

MARSHALL ISLANDS RADIOLOGICAL SURVEILLANCE GROUP



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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

Misconceptions about the links between radiation exposure and genetic (birth) defects

There has been attention in recent years to the appearance of an unusual birth defect syndrome in at least two children born to parents living in the northern Marshall Islands. This medical disorder has been diagnosed by physicians in Hawaii as Waardenburg's syndrome. Waardenburg's syndrome is a well known to physicians as a syndrome that includes patches of light-colored hair, hearing defects, changes in the pigmentation of the eyes, and other characteristic features. It may occasionally be associated with cleft lip or palate, a gastrointestinal disorder called Hirschprung disease that can cause intestinal blockage, and abnormal development of the limbs. Unfortunately, some affected children may die prematurely.

The syndrome was named after the Dutch Physician who first described it in 1951. There are actually several different manifestations of this syndrome that have been identified subsequently. There are now at least four types of Waardenburg's syndrome and several sub-types. Its appearance can be highly variable; some individuals may have all or just a few of the features.

In most cases the syndrome is inherited in an autosomal dominant pattern, meaning that it only takes one inherited gene from either of the parents for the child to be affected. In this case, one of the parents usually has

some signs of the disease. Some forms of Waardenburg's syndrome are autosomal recessive, meaning that genes would have to be inherited from both parents. In this case, the parents usually have no signs of disease. In either situation, it is possible for a family to have more than one child with the Waardenburg's syndrome. While the information is incomplete, it appears that the Marshall Islands cases are probably of the second (recessive) type.

Waardenburg's syndrome is not common in the general population, occurring in only one out of about 42,000 births. The frequency can be higher in some population groups. But in schools for the deaf, typically 2-3% of the students have this condition, so it is a common cause of deafness. All races and sexes appear to be affected equally. The disease has been recognized in many parts of the world. The genes that control the syndrome have also been identified and genetic testing can be done. Unfortunately, there is no specific treatment or cure. Genetic counseling is available to assist parents of a Waardenburg's syndrome child to understand their risk for having another affected baby.

The question of whether there could be a connection between radiation exposure and Waardenburg's syndrome deserves some discussion. This question has two parts. First, there is the issue of exposure to the

parents. No heritable birth defects from radiation exposure have ever been observed in humans. More specifically, the National Research Council found no statistically demonstrable adverse genetic effects attributable to radiation exposures sustained by the (Japanese)

survivors and no significant adverse effects in more than 30,000 progeny from parents who received low doses of radiation. Similarly, the International Commission

on Radiological Protection (ICRP) says that up to the time a child is conceived, radiation exposure to the testes and ovaries of either parent has not been shown to cause birth defects in children. Although there is no proof of radiation-induced inherited genetic defects in humans, some animal studies do show that inherited genetic defects may result from experimental radiation exposure. Based on animal data, current risk estimates to grandchildren of persons exposed to radiation represents 0.4 to 0.6% of the natural incidence of

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Misconceptions

heritable effects for all classes of disease. For autosomal recessive forms of disease (as identified above), the risk is effectively zero because induced recessive mutations do not normally precipitate disease in the first few generations.

The second part of this question is whether it is possible for direct radiation exposure to a pregnant woman to cause the Waardenburg's syndrome. There are no cases of Waardenburg's syndrome caused by radiation expo-

There is no report of any cases of Waardenburg's syndrome from radiation exposure.

sure reported in the medical literature. In addition, scientists think that the threshold for fetal malformations is 100-200 mGy of radiation to the fetus during pregnancy,

which would be an unusually high dose for a pregnant woman to receive given the current data about levels of radiation exposure in the Marshall Islands. Receiving 100 – 200 mGy of radiation is the equivalent to obtaining three CT scans or 20 conventional x-rays. Based on current medical and scientific data a connection between Waardenburg's syndrome and radiation exposure in the Marshall Islands is very unlikely.

Dr. James Seward and Dr. Terry Hamilton, Lawrence Livermore National Laboratory



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.



