

Steven L. Simon, Ph.D.
Representing self

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

Oversight Hearing on
The United States Nuclear Legacy in the Marshall Islands: Consideration of Issues
Relating to the Changed Circumstance Petition
25 May, 2005

Thank you, Mr. Pombo, for your invitation to appear before the joint Committees today. I am Steven L. Simon, PhD. I am employed by the National Cancer Institute, National Institutes of Health (NIH), but I am here today solely in a personal capacity. I am only representing myself. My statement today has not been prepared or influenced by my present employer, nor have they been reviewed at the NIH. Hence, this statement does not necessarily represent the opinion of the NIH. I request that my statement be entered into the record.

I would first like to present my credentials. In addition to a B.S. and M.S. degree in Physics and Radiological Physics, respectively, and a Ph.D. in Radiological Health Sciences, I have approximately 28 years experience in the field of radiation epidemiology, radiation treatment of cancer, and radiation protection. My primary fields of expertise are radiation measurement and radiation dosimetry. I was employed by the Government of the Marshall Islands from early 1990 through mid-1995 as the sole radiation scientist in residence in the RMI. In that position, I directed the Marshall Islands Nationwide Radiological Study from its inception through its completion and designed and oversaw the construction of the first permanently based radiological measurements laboratory in the Marshall Islands. During that time, I was also a member of the 3-person scientific management team for the U.S.-funded Rongelap Resettlement Project and was director of the Nationwide Thyroid Disease Study. Since leaving the RMI, I directed the radiological survey of Johnston Island, another U.S. Pacific nuclear test site. I was a member of the International Atomic Energy Agency (IAEA) survey teams of the French nuclear test sites in Algeria and in French Polynesia. I was the lead dosimetrist in the well known epidemiologic studies of downwinders conducted by the University of Utah and am presently the lead dosimetrist in the NCI's current study of thyroid disease in areas adjacent to the former Soviet nuclear test site in Kazakhstan. I formerly have had research and academic faculty appointments at the University of New Mexico, University of Utah, and University of North Carolina at Chapel Hill. Presently, I hold adjunct faculty appointments at Colorado State University and Baylor College of Medicine. I am an elected member of the National Council on Radiation Protection and Measurements. I am a member of the editorial board of *Health Physics*, the most prestigious journal in this country in the field of radiation protection and have been on that editorial board for the

last 13 years. I have an extensive publication resume and have authored 18 peer-reviewed papers, 19 reports or book chapters and 1 book, all on issues related to radiation in the Marshall Island.

The purpose of my testimony is to clarify what I believe are the seminal findings of the Nationwide Radiological Study and the Nationwide Thyroid Disease Study, two studies I directed. First, let me say that I am pleased to see the findings of the Nationwide Radiological Study (NWRS) being considered in this hearing even though they are being cited by the U.S. Government and the RMI Government in support of differing views. To me, this validates the most important characteristic of that study: that it was scientific in nature, objective in its conclusions, and that it was designed and conducted without any political purposes in mind.

Despite my gratification at seeing the recognition of the NWRS data, I am surprised to see that now, more than 10 years after the studies were completed, the RMI Government, for the first time, publicly recognizes the data. In early 1995, following the completion of the studies I directed, the Nitijela (parliament) of the Marshall Islands invited me to present the findings to them while they were in session, but upon arriving at their chambers on more than one occasion, they never actually allowed me to make the presentation. Near to that time, Mr. Bill Graham of the Nuclear Claims Tribunal provided in-person oral testimony to the Nitijela and his comments served to discredit the study. Following his statement, the Nitijela enacted a resolution to formally reject the findings of the NWRS. Neither the Nuclear Claims Tribunal website nor the RMI Embassy website has acknowledged the study or made its findings available.

