PRIVACY ACT MATERIAL REMOVED

401180 1 June 1979

MEMORANDUM FOR THE RECORD

Subj: USS RENSHAW (DDE-499) Visit to the Atoll of LIKIEP 5-6 March 1954

Ref : (a) Phonecon from Gordon Facer, DOE, on 22 May 79, regarding the New Marshallese Government's request for information about a Navy ship reported to have been at the Atoll of LIKIEP in early March 1954

Encl: (1) Deck Log entries 5-6 March 1954 for the USS RENSHAW (DDE-499)
(2) Document concerning Long Term Activity Estimates for the Northern Marshall Islands

1. Reference (a) indicates that the New Marshallese Government is attempting to locate any measurements or pictures that may have been taken at the Atoll of LIKIEP several days after the detonation of Operation CASTLE, Shot BRAVO in early March 1954. Their interest has focused on a Navy ship that is reported to have arrived at the atoll, unloaded instruments, and taken some pictures at that time.

2. The deck log of the USS RENSHAW (DDE-499) for Friday 5 March 1954 indicates that the ship arrived at the Atoll of LIKIEP that evening. The log makes no mention of off-loading instrumentation or of taking any pictures. Other entries indicate that a landing party departed for LIKIEP Island at 0705 on Saturday 6 Mar 1954 and returned to the ship at 0937 that morning. The RENSHAW departed the Atoll of LIKIEP at 1133 on 6 March 1954. Copies of these entries are included as enclosure (1).

3. The log of the RENSHAW does not make mention that she had any scientific personnel on board or that she was involved in any special survey operations. It is, of course, possible that when the landing party went ashore, some type of instrumentation might have been taken along. None of the currently available data, however, provides any information on the results of such measurements and it does not appear likely that any final reports would include results of such specifics as these.

4. Enclosure (2) entitled, "Long Term Activity Estimates for the Northern Marshall Islands" (unknown source) has been located which provides information on Marshall Islands affected by BRAVO and YANKEE fallout. Although LIKIEP is not included in Table 5, the island of AILUK to the northeast is listed. The table indicates that the dose rates at one hour after detonation on AILUK was 1 R/hr after BRAVO and 0 R/hr after YANKEE. Figure 2 indicates that a 0.1 R/hr fallout intensity isodose line at H + 1 hrs for Shot BRAVO ran approximately through the northern part of LIKIEP.

R. T. Bell
R. T. BELL
LCDR MSC USN

[redacted]

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AT CIC 05

104803

UNITED STATES SHIP RENSHAW (DDE-499) Friday 5, March (Date) (Date) (Month) 54

00-04
Steaming in company with USS MUNRO (DE-422), enroute from Utirik Atoll to Kwajalein Island in accordance with CTG 7.3 disp. 040312Z. Course 218 T&PGC, 208 PSTGC. Speed 11 knots. Ships in column, MUNRO, 2000 yards astern. This ship guide and OTC. Steaming on boilers Nos. 2 and 4, split plant. Condition of readiness three and material condition Baker set. 0330, Sighted Kwajalein Island Aero beacon, bearing 225,T, distant 20 miles.

E.W. MONROE, LTJG., USNR

04-08
Steaming as before. 0528, C/C to 270 T&PGC, 260 PSTGC. 0600, C/C to 305 T&PGC, 295 PSTGC. 0610, USS MUNRO (DE-422) assumed guide, 2000 yards ahead. 0636, C/C to 330 T&PGC, 322 PSTGC. 0645, C/C to 340 T&PGC, 330 PSTGC. 0646, Set the special sea detail. OOD has the conn. Captain and Navigator on the bredge. USS MUNRO detached to proceed independently. 0710, Pilot Bos'n came aboard. 0729, Passed between buoys Nos. 1 and 2, standing into Gea Pass Kwajalein Atoll Harbor. Steering various courses and at various speeds conforming to the channal.

M.A. HEYMAN, LTJG., USNR

08-12
Steaming as before. 0809, Captain has the conn. 0830, Moored starboard side to Berth Easy, Kwajalein Atoll Harbor, with standard mooring lines. Ships present include various units of the U.S. Pacific Fleet. SOPA is COMNAVSTA, Kwajalein. 0831 Pilot Bos'n left the ship. 0836, Secured the special sea detail. 0842, COMNAVSTA, Kwajalein came aboard. 0850, Secured boiler No. 2. Boiler No. 4 in use for auxiliary purposes. 0902, COMNAVSTA, Kwajalein left the ship. 0913, Disembarked 454 civilian evacuees from Utirik Atoll. 0940, Made daily inspection of magezine and smokeless powder samples; conditions normal. 1000, YOG 73 came alongside to port. 1040, Commenced fueling from YOG 73, draft fwd. 13' 5", aft 13' 1".

