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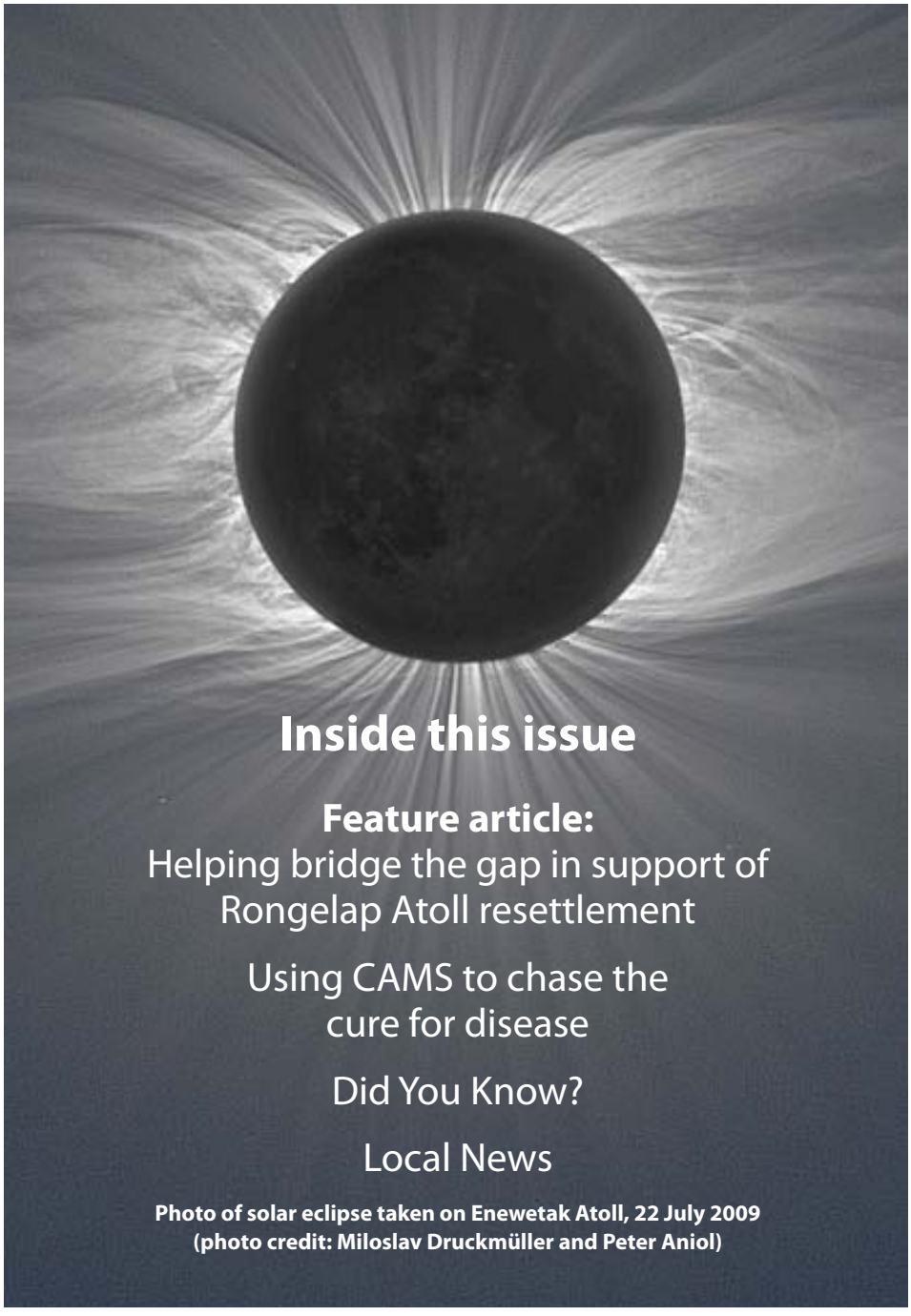
MARSHALL ISLANDS RADIOLOGICAL SURVEILLANCE GROUP

BIKINI • ENEWETAK • RONGELAP • UTROK

MARSHALL ISLANDS MONITOR



Inside this issue

Photo of solar eclipse taken on Enewetak Atoll, 22 July 2009 (photo credit: Miloslav Druckmüller and Peter Aniol)

A note from the editor

Welcome to the *Marshall Islands Monitor,* a quarterly newsletter featuring work performed under the Marshall Islands Dose Assessment and Radioecology Program at the Lawrence Livermore National Laboratory.

Each issue of this newsletter will include a feature article dealing with the broader aspects of the consequences of the nuclear test program that took place from 1946 to 1958 in the Marshall Islands as well as updates on specific program activities and findings.

The newsletter is available through a free e-mail subscription and is also accessible on the Web at https://marshallislands.llnl.gov/. You can subscribe to future e-mail issues by sending an e-mail message to freitas21@llnl.gov and include the words "subscribe MIMonitor" in the subject box.

Terry Hamilton, PhD
Editor in Chief

Feature Article

Helping bridge the gap in support of Rongelap Atoll resettlement

Through the Rongelap Resettlement Act, the U.S. Congress approved and continued a 1996 resettlement agreement between the United States and the Rongelap Atoll Local Government (RALG), and extended distribution authority for ten years to advance resettlement. As a part of the 1996 resettlement agreement, a Phase I resettlement program was initiated in 1998. The Rongelap leadership engaged the U.S. Department of Energy (DOE) in developing a resettlement support plan to provide environmental monitoring to verify effectiveness of cleanup methods, and to develop local resources and expertise in radiological protection monitoring. The DOE, RALG, and the Republic of the Marshall Islands signed an MOU in 1999 to enact such provisions in show of solidarity in support of Rongelap resettlement. A strong focus for this partnership was a provision to develop an individual radiological protection monitoring program based on whole body counting (WBC) and plutonium bioassay (urinalysis). RALG was tasked with the construction of a permanent whole body counting facility on Rongelap Island. The DOE was tasked with (i) equipping the WBC facility; (ii) recruiting and training Marshallese technicians to operate the WBC facility; (iii) developing an occupational radiological protection monitoring program for resettlement workers living on Rongelap Island; (iv) developing quality assurance protocols and an accessible reporting platform for the monitoring program; and (v) verifying effectiveness of cleanup measures.

