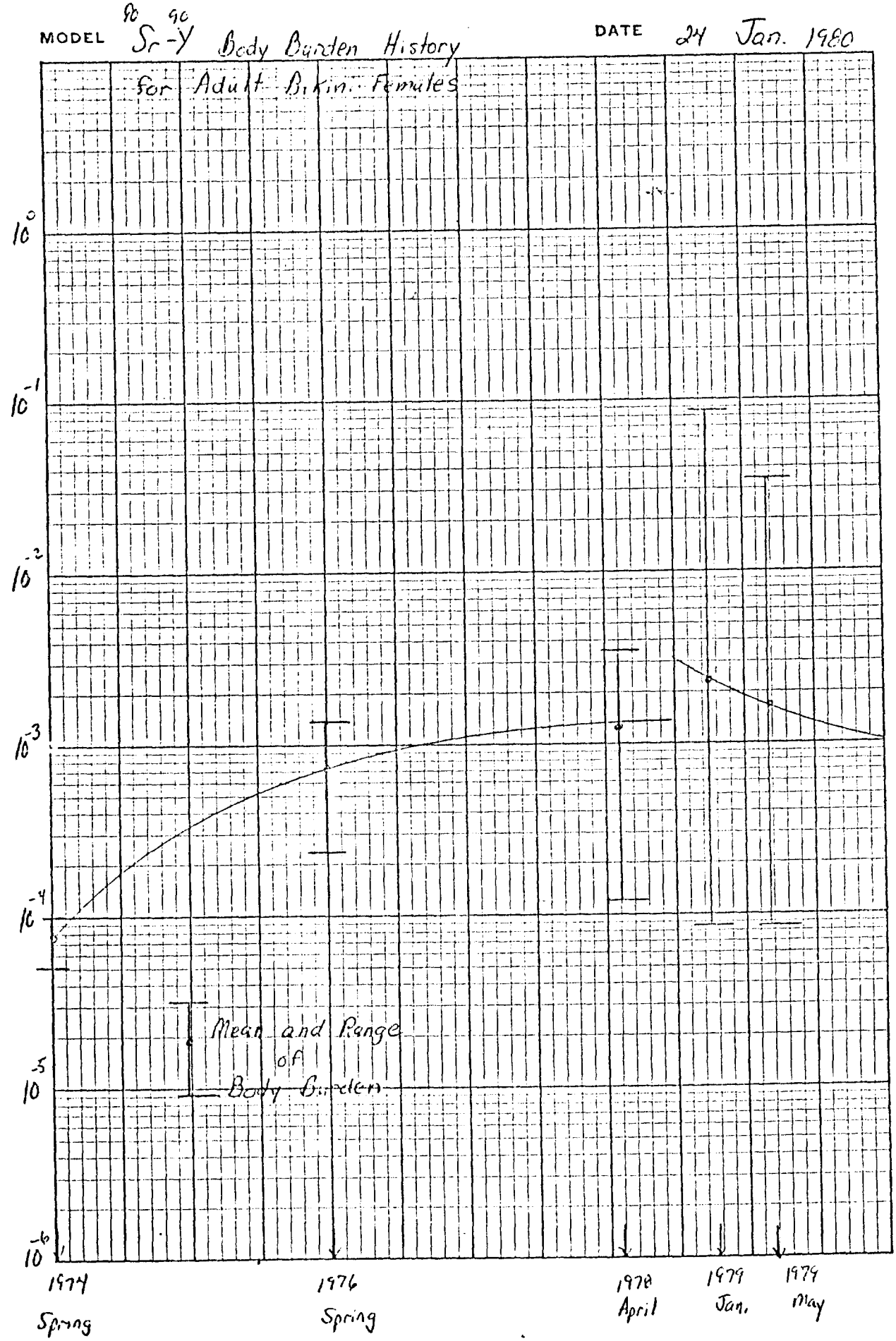
Attachments

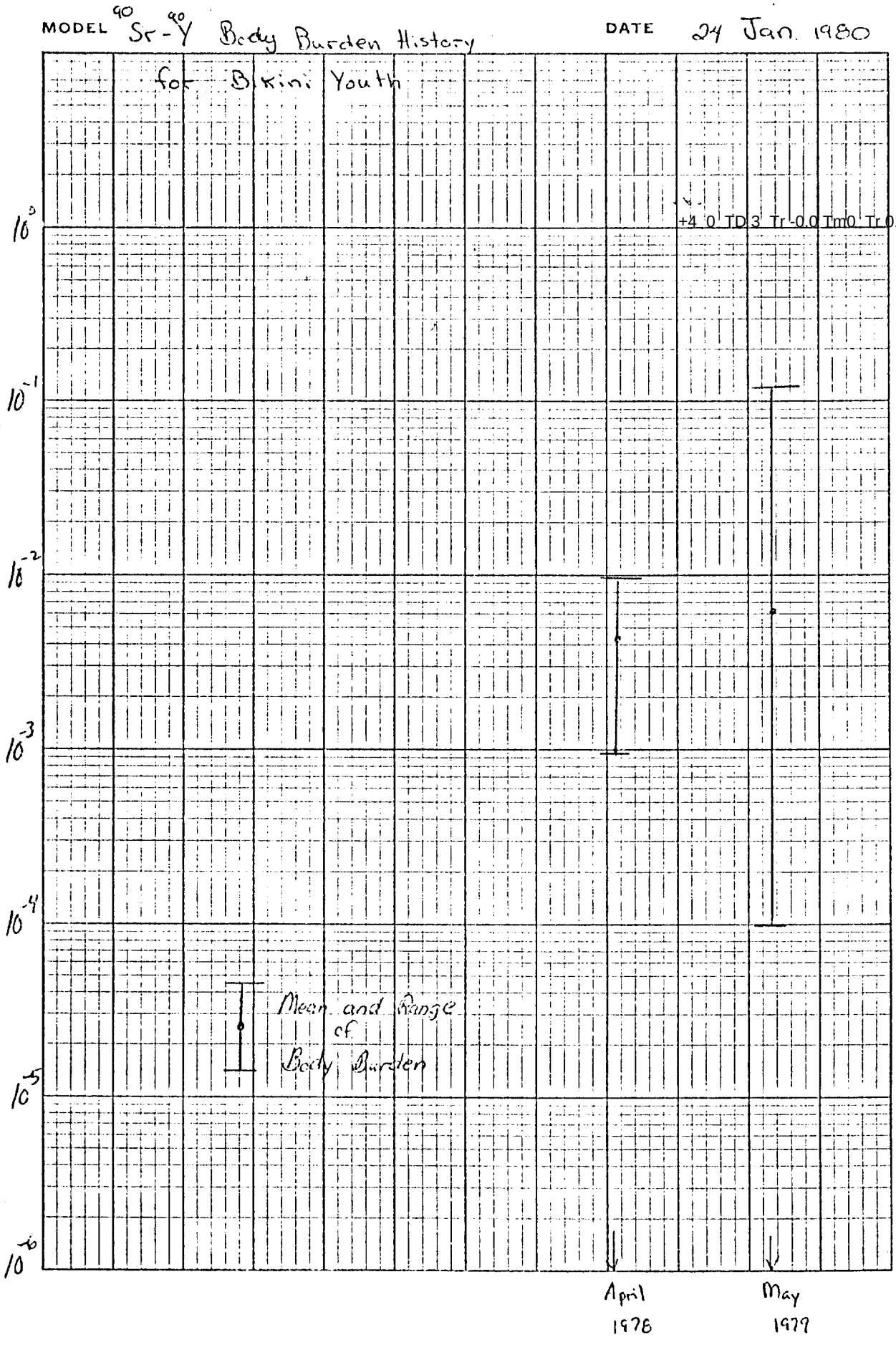
cc: N. Greenhouse
A. Hull
B. Wachholz

[redacted]

the composite. Due to the uncertainty in measurement, the small sample size and the normal variance in urine activity concentrations, the post departure estimated true value for mean body burden does not correlate well with the expected value for adult female and child/adolescent groups.


