Bikini Atoll

NOMINATION BY THE

REPUBLIC OF THE MARSHALL ISLANDS

FOR INSCRIPTION ON THE

WORLD HERITAGE LIST 2010

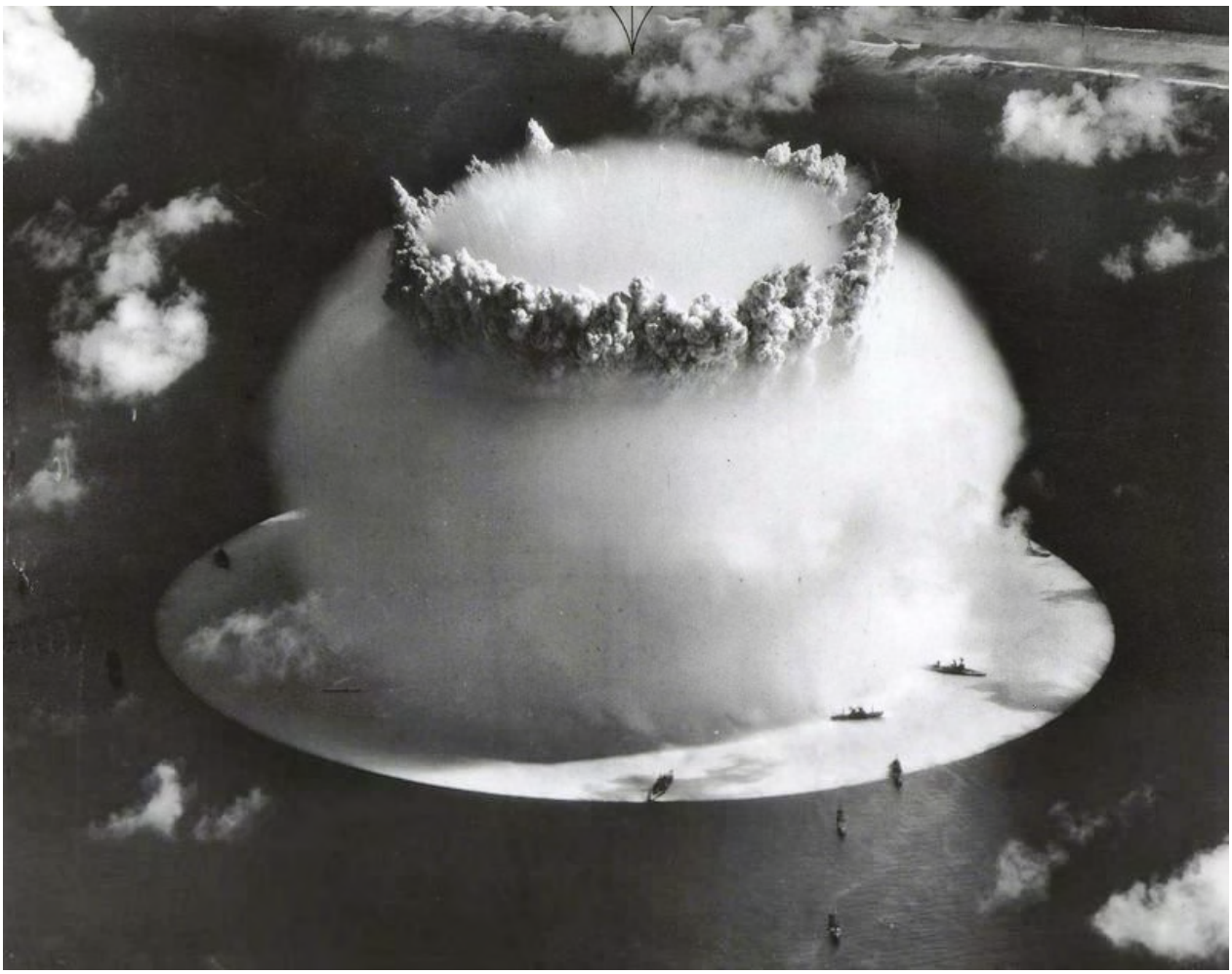
"For the good of mankind and to end all world wars"

Commodore Ben H. Wyatt, military governor of the Marshall Islands, March 1946

JANUARY 2009

“mankind’s destiny is being decided today—now—this moment”

Albert Einstein, May 1946



Operation Crossroads Baker test, July 25, 1946 at Bikini Atoll (National Nuclear Security Administration, 1946)

“A peace enforced through fear is a poor substitute for a peace maintained through international cooperation based upon agreement and understanding. But until such a peace is brought about, this nation can hope only that an effective deterrent to global war will be a universal fear of the atomic bomb as the ultimate horror in war.”

Report of the Joint Chiefs of Staff,
Operations Crossroads, June 30, 1947

“Shall we put an end to the human race; or shall mankind renounce war? ...There lies before us, if we choose, continual progress in happiness, knowledge and wisdom. Shall we instead, choose death, because we cannot forget our quarrels? We appeal, as human beings to human beings: Remember your humanity, and forget the rest.”

Russell-Einstein Manifesto, July 1955

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From the Senator for the People of Bikini

We, the representatives of the people of Bikini Atoll, are proud to endorse the nomination of Bikini Atoll to the World Heritage Centre for consideration by the World Heritage Committee.

We welcome the World Heritage process as an opportunity for the dramatic events at Bikini Atoll to be remembered. The experience of nuclear testing, the displacement of our people from our homeland and the devastating contamination of our country is a story that has been repeated in many places around the world including Australia, French Polynesia, Algeria and Kazakhstan. As a World Heritage site, Bikini Atoll will forever tell the story of this period of human history.

We wish also for the world to remember the role of our tiny atoll in the global politics of the 20th Century - for the role of the Bikini tests in the start of the Cold War and the nuclear arms race.

We, the people of Bikini, will always remember Bikini Atoll as our beloved homeland and will always feel pain for what we have lost. As a World Heritage site, Bikini Atoll will remind all of us, around the world, of the need for global peace and the elimination of weapons of mass destruction. Bikini Atoll may then actually fulfill the promise for which we reluctantly left our homeland, more than 64 years ago, "for the good of mankind and to end all world wars."

In support of this nomination and the ongoing protection and management of Bikini Atoll, the community will move to establish the Bikini Atoll Conservation Management Board and undertake to develop the resources and partnerships required to effectively implement the Bikini Atoll Conservation Management Plan. We will make every effort to tell the story of Bikini to visitors, to people around the world, and most of all to our children – "for the good of mankind"—and may we never forget.