for J.W. REED, LTJG., USNR

12-16
Moored as before. 1206, Lighted fires under boiler No. 2, and commenced making all preparations for getting underway. 1226, Completed fueling, draft fwd, 13' 9", aft 13' 8". 1300, Completed all preparations for getting underway. Cut in boiler No. 2 and 4, on the main steam line. 1304, Major , 0507805, USA, and Mr. Marshallese interpreter came aboard. 1307, Underway for Likiep Atoll in complinace with verbal orders from CTF 7. Steaming on boilers Nos. 2 and 4, split plant. Special sea details set. Material condition Baker set. Captain at the conn, Navigator on the bridge. 1314, Steering various courses and at various speeds to conform to the channel. OOD was given the conn. 1346, Passed between buoys Nos. 1 and 2, took departure for Likiep Atoll, set base course 180 T, speed 18 knots. 1348, Secured the special sea detail, set condition of readiness three. 1355, C/C to 127 T&PGC, 117 PSTGC, 1405, C/C to 123 T&PGC, 113 PSTGC. 1425, C/C to 090 T&PGC, 080 PSTGC. 1432, C/C to 053 T&PGC, 046, PSTGC. 1436, C/C to 052 T&PGC, 045 PSTGC. 1447, C/S to 25 knots.

J.J. EMERSON, LTJG., USNR

16-20
Steaming as before. 1750, Sighted Likiep Atoll, bearing 080 T., distant 25 miles. 1828, C/C to 085 T&PGC, 079 PSTGC. C/S to 22 knots. 1851, C/C to 080 T&PGC, 074 PSTGC. Set the special sea details. OOD at the conn. Captain and the Navigator on the bridge. Steering various courses and at various speeds standing into Likiep Atoll Lagoon. 1905, Captain at the conn. 1918, All engines stopped. Anchored in Likiep Lagoon, in 23 fathoms of water, sand and coral bottom, 90 fathoms of chain to the port anchor on the following bearings; Flag Staff Likiep Island, 105 T., Entrance Island 252 T, Knenuuwan Island 126 T. 1929, Secured the special sea detail. 1935, Secured boiler No. 2. Boiler No. 4 in use for auxiliary purposes. Ships present: USS RENSHAW. SOPA is C.O. RENSHAW.

E.W. MONROE, LTJG., USNR

20-24
Anchored as before.

B.J. GUDGE, ENS., USNR

EXAMINED

[redacted] Enclosure (1)

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PRIVACY ACT MATERIAL REMOVED

NAVPERS 15A (REV. 9-42) DECK LOG—REMARKS SHEET

UNITED STATES SHIP PENSEAW (DDE-499) Saturday 6, March 44
(Day) (Date) (Month)

00-04

Anchored in Likiep Lagoon, Marshall Islands, in 23 fathoms of water, sand and coral bottom, with 90 fathoms of chain to the port anchor on the following bearings; Flagstaff, Likiep Island, 105 T., Entrance Island 252 T., Enenuuwau Island, 126T. Ship in condition of readiness four, material condition Baker set. Boiler No. 4 in use for auxiliary purposes. Ships present: None.

J.A. EMERSON, LTJG., USNR

04-08

Anchored as before. 0700, Lighted fires under boiler No. 2, commenced making all preperations for getting underway. 0705, Landing party departed for Likiep Island.

V.G. BANDEL, LTJG., USNR

08-12

Anchored as before. 0827, Cut in boilers Nos. 2 and 4, on the main steam line. 0840, Completed all preparations for getting underway. 0937, Recovered landing party from Likiep Island. Underway for Jemo Island, in accordance with CTG 7.3, disp. 050758Z. Steaming on boilers Nos. 2 and 4, split plant. Material condition Baker set. Maneuvering to clear the anchorage. Captain at the conn, Navigator on the bridge. 0944, Steering various courses and at various speeds, standing out of Likiep Atoll Lagoon. 0951, Cleared the channel and took departure for Jemo Island, set course 180 T&PGC, 168 PSTGC, speed 17 knots. 0952, OOD was given the conn. 0954, C/C to 100 T&PGC, 093 PSTGC. C/S to 22 knots. 0957, Secured the special sea detail, set condition of readiness three. 1000, Made daily inspection of magazines and smokeless powder samples; conditions normal. 1010, C/C to 055 T&PGC, 047 PSTGC. 1022, C/C to 047 T&PGC, 040 PSTGC. 1044, C/C to 030 T&PGC, 022 PSTGC. 1058, Captain at the conn. C/C to 045 T&PGC, 037 PSTGC. C/S to 15 knots. 1103, Maneuvering at various courses and at speeds, standing off Jemo Island. 1115, Disembarked landing party. 1133, Proceeding on various courses and at various speeds, circling Jemo Island for charting purposes.

