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Safety & Environmental Protection Division

March 11, 1988

ACTION HPE ✓
INFO AMESH
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AMOE

Mr. David Wheeler
United States Department of Energy
Nevada Operations Office
2753 South Highland Drive
Las Vegas, NV 89109

Dear Mr. Wheeler:

I recently spoke with Mr. Bruce Church and he advised me that I should appraise you of the status of BNL's program for Pu-239 studies. I am overwhelmed by the recent interest of many people. Rather than make several phone calls in order to update all those who have an interest in the information, I am sending a copy of the enclosed memo to each person. This appraisal should provide everyone with an idea on what the problems and costs of the program are.

Best regards.

Sincerely,

Edward T. Lessard

Edward T. Lessard

ETL:stc

Enclosure

Copy to: H. Brown
B. Church
H. Kohn

Bioassay-Dosimetry Review 87

HARRY BROWN'S Files, NV

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MAR 15 1988

BROOKHAVEN NATIONAL LABORATORY

M E M O R A N D U M

DATE: March 11, 1988

TO: C. B. Meinhold

FROM: E. T. Lessard ETL

SUBJECT: Pu-239 Program for Rongelap and Bikini Residents

Task

Determine the body content of Pu-239 in Rongelap and Bikini residents.

Approach

The BNL approach is to collect and analyze samples of urine from former residents of Bikini and Rongelap Atolls, and interpret the measured results for Pu-239 after accounting for individual exposure patterns. Past field trips to the Marshall Islands have resulted in the collection of urinary samples. These samples are transported to Brookhaven National Laboratory where they are analyzed for Pu-239 using the method described by Moorthy (1). Presently, there are 70 Bikinian and 299 Rongelapese urinary samples analyzed. Approximately 14 adult male urinary sample results have been interpreted from the Bikini batch (2). A list of the Rongelap samples which remain to be interpreted is given in Table 1. The stock of urinary samples that remains to be analyzed consists of 218 samples which were collected from Utirik residents and 1621 samples which were collected from Enewetak residents.

Other urinary sample measurements have been performed for Pu-239, but have resulted in questionable results (3,4,5). These prior efforts to define the impact of Pu-239 led to the implementation of the Photon-Electron Rejecting Alpha Liquid Scintillation (PERALS) method in 1983, which ultimately proved to be insensitive to low levels of Pu-239. On the other hand, our continued efforts led to the successful development of the fission track etch method. It is my understanding that the 27 Rongelap samples which were analyzed by the PERALS method could be analyzed again by fission track etch, but this needs some development work. Additionally, we have 250 fecal samples but we have not adapted the fission track etch method to this type of sample, and these samples are in storage. The BNL fission track etch method has been producing high quality results for urinary samples for over one year.

Table 1 Rongelap Urinary Samples Which Have Been Analyzed for Pu-239 by the Fission Track Etch Method but Not Interpreted

Collection Year	Age Group	Sex	Number of Samples
1981	>20	M	17
	5-20	M	26
	>20	F	18
	5-20	F	14
1982	>20	M	12[a]
	5-20	M	28[b]
	>20	F	8[a]
	5-20	F	9[c]
1983	>20	M	12
	5-20	M	31
	>20	F	24
	5-20	F	21
1984	>20	M	16
	5-20	M	24
	>20	F	16
	5-20	F	23

a All samples analyzed PERALS.
b Four samples analyzed by PERALS.
c Three samples analyzed by PERALS.

Radiochemical Analyses

Urines are processed weekly in batches of 10 along with 6 controls which are composed of duplicates, blanks and standards. When the reactor is in operation, results are available in 3 to 6 weeks. About 500 samples are processed annually. We anticipate that sample input may be increased to a small extent with our present resources, but major expansion requires additional FTE support and laboratory facilities. Approximately 3.5 scientific/ technical FTEs are required to process 500 samples per year.

Interpretation of Bioassay Measurements

In 1985, BNL requested permission from Roger Ray of the DOE Nevada Operations Office to continue obtaining and interpreting bioassay samples from the Rongelapese who had moved from Rongelap (6). Since that time, the BNL field program was eliminated and the overall budget pared down. I have a file cabinet full of letters, internal documents, and data which relates to the Marshall Islands' studies, but I have difficulty dropping my

present activities in order to do part-time research on Marshall Islands' issues. Since early 1986, BNL focused its limited resources on the analyses of urinary samples for Pu-239. No funds have been available for additional BNL services for several years. Yet I am often requested to act in the leadership role. It is stressful to be *de facto* responsible for a DOE research project which is outside my own line management's authority, and at the same time devote myself to my current job. The Marshall Islands' program does not have manpower to interpret measurements, nor does it have a program leader. There are no FTEs allocated to close out the task with the results obtained to date and provide an undisputed answer to the stated problem.

Poor statistics due to the lack of urinary sample measurements (see Table 1) will cause an uncertain estimate for the mean and range of body content of Pu-239 in the population under study. Since the group is small and the variance large, sampling urinary excretion for Pu-239 for all members of the group must define the range and mean values. Presently, I have not found a method to interpret measurements of Pu-239 in excreta of nonadults in terms of intake. On the other hand, a protracted study on urinary samples from repeated sampling of the younger age groups should produce the excretion function. While I have investigated the origin of the excretion function for adults (7), there is no widely accepted function.

Based on urinary output of Pu-239, an uptake of Pu-239 in the Rongelapese and the Bikinians is certain, but the mode of intake is not, e.g. is the intake through skin absorption or skin breaks, ingestion, or inhalation? Answering this question is important if one is to factor in lung and GI tract dose equivalent. Additionally, any future sample collection program has to be designed to eliminate the impact of sample variance, and this can be accomplished by collecting several samples from each person. Compositing several samples collected during a field trip will reduce variance and keep analysis cost down. The future program should determine the impact of diet on the excretion of Pu, such as the impact of EDTA (8) which is a common food additive used to scavenge metals which are imparted from pots and pans during food preparation.

The future program leader has to receive guidance from DOE on which product to focus on: annual effective dose equivalent, committed effective dose equivalent, dose equivalent to specific organs, or annual intake. Focusing on annual dose equivalent will result in determining the actual dose equivalent received in a future year from all previous Pu-239 intakes (9). This triggers considerable retrospective study of exposure. This is because Pu-239 taken up by Rongelap residents in 1954 and from 1957 to 1985 continues to irradiate exposed individuals today. Focusing on annual dose equivalent entails considerable interpretive study since specific organ distributions will need to be determined or assumed.

Focusing on committed dose equivalent will emphasize the assessment of its surrogate which is annual intake. While we could investigate the mode of intake, the alternate which is to assume either ingestion or inhalation and use parameter values which match an uptake to intake conversion, as used by ICRP, is just as good. BNL should estimate intake from empirical excretion models (7) and compare with ICRP guidance on acceptable levels of intake (10,11). ICRP developed the intake limits based on reasonable assumptions about the dose equivalent, and additional work to interpret the dose equivalent is not necessary in order to carry out a radiological safety mission. The focus of the program should be to attempt to develop estimates of annual intake for each age group based on excretion of Pu-239. A program leader must relate the intake to the findings of Lawrence Livermore National Laboratory. He must communicate results back to DOE, Dr. Cohn and/or the Marshallese.

New urinary sampling should begin immediately. Samples should be obtained from former residents of Bikini ~~and Ronge~~lap and sent back to BNL for analysis before these people return to the contaminated islands. The Marshallese people should be instructed on a method for providing "clean catch" urinary samples. Ten samples from each individual should be collected over a period of two years. This will reduce the uncertainty associated with estimates of derived quantities, such as intake, uptake, or body content, and provide a time study for us to derive the elimination pattern for different age groups.

Costs

I estimate the cost associated with a two year effort to collect additional urinary samples from Rongelapese to be $50,000. I base this on 2 urinary samples per person per field trip x 5 trips x $10,000 per field trip for travel, materials and shipping. Since the program should include samples from Bikinians, an additional 1,000 urinary samples per 100 Bikinians should be collected which adds $50,000. The two samples per person per field trip should be composited for analysis. An additional cost of $1,000,000 is associated with the radiochemical analysis of 1,000 composited urinary samples for Pu-239. The cost of manpower for data interpretation and program leadership is $170,000 per year. The total estimated 2 year expense is about $1,500,000. The above costs should not be construed to cover any additional costs associated with a whole-body counting program or for bioassay for Sr-90. I should like to point out that I am not representing BNL in this estimate of cost. Rather, I am providing an estimate of cost based on my personal opinion.

1. A. Moorthy, C. J. Schopfer, and S. Banerjee, "Plutonium From Atmospheric Weapons Testing: Fission Track Analysis of Urine," Analytical Chemistry, in press, 1988.

2. E. T. Lessard, "Marshall Islands Program Review," Presented to the Marshall Islands Dosimetry Review Group, Technical Review Meeting, DOE Nevada Operations Office, Las Vegas, NV, September 30, and October 1, 1986.

3. R. A. Conard et. al., A Twenty Year Review of Medical Findings in a Marshallese Population Accidentally Exposed to Radioactive Fallout, BNL 50424, Brookhaven National Laboratory, Upton, NY, 11973, 1974.

4. E. T. Lessard, R. P. Miltenberger, S. H. Cohn, S. V. Musolino and R. A. Conard, "Protracted Exposure to Fallout: The Rongelap and Utirik Experience," Health Physics V46, pp.511-527, 1984.

5. E. T. Lessard to William Bair, Letter of August 8, 1984 and William Robison to William Bair, Letter of August 24, 1984.

6. E. T. Lessard to R. Ray, Letter of June 7, 1985.

7. A. Brodsky and E. T. Lessard, Emergency Bioassay for Accidental Exposure to Alpha Emitters, NUREG\CR 4884, Brookhaven National Laboratory, Upton, NY, 11973, 1988.

8. National Council on Radiation Protection and Measurements, Management of Persons Accidentally Contaminated with Radionuclides, NCRP Report No.65, NCRP Publications, P. O. Box 30175, Washington, DC, 20014, 1980.

9. Department of Energy, "Radiation Protection for Occupational Workers," DOE Order 5480.11, August, 1987.

10. International Commission on Radiological Protection, Limits on Intakes for Workers, ICRP Publication 30, Pergamon Press, Oxford, 1978.

11. International Commission on Radiological Protection, "Annual Limits on Intake (ALI) and Derived Air Concentrations of Radionuclides for Members of the Public," ICRP draft publication from Committee 2, 1982.

COPY TO:

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