Sincerely,

Hon. Tomaki Juda

Senator for the People of Bikini

Executive Summary

State Party

Republic of the Marshall Islands

State, Province or Region

Bikini Atoll

Name of Property

Bikini Atoll

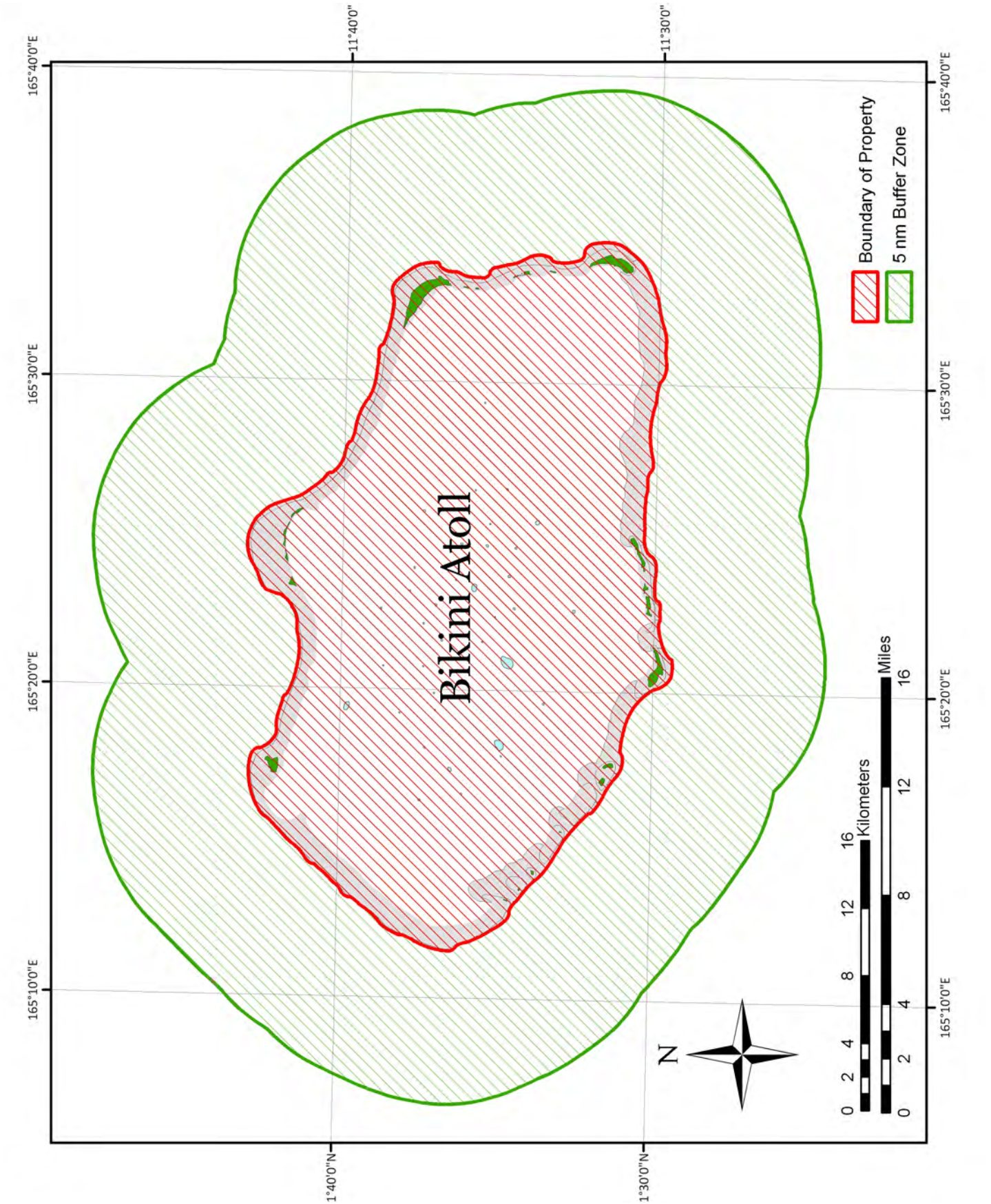
Geographical coordinates

UTM Coordinates N 11˚36’0” E 165˚22’50” (approximate centre of the property).

Textual description of the boundaries of the property

The property includes the lagoon, all islets and reefs of the atoll. The boundary is on the oceanward side of the atoll at the territorial baseline, being defined as a line connecting the seaward ocean shorelines of all islands at a depth of mean lower low water. The buffer zone consists of the surrounding seas extending five nautical miles seaward of the territorial baseline.

A4 size map of the nominated property showing boundaries and buffer zone



Statement of Outstanding Universal Value

Nuclear bomb tests at Bikini Atoll shaped the history of the people of Bikini, the history of the Marshall Islands and the history of the entire world. Bikini Atoll is distinctly 20th century heritage, standing testimony to the dawn of the nuclear age, the start of the Cold War and the era of nuclear colonialism – stages in human history of global significance.

Bikini Atoll is an outstanding example of a nuclear test site. The entire landscape and seascape of Bikini testifies to its history as a nuclear test site, from the ensemble of sunken ships and the purpose-built bunkers, to the disappeared islands and the Bravo crater. The lonely rows of coconut trees, placed in preparation for a failed resettlement, and the conspicuous absence of humans speak to the fate of a nuclear test site rendered uninhabitable.

Bikini Atoll stands as a monument and memorial to the dawn of the nuclear age. At Bikini, the quintessential tropical paradise, beloved by our modern culture as a place of peace and simplicity, is juxtaposed with the artifacts of nuclear bomb testing, evoking a remembrance of a time of lost innocence—when men held and wielded a power reserved for gods.

Bikini Atoll played host to events of global significance which are illustrated in the landscape and seascape. The sunken vessels bear witness to Operation Crossroads—the first peacetime atomic bomb tests, implicated in the start of the Cold War. The Bravo crater is evidence of the Castle Bravo test—the first deliverable hydrogen bomb, and the event that introduced the world to fallout. Aside from the bombs dropped on Hiroshima and Nagasaki, few, if any, other nuclear weapons events have had this scale of impact on the world.

The process of nuclear colonialism around the world is exemplified by Bikini, from the selection of Bikini as a remote site, distant from the population of the testing nations, to the representation of Bikini as a *terra nullius*, to the displacement of the Bikinians and the irradiation of Marshallese and military personnel. Bikini was the first site of nuclear colonialism and remains the outstanding illustration of this significant stage in human history.

Ideas and beliefs of outstanding universal significance are directly and tangibly associated with Bikini Atoll. Emanating from this narrow circle of tiny islands in the middle of a vast ocean is a myriad of symbolism that has permeated our global culture, including the universally recognized and understood mushroom cloud, the bikini swimming costume, and the radioactive pop-culture icon, Godzilla. The breadth, diversity and global significance of Bikini's symbolic reach is evidenced in the innumerable works of art, music, film and literature that have been touched and inspired by the events at Bikini, illustrating the profound impact of events at Bikini on the global culture and psyche.

Events at Bikini led directly to the creation of political and ideological movements that have shaped global society in the second half of the 20th century, mostly connected with the Castle Bravo test on March 1, 1946. The return of the irradiated *Daigo Fukuryū-Maru* and her ill crew in March 1946 led to the momentous "Suginami" petition, which in turn led to the establishment of Gensuikyo: the Japan Council Atomic and Hydrogen Bombs, an enormously significant mass movement in Japan. The Bravo shot led Albert Einstein and Russell Bertrand to write the Russell-Einstein Manifesto, which in turn led to the establishment of the Pugwash movement of influential scholars and public figures concerned with reducing the danger of armed conflict and seeking cooperative solutions for global problems. The anniversary of the Bravo test continues to be celebrated as "Bikini Day" in Japan, and as the "Nuclear Free and Independent Pacific Day" throughout the Pacific.

Criteria under which property is nominated

Bikini Atoll is nominated as a cultural site against criteria (iv) and (vi) as set out in Paragraph 77 of the *Operational Guidelines for the implementation of the World Heritage Convention,* that it:

> (iv): be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history; and
>
> (vi): be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance.

Name and contact information of official local institution

Managing Institution

Kili-Bikini-Ejit Local Government
Post Office Box 1096
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Attention: Jack Niedenthal, Trust Liaison for the People of Bikini
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Part 1. Identification of the Property

1.a State Party

Republic of the Marshall Islands

1.b State, Province or Region

Bikini Atoll

1.c Name of Property

Bikini Atoll

1.d Geographical coordinates

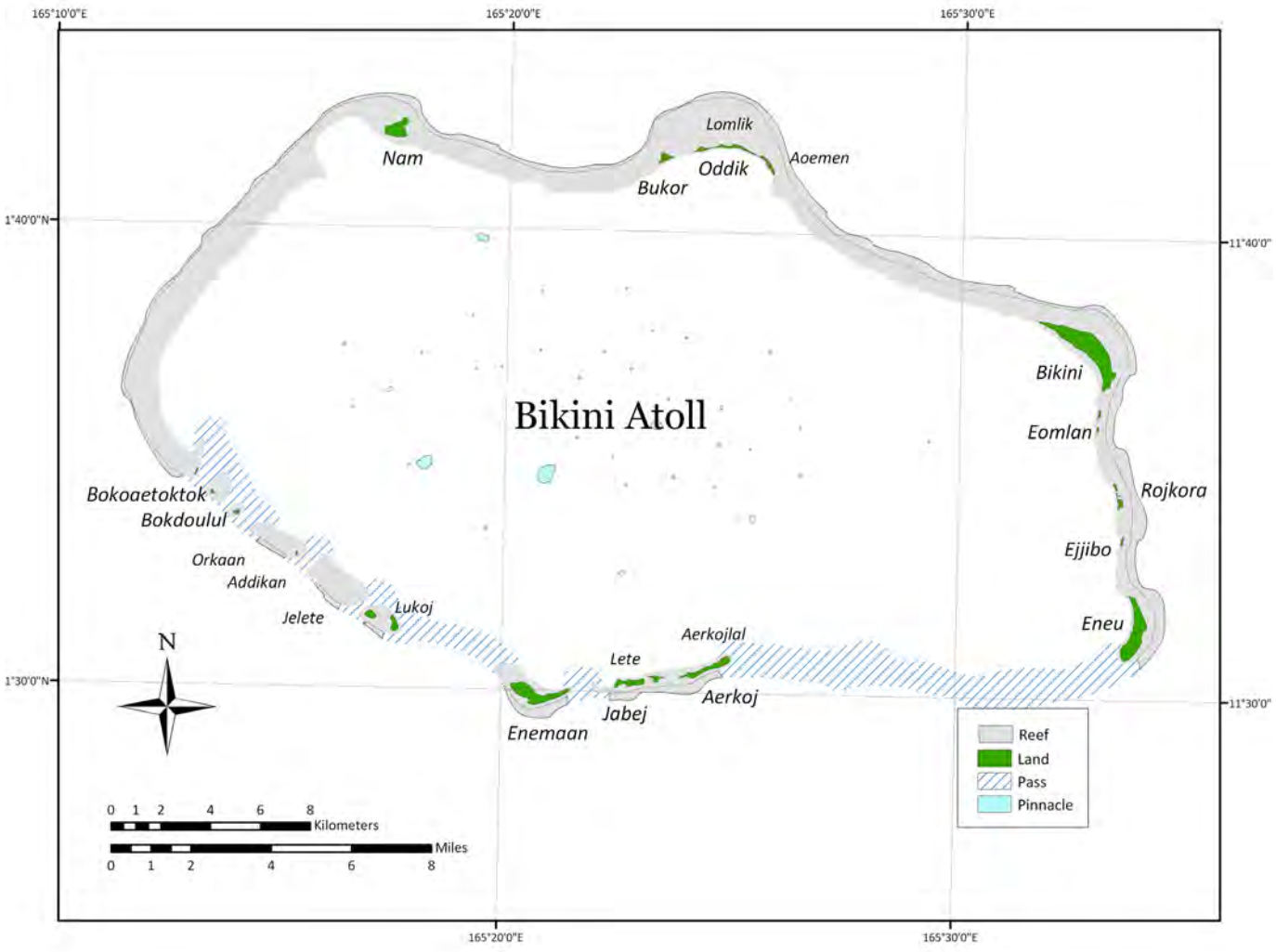
UTM Coordinates N 11˚36’0” E 165˚22’50” (approximate centre of the property).

