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February 20, 1990

Honorable Ron de Lugo
Chairman, Subcommittee on Insular
and International Affairs
Committee on Interior and Insular
Affairs
1626 Longworth House Office Building
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

Enclosed is my response to questions posed in your letter dated January 12, 1990. I hope the answers are helpful.

Sincerely,

W.J. Bair, Ph.D.
Manager
Life Sciences Center

xc: RW Baalman
CD Fransen
R Ray
WL Robison
BW Wachholz

REPOSITORY P.N.N.L.
COLLECTION Marshall Islands
BOX No. 5689
FOLDER T4 Marshall Islands

DOCUMENT DOES NOT CONTAIN ECI
Reviewed by Schuetto Date 5/1/97

[redacted]

scientific and medical concepts.

[redacted]

Radiation for Those Atolls in the Northern Part of the Marshall Islands That Were Surveyed in 1978."

Response to Question 2

a. I do not have precise information about when the survey was initiated.
b. I assume that the survey was completed with the publication of Lawrence Livermore National Laboratory's report, UCRL-52853 Pt. 5, dated August 1983.
c. I do not know what the Rongelap people were told about the survey prior to their receipt of the DOE-1982 booklet.
d. Marshallese government officials, including representatives of the Rongelap people, attended a meeting in Majuro in December 1982 at which the information contained in Marshallese in the DOE-1982 booklet was presented. I was present at the meeting. Also, in the spring of 1983 a DOE team visited Rongelap. I was not able to participate in the visit to Rongelap.
e. I do not have knowledge about studies, reports, briefings, or other communications given the Rongelap people during the time the study team was engaged in its work.

Response to Question 3

a. Changes made between the first two books and the DOE-1982 booklet included:
   (1) Improved description of radioactivity and radiation from atomic bombs and from natural sources.
   (2) Improved description of transport of radioactive materials from soils to the food chain and to man.
   (3) A more detailed approach to describing how radiation causes changes in cells which lead to biological effects.

[redacted]

issues raised by discussions with the people from Enewetak and Bikini, their attorneys, and representatives), changes were made to improve communication of information about radiation. Also, information specific to Enewetak and Bikini was omitted, and information specific to all the northern Marshall Islands was added.

c. In the Enewetak and Bikini books, specific information was given for plutonium and americium because the tests of nuclear weapons on these atolls resulted in local deposition of sufficient quantities of these radionuclides to cause concern that they could contribute significantly to radiation doses at those atolls. This was not the case on Rongelap Island. According to the survey results published in the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982, the people living on Rongelap Island might receive an integrated bone marrow dose of 3.3 rem, of which only 0.00051 rem was from ingestion and 0.0078 rem was from inhalation of plutonium. The contribution of americium to the 3.3 rem was 0.0012 rem and 0.0033 rem from ingestion and inhalation, respectively. These radionuclides contribute, therefore, about 0.4% of the total bone marrow dose. The dose values published in the DOE-1982 booklet included these very small contributions from plutonium and americium. The profiles for plutonium and americium were not included because of their relatively small contributions to total dose in comparison with their contributions on Enewetak and Bikini and in comparison with the important contributions to the dose on Rongelap from cesium and strontium.

d. I believe the clarity of the booklet was improved by not including irrelevant information about plutonium and americium.

Response to Question 4

a. I believe the radiation doses in the DOE-1982 booklet included contributions from all the atomic bomb tests, because the Lawrence Livermore National Laboratory survey team measured the total radionuclide contents of soils and foods.

b. The DOE-1982 booklet did not consider radiation and related effects only from the March 1, 1954 "Bravo" test.

c. To the best of my knowledge, the DOE-1982 booklet considered all of the bomb tests, including "Bravo."

d. The baseline used for defining radiation effects was the dose information reported in Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982.

[redacted]

total, 450 millirem of radiation annually. The booklet does say that the largest amount a Rongelap person would receive in a year by eating local food only from Rongelap Island (not grown on other more contaminated islands) in addition to imported food is about 400 millirem from radioactive material deposited by the bomb tests plus an estimated 50 millirem from natural sources and any radiation they might receive from medical tests.

d. The source of the figure "400 millirem" is the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982. On page 40, the maximum annual bone-marrow dose for Rongelap Island is given as 135 millirem. This number was multiplied by 3 to estimate the highest dose any person might receive because the Federal Radiation Council Report No. 1, 1960, suggests using the arbitrary assumption that the majority of individuals do not vary from the average by a factor greater than 3.

e. The authors of the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982 developed a figure of 135 millirem. The authors of the DOE-1982 booklet multiplied it by 3 to obtain an estimate for the highest dose any person might receive.

