

# CASE STUDY

## U.S. NUCLEAR TESTING ON THE MARSHALL ISLANDS: 1946 TO 1958

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### PRÉCIS

Over a period of twelve years the United States detonated 67 atomic explosions on the Marshall Islands beginning with Operation Crossroads on June 6<sup>th</sup>, 1946, and ending with the last explosion under Operation Hardtack I (32<sup>nd</sup> within that program) on August 18<sup>th</sup>, 1958. While the military/scientific experiments yielded valuable information on the newly developed atomic bomb that ended WWII, it had significant negative impact on areas in the Marshall Islands where the explosions took place. Both the United States and the Marshall Islands acknowledge the tragic consequences of these tests and the United States has made efforts to compensate the people and government of the Marshall Islands. Ethically, concerns focus on the moral culpability of the United States for these damages and the adequacy of efforts to clean up and to compensate the people affected by the tests. Finally, with the recent availability of previously unreleased material, concerns of possible cover-up and deception have surfaced.



## **PERTINENT BACKGROUND INFORMATION**

### **The Marshall Islands and Micronesia**

The Marshall Islands are part of the larger Micronesia islands chain in the Pacific Ocean that stretches from Hawaii to the Philippines. The Marshall Islands consist of 34 islands scattered over 500,000 square miles. They were formed by ancient coral reefs set on top of volcanic mountains arising from the floor of the ocean. The average height above sea level is only 7 feet, with some parts of atolls becoming submerged during the high tides of storms. These relatively flat islands or atolls have a population of 68,088 people (2000 census), giving an average density of 974 people per square mile.

At the end of World War II (1947), the Marshall Islands were made part of the United Nations Trust Territory of the Pacific Islands (encompassing most of Micronesia) under jurisdiction of the United States. In 1978 the Marshall Islands drew up its own constitution and eventually signed a Compact of Free Association with the United States in 1982; this document had three main provisions: 1) the use of Kwajalein Atoll for missile testing; 2) financial assistance to the islands including compensation for the people of the four atolls affected by the U.S. nuclear testing; and 3) it allowed for the republic to become fully independent and to alter its status with the United States at any time, subject to approval of the residents. Adjustments to the second provision regarding appropriate compensation and adequate financial support by the United States have been on-going since the compact was developed. Further, acting on the third provision after an islands-wide vote, the Trust Territory was dissolved in 1990 with the approval of the UN Security Council, and on Sept. 17, 1991, the Marshall Islands became a member of the United Nations.

### **The Nuclear Testing and Its Effects on the Marshall Islands**

In 1946 Bikini Island became the site of Operation Crossroads, a vast military/scientific experiment to determine the impact of atomic bombs on naval vessels. During the next twelve years the U.S. Nuclear Testing Program (NTP) detonated 67 nuclear bombs from the air, water, and land under seven operations: Crossroads, Sandstone, Greenhouse, Ivy, Castle, Redwing, and Hardtack I. The total destructive output of these bombs was 108,496 kilotons, more than 7,200 times greater than the atomic weapons dropped on Japan during WWII.



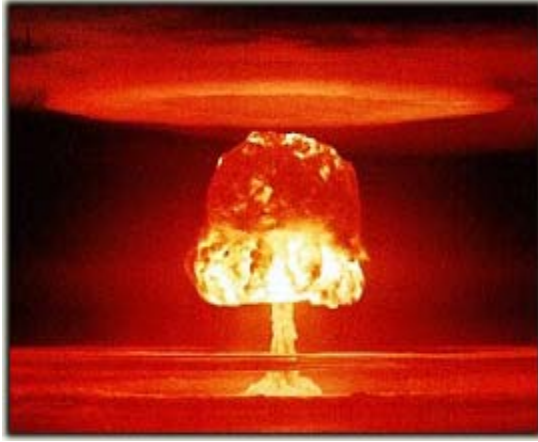
The world's first peacetime atomic-weapons test was conducted at Bikini Atoll on July 1, 1946. A 20-kiloton atomic bomb test code named "Able" exploded in the air over a fleet of about 80 obsolete World War II unmanned naval vessels, among them battleships and