Mean and Range
of
Body Burden
10^{-5}
10^{-10}
1974
Spring
1976
Spring
1978
April
1979
Jan.
1979
May


MODEL 90 90 Sr-Y Body Burden History
for Adult Bikin. Females
DATE 24 Jan. 1980
Body Burden, μCi
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
Mean and Range of Body Burden
1974 Spring
1976 Spring
1978 April
1979 Jan.
1979 May
SEMI-LOGARITHMIC
7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO.
46 6460



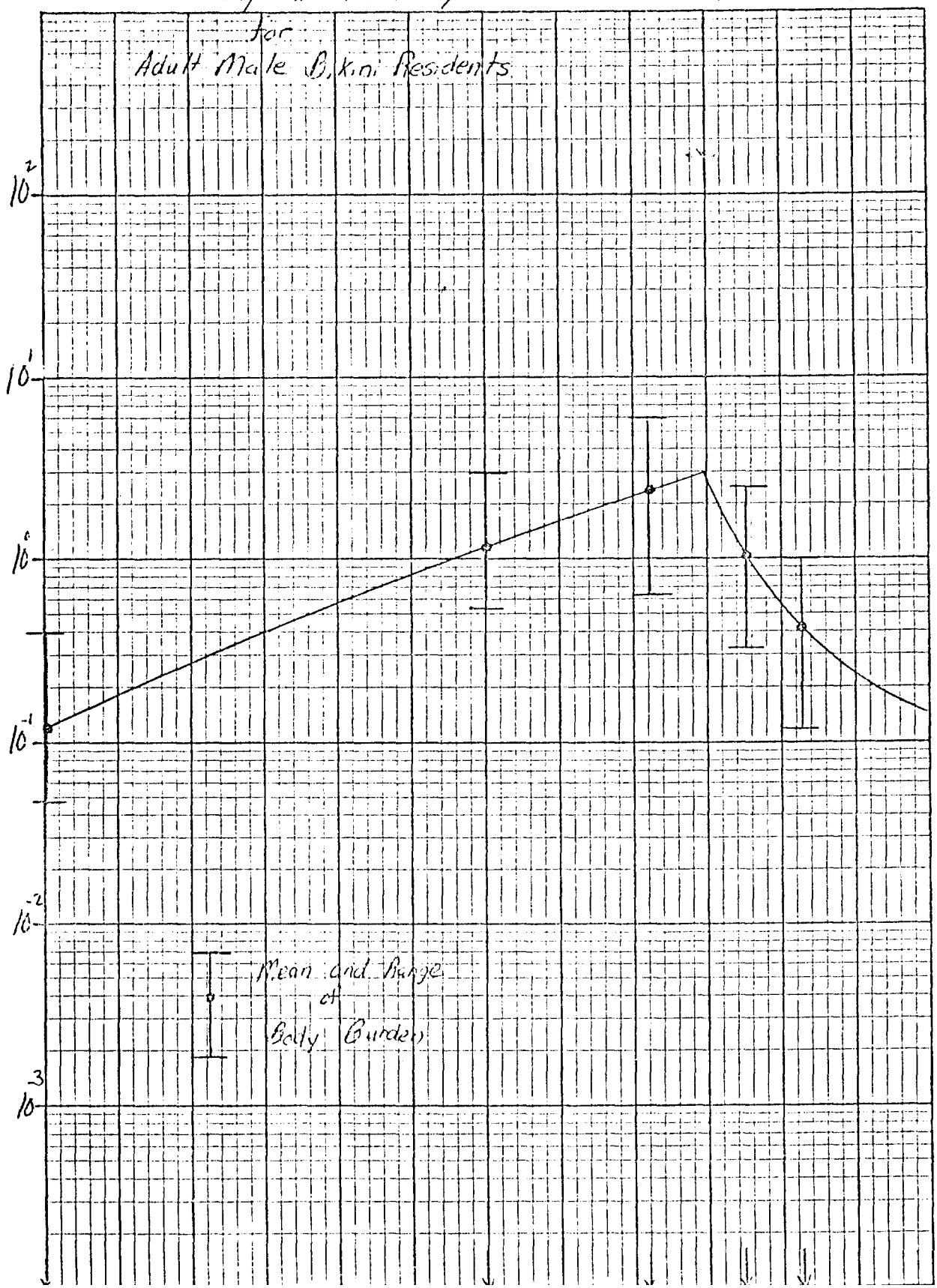
^{137}Cs-^{137m}Ba Body Burden History Curves for Former Bikini Residents

A statistical analysis, based on the demonstrated variance of the whole body count results and sample size, indicates a 90-95% confidence level applies to the estimated true value for the mean body burden for adult and youth population groups. A non-equilibrium between ^{137}Cs in the environment and ^{137}Cs in persons was maintained throughout the residence period on Bikini Island. The increasing burden has been attributed to the increasing availability of locally grown dietary items containing ^{137}Cs in particular coconut. In the Spring of 1977, approximately 5% of the adult male body burdens exceeded the International Committee on Radiation Protection's recommended limit for the general public (3 μCi). In April 1978, approximately 9% of the adult female body burdens and 30% of the adult male body burdens exceeded the ICRP recommendation.

MODEL ^{137}Cs Body Burden History DATE 24 Jan. 1980

for

Adult Male Bikini Residents

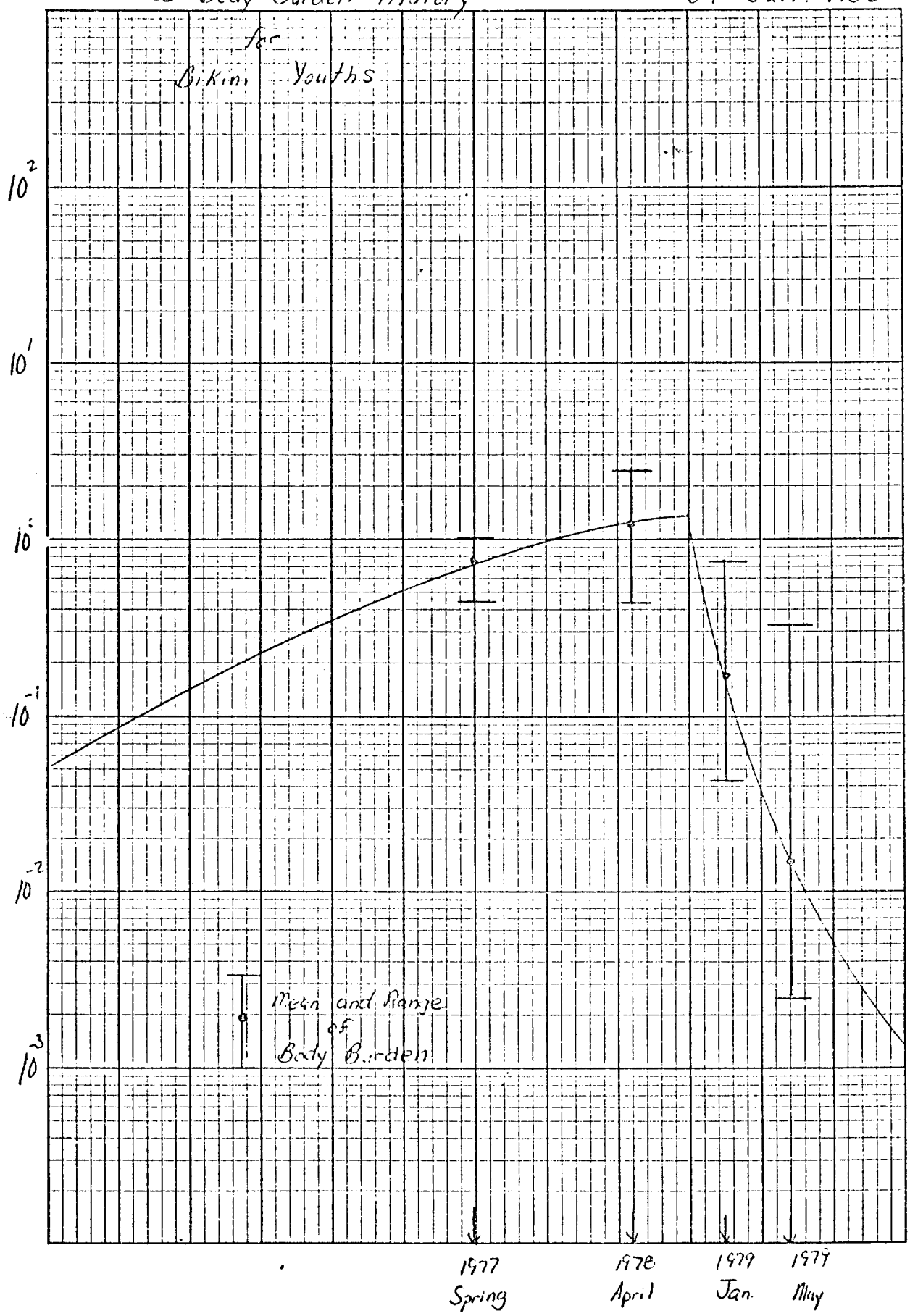


Body Burden, μ Ci

Body Burden, μCi
10^0
10^-1
10^-2
10^-3
Mean and Range of Body Burden
1974 Spring
1977 Spring
1978 April
1979 Jan.
1979 May

MODEL 137 Cs Body Burden History for Bikini Youths

DATE 24 Jan. 1980



Individual Dosimetry Data for Bikinians - Explanation of Column Headings

Column	Item or Derived Quantity	Measured Quantity	Comments
1	Name	-	Personal Interview
2	ID Number	-	BNL Medical Dept. & S&EP Div. Records
3	Residence Interval	-	Personal Interviews
4	^{90}Sr and ^{90}Y Bone Marrow Dose Equivalent During and Post Residence Interval	Urine Activity Concentration	Three Compartment Model, Constant Continuous Uptake
5	^{137}Cs + ^{137m}Ba Dose Equivalent During and Post Residence Interval	Body Burden Measurements	Two Compartment Model, Monotonically Increasing Uptake
6	Net External Dose Equivalent During Residence Interval	External Exposure Rate Measurements	Assumed Living Patterns
7	Total Body Dose Equivalent	-	Sum of Columns 5 and 6
8	Total Bone Marrow Dose Equivalent During and Post Residence Interval	-	Sum of Columns 4, 5 and 6