The ultimate goal of resettlement support was to develop infrastructure and manpower resources necessary to monitor return of the resettled population while demonstrating that radiological conditions on Rongelap comply with national and international safety standards for radiological protection of the public. The DOE has since developed several new initiatives to address more specific concerns raised by the Rongelap community and its leadership. For example, at the request of RALG, the DOE was asked to develop updated radiological data for pantry islands on the atoll. An initial mission covering the northern islands of Rongelap was conducted by scientists from Lawrence Livermore National Laboratory (LLNL) during the summer of 2009, and more work is planned for 2010. Additionally, Livermore scientists developed an experimental garden plot on Rongelap Island to study the uptake of cesium-137 (^{137}Cs) and strontium-90 (^{90}Sr) in selected vegetable products. The garden project was formulated in response to current efforts in the Marshall Islands to promote dietary change to help combat the high incidence of life-style diseases such as diabetes, and is supportive of a working philosophy to evaluate potential exposures that may occur both for current and future land-use conditions.

The following Phase 1 initiatives were developed in support of Rongelap resettlement.

1. To assess worker exposure to internally deposited ^{137}Cs.

It is well established that ingestion of ^{137}Cs from consumption of locally grown foods forms the most critical pathway for exposure of people to radiation generated from residual nuclear fallout contamination in the northern Marshall Islands. Whole body counting is a very accurate technique used to measure how much ^{137}Cs people have acquired in their bodies from eating local foods. Residents who return to Rongelap will now be able to receive regular whole body counts, and make an informed decision about their eating habits based on what is considered a 'safe' or acceptable health risk. In this way, the continuing radiological protection monitoring program on Rongelap will, for the first time, be positioned to monitor the return of a displaced community, and provide assurances that radiation related health risks remain at or below safety standards in radiological protection.

Through 2008, the Rongelap Island WBC facility database had acquired 1485 verified records and 321 registered volunteers. The WBC program volunteer cohort population is composed almost entirely of adult male resettlement workers but participation is offered to all visitors to the island. Data and information from the WBC program is made publicly available in de-identified form in reports and publications as well as over the internet (https://marshallislands.llnl.gov/). These activities are sanctioned by the Institutional Review Board (IRB) at LLNL. The IRB ensures that appropriate protocols are implemented to protect the rights and privacy of subject volunteers participating in the program.

The highest level of internally deposited ^{137}Cs observed in people living in the Marshall Islands is usually observed in the adult male population. A comparison of historical whole body count measurements for adult males from the Rongelap population group (1958-94) and from resettlement workers living on Rongelap (1999-2008) is shown in Figure 1.

Whole body counting data on internally deposited ^{137}Cs for the Rongelap population group (1958-1994) was developed by the Brookhaven National Laboratory (BNL). The low-level of internally deposited ^{137}Cs observed between 1989 and 1994 coincides with the time that people from Rongelap Atoll moved to Majetto at Kwajalein Atoll. In general, these data show that levels of internally deposited ^{137}Cs have decreased significantly since the end of the nuclear test program in the Marshall Islands. Moreover, although the resettlement workforce on Rongelap is temporary in nature, the continuing WBC program on Rongelap provides some helpful insights into the range of exposures likely to be seen in a hypothetical resident population. What is very clear is that levels of internally deposited ^{137}Cs measured in resettlements workers (1999-2008) are more similar to levels observed on Majetto (1989-93) than for the resident male population living on Rongelap during the 1980s. By this simple analogy, we can clearly state that it appears safer to live on Rongelap now than at any time since the beginning of the atmospheric nuclear testing program in the Marshall Islands.

The average annualized dose delivered to resettlement workers from internally deposited ^{137}Cs over the past five years has ranged from 1.4 mrem to 2.4 mrem. This compares with a cleanup standard of 15 mrem per year as accepted by the Marshall Islands Nuclear Claims Tribunal (NCT) (Figure 1). This environmental statute is based on guidance from the United States Environment Protection Agency (EPA) to ensure cleanup of contaminated sites to acceptable levels, and the return of property to a condition suitable for unrestricted use. The high-end annualized doses assessed at the 95th percentile of the measured distribution over this same period varied from 1.7 to 6.5 mrem. No resettlement workers exceeded the 15 mrem per year cleanup criterion as adopted by the NCT.

There are legitimate concerns about using the results of the existing whole body counting program for resettlement workers as a basis for showing compliance with cleanup criterion for full unrestricted resettlement of Rongelap Atoll. By making direct comparisons between exposures to workers and the established cleanup (safety) criterion of 15 mrem per year, we assume that the living (dietary) pattern of workers resembles that of a hypothetical permanent resident. Is that true? We can make a reasonable argument for stating that this is indeed the case based on a retrospective analysis of WBC data collected during the 1980s. These data presumably provide a reasonable reflection of unrestricted living patterns of that era. The resettled population on Rongelap will most likely receive signifinant quantities of imported foods under a supplemental food program, so the historical WBC data is also seen as a conservative benchmark to assess doses under present-day living conditions.

Using our extensive knowledge of the behavior of ^{137}Cs in the environment (Robison et al., 2003; Robison and Hamilton, 2010), we estimate that the dose contribution from internally deposited ^{137}Cs on Rongelap should be a factor of ~8 less than levels observed in 1984 or around 2.5 mrem per year (at least for the adult male population examined here). This compares with average annualized dose estimates in the range of 1.4 to 2.4 mrem for workers living on Rongelap over the past 5 years. The internal consistency of these data suggests that the dietary pattern of a hypothetical resident living on Rongelap Island will not be that dissimilar to that of resettlement workers, and provides added confidence that the dose contribution from internally deposited ^{137}Cs will not exceed the 15 mrem per year cleanup criterion. This would apply even where no additional steps are taken to reduce the levels of