aircraft carriers. On July 25, the second test, "Baker," was the world's first underwater atomic explosion; besides sinking nine ships, it pushed a mile-wide column of water high into the sky. Of particular significance are the millions of tons of debris and water that descended back to earth unleashing a huge wall of mist that traveled at 60 miles per hour destroying anything in its way; further, a massive 43 foot wave was created that tossed aircraft carriers and battleships around as if they were toys. All told, this blast created the greatest amount of radioactive fallout yet to be witnessed by humankind.<sup>1</sup>

In 1952 the U.S. government conducted the world's first thermonuclear test (fusion instead of fission based explosion), code named "Mike," on Enewetak Atoll. This test literally vaporized the island of Elugelab and was estimated to be 10.4 megatons, 750 times larger than the bomb dropped on Hiroshima and containing



more energy than all previous atomic blasts combined (including those of Russian origin). It was the largest fireball produced to date, measuring  $3\frac{1}{4}$  miles in diameter, a blast that would have engulfed  $\frac{1}{4}$  of the island of Manhattan and would require 32 Empire State buildings be stacked on top of each other to reach the cloud's height. Ten minutes after the blast, the cloud had extended to a diameter of one hundred miles and a height of ten miles.



But perhaps the most famous blast, “Bravo,” under Operation Ivy, was detonated on Bikini Atoll on March 1, 1954; it was a 15 megaton hydrogen bomb, the largest blast to date, 1000 times more powerful than the Hiroshima bomb. Due to the decision to continue with the detonation of this massive bomb in

spite of unfavorable weather conditions that developed shortly before the test, a literal snowstorm of gritty, white ash descended on several nearby atolls within hours of the blast. Those exposed experienced nausea, vomiting, and irritation on their skin and eyes. Residents of Rongelap were evacuated 48 hours later and those residing on Utrik were evacuated 72 hours after “Bravo” was detonated.

Through the nuclear explosions on the Marshall Islands, the NTP gained a much more sophisticated understanding of nuclear weapons and just as important, the health effects of exposure to excessive dosages of radioactive fallout. After the “Bravo” test the Atomic Energy Commission (AEC) began Project 4.1, “the study of the response of human beings exposed to significant beta and gamma radiation due to fallout from high-yield weapons.”<sup>2</sup> Citizens of the Marshall Islands were divided into “exposed” and “control” groups to observe the short- and long-term effects of exposure to radiation from fallout and the contaminated environment where they lived. This 1954 study was stamped “secret restrictive data” due to the anticipated negative public reaction to its findings and was only declassified in 1994.

The human aspect of these tests is the real subject of this case study. Though the mishap associated with the massive “Bravo” blast just mentioned is most unfortunate, it is but one of many such incidents. The initial tests made it necessary to first relocate the Bikini Atoll’s 167 native Micronesians to Rongerik and then to Kili Island (after nearly starving on Rongerik for 6 months), about



500 miles southeast of Bikini. The Bikini Atoll suffered serious radioactive contamination which persists to this day.

As noted in reference to the “Bravo” blast, the inhabitants of Rongelap were seriously exposed to radiation over an extended period of time. On average, they received a radiation dose of about 190 rems (radiation units). This dose was, according to current medical opinion, sufficient to cause an extra 1 in 7 risk of dying of cancer. Medical examinations carried out on adults in Rongelap between 1970 and 1974, which compared exposed and unexposed inhabitants, showed that there was a higher-than-average incidence among those exposed of anemia, thyroid disease, rheumatic heart disease, and tumors.

In 1969, the U.S. government began work on a long-range project to reclaim the land and ultimately to repatriate the Bikinian population. Some Marshallese began returning to Bikini in the late 1960s, but their atoll was found to be too contaminated for permanent habitation and in 1978, the people, once again, had to be evacuated back to Kili. In January 1999, decontamination began on U.S. nuclear weapons test sites on Enewetak; today, the Enewetak people have returned to their homeland, and a program to monitor Bikini has been put in place. Still, all water samples taken from Bikini and Enewetak islands show that the levels of radioactive contamination are too high to allow islanders to live exclusively on food grown and caught there.