Findings of publicly funded scientific investigations should be published and the information made available. To that end, I went to great effort to publish the findings of the NWRS without any salary or financial support. In 1997, I was one of two appointed editors of a special issue of the journal, *Health Physics*, completely devoted to the radiological consequences in the Marshall Islands. The issue included 23 papers by 60 authors in addition to me. The Marshall Islands Government, for reasons never apparent to me, tried to stop publication of that issue. This issue has been available in its entirety on the internet [1] since a short time after publication, courtesy of *Health Physics* and the Department of Energy. In addition, I have made the summary report of the NWRS

available for the last 8 years online [2]; courtesy of the Baylor College of Medicine that maintains the website.

The primary goal of the NWRS was to document the geographic distribution of residual radioactivity from the nuclear testing conducted in Bikini and Enewetak and to assess the present and future levels of residual radioactivity. The NWRS was extremely successful in doing that [3, 4]. In addition to being published in the scientific peer reviewed literature, the data was reviewed either in its entirety or in parts, by three expert international groups, including the RMI Government appointed Scientific Advisory Panel and the IAEA panel to review the radiological situation of Bikini atoll. There has not been a single scientifically based challenge to its quantitative findings or to its degree of comprehensiveness. Despite that there are over 1,000 islands of varying size in the RMI; there is not a single island larger than a bare sandbar where at least one radiation measurement was not made. Moreover, the largest and most important islands in the 29 atolls were the sites of dozens of radiation measurements. Any claim made, that there might still be unidentified hotspots, is unlikely to be true due to comprehensive sampling based on the relative land area of each atoll and the typical variability of measurements, and use of systematic grid-based sampling plans. I make the claim, that if one could find a location with higher radiation level than was recorded by the NWRS, it would be of inconsequentially small size.

One of our areas of emphasis was measurement of Cesium-137 (Cs-137) in the terrestrial environment, e.g. soil, fruits, etc. Cs-137 has been measured worldwide as a marker of fallout contamination since it is only produced by nuclear fission. It has a 30-year half-life and it is conveniently detected by modern instruments. The NWRS documented the average as well as the range of contamination at all atolls of the Marshall Islands, even those islands and atolls traditionally uninhabited. We measured all other detectable gamma emitting radionuclides as well, though, in general, they are of little interest so many years after testing. In addition, we measured fallout plutonium in soil. Cs-137 was detectable at all atolls, but this is hardly surprising since it is detectable virtually anywhere in the world as a consequence of fallout from atmospheric nuclear tests conducted throughout the world. We compared the measured levels of Cs-137 to the value expected in the mid-Pacific region from the deposition of global fallout to

discern the atolls where locally produced fallout was in excess of the background from global fallout. At this point, I would now like to refer to Fig. 1 which presents the measurements of Cs-137 in soil from the NWRS, ordered from left to right by the highest observed value at each atoll. The light yellow horizontal band represents the range of values of Cs-137 (as of 1994) deposited in this region of the Pacific from global fallout. You will also note that the vertical scale is logarithmic, meaning that each major horizontal line is 10-fold greater than the horizontal line below it.

The NWRS study found that atolls located south of nine degrees north latitude had nearly the same levels of residual fallout activity and that it was at a level indistinguishable from that expected from global fallout. In the study's summary report to the RMI Government, I reported that there were 10 atolls for which the study could not conclusively determine whether they had received fallout from the tests conducted in the Marshall Islands. I later learned from a public statement by the now-deceased NCT Chairman, Oscar de Brum, that the NCT interpreted that to be a failing of the study as a result of inadequate funding. That is not the interpretation that was intended, nor was it a failing of any kind. The intended interpretation was the following: *if* there is any locally produced fallout contamination at those locations, it is very, very small...so small, in fact, that it is indistinguishable from the global fallout that originated from nuclear testing worldwide. Our inability to detect any excess fallout was a result of the diminutive amount of local fallout deposited there. Here, it should be noted that we did not use crude instruments that lacked sensitivity. Our measurements relied on gamma spectrometry with liquid-nitrogen cooled high-purity germanium detectors. These devices represent, even today, the state-of-the-art gamma radiation detection instrument.

