

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

October 23, 1973

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PUBLICATION OF REPORT "EXPOSURE RATE REDUCTION ON BIKINI ISLAND
DUE TO CONCRETE DWELLINGS"

The enclosed report is being considered for publication as an
AEC Technical Information Document, TID. Please provide us your
comments by November 1, 1973.

A handwritten signature in cursive script that reads "T. F. McCraw".

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Enclosure:
As stated

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TFM: SA:ADHP
10/19/73

EXPOSURE RATE REDUCTION ON BIKINI ISLAND
DUE TO CONCRETE DWELLINGS

by

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June 1973

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EXPOSURE RATE REDUCTION ON BIKINI ISLAND
DUE TO CONCRETE DWELLINGS

INTRODUCTION

During the May 1972 AEC sponsored resurvey of Bikini Atoll measurements were made to determine the reduction of exposure rates at dwelling sites due to the shielding effect of the concrete structures being erected for occupancy by the returning Bikini people. Exposure rates were measured at several points around and within each dwelling using a Baird Atomic NE-148 Scintillation Monitor 904-148, sodium iodide system calibrated with respect to ^{137}Cs .

The dwellings are constructed of wood and concrete. The floors are concrete slab, not extending beyond the walls of the houses. The concrete slab walls are pierced by windows and, on the longer sides, by entrance ways. The roofing is constructed of wood framing and aluminum sheet.

Local sources of sand and coral aggregate suitable for use in making concrete were identified by AEC prior to construction as having the minimum radioactive material content of those available on the atoll. The architectural drawings of the dwellings that were developed by the Office of Trust Territory, Department of Interior, in consultation with the Bikini people, were reviewed by the AEC staff. Recommendations were made that would reduce radiation levels and thus keep exposures as low as feasible.

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A total of 33 structures were examined. These were in various stages of construction that varied from floor slab only to essentially complete and occupied (by the contractor supervisor). The locations of the structures are shown in Figure 1. Figure 2 is a sketch of a completed dwelling.

A typical building layout is indicated in Figure 3, showing the points at which measurements were made: on the center line of each wall, 10 feet out from the wall, 3 feet above the surface of the ground; in the center of the building, at a height of 3 feet; and in the center of the building, on the floor.

FINDINGS

Raw Data

The exposure rates measured are indicated in Table 1, in micro roentgens per hour ($\mu\text{R}/\text{h}$). External exposure rates ranged from 7 $\mu\text{R}/\text{hr}$ to 55 $\mu\text{R}/\text{hr}$, with an arithmetic mean value of 20 $\mu\text{R}/\text{hr}$.

Treated Data and Results

Exposure rate reduction factors (RF) were computed for each dwelling except for seven "slab only" sites where no external measurements were made. The reduction factor (RF) is expressed in percent and was determined utilizing the following equation:

$$\text{RF} = \left(1 - \frac{\text{Interior Exposure Rate}}{\text{Exterior Exposure Rate}}\right) \times 100$$

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The interior exposure rate is that which was observed at the center of the dwelling at a height above the floor of three feet or at contact with the floor. Both values were investigated. The exterior exposure rate used in the above equation was the arithmetical average of the four external exposure rates measured around each dwelling site.

Exposure rate reduction factors for each dwelling are indicated in Table 2 for the floor and three foot height situations. The measurements are stratified according to each aspect of construction encountered. The average interior exposure rate at floor level and at three feet in the center of the dwellings (excluding those filled with masonite and those having only a slab) is about 11 μ R/hr.

CONCLUSIONS

On Bikini Island, exposure rates present from radioactivity remaining post nuclear testing are reduced within the concrete dwellings by a significant amount. Upon completion of the housing construction effort, an exposure reduction factor of about 50% may apply. This is about what was expected provided materials of construction contained low levels of radioactivity. Even greater reduction can be expected when the housing area is covered with one to two inches of coral gravel as has been recommended. Depending on the occupancy time for residents of these houses, total exposure to external radiation can be expected to be reduced accordingly.

ACKNOWLEDGEMENT

The authors wish to recognize the role of the Department of the Interior and particularly the Office of Trust Territories of the Pacific

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Islands in obtaining favorable results of exposure rate reduction in construction of dwellings to be occupied by the Bikini people when they return.