## ETHICAL ISSUES

Before embarking on the assorted ethical issues generated out of the U.S. Nuclear Test Program in the Marshall Islands, it should be acknowledged that while there are certain indisputable facts, there is also much that is in dispute. There have been at least four formal studies of environmental radioactivity levels on the four main islands affected, measuring contamination of food, animals, plants, and human beings; each test has required several years to complete. Two long-term U.S.-sponsored research studies are still being carried out. At this juncture, most of the scientific community has come to the position that relatively safe radiation levels have been reached on all islands, such that repopulation of the inhabitants can be accomplished with some safeguards put in place regarding limitation of intake of food grown and caught on the contaminated areas.

In spite of the fact that this conclusion was reached by several independent studies that were in turn, checked, and evaluated by indepen-

dent, internationally-constituted groups of experts in relevant fields for these studies, the Marshallese government has still not accepted the findings of these scientific groups. In fact, it continues its demand against the United States government for further compensation in the amount of \$300 million dollars for losses incurred due to the atomic testing over the twelve years.

### Issues of consent, safety, compensation, restoration, and deception

One can begin with the acknowledgement that the United States *did* ask permission from the Marshallese people before the bombings began, but the manner in which it was communicated raises questions. Similar to human subjects testing in medical research studies (which was not the intention of the nuclear tests themselves), it is not sufficient simply to ask the inhabitants of Bikini to participate; one must also inform them of the nature of the testing in some detail and indicate what dangers might befall them. Let us summarize how the “permission” was granted.

One month *prior* to speaking to the Marshallese about using their island for atomic bomb testing, the U.S. Senate passed Joint Resolution 307 authorizing the testing of atomic weapons in the Marshall Islands which was immediately signed by President Truman. Subsequently, Navy Commodore Ben H. Wyatt arrived on Bikini Atoll just after Sunday church services had ended, and couched the test request in biblical terms, comparing the Bikinians to the children of Israel whom the Lord saved from their enemy and led into the Promised Land. In like manner, the Marshallese had a role to play in ending all war for the betterment of humanity, as the atomic bomb to be tested would serve to silence the evil forces that threaten the world now and in the future. Given their suffering under the Japanese (who had just been defeated) and their new prosperity and freedom provided by the United States, it is not surprising that they replied in the affirmative.

“King” Juda, leader of the Bikini people, replied, “If the United States government and the scientists of the world want to use our island and atoll for further development, which with God’s blessing will result in kindness and benefit to all mankind, my people will be pleased to go elsewhere.”<sup>3</sup>

It should be noted that no effort was made by Commodore Wyatt or those who immediately followed him to warn the people of Bikini Atoll of potential dangers to their health or long-term danger to their island — even though such concerns had been a significant part of the

discussions back in Washington, D.C. No one knew with certainty what to expect in terms of environmental damage from radiation poisoning.

Rear Admiral Draper L. Kaufman, one of Operation Crossroad's planners, is quoted to have said, "Our scientific friends went from one extreme to another. One extreme even thought the island would disappear and that it would be weeks before we could go back into the lagoon. Another extreme said that we could go back in right away, that there would be very little radiation."<sup>4</sup>

In spite of this prevailing uncertainty and disagreement amongst leading scientists in atomic technology, it *is* certain that the U.S. government had a moral obligation to share all scientifically-based scenarios in its initial discussions with the Bikinians. It is likely that U.S. officials were reluctant to share the "doomsday" predictions with the island officials for fear they might not consent. Further, as the Bikinians were often referred to as "primitive people" in military documents and interagency communications, it is also likely that the Navy officials did not view the local population as being capable (at the time) of understanding the mechanics of nuclear reactions and what it might do to the island in terms of nuclear fallout and radiation contamination. It is clear from communications recorded at the time and recollections by U.S. officials later, that their sole interest with the local islanders was to remove them from the test site to a safe location in an efficient manner so that tests could begin.