Response to Question 7

a. The estimate for cancer deaths in the United States was given in the National Academy of Sciences report, "Biological Effects of Ionizing Radiation" (BEIR) III (1982), as 16.4%. Since this 16.4% applied to a heavily industrialized nation, the United States, the authors of the DOE-1982 booklet used a value of 15% as being more applicable to the population of the world, which includes a large fraction in lesser industrialized countries. Since the northern Marshall Islands are not industrialized, the authors believed cancer deaths were more likely to be about 15% than as high as the 16.4% in the United States.

The value of 10 deaths in 30 years from nonradiation-related cancer among the Rongelap population was estimated by first calculating the estimated number of births and deaths using information from the final draft of the Marshall Islands Five Year Health Plan, prepared by the Trust Territories Department of Health Services, Office of Health Planning and the Resources Department. From this Plan, the following were obtained:

(1) Rate of increase of the population had been ~3.8% per year
(2) Infant death rate: 3.2 deaths per 100 births
(3) Overall death rate: ~0.54% per year
(4) Birth rate: 4.2% per year

Total population at end of 30 years (beginning with 233 people), P_{30}:

$$P_{30} = 233\ (1 + 0.038)^{30} = 713$$

Number of Births, B:

$$B = 0.042 \times 233 \int_0^{30} (1.038)^x\, dx \quad (x = \text{time between 0 and 30})$$

$$B = 541$$

$$\text{Deaths} = 0.034 \times 233 \int_0^{30} (1.038)^x\, dx = 70.$$

Assuming 15% of deaths are due to naturally occurring cancer, 15% of 70 = ~10.

b. I do not know if DOE has a position on whether nonradiation-induced cancers are a greater threat and risk to the Rongelap people than radiation-related cancers.

c. Since, as stated in 7b above, I am not aware of any position held by DOE in this regard, there is no basis for a statement.

Response to Question 8

a. In the DOE-1982 booklet, estimates were given for the person, who in some one year, might receive a radiation dose larger than anyone else because his or her dietary practices and metabolism might have led to intakes and retention of radioactive material greater than that of the average person. In this booklet, the highest average radiation doses

people might receive in 30 years to the whole body and the bone marrow are calculated using the average dietary intake, radionuclide concentration, radionuclide fraction absorbed into the body from that ingested, biological residence times, and external dose rate.

b. There is no distinction in the Marshallese text between "of radiation *people* might receive in the coming 30 years" and "of radiation a *person* might receive in the coming 30 years." The English translation made the distinction using the word *people* for the populated islands and the word *person* for the nonpopulated islands, but I do not recall the reason for this.

c. The scientists referred to in the second paragraph are the authors of the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982.

d. The scientists are Drs. W. L. Robison, M. L. Mount, W. A. Phillips, C. A. Conrado, M. L. Stuart, and C. E. Stoker, of the Lawrence Livermore National Laboratory.

e. The specific basis for the estimates cited in the DOE-1982 booklet was the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982, which in turn is based upon the results of the radiological survey.

f. The figures presented on page 39 were based on actual calculations and measurements developed by Lawrence Livermore National Laboratory scientists.

g. The figures presented on page 39 were taken from the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982.

h. Although calculated from actual measurements, the figures are estimates because it is not possible to predict precisely the radiation doses any individual will receive during the next 30 years.

i. The *largest amount* pertains to the hypothetical person who, because of unusual dietary practices and/or metabolism, would be expected to take in and retain more radioactivity than the average person.

j. The *highest average* pertains to the average dose calculated using the diet that yields the highest dose value.

k. In the Lawrence Livermore National Laboratory report, *average doses* were calculated using two different diets. The *highest average* dose was used in the DOE-1982 booklet.

l. The difference between *largest amount* and *highest average* were explained in (i) and (j).

m. The figure 400 millirem applies exclusively to Rongelap Island and the consumption of local food grown only on Rongelap Island plus imported food as described on pages 29 and 40 in the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982.

n. The figures 2500 millirem and 3300 millirem apply exclusively to Rongelap Island and the consumption of local food grown only on Rongelap Island plus imported food as described on pages 29 and 43 in the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4., September 30, 1982.

