

THE DOE MEDICAL PROGRAM IN THE MARSHALL ISLANDS

Following the accidental exposure to radioactive fallout (March 1, 1954) of 244 Marshall Islanders and 28 American servicemen, the AEC (now DOE) initiated a regular medical examination and treatment program for radiation effects in the exposed Marshallese which has been under the direction of Brookhaven National Laboratory since 1956. The examinations have been carried out with the cooperation and participation of medical personnel from the Trust Territory. The examinations have been on an annual basis for the Rongelap people and every three years for the Utirik people until six years ago when all of the people have been examined annually and, in addition, quarterly medical visits to Rongelap and Utirik have been made whenever possible by a Resident Physician in the islands (a BNL physician). A group of 150 unexposed Marshallese serve as a control group and are examined the same as the exposed groups. The medical findings are summarized below in section I and in section II are outlined the various measures taken by AEC/DOE to aid the exposed people.

I. Summary of medical findings and treatment:Early Effects

The fallout accident in 1954 resulted in exposure of the Marshallese on Rongelap, Ailingnae and Utirik atolls to fallout radiation before they were evacuated by about 2 days. Whole-body exposure from penetrating gamma radiation gave an estimated 175 rads to the 64 people living on Rongelap, 69 rads to the 18 people on Ailingnae (these were Rongelap people on a fishing trip to this nearby atoll during the fallout) and 14 rads to 157 people living on Utirik atoll. In addition, there was internal absorption of radionuclides from inhalation and ingestion of contaminated food and water and fallout deposited on the body caused significant skin exposure in the Rongelap and Ailingnae groups. The radiation to the skin was spotty and superficial and the dose, though indeterminate, was probably greater than 1000 rads. Except for radioisotopes of Iodine, the radionuclides absorbed from the fallout are not believed to have resulted in significant internal exposure. The magnitude of the dose to the thyroid glands from radioactive iodines was not appreciated until later when thyroid nodules unexpectedly developed and reevaluation of the dose showed that the early estimates had to be revised upward, particularly in the children. (It was estimated adults on Rongelap had total thyroid doses of 335 rads and young children 700-1400 rads.)

The Rongelap and Ailingnae people were the only ones to develop acute effects of exposure (transient nausea and vomiting, hemopoietic depression and widespread beta skin burns and epilation, but with no detectible acute effects related to internal absorption of radionuclides). The low dose Utirik group showed only statistically a slight depression in platelets without clinical signs of exposure. There were no deaths associated with the acute exposure of the Marshallese and, except for the skin burns, no treatment was necessary. Blood levels returned to near normal by one year and beta burns healed and hair regrew within a year with only a mild scarring and residua in about 15 people.

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During the ensuing decade the people remained as healthy as the population of unexposed Rongelap people used as a control group (about 200) with no further evidence of radiation effects, except an increase in miscarriages and stillbirths in exposed women which is questionably related to exposure.

## II. Late Effects

### A. Studies with negative findings

Animal studies have shown some nonspecific late effects such as accelerated aging and premature deaths from degenerative diseases. Such effects have not been detected in human exposures. Radiation-induced shortening of life span appears to be related entirely in human beings to certain malignancies. In the Marshallese numerous studies of premature aging effects, similar to those carried out in the Japanese, have not revealed evidence for such effects. There has been no indication thus far of any increase in degenerative diseases among the exposed Marshallese or Japanese. Similarly, though genetic defects in offspring of irradiated animals have been demonstrated, such defects have not been positively identified in studies of the first generation children of the Japanese. In view of the negative nature of the Japanese findings no organized genetic studies of the Marshallese children have been carried out, though no apparent effects have been noted in the newborn, most of whom have been examined. Dr. J. Neel (Univ. of Michigan) has examined, with negative results, a limited number of blood samples of children of exposed Marshallese for variants of serum proteins and erythrocyte enzymes that might indicate genetic mutations.

### B. Possible radiation late effects in the exposed Marshallese

#### 1. Thyroid

##### (a) Growth retardation, development of nodules

Between 5-10 years after exposure growth retardation in several of the children exposed at less than 5 years of age (particularly notable in two boys exposed at 1 year of age) was the first evidence of thyroid injury. Thyroid nodularity first began to appear at 9 years after exposure in the Rongelap people and shortly thereafter in the Ailingnae group and more recently in the Utirik population. The accompanying table shows the present status of the thyroid findings, including the results of surgery. There have now been 45 thyroid abnormalities (34 with surgery) among the 244 exposed Marshallese (39% of the Rongelap people and 7.0% of the Utirik people compared with about 5% in unexposed Marshallese). The occurrence of three thyroid cancers in the exposed Utirik population (compared with four in the Rongelap group) appears to implicate radiation exposure in the etiology but the high incidence is puzzling since it is greater than would be predicted based on Rongelap and Japanese data, and there does not appear to be any increase in benign thyroid tumors in the group compared to the much greater prevalence in the Rongelap group.

The institution of hormone treatment (Synthroid) in all exposed Rongelap people, which began in 1965, has been essential in maintaining a euthyroid state in the operated cases and has been important in correcting growth

retardation in the children. However, the continued development of thyroid nodularities causes us to question the efficacy of the treatment in preventing the development of such nodularities. Several years ago the Ailingnae group were also included in the treatment program.

(b) Development of hypothyroidism

During the past several years, with the development of more sensitive tests of thyroid function (RAI for T<sub>4</sub>, TSH, T<sub>3</sub>, TSH and TRH stimulation tests) extensive examinations of the exposed Rongelap people have indicated that some of them without thyroid nodules are developing hypothyroidism. There are at least 4 people definitely in this category, but there are 6-8 more who have suggestive findings in this regard.

2. Leukemia and other malignancies

In 1972 a young, exposed Rongelap man died of acute myelogenous leukemia. One death also occurred in an exposed Rongelap man due to cancer of the stomach. These are the only two deaths in the exposed Marshallese that may be related to radiation exposure.

C. Other diseases

Middle-age onset diabetes is very common in the Marshallese and presents a very serious problem. The BNL medical team has been studying this disease in order to advise the Trust Territory concerning the best treatment. Intestinal parasitism is prevalent throughout the islands and an evaluation and successful treatment program has been instituted for Rongelap and Utirik Atolls. Many other diseases are also treated by the doctors on their visits to the Islands.

D. Radiological monitoring of personnel

Continued evaluation of body burdens of personnel living on Rongelap and Utirik were carried out by gamma spectrographic analysis (whole body counting) of personnel and by radiochemical urinalysis. Body burdens have been well below the established maximum permissible levels and the slight exposure received by the people is believed to be far below levels that would produce detectable effects.

III. Measures by AEC/DOE to Aid Exposed People of Rongelap and Utirik

A. Medical Program

1. Annual medical examinations - with donation of time and effort by medical specialists from the U.S.
2. Past 6 years establishment of Resident Physician in the Islands and recently a Marshallese nurse.
3. Expanded health care program since 1972, examining everyone on Rongelap and Utirik (including children) and supplemented with quarterly

visits by the Resident Physician. Treatment has been given when possible on the Islands or referred to medical centers.

4. Special examinations and treatment for possible radiation effects in U.S. Thyroid cases studied at BNL with surgery at either Boston or Cleveland (38 cases). Leukemia case to BNL and NCI.

5. At time of surveys donations of eyeglasses for reading; drugs for dispensary. Also gift food to Islands to last several days.

B. Other Assistance

1954

1. Remuneration for loss of personal effects and livestock to Rongelap and Utirik people.
2. Built temporary village at Majuro for Rongelap people with subsidization until return to Rongelap Island.

1957

Built new village at Rongelap. Partial food subsidization for several years (?)

1965

~ \$11,000 compensation to each exposed Rongelap person.

1973

1. ~ \$18,000 "inconvenience payment" to Utirik people.
2. DOE/TT agreement to pay \$20,000 annually in support of PL-5-52 to help pay for cost of transportation and hospitalization of Rongelap and Utirik people on the BNL examination roster.

1978

1. \$25,000 compensation for thyroid surgical and other cases in exposed Rongelap and Utirik people.
2. New agreement pending for DOE support of revised PL-5-52.

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Thyroid Lesions in Marshallese, May 1978

Group	Age at exposure	Est. thyroid dose <sup>a</sup> , rads	% Subjects <sup>b</sup> with thyroid lesions	No. subjects with surgery	% Subjects <sup>b</sup> with malignant lesions
Rongelap exposed (175 rads)	< 10	810-1150	89.5 (17/19)	15	5.3 (1/19)
	10-18 <sup>c</sup>	335-810	25.0 (3/12)	2	8.3 (1/12)
	> 18	335	21.2 (7/33) <sup>d</sup>	4	6.1 (2/33)
	All	556 <sup>e</sup>	42.2 (27/64)	21	6.3 (4/64)
Ailingnae exposed	< 10	275-450	33.3 (2/6)	1 <sup>f</sup>	
	10-18	190	0.0 (0/1)	0	
	> 18	135	36.4 (4/11)	3	
	All	217 <sup>e</sup>	33.3 (6/18)	4	
In utero exposed		175+?	33.3 (1/3)	1	
		69+?	0.0 (0/1)	0	
Rong. + Ail.	All	135-1150	39.5 (34/86)	26	4.7 (4/86)
Utirik exposed (14 rads)	< 10	60-95	3.4 (2/58)	1	1.7 (1/58)
	10-18	27-60	14.3 (3/21)	2	4.8 (1/21)
	> 18	30	7.6 (6/79)	5	1.3 (1/79)
	All	50 <sup>e</sup>	7.0 (11/158)	8	1.9 (3/158)
Rong. + Ail. + Utirik	All	30-1150	18.4 (45/244)	34	2.9 (7/244)
Rongelap unexposed	< 10		0.0 (0/72)	0	
	10-18		13.3 (2/15)	2	
	> 18		5.7 (7/122)	2	0.8 (1/122)
	All		4.3 (9/209)	4	0.5 (1/209)
Utirik unexposed	< 10		4.4 (4/90)	3	1.1 (1/90)
	10-18		12.5 (2/16)	0	
	> 18		9.4 (3/32)	0	
	All		6.5 (9/138)	3	
Likiep unexposed	< 10		0.0 (0/43)	0	
	10-18		0.0 (0/17)	0	
	> 18		5.6 (5/89)	0	
	All		3.4 (5/149)	0	
Wotje unexposed	< 10		4.9 (4/82)	1	
	10-18		6.3 (1/16)	0	
	> 18		5.0 (3/60)	0	
	All		5.1 (8/158)	1	
All unexposed	< 10		3.1 (9/287)	4	0.3 (1/287)
	10-18		7.8 (5/64)	2	
	> 18		5.9 (18/303)	2	0.3 (1/303)
	All		4.9 (32/654)	8	0.3 (2/654)

<sup>a</sup>Dose from <sup>131</sup>I, <sup>132</sup>I, <sup>133</sup>I and <sup>135</sup>I plus gamma; mean dose extrapolated from calculations for adults and 3-year olds.

<sup>b</sup>Based on number of people exposed, excluding those in utero (number of cases/total number in group)

<sup>c</sup>The thyroid is considered to be fully developed by about age 18.

<sup>d</sup>One additional case of adenoma, found at autopsy, not included here. <sup>e</sup>Weighted mean dose.

<sup>f</sup>Pathologists differed as to whether this lesion was malignant; it was scored as benign.

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