It is difficult to make a single general characterization of the U.S. government's care in safeguarding the well-being of the people of the Marshall Islands during and after the time it carried out these tests. Often in conducting research there are a lot of uncertainties and unexpected results. If one examines the complex history that surrounds these nuclear tests and the years of litigation, scientific studies, and assorted efforts to clean up the affected areas and relocation of peoples, one will see that much of the efforts by the U.S. government were *reactive* rather than *proactive*; in the minimum, one could make a case for fault with regard to this general attitude, given the high stakes brought on by these extremely powerful and dangerous nuclear explosions.

There can be no disagreement that some precautions were taken to protect the health of both the indigenous population along with the military and civilian people in the area of the blasts. Yet it is also indisputable that government officials in charge of the tests did not heed the advice of many scientists intimately connected to the research of atomic weaponry; there were those who predicted many of the negative consequences of

the tests that adversely affected many thousands of people living in the Pacific rim, not to mention harm done to countless animals and plants living in the area. If safety precautions were made to protect the people in light of the anticipated “worst case scenarios” predicted by some scientists over the years, then a great deal of the collateral damage that has so adversely affected so many people’s lives could have been avoided or at least greatly minimized. Instead, the U.S. policy-making efforts followed a “learn as we go along” attitude, taking moderate precautions that countered only what was collectively recognized as indisputable dangers that would be inflicted on the inhabitants of the two islands used in the bombing if they were not moved far enough away from the test sites.

As with all human disasters, from the sinking of the Titanic to the more recent Discovery Space Shuttle mishap, a trail of human incompetence, negligence, arrogance, and often a general insensitivity to possible dangers can be traced back in the events leading to such calamities. While it is unrealistic to expect that *all* anticipated negative scenarios (however remote and unlikely) will be addressed due to time and money constraints, nevertheless it is expected that significant resources be allocated to protect human life and the environment that surrounds it. Each person when reviewing the facts of this case must assess whether this basic condition was met in the nuclear testing done in the Marshall Islands over the twelve-year period.

A further moral concern can also be addressed in this regard, namely, whether there were efforts to cover up negative outcomes both from the people affected and from the general public; this intentional deception, if it occurred, would harm the people still exposed to the radiation in the contaminated areas by allowing future testing that exacerbates the existing dangers from previous nuclear tests.

Since space is limited here, reference can be made to only some of the more notorious instances where the U.S. government *appears* to have lapsed in its responsibilities and acted irresponsibly in its role of overseer of the health and welfare of people living in harms way of these multiple atomic blasts.<sup>5</sup> Initially it can be noted that there was a general denial by the U.S. government as to the reality of “radiation poisoning” that continued to kill and maim people after the initial blast of the atomic bomb. When Japanese reports began to arrive detailing numerous radiation injuries amongst the survivors of the Hiroshima blast, the U.S. government labeled it as anti-American propaganda and the Los Alamos scientists were incredulous, believing that the atomic bomb was only a “bigger bomb” that had no new means of death except the initial explosion.

While the U.S. scientists recognized the possibility of 20,000 deaths, the actual count showed the bomb killed 80,000 people instantly, followed by another 50,000 to 60,000 in the next several months. Most likely this attitude reflected ignorance mixed with arrogance rather than deliberate deception; nevertheless, the end result was that they refused to recognize an important difference between atomic explosions and conventional bombs; this led to a lack of anticipation and preparation for the high levels of radiation poisoning that later contaminated the Marshall Islands.

