Fact Sheet

Defense Threat Reduction Agency
U.S. Strategic Command Center for Combating Weapons of Mass Destruction
Standing Joint Force Headquarters for Elimination

The Radiological Cleanup of Enewetak Atoll

Note: For information related to claims, call the Department of Veterans Affairs (VA) at 800-827-1000. For all other information, call the Nuclear Test Personnel Review (NTPR) Program at 800-462-3683.

Historical Background

The Enewetak Atoll has a total land surface area of about 2.75 square miles consisting of 40 islands surrounding a central 388 square mile lagoon in the Pacific Ocean. Following World War I, the Treaty of Versailles awarded control of the atoll to Japan with the stipulation that the atoll could not be fortified. During World War II, Japan used the atoll as a strategic base in violation of the Treaty. In 1944, the U.S. military captured the atoll and used it as a support and staging area. After Japan surrendered, the United Nations agreed to the U.S. trusteeship of the atoll, which placed the atoll under U.S. administration, legislation, and jurisdiction.

The Trinity Test, the first nuclear weapon detonation, in Alamogordo, New Mexico and then the use of nuclear weapons in Hiroshima and Nagasaki, Japan ushered in the nuclear age. With the advent of these new weapons of war, additional testing and development was necessary. The Enewetak Atoll was a desirable testing location since:

1. It was under the control of the U.S.
2. The area was uninhabited or subject to evacuation without imposition of unnecessary hardship on a large number of inhabitants.
3. It was within 1,000 miles of the nearest B-29 aircraft base, as it was expected that one test nuclear device was to be delivered by air.
4. It was free from storms and extreme cold.
5. It has a protected harbor at least six miles in diameter thereby being large enough to accommodate both target and support vessels.
6. It was away from cities or other population concentrations.
7. The local winds were predictably uniform from sea level to 60,000 feet.
8. The water currents also were predictable and not adjacent to inhabited shorelines, shipping lanes, and fishing areas which avoided contaminating populaces and their food supply.

The residents of the Enewetak Atoll had to be evacuated before the initiation of the nuclear weapons testing. To minimize the hardship to the residents, the U.S. Navy constructed a small village on a much smaller atoll, Ujelang, 124 miles southwest of Enewetak and transported the residents to their new location on December 21, 1947.

The nuclear tests were primarily conducted in the atoll's northwestern quadrant to minimize radioactive contamination to the base camps on the southern islands. In 1958, the U.S. ceased nuclear testing on Enewetak in response to a trilateral testing moratorium between the United Kingdom (U.K.), Soviet Union (U.S.S.R.) and U.S. This moratorium was short lived, but in 1963, the Limited Test Treaty was signed by the

U.K., U.S.S.R., and U.S. that officially and effectively banned atmospheric weapons testing by the partner states.

In the early 1970s, the U.S. decided that control of the atoll was no longer necessary due to the cessation of nuclear weapons testing and decided it would be best to return control to the Trust Territory of the Pacific Islands. The U.S. felt there was a moral and potentially legal obligation to remediate the atoll due to the debris, unexploded munitions, dilapidated buildings and radiological contamination. To evaluate the radiological conditions on the atoll an extensive pre-cleanup survey was performed in late 1972 through early 1973. Congress directed DOD to manage the cleanup operation and the Department of Energy to provide technical support. This three year remediation project commenced in May 1977 and ended on May 13, 1980 when the final 45 cleanup personnel departed the Enewetak Atoll.

Today, all of the atoll islands and the lagoon are accessible with the exception of Runit Island. Runit Island was quarantined due to residual sub-surface soil contamination and the use of "Cactus Crater". The concrete lined crater was created in 1972 and was used as a permanent disposal location for radiologically contaminated waste. After the crater was filled and no longer required, it was sealed with a cement dome cap.

In 1986, the U.S. government officially returned the atoll to the Marshall Island Republic (MIR) sovereignty and created a partnership with the MIR to provide continued annual personnel monitoring. Islanders maintaining a typical islander lifestyle that includes locally grown or caught food are found uniformly to have very little to no intake of residual radionuclides and their annual radiation doses are below U.S. averages.

Summary of the Radiological Cleanup of Enewetak Atoll

The DOD organized three separate efforts in support of the cleanup: Removal and lagoon-dumping of uncontaminated debris and structures, removal and crater-entombment of radiologically contaminated debris and structures, and excision and crater-entombment of radiologically contaminated soil from the islands.

The islands of the atoll were classified based on intended use which determines the acceptable soil contamination level, see Table 1. The contamination criterion was established to limit the annual lung and bone doses to a resident living the typical island lifestyle to 0.010 and 0.013 rem[1] per year, respectively

Radiological surveys were used to identify which islands required decontamination and to develop the remediation and radiological safety plans. The soil plutonium concentration level was evaluated to determine the necessity and extent of soil remediation, which were divided into three categories.

- Level 1: Plutonium concentration was greater than 400 pCi/g – soil removal by scraping.
- Level 2: Plutonium concentration was between 40 and 400 pCi/g – individual case consideration.
- Less than 40 pCi/g did not require cleanup.

Table 1. Island contamination criteria based on intended use

Intended Use	Contamination Criteria (pCi/g)	Number of Islands
Residential	< 40	30

[1] A rem is a radiation protection unit of measure that quantifies the risk of biological effects resulting from exposure to ionizing radiation. Ionizing radiation is any radiation (gamma, x-ray, beta, neutron, or alpha) capable of displacing electrons from atoms or molecules, thereby producing ions. According to the National Council on Radiation Protection and Measurements (NCRP, Report No. 160, Table 1.1), the general U.S. population receives about 0.62 rem per year from natural background radiation sources (radon, cosmic rays, and rocks) and man-made radiation sources (medical diagnostic x-rays and consumer products). As a basis of comparison, a standard diagnostic chest x-ray delivers a radiation dose of about 0.02 rem.