1.e Maps and plans, showing the boundaries of the nominated property and buffer zone

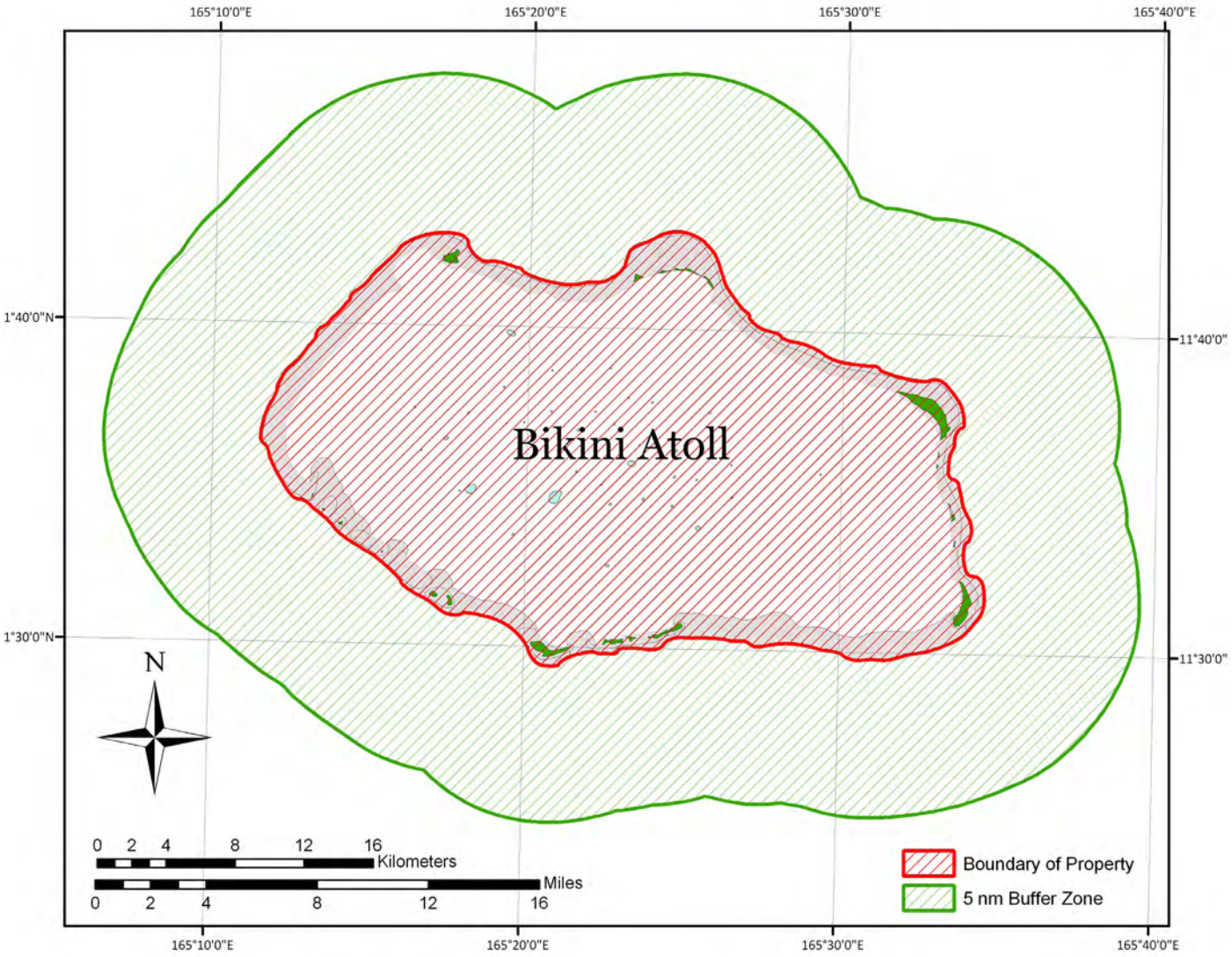
A4 size copies of these maps are attached in Annex 1, and are included in jpeg and pdf form on the accompanying DVD.

1.e.(i) Map of Bikini Atoll showing reef and land

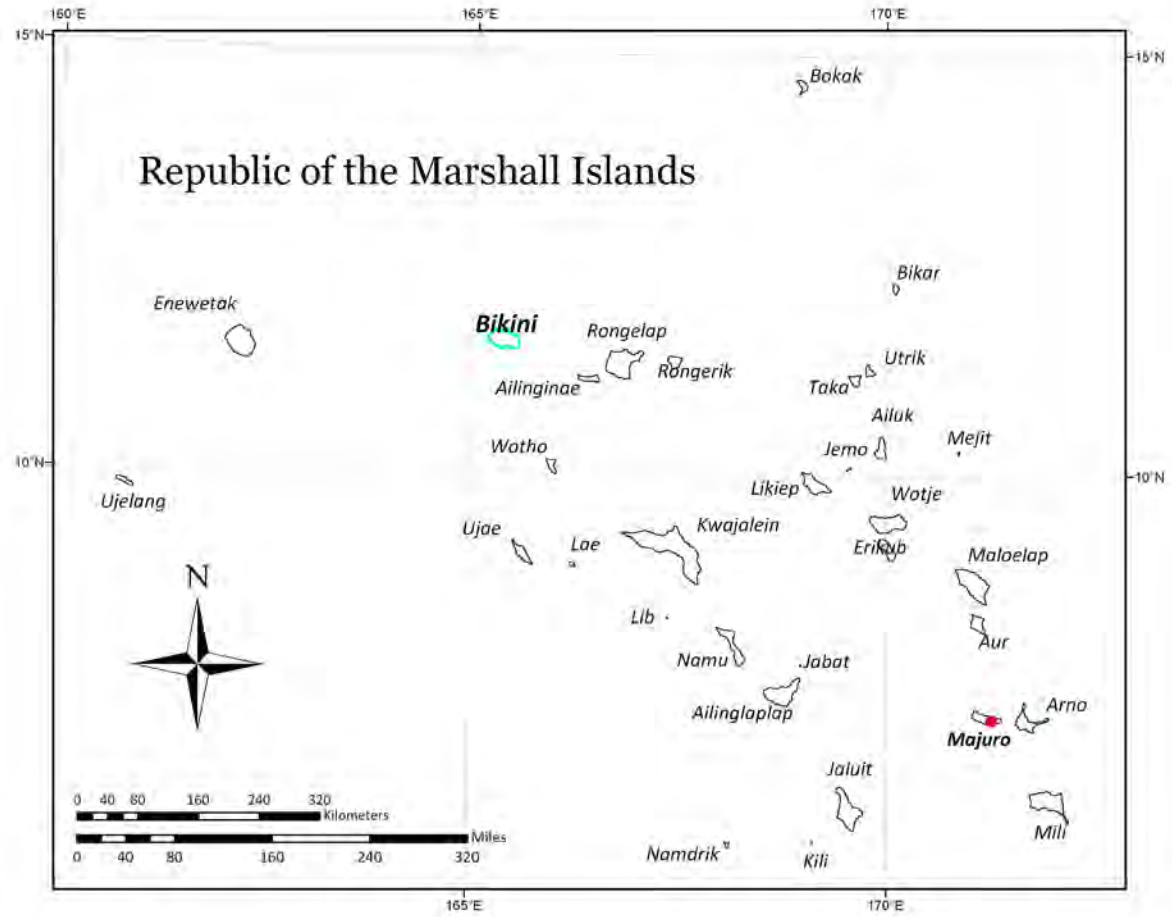
(Note: a topographical map is not available as all land is below about 2m above sea level).