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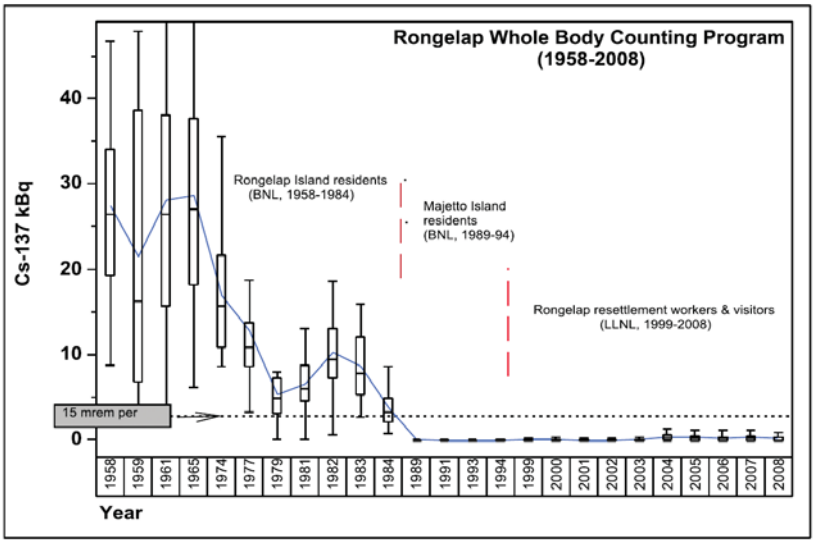

Box plots represent 25 to 75th percentiles ranges; box lines (or whiskers) represent the 10 to 90th percentile ranges; reference line represents the internal deposit of ^{137}Cs required to deliver a dose of 15 mrem to an adult male (app. 3 kBq); similarly, the internal deposit of ^{137}Cs required to deliver a 15 mrem dose to an adult female, teenager, adolescent and child is approximately 2.5, 2.4, 1.5 and 1 kBq, respectively (after Daniels, et al., 2007).

Figure 1. History of internally deposited ^{137}Cs in adult males from Rongelap (BNL, 1958-1994) and for resettlement workers and visitors on Rongelap Island (LLNL, 1999-2008).

Continued from previous page
Rongelap resettlement

^{137}Cs in locally grown food products. Soil remediation (as discussed below) as well as other forms of cleanup such as the addition of potassium to agricultural fields will provide an added margin of safety and perhaps, most importantly, build public trust in the resettlement process.

This analysis also assumes that the ingestion dose from consumption of ^{137}Cs contained in locally grown foods will dominant the dose contribution from other radionuclides and pathways. Based on decades of relevant experience in radioecology and our ongoing cleanup verification monitoring program on Rongelap, we estimate that internally deposited ^{137}Cs will account for at least 50% (perhaps as much as 70-90%) of the total effective dose for resettlement of Rongelap during 2010 (Hamilton et al., 2009). As such, the total effective dose delivered to a hypothetical resident population should also comply with the 15 mrem per year cleanup criterion and, by analogy, serves as a basis for declaring Rongelap as safe for resettlement. Moreover, in relative terms, the estimated dose contribution from exposure to residual fallout contamination on Rongelap represents a small fraction (less than 2 percent) of the total radiation dose people normally experience from natural background radiation in the Marshall Islands (Robison and Hamilton, 2010). Also, as previously shown, the small excess risk from exposure to residual nuclear fallout contamination on Rongelap Island is such that it is more likely than not that there will be zero cancers arising from fallout-related exposures based on resettlement of up to five hundred people (Robison et al., 1994).

2. To assess worker exposure to internally deposited plutonium.

Under this subtask, scientists from LLNL developed a plutonium bioassay monitoring program for resettlement workers on Rongelap. The bioassay program included assessments of 115 resettlement workers using advanced measurement technologies based on Accelerator Mass Spectrometry (AMS). The urinary excretion of plutonium-239 from resettlement workers averaged around 0.1 µBq per 24-h void. The level of plutonium-239 observed in bioassay samples was statistically higher than the background concentration measured in a set of field blanks ($p < 0.001$) prepared under similar field conditions but is identical to levels reported for other Marshallese populations (Hamilton et al., 2006, 2007) and is well within the normal baseline range of urinary excretion of plutonium from people exposed to worldwide fallout contamination in the Northern Hemisphere.

Many of the workers on Rongelap who provided bioassay samples were exposed to potentially high resuspension conditions associated with soil remediation activities. This represents a worst-case scenario for plutonium inhalation and absorption into the human body. The fact that none of workers participating in the bioassay monitoring program acquired elevated levels of plutonium in their urine suggests that plutonium exposure is unlikely to be an issue of concern associated with resettlement of Rongelap Island. Assuming low-level chronic exposure conditions, a urinary excretion rate of 0.1 µBq of plutonium-239 per 24-h void from an adult equates to an effective dose from plutonium (plutonium-239 + plutonium-240) of around 0.05 mrem per year or a 50-y CEDE under steady state exposure conditions of around 2.5 mrem. It should be noted that under the current system for radiological protection, practices giving rise to annual effective doses of less than 1 mrem are commonly exempted from regulatory requirements on the basis that the doses are so small that they can be considered negligible, and the excess lifetime risk of fatal cancer as *de minimis*.

Plutonium is a concern to the people of the Marshall Islands because of its long half-life (T1/2 = 24,000 years), and persistence both in the environment and in the human body. Unfortunately some of the early plutonium bioassay data reported for the Marshall Islands was of questionable quality, and may have contributed to the decision taken in 1985 for the people of Rongelap to abandon their ancestral homeland (Sun et al., 1992; National Research Council, 1994). Scientists from the BNL developed a more refined measurement technique based on Fission Track Analysis (FTA); however, measurement technologies in low-level plutonium bioassay