During the 1954 test of “Bravo” (mentioned earlier in this paper) a more obvious case of “damage control” can be found. Ignoring or underestimating repeated warnings of “unfavorable” weather conditions that showed winds were blowing in the direction of inhabited islands, the Joint Task Force 7 continued with the planned detonation of March 1<sup>st</sup> on Bikini Atoll. Within a few hours of the detonation, 28 American weathermen were exposed to the snowstorm of fallout while hundreds of Marshallese living on Rongelap, Rongerik, Ailinginae, and Utrik Atolls were showered with the fallout mist—as well as 23 people located on the Japanese fishing vessel, Lucky Dragon, that was located 100 miles away from the blast. Experiencing nausea, vomiting, and itching skin and eyes, they were all evacuated over the next 72 hours and began to receive emergency treatment for severe skin burns and hair loss. Yet the U.S. Atomic Energy Commission issued a public statement calling “Bravo” a “routine atomic test,” with some Americans and Marshallese “unexpectedly” exposed to some slight radiation though there were no burns or serious injuries.

This example, though one of the worst, exemplifies the general attitude of the U.S. government toward the human costs of these tests. While being concerned about unanticipated radiation contamination and poisoning, their efforts to remedy the situation and prevent future dangers to the populations on neighboring islands seemed secondary to assuring the overall success of the tests themselves. The same general approach can also be seen in their clean-up details where U.S. servicemen would often sleep and eat on contaminated ships during the removal of radioactive materials from the ships. In 1980 over 4,000 U.S. servicemen assisted in the cleanup of Enewetak Atoll resulting in the death of six during the procedure; studies indicate that many more died an early death of tumors and health complications brought on by high radiation exposure.

As a comparison, the amount of contamination was 42 times greater than the approximately 150 million curies released as a result of testing in

the western United States. Readings of such radioactive debris suspended in the air started in 1946 and ended as late as 1974. It is well established that the assorted isotopes found in this fallout cause various types of genetic damage to biological organisms, and the longer the debris is present in the environment the more damage the island sustains. Using the Radiation Exposure Compensation Act set up by the Federal Government in 1998 as a guide, it is argued that Guam more than qualifies for compensation. Clearly, the United States did not fully realize the short- and long-term problems generated from the nuclear tests, but those who see themselves as victims of this oversight are arguing that the United States must face up to its moral and financial responsibilities by compensating those who were adversely affected.

So far no other areas in Micronesia have been compensated for nuclear contamination other than select populations on the Marshall Islands. In the years subsequent to these tests, the U.S. government has denied that the radiation from these tests posed any health dangers to any of the other Micronesian islands other than in the Marshall Islands themselves — in spite of the fact that they themselves had set up radioactive sensing instruments on several islands in what is now the Federal States of Micronesia, i.e., Chu'uk, Yap, Pohnpei, etc. Some Guam residents contend that they underwent nuclear contamination as a result of both atmospheric fallout (“downwinder”) and decontamination runoff from military ships and aircraft brought to Guam for nuclear clean up. (This claim is supported in resolution by the current Guam legislature.) Their principal contention is that the detonation of 108,496 kilotons of nuclear explosive in the Marshall Islands released nuclear fallout into the upper atmosphere jet stream leading straight to Guam.

In the fifty plus years since the first bomb was dropped on Bikini Atoll, well over \$350 million dollars has been awarded directly to groups of Marshallese people as compensation for harms committed against them. Millions more has been spent by the U.S. government to cover the costs of numerous scientific studies, care for the sickened individuals contaminated by the blast, large-scale cleanup and decontamination projects, and general efforts to reestablish the communities and economy of the Marshall Islands. Yet it is argued by the Marshallese that the United States has not lived up to its financial obligation to the people of the affected atolls. When divided amongst all concerned parties over the years since the first test, the U.S. government has paid on average \$15 compensation per person annually. To summarize, given the long-range serious health effects that began to appear some nine years after initial

radiation exposure, the denial of use of prime land and harbor areas, and the inability to harvest fish reserves due to contamination, one can question whether the United States is adequately compensating those who were dramatically affected by the tests either directly or indirectly.

It is difficult to estimate exactly how much financial compensation is required to satisfy rectificatory justice due to someone mistreated — whether intentional or unintentional. Yet given that one is obligated to help another who one injures, the amount of restitution required to compensate the injured should work toward the restoration of their life to a time prior to the harm committed. Accordingly, the U.S. government has a continual obligation to determine if such compensation is being met and to explore the possibility that other outer Micronesian regions may have been contaminated either through long-range fallout or radiation contamination from vessels being decontaminated in their harbors.