James P. Seward, MD MPP MMM

Dr. James Seward is Medical Director at Lawrence Livermore National Laboratory. He holds academic appointments as Clinical Professor of Medicine at UCSF and Clinical Professor of Public Health at UC Berkeley. He teaches in occupational medicine and preventive medicine at the UC Berkeley School of Public Health and serves as Chair of the UCSF Occupational Medicine Residency Advisory Committee. He is Co-Director of the UCSF-UCB Joint Residency Program in Preventive Medicine and Public Health and is a member of the UCSF Global Health Sciences Faculty.

Dr. Seward received his medical training at UCSF and also completed residencies in Internal Medicine and Occupational Medicine at UCSF. He is board certified in Internal Medicine and Preventive Medicine (Occupational Medicine). He completed a Masters in Medical Management at Tulane University, and he also holds a Masters in Public Policy from UC Berkeley. He was a Robert Wood Johnson Clinical Scholar and a Fulbright Scholar. He is a Fellow of the American College of Occupational and Environmental Medicine, the American College of Preventive Medicine, and the American College of Physician Executives.

Dr. Seward is recent past President of the Western Occupational and Environmental Medicine Association and has served as the Occupational Medicine Regent for the American College of Preventive Medicine. He is also Past President of the California Academy of Preventive Medicine.



Local News

Bikini goes for World Heritage

(Marshall Islands Journal)

Bikini Atoll is applying for World Heritage status. The nomination proposal is being prepared by Bikini Liaison Jack Nietenthal and Australian-based consultant Nicole Baker. Both believe that a listing by World Heritage would increase Bikini's visibility internationally and bring more visitors to the former nuclear weapons test site. A final decision from the World Heritage Committee is not expected until June of 2010.

N-cases dismissed

(Marshall Islands Journal)

A panel of United States appeal judges has dismissed a claim to enforce a more than \$1 billion test compensation settlement for Bikini and Enewetak Atolls. Bikini attorney Jonathan Weisgall and Enewetak lawyer Davor Pevec will not give up the fight, and plan to continue to seek justice for the people of Bikini and Enewetak Atolls from other branches of the U.S. Government.

Drought conditions in the Northern Marshall Islands

Lawrence Livermore National Laboratory has been maintaining weather station data on Bikini Atoll for over 20 years. This past 12-18 months were the driest on record. Bikini Island received just over 15 inches of rain during 2008, or less than 25 percent of the normal average annual rainfall since 1989.

Livermore team completes successful mission to Bikini Atoll

During December 2008, scientists from the Lawrence Livermore National Laboratory conducted a successful 10-day mini-mission to Bikini Atoll to investigate radiological conditions of old concrete test bunkers. Dr. Terry Hamilton and his field team performed external gamma radiation surveys of nine separate bunker locations, and collected a range of samples for detailed analysis in the United States. Preliminary data suggests that the bunkers are not "leaking radiation" as allegedly reported but do represent a general hazard because of spalling of concrete and the possibility that people entering the bunkers may be hit or trapped by falling pieces of debris (refer to adjoining photographs). DOE representative, Mr. William Jackson, and the atoll leadership have been informed about conditions inside the bunkers.



The photos above were taken from inside old concrete test bunkers constructed on Omen Island (Bikini Atoll) during the nuclear test program (1946-58) in the Marshall Islands. (Photos by Terry Hamilton)

The mission to Bikini Atoll was conducted aboard the Marshallese vessel *Jeljelat Ae*. Dr. Hamilton and his field team take this opportunity to thank the logistics team from Pacific Operations International, Inc. (POII) and Captain Lussier and his crew for helping support the mission.



Field mission team (December 2008, Bikini Atoll) (Photo by Sherwood Tibon)

Marshall Islands Whole Body Counting Program

Whole body counting has been used for the measurement of internally deposited radionuclides since the mid-1920s. The first populations measured were the radium dial painters who worked in factories that applied radioactive luminous paint to instrument dials so that the dials would glow in the dark. Since this time, the majority of whole body counts have been performed on workers who have potential for the intake of radionuclides. Whole body counting has been used to monitor radiation exposures to nuclear fallout contamination in the Marshall Islands since the 1960s. Today, under the auspices of the U.S. Department of Energy (DOE), the Marshall Islands Whole Body Counting Program is the largest per capita whole body counting program in the world for members of the general public. The current database of personnel counted (~3000) represents approximately 5 percent of the total population of the Marshall Islands.