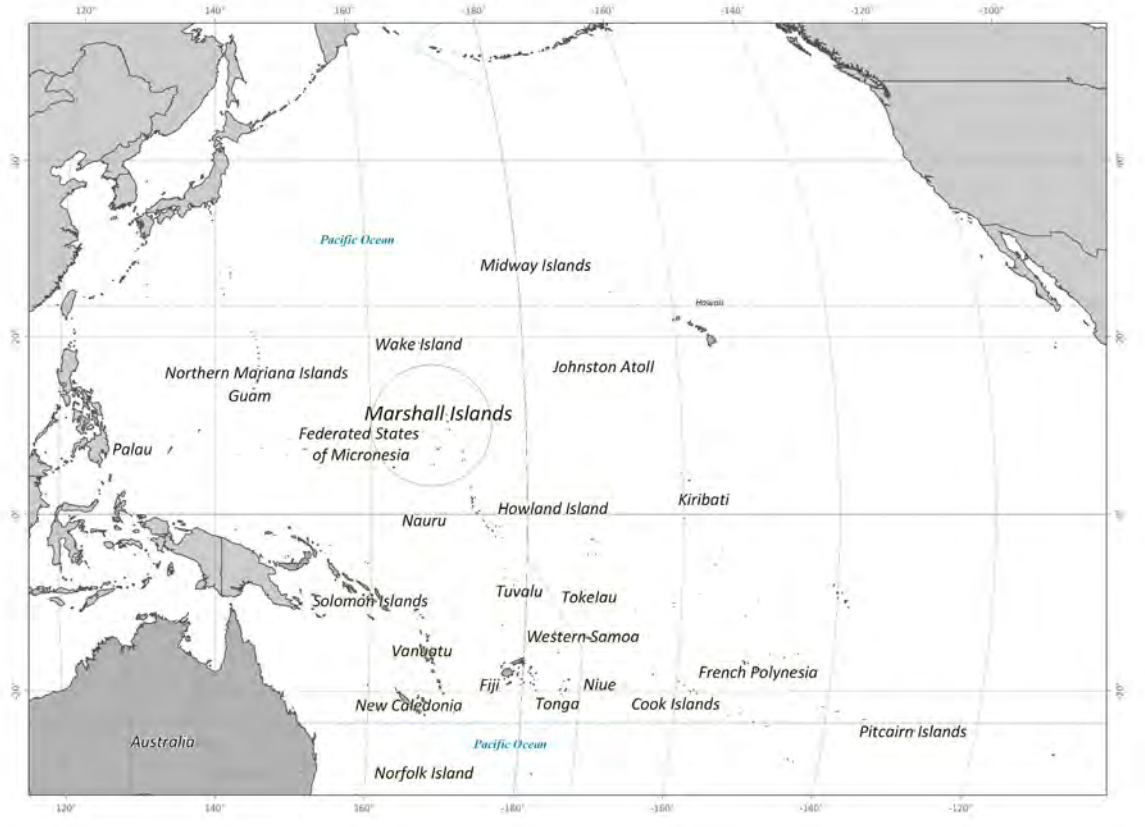
1.e.(ii) Map of Bikini Atoll showing boundary of property (red) and of buffer zone (green)



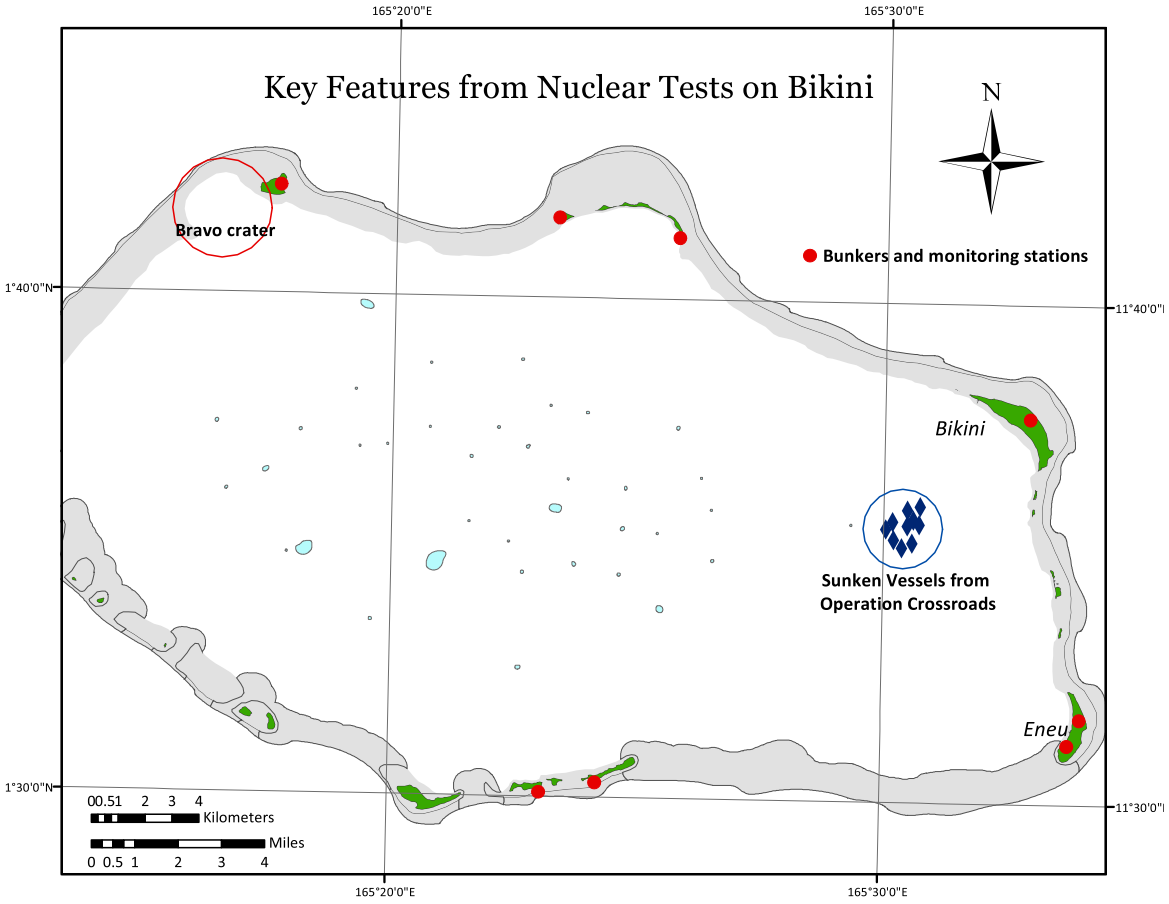
1.e.(iii) Map showing the location of Bikini Atoll within the Marshall Islands