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS

me	ID Number	Residence Interval Years	age	^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	^{137}Cs + ^{137m}Ba Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
♂	6001	7.3	66	130*	480	950	1400	1600
♂	6127	7.3	13	39	580	950	1500	1600
♂	6130	.72	29	49	200	94	300	300
♂	6076	3.3	39	9.9	900	430	1300	1300
♂	813	4.3	23	77*	600	560	1200	1200
♂	6019	5.3	46	190	420	690	1100	1300
♀	6111	.80	32	7.7	150	100	250	260
♀	6097	4.3	19	51*	430	520	950	1000
♀	6115	7.3	43	97	760	880	1600	1700
♀	6109	4.3	15	51*	240	520	760	810

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

e	ID Number	Residence Interval Years	age	^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	^{137}Cs + ^{137m}Ba Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
♀	6091	6.3	13	74*	550	760	1300	1400
♂	6132	2.3	12	62	1200	300	1500	1600
♀	6046	2.0	43	27	400	240	600	700
♀	6061	6.3	32	65	630	760	1400	1500
♂	6066	3.3	32	59*	400	430	830	890
♂	6070	10.3	28	185*	870	1300	2200	2400
♂	6118	6.3	22	42	420	820	1200	1300
♂	6117	6.3	22	110*	610	820	1400	1500
♂	6128	7.3	31	130*	810	950	1800	1900
♀	6122	10.3	70	86	380	1200	1600	1700

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

Name	ID Number	Residence Interval Years		^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	$^{137}Cs + ^{137m}Ba$ Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
♂	6015	1.7	11	31*	650	220	870	900
♀	6030	3.3	10	39*	1200	400	1600	1600
♀	6129	4.3	13	51*	330	520	850	900
♀	6027	3.3	6	39*	760	400	1200	1200
♀	6010	7.3	8	86*	1100	900	2000	2100
♀	6105	3.3	5	39*	1100	400	1500	1500
♂	6033	8.3	27	150*	900	1100	2000	2100
♂	6007	.88	35	15	190	110	300	310
♂	6008	4.3	32	77*	850	560	1400	1500
♂	6071	1.0	32	18*	220	130	350	370

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

Name	ID Number	Residence Interval Years	age	^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	$^{137}Cs + {}^{137m}Ba$ Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
♂	863	4.3	27	120	620	600	1200	1300
♂	6086	8.3	46	240	990	1100	2100	2300
♂	6069	8.3	32	150*	580	1100	1700	1900
♂	6073	7.3	24	130*	490	950	1400	1600
♂	6072	1.0	20	18*	330	130	460	480
♂	6119	7.3	17	130*	730	930	1700	1800
♂	864	7.3	51	130*	960	950	1900	2000
♂	966	7.3	56	130*	1400	950	2300	2500
♀	6059	1.3	19	15*	240	160	400	410
♀	6124	.88	54	10*	180	110	390	400

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

Name	ID Number	Residence Interval Years	age	^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	$^{137}Cs + {}^{137m}Ba$ Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
♀	6058	5.3	18	63*	550	600	1200	1300
♀	6036	.64	27	7.6*	260	77	340	340
♀	6110	8.3	32	98*	450	1000	1400	1500
♀	6051	5.3	19	63*	520	600	1200	1200
♀	6092	6.3	8	74*	1600	800	2400	2400
♀	6080	.88	7	10*	200	110	310	320
♀	6038	2.3	6	27*	1100	280	1400	1400
♀	6103	3.3	9	39*	1200	400	1600	1600
♀	6028	5.3	7	63*	1200	600	1800	1900
♀	6044	5.3	6	63*	1600	800	2200	2300

INDIVIDUAL D

Name	ID Number	Residence Interval Years		^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	^{137}Cs Dose During Reside mR
♀	6062	4.3	21	51*	54
♀	6034	7.3	46	86*	88
♀	865	7.3	45	86*	43
♀	6050	2.3	22	27*	41
♂	6009	4.3	6	77*	160
♂	6049	2.3	8	41*	160
♂	6042	.55	7	10*	51
♂	6014	1.6	5	29*	130
♂	6012	7.3	7	130*	150
♂	6016	7.3	10	130*	150

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

Name	ID Number	Residence Interval Years		^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	^{137}Cs + ^{137m}Ba Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
♂	6013	2.3	5	41*	1300	300	1600	1600
♀	6094	6.3	10	74*	1300	800	2100	2200
♂	6005	1.8	38	12	470	230	700	710
♂	6135	1.3	35	11	330	170	500	510
♂	6125	9.3	35	45	890	1200	2100	2100
♂	6067	7.3	56	54	780	950	1700	1800
♂	6002	2.3	65	7.7	370	300	670	680
♂	6006	1.0	37	9.5	260	230	490	500
♀	6112	1.3	35	12	260	160	420	430
♀	6035	6.3	20	140	600	760	1400	1500

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

Name	ID Number	Residence Interval Years	Age	^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	^{137}Cs + ^{137m}Ba Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
♂	6096	3.3	48	46	680	430	1100	1100
♂	80	1.0	69	18*	200	130	330	350
♂	6017	8.3	49	330	1200	1100	2300	2700
♀	6045	1.0	28	9.0	150	120	270	280
♀	6108	4.3	24	43	210	520	730	770
♀	6063	4.3	24	19	620	520	1100	1100
♀	525	1.0	37	5.6	350	120	470	480
♀	934	6.3	43	120	1300	760	2100	2200
♂	6058	6.3	56	60	630	820	1500	1600
♀	6106	3.3	6	39*	750	400	1100	1200
♀	6025	3.3	5	39*	900	400	1300	1300

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

ID Number	Residence Interval Years	Age	^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	^{137}Cs + ^{137m}Ba Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Dose Equiv and Post Interval mR
6113	4.3	25	19	360	520	880	9
6060	2.3	22	27*	510	280	790	8
6032	3.3	32	39*	960	400	1400	14
6123	4.3	50	50*	480	520	1000	11
6098	3.3	16	39*	320	400	720	7
6065	4.3	19	130	390	520	910	10
6004	.55	28	10*	130	72	200	2
6018	6.3	34	150	1100	820	1900	21
6126	2.3	35	45	1100	300	1400	14
6003	8.3	22	250	580	1100	1700	19
6114	1.0	32	12*	170	120	290	3

INDIVIDUAL DOSIMETRY DATA FOR BIKINIANS (cont'd)

ne	ID Number	Residence Interval Years	Age	^{90}Sr & ^{90}Y Bone Marrow Dose Equiv. During & Post Residence Int. mRem	^{137}Cs + ^{137m}Ba Dose Equiv. During & Post Residence Int. mRem	Net External Dose Equiv. During Residence Interval mRem	Total Body Dose Equiv. During & Post Residence Int. mRem	Total Bone Marrow Dose Equiv. During and Post Residence Interval mRem
	6064	7.3	30	86*	400	900	1300	1400
♀	6023	4.3	8	77*	990	560	1500	1600
♂	6131	6.3	14	110*	950	820	1800	1900
♂	6011	6.3	11	170	550	820	1400	1600
♂	6081	.97	9	12*	490	120	610	620
♀	6133	7.3	11	130*	1900	950	2800	3000
♂	6048	.55	13	6.5*	590	72	660	670
♀								

*These values were derived from average male or average female daily activity ingestion rates for Sr-90.

Tot. 124,790

Body Burden Data for Medically Registered Adult Males Relocated from Bikini Atoll