To put the past efforts to compensate the Marshallese people in perspective, consider the following comparison. The U.S. government (at the time of this writing) has spent only one-third the money *over fifty years* for restoration and cleanup in the Marshall Islands from *12 years of nuclear bombing*, that it is currently spending *weekly* during the restoration and cleanup efforts after the *120 day* war in Iraq. If, as many predict, this restoration in Iraq goes on for ten years, we are looking at a possible total expenditure of 520 billion dollars for people who have never been U.S. citizens compared to the modest \$350 million dollars outlaid to restore “semi-safe” living conditions to naturalized U.S. citizens who underwent significantly worse hardship, danger, contamination and death over 12 years rather than a mere 120 days.

Adding to this apparent lack of rectificatory justice to the Marshall Islanders just noted, one can raise the further question — in light of new possibilities of contamination in more distant regions of the Pacific — whether the U.S. government has shown any signs of becoming sensitive to the short- and long-term problems generated from such nuclear testing to this wider area of potential contamination. So far no U.S. agency has entertained the new claims and evidence presented by other Micronesian states. If one goes back and examines the way these tests were set up, it can be queried on an even more fundamental level, whether 67 independent nuclear bomb tests were really required over the period of 12 years — finally ending in 1958. Once the radiation contamination became obvious, should the U.S. have continued to explode more and more deadly bombs that further threatened the area?

It can be replied that part of the reason for these continued tests lies not merely in gaining new information about building a better nuclear bomb, but in a propaganda exchange with the Soviet Union during the cold war that began shortly after WWII. Government officials felt that these well-publicized tests sent a strong message to the Soviet Union that any war with the United States was suicidal on their part, since an attack on the U.S. would result in nuclear holocaust due to a massive U.S. nuclear missile response launched against them. Some still contend that the mutual nuclear deterrence during the cold war prevented a WWII that could have led to the annihilation of most life on earth. Even if this is the case (which some would dispute), does this line of reasoning still hold in today's political realignment of world powers?

The political developments in Eastern Europe and the Soviet Union from 1989 to 1991 ended the Cold War; consequently, concern in America and Europe about a massive nuclear attack has diminished greatly; as such, there is no longer a justification for a continual buildup of nuclear weapons nor for further nuclear testing. On September 10, 1996, the United Nations overwhelmingly approved the Comprehensive Test Ban Treaty (CTBT), a treaty ending all nuclear testing, of any yield, at any location, for all time. The United States and all other declared nuclear weapon states signed that treaty. This *appeared* to signal a final universal recognition of the dangers of such testing as well as the need to try to disarm the world of such weapons of mass destruction and the need to stop new nations from gaining the use of such weapons. Yet, in that same year, France ended its 3½ year-old moratorium on nuclear tests, beginning its sixth series of nuclear weapons tests on the Fangataufa Atoll in French Polynesia. The fact that there was world-wide condemnation of the tests — even by the United States — demonstrated the world's readiness to have finally learned from the harms of previous testing and recognize the need to end it once and for all. Even France indicated that these would be their last tests.

## EPILOGUE

As a final note involving recent events related to nuclear testing, on October 3, 2002, while stopping short of overturning his father's moratorium on nuclear testing, U.S. President George W. Bush thrust the testing issue back into the political foreground with the Pentagon's new Nuclear Posture Review (NPR). The NPR called for acceleration in "test-

ing readiness” so the Department of Energy would be able to resume such tests within a one-year window.

In years past, the first President Bush and President Clinton declared that they intended to uphold the UN moratorium on nuclear testing. Though the current Bush administration has publicly given “unconditional support” for the moratorium, it appears to have retracted this stance by suggesting that the moratorium may be lifted. The administration’s repudiation of the Comprehensive Test Ban Treaty, signed by 154 nations, has caused consternation among many U.S. friends and allies who say the treaty helps prevent the spread of nuclear weapons.