Agricultural	> 40 and < 160	7
Food Gathering	< 160	2
Quarantined	-	1

The radiological soil surveys identified 12 islands with plutonium concentrations greater than 40 pCi/g; however, not all of these islands required remediation since they were not intended for residential use. The Planned Use Condition, Final Qualification Condition and Final Soil Survey results are recorded in Table 2.

Table 2. Radiologically contaminated islands with respective contamination levels

Island Name	Code Name	Average Final Soil Survey (pCi/g)	Planned Use Condition[1]	Final Qualification Condition[1]
Taiwel	Percy	6	Food Gathering	Residential
Bokenelab	Mary	19	Food Gathering	Residential
Mary's Daughter	Fern	139	Food Gathering	Food Gathering
Lujor	Pearl	63	Agricultural	Agricultural
Pearl's Daughter	Gwen	123	Food Gathering	Food Gathering
Aej	Olive	54	Agricultural	Agricultural
Billae	Wilma	3	Food Gathering	Residential
Alembel	Vera	7	Agricultural	Residential
Elle	Nancy	52	Food Gathering	Agricultural
Boken	Irene	80	Food Gathering	Agricultural
Bokoluo	Alice	140	Food Gathering	Food Gathering
Bokombako	Belle	95	Food Gathering	Food Gathering
Mijikadrek	Kate	20	Food Gathering	Residential
Kidrinen	Lucy	77	Food Gathering	Agricultural
Louj	Daisy	43	Food Gathering	Agricultural
Bokinwotme	Edna	33	Food Gathering	Residential
Edna's Daughter	-	103	Food Gathering	Food Gathering
Kirunu	Clara	65	Food Gathering	Agricultural
Elelron	Ruby	8	Food Gathering	Residential
Aomon	Sally	7.5	Agricultural	Residential
Sally's Child	Zoe	21	Food Gathering	Residential
Bijire	Tilda	7	Agricultural	Residential
Enjebi	Janet	20	Residential	Residential
Runit	Yvonne	Permanently Quarantined		

Table 2. Radiologically contaminated islands with respective contamination levels (cont'd)

Island Name	Code Name	Average Final Soil Survey (pCi/g)	Planned Use Condition[1]	Final Qualification Condition[1]
Boko	Sam	0.3	Food Gathering	Residential

Munjor	Tom	0.3	Food Gathering	Residential
Inedral	Uriah	0.2	Food Gathering	Residential
-	Van	0.2	Food Gathering	Residential
Jinedrol	Alvin	0.3	Food Gathering	Residential
Ananij	Bruce	0.2	Agricultural	Residential
Jinimi	Clyde	0.15	Food Gathering	Residential
Japtan	David	0.2	Residential	Residential
Jedrol	Rex	0.2	Food Gathering	Residential
Biken	Leroy	2.5	Food Gathering	Residential
Kidrenen	Keith	0.3	Food Gathering	Residential
Boken	Irwin	0.4	Food Gathering	Residential
Ribewon	James	0.2	Food Gathering	Residential
Mut	Henry	0.4	Food Gathering	Residential
Ikuren	Glenn	0.2	Food Gathering	Residential
Bokandretok	Walt	0.2	Food Gathering	Residential
Medren	Elmer	0.3	Residential	Residential
Enewetak	Fred	0.5	Residential	Residential
Lojwa	Ursula	1.9	Agricultural	Residential

Radiation Protection Standards

The primary radiological contaminants of the soil on the northern islands were long-lived transuranic elements (plutonium and americium) and relatively short-lived radioisotopes cesium-137, strontium-90 and cobalt-60. The principle purpose of the cleanup was to reduce the long-lived transuranic elements to levels that did not pose a long-term hazard to the returning people of Enewetak.

Due to extensive surveys providing an understanding of the radiological environment of each of the islands, rigid control of access to contaminated islands was employed to minimize exposure to radiation. The personnel working on the contaminated islands were supervised by the Radiation Control Division and under constant surveillance of the Field Radiation Support Teams. These workers were tracked by island access cards, wore dosimetry, and in the likelihood of internal contamination, received a bioassay. The Field Radiation Support Teams issued personal protective equipment and established monitoring requirements based on potential exposure environments, conditions and work assignments.

Radiation Doses

Due to the time between the last nuclear test at the atoll and the start of the Enewetak Cleanup Project, much of the short-lived radioisotopes had decayed to levels that resulted in extremely low dose rates. Approximately 68% of the 12,248 film badge readings showed no detectable exposures with less than 0.03% exceeding 0.07 rem. 7,519 thermoluminescent dosimeters were also issued, 99.97% of the readings were less than 0.042 rem.

Air samples were taken to monitor for the possibility of internal radiological contamination due to inhalation. Of the 5,204 air samples collected, 95% of the samples were less than 1% of the established limits with none of the samples exceeding 10% of the limits. To verify workers in contaminated areas were not internally contaminated, bioassay (urine) samples were collected and analyzed for plutonium intake. The samples were overwhelmingly (99.97%) negative, which indicates that the controls in place were effective in protecting the workers from internal contamination.

More information regarding the 1980 Radiological Cleanup of Enewetak Atoll is available at the NTPR public webpage at http://www.dtra.mil/Home/NuclearTestPersonnelReview.aspx.

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