The DOE and local atoll governments presently operate and maintain three whole body counters in the Marshall Islands. These facilities are located on Enewetak, Majuro and Rongelap Atolls, and contain a whole body counting chair and detector system similar to the one shown in the adjoining photograph. A whole body counter tests for presence of a cesium-137 (radiocesium) inside peoples' bodies. Why is this important?

Firstly, cesium-137 is radioactive isotope of cesium and was released to the environment as fallout deposition from atmospheric nuclear weapons testing. Cesium-137 has a relatively long half-life of 30.23 years so it persists in the environment for a long time. Elevated levels of cesium-137 can still be detected in coral soil and some plants from the Marshall Islands, especially at Bikini and Enewetak Atolls and other atolls in the northern Marshall Islands.

Secondly, the behavior of cesium-137 in coral soils is very unique in that it is readily taken



Whole body counting chair and detector system used to test for presence of cesium-137 (radiocesium) inside peoples' bodies.

up by plants and may be stored in locally grown foods such as coconut, Pandanus fruit and breadfruit. Cesium-137 gives off invisible waves of ionizing radiation called gamma-rays. If this radiation deposits energy in a person, he or she receives a radiation dose. Radiation doses from exposure to nuclear fallout contamination in the environment are normally reported in units of millisievert (mSv). Agencies in the United States prefer to use traditional units of millirem (mrem). 1 mSv is equal to 100 mrem and there are one thousand millirem in one rem (1000 mrem = 1 rem). The primary risk associated with radiation exposure is an increased risk of cancer. The risk factors depend on the magnitude of the dose, the time period in which the dose was received, and the body parts that are exposed to the radiation. Cesium-137 is uniformly distributed through the body with higher concentrations in muscle tissue and less in bone. Cesium-137 deposited in the person's body will eventually be lost through radioactive decay or excretion. The biological half-life of cesium-137 is relatively short at 110 days, so any

cesium-137 that enters a person's body will be all gone within about two years. This means that if you stop or reduce your intake of cesium-137 by eating less locally grown foods or eat foods containing less cesium-137, then your dose contribution from cesium-137 will also decrease.

The Whole Body Counting Program has been monitoring the radiation dose delivered to various Marshallese population groups from internally deposited cesium-137 using the results from whole body counting programs on Enewetak, Rongelap and Majuro Atolls (<https://marshallislands.lni.gov/>). The aim of these programs is to ensure that the dose contribution from ingestion of cesium-137 via consumption of locally grown foods remains at or below regulatory guidelines for protection of the public. Basic radiological safety standards for the protection of the public assume that a person who receives a whole body radiation dose of 25,000 millirem (mrem) over his or her lifetime has an increased risk of dying from cancer by as

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Whole Body Counting

much as 1 percent. Although radiological protection standards assume low-level radiation doses increase the risk of getting cancer, studies have not demonstrated any adverse effects in individuals who are chronically exposed to low doses of radiation over a period of many years (e.g., for people receiving total doses up to 10,000 mrem above the average background dose).

Summary data from the Marshall Islands Whole Body Counting Program for calendar year 2008 are shown in the graph below. Over 1000 whole body counts were performed on volunteer program participants during this period, mostly on workers or residents living on Enewetak, Kwajalein, Majuro and Utrok Atolls. The majority of volunteers working or living on the northern atolls had a measureable dose contribution from internally deposited cesium-137. The number of program participants (N) and the average annual dose contribution from cesium-137 (given as the arithmetic mean value) on various atolls were as follows: Arno Atoll (N=6, <0.1 mrem), Enewetak Atoll (N=287, 0.9 mrem), Kwajalein Atoll (N=14, 0.3 mrem), Majuro Atoll (N=264, <0.1 mrem), Mejit Atoll (N=6, 2.0 mrem), Rongelap Atoll (N=11, 2.4 mrem), Utrök Atoll (N=104, 1.6 mrem) and Wotje Atoll (N=6, <0.1 mrem).