1.e.(iv) Map showing location of the Marshall Islands in the Pacific region

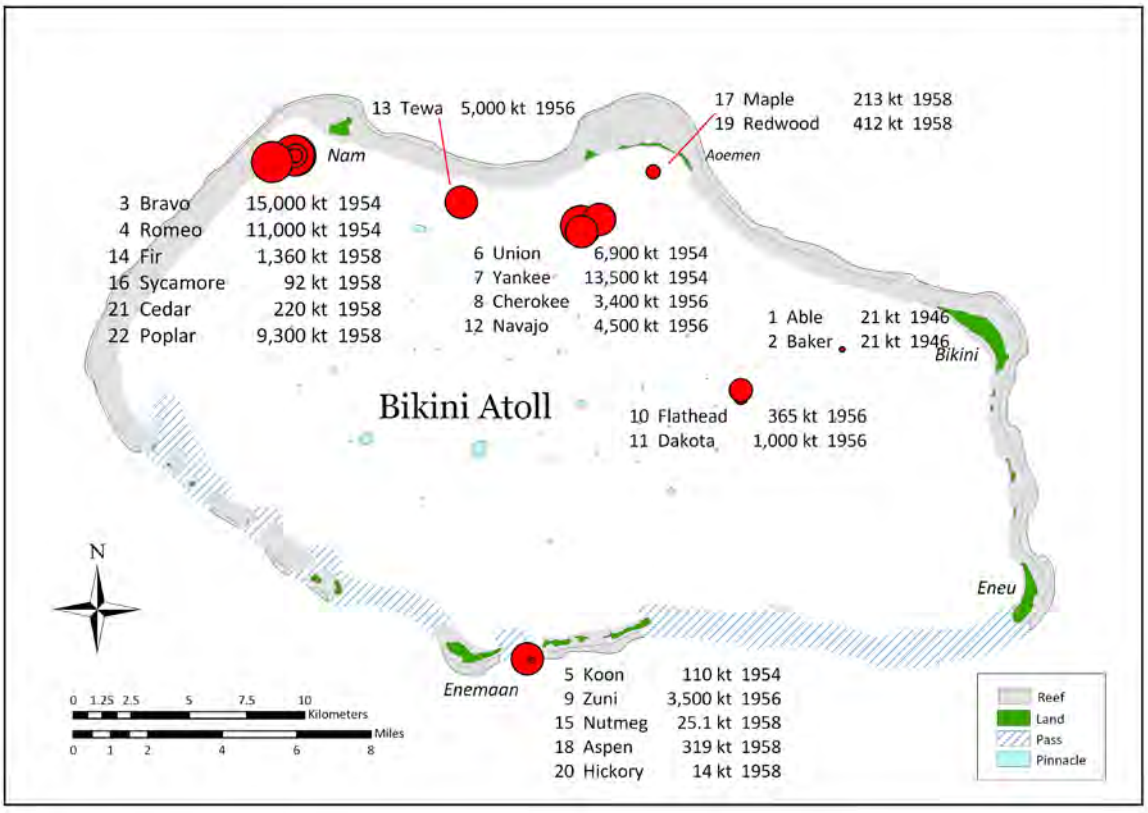


1.e.(v) Map showing locations of key features from nuclear tests on Bikini Atoll



1.e.(vi) Map showing locations of nuclear detonations on Bikini Atoll

(Source of data on location of detonations: Noshkin et al., 1997)



1.f Area of nominated property and proposed buffer zone

Area of nominated property: 73,500 ha.

Buffer zone: 130,425 ha.

Total: 203,925 ha. (2,039 square kilometers or 787 square miles)

Part 2. Description

2.a Description of Property

Forgotten by the world, and isolated in the mid-Pacific, a tiny island bears witness to survival, and to loss. It recalls the innocence of another age. This is Bikini; a coral atoll in Micronesia. It is the home of a people whose lives were destined to be changed. For in 1946 they were banished from it, their peaceful lagoon filled with warships… It was the beginning of the atomic age.

(Livingston & Rawlings, 1992)

Bikini Atoll played host to astounding spectacles, the facts and the myths of which were to change life in the 20th century forever. Despite being the stage for enormous displays of destructive power, Bikini Atoll today has a remarkable beauty and sense of peace. A ring of tiny, low-lying islands bordered by sweeping white-gold beaches and covered in lush green vegetation and swaying palm trees surround a lagoon of invitingly warm turquoise waters. It is one of the images treasured by modern culture—the untouched, wild, desert island.

Upon closer inspection, however, this island paradise bears deep and dramatic scars from the testing of twenty-three nuclear weapons by the United States of America. Today, the remains of crumbling grey concrete bunkers and monitoring stations emerge incongruously from the vegetation reclaiming the islands. A gaping hole a mile wide on the north-western side of the atoll reminds us where the world's first deliverable hydrogen bomb, code-named Castle Bravo, destroyed three islands before its fallout covered eighteen thousand square kilometers (seven thousand square miles) of the Pacific Ocean.

The lagoon is home to spectacular, very large branching *Acropora* and other corals, arrays of multi-colored fish, sponges and giant clams. A reef of remarkable health and richness of species, hovering and gliding seabirds and significant populations of rare and endangered animals, including sharks and turtles, exist here largely free from human disturbance.

Beneath the waters of Bikini lie sixteen sunken naval vessels, the evocative remnants of the Operation Crossroads tests. "Eerily perfect" (Davis, 2005, p. 616) rows of coconut trees cover the larger islands, speaking to the failed resettlement of the people of Bikini. What cannot be seen, although they can be measured, are the invisible and persistent radioactive elements in the soil, plants and animals of Bikini.

At one time the cherished and idyllic home to less than two hundred Bikinians, the beautiful and productive atoll witnessed the comings and goings of tens of thousands of military personnel, enormous quantities of machinery and equipment, and the detonation of weapons of massive destructive capacity. Bikini has now been largely abandoned: "The atoll has the air of a house long unoccupied, but also the feel of an old battlefield, of great events that once were" (Weisgall, 1994, p. 315). The site, as it stands today, eloquently illustrates the fate of a nuclear test site. The entire property of Bikini Atoll—the technological ensemble of sunken ships, along with the various bunkers, the craters and disappeared islands, and the conspicuous absence of people—stands as testimony to a significant stage in human history that encompasses nuclear colonialism, the start of the Cold War and the age of nuclear weapons.

2.a.(i) Geography of Bikini Atoll

Bikini Atoll is the northern-most atoll in the western, *Ralik*, chain of atolls—one of 29 low-lying coral atolls that rise over 6,000 meters from the abyssal plain to no more than a couple of meters above sea level, and comprise the Marshall Islands, known to the Marshallese as *Aelōñ Kein.* The atolls consist of biotic limestone on a deep basalt core, built over millions of years by living coral organisms that grew as the basalt core slowly subsided, creating a marine environment extremely rich in productivity, diversity and complexity.

The entirety of the Marshall Islands lies in the central-western part of the Conservation International Polynesia-Micronesia Hotspot (Conservation International, 2007) and the northern Marshall Islands form the Key Biodiversity Area, Kabin Meto (Conservation International, 2004). Bikini Atoll lies in this drier, northern part of the Marshall Islands. Air and water temperatures hover around 28 degrees Centigrade (82 Fahrenheit) year round, varying little from this. Annual rainfall is an average of 1500mm (60 inches).

Bikini's 23 islands, a total land area of only 720 hectares (1780 acres) encircle an elongated and irregular lagoon which extends 40 kilometers (26 miles) long, east to west, 22 kilometers (15 miles) wide, north to south, and is around 60 meters (200 feet) at its deepest. Most of these islands are joined by a shallow reef, with several deep channels on the southern side of the lagoon. Eneu Channel, the largest, is 15 kilometers (9 miles) wide. Most of the islets on Bikini are small; Bikini Island is the largest with a total area of 212 hectares (524 acres) and Eneu the next largest at 115 hectares (284 acres).

2.a.(ii) Man-made features

The Bravo crater

Originally there were 25 islands around the reef of Bikini, but three of these in the north-west of the atoll—Bokonijien, Aerokojlol and part of Nam—were destroyed by the Bravo shot in 1954. While there are other craters around the atoll at the sites of detonations, the Bravo crater—at over 2 km wide (over a mile wide) and 80 meters (250 feet) deep—is the most obvious physical scar on Bikini (see Figures 1 and 2).

Figure 1. An aerial view of the Bravo crater (E. Hanauer, 2006) (above)

Figure 2. Satellite Image of Bikini showing the Bravo crater (center left of image) in the north-west corner (Google Earth, 2008) (right)

The sunken vessels

Five kilometers from Bikini Island, in 60 meters of water, lies the *Saratoga,* victim of Bikini's second bomb, Crossroads Baker. Upright on the lagoon floor, her mast-top sits just below the surface. Three Helldiver planes and an Avenger torpedo bomber sit on her deck, with 500 pound bombs stacked on nearby racks and her anti-aircraft guns facing skyward. Nearby lies the flagship of the Japanese fleet, the *Nagato*—the scene of operational planning for the attack on Pearl Harbor. These are but two of the ten ships and several lesser vessels that were sunk directly as a result of Crossroads Able and Baker tests, comprising the most prominent remains of the nuclear testing on Bikini. As leading maritime archaeologist, Delgado (1991), describes:

> The ships assembled at Bikini for Operation Crossroads and sunk in the tests represent 34 years of naval design and development , from the oldest ship, *Arkansas*, built in 1912, to the newest, ARDC-13, which was rushed to completion in March 1946. These vessels, as the test planners intended, reflect a range of ship types, construction methods, and hull forms and in total represent in microcosm many of the elements of a typical naval force, with an aircraft carrier, battleships, cruisers, destroyers, submarines, attack transports, and landing craft. Some of these vessels, such as USS *Anderson*, are the sole surviving intact representatives of specific classes of ships… Most ships now sunk at Bikini also had significant World War II careers including roles in major engagements and battles—the Bismarck breakout, Pearl Harbor, the Battle of the Coral Sea, Midway, the Aleutians campaign, the Battle of the Solomons, the Battle of the Philippine Sea, and the Battle of the Leyte Gulf—and represent some of the better known and significant aspects of the war at sea such as wolf pack attacks in the submarine war of attrition against Japan, the seaborne line of supply and replenishment, shore bombardment, kamikaze attacks, and the development of the fast carrier task force. (Delgado et al., 1991, p. 143)

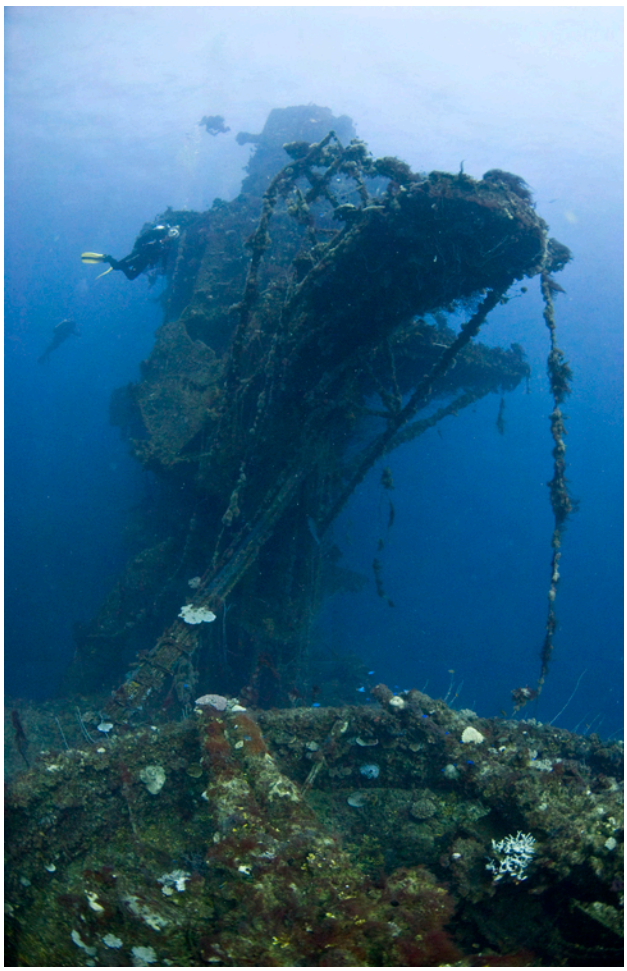


Figure 3. View of part of the *Saratoga* wreck (E. Hanauer, 2006)

Figure 4. Bridge of the *Saratoga* (E. Hanauer, 2006)

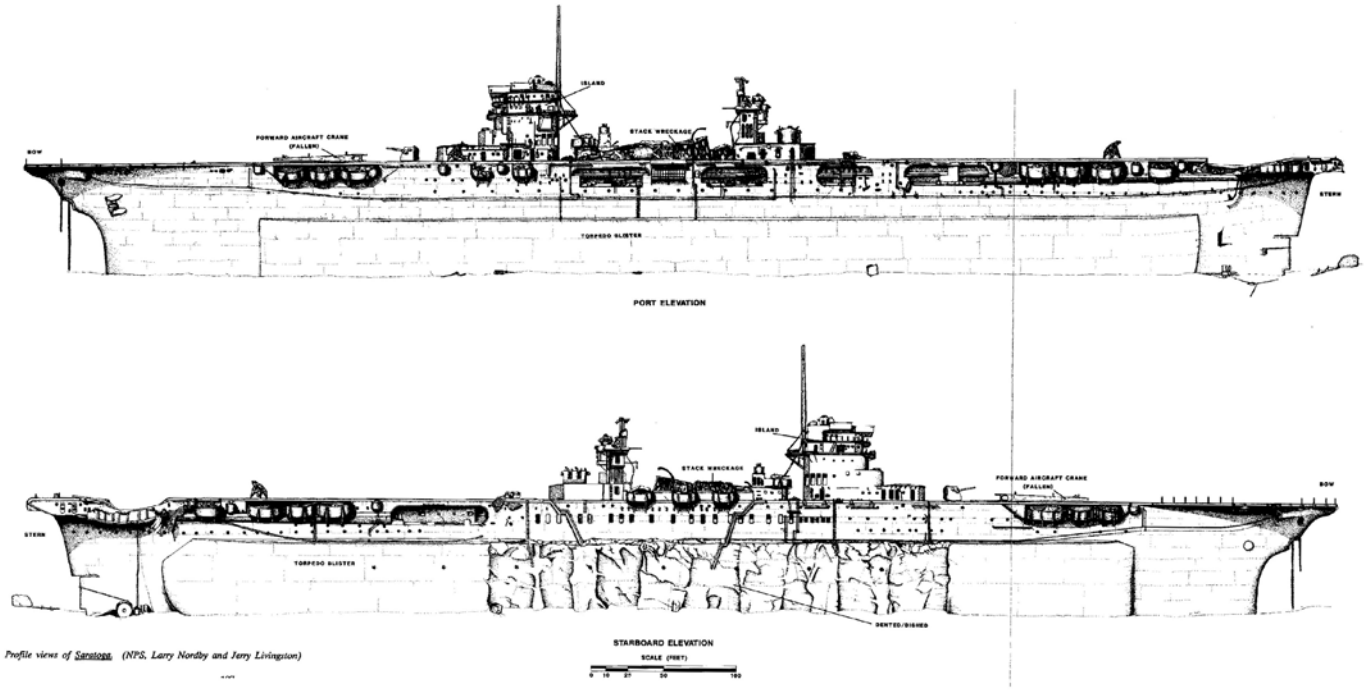
Most of these vessels lie in their original deposition, clustered in and around the shallow crater formed by the Crossroads Baker test of July 25, 1946. All exhibit structural damage from the Crossroads tests, as can be seen in the drawings of the plate damage on the *Saratoga* in Figure 7, and in the photos of the damage of ships after the blasts in Figures 5 and 6. A remarkable assemblage of war technology, nine of these ships are accessible to divers, forming the basis of a small-scale tourism operation and one of the most sought-after diving experiences in the world. It is a unique aesthetic experience to observe the slow reclamation by nature of the once-sleek warships resting here—their smooth grey surface now replaced by a patina of gloriously colored algae, sponges and corals—while sharks, turtles, groupers and myriad fish and other animals make their home in these wrecks.

The global significance of these ships is not in their role in the development of naval technology nor in their World War II actions, but in their role as test instruments for atomic weapons. As Delgado explains, "each of these vessels passed over a threshold at the 'crossroads' between conventional and nuclear warfare, as did the world that had built and manned them" (Delgado et al., 1991, p. 144). The significance of the ships is further discussed in Part 3.

Figure 5. Ship showing structural damage from the Crossroads tests (Bob Landry, 1946, Time Inc.)

Figure 6. Damage from the Crossroads tests on the USS *Independence* (Fritz Goro, 1947, Time Inc.)

Figure 7. Elevation drawing of the sunken *Saratoga* showing damage to the platework on the starboard side (L. Nordby and J. Livingston in Delgado et al., 1991, p. 107-108)



Major vessels sunk during the "Able" test of July 1, 1946

Destroyer USS *Anderson*
Destroyer USS *Lamson*
Attack Transport USS *Gilliam*
Attack Transport USS *Carlisle*
Cruiser HIJMS *Sakawa*

Major vessels sunk during the "Baker" test of July 25, 1946

Aircraft carrier USS *Saratoga*
Battleship HIJMS *Nagato*
Battleship USS *Arkansas*
Submarine USS *Apogon*
Submarine USS *Pilotfish*

Box 1. Major vessels sunk at Bikini Atoll during Operation Crossroads

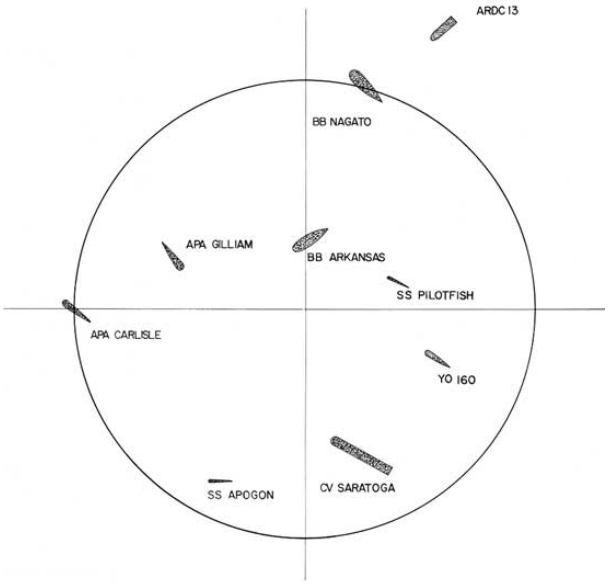


Figure 8. Actual positions of the sunken ships in or near the crater formed by the Crossroads Baker test, as plotted by the US Navy in 1989 (R. Jackson in Delgado et al.,1991,p. 84)

Bunkers and buildings

On Eneu Island of Bikini Atoll there are two structures from the testing period: the remains of the concrete Communications Station, where the officials stationed on Bikini would call the President of the United States requesting permission to go forward with the various nuclear tests, and also the concrete Monitoring Bunker from where the tests were viewed by the US military. In the late 1980s the local government decided to tear down the Bomb Assembly Building because it was in very poor condition.