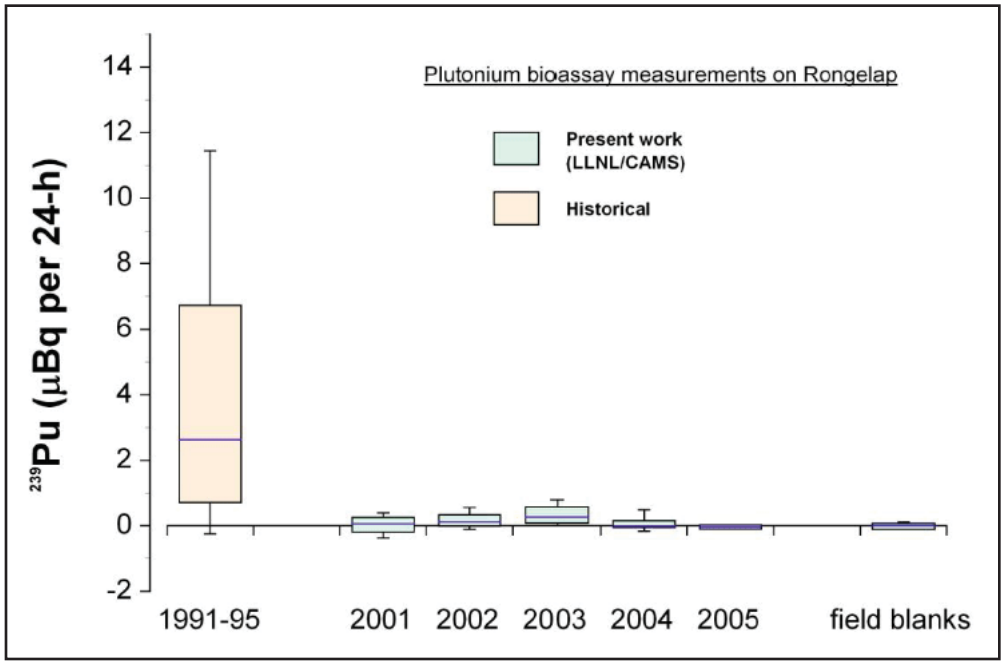

Figure 2. Plutonium bioassay measurements for former residents (1991-95) and resettlement workers living on Rongelap Island (2001-2005).

have continued to advance, especially in relation to the development of isotope specific detection methodologies based on mass spectrometry. These techniques not only provide improved detection sensitivity but tend to be more reliable and are much less susceptible to interferences (Hamilton et al., 2004).

Based on AMS measurements performed at the LLNL, urinary excretion rates of plutonium-239 from Rongelap resettlement workers (Figure 2) as well for other Marshallese populations appear to be consistently lower and are much less variable that previously reported. In general, these data have very important implications for the Marshall Islands, and demonstrate that AMS is sufficiently sensitive to not only make accurate assessments of plutonium exposure under present-day living conditions but potentially allow assessments of systemic burdens of plutonium acquired from previous exposures. As reported in the last edition of this newsletter, the improved detection sensitivity of AMS plutonium bioassay provides a reachback capability where we can now reconstruct doses from previous exposures to plutonium. Such measurements provide a basis for assessing the quality and reliability of historical plutonium data from the Marshall Islands. In more general terms, the improved quality, reliability, and detection sensitivity of AMS for low-level plutonium bioassay studies will enable the DOE to develop high-quality, baseline data for the resettled population on Rongelap. These data will be essential in terms of accurately assessing or tracking potential low-level chronic exposures to plutonium associated with resettlement, and from long-term changes in plutonium behavior and/or exposure conditions at the atoll.

3. Verify the effectiveness of soil remediation activities in the village and service area on Rongelap.

The remediation goal was to limit the external dose rate from residual ^{137}Cs in village soil to less than 1 mrem per year for full occupancy using a combination of limited soil removal and the addition of crushed coral fill. Under this subtask, the resettlement contractor was tasked with removing the top 25 cm of contaminated surface soil around the housing and service area, and replacing it with clean, crushed coral fill. The main objective of soil remediation was to reduce the external exposures from gamma (and beta) radiation in areas where people spend most of their time. However, the methodology of adding crushed coral fill to reduce external gamma radiation is also effective in reducing the resuspension of fallout radionuclides in the air that people breathe and, therefore, also helps reduce risks from inhalation exposure.

The local contractor was successful in achieving almost an order of magnitude reduction in external gamma dose rates around the village and service area, and individual home sites.

The measured external gamma dose rate in the new village and service area on Rongelap is expected to be around 1 mrem per year for a resettlement date of 2010. This compares with external dose rate estimates for the interior of the island that range from 4 to 8 mrem per year (Hamilton et al., 2009; Robison and Hamilton, 2010).

4. Verify effectiveness of reducing ^{137}Cs uptake in food tree crops by the addition of potassium.

Under this subtask, Livermore scientists were asked to provide verification monitoring of tree crop products to study the effectiveness of adding potassium to help reduce the uptake of ^{137}Cs into plants. Potassium was added to an area on northern Rongelap Island extending from the main village and service area to the end of the island. The effectiveness of the treatment was estimated by comparing the activity concentration of ^{137}Cs in drinking coconut meat with measurements performed during the early to mid 1990s. The potassium treatment reduced the uptake of ^{137}Cs in drinking coconut meat by a factor of about 2 or down to about 50% of the pretreatment level. This was slightly less than what was expected. The observed 50% reduction was estimated using results randonly selected sample trees. Controlled experiments on Rongelap Island using sorghum and corn reduced ^{137}Cs uptake to 33% of pretreatment levels (Robison and Hamilton, 2010). There is no record of how potassium was applied to the coconut grove area on Rongelap, nor the amount and uniformity of application. The observed difference in the effectiveness of potassium treatment between the LLNL controlled experiment and remediation work on Rongelap most likely reflects differences in ^{137}Cs concentration in the soil and/or irregularities in the potassium application. It is recommended that future efforts to apply potassium at Rongelap be supervised and monitored by LLNL scientists.

5. Supplemental support activities.

A pantry style radiological survey mission was conducted on northern Rongelap Atoll in the summer of 2009. During the mission, a wide variety of food products were collected for radiometric analysis including coconut meat, coconut juice, Pandanus fruit, several different species of fish along with clam, birds, and coconut crabs.

Preliminary results from the pantry sampling program on northern Rongelap will become available in the second of half of 2010.

In developing our approach to assessing radiation doses and risks for protection of the resident populations in the northern Marshall Islands, we attempt to evaluate reasonable maximum exposures expected to occur both for current and future land use conditions.