[redacted]

years contained in the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982.

d. Neither I nor the other authors of the DOE-1982 booklet prepared dose estimates.

e. The dose estimates were prepared by the authors of the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982.

f. The authors of the DOE-1982 booklet prepared the cancer projections using doses from the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982 and risk factors from the 1982 National Academy of Sciences BEIR III report.

g. Not applicable.

h. The authors of the DOE-1982 booklet prepared projections of health defects at birth using doses from the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982 and risk factors from the 1982 National Academy of Sciences BEIR III report.

i. Not applicable.

Response to Question 11

Some of the values reported in the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982, exceeded U.S. guidelines. They were included in the DOE-1982 booklet. Examples are on page 39 in reference to Naen, Namen and Melu Islands.

a. See above.
b. See above.

Response to Question 12

The Lawrence Livermore National Laboratory report did not calculate separate doses for children and adults.

Response to Question 13

The DOE-1982 booklet made *no* statement about Rongelap or any island in the Marshall Islands being safe or unsafe.

Response to Question 14

a. Not all radiation issues were addressed in the DOE-1982 booklet.
b. The DOE-1982 booklet did not address radiation doses already received by the Marshallese nor the potential health effects that might have resulted therefrom.
c. The authors of the DOE-1982 booklet were asked only to communicate the results of the 1978 survey, which were reported in the Lawrence Livermore National Laboratory Report, UCRL-52853 Pt. 4, September 30, 1982.

Response to Question 15

a. When the information in the DOE-1982 booklet was presented to the Marshallese government officials and representatives from the northern islands at Majuro in December 1982, the representatives from Rongelap expressed concern about past exposures to radiation.
b. I do not have information about what was done.
c. In the spring of 1983, DOE officials and scientists from Lawrence Livermore National Laboratory and others visited all of the populated northern Marshall Islands to explain the DOE-1982 booklet. Because of other commitments, none of the authors were able to participate.
d. I do not believe I have any documents, letters, memoranda or other materials which address this matter.

Response to Question 16

a. I did not perform a detailed assessment of the Kohn Report. I commented only on those points that dealt with the DOE-1982 booklet.
b. I do not believe Dr. Kohn understood the purpose of the DOE-1982 booklet. His report purported to be a review of the DOE-1982 booklet when, in fact, it appeared to be a review of the work of the Lawrence Livermore National Laboratory team and Report UCRL-52853 Pt. 4, September 30, 1982.

I am not aware of anything further that the Committee should know about Rongelap Atoll, the people of that atoll, or the DOE-1982 booklet, "Melelen Radiation Ilo Ailiñ ko Ituiōñ Ilo Majōl, ko Rar Etali Ilo 1978."

Response to Question 18

I have never withheld any information regarding the preparation of the DOE-1982 booklet. I worked on the booklet in response to a request from DOE because I was sympathetic to their interest in wanting to communicate technical information to the Marshallese people so that the Marshallese might be better prepared to make decisions about the future uses of the islands contaminated by the U.S. weapons tests. While the DOE-1982 booklet was limited in scope and may not have provided all the answers that the Rongelap and other Marshallese wanted, it appears to have succeeded in stimulating their thinking and has led them to express their questions and concerns to the world's scientific and political communities.

file

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September 10, 1988

Dr. William L. Robison
Terrestrial & Atmospheric Sciences
Lawrence Livermore National Laboratory
University of California
P.O. Box 808
Livermore, CA 94550

Dear Bill:

This is to confirm our discussion of the origin of the dose data used in the 1982 publication, "The Meaning of Radiation for Those Atolls in the Northern Part of the Marshall Islands That Were Surveyed in 1978." The dose data were taken from your report, UCRL 52853.