M.A. HEYMAN, LTJG., USNR

12-16

Steaming as before. 1241, Recovered landing party from Jemo Island. 1252, Proceeding to Ailuk Atoll. Base course 060 T&PGC, 053 PSTGC. Speed 15 knots. 1424, C/C to 068 T&PGC, 061 PSTGC. 1426, C/C to 072 T&PGC, 065 PSTGC. 1432, Set the special sea details. OOD at the conn, Captain and Navigator on the bridge. 1442, Captain has the conn. 1454, Standing into Ailuk Atoll Lagoon. Steering various courses and at various speeds conforming to the channel.

J.W. HEAD, LTJG., USNR

16-20

Steaming as before. 1605, All engines stopped. Anchored one mile Northwest of Ailuk Island, in 16 fathoms of water, coral bottom, with 55 fathoms of chain to the port anchor on the following bearings: Kneoa Island, 072 T., Enemanaman Island, 052 T., Ailuk Island, 152 T. Ships present: USS RENSHAW. SOPA is C.O. Renshaw. 1614, Secured the special sea detail. 1624, Secured boiler No. 2. Boiler No. 4 in use for auxiliary purposes. 1626, Disembarked landing party. 1750, Landing party returned.

M.A. HEYMAN, LTJG., USNR

20-24

Anchored as before.

D.D. RUSSELL, ENS, USNR

EXAMINED

LOG OF THE UNITED STATES SHIP RENSHAW (Name) (DDE-499) (Hull number)

AT/FROM/ LIKIEP ISL. Satur 6, March 54

ZONE DESCRIPTION -12 L.E. ALFORD, CDR., U.S.N. COMMANDING.

HOUR	"ALL SHAFT" AVERAGE REVOLUTIONS	BY REVS. NAUTICAL MILES	BY REVS. TENTHS	BY LOG NAUTICAL MILES	BY LOG TENTHS	COURSE	WIND DIRECTION MOVING FROM	WIND VELOCITY (Knots)	BAROMETER HEIGHT IN INCHES	BAROMETER READING AT. THER.	TEMP. AIR, DRY BULB	TEMP. AIR, WET BULB	TEMP. WATER MAIN INJECTION	WEATHER BY SYMBOLS	CLOUDS FORM LOW	CLOUDS FORM MIDDLE	CLOUDS FORM HIGH	CEILING	MOVING FROM	AMOUNT	VISIBILITY
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
A.M. 1							130	5	29.79		80	80		1	CU			16	130	4	7
2							130	5	29.78		80	78		1	CU			16	130	4	7
3							130	5	29.78		80	78		1	CU			16	130	4	7
4							100	3	29.78		80	78		1	CU			NC	100	4	7
5							100	3	29.78		80	78		1	CU			NC	100	4	7
6							100	5	29.78		80	78		2	CU			16	100	6	7
7							085	5	29.75		79	79		1	CU			16	085	4	7
8							100	5	29.78		80	80		14	CU	NS		16	100	2	7
9							100	8	29.76		80	79		1	CU	AS		16	100	3	7
10	111.0	11	3	11	0	100	140	14	29.76		80	79	84	1	CU	AS		16	140	4	7
11	226.3	22	0	21	5	030	140	12	29.80		77	76	84	2	CU	AS		16	140	6	7
12	17.0	1	7		9	315	140	10	29.78		81	78	84	2	CU	AS		16	140	4	7
P.M. 13	113.3	11	5	13	4	060	140	10	29.76		81	79	84	2	CU	AS		16	140	5	7
14	147.0	15	0	14	8	060	140	10	29.70		81	80	84	2	CU	AS		16	140	7	7
15	131.8	13	4	13	5	126	140	10	29.69		83	81	84	2	CU	AS		16	140	5	7
16	92.9	9	3	10	1	106	140	8	29.68		80	79	84	2	CU	AS		16	140	6	7
17							140	8	29.70		86	85		2	CU	AS		16	140	6	7
18							140	8	29.71		85	83		2	CU	AS		16	140	6	7
19							140	8	29.70		85	84		2	CU	AS		16	140	6	7
20							140	8	29.70		85	84		2	CU	AS		16	140	6	7
21							110	8	29.80		80	82		1	CU	AS		16	110	2	7
22							110	8	29.80		80	82		1	CU	AS		16	110	2	7
23							110	8	29.80		80	82		1	CU	AS		16	110	2	7
24							110	8	29.80		80	82		1	CU	AS		16	110	2	7