At locations north of 9° north latitude, we observed a moderately smooth increase in the average and maximum level of Cs-137 measured and it reached a maximum value on the northern end of Rongelap Atoll, on Bikini Island, and the north end of Enewetak Atoll. That there was a uniform degree of contamination at latitudes south of 9° N, and that it was about the same magnitude as that from global fallout may not have been a surprise to some knowledgeable scientists, though in all honesty, I did not have preconceived expectations since there were few historical measurements on which to base an *a priori* opinion. The observable increase in residual fallout activity above the

global background level, at latitudes between 9° and 10° north (i.e., at Erikub [uninhabited] and at Wotje) can be considered to be new information, though one could have deduced it from the 1955 AEC report [5] following the CASTLE series of tests. Atolls located north of Wotje (latitude of 9.5° N) were included in the 1978 Department of Energy (DOE)-sponsored aerial radiological survey. Since the NWRS measurements did not appreciably differ from the DOE measurements (except at the lowest contamination levels where the NWRS had somewhat greater sensitivity [6]), there was not a great deal of new information for the northern atolls obtained, except that the DOE measurements were validated, and much more detail about the contamination at Rongelap was obtained during the course of the Rongelap Resettlement Project. But the fact that residual fallout contamination increased north of Wotho to a maximum at Bikini, northern Enewetak and northern Rongelap, had been documented in the DOE survey of 1978.

Before moving on, I would like to comment on the relationship of the NWRS data to estimating past radiation doses, as well as the value of dose estimation to the changed circumstance petition. In my view, the data obtained in the NWRS, supplemented with other information, can be used for estimating past radiation doses with the understanding that individual estimation is highly uncertain. It is also my view, however, that estimates of radiation dose, new or old, while not totally irrelevant, are not terribly pertinent to the discussion of changed circumstances. My reasoning is two-fold. First, the compensation plan, as developed by the NCT, has no criterion for admissibility based on radiation dose. That makes dose, largely irrelevant from their standpoint. Second, the radiation-related cancer burden for the nation as a whole is likely to be relatively small compared to that from naturally occurring cancers. Hence, a well budgeted compensation plan of the sort implemented by the NCT would primarily need to plan to pay for naturally occurring cancers. The number of radiation related cases that can only be predicted from dose adds only a modest increment.

Now let me briefly address what the measurements of the NWRS imply in terms of future radiation protection requirements. First, it should be realized that measurement of *any* amount of fallout radioactivity should not be cause for alarm; everyone in the world lives with it today. As a comparison, here in Washington, DC, the amount of Cs-137 per

unit area of ground that is attributed to global nuclear testing, is about five-times that in the Marshall Islands [7].

The data of the NWRS was translated into terms of annual whole-body external effective dose and into annual external plus internal dose assuming that Marshallese eat a diet of 75% locally grown food, a scenario that is unlikely today for most Marshallese. The external dose is received from gamma rays emitted from fallout that is still in the soil, while the total dose calculation includes the dose from Cs-137 that would be ingested from fruits that can absorb Cs-137 from the soil via plant roots.

The external annual effective dose could exceed 100 mrem per year at only a few locations: on northern Enewetak Atoll, northern Rongelap Atoll, and on some islands of Bikini Atoll. The value of 100 mrem per year is accepted internationally as guidance for limiting exposure to the public. It is about equal, for example, to the amount of radiation we receive in the U.S. from natural terrestrial and cosmic ray radiation. These findings are not different than predicted from the 1978 DOE-sponsored aerial survey of the Marshall Islands.

Including the dose contribution from ingestion of Cs-137 in locally grown foods might lead to annual effective doses in 1994 (though would be 22% lower today due to radiological decay) in excess of 100 mrem per year on Rongerik, Enjebi Island of Enewetak, northern Rongelap, and Bikini Island. These findings do not differ from findings available from the 1978 DOE survey except possibly in assuming a diet so highly reliant on local food. These various findings are the basis of the statements by the NWRS and its Scientific Advisory Panel that:

“...the current levels of radioactive contamination of the territory of the Marshall Islands pose no risk of adverse health effects to the present generation. Similarly, on the basis of current genetic knowledge, we judge the risk of hereditary diseases to future generations of Marshallese to be no greater than the background risk of such diseases characteristic of any population.

Four atolls have been identified where exposure rates are elevated to the extent that remedial actions are indicated for some of the islands...” [3].

Now, I would like to briefly turn to the Nationwide Thyroid Disease Study (NWTDS) that I directed in collaboration with medical specialists from England and Japan. Part of the motivation for that study stems from the well-known sensitivity of the thyroid gland of young children to ionizing radiation. Studies elsewhere indicate that exposure to radioactive iodine released from nuclear tests might be responsible for an increase in thyroid cancer. In addition to aiming to provide a public health service by providing free examinations, we set out to examine the hypothesis put forth by Hamilton et al. [8] concerning the prevalence of thyroid nodules among 2273 inhabitants of 14 of the 24 inhabited atolls born before the 1954 BRAVO test. His finding was that the prevalence of nodules decreased among that group with increasing distance from Bikini. His interpretation was that exposure to radioiodines was likely much broader than believed prior to his publication of 1987. The NWTDS examined 4762 Marshallese born before the end of nuclear testing in the Marshall Islands. Our examinations used palpation (feeling of the neck), as did Hamilton, though we also used high-resolution ultrasound that Hamilton did not. We found a relatively high frequency of thyroid cancer and benign thyroid nodules and we provided written medical evidence of each finding to each person examined, the Majuro Hospital, and the Nuclear Claims Tribunal. The high frequency of nodules and thyroid cancer, is consistent with observations by other investigators for island locations throughout the Pacific where there is no evidence of exposure to radioactive iodine. Of more relevance here, is that the observations of the NWTDS did *not* confirm the hypothesis of Hamilton et al., i.e., we did not find a significant decrease in nodule prevalence with increasing distance [9, 10]. Though our data suggested that the occurrence of thyroid cancer might be related to our preliminary estimates of radiation dose, there was no such evidence when the observations from Utrik atoll were removed from the data set. I would like to note here that because our study did not confirm Hamilton's hypothesis, it does not disprove it. However, replication of scientific findings is considered part of the gold standard in scientific research and our study that was larger and used more sensitive techniques to detect nodules, did not replicate his findings.

Due to time limitations, this concludes my statement. I hope you have found this information to be useful.

