Testimony
Before the Committee on Resources and the Subcommittee on Asia and the Pacific of the Committee on International Relations
United States House of Representatives

NCI's Development of Baseline Cancer and Radiation-Related Illness Rates Relating to Nuclear Weapons Testing in the Marshall Islands

Statement of
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Chairman Pombo and Chairman Leach, Members of the Committee on Resources and the International Relations Subcommittee on Asia and the Pacific, thank you for the opportunity to testify on behalf of the National Cancer Institute (NCI) of the National Institutes of Health, an agency of the U.S. Department of Health and Human Services. I am Andre Bouville, Ph.D., lead radiation dosimetrist with the NCI's Division of Cancer Epidemiology and Genetics. My testimony will describe the findings from NCI's October 2004 correspondence with the Senate Committee on Energy and Natural Resources, discussed below, and will describe some of the scientific uncertainties associated with our findings.

Last summer, Senators Domenici and Bingaman of New Mexico, the Chairman and Ranking Minority Member of the Senate Committee on Energy and Natural Resources, asked NCI for "its expert opinion" on the estimated number of baseline cancers and radiation-related illnesses from nuclear weapons testing in the Republic of the Marshall Islands. Our Division was tasked with developing this response because of our robust research program in radiation epidemiology, dose reconstruction, and risk estimation.

We developed unrefined estimates of radiation doses and numbers of radiation-induced cancers, based on: (1) measurements of Iodine-131 (I-131) in the urine of adults from two islands, Rongelap and Ailinginae, collected after the test BRAVO in 1954; (2) measurements of the contents of Cesium-137 (Cs-137) and other radionuclides in the body of inhabitants of Rongelap and of Utrik who returned to their atolls in 1954 and 1957; and (3) environmental measurement data on radionuclide deposition provided for

all atolls by the Marshall Islands-sponsored radiological survey completed in 1994. We combined these elements with a standard analytic approach to develop basic answers about cancer incidence. This is, to our knowledge, the first time radiation doses and numbers of radiation-induced cancers have been estimated in a systematic manner over the entirety of the territory of the Marshall Islands.

The NCI Director, Dr. Andrew von Eschenbach, sent his reply to the Senate Energy and Natural Resources Committee with the following estimates:

- About 5600 *baseline* cancer cases (i.e., those which are expected to occur, in the absence of exposure of fallout) may develop within the lifetime of the cohort alive during the test years 1946-1957, with an estimated population size of 13,940. About half of those baseline cases, approximately 2800, have already occurred.
- In addition, about 500 cancers may develop as a result of exposure to fallout radiation. Hence, exposure to fallout could result in about a 9 percent increase – to about 6100 – in the total number of fatal and nonfatal cancers expected.
- We estimate that the thyroid gland was the most heavily exposed organ because it is the target organ for radioactive iodine, a major component of fallout. Of the estimated additional 500 fallout-related cancers, approximately 260 cases are expected to be thyroid cancer.
- We expect that about 400 out of the estimated additional 500 radiation-related cancer cases will occur in the 35 percent of the population who were under 10 years old when exposed to fallout. Since members of this age group are now

between ages 50-60, almost all of those cancers are likely to have occurred by the end of the next few decades.

- Higher excess cancer rates are expected in the populations exposed to the highest doses that lived in the northern atolls.

Estimation of diseases other than cancer has not been made. Such work would require expertise and data not readily available in NCI.

To obtain the cancer risk figures I have presented, three calculations had to be made: we estimated doses, then baseline cancer rates, and derived radiation risks from epidemiologic studies of various irradiated populations. It should be recognized that the estimated numbers of cancers to be expected are highly uncertain, because: (1) dose estimates are uncertain; (2) baseline cancer rates are approximate; and (3) organ-specific doses estimated for some atolls are so high that simple extrapolations based on the experiences of other irradiated populations, such as A-bomb survivors, may not be appropriate. However, the doses were estimated so as to avoid significant under-estimation of the numbers of radiation-related cancers expected to occur.