POSITION

HOUR	LATITUDE	LONGITUDE
0800		
1200	10 05 N	169 36 E
2000		

GALLONS	HEAVY FUEL	DIESEL FUEL	MOTOR GASO.	AVIA GAS	SHIP LUB	AVIA. LUB.
RECEIVED				For 051		
EXPENDED	6,414					
ON HAND	125,951	6,710		8,225	4,685	

CURRENT
TIME FROM (hour) (date)
TO
SET not observed
DRIFT

GYRO COMPASS IN USE
ERROR 0

STANDARD MAGNETIC COMPASS
COMPASS NO. 861
S.H. 145
ERROR 7 E
VARIATION 8.5 E
DEVIATION 1.5 W

WATER
DISTILLED 11,730
RECEIVED
EXPENDED 10,255
ON HAND 26,362

DRAFT BEFORE LEAVING PORT
FORWARD
AFT

DRAFT AFTER ENTERING PORT
FORWARD
AFT

MAGAZINE TEMPERATURES
MAXIMUM 93
MINIMUM 78

GENERAL DRILLS AND EXERCISES
MORNING | AFTERNOON

SUBMERGED RUN DATA—SUBMARINES

	1	2	3	4	5
RUN NO. (SERIAL)					
TIME TO SUBMERGE					
GREATEST DEPTH					

HOUR	SEA TEMP. SURF.	SEA FROM	SEA AMOUNT	SWELL FROM	SWELL AMOUNT	HOUR	SEA TEMP. SURF.	SEA FROM	SEA AMOUNT	SWELL FROM	SWELL AMOUNT
	22	23	24	25	26		22	23	24	25	26
A.M. 1						P.M. 13	84	4	2	4	2
2						14	84	4	2	4	2
3						15	84	4	2	4	2
4						16	84	4	2	4	2
5						17					
6						18					
7						19					
8						20					
9						21					
10	84	4	2	4	2	22					
11	84	4	2	4	2	23					
12	84	4	2	4	2	24					

HYDROGRAPHIC AND METEOROLOGICAL REMARKS

Jemo Island Reef found to run in a direction of 055T. and the geometric center of the island is 3 3/4 miles brg. 225 from its charted position.

No navigational aids were found in Ailuk Lagoon.

There is a small stone pier built on the western side of Ailuk Island, large enough for 26 ft. MWB.

Detailed letter to H.O. will be made.

[illegible signature]

[redacted]

This is available at CIC, Las Vegas as DOC # 104804

Long Term Activity Estimates
For The Northern Marshall Islands

This paper provides preliminary upper-bound estimates of the residual gamma activity on the northern Marshall Islands due to U.S. atmospheric testing at Bikini. These estimates are intended to be indicative of the activity to be determined by up-coming detailed surveys. Estimates are also provided for islands in the Enewetak atoll and compared with the 1972 survey. Finally, an analysis of wind profiles and fallout patterns is presented which serves to delineate those northern Marshall islands which were uncontaminated by fallout from the Bikini tests.

I. APPROACH

After 20 years or so, the principal fission products of interest are Sr^{90} and Cs^{137}, whose characteristics are summarized below.

Isotope	Curies/kt of Fission at H+1	Fraction of Total Curies	Half Life	Decay Mode
Sr^{90}	110	2.1×10^{-7}	29y	β only
Cs^{137}	320	6.1×10^{-7}	30y	β(100%) and γ(93%)

The fractional contribution of Cs^{137} to the one-hour dose rate is not the same as the fraction of total Curies at one hour since the Cs^{137} γ energy is lower than that average energy for all fission products (.66 MeV vs. 2 MeV). This results in a roentgen response for Cs^{137} that is 0.41 times that for the inventory taken as a whole. At some time after burst, when Cs^{137} is the only remaining fission product γ-emitter, the dose rate is given by

$$\dot{D}(T) = \dot{D}(1\ hr)\ [6.1 \times 10^{-7} \times 0.41]\ (0.5)^{T/30}$$

where T is in years. Note that beta activity is not being considered here on the presumption that the survey techniques distinguish between

[redacted]

Enclosure (2)

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beta and gamma. The above equation permits estimating the long term gamma activity, provided there are one-hour dose rate measurements at the locations of interest.