An experimental garden plot was also developed on Rongelap Island during the 2009 mission. This garden experiment was designed to mirror efforts in the Marshall Islands to help reduce the incidence of life-style diseases such as diabetes through the introduction of different types of vegetables into the local Marshallese diet. We anticipate that the resettled community may start to grow vegetables on Rongelap Island for personal consumption or possibly for commercial sale. The initial planting of vegetables at Rongelap was very successful.

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Continued from previous page
Rongelap resettlement

The first series of garden plot samples including several different species of cabbage as well as cucumber, vegetable soybean, peppers, radish, and sweet corn are in the process of being shipped to LLNL for radiometric analysis. In general, results from the garden experiment will provide valuable information in helping develop a more comprehensive and accurate assessment of radiological conditions on Rongelap.

Summary remarks

The data and information presented in this article were developed as part of a cooperative agreement between the DOE, RALG, and the Republic of the Marshall Islands. The following summary points attempt to address a number of key issues related to resettlement of Rongelap Island.

i. The radiological situation on Rongelap Island has improved dramatically since the community left the island in 1985.

ii. RALG contractors have carried out an extensive remediation project that has reduced the dose from external radiation in the main village and service area to negligible levels.

iii. If the resettled population on Rongelap adopts a dietary (living) pattern similar to that of the resettlement workers or that of former residents, the population average and reasonable maximum exposures on Rongelap should not produce doses that exceed the 15-mrem-per-year cleanup (safety) criterion accepted by the Marshall Islands Nuclear Claims Tribunal. The same conclusion is reached whether using (i) predictive dose assessments based on environmental data and modeled dietary assumptions; (ii) whole body count records of internally deposited ^{137}Cs measured in resettlement workers living on Rongelap over the past decade; and (iii) extrapolation of results from historical whole body count records of internally deposited ^{137}Cs measured in permanent residents living on Rongelap during the 1980s. No assumptions were made in this analysis about the introduction of additional cleanup measures on Rongelap Island beyond the scope of existing work.

iv. Individual exposure and risk will largely be controlled by three main factors (i) the quantity of locally grown terrestrial food consumed, (ii) the source of the locally grown food (northern versus southern islands), and (iii) how much time a person spends on the interior of islands, especially in relation to occupancy of the northern islands. The marine exposure pathway is expected to make a very minor (negligible) dose contribution.

v. It is common practice in radiological protection to consider potential benefits as well as the detriment. Apart from potential social and cultural benefits of resettlement, the availability of clean water and spacious housing on Rongelap as well as access to a rich, thriving atoll ecosystem with plentiful quantities of fish and other marine resources will likely lead to tangible improvements in the general wellness of the community, i.e., an overall improved health consequence not a detriment.

vi. The risk from radiation exposure on Rongelap Island is such that it is more likely than not that there will be zero cancers arising from fallout-related exposures in association with resettlement.

vii. Continuing support will be offered by the DOE to ensure that the resettled population on Rongelap is closely monitored, and that radiation related health risks remain at or below safety standards in radiological protection.

Terry Hamilton, Lawrence Livermore National Laboratory

Edward Kaplan & Stephen Musolino, Brookhaven National Laboratory

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About the Authors

Terry F. Hamilton, PhD

Dr. Hamilton received his doctorate from the University of Melbourne, Australia, in 1987 and earned undergraduate degrees in chemistry and applied science. He served as a postdoctoral researcher at Flinders University of South Australia before joining the United Nations (1988-95) as a Group Leader in the International Atomic Energy Agency's Monaco Laboratory (IAEA-MEL).

In 1996, Dr. Hamilton joined the Lawrence Livermore National Laboratory under the UC Berkeley Scholar Program and has held positions as the Deputy Director of the Marshall Islands Program, as Group Leader of Environmental Measurements and Characterization Group–Health and Ecological Assessments Division, and as Deputy Division Leader of the Environmental Science Division. Dr. Hamilton has over 20 years of international experience solving problems related to the health and ecological impacts of radionuclide releases to the environment. He has been involved in studies in the Russian Arctic , Mediterranean Sea, Adriatic Sea, Sea of Japan, and at test sites in the Aleutian Islands, in French Polynesia and at the Maralinga test site in South Australia. Dr. Hamilton has multidisciplinary expertise in the fields of marine and terrestrial radioecology, health physics, radiochemistry and in studies on the fate and transport of radionuclides using advanced analytical techniques.

Dr. Hamilton is currently serving as the Scientific Director of the Marshall Islands Dose Assessment and Radioecology Program at the Lawrence Livermore National Laboratory.

Edward Kaplan, PhD

Edward Kaplan holds a B.A. and M.S. in physics (New York University, 1964 & 1966), and a Ph.D. in environmental systems analyses (University of Pennsylvania, 1973). Between 1967-1973 he worked as an environmental scientist at General Electric Co., then joined Argonne National Laboratory in 1973 where he studied energy-related impacts to Lake Michigan. In 1976, Dr. Kaplan moved to Long Island, NY, where he accepted a position as an environmental scientist at Brookhaven National Laboratory. He also accepted a position on the faculty of the Department of Technology and Society at SUNY/Stony Brook, where he developed a program in environmental engineering and waste management, and taught graduate courses in environmental systems engineering.

While at BNL, Dr. Kaplan conducted policy analyses for the U.S. Environmental Protection Agency, the Department of Energy, and the Nuclear Regulatory Agency.

He led projects analyzing environmental hazards from geothermal wastes and potential ground water contamination from tertiary oil recovery, impacts of acid rain on aquatic ecosystems, and the performance of high-level radioactive waste packages.

His most important contributions at BNL involved assessing radiological aspects of fallout in the south Pacific Marshall Islands, and nuclear safeguards, providing technical assistance to nuclear materials control and accounting in the former Soviet Union.

Dr. Kaplan holds a patent on the use of wireless, passive neutron detectors for anti-terrorism applications, and also developed innovative multi-layer ground water samplers and membrane devices to detect chemical warfare agents.

Dr. Kaplan has authored over 150 professional papers and reports, has edited two texts, and currently serves as a member of the editorial board of an environmental journal.

He retired from BNL in 2007 but continues his safeguard activities as consultant to Savannah River National Laboratory, and he continues to teach at SUNY/Stony Brook.