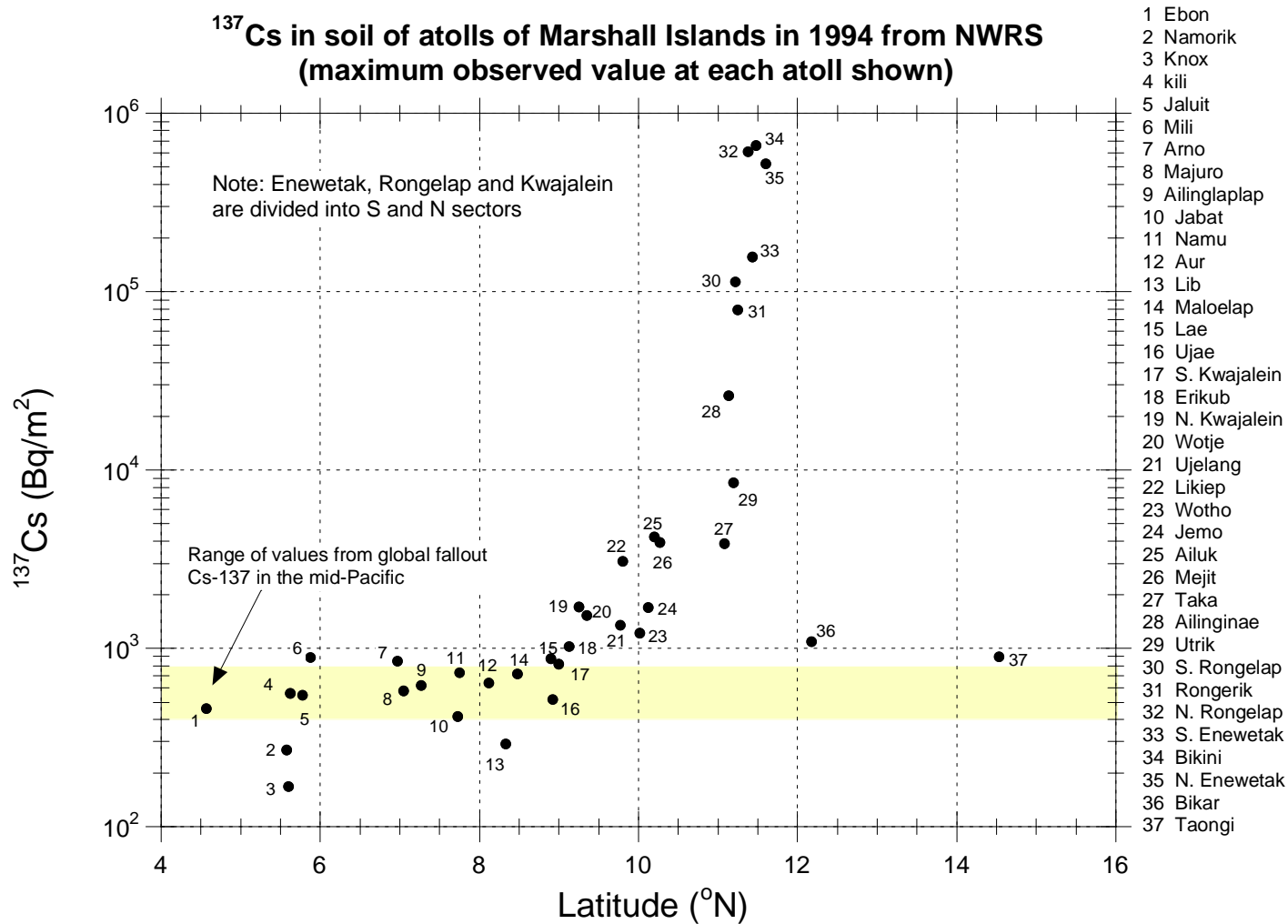


Fig. 1. Maximum observed value of Cs-137 at each atoll from the NWRS in 1994) [4].

REFERENCES

1. <http://www.eh.doe.gov/health/marshall/marsh/journal/>
2. http://radefx.bcm.tmc.edu/marshall_islands/
3. Simon SL, Graham JC. Findings of the Nationwide Radiological Study: Summary Report, submitted to the Cabinet of the Government of the Republic of the Marshall Islands. December 1994. Ministry of Foreign Affairs, Government of the Republic of the Marshall Islands, Majuro, Marshall Islands, 96960.
4. Simon SL, Graham, JC. Findings of the First Comprehensive Radiological Monitoring Program of the Republic of the Marshall Islands. *Health Physics* 73(1):66-85, 1997.
5. Breslin, AJ, Cassidy, ME. Radioactive debris from Operation Castle, islands of the mid-Pacific. New York: New York Operations Office, Health and Safety Laboratory, U.S. Atomic Energy Commission. NYO-4623 (Del.). 1955.
6. Simon SL, Graham, JC. A comparison of aerial and ground level spectrometry measurements of ^{137}Cs in the Marshall Islands. *Environmental Monitoring and Assessment - An International Journal* 53(2): 363-377 1998.
7. Beck HL, Bennett, BG. Historical overview of atmospheric nuclear testing and estimates of fallout in the continental United States. *Health Physics*. *Health Physics* 82(5):591-60885, 2002.
8. Hamilton TE, van Belle G, LoGerfo JP. Thyroid neoplasia in Marshall Islanders exposed to nuclear fallout. *JAMA* 258:629-636. 1987.
9. Takahashi T, Trott, K, Fujimori K, Nakashima N, Ohtomo H, Schoemaker MJ, Simon, SL. Thyroid Disease In The Marshall Islands, Findings from 10 Years of Study. Tohoku University Press, Sendai, Japan. 2001.
10. Gilbert E.S., Land C.E., Simon S.L. 2002. Health Effects from Fallout. *Health Phys* 82(5): 727-735.