II. RESULTS

The first step in the analysis was to compare the dose-rate estimates developed as prescribed above with recent surveys performed for the Enewetak atoll. This comparison would indicate the magnitude of the difference due to neglecting the migration of the isotopes into the soil and plant uptake. Figure 1 is a map of the Enewetak atoll showing the location of 3 islands chosen for the comparison--Alice, Janet, and Yvonne. Table 1 lists the measured dose rate from the 1951-58 operations for these three islands as well as the 1972 estimates for the Cs^{137} component.

The 1972 survey (reported in NVOO-140) provides average exposure rates separately for Cs^{137} and Co^{60}. (This latter isotope is not a fission product but results from weapon debris activation). In addition, average profiles are provided of Cs^{137} concentration (pCi/g) versus soil depth for Alice and Janet. It is important to note that there evidently have been no cleanup activities (which would invalidate the comparisons discussed here) on Alice and Janet. Yvonne is a different situation because of construction and earth moving activities during the testing period. Large variations in exposure rates occur on Yvonne; thus, mean levels are misleading. For this reason, Yvonne will be dropped from the comparison.

Table 2 provides the Cs^{137} survey data for Alice and Janet. The dose rates can be compared directly with the estimates of Table 1. As expected, the estimates are high since among other reasons it was assumed that the activity was all on the surface. The soil profiles of activity concentration versus depth can be used to develop a pseudo dose rate by relocating the activity back to the surface. A comparison of this value with the estimate is useful in that the difference is