I would like to bring to your attention the assumptions and uncertainties factored into our estimates:

- In the absence of registry-based *baseline cancer rates* for the Republic of the Marshall Islands, the NCI Surveillance, Epidemiology and End Results Program (SEER)[1] rates representative of native Hawaiians were used as a surrogate.
- Dose models were developed in an unrefined fashion. They are, however, based on our years of experience and understanding of radiation dosimetry and weapons fallout. We used as input data all that were available to us, including monitoring data from the 1950s.
- To present the best figures for this particular request, we made assumptions that likely have led to over-estimates of the average doses received and of the number of projected radiation-related cancers. For example, we assumed a population size from the 1958 census, even though most of the exposure was received years before when the population is believed to have been smaller. *Lifetime cancer risks from radiation exposure* were then estimated using risk projection models developed over many years at the NCI.
- While nearly one-third of the excess radiation-related cancers projected for the entire RMI could be attributed to cases on Rongelap and Ailinginae, we must emphasize that, because of the extremely high radiation doses received at those two atolls, current risk-projection models are likely to over-predict incidence. Since lifetime risk is generally proportional to dose, the assessment of lifetime

[1] SEER: NCI's Surveillance, Epidemiology and End Results Program (http://seer.cancer.gov/about/) currently collects and publishes cancer incidence and survival data from 14 population-based cancer registries, including the state of Hawaii, and three supplemental registries covering approximately 26 percent of the US population.

risk for persons who received particularly high doses generates an estimate that all such persons will develop a radiation-related disease. Since we cannot say for certain that will be the case, the estimated numbers of radiation-related cancers over the whole nation should be treated as an upper limit of cases.

As NCI wrote in its response to the Senate questions, there is a large library of published scientific literature and estimation tools, many of which we used to develop unrefined dose and risk estimates for the exposed populations. What NCI did last summer was to perform the first dose-reconstruction for the entire Marshall Islands from available exposure data, and then develop risk assessment from mathematical tools not refined until 2003. Nevertheless, there are a large number of uncertainties associated with our estimates, only some of which could be reduced in the framework of a comprehensive study. In the long run, this would require a large, multidisciplinary effort undertaken over several years at considerable cost. The decision whether to move forward with such a study must be made with the understanding that the likelihood of reducing significantly the uncertainty regarding the total number if excess cancers is quite small. The incremental information thus gained would be of little practical significance in terms of public health management in the Marshall Islands. The NCI, therefore, does not believe that a comprehensive study should be conducted.

In the short term, NCI plans to submit the dosimetry and epidemiologic methods used to obtain this set of estimates to peer-review for publication in the scientific literature. In

this way, our work can be verified, refined, and employed by others who take an interest in the welfare of the Islanders.

I hope this information about the development of NCI's estimates for baseline cancer incidence and radiation-related cancer risks in the population of the Marshall Islands has been helpful to you. I would be pleased to answer your questions.

Estimated rounded numbers of cancers
in the Republic of the Marshall Islands

	Time period		
	1946-2003	**2004 and Future Years**	**Lifetime**
THYROID CANCERS			
Without fallout	100	30	130
Due to fallout	160	100	260
Total	260	130	390
Increase due to fallout	**160%**	**330%**	**200%**
ALL CANCERS			
Without fallout	2 740	2 860	5 600
Due to fallout	240	290	530
Total	2 980	3 150	6 130
Increase due to fallout	**9%**	**10%**	**9%**

Estimated number of cancers in the RMI

	Time period		
	1946-2003	2004+	Lifetime
THYROID CANCERS			
Without fallout	100	30	130
Due to fallout	160	100	260
Total	260	130	390
Increase due to fallout	160%	330%	200%
ALL CANCERS			
Without fallout	2 740	2 860	5 600
Due to fallout	240	290	530
Total	2 980	3 150	6 130
Increase due to fallout	9%	10%	9%

Table 3. Estimated excess (radiation related) cancers by atoll group and organ

	Rongelap, Ailinginae	Utrik	Other northern atolls**	Southern atolls: Low exposure atolls***	Southern atolls: Very low exposure atolls****	Totals (number of baseline cancers in parentheses)
Population size*	82	157	2005	3834	7862	13940
Leukemia	1.5	0.61	2.1	0.44	0.27	5 (123)
Thyroid	43†	46	132	26	15	262 (127)
Stomach	8.4	1.4	4.4	0.69	0.37	15 (326)
Colon	64†	31	49	9.2	4.0	157 (470)
Other cancers	31	8.5	39	8.6	5.9	93 (4550)
All Cancers combined (rounded totals)	148††	87	227	44	26	532 (5596)

*Estimated from 1958 census (except for evacuated populations) as described in text.

**Ailuk, Mejit, Likiep, Wotho, Wotje, Ujelang

***Lae, Kwajalein, Maloelap, Namu, Arno, Mili

****Lib, Aur, Ailinglaplap, Majuro, Ujae, Kili, Jaluit, Namorik, Ebon

†Based on linear-model estimates applied to doses far higher than those in other studied populations, and therefore the estimate of excess cases is likely to be a rough upper bound (see text). This caveat is less applicable to estimates for Utrik, and does not apply to the other atolls (see Table 1 for average doses by atoll).

††Estimated number of cancers exceeds number of exposed (see text)