On Bikini Island there is a small bunker at the back of the island that was used for storage and also communications. On several of the outer islands of Bikini Atoll there are concrete monitoring stations that are still intact. These stations can be found on Aerkoj, Aerkojlol, Enemaan, Nam, Bukor, and Aoemen.

Figure 9. Monitoring bunker on Bikini Island (E. Hanauer, 2006)

Other buildings

More recent construction was carried out to develop facilities for tourism on Bikini. Also on Eneu Island there is a crushed coral runway that allows for the landing of aircraft ranging from large propeller planes to small Lear jets. Eneu Island has a small airport terminal, several warehouses, crew quarters, a pier and dock, repair shops, a power plant, and several unfinished buildings that at one time were intended to be utilized for tourism until it was decided by the Local Government Council to use Bikini Island to accommodate tourists.

On Bikini Island there are two buildings used to house tourists that are situated along the beach, a large structure utilized as a dining hall and warehouse for supplies, a dive shop and tank filling station, a garage that also houses a water-making complex, a TV/briefing room and office used for the tourism program, several buildings used by the US Department of Energy for their ongoing monitoring program, a dock facility, a fuel farm, a power plant, and several buildings used as repair shops for routine maintenance work on the facilities.

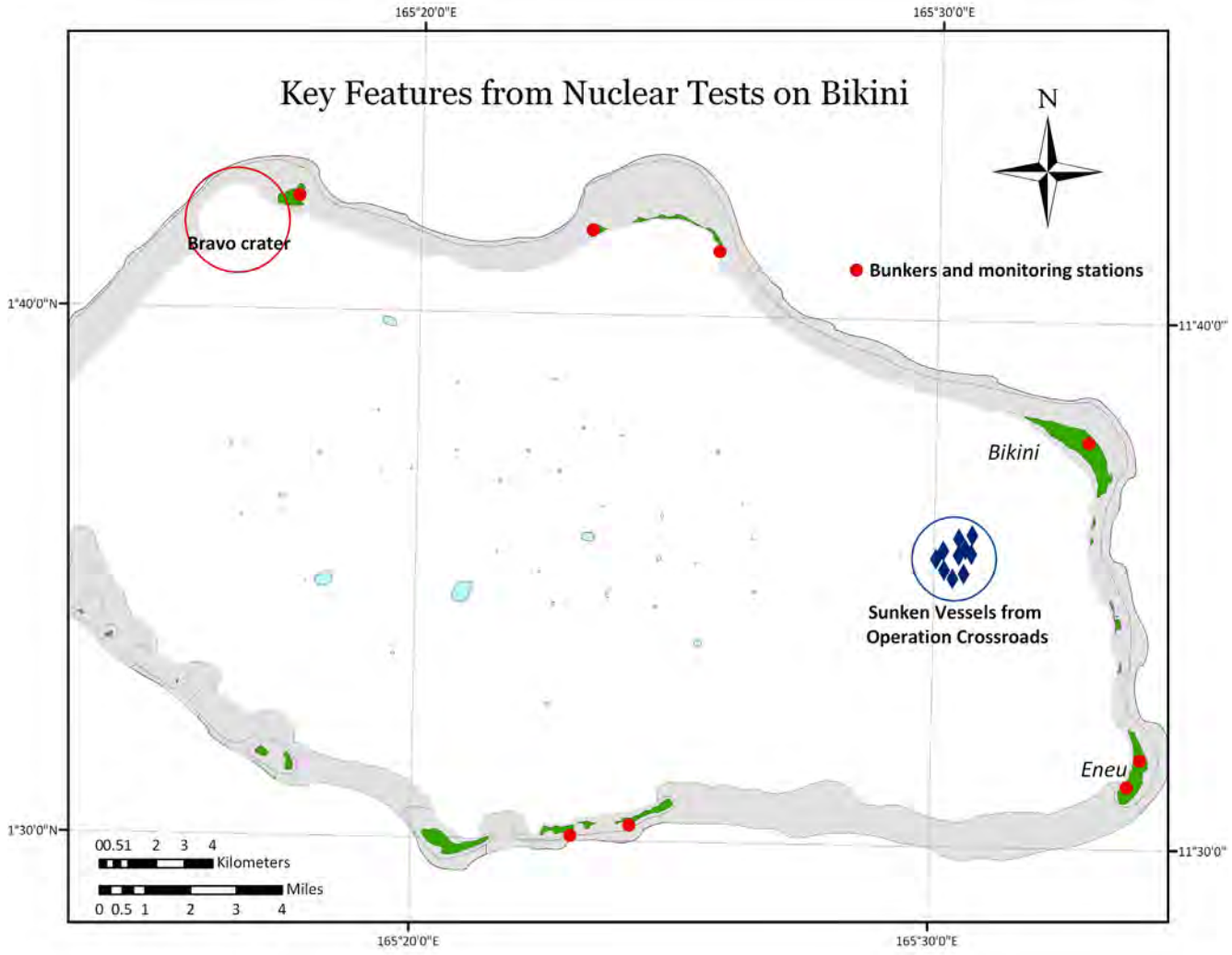


Figure 10. Map showing key features from the nuclear testing: the Bravo crater, the locations of bunkers and monitoring stations and the ships sunk during Operation Crossroads

Radiation

The International Atomic Energy Agency's (IAEA) Bikini Advisory Group preliminary findings issued in 1996 contain the following statements with regard to background radiation on Bikini:

> It is safe to walk on all of the islands...The Advisory Group reaffirmed: although the residual radioactivity on islands in Bikini Atoll is still higher than on other atolls in the Marshall Islands, it is not hazardous to health at the levels measured. Indeed, there are many places in the world where people have been living for generations with higher levels of radioactivity from natural sources—such as the geological surroundings and the sun--than there is now on Bikini Atoll...By all internationally agreed scientific and medical criteria...the air, the land surface, the lagoon water and the drinking water are all safe. There is no radiological risk in visiting the lagoon or the islands. The nuclear weapon tests have left practically no cesium in marine life. The cesium deposited in the lagoon was dispersed in the ocean long ago.
>
> The main radiation risk would be from the food: eating locally grown produce, such as fruit, could add significant radioactivity to the body... Eating coconuts or breadfruit from Bikini Island occasionally would be no cause for concern. But eating many over a long period of time without having taken remedial measures might result in radiation doses higher than internationally agreed safety levels. (quoted in Niedenthal, 2002, pp. 162-163)

The majority of radionuclides[1] produced in nuclear weapons testing are short-lived, so radiation on Bikini was most severe in the few days following a testing event. Radionuclides of concern at Bikini today include residual concentrations of cesium-137 (^{137}Cs, half-life 30 years), strontium-90 (^{90}Sr, half-life 28 years), and, to a lesser extent, plutonium-239 (^{239}Pu, half-life 24,100 years), plutonium-240 (^{240}Pu, half-life 6,560 years), and americium-241 (^{241}Am, half-life 433 years). The cesium-137 radiation burden on Bikini is about 160 times the usual expected from globally-deposited fallout, and in some parts of the atoll it could vary up to 1000 times the expected background level due to heterogeneous fallout deposition (Hamilton & Robison, 2004).