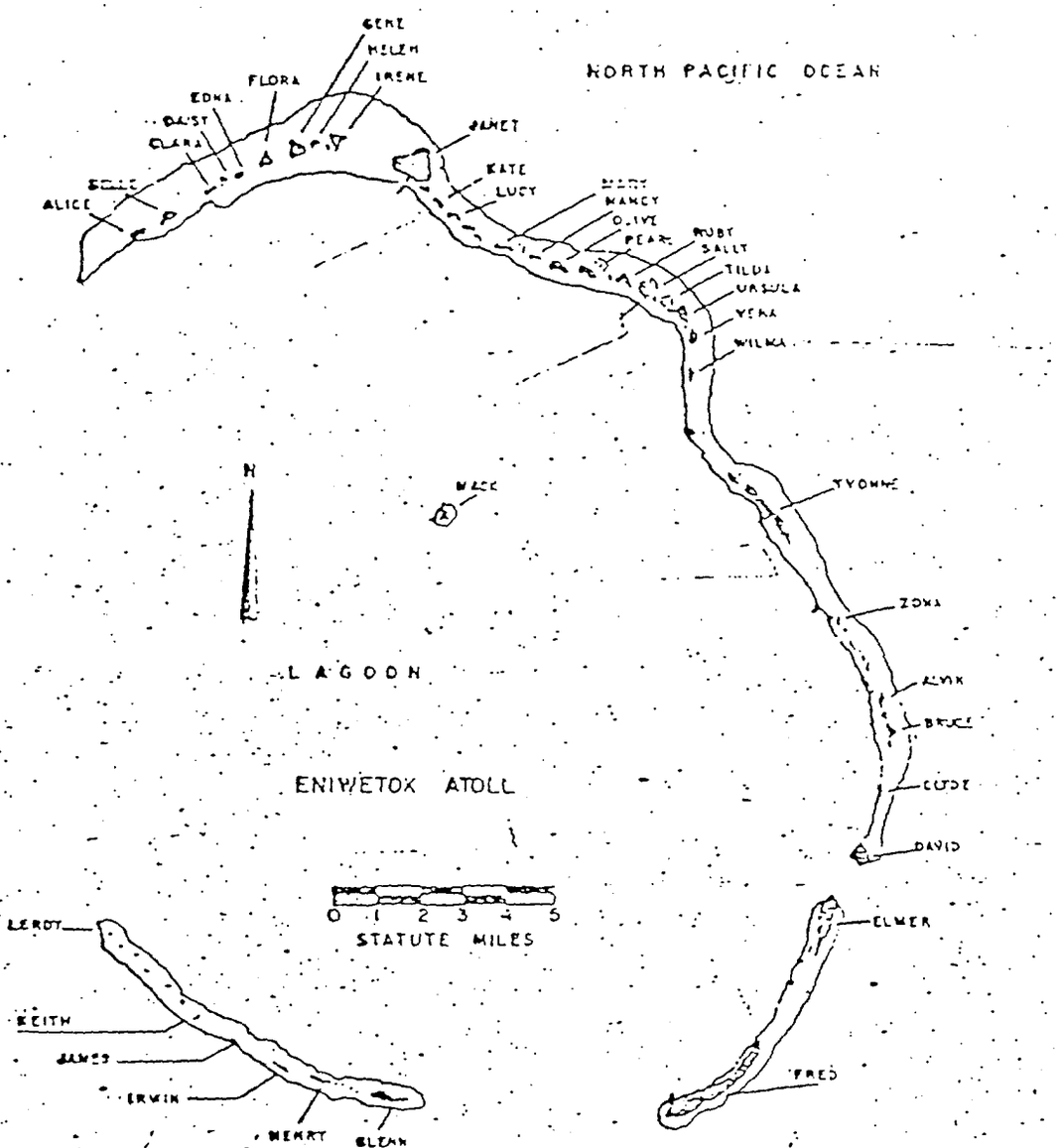

Figure 1. Islands in the Enewetak Atoll

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Table 1. Dose Rate Estimates for Enewetak

OPERATION	YEAR	ONE-HOUR DOSE RATES * (R/HR)		
		ALICE	JANET	YVONNE
GREENHOUSE	51	550	800	0-1000
IVY	52	2000	2000	55
CASTLE	54	50	15	0
REDWING	56	430	480	550-8060
HARDTACK	58	850	90	305-2500

* DASA-1251

ISLAND	1972 DOSE-RATE* ESTIMATE (MR/HR)
ALICE	0.7
JANET	0.7
YVONNE	0.2-2.0

*Cs^{137} only.

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Table 2. Selected Cs^{137} Data from 1972 Enewetak Survey

Island	Surface Dose Rate (mr/hr)	Activity Density (pCi/g) as a Function of Soil Depth (z in cm)
Alice	.042	67 exp (-.011 z), 0 < z < 70
Janet	.025	47 exp (-0.67 z), 0 < z < 8.2 22 exp (-.025 z), 8.2 < z < 75 0.55 exp (-.0031 z), 75 < z < 180

[redacted]

then attributable not to soil migration but rather to plant uptake and other losses. To develop this pseudo dose rate, the following equation was used:

$$A(Ci/m^2) = \rho \times 10^{-8} \int_0^{z_{max}} \alpha(z)dz$$

where α is the activity density in pCi/g, z is the depth in cm, ρ is the soil density ($1.8 g/cm^3$) and the factor of 10^{-8} provides the conversion from pCi to Ci and from cm^{-2} to m^{-2}. The dose rate for Cs^{137} is given by

$$\dot{D}(R/HR) = 6.21\ A(Ci/m^2)$$

Table 3 summarizes the comparison between the estimated and measured Cs^{137} dose rate and the pseudo dose rate as well. As can be seen, the estimate is a factor of about 20 higher than the measured value and that roughly half of this difference can be accounted for by mechanisms other than soil migration. This comparison indicates that simple estimates can be used to provide bounding upper limits and that it might be possible to refine these estimates to within an order of magnitude by correcting for soil migration. The conditions for this refinement would be:

a.) that for the location of interest, there had been no cleanup or major earth moving prior to the survey and

b.) that the soil profiles would be similar to that found on undisturbed Enewetak islands receiving fallout (such as Fig. 1409 of "Summary of Findings" chapter of NVOO-140).

Having compared dose rate estimates with survey results for Enewetak, we can now turn to those islands in the northern Marshalls that were contaminated by fallout from shots at Bikini.

Because the estimating scheme being used requires the one-hour dose rate as input, it is important to first establish that off-site measurements were made in all cases where there was fallout on the islands of interest. If these data are incomplete, estimations cannot

Table 3. Comparison of Estimated and Measured Cs^{137} Activity

ISLAND	DOSE RATE (MR/HR)		
	ESTIMATE	DIRECT MEASUREMENT	INFERRED FROM SOIL PROFILE*
Alice	0.7	.042	0.50
Janet	0.7	.025	0.10

*Calculated by relocating activity to surface.

ISLAND	RATIO (ESTIMATE/MEASURED)	
	DIRECT MEASUREMENT	INFERRED MEASUREMENT*
Alice	17	1.4
Janet	28	7.0

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be made. Table 4 summarizes the fallout pattern characteristics from the Bikini tests. The last column in most cases indicates that the wind directions precluded fallout on the islands. The definite exceptions are Bravo and Yankee. For Bravo and Yankee, off-site measurements were in fact made. None of the Enewetak shots resulted in fallout on Bikini or other islands to the east, so the test operations in Table 1 can be ignored.