The population average annualized dose from cesium-137 across each of the identified atolls falls well below the safety standard of 15 mrem per year adopted by the Marshall Islands Nuclear Claims Tribunal (NCT) for clean-up of radioactively contaminated sites. A small number of volunteers (N=7) received doses from internally deposited cesium-137 in the range of 10 to 15 mrem per year. One key benefit of the DOE Individual Radiological Protection Monitoring Program in the Marshall Islands is that we can accurately assess doses to high-end individuals rather than rely on population average doses predicted from historical environmental data and model dietary assumptions. The continuing whole body counting program in the Marshall Islands also provides a scientific basis for tracking future change in

radiological conditions, especially in relation to assessing the impacts of changes in land-use and dietary habits on radiation exposure conditions. We therefore strongly encourage all Marshall Islanders to participate in this voluntary program.

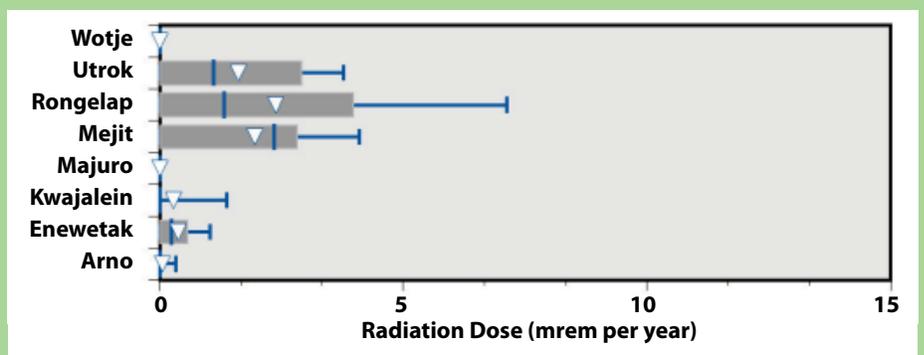
The whole counting facility on Majuro is located at the DOE/Pacific Operations International, Inc. (POII) program office in Delap. If you are interested in receiving a free test to determine the amount of radiation in your body, please drop by the the DOE/POII program office or call 625-8922 to schedule an appointment. Normal office hours are between 9:00-12:00 am and between 1:30-4:30 pm. The program offers free transportation to and from the facility. A whole body count only takes about 30 minutes to complete and you'll receive an immediate printout of your results. The DOE operates similar whole body counting facilities on Enewetak and Rongelap Atolls. Again, temporary workers and visitors as well as local residents on Rongelap and Enewetak are strongly encouraged to receive regular (at least annually) whole body counts.

Readers are also reminded that national and international agencies such as the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) use a dose limit for protection of the public of 100 mrem per year.

If you are interested in receiving a free test to determine the amount of radiation in your body, please drop by the DOE/POII program office in Delap or call 625.8922 to schedule an appointment.

Dose contribution from internally deposited cesium-137 based on whole-body counting

Annual Doses for Calendar Year 2008



Notes:

The highest, second highest, middle, second lowest and lowest (not visible) represent the 90th, 75th, medium, 25th and 10th percentiles, respectively. The mean values for each atoll are represented by triangle symbols.

Did you know?

Radiation up in medicine

(Tri-City Herald) The average American is receiving about six times more radiation each year from medical procedures than 25 years ago, according to a report by the National Council on Radiation Protection and Measurements. The average medical exposure is now around 300 mrem per year compared with about 53 mrem 25 years ago. The increase has been attributed to the significant growth in medical imaging techniques such as CT scans.

Background radiation

People around the globe are exposed to natural background radiation in rocks and soils (including radon gas that seeps into homes and other buildings), from deep space and from inside the human body, on average, about 360 mrem per year. People living in the Marshall Islands receive less than half this amount of radiation so anyone planning on relocating to the U.S. from the Marshall Islands, will actually double his or her overall risk from radiation exposure.

DOE appoints new medical and logistical management team

The U.S. Department of Energy (DOE) has appointed a new contractor to manage the DOE medical-care and cancer-screening program for eligible patients identified as victims of the 1954 Bravo test or selected as part of a control group. This will include all logistical support for the program. Christus Spohn Health Systems Foundation officially took over the program on 1 January 2009 under sub-contracts with Comprehensive Health Services, Inc. (CHS), a Florida-based company, and Pacific Operations International Inc. (POII). The parent organization operates more than 40 hospitals in the southern and southeastern states of the U.S. and parts of Mexico, and is a leader in the field of cancer research and treatment. Dr. Gael Lavina,

former administrator of the 177 Health Program on Majuro, has been appointed as the new head of clinical operations for the program, while Dr. Tom Jack will continue to serve as the program's chief physician at Kwajalein Atoll.

POII is a logistics support group managed by Michelle and Lance Yamaguchi. Mr. Yamaguchi and his team have a long history of working in the Marshall Islands, and will continue to provide logistics support for both the medical and environmental programs. DOE officials and program contractors met for the first time in early December in Corpus Christi, TX. Christus Spohn, CHS and POII program managers along with the Program Manager Mr. William Jackson from the DOE are expected to visit the RMI sometime early in 2009 to meet with government officials and the local leadership from Rongelap and Utrök Atolls.

Government buys back radioactive home

(Sydney Morning Herald) SYDNEY – In an out-of-court settlement, the State Government of New South Wales reached an in-principle agreement to pay a Hunters Hill family to buy their radioactive home, allegedly built on a uranium dump. Inspectors were said to have produced a glowing report.

Future of Yucca Mountain nuclear waste repository project under question

(Washington Post) WASHINGTON – Yucca Mountain, located on a volcanic ridge about 100 miles northwest of Las Vegas, Nevada, has been under consideration as a nuclear waste repository site since the 1980s. President Obama's proposed budget cuts place this project in jeopardy and raises new questions about what to do with radioactive waste generated from the nation's nuclear power industry.

DOE delivers on Waste Isolation Pilot Plant

(Carlsbad Current-Argus) In a significant milestone for the U.S. Department of Energy (DOE), the first shipment of remote-handled transuranic waste arrived safely at the Waste Isolation Pilot Plant near Carlsbad, NM, after a 1,300 mile journey from the Oak Ridge Transuranic Waste Processing Center in Tennessee.

New studies on locally grown vegetables and grains

Do vegetables grown in the Marshall Islands contain nuclear fallout contamination? Dr. Terry Hamilton from the Lawrence Livermore National Laboratory believes that vegetables grown in the Marshall Islands are perfectly safe to eat (and provide many additional health benefits) but has asked the DOE to support efforts to develop experimental garden plots on a number of different atolls to help verify that this is indeed the case.

Local atoll leaders and the Ministry of Resources and Development have all offered assistance. This is an important study because new varieties of vegetables and grains have been introduced into the Marshall Islands in recent years as part of a nation-wide health initiative to combat the high incidence of heart-disease and life-style diseases such as diabetes.

The main aim of the garden study is to develop baseline data on the levels of nuclear fallout contamination in locally grown vegetables, and then use these findings to assess long-term impacts (if any) on human health.



Calendar of Events



May 4--6, 2009

"Late Health Effects of Ionizing Radiation: Bridging the Experimental and Epidemiologic Divide," Lombardi Comprehensive Cancer Institute at Georgetown University, Washington, D.C. For more information see <http://lombardi.georgetown.edu/events/radconf09/index.htm>.

MARSHALL ISLANDS PROGRAM

-Schedule of Events-

May 2009

U.S. Department of Energy-Republic of the Marshall Islands (DOE-RMI) Annual Program Meeting, Corpus Christi, Texas.

June 2009

Lawrence Livermore National Laboratory (LLNL) Rongelap Atoll survey mission to establish a garden project on Rongelap Island and begin to develop updated radiological data for pantry islands.

July 2009

LLNL Bikini Atoll five-day mission to establish a garden project on Bikini Island.

July 2009

LLNL Enewetak Atoll 10-day mission to perform bioassay collections, and establish a garden project on Enewetak Island.

September 2009

LLNL Utrök Atoll 10-day mission to conduct initial survey of identified "hot-spot" locations on Utrök Island, and support the implementation of a garden project.



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