Dr. Kaplan serves as a trustee of the Stony Brook Environmental Conservancy, and supports the director of Brookhaven National Laboratory as a member of the BNL's Community Advisory Council. He has been married for 43 years, has three sons and one grandson.

Stephen Musolino, PhD

Dr. Stephen Musolino is a scientist in the Nonproliferation and National Security Department at the Brookhaven National Laboratory. During his 31 years at BNL, Dr. Musolino has worked on many radiological safety projects, including as the Marshall Islands Radiological Safety Program that monitored populations living on Pacific islands affected by atmospheric nuclear tests conducted in the 1950s. In the 1990s, Musolino developed and managed the Environmental, Safety & Health program for BNL's world-class accelerator, the Relativistic Heavy Ion Collider (RHIC), from the construction through the commissioning of the $600-million facility. As a member of the DOE/NNSA Radiological Assistance Program, known as the RAP team, Musolino is trained to evaluate the consequences of a radiological emergency and advise local authorities on what actions need to be taken to minimize the health and environmental effects of an incident. He received his M.S. in Nuclear Engineering from The Polytechnic Institute of New York, and Ph.D. in Health Physics from the Georgia Institute of Technology. Dr. Musolino is certified by the American Board of Health Physics, is a Fellow of the Health Physics Society, and a member of the National Council on Radiation Protection and Measurements.

Using CAMS to chase the cure for disease

LAB NEWS (20 November 2009). Using a technique dubbed "microdosing," researchers in the Center for Accelerator Mass Spectrometry (CAMS) at the Lawrence Livermore National Laboratory have been applying accelerator mass spectrometry (AMS) to biological research for more than 20 years.

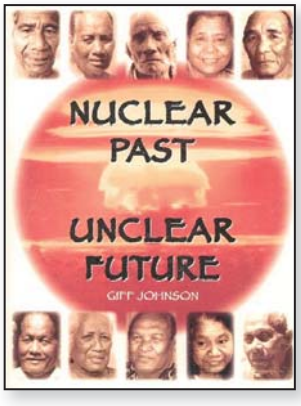
Highly sensitive AMS was originally used for carbon-14 dating in research areas such as archaeology, paleoclimatology and paleobotany. Microdosing is not used as part of the DOE Marshall Islands Program. However, LLNL has developed a new measurement technology based on AMS detection to enhance its capability of measuring small quantities of plutonium in bioassay samples collected from the Marshall Islands. These results clearly show that the dose contribution from plutonium exposure in the Marshall Islands is very low, and is of no consequence to human health.

Today, AMS studies of new drugs, nutrients and toxic compounds can use human subjects because the safety of the AMS approach has been demonstrated repeatedly. The amount of radioactive carbon-14 used to tag a biomolecule is less than the naturally occurring cosmic radiation an airline traveler encounters during a routine flight.

Microdosing involves labeling a small quantity of a new or established drug with carbon-14. A tiny quantity is then given to a patient to determine if the drug finds its way to the site where infection or disease occurs. Tests taken a few hours later measure the amount of the drug in the body and its location. From there, a pharmaceutical company could determine if the new drug could be given to humans in larger amounts (at potential therapeutic levels to treat disease). "This is a small, safe amount to treat patients at the sub-therapeutic level," said LLNL biochemist Ken Turteltaub, a co-developer of AMS for biological research. "Microdosing could reduce the amount of preclinical work, time and cost of getting new drugs to market."

Ted Ognibene of Lawrence Livermore National Laboratory loads a sample in the NEC 1 MV Tandem Accelerator at the Center for Accelerator Mass Spectrometry.

Booklet Review



A recent booklet entitled *Nuclear Past—Unclear Future* by Giff Johnson chronicles some history of the United States nuclear testing program in the Marshall Islands. The booklet describes initial and subsequent relocations of Bikini and Enewetak Atoll populations and relocation of Rongelap and Utrōk Atoll communities after the Bravo test at Bikini Atoll on March 1, 1954. Included is a useful summary by year and month (1946 to 2009) of many issues and events that occurred in the Marshall Islands. Health, political, and science issues are discussed.

Some of the topics are distorted by lack of knowledge of the science and led to misinterpretation of issues. The discussion also fails to give any credit to doctors, such as Dr. Bill Adams from the Brookhaven National Laboratory, who was the ultimate embodiment of a true physician and whose only purpose was the expert medical care of his patients. He also pioneered bringing specialists from the U.S. and around the world on each of his missions over the many years he ran the medical program.

Also, attention is brought to various claims and compensation issues that are yet to be fully resolved. Overall the booklet is a good, although brief, summary of many issues that have developed since the beginning of U.S. nuclear testing in the Marshall Islands.

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Did you know?

What the heck is 'health physics'?

The name sounds like it is all about pendulums and inclined planes, but it is really about radiation protection. The most entertaining story about the origin of the job description "health physicist" is that it came about during the "Manhattan Project" when scientists needed to protect themselves from the radioactive materials they used. According to the story, the term, "health physicist" was chosen to be an intentionally confusing description to disguise the work on the atomic bomb.

Over the last 60 years, health physics has developed into an important and complex scientific discipline and profession. There are entire university degree programs devoted to it as well as professional-level certification. In keeping with the confusing name, health physicists have many confusing terms and units such as rem, rad, roentgen, effective dose equivalent, and committed dose, just to name a few. If that weren't confusing enough, health physicists also use the international system of units (Sieverts and Gray).

Today many health physicists work in nuclear power plants, hospitals and industries, all places where radiation is used. Some also work at EPA, since EPA is the primary Federal agency charged with protecting the public from the harmful effects of radiation. Many of them became involved in health physics because they were interested in the science of radiation. I once had a manager tell me that health physicists were unique at EPA because they were the only ones who "thought their pollutant was cool."

I think the hardest job health physicists have is explaining radiation to the public and to other scientists at the EPA. We know a lot about radiation, but for low level radiation exposure, there is a lot that we need to assume and estimate, and many areas where the science is not clear. I usually start out my discussions about radiation by reminding people that this is a radioactive world

Reported by Richard Poeton, CHP-US EPA Region 10 Seattle Office
http://blog.epa.gov/blog/2009/09/29/what-the-heck-is-health-physics/

Can your flip-flops kill you?