Figure 2 shows the Marshall Islands relative to the test locations. The Bravo fallout pattern has been reconstructed independently by AFSWP, NRDL and RAND using some modelling, while the Yankee pattern is based on extensive surveys. The one-hour dose rates for affected islands are given in Table 5. All of the listed islands are outside the lowest dose-rate (100R/HR) contour for Yankee (Rongelap is just barely); the levels are stated only to the nearest decade since extrapolation had to be used. The range of values for Rongelap and Rongerik is due to the variation of the Bravo pattern across the respective island. By and large, Bravo is the predominant contributor.

Table 6 provides 1977 estimates of the Cs^{137} dose rate for these islands. On the basis of the limited comparison performed for the Enewetak case, these values could be reduced by a factor of about 6 to account for soil migration, provided the geology is similar to that for Enewetak.

The final part of this paper is devoted to identifying with high confidence which islands did not receive fallout from the Bikini tests. Table 4, as discussed above, indicates that only Bravo and Yankee definitely resulted in fallout on the islands; this is based on the use of off-site measurements to reconstruct their respective fallout patterns. The other shots in the Castle operation, for which there were no off-site measurements, apparently were not a problem. However, a detailed investigation is warranted and is reported on in the appendix. Also contained there is an extrapolation of the Bravo and Yankee patterns to a level consistent with background.

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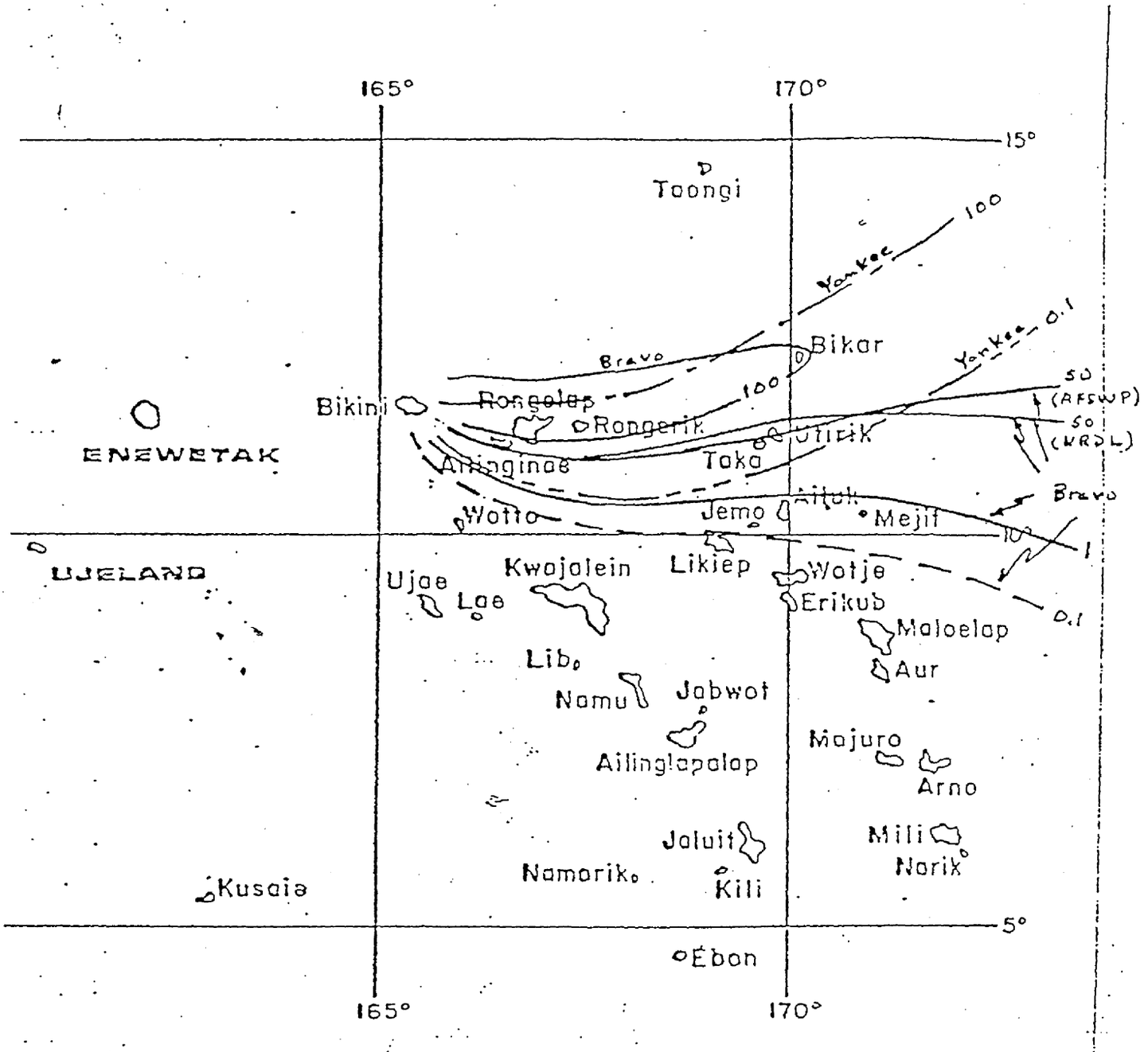
Table 4. Fallout From Bikini Shots

Shot	Yield	Type	Wind Dir (to)	Off-Site Meas.	Concl.
CROSSROADS					
Able (6-30-46)	23KT	Air	W	No	Direction
Baker (7-24-46)	23KT	UW	N	No	Direction
CASTLE					
Bravo (2-28-54)	15MT	Surface	E	Yes	Problem
Romeo (3-28-54)	+	Barge	W	No	Direction
Koon (4-6-54)	110KT	Surface	NE	No	Direction
Union (4-25-54)	+	Barge	NE	No	Direction
Yankee (5-4-54)	+	Barge	NE	Yes	Problem
REDWING					
Cherokee (5-20-56)	>1MT	Air	NW	No	Direction
Zuni (5-27-56)	3.5MT	Surface	NW	Yes	Direction
Flathead (6-11-56)	+	Barge	N	Yes	Direction
Dakota (6-25-56)	+	Barge	N	No	Direction
Navajo (7-10-56)	+	Barge	NW	Yes	Direction
Tewa (7-21-56)	5MT	Barge	NW	Yes	Direction
HARDTACK					
Fir (5-11-58)	+	Barge	W	No	Direction
Nutmeg (5-21-58)	N	Barge	W	No	Direction
Sycamore (5-31-58)	-	Barge	W-NE	No	Direction
Maple (6-10-58)	-	Barge	W-N	No	Direction
Aspen (6-14-58)	-	Barge	N	No	Direction
Redwood (6-27-58)	-	Barge	NW	No	Direction
Hickory (6-29-58)	N	Barge	W	No	Direction
Cedar (7-2-58)	-	Barge	NE	No	Direction
Poplar (7-12-58)	+	Barge	N-W	No	Direction
Juniper (7-22-58)	-	Barge	NW	No	Direction



Fallout Intensities in R/hr @ H+1

Figure 2. Marshall Islands Affected by Bravo and Yankee Fallout

[redacted]

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Table 5. One Hour Dose Rates for Bravo and Yankee

Island	Dose Rate (R/Hr)	
	Bravo	Yankee
Rongelap	200-2400	100
Ailinginae	100-200	0.1
Rongerik	200-800	10
Taka	20	0.1
Bikar	100	10
Utirik	25	0.1
Ailuk	1	0

Table 6. Cs^{137} Dose Rate Estimates for 1977

Island	Dose Rate (mR/HR)
Rongelap	.044 - 3.7
Ailinginae	.015 - .030
Rongerik	.030 - .12
Taka	.003
Bikar	.015
Utirik	.004
Ailuk	.00015

On the basis of this investigation, the following islands are extremely unlikely to have received fallout from the Bikini or Enewetak tests at levels higher than the background exposure of 200 mrem/year:

Wotto	Likiep	Aur
Ujae	Wotje	Namu
Lae	Erikub	Jabwot
Lib	Maloelap	Ailinglapalap
Majuro	Arno	Mili
Namorik	Kili	Narik
Kusaie	Kwajalein	Jaluit
		Ebon

and any other islands circumscribed by the above.

The following islands may have received some fallout from nuclear tests. It is unlikely that the intensities would have resulted in an exposure of more than 2 rem the first year; subsequent annual exposures would have been less than background:

Jemo	Ailuk	Mejit

The following islands did receive fallout with intensities ranging from 1 to 2000 R/hr at 1 hr. They are listed in estimated order of decreasing residual activity:

Rongelap
Taongi (based on cloud drift only - no survey data available)
Rongerik
Ailinginae
Bikar
Utirik
Taka

III. CONCLUSIONS

The above estimates, even when corrected for soil migration, can only be considered preliminary; they are very likely to be upper bounds. Note that only Cs^{137} has been considered. The addition of Sr^{90} (a beta-emitter) and Co^{60} (which results from weapon debris activation) are necessary in completing the estimates of the total activity present.

The distribution of the activity in the soil, plants and organisms will not be determined by a simple survey of surface contamination. The estimates in this paper, along with such a survey, would be useful in determining such a distribution from the following kinds of additional data:

a.) water table height and variation

b.) physical characteristics of the soil strata

c.) plant categories and root depth.

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