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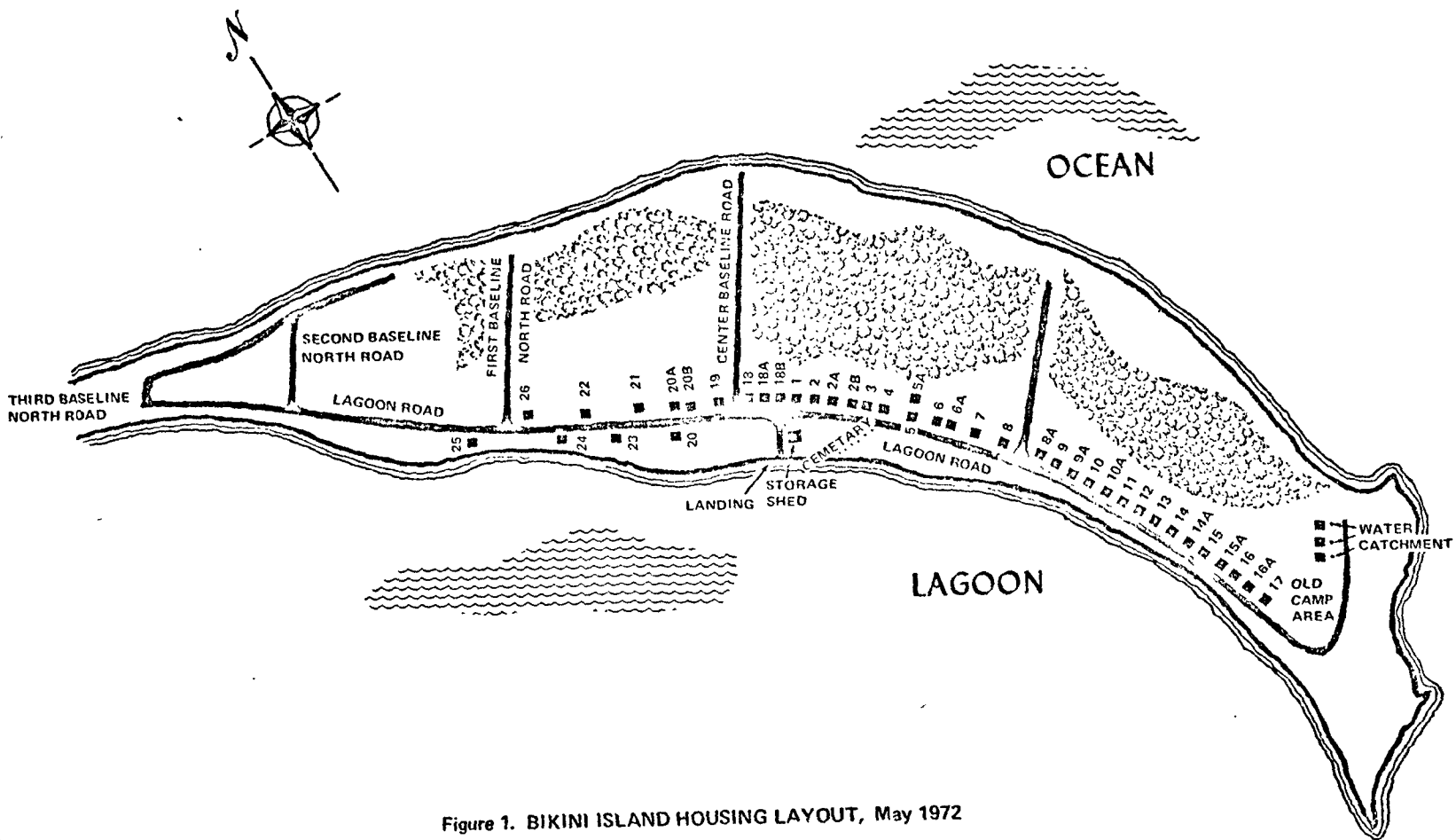