The 30-year bone marrow doses and the 30-year whole body doses used in our publication were those you calculated on the basis of the Brookhaven National Laboratory Community A & B Survey Diets. We used the higher of the two values. We did not do any independent dose calculations. Thus, Dr. Kohn's report is incorrect on page 40 when he says, "DOE-1982 stated that the diet on which its reported doses were based consisted only of local foods from Rongelap Island. That statement is incorrect."

The 1982 publication states clearly, "If 233 people live on Rongelap Island and eat local food only from Rongelap Island." It does not say, "eat only local food." We were very careful about that point because we did not want to misrepresent the doses you calculated. I recognize that the statement in the book could be misinterpreted if it were not read carefully. However, the information I sent Dr. Kohn on October 8, 1987 was clear about that point. In the tables of calculations a footnote to the dose columns indicated that the highest dose values were used based on BNL Community A or B Surveys. I also included copies of Tables 21 and 22 showing the origin of the data. In Table 22 the values used for Rongelap were marked, they were based on the B Diet Survey. I am enclosing a copy of the ~~my~~ 1987 letter to Dr. Kohn.

Because of problems in translating from English to Marshallese, we could not include a lot of detailed explanation. In retrospect, a few words about imported foods supplementing local food would have been useful. However, we were writing for the Marshallese and not the scientific community. We assumed those interested in the dose details would go to you.

Battelle

I hope this helps.

With best regards,

Bill

W.J. Bair, Ph.D.
Manager
Life Sciences Center

WJB:taz

Enclosure

cc: JW Healy
BW Wachholz
HI Kohn

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February 29, 1988

Dr. Henry Kohn
RRP
1203 Shattuck
Berkeley, CA 94709

Dear Henry:

I am enclosing comments on your February 20, draft report "Rongelap Reassessment Project." I am sending copies to several of your consultants, Drs. Adelstein, Dunster, Paretzke, and Schull, with whom I've had close associations. I am also sending a copy to Dr. Robison. You may want to send a copy to Mr. Franks since he called me.

My principal concern is that the purpose and scope of your report are misrepresented. It is proported to be a review of a 1982 DOE book authored by Bruce Wachholz, Jack Healy and me, when in fact it is much more. Your report does briefly review the material in our book pertaining to Rongelap, a small part of our total book, but it is more a review of the 1980, 1981, 1982 Lawrence Livermore reports, the Northern Marshall Islands Radiological Survey, parts 1-4, by Dr. W.L. Robison and colleagues. Further, you have undertaken a complete radiological assessment of Rongelap using data not available to us in 1982.

I commend you for this effort and urge that this be identified as the objective of your report. As I have noted several times in the accompanying comments, in writing the 1982 bilingual book, "The Meaning of Radiation for Those Atolls in the Northern Part of the Marshall Islands That Were Surveyed in 1978," our only objective was to communicate information for use by the Marshallese. The book contains no conclusions or original information. Only risk factors and radiation protection standards accepted by the U.S. Government were included. It was necessary to keep the report simple because of the great difficulty in translating technical information into Marshallese. This translation problem led to our writing three bilingual books (the other two were for Enewetak and

Bikini) because it was deemed impossible to accurately translate the excellent detailed technical reports from Livermore and Brookhaven. I believe your report will suffer the same problem.

With best regards,

Bill

W. J. Bair, Ph.D.
Manager
Life Sciences Center

WJB:lc

Attachment

cc: SJ Adelstein
HJ Dunster
JW Healy
HG Paretzke
WL Robison
WJ Schull
BW Wachholz

approach for all atolls; in-vivo counting data were not available for all people in the Northern Marshalls. More importantly, as noted before, the

[redacted]

1, the FRC suggests using the arbitrary assumption that the majority of individuals do not vary from the average by a factor greater than 3. Thus, we multiplied Dr. Robison's values for the average dose for the population to obtain "the largest amount of radiation a person might receive in one year."

Dr. Robison discussed dose distributions in a 1983 report (NCRP - Proceedings of the Nineteenth Annual Meeting of the NCRP) and concluded that "a dose three times the average falls at or above the 96th percentile" and "there is less than a 5% chance for a person to receive a dose that is greater than three times the average dose." Thus, our calculations of the doses to the maximum individual in the 1982 book are probably reasonable.

Page 52, section 6.1: In paragraph 1 you neglected to account for the 70 deaths in deriving an irradiated population of 427.