Various reports on the radiological conditions of Bikini point out that there are places in the world where people have lived for many generations with higher levels of environmental radiation from natural sources. However, during predictive human dose assessments on Bikini by the Lawrence Livermore National Laboratory (LLNL) in the 1980s, it was realized that "the most significant pathway for human exposure to *residual* fallout contamination in the Marshall Islands was ingestion of ^{137}Cs present in locally grown foods such as coconut, breadfruit, and pandanus" (Hamilton & Robison, 2004, p. 5). The reason that this particular pathway is significant is that coral atoll soil is potassium-poor, and so plant uptake of the chemically-similar cesium is higher than on continental soils. As part of this finding, the application of potassium fertilizer was found to be effective in reducing the cesium-137 uptake in plants, and large-scale field experiments were established on Bikini.

Radiological assessments have focused on the potential for resettlement on Bikini. The recommendations consistently state that if rehabilitation of the land by a combination of soil-scraping and application of potassium were carried out, and if food were a mixture of imported food and locally grown, then people could live safely on Bikini, subject to radiation doses higher than the average, but lower than many populated areas in the world (Lokan et al., 1998; Hamilton & Robison, 2004).

1 A "radionuclide" is an unstable form of a chemical element that decays spontaneously, emitting radiation.

2.a.(iii) Natural environment

The natural environment is discussed in some depth here although at this time Bikini is being nominated as a cultural site (and not as a cultural landscape or a mixed site). The natural environment of Bikini and its condition form an integral part of the part of the landscape and seascape comprising the nuclear test site. What is especially remarkable is the recovery of the marine environment to a healthy and diverse ecosystem, and the ecological processes in play as a direct result of the bomb detonations. It is thought that research on the attributes of the marine environment, discussed below, is of enormous value to science and, in the future, may constitute a justification for nomination of Bikini under criterion *(ix): be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals*.

The Bikini property is a holistic single atoll system surrounded by open ocean. The location provides natural isolation from neighboring systems and from human intervention. This provides sufficient size for the ongoing functioning of the natural systems. While the terrestrial environment has been significantly disturbed, the marine environment reef system has a very high biodiversity, showing the range of species—including endemic biota, apex predators (sharks) and migratory species such as turtles—that demonstrate the system is functioning well. In addition, there are increasing numbers of birds, probably due to the absence of human hunting pressure.

Marine environment

Bikini Atoll presents an excellent example of the ongoing ecological and biological processes in the development and evolution of coral reefs, demonstrating an impressive recovery of corals and marine life after repetitive human intervention and modification through nuclear blasts. The study of this is of significant interest to science for understanding the impact on marine ecosystems following major disruption and the subsequent processes of recovery of these ecosystems.

The Bravo crater resulted from three islands being pulverized and millions of tons of sediment and carbonate being airborne and subsequently suspended, transported and deposited. While this extraordinary disturbance event was devastating for reefs directly impacted, it created new lagoonal space and new opportunities for reef development and colonization. A coral biodiversity study conducted at Bikini in 2002 presents stunning evidence of the recovery of coral reefs in the Bravo crater five decades after the event (Richards et al., 2008). One of the most profound aspects of the Bravo crater site is the occurrence of huge thriving matrixes of branching coral. The coral clearly colonized the site after the bombing ceased, and it is suggested that through time, as more calcifying organisms inhabit the microhabitat provided by the branching (*Porites cylindrica*) coral, the reef will solidify to eventually form the consolidated patch reef that is typical of lagoonal habitat found elsewhere. In this way, Bikini Atoll, and particularly the Bravo crater site, provides a superb example of early succession and the development of reef structure.

In providing a rare opportunity to examine the long-term impacts of nuclear testing on coral biodiversity in-situ, Bikini also offers science an opportunity to understand the resilience, or capacity for biodiversity to persist after disturbances of coral reefs—crucial information for devising appropriate management actions to mitigate biodiversity loss. Current records of long-term or large-scale resilience to disturbances are scant. There are few opportunities to study large-scale impacts and long-term recovery because most disturbances are cumulative and on-going. Bikini Atoll provides an opportunity to investigate biodiversity resilience in-situ because the disturbance to the reef system was acute and there have been minimal subsequent anthropogenic or natural disturbances since the testing ceased.

There is growing concern about the insidious effects of enhanced greenhouse gas concentrations on ocean chemistry (Feely et al., 2004). The ability for organisms to calcify is decreased and the ability for reefs to form and maintain their structure in increasingly acidic environments is compromised. Our understanding of the full range of consequences of changing ocean chemistry is extremely limited at present, hence the reef structures in the Bravo crater provide an unparalleled opportunity to document the geological processes of reef development under the current and forecasted future sub-optimal oceanic conditions in the absence of other anthropogenic impacts.

Figure 11. Scientist Zoe Richards collects samples of coral in the Bravo crater at Bikini (S. Pinca, 2002)

In addition to its value for understanding coral reef ecosystem function, the marine environment of Bikini is home to many species that are threatened or depleted in the rest of the world, including coral species, giant clams, turtles and sharks. Recent red-listing of Scleractinian coral species revealed alarming results with one-third of reef-building corals threatened with extinction (Carpenter et al., 2008). Approximately 50 of the 183 species of coral recorded at Bikini Atoll (Richards et al., 2008) fall within an IUCN threatened category. Given that Bikini Atoll reef ecosystems are relatively pristine (Pinca et al., 2002) in comparison to reefs occurring in more populated regions, Bikini provides some of the most significant reef habitat in the northern Pacific and, in effect, a refuge that may support the recovery in other more heavily impacted parts of the world such as South East Asia. Today, Bikini Atoll is the type locality of two species of coral (*Acropora vaughnai* and *Acropora palmarae*). Surveys of coral biodiversity carried out in 2002 (Richards et al., 2008) revealed that eleven species of coral occur at Bikini Atoll despite never before being recorded in the Marshall Islands. Four of these species are considered, on current records, to be regionally restricted to Bikini Atoll–*Acanthastrea hillae*, *Acropora bushyensis*, *Montipora cocosensis* and *Polyphyllia talpina*. Two species (*Acanthastrea brevis* and *Montastrea salebrosa*) were found to be locally abundant and distributed widely at Bikini Atoll, indicating that Bikini Atoll provides significant habitat for the conservation of these species.

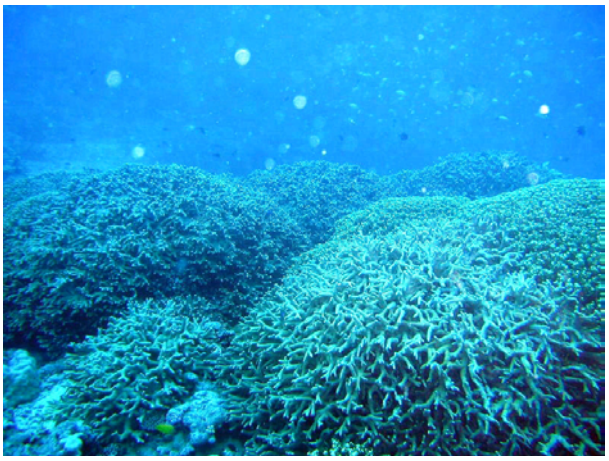


Figure 12. Giant branching acropora have reestablished in the Bravo crater (S. Pinca, 2002)

The rare and threatened species of giant clam *Tridacna gigas* appeared to be particularly abundant in Bikini lagoon compared to many other atolls of the Marshall Islands. This species is literally disappearing from the Pacific region and is found freely growing in Bikini as well as in the nearby atolls of Rongelap and Ailinginae. The locations where it was mostly found in Bikini are the lagoonal sites in the northwest (near the Bravo crater) and central northern areas (in front of Aomoen Island). At this latter site, many *Hyppopus hyppopus* giant clams are similarly found (Pinca et al., 2002).

Pinca et al. (2002) found very high diversity of fish fauna at Bikini (species richness is 359) due to the high variability of habitats offered by lagoon, pass and ocean environments. The southern and eastern walls of Bikini sustain a high biomass of carnivores (*Lutjaunidae, Lethrinidae, Sphyraenidae, Carangidae*), while the lagoon is rich in invertebrate feeders and herbivores (*Mullidae, Ephinephelidae, Caesionidae*) (Pinca et al., 2002).

Figure 13. Gray reef sharks at Shark Pass on Bikini Atoll (M. Harris, 1999)

One special characteristic of Bikini that differentiates it from other atolls in the Marshalls and from many reefs in the world is the particularly high concentration of several shark species that are considered threatened, including gray reef shark (*Charcharhinus amblyrhyncos),* reef whitetip shark (*Trienodon obesus),* reef blacktip shark *(C. melanopterus)* and silvertip shark (*C. albimarginatus)*. The highest concentration is found at the so-called Shark Pass in the south where hundreds of *C. amblyrhyncos* swim inoffensively and undisturbed along the inner wall and at the pass itself. Silