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RADIATION EXPOSURES AT ROMDIK, UTRIK AND AILUK

Because the analysis of samples and the interpretation of results from the 1978 survey of the Northern Marshalls are still incomplete, the quantitative statements contained herein will be approximate and will be followed later by more precise predictions and conclusions.

First, we need a perspective from which to view radiation exposures in the Marshalls. A good starting point is the enclosure pamphlet "Radiation - A Fact of Life," which portrays the presence of radiation in our environment wherever on earth we may live. The sources and the intensity of naturally occurring radiation vary from place to place and in any practical sense cannot be controlled. What can be controlled is the exposure of individuals or populations to man-caused or man-made radiation, such as occupational and medical exposures and limiting releases of radioactivity from nuclear facilities and their associated operations are examples of this. Medical use of radiation for both diagnosis and therapy is widely accepted and has its own risk-benefit discipline. The control of occupational exposures and limitations on the releases of radioactivity into the public environment are subjects of international and U.S. Federal guidelines which are widely accepted and applied. These guidelines for exposure to radiation are expressed in units known as rem (roentgen equivalent, man). A millirem (mrem) is the thousandth part (1/1000) of a rem. For general populations, the U.S. Federal guideline prescribes that exposures (averaged over six minutes) should not exceed 170 mrem per year. No individual exposure should exceed 500 mrem (1/2 rem) per year and 30 year cumulative exposures should not exceed 5 rem. These limits are over and above the exposures received from natural sources and from medical procedures.

As noted in the enclosed pamphlet (page 6), typical radiation exposures from natural sources in mainland U.S. locations are about 300 mrem per year. About half of this exposure (about 100 mrem per year) is external, i.e., due to cosmic rays plus radiation from naturally occurring radioactive elements in the earth's crust. The other half is internal exposure from naturally occurring elements taken into our bodies in food and water and in the air we breathe. This natural radiation exposure in the U.S. is about the same value as the Federal guideline for control of exposures of the public to man-made radiation.

On a Pacific coral island several things combine to make exposures to naturally occurring radiation significantly lower than in the U.S. The low latitude, low elevation and low levels of naturally occurring radioactivity in the soil result in an external exposure of about 8 mrem per year in the Northern Marshalls (the coral formations are quite remote from the earth's crust and therefore very low in concentration of naturally occurring radioactive materials such as mainland soils.) The internal exposure of 33 mrem per year in the Marshalls, including Rongelap, is compared with about 100 mrem per year for the U.S. mainland.

Measurements of radioactivity in the bodies of Rongelap residents indicate that the naturally occurring radionuclide that contributes most of the internal exposure, gives about 18 to 20 mrem per year. Thus, naturally occurring radiation contributes a total exposure (external plus internal) of about 53 mrem per year on Rongelap, compared to 300 mrem per year in the U.S.

As with locations in the U.S. mainland, there are quantities of fallout in the soil of land areas in the Pacific as a result of past atomic testing in the atmosphere. Radiation from these fallout radionuclides are an additional source for both internal and external exposures for persons living in the

U.S. and in the Pacific. It would appear meaningful to compare the radiation exposures from fallout, both external and internal, to those from naturally occurring sources that have been quantified above.

The levels of external radiation at Rongelap Atoll have been measured repeatedly since 1954. These measurements show a steady decline since that time. Through radioactivity decay and weathering, the residual fallout radionuclides in the soil, the external radiation dose on Rongelap Island (corrected for natural background) have decreased to about 28 mrem per year in 1981. The major contributor to this exposure is a radioactive isotope in the soil known as Cesium-137. This level of exposure will continue to decrease with time.

For internal exposure due to fallout, the picture is somewhat more complex, but can be simplified. In an atoll, the fallout is distributed in the soil of the island and in the sediments in the lagoon. The levels are slowly declining with time. These radionuclides are transmitted to man through food, water, and air. Internal radiation exposure through the terrestrial food pathway, i.e., use of foods grown on the island, is strongly dominant and again, Cesium-137 ~~(Abbreviated ^{137}Cs)~~ is the major contributor. Other radionuclides such as Strontium-90, Cobalt-60, and Plutonium-239 are present, but their contribution to exposure is less than that of Cesium-137. Cesium-137 in the body is relatively easy to measure. A monitoring program, covering a number of locations in the Marshall Islands, has been conducted since 1954. One of the techniques used is called whole body counting. An instrument is used that can measure radiation coming from the body. Since the various nuclides emitting this radiation can be identified and quantified, the results of these whole body measurements, radiation exposure from Cesium-137 and Cobalt-60 can be (and are) accurately calculated. The amounts of Strontium-90 and Plutonium-239 are determined by analysis of urine and fecal samples.

For Rongelap, sufficient [illegible] data are available to provide for reliable estimates to be made of internal exposure. The total internal dose due to fallout for residents of Rongelap [illegible] to fallout is calculated to be 30 mrem per year. This, added to the previously discussed external exposure of 28 mrem/year, leads to a total whole body exposure of approximately 58 mrem per year.

By comparisor, the average exposures in the U. S. mainland due to fallout are less than at Rongelap. External exposure is about 2.8 mrem per year and internal exposure is about [illegible] mrem per year. Thus, total external plus internal exposure is about 4 mrem per year.

For ready comparison, all of the exposure estimates just described are presented together in the table that follows. It indicates that in the U.S., radiation exposure due to naturally occurring radiation is higher than that due to fallout. The total in the U.S., natural plus fallout, is ~~20~~ 203 mrem per year. At Rongelap, the exposure due to fallout is about the same as that due to natural radiation. The total in the U.S., natural plus fallout, is about two times the total at Rongelap, i.e., 203 versus 108 mrem per year.

Exposure Comparisons (mrem/yr)

	Natural				Fallout***		Natural & Fallout
	Int.	Ext	Tot.		Ext.	Tot	Tot.
U.S.	100	100**	[illegible]		2.8**	4	203
Rongelap	20*	33**	[illegible]		2**	58	108

U.S. Standard
Population [illegible]
Individual [illegible]

* Due to Potassium-40. Body burdens of K-40 are about the same at Rongelap as in the U.S.
** No shielding factors in dose.
***References:
Rongelap values - BNL 5125
U.S. values - ORP/CSD 72-1

For Utirik, evnironmental concentrations of fallout are lower than those at Rongelap, while the levels of natural radiation are the same. External radiation due to fallout on Utirik is about [illegible] per year.

Environmental levels at Ailuk are [illegible] less than a third of those at Utirik, leading to a still lower estimate of [illegible] exposures for residents of that

Now, what does this all mean to a Peace Corps worker in the Marshalls? As noted above, exposures in the range of [illegible] per year (exclusive of occupational and medical exposures) are quite common in the United States, where naturally occurring radioactive elements [illegible] a low-lying tropical atoll. Thus, the Peace Corps worker [illegible] two years on Rongelap will very likely sustain a radiation dose which [illegible] than the same worker might have received in his own hometown. Serving on either Utirik or Ailuk would, as noted, reduce this exposure far below the U.S. mainland experience

And, finally, if we assume that the Peace Corps worker makes the round trip to the Marshalls from his east coast home by [illegible] his exposure to cosmic radiation during the hours he [illegible] will be about equal his exposure to radiation from all sources over [illegible] weeks on Rongelap.