Page 52, paragraph 2: the cancer risk factors were taken from both BEIR I and BEIR III. You have rounded the value we used, which is OK if acknowledged. The values given for cancer mortality do not agree with the values in the book, or those in the table I sent to you, 0.1 to 0.6, rounded from 0.095 to 0.647, respectively.

Page 53: The values for genetic defects do not agree with the values in the book or those in the table I sent you, 0.007 to 0.1.

If the values on pages 52 and 53 are intended to be your calculations, they should not be attributed to our book.

Page 54, first paragraph: Our 1982 book contained no statement or conclusions about resettlement of Rongelap. That was not within our scope. Further, people were still living on Rongelap.

Page 55, second paragraph: If our not using in-vivo counting data for Rongelap in the 1982 book puzzled you so much, I am surprised you didn't ask me about it.

There are no dose calculations in our 1982 book.

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April 29, 1988

Dr. Henry I. Kohn
1203 Shattuck Avenue
Berkeley, CA 94709

Dear Henry:

Thank you for sending me a copy of the third draft of your report "Rongelap Reassessment Project." I have just now had a chance to look at it since I have been away. It is progressing very well and should be an excellent report of considerable use to the Marshallese.

I found a few statements that I believe should be corrected in the interest of not misleading readers of the report, including members of Congress and their technical staffs.

Your report purports to be a review of the DOE book (your reference DOE-1982), The Meaning of Radiation for Those Atolls in the Northern Part of the Marshall Islands that were Surveyed in 1982, when, in fact, it addresses the origin of three dose estimates used in the DOE book. The origin of these dose estimates is found in the Livermore reports, your references Robinson, et al., 1980, 1981, 1982a and 1982b. Thus, you have actually reviewed the Livermore work and not the DOE book. This is emphasized by the fact that you do not compare your estimates of potential health consequences (page 50) with those in the DOE book, the only calculations actually made by the authors of the DOE book.

Readers of your report, as it is now written, will also be misled about the content and purpose of the DOE book. It would be helpful to inform the reader that the DOE book was written to explain to the Marshallese how the Livermore survey of the northern atolls was done and the meaning of the dose estimates calculated and published in the Livermore survey reports. You do state on page 3 that Rongelap was addressed in only one page of text, reproduced as Note 1, and a map in the DOE book.

I believe it is important to be accurate about these points because a reader of your report who wanted to examine your source documents could be misled in believing the DOE book contained the dose calculation and all supporting

Battelle

In addition to wanting our efforts on the DOE book accurately represented, we want the Livermore people to receive the credit due them for their excellent work, confirmed by your verification of their dose estimates. The following comments bear on these points.

Page 18, para. 2, line 4 - DOE-1982 includes no conclusions about Rongelap's being safe. The report only used dose estimates from the Livermore report (your reference Robison 1982b) and gave estimates of possible future health effects. Conclusions were left to the reader, since we did not feel qualified to make any judgment about what the Marshallese should consider safe or unsafe. The authors of DOE-1982 would prefer that you merely make the statement, "The information in the 1982 book was not accepted by the Rongelap people," which is more accurate.

Page 23, para. 2, line 5 - "failed to consider" seems unfair criticism of the authors of DOE-1982 and of the Livermore report. Since we used in-vivo counting data in the Bikini book, it's obvious we would have used it in the 1982 book had the data for people living on all the northern atolls been accessible. Giving equal treatment to all the atolls and using a common approach that allowed comparisons precluded using in-vivo counting data for only one. Had we been asked to prepare a book specifically for Rongelap, using available in-vivo counting data would likey have been considered.

Page 28, para. 1 - This implies, incorrectly, that the authors of DOE's-1982 calculated the dose values. The original source is your reference, Robison 1982b, the authors of which made assumptions about the diet (which seemed reasonable at the time).

Page 34, para. 2, line 3 - As noted above, DOE-1982 did not choose the BNL Community B diet. It was chosen by the authors of Robison 1982b.

Page 42, para. 3, line 1 - DOE-1982 used a cesium dose from Robison 1982b that overstated the dose compared to whole body counting. (Your statement reads like a criticism of the Livermore work. DOE people were clear in not wanting under-estimates. A factor of 3 over-estimate was certainly preferable to a factor of 3 under-estimate). You might want to discuss this and the previous item with Bill Robison.