Bush’s nuclear policy advisers have argued for the development of simple, low-yield, precision-guided nuclear weapons for possible use against hard and deeply buried targets such as underground biological weapons facilities or protected bunkers built deep in the ground. The proposed testing would be conducted in an underground facility outside of Las Vegas, Nevada, sparing the Marshall Islands of any future tests — however unlikely that the Marshallese would provide permission this time around. Obviously one troubling scenario resulting from the Bush plan to test mini-nuclear “bunker busting” bombs would be the likely abandonment of the Nuclear Non-Proliferation Treaty by a number of non-nuclear nations once the U.S. breaks the treaty. Given its spotted history in causing undue harm and hardships to peoples both in the Marshall Islands and the Southwest from nuclear testing, how can the U.S. morally and politically indicate a willingness to resume such destructive activity? Can the proposed new weapons technology be justified in comparison to the possible harm done to the environment where the testing takes place and the possibility that such activity will cause the breakdown of the Comprehensive Test Ban Treaty, hence leading to more testing by other countries as well as to the acquisition of atomic weapons by other countries who do not possess them now?

## STUDY QUESTIONS

Several ethical questions come to mind:

1. Did the U.S. government seek adequate permission from the Marshallese before beginning the nuclear tests? Further, did the call for consent include adequate warning as to *all* foreseeable negative effects of the testing on the environment and people living in the area?

2. Did the U.S. government take all necessary precautions in seeing to the safety of the inhabitants of the test site area, insuring that they were moved to a suitable location safe from the bomb?
3. Once the extent of the radiation contamination was recognized, did the U.S. government (a) provide proper medical treatment to injured parties (b) appropriately compensate the islanders for their loss and suffering, and (c) adequately cleanup the environment?
4. Can the damage caused by the nuclear testing be offset by either the knowledge gained in the interest of national defense or the deterrence of a future nuclear war?
5. In the years during and after the Marshall Islands tests, did the United States react responsibly and make suitable modifications to its nuclear testing plans in light of problems discovered in conducting a nuclear test program?

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## NOTES

<sup>1</sup> It is worth noting that Jonathan M. Weisgall in his book, *Operation Crossroads* (Annapolis: Naval Institute Press, 1994), refers to this underwater test as the world's first nuclear disaster, America's Chernobyl.

<sup>2</sup> For a fuller description of Project 4.1 see "The Republic of the Marshall Islands and the United States: A Strategic Partnership" on the Marshall Islands website, <http://www.rmiembassyus.org/nuclear/exhibit.html>. Note: Photographs used in this article were obtained from a photographic exhibit found on this website.

<sup>3</sup> *Honolulu Star-Bulletin*, February 23, 1946, p. 11, as quoted in Weisgall, *op. cit.*, p. 107.

<sup>4</sup> Laurence, William L. (1946). *Men and Atoms: The Discovery, the Uses, and the Future of Atomic Energy*. New York: Simon & Schuster. pp. 110-111.

<sup>5</sup> The reader is advised to look at the following websites that contain useful chronological listings of specific events in this long saga brought on by the U.S. nuclear testing program. Detailed bibliographies containing extensive listings of government and private studies, assessment reports, and commentary on the events during the tests and thereafter are also contained in these online databases. Here are some of the most useful resources currently available:

<http://www.rmiembassyus.org/links/links.html>;

<http://www.tis.eh.doe.gov/health/marshall/marsh/journal/rpt-1.pdf>;

<http://marshall.csu.edu.au/html/SCRU/atomic.pdf>;

[http://www.osti.gov/html/osti/opennet/document/press/pc28.html#ZZ2;](http://www.osti.gov/html/osti/opennet/document/press/pc28.html#ZZ2)

[http://www.history.navy.mil/faqs/faq4-1.htm;](http://www.history.navy.mil/faqs/faq4-1.htm)

<http://www.nv.doe.gov/news%26pubs/publications/historyreports/default.htm>