Medical ID	Weight in Kilograms	Age (Yr)	Years on Bikini	1974[1] Potassium grams	1974[1] ^{137}Cs µCi	1974[1] ^{137}Cs kBq	1977[2] Potassium grams	1977[2] ^{137}Cs µCi	1977[2] ^{137}Cs kBq	1978 Potassium grams	1978 ^{60}Co nCi	1978 ^{60}Co Bq	1978 ^{137}Cs µCi	1978 ^{137}Cs kBq	January 1979 Potassium grams	January 1979 ^{60}Co nCi	January 1979 ^{60}Co Bq	January 1979 ^{137}Cs µCi	January 1979 ^{137}Cs kBq	May 1979 Potassium grams	May 1979 ^{60}Co nCi	May 1979 ^{60}Co Bq	May 1979 ^{137}Cs µCi	May 1979 ^{137}Cs kBq
80	61	69	0.75	-	-	-	-	-	-	97.6	1.42	53	1.14	42	-	-	-	-	-	133	MDL	MDL	0.12	4.4
6006	63	37	0.75	-	-	-	-	-	-	141	2.39	88	1.47	54	-	-	-	-	-	-	-	-	-	-
863	67	27	4	-	-	-	146	0.729	27	156	4.93	180	2.34	87	179	2.5	93	1.1	41	-	-	-	-	-
6070	85	28	10	170	0.093	3.4	167	1.51	56	152	8.17	300	3.92	150	137	3.0	111	1.6	59	-	-	-	-	-
6004	95	28	0.25	-	-	-	-	-	-	167	1.88	70	1.33	49	-	-	-	-	-	-	-	-	-	-
6033	79	27	6	148	0.095	3.5	136	1.52	56	132	8.65	320	3.84	160	-	-	-	-	-	-	-	-	-	-
6018	89	34	6	198	0.22	8.2	-	-	-	180	14.3	530	5.88	220	-	-	-	-	-	-	-	-	-	-
6069	61	32	8	-	-	-	-	-	-	132	4.01	150	1.17	43	-	-	-	-	-	166	2.0	74	0.38	14
6068	79	56	6	165	0.051	1.9	144	0.778	29	141	6.17	230	3.07	110	-	-	-	-	-	-	-	-	-	-
6067	74	56	7	-	-	-	-	-	-	151	5.91	220	2.99	110	137	2.4	89	1.0	37	169	1.2	44	0.63	23
6066	94	32	3	-	-	-	-	-	-	168	2.04	75	0.820	30	171	1.2	44	0.48	18	197	MDL	MDL	0.45	17
6017	80	49	8	-	-	-	-	-	-	153	13.9	510	5.72	210	-	-	-	-	-	165	1.5	56	0.52	19
6019	60	48	5	-	-	-	119	0.791	29	107	3.95	150	1.03	38	135	2.9	107	0.39	14	-	-	-	-	-
6001	85	66	7	143	0.078	2.9	-	-	-	126	3.33	120	1.73	64	132	1.9	70	0.77	28	-	-	-	-	-
6073	85	24	7	-	-	-	132	0.775	28	127	4.19	160	2.18	80	-	-	-	-	-	134	MDL	MDL	0.12	4.4
6005	70	58	1.5	-	-	-	-	-	-	133	3.40	130	2.08	77	-	-	-	-	-	177	1.1	41	0.16	5.7
6008	55	32	4	-	-	-	153	1.98	74	125	5.00	190	1.94	72	148	3.2	118	1.3	48	-	-	-	-	-
6086	78	46	8	170	0.17	6.2	149	2.14	79	151	7.92	290	3.51	130	179	2.8	104	0.86	32	161	1.9	70	0.40	15
6071	78	32	0.75	-	-	-	-	-	-	136	2.26	84	1.72	64	136	1.2	44	0.93	34	-	-	-	-	-
6076	69	39	3	-	-	-	-	-	-	163	6.64	250	3.44	130	171	2.9	107	2.4	89	-	-	-	-	-
6072	55	20	0.67	-	-	-	-	-	-	128	2.96	110	1.75	65	-	-	-	-	-	-	-	-	-	-
813	58	23	4	-	-	-	143	0.935	37	138	3.65	140	1.69	62	154	1.8	67	0.61	23	-	-	-	-	-
6118	55	22	6	126	0.77	2.9	-	-	-	108	1.92	71	0.631	23	144	1.6	59	0.75	28	126	0.90	33	0.41	15
6126	55	35	2	-	-	-	149	2.21	82	137	7.79	290	3.30	120	-	-	-	-	-	-	-	-	-	-
6003	77	22	8	168	0.076	2.8	161	0.923	34	139	5.60	210	2.44	90	-	-	-	-	-	-	-	-	-	-
6117	80	22	6	-	-	-	159	1.15	43	148	6.09	230	2.68	99	172	2.9	107	0.90	33	168	1.5	56	0.44	16
6123	52	31	7	-	-	-	149	1.29	48	119	4.79	180	1.85	69	153	2.7	100	0.92	34	-	-	-	-	-
6125	64	35	9	159	0.10	3.8	150	1.54	57	144	5.65	210	2.52	93	-	-	-	-	-	164	2.0	74	0.33	12
6007	82	35	0.58	-	-	-	-	-	-	127	2.58	95	1.49	55	144	0.67	25	0.32	12	-	-	-	-	-
6130	69	29	0.42	-	-	-	-	-	-	143	2.20	81	1.46	54	156	1.5	56	1.5	56	134	MDL	MDL	0.97	36
																				-	-	-	-	-

Body Burden Data for Medically Registered Adult Males Relocated from Bikini Atoll (Cont'd)

Medical ID	Weight in Kilograms	Age (Yr)	Years on Bikini	1974[1] Potassium grams	1974[1] ^{137}Cs µCi	1974[1] ^{137}Cs kBq	1977[2] Potassium grams	1977[2] ^{137}Cs µCi	1977[2] ^{137}Cs kBq	1978 Potassium grams	1978 ^{60}Co nCi	1978 ^{60}Co Bq	1978 ^{137}Cs µCi	1978 ^{137}Cs kBq	January 1979 Potassium grams	January 1979 ^{60}Co nCi	January 1979 ^{60}Co Bq	January 1979 ^{137}Cs µCi	January 1979 ^{137}Cs kBq	May 1979 Potassium grams	May 1979 ^{60}Co nCi	May 1979 ^{60}Co Bq	May 1979 ^{137}Cs µCi	May 1979 ^{137}Cs kBq
6119	54	17	7	-	-	-	138	0.641	24	124	4.58	170	2.13	79	-	-	-	-	-	-	-	-	-	-
864	90	51	7	163	0.29	11	133	3.23	120	136	5.99	220	3.05	110	-	-	-	-	-	-	-	-	-	-
966	75	56	7	-	-	-	152	2.22	82	174	14.8	550	5.71	210	-	-	-	-	-	149	2.5	93	0.48	18
6135	81	35	1	-	-	-	-	-	-	142	3.30	120	2.12	78	-	-	-	-	-	-	-	-	-	-
6096	66	48	3	-	-	-	145	1.93	64	146	4.32	160	1.91	71	146	2.5	93	1.3	48	156	0.9	33	0.70	26
6002	66	65	2	-	-	-	130	1.04	38	116	2.21	82	1.26	46	-	-	-	-	-	-	-	-	-	-
6161[3,4]	64	34	5	130	0.081	3.0	-	-	-	-	-	-	-	-	142	MDL	MDL	.109	4.0	126	MDL	MDL	0.048	1.8
6166[3,4]	64	58	7	150	0.072	2.7	-	-	-	-	-	-	-	-	146	MDL	MDL	0.023	0.85	146	MDL	MDL	0.011	0.41
6184[4]	50	59	5	160	0.043	1.6	-	-	-	-	-	-	-	-	130	MDL	MDL	0.067	2.5	144	MDL	MDL	0.025	0.93
6210[4]	85	35	10	156	0.124	4.6	0.74	27	-	-	-	-	-	-	-	-	-	-	-	160	MDL	MDL	0.290	11

[1] ∞ 75

[2] ∞ 77

[3] Individuals left Bikini Atoll 8 months prior to the August 1975 Relocation Program.

[4] Individuals received sick call medical care prior to April 1978 but were not officially registered.

Body Burden Data

Medical ID	Weight in Kilograms	Years on Bikini	Age (Yr)	1974[1] Potassium grams	1974[1] ^{137}Cs µCi	1974[1] ^{137}Cs kBq	1977[2] Potassium grams	1977[2] ^{137}Cs µCi	1977[2] ^{137}Cs kBq
6045	83	0.75	28	-	-	-	-	-	-
6112	90	1	35	-	-	-	-	-	-
6114	54	0.75	32	-	-	-	-	-	-
6111	84	0.5	32	-	-	-	-	-	-
6122	73	10	70	94	0.033	1.2	-	-	-
6123	77	4	50	-	-	-	107	1.53	5
6059	45	1	19	-	-	-	-	-	-
6063	49	4	24	-	-	-	89.6	0.799	3
6032	63	3	32	-	-	-	96.4	1.88	7
6124	53	0.58	54	-	-	-	-	-	-
6109	86	4	24	94	0.029	1.1	98.0	0.705	2
6058	66	5	18	106	0.077	2.9	88.6	0.690	2
6113	54	4	25	-	-	-	91.7	0.534	2
6065	52	4	19	-	-	-	101	0.734	2
6097	53	4	19	86	0.036	1.3	88.9	0.488	1
6109	30	4	15	-	-	-	110	0.521	2
6046	85	1.75	43	-	-	-	94.3	0.803	3
6098	60	3	16	-	-	-	91.8	0.706	2
6060	55	2	22	-	-	-	-	-	-
6035	56	0.34	27	-	-	-	-	-	-
6110	77	8	32	111	0.11	4.0	-	-	-
325	76	0.75	37	-	-	-	-	-	-
6064	60	7	30	-	-	-	-	-	-
6061	65	6	32	-	-	-	-	-	-
6051	50	5	19	-	-	-	95.9	0.545	2
934	74	6	43	-	-	-	98.8	2.23	8
6052	54	4	21	-	-	-	96.8	0.840	3
6033	77	6	20	-	-	-	110	0.573	2
6115	56	7	43	95	0.058	2.2	85.9	1.13	4
6034	76	7	46	102	0.12	4.3	93.7	0.835	3
865	54	7	45	59	0.018	0.67	89.4	0.550	2
6050	62	2	22	-	-	-	112	1.14	4
6157[3,4]	69	7	59	89	0.030	1.1	-	-	-
6158[3,4]	111	4	27	124	0.073	2.7	-	-	-
6148[3]	94	3	42	60	0.018	0.67	-	-	-
6163[3,5]	84	-	33	-	-	-	102	0.570	2
6151[3]	82	2	31	-	-	-	102	0.871	3

1 CO 75
2 CO 77
3 Individuals received sick cell medical care prior to April 1978 but
4 Individuals left Bikini Atoll 8 months prior to the August 1978 Re
5 Individuals left Bikini Atoll 14 months prior to the August 1978 Re

Body Burden Data for Medically Registered Adolescents Relocated from Bikini Atoll

Medical ID	Weight kilograms	Years on Bikini	AGE (Yr)	1977 Potassium gram	1977 ^{137}Cs µCi	1977 ^{137}Cs kBq	1978 Potassium Grams	1978 ^{60}Co nCi	1978 ^{60}Co Bq	1978 ^{137}Cs µCi	1978 ^{137}Cs kBq	January 1979 Potassium grams	January 1979 ^{60}Co nCi	January 1979 ^{60}Co Bq	January 1979 ^{137}Cs µCi	January 1979 ^{137}Cs kBq	May 1979 Potassium grams	May 1979 ^{60}Co nCi	May 1979 ^{60}Co Bq	May 1979 ^{137}Cs µCi	May 1979 ^{137}Cs kBq
Males																					
6147	36	4.5	12	84	0.959	36	-	-	-	-	-	53	MDL	MDL	0.204	7.6	94	MDL	MDL	0.075	2.8
6132	33	2	12	-	-	-	58	3.45	130	1.85	68	-	-	-	-	-	-	-	-	-	-
6131	38	6	14	96	1.33	49	69	3.40	130	1.69	63	108	2.1	78	0.76	28	133	1.4	52	0.32	12
6011	40	6	11	-	-	-	53	1.34	50	0.830	31	59	1.0	37	0.055	2.0	74	MDL	MDL	0.017	0.6
6127	32	7	13	91	0.824	31	53	2.17	80	0.732	27	95	2.0	74	0.21	7.8	60	MDL	MDL	0.053	2.0
6133	27	7	11	-	-	-	53	3.42	130	2.09	78	-	-	-	-	-	55	1.0	37	0.027	0.8
6015	29	1.42	11	-	-	-	57	1.18	44	1.28	47	37	MDL	MDL	0.071	2.6	60	MDL	MDL	0.0	0.6
Females																					
6129	48	4	13	91	0.682	25	69	1.32	49	.744	28	73	1.2	44	0.27	10	89	MDL	MDL	0.076	2.8
6048	40	0.25	13	-	-	-	70	2.61	96	2.05	76	-	-	-	-	-	121	MDL	MDL	0.074	2.7
6091	43	6	13	-	-	-	69	2.20	82	1.17	43	103	1.4	52	0.15	5.6	86	MDL	MDL	0.037	1.4

Body Burden Data for Medically Registered Children Relocated from Bikini Atoll

Medical ID	Weight kilograms	Years on Bikini	AGE (Yr)	Potassium Grams	1978 ^{60}Co nCi	^{60}Co Bq	^{137}Cs µCi	^{137}Cs kBq	Potassium grams	January 1979 ^{60}Co nCi	^{60}Co Bq	^{137}Cs µCi	^{137}Cs kBq	Potassium grams	May 1979 ^{60}Co nCi	^{60}Co Bq	^{137}Cs µCi	^{137}Cs Bq
Males																		
6009	20	4	6	36	0.98	36	1.26	47	-	-	-	-	-	59	MDL	MDL	0.007	0.26
6049	23	2	8	47	2.7	99	1.71	63	-	-	-	-	-	-	-	-	-	-
6042	23	0.25	7	43	1.0	38	1.07	39	-	-	-	-	-	-	-	-	-	-
6014	20	1.34	5	41	1.7	64	1.50	56	-	-	-	-	-	69	MDL	MDL	0.012	0.44
6012	24	7	7	41	1.7	63	1.27	47	-	-	-	-	-	63	MDL	MDL	0.022	0.81
6023	28	4	8	52	1.7	62	1.28	47	43	0.91	34	0.16	5.9	-	-	-	-	-
6016	27	7	10	53	2.5	93	1.43	53	-	-	-	-	-	51	1.3	48	0.039	1.4
6013	18	2	5	33	1.3	50	1.00	37	-	-	-	-	-	-	-	-	-	-
Females																		
6094	34	6	10	51	2.3	86	2.02	75	-	-	-	-	-	-	-	-	-	-
6092	29	6	8	52	2.8	100	2.25	83	-	-	-	-	-	-	-	-	-	-
6080	34	0.58	7	50	MDL	MDL	0.543	20	-	-	-	-	-	-	-	-	-	-
6010	29	7	8	56	1.8	67	1.41	52	50	MDL	MDL	0.17	6.3	-	-	-	-	-
6038	21	2	6	42	1.3	47	1.00	37	-	-	-	-	-	-	-	-	-	-
6105	22	3	5	31	1.2	43	0.967	36	65	MDL	MDL	0.053	2.0	29	1.0	37	0.0074	0.27
6103	-	3	9	43	1.6	58	1.40	52	-	-	-	-	-	-	-	-	-	-
6028	25	5	7	52	1.4	51	1.26	47	-	-	-	-	-	49	1.0	37	0.015	0.6
6030	34	3	10	58	3.0	110	2.38	88	34	MDL	MDL	0.26	9.6	70	MDL	MDL	0.064	2.4
6027	22	3	6	36	5.6	210	1.16	43	58	MDL	MDL	0.042	1.6	-	-	-	-	-
6044	18	5	6	35	6.4	240	1.15	43	-	-	-	-	-	34	MDL	MDL	0.0062	0.23
6025	21	3	5	44	0.97	36	1.03	38	45	MDL	MDL	0.13	4.8	67	MDL	MDL	0.028	1.0
6031	26	0.67	9	49	MDL	MDL	1.02	38	-	-	-	-	-	-	-	-	-	-
6106	22	3	6	32	MDL	MDL	0.622	23	37	MDL	MDL	0.077	2.9	44	MDL	MDL	0.013	0.48

Body Burden Data for Medically Registered Children Relocated from Bikini Atoll

ID #	Name	Sex	Age (yr)	Height (cm)	Weight (kg)	Yrs On Bikini	Yrs Off Bikini	January 1979 ^{137}Cs Result nCi	January 1979 ^{137}Cs Result kBq	January 1979 Potassium Result Grams	May 1979 ^{137}Cs Result nCi	May 1979 ^{137}Cs Result kBq	May 1979 Potassium Result Grams
6031	*	M	5	105	20	3	.70	—	—	--	2.8	0.10	35
6029		M	6	112	20	5	.70	--	--	--	4.7	0.17	25
6100	*	M	5	99	17	4.3	.70	--	--	--	15	0.56	24
6021	*	M	5	103	19	4.3	illegible	46	1.7	NC	6.2	0.23	51
6020		M	6	107	20	2	illegible	56	2.1	72	7.4	0.27	37
6107	*	M	5	96	15	4.3	illegible	16	0.59	46	2.6	0.096	40
6074	*	M	5	104	20	4.3	illegible	9.0	0.33	34	MDL	MDL	25
6078	*	F	5	99	17	—	0.40	3.0	0.11	28	—	--	--
6088	*	F	5	95	15	4.3	illegible	—	--	—	3.0	0.11	33
6090		F	6	108	25	5	.70	--	--	--	4.9	0.18	31
6101		F	6	104	19	5.3	illegible	51	1.9	12	6.9	0.26	15
6056	*	F	6	100	17	4.3	illegible	46	1.7	NC	7.4	0.27	49
6057		F	7	107	26	1	.72	—	--	--	5.8	0.22	66

*Indicates children were 4 yrs or less April, 1978

NC = Not Calculated

Body Burden Data for Non-Medically Registered Adult Male Prior Residents of Bikini Atoll

ID #	Name	Sex	Age (yr)	Height (cm)	Weight (kg)	Yrs on Bikini	Yrs off Bikini	May 1979 ^{137}Cs Result nCi	kBq	May 1979 Potassium Result Grams
6190		M	19	166	57	0.25	2	6.0	0.22	161
6205		M	42	170	81	4	4.5	MDL	MDL	159
6211		M	19	163	55	1	3	MDL	MDL	134
6218		M	56	158	72	2	10	MDL	MDL	169
6219		M	30	173	60	2	9	MDL	MDL	143
6220		M	26	166	66	2	9	MDL	MDL	165
6221		M	53	175	82	2	9	4.2	0.16	139
6223		M	66	152	65	2 days May 14, 15, 1979	.016	99	3.7	127
6224		M	45	158	55	2 days May 14, 15, 1979	.016	120	4.4	146
6226		M	18	164	58	2 yr	3	MDL	MDL	137

Body Burden Data for Non-Medically Registered Adult Male Prior Residents of Bikini Atoll

ID #	Name	Sex	Age (yr)	Height (cm)	Weight (kg)	Yrs. On Bikini	Yrs. Off Bikini	January 1979 ^{137}Cs Result nCi	kBq	January 1979 Potassium Result Gram	May 1979 ^{137}Cs Result nCi	kBq	May 1979 Potassium Result Gram
6136		M	48	150	58		4	8.5	0.31	144	—	—	—
6138		M	20	163	57		3	2.8	0.10	165	—	—	—
6153		M	23	180	65	1	1.42	5.8	0.21	170	5.4	0.20	146
6168		M	16	150	44	7	1.0	2.4	0.089	101	MDL	MDL	100
6174		M	52	174	84		6	17	0.63	158	—	—	—
6180		M	22	173	67	4	1	34	1.3	141	—	—	—
6182		M	18	161	53	6	0.42	1220	45	122	620	23	131

Body Burden Data of Non-Medically Registered Adult Female Prior Residents of Bikini Atoll

ID #	Name	Sex	Age (yr)	Height (cm)	Weight (kg)	Yrs. On Bikini	Yrs. Off Bikini	January 1979 ^{137}Cs Result nCi	January 1979 ^{137}Cs Result kBq	January 1979 Potassium Result Gram	May 1979 ^{137}Cs Result nCi	May 1979 ^{137}Cs Result kBq	May 1979 Potassium Result Gram
6137		F	38	161	64	0.33	4	3.8	0.14	113	1.7	0.063	112
6139		F	22	140	38	—	3	2.1	0.078	89	—	—	—
6140		F	16	146	46	0.17	0.42	27	1.0	94	8.6	0.32	94
6144		F	21	150	44	1	0.42	37	1.4	105	13	0.48	89
6152		F	20	157	59	1	1.42	2.4	0.089	123	3.9	0.14	117
6155		F	24	155	66	6	0.42	390	15	120	150	5.6	96
6160		F	65	153	55	6	0.67	360	13	67	140	5.1	87
6165		F	36	142	60	—	1.5	6.6	0.24	76	—	—	—
6175		F	24	155	63	—	—	11	0.41	90	5.2	0.19	92
6181		F	44	151	53	4	1	8.5	0.31	105	4.6	0.17	105
6185		F	21	144	41	3	2.5	2.7	0.10	74	3.4	0.13	79

Body Burden Data of Non-Medically Registered Adult Female Prior Residents of Bikini Atoll

ID #	Name	Sex	Age (yr)	Height (cm)	Weight (kg)	Yrs on Bikini	Yrs off Bikini	May 1979 ^{137}Cs Result nCi	kBq	May 1979 Potassium Result Gram
6187		F	21	152	54	0.019	1	1.6	0.059	107
6189		F	21	155	—	2.5	1	1.9	0.070	114
6205		F	32	151	73	3	5.5	MDL	MDL	116
6222		F	39	156	66	2.5	3	MDL	MDL	98

Body Burden Data for Non-Medically Registered Adolescents and Children Prior Residents of Bikini Atoll

ID #	Name	Sex	Age (yr)	Height (cm)	Weight (kg)	Yrs. On Bikini	Yrs. Off Bikini	January 1979 ^{137}Cs Result nCi	January 1979 ^{137}Cs Result kBq	January 1979 Potassium Result Gram	May 1979 ^{137}Cs Result nCi	May 1979 ^{137}Cs Result kBq	May 1979 Potassium Result Gram
6156		M	9	130	34	6	1.0	2.0	0.074	53	3.4	0.13	59
6164		M	5	85	15	—	1.5	8.0	0.30	40	—	--	--
6169		M	14	167	45	7	1.0	1.2	0.044	108	MDL	MDL	120
6172		M	10	130	30	7	1.0	2.8	0.10	49	1.9	0.070	74
6178		M	12	157	33	4	1.0	2.0	0.074	46	1.7	0.062	70
6183		M	12	139	35	--	1.67	1.0	0.037	36	MDL	MDL	74
6179		F	8	115	22	4	1	1.2	0.044	MDL	MDL	MDL	59
6177		F	6	103	18	—	6	MDL	MDL	MDL	MDL	MDL	36
6176		F	8	144	24	—	6	MDL	MDL	MDL	MDL	MDL	38
6173		F	13	142	47	3	0.42	4.0	0.15	53	MDL	MDL	48
6171		F	6	96	15	2.67	1.0	4.0	0.15	16	1.1	0.041	47
6170		F	13	140	45	7	1.0	2.8	0.10	58	1.8	0.067	77
6162		F	12	147	50	—	1.5	5.0	0.19	35	--	--	—
6157		F	5	106	20	4	1.0	7.2	0.27	32	MDL	MDL	54
6158		F	6	103	20	4	1.0	3.5	0.13	32	1.2	0.044	46
6150		F	8	120	25	4	0.42	4.0	0.15	42	1.5	0.056	40
6149		F	5	99	19	4.3	0.42	1.6	0.059	37	MDL	MDL	32

Body Dur

ID #	
6200	
6202	
6207	
6208	
6225	
6203	
6204	
6212	
6213	
6217	

Body Burden Data for Non-Medically Registered Adolescents and Children Never on Bikini Island

ID #	Name	Sex	Age (yr)	Height (cm)	Weight (kg)	January 1979 ^{137}Cs Result nCi	January 1979 ^{137}Cs Result kBq	January 1979 Potassium Result Gram	May 1979 ^{137}Cs Result nCi	May 1979 ^{137}Cs Result kBq	May 1979 Potassium Result Gram
6141		F	12	138	33	2.7	0.10	63	1.5	0.056	112
6142		F	10	126	26	2.3	0.085	52	1.0	0.037	72
6143		F	4	104	19	1.2	0.044	41	MDL	MDL	35
6145		M	5	110	21	1.0	0.037	46	—	—	—
6186		M	5	104	20	—	—	—	MDL	MDL	22
6188		F	14	146	49	—	—	—	2.9	0.11	107
6191		F	6	113	23	—	—	—	1.1	0.041	61

Medically Registered Relocated Bikini Atoll Residents

Not Whole Body Counted Since 1978

ID #	Age	Name	Sex	Location
6132	12		M	Kili
6049	8		M	Kili
6042	7		M	Jaluit
6013	5		M	Kili
6094	10		F	Wotje
6092	8		F	Wotje
6080	7		F	Kili
6038	6		F	Kili
6103	9		F	Maloelap
6081	9		F	Majuro, Ejit
6006	37		M	Kwajalein, Ebeye
6004	28		M	Jaluit
6033	27		M	Majuro
6018	34		M	Wotje
6068	56		M	Majuro
6072	20		M	Kili
6126	35		M	Kili
6003	22		M	Enewetak
6119	17		M	Majuro
864	51		M	Majuro, Ejit
6135	35		M	Lib
6002	65		M	Kili
6045	28		F	Kwajalein, Ebeye

Medically Registered Relocated Bikini Atoll Residents

Not Whole Body Counted Since 1978

(Cont'd)

ID #	Age	Name	Sex	Location
6059	19		F	Kili
6124	54		F	Kili
6058	18		F	Majuro, Ejit
6036	27		F	Jaluit (Rongelap)
6061	32		F	Wotje
6050	22		F	Kili

Total Missed = 30

DOSIMETRIC RESULTS FOR THE BIKINI POPULATION

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During the mid 1940's through 1958, the United States conducted high yield weapons tests at Bikini and Enewetak Atolls. These areas were contaminated with fallout from the tests. A restoration program, concentrating on the main residence islands of Bikini and Eneu Islands at Bikini Atoll, began in 1969. Approximately thirty Trust Territory residents including some former Bikini Atoll inhabitants participated in the initial cleanup and redevelopment of the Atoll. During subsequent years, the Bikini population increased to some 140 individuals at the time of their departure in August 1978.

Between 1969 and 1974, scrub vegetation on Bikini and Eneu Islands was cleared and indigenous food crops were planted. These crops consisted mainly of coconut, pandanus and breadfruit trees but included a garden development where squash, papaya, bananas and other crops were grown (RO 77). During the maturation interval for most of the tree crops (5-7 years), the majority of the food consumed on Bikini Island was imported by Trust Territory supply vessels. As the local vegetation developed, the diet became less restricted to imported foods so that by 1978, the diet contained substantial quantities of locally grown items.

[redacted]

sessment of dose to the Bikini population from chronic exposure to im-
portant fallout radionuclides in their home atoll environment.

Results

In the following tables, the dose equivalent during the residency interval and dose equivalent commitments to bone, bone marrow and the total body are presented. The mean for the dose equivalent and dose equivalent commitment was determined from individual data points which represent a wide distribution of residence intervals. The mean value corresponds to the mean residence interval (years) for the population described. Residence intervals were determined through verbal interrogation of participants in the personnel monitoring program.

Table 3 depicts the external dose equivalent resulting from living on Bikini Island. The dose equivalent during the residency interval varies for subgroups within the population according to the assumed living pattern selected. Since these values were obtained from ion chamber measurements and hypothetical living patterns, no range of results has been provided. In this report, one Roentgen is assumed equal to one Rem.

Table 4 presents the average whole body doses due to the ingestion of ^{137}Cs. Data were derived from whole body counting measurments made in 1974, 1977 and 1978. Constant continuous uptake of ^{137}Cs in the diet was not assumed. For these calculations, the uptake period was divided into three intervals during which the ^{137}Cs activity ingestion rate for a given interval remained constant, but increased stepwise with time to account for observed increases in ^{137}Cs body burdens.

Table 5 summarizes the total body dose equivalent during the residency period from internal ^{137}Cs and man-made external radiation, and the total body dose equivalent commitment upon departure from Bikini Atoll in August 1978. A standard deviation for these quanti-

TABLE 2

^{90}Sr-^{90}Y Bone Marrow Dosimetric Averages for Bikinans

Population Description	Number of Persons	Mean Residence Interval, Years	Dose Equivalent During Residence Interval, mRem			Dose Equivalent Commitment, mRem		
				Range			Range	
			Mean	High	Low	Mean	High	Low
Adult males	19	4.2	27	120	.57	61	210	6.7
Adult females	15	4.1	14	41	.34	38	98	5.3
Male children (11-15 years of age)	3	5.3	47	120	13	120	290	26

scintillation survey meters to map the external radiation fields, a portable gamma spectroscopy system to define the major energy components of the external field and to determine energy dependence correction factors for the ion chamber, and LiF thermoluminescent dosimeters to measure long term integral exposures. External exposure estimates were developed based on these measurements and an assumed living pattern (GU 76, GR 79).

Urine samples for radionuclide bioassay were collected during BNL medical field trips to Bikini between 1970 and 1976 (CO 75, unpublished results). This program was reinstated by BNL Safety and Environmental Protection Division in 1978 with systematic 24 hour urine collections from all adult Bikinians. Urine bioassay results were used to calculate ^{90}Sr- ^{90}Y and ^{137}Cs- ^{137m}Ba body burdens and resultant radiation dose equivalents for all Bikinians from whom a satisfactory urine sample was obtained.

Whole body counting was performed in 1974 and 1977 by the BNL Medical Department (CO 75, CO 77), and the program continued in 1978

gimes for the uptake, retention and excretion of internally deposited radionuclides. Finally, dosimetric models which allow for constant continuous uptake of ^{90}Sr and stepwise increasing uptake for ^{137}Cs were chosen to determine the internal dose equivalent and dose equivalent commitment for all inhabitants. Thus for residence periods between the years 1969 and 1978, these figures evince a maximally exposed person receiving a whole body dose equivalent and commitment of 3 rem, and a population average dose equivalent and commitment of 1.2 rem from man-made radioactivity on Bikini Island.

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TABLE 1

^{90}Sr-^{90}Y Bone Dosimetric Averages for Bikinians

Population Description	Number of Persons	Mean Residence Interval, Years	Dose Equivalent During Residence Interval, mRem			Dose Equivalent Commitment, mRem		
				Range			Range	
			Mean	High	Low	Mean	High	Low
Adult males	19	4.2	28	120	.59	68	230	7.3
Adult females	15	4.1	15	42	.35	42	110	5.8
Male children (11-15 years of age)	3	5.3	47	120	13	130	310	29

REFERENCES

CO 75 Conard, Robert, A., et al., 1975, A Twenty Year Review of Medical Findings in a Marshallese Population Accidentally Exposed to Radioactive Fallout, BNL 50424 (Brookhaven National Laboratory, Upton, New York).

CO 77 Personal Communications with S. Cohn, Medical Department, Brookhaven National Laboratory.

GR 79 Greenhouse, N. A., Miltenberger, R. P., Lessard, E. T., External Exposure Measurements at Bikini Atoll, BNL 51003 (Brookhaven National Laboratory, Upton, New York).

GU 76 Gudiksen, P. H., Crites, T. R. and Robison, W. L., 1976 External Dose Estimates for Future Bikini Atoll Inhabitants, UCRL-51879, Rev. 1, (Lawrence Livermore Laboratory, Livermore, California).

MI 79 Miltenberger, R. P., Greenhouse, N. A. and Lessard, E. T., Whole Body Counting Results from 1974 to 1979 for Bikini Island Residendents, Health Physics Journal, in press.

RO 77 Robison, W. L., Phillips, W. A. and Colsher, C. S., 1977, "Dose Assessment at Bikini Atoll: UCRL-51879, Part 5, (Lawrence Livermore Laboratory, California).

TABLE 3

External Total Body Dosimetric Average for Bikinians

Population Description	Number of Persons	Mean Residence Interval, Years	Dose Equivalent During Residence Interval, mRem
			Mean
Adult males	17	4.9	600
Adult females	16	4.3	500
Children (5-14 years)	12	4.4	500

TABLE 4

^{137}Cs-^{137m}Ba Total Body Dosimetric Averages for Bikinians

Population Description	Number of Persons	Mean Residence Interval, Years	Dose Equivalent During Residence Interval, mRem			Dose Equivalent Commitment, mRem		
			Mean	Range High	Range Low	Mean	Range High	Range Low
Adult males	17	4.9	470	810	120	110	200	43
Adult females	16	4.3	330	770	91	85	190	29
Children (5-14 years of age)	12	4.4	670	920	270	140	270	57

TABLE 5

Total Body Dosimetric Average for External
Plus Internal Sources for Former Bikini Residents

Population Description	Number of Persons	Mean Residence Interval, Years	Dose Equivalent During Residence Interval, mRem	Dose Equivalent Commitment, mRem
Adult males	17	4.9	1100	110
Adult females	16	4.3	830	85
Children (5-14 years)	12	4.4	1200	140

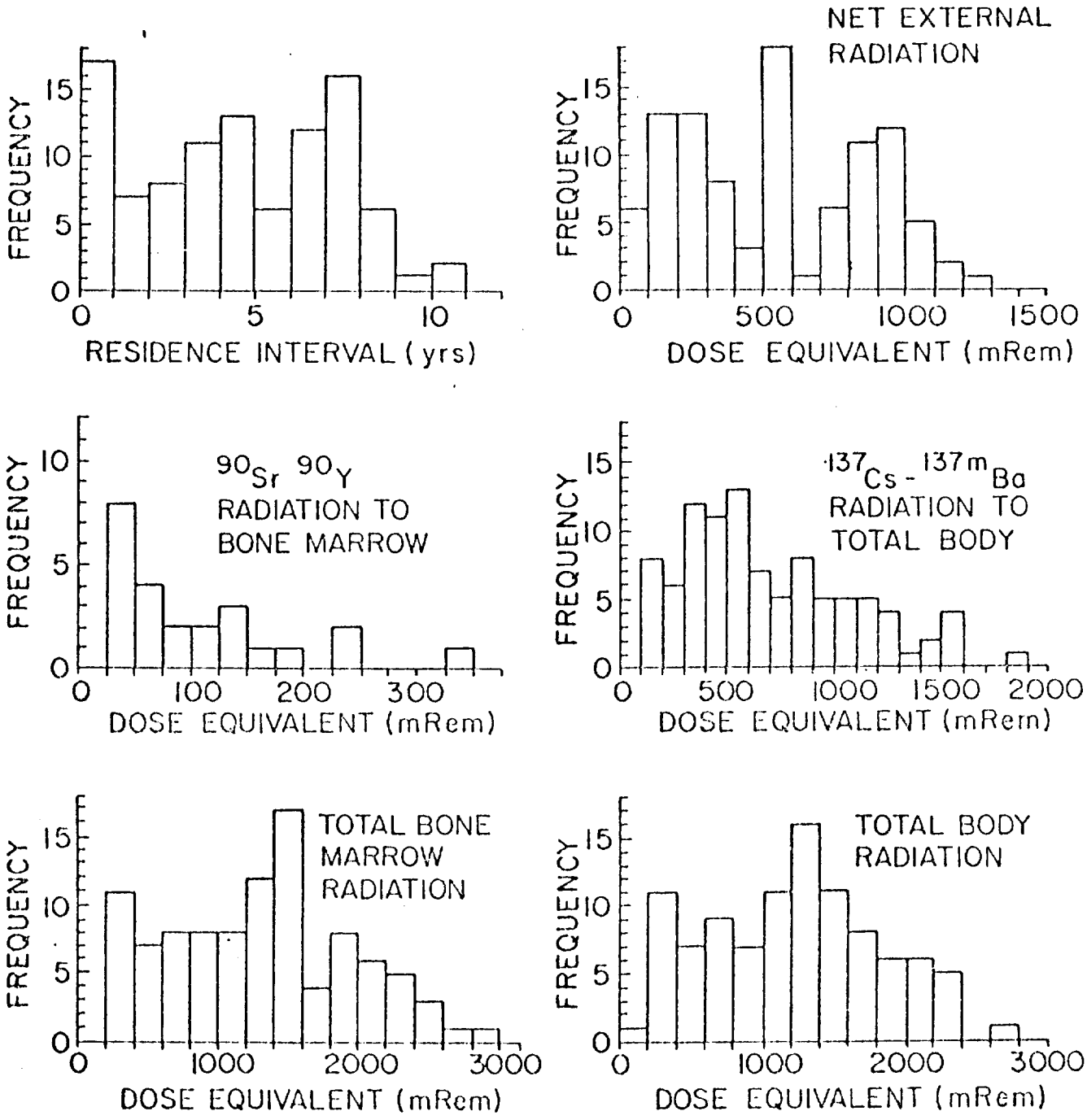

Fig. I. TOTAL MALE AND FEMALE DISTRIBUTION OF DOSE EQUIVALENT (DURING AND POST RESIDENCE) OR RESIDENCE INTERVAL FOR INHABITANTS OF BIKINI ISLAND, BIKINI ATOLL

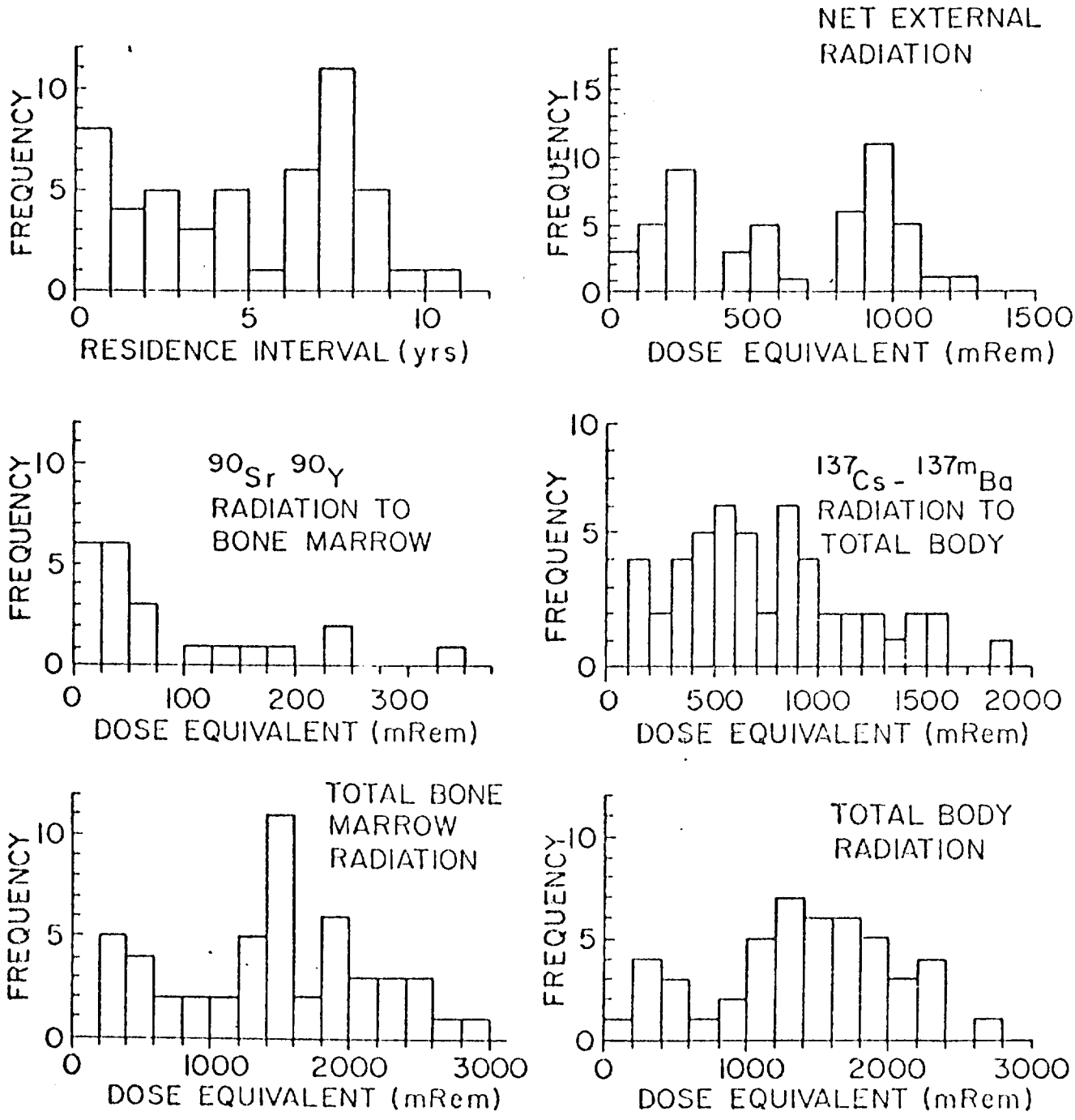

Fig. 2. TOTAL MALE DISTRIBUTION OF DOSE EQUIVALENT (DURING AND POST RESIDENCE) OR RESIDENCE INTERVAL FOR INHABITANTS OF BIKINI ISLAND, BIKINI ATOLL

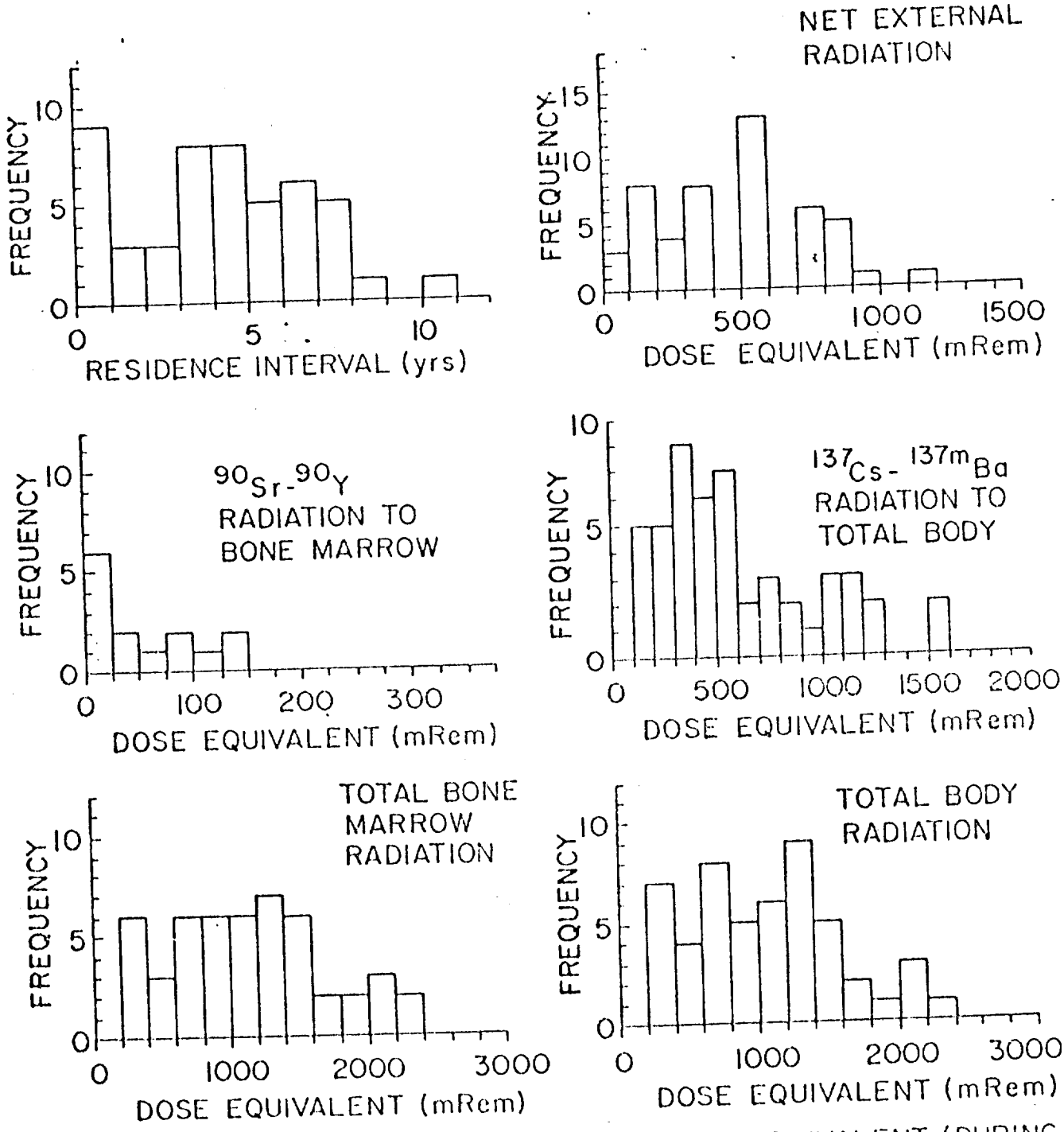

Fig.3. TOTAL FEMALE DISTRIBUTION OF DOSE EQUIVALENT (DURING AND POST RESIDENCE) OR RESIDENCE INTERVAL FOR INHABITANTS OF BIKINI ISLAND, BIKINI ATOLL

REPOSITORY PNNL

COLLECTION Marshall Islands

BOX No. 5684

FOLDER Bikini - 1981

DOCUMENT **DOES NOT** CONTAIN ECI

Reviewed by P K Schuette Date 4/30/97