Page 42, last para. - This again implies, incorrectly, that the authors of DOE-1982 made the calculations that you have confirmed. The credit rightfully goes to Bill Robison and his colleagues.

Battelle

This last comment leads again to my major point. Your review is not really of the book written by Jack Healy, Bruce Wachholz and me. It is really a review of the dose estimates calculated by Bill Robison, et al. You have confirmed that our confidence in using their estimates was not misplaced. That is the only credit we deserve. All the rest goes to the Livermore people, whose performance in the Marshall Islands has been exceptional. I am not surprised their work has been verified.

Good luck with your testimony.

With best regards,

Bill

W.J. Bair, Ph.D.
Manager
Life Sciences Center

WJB:taz

cc: J Healy
WL Robison
BW Wachholz

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May 23, 1988

Dr. Henry I. Kohn
1203 Shattuck Avenue
Berkeley, CA 94709

Dear Henry:

Thank you for sending me the corrected pages of your draft report. I've marked a few places that might be improved for technical clarity. I appreciate your patience.

I believe our book was mistakenly identified in the task assigned to you. All the technical effort was done by Bill Robison and colleagues. You have wisely reviewed their work rather than our book, but it is still not fully clear in your report. However, this doesn't detract from your excellent work.

With best regards,

Bill

W.J. Bair, Ph.D.
Manager
Life Sciences Center

WJB:taz

Henry I. Kohn, MD, PhD
RONGELAP REASSESSMENT PROJECT

RECEIVED
MAY 18 1988
W.J. BAIR

May 9, 1988

W. J. Bair, Ph.D.
Manager, Life Sciences Center
Pacific Northwest Laboratories
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Richland, WA 99352

Dear Bill,

Thank you for your comments on the draft of April 20, 1988. I have changed the current draft to follow the intent of your remarks, and the changes are shown on the pages which are enclosed.

As I understand it, you and Drs. Healey and Wacholtz were in the position of messengers delivering a message for DOE. In writing the text, I have always tried to make DOE responsible for DOE-1982, not you. I hope the changes introduced now will make this quite clear. Note especially the statement in Section 1.2, paragraph 1.

Sincerely yours,

Henry

Encl. Pp.3,4; 11 (your 18): 15 (your 23); 19 (your 28); 23 (your 34); 29 (your 42).

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read, especially, the parts of the Report referring to them. It should be noted that DOE-1982 is a statement by DOE and is always referred to as such in this Report, [redacted].

Dr. William Robison (Lawrence Livermore National Laboratory, Livermore CA 94550), who supplied the field data and the dose calculations for DOE-1982, was also interviewed and has read this Report.

[redacted]

however, was greatly facilitated by employing an international panel of experts, selected so as to represent a variety of overlapping specialties that would cover the problems under examination.

If they chose to do so, the consultants who were still in disagreement with the final draft of the Report (having discussed earlier versions with Dr. Kohn), were asked to write brief notes on their own views to be mentioned in the text and to be included as footnotes or among the "Notes to the Text". The absence of such comment, however, does not necessarily indicate agreement with the entire text. A major commentary by Dr. Bertell and Mr. Franke is given in Note 13.

[redacted]

that the people had been used as "guinea pigs".

With the foregoing as background, let us now attempt to answer the questions which the Congress has asked: Were the doses used by DOE-1982 correct (Robison 1982b)? Does it follow that Rongelap is habitable? If not, what should be done?

It should be noted that the technical position has changed since 1982. More data have been published so that the original meager sampling has become more robust. In addition, we shall consider the findings of the Brookhaven National Laboratory, using an important method which DOE-1982 did not consider, and also our own findings.*

The data base employed by DOE-1982 comprised the results of the Northern Marshall Islands Survey of 1978 (September-November) which had been planned as an aerial reconnaissance to map external gamma-ray exposure rates (normalized to 1 meter above ground level) (Tipton & Meibaum,1981). Two helicopters were employed, operating from a major support vessel, the U.S.N.S. Wheeling.

Subsequently the Livermore Laboratory program was added to obtain soil, water, vegetation and fish samples at each atoll "as time and facilities might permit" (Robison et al, 1982, Part 1). The time spent at Rongelap Atoll permitted 7 days for 9 islands, of which the major one was Rongelap. Operating from a large ship that had to cruise at a considerable distance offshore, and whose primary function was aerial reconnaissance, restricted the terrestrial work significantly.

The radionuclides dealt with were five: cesium-137, which is distributed throughout the body; strontium-90, a bone seeker; plutonium-239,-240 and americium-241, which have very long half-lives and which are tightly bound by bone, liver and testes (Table 3 #1). *suggest the given rate is greater than it really is. See below*

The Livermore group took soil samples from some 20 scattered locations on Rongelap Island whose averages (picocuries/gram) for 0-10 cm depth were: cesium-137, 12; strontium-90, 7.1; plutonium-239,-240, 2.6; americium-241, 0.9 (Table 3 #2).

This soil contamination provided the basis for human exposure in two ways. Radiations emanated from the ground or standing vegetation leading to external dose. Radiations that emanated from food and water after entering the human body were responsible for internal dose.

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* B. Franke states that the enabling legislation calls for study of only the original findings and report. A second committee should consider subsequent findings, and a third group should execute its recommendations.

retention time is probably long; however, only about 10^{-4} to 10^{-5} of systemic Pu is deposited in testes or ovary & the ratio of ingested Pu that is absorbed into the blood is about 10^{-4}.

[redacted]

employing the original data and corrected assumptions, and by those employing subsequent findings on additional field samplings.

However, the independent assessment by the Brookhaven National Laboratory, based on whole-body counting for cesium and urinary analysis for strontium, lowers the whole-body dose significantly. This estimate, in my opinion, is the definitive one.

Brookhaven's estimate of the transuranic dose (plutonium, americium) has raised the question of the size of its contribution to dose--a matter which is under discussion--but in any case, apparently not great enough to prevent a decision from being made. This matter will be discussed.

The question of infant dosage, neglected previously, has been dealt with specifically (or will be).

4.2 Internal Dose - Lawrence Livermore National Laboratory

Lawrence Livermore attacked the problem by determining what went into the body by ingestion and inhalation (picocuries per day), and then applying appropriate factors to such input (exposure) to obtain the dose in rem. The particular ones I have used are given in Table 4.2 #1.

Ingestion. The major uncertainty lies in the diet--no one knows precisely what it is, although several attempts have been made to define it. DOE-1982 used the BNL community B diet, i.e., one involving a greater amount of food and also a greater input of contaminated food (Note 11). Naidu et al (1980) who originally described it commented that the diet represented prepared, not eaten food, and that in fact it was more than a person could eat. This results in overestimation of dose. The Lawrence Livermore group that used it for dose calculations concurred.

The 1978 specific activities measured by the Livermore team were made on 21 samples of coconut, 5 of Pandanus, 1 of breadfruit, 1 chicken, 2 pigs and 98 fish, on the whole a barely adequate number (Robison et al, 1981a, 1982b). In 1986, however, that Laboratory took additional samples (Robison 1988), and in 1987 this reassessment project also collected some which were analyzed independently. The results, summarized in Table 4.2 #2, show remarkable agreement for the Livermore 1978 and 1986 cesium data on the foods contributing the major part of exposure and also good agreement for our independent samples in 1987 (Note 8).

I am therefore taking 4400 picocuries/day as the exposure due to cesium-137, based on a total of about 4000 for foods listed in Table 4.2#2 plus a 10% allowance for a miscellaneous variety of others (Note 11, Table #1). The whole-body, red marrow and bone surface doses for 30 years are just about equal, 1.65 rem (Table 4.2 #1).

The strontium estimates at present are based on the original 1978 sampling. (No strontium analyses were done on the Livermore 1986 samples, nor were our 1987 samples delivered soon enough to have them done on time.) I am therefore taking .035 picocuries/day for the exposure, based on the field samples plus a 25% increment for other miscellaneous foods. The 30-year doses for whole-body, red marrow, and bone surface are .032, .175 and .385 rem, respectively.

In the case of the transuranics, the Livermore group is now summarizing their Rongelap work through 1987 and this involves some revision of both data and dose calculations (Table 4.2#3). Based on a

[redacted]

marrow .11 rem; bone surfaces, .25 rem.