Ah, the casual, comfortable flip-flop: A symbol of summertime, an emblem of relaxation — and a harbinger of death? OK, well, that may be overstating it a little bit — but not by too terribly much, health experts say.

TODAY, with the help of the University of Miami emergency mobile flip-flop lab, tested some footwear and found that there were more than 18,000 bacteria on just one pair of flip-flops. Even more shocking than the number of germs were the types represented — bacteria from fecal matter, skin and respiratory germs. One pair of 6-year-old flip-flops had germs that cause yeast infection and diaper rash.

Reported by Laura T. Coffey, TODAY
http://today.msnbc.msn.com/id/32453516/ns/today-today_health/

Panel sees no need for A-bomb upgrade

In a new report, a secretive U.S. federal panel has concluded that programs to extend the life of the nation's aging nuclear arms are sufficient to guarantee their destructiveness for decades to come, obviating a need for a costly new generation of more reliable warheads. The finding, by the Jason panel, an independent group of scientists that advises the federal government on issues of science and technology, bears on the growing debate over whether the United States should ratify the Comprehensive Test Ban Treaty or, instead, prepare for the design of new nuclear arms.

Reported by William Broad, New York Times
http://www.nytimes.com/2009/11/20/us/20nuke.html?_r=2

France to pay nuclear test compensation

BBC — Nearly 40 years after the first of its 210 nuclear tests, France is preparing to compensate people affected by the fallout. The move leaves the United Kingdom isolated in its policy of rejecting liability for illnesses suffered by test participants, reports Aidan Lewis. Only now, with many of the veterans dead or dying, is the French government drawing up a bill that starts to satisfy their demands. The new bill would offer money to people present at tests — which continued until 1996 - who have contracted one of 18 types of cancer designated by the United Nations. This brings France broadly into line with the United States.

After presenting the bill to the cabinet late last month, Defense Minister Herve Morin said that if the government had moved sooner, the effect could have been like "sticking a pin in a balloon". "For a very long time, engaging in a process of compensating the victims of nuclear tests was to risk weakening this colossal effort that France made to give itself a nuclear weapon, and thus to preserve its sovereignty," he said. But he also acknowledged the "physical and psychological distress" of the veterans, and the need for France to "put its conscience at rest".

http://news.bbc.co.uk/2/hi/europe/8076685.stm
Releated: Former Soldiers Sue State for Nuclear Radiation Damages. The Santiago Times English-language Network, Chile.

Radiation overdoses point up dangers of CT scans

At a time when Americans receive far more diagnostic radiation than ever before, two cases under scrutiny in California — one involving a large, well-known Los Angeles hospital, the other a tiny hospital in the northern part of the state — underscore the risks that powerful CT scans pose when used incorrectly. Cedars-Sinai Medical Center in Los Angeles disclosed that it had mistakenly administered up to eight times the normal radiation dose to 206 possible stroke victims over an 18-month period during a procedure intended to get clearer images of the brain. State and federal health officials are investigating the cause. Hundreds of miles north at Mad River Community Hospital in Arcata, the other case — involving a 2 ½-year-old boy complaining of neck pain after falling off his bed — has led to the revocation of an X-ray technician's state license for subjecting the child to more than an hour of CT scans. The procedure normally takes two or three minutes.

Reported by Walt Bogdanich, New York Times
http://www.nytimes.com/2009/10/16/us/16radiation.html

Australia keen to embrace nuclear power

A new poll says there has been a significant shift in support for nuclear power in Australia. It has found that almost half of all Aussies believe the technology should be considered as an alternative source of energy to help combat the effects of climate change. The survey, conducted by the Melbourne Age newspaper and the Nielson polling company, shows a marked change in Australian attitudes to nuclear power, in the last three years. In 2006, only a third of respondents thought the atomic option was a good one. Today almost 50 percent believe it would be a sensible alternative source of energy in a country that is heavily dependent on fossil fuels. On a per capita basis, Australia is one of the world's worst emitters of greenhouse gases and scientists have warned it is particularly vulnerable to the effects of a shifting climate.

Supporters of nuclear power have insisted it is the only practical low-emissions substitute for coal. However, critics are worried about the risk of accidents and the awkward issue of safely storing radioactive waste. Opponents also assert that it would take too long for Australia to develop a nuclear power industry.

At the moment, the federal government has no plans to go down the nuclear path, preferring instead to investigate clean-coal technology and a raft of renewable energy sources. Australia has just one atomic facility, on the outskirts of Sydney, which is used mainly to produce radiopharmaceuticals.

Reported by Phil Mercer, VOANews.com

Shortage slows a program to detect nuclear bombs

WASHINGTON — The Department of Homeland Security has spent $230 million to develop better technology for detecting smuggled nuclear bombs but has had to stop deploying the new machines because the United States has run out of a crucial raw material, experts say. The ingredient is helium 3, an unusual form of the element that is formed when tritium, an ingredient of hydrogen bombs, decays. Helium 3 is used to detect neutrons, the subatomic particles that sustain the chain reaction in a bomb or a reactor. Plutonium, the favorite bomb-making material of most governments with nuclear weapons, intermittently gives off neutrons, which are harder for a smuggler to hide than other forms of radiation. The government wanted 1,300 to 1,400 machines, which cost $800,000 each, for use in ports around the world to thwart terrorists who might try to deliver a nuclear bomb to a big city by stashing it in one of the millions of containers that enter the United States every year.

Reported by Matthew L. Wald, New York Times

http://www.nytimes.com/2009/11/23/us/23helium.html?_r=1

Low Dose Radiation 'Harms Heart'

BBC — Low doses of radiation can cause cardiovascular disease, according to work carried out by mathematicians at Imperial College in the United Kingdom. They have constructed a model which suggests that the risk would increase as the dose increases. Studies have shown that nuclear workers exposed to long-term doses of radiation have higher levels of heart disease. But experts said it was too early to draw such conclusions without the biological research to back it up.

The team at Imperial College, writing in the journal PLOS Computational Biology, say they explored a novel mechanism that suggests radiation kills monocytes, which travel across the arterial wall to mop up a protein called MCP-1. High levels of MCP-1 are thought to cause the inflammation which leads to cardiovascular disease. Their model was consistent with the rates of heart disease seen in nuclear workers and also predicted the changes in MCP-1 caused by high levels of cholesterol in the diet.

http://news.bbc.co.uk/2/hi/health/8321286.stm

San Onofre — an example of a nuclear power plant located at San Clemente, California, USA

Publications

Davisson, M. Lee, and T.F. Hamilton (2009). The Low-level Radioactive Waste Disposal Site of Runit Dome on Enewetak Atoll, Marshall Islands: Its History, Construction, and Need for Characterization and Monitoring, Poster presentation LLNL-POST-420784, APSORC '09 (Asia-Pacific Symposium on Radiochemistry '09), November 29 – December 4, 2009, Napa Valley Marriot, Napa, California, USA.

Davisson, M. Lee, T.F. Hamilton, A.F.B. Tompson (2009). Radioactive Waste Buried Beneath Runit Dome on Enewetak Atoll, Marshall Islands, Lawrence Livermore National Laboratory, LLNL-JRNL-421842, Livermore, California (submitted Radiochimica Acta).

Hamilton, T.F., S.R. Kehl, E. Kaplan, P.P. Gu, S. Musolino, D. Henry, K. Johannes, and D.P. Hickman (2009). Post Resettlement History of Cesium-137 Exposure on Enewetak Atoll Based on Whole Body Counting, Poster presentation LLNL-PRES-418701, 55th Annual Radiobioassay and Radiochemistry Measurements Conference, October 26 – October 30, 2009, San Antonio, Texas.

Hamilton, T.F., S.R. Kehl, R.E. Martinelli, F. Gouveia,, E. Kaplan, S. Musolino, and W.L. Robison (2009). Rongelap Island Resettlement Support: Status Report, Lawrence Livermore National Laboratory, LLNL-TR-421381, Livermore, California.

Hamilton, T.F., T.A. Brown, R.E. Martinelli, A.A. Marchetti, S.J. Tumey, R.W. Williams, and S.R. Kehl (2009). Accelerator Mass Spectrometric Measurements of Plutonium Isotopes in Soil Samples Collected from Enewetak Atoll in the Northern Marshall Islands, Oral presentation LLNL-PRES-420750, APSORC '09 (Asia-Pacific Symposium on Radiochemistry '09), November 29 – December 4, 2009, Napa Valley Marriot, Napa, California, USA.

Robison, W.L., and T.F. Hamilton (2010). Radiation doses for Marshall Islands atolls affected by U.S. nuclear testing: all exposure pathways, remedial measures, and environmental loss of ^{137}Cs, Health Phys., 98(1), 1-11.

Local News

LLNL completes successful mission to Rongelap

Staff from LLNL and Pacific Operations International, Inc (POII) recently completed a successful mission to northern Rongelap Atoll. This two-week mission aboard the Marshallese vessel Jeljelat Ae was the first in a series of scheduled science missions to Rongelap designed to develop updated radiological data on pantry islands around the atoll. Drought conditions severely limited the collection of tree-crops products such as coconut and Pandanus fruit. Other types of samples collected included a wide variety of reef and pelagic fish, marine and terrestrial crabs, and birds thanks largely to the combined efforts of Dr. Tom Jack (team physician) and an enthusiastic boat crew. Livermore scientists also developed an experimental garden on Rongelap Island to study the uptake of ^{137}Cs and ^{90}Sr into leafy green vegetables as well as other root and seed crops. Results from the mission will become available in the second half of 2010.

Vegetable garden growing on Rongelap Island (photo: Mr. Willma Riklon)

Whole body counting facility on Majuro relocated

The Majuro Whole Body Counting Facility and the U.S. Department of Energy (DOE) logistics support office was moved this past November to the Robert Reimers Complex at Uliga. The facility provides a free public service to check if people have acquired measurable quantities of ^{137}Cs in their bodies. ^{137}Cs is a radioactive product that was dispersed into the environment from atmospheric testing of nuclear weapons, and may enter the food chain through soil-to-plant transfer.

"We hope that this new, centralized downtown location will encourage more 'walk-ins' volunteers" said Mr. William Jackson, the DOE Marshall Islands Program Manager. "If people are concerned about being exposed to radiation from bomb fallout then they should come into the facility and receive a free count," he said.

A whole body counting chair weighing in excess of 3000 lbs on the move in Majuro (photo: Mr. Lance Yamaguchi)

We take this opportunity to thank Norbert Reimers and his work crew for helping facilitate the move.

Calendar of Events

Meetings

APSORC '09 (Asia-Pacific Symposium on Radiochemistry '09), November 29 – December 4, 2009, Napa Valley Marriot, Napa, California, USA.

HPS Midyear Meeting, January 24-27, 2010. Radiation Risk Communication to the Public (the 42nd Midyear Topical Meeting of the Health Physics Society), Albuquerque, New Mexico, USA.

NCRP 2010 Annual Meeting, March 8-9, 2010. Communication of Radiation Benefits and Risks in Decision Making, National Council on Radiation Protection & Measurement (NCRP), Hyatt Regency Bethesda, Bethesda, Maryland, USA.

55th Annual Meeting of the Health Physics Society, Salt Lake City, USA.

Events

January 2010

Initial survey mission to Utrōk Atoll to develop plans to assess hot-spot locations on Utrōk Island, and implement a garden project to study the uptake of ^{137}Cs and ^{90}Sr in leafy vegetables as well as other root and seed crops.

April-June 2010

LLNL mission to Enewetak to collect bioassay samples from a selected cohort population known to be working on the northern islands digging for copper cables, assess support needs and interest in developing a garden project on Enewetak, Medren or Japtan Islands, and continue ongoing field studies.

LLNL field mission to Rongelap to develop updated radiological data on Tufa Island, and provide ongoing support for the resettlement program.

LLNL field mission to Bikini Atoll to establish an experimental garden to study the uptake of ^{137}Cs and ^{90}Sr in leafy vegetables as well as other root and seed crops, and continue ongoing field studies.

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