Figure 1. BIKINI ISLAND HOUSING LAYOUT, May 1972

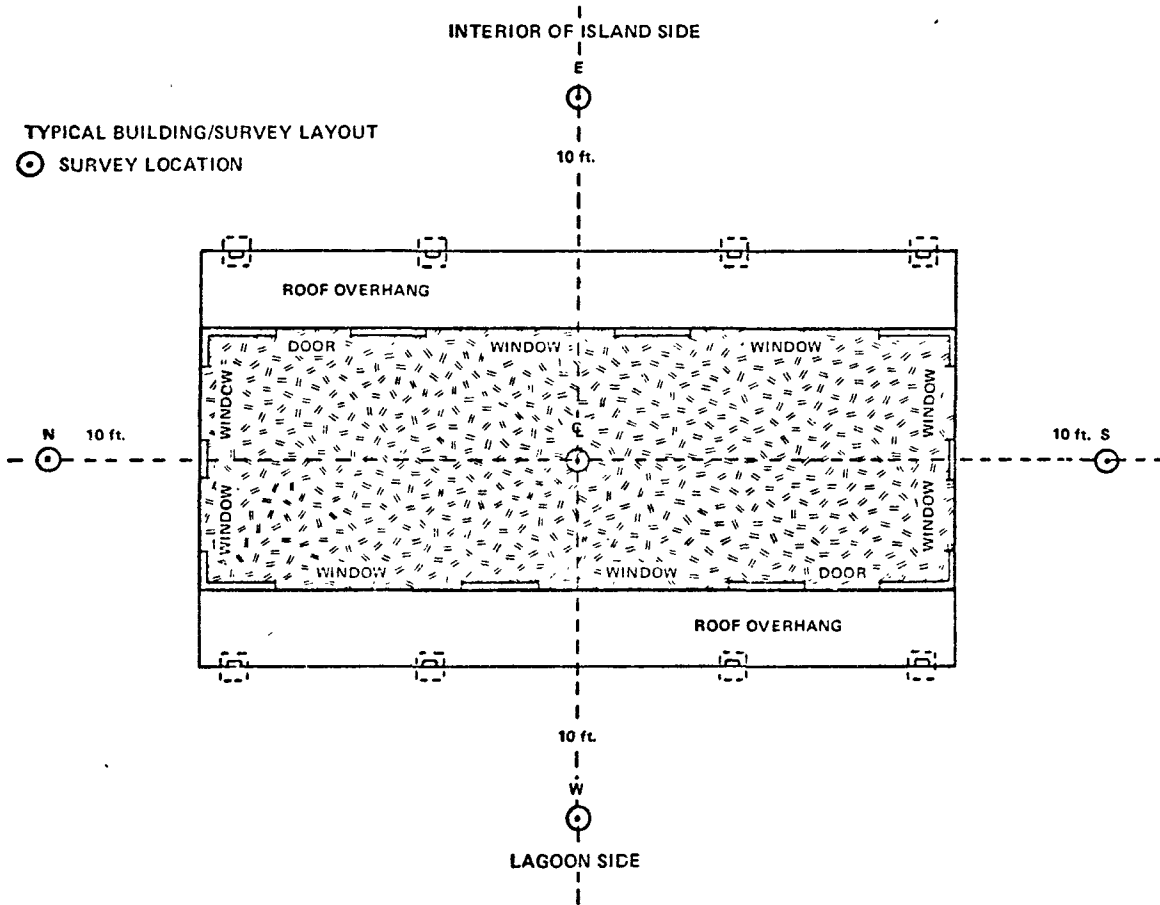
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Figure 2. SKETCH OF COMPLETED DWELLING

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BIKINI ISLAND HOUSING GAMMA SURVEY SURVEY LAYOUT



READINGS OBTAINED AS INDICATED AT 3 FOOT HEIGHT EXCEPT AT CENTER OF HOUSE WHERE A CONTACT READING WAS ALSO OBTAINED.

Figure 3.

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House No.	N.10'@3'	S.10'@3'	E.10'@3'	W.10'@3'	Interior		Remarks
					Floor	+3'	
1	-	-	-	-	6	10	Slab only
2	-	-	-	-	8	10	Slab only
2A	-	-	-	-	8	10	Slab only
2B	-	-	-	-	9	10	Slab only
3	-	-	-	-	8	8	Slab only
4	7	7	7	7	5	5	Walls, slab & roof
5	9	10	9	10	7	7	Slab and walls
5A	10	11	10	12	7	7	Slab and walls
6	15	12	11	12	9	9	Slab only
6A	11	14	11	11	8	8	Slab only
7	19	19	27	19	11	11	Slab only
8	42	25	42	22	12	12	Slab and walls
8A	25	27	21	38	14	14	Slab and walls
9	19	21	17	36	10	10	Slab and walls
9A	26	45	26	42	15	16	Slab, walls & roof
10	19	17	16	17	10	10	Slab, walls and roof
10A	18	23	18	22	8	9	Slab, walls & roof
11	24	35	20	20	10	11	Slab, walls & roof
12	19	16	23	20	10	10	Slab, walls & roof
13	20	20	20	15	9	9	Slab, walls & roof Bldg. filled w/masonite
14	35	19	18	20	11	11	Slab, walls & roof Bldg. filled w/masonite
14A	10	10	12	15	6	6	Slab, walls & roof Bldg. filled w/masonite
15	19	26	17	24	11	12	Slab, walls & Roof Bldg filled w/masonite
15A	15	11	25	15	6	7	Slab, walls & Roof Bldg. filled w/masonite
16	14	14	10	25	10	11	Slab, walls & roof
16A	20	20	10	18	8	9	Slab, walls & roof
17	9	15	15	18	7	7	Slab, walls & roof (Occupied)
18	10	20	13	10	7	9	Slab and walls
18A	-	-	-	-	11	15	Slab only
18B	-	-	-	-	11	11	Slab only
19	16	18	14	16	9	10	Slab and walls
20	14	12	20	11	9	10	Slab and walls
20A	25	19	15	16	11	12	Slab and walls
20B	28	10	16	14	7	9	Slab and walls
21	50	23	45	50	18	20	Slab, walls & roof
22	40	55	20	40	17	20	Slab and walls
23	21	15	16	23	8	10	Slab, walls & roof
24	30	30	24	27	14	15	Slab & walls
25	30	40	27	10	14	15	Slab & walls
26	25	27	30	15	15	15	Slab & walls

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Table 2

House No.	Avg. External $\mu\text{R/hr}$	Interior Floor $\mu\text{R/hr}$	Interior + 3 ft. $\mu\text{R/hr}$	Reduction Factor Floor	Reduction Factor + 3 ft.
Slab only					
6	12.5	9	9	28%	28%
6A	11.75	8	8	<u>32%</u>	<u>32%</u>
			Average	30%	30%
Slab & walls					
5	9.5	7	7	26%	26
5A	10.75	7	7	35	35
7	21	11	11	48	48
8	32.75	12	12	63	63
8A	27.75	14	14	48	48
9	23.25	10	10	58	58
18	13.25	7	9	47	32
19	16	9	10	44	38
20	14.25	9	10	37	30
20A	18.75	11	12	41	36
20B	15	7	9	33	40
22	38.75	17	20	56	48
24	27.75	14	15	50	46
25	26.75	14	15	48	44
26	24.25	15	15	<u>38</u>	<u>38</u>
			Average	46%	42%

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Slab, Walls and Roof

Table 2

House No.	External $\mu\text{R/hr}$	Interior Floor $\mu\text{R/hr}$	Interior + 3 ft. $\mu\text{R/hr}$	Reduction Factor % Floor + 3 Ft.	
4	7	5	5	30	30
9A	34.75	15	16	57	54
10	17.25	10	10	33	33
10A	20.25	8	9	60	56
11	24.75	10	11	60	56
12	19.5	10	10	39	39
16	15.75	10	11	37	30
16A	17	8	9	53	47
21	42	18	20	57	52
23	18.75	8	10	<u>57</u>	<u>47</u>
Average =				48%	44%

Slab, walls, roof
Bldg. filled w/masonite

13	18.75	9	9	52	52
14	23	11	11	52	52
14A	11.75	6	6	49	49
15	21.5	11	12	49	44
15A	16.5	6	7	<u>64</u>	<u>58</u>
Average =				53%	51%

Slab, walls and roof,
occupied

17	14.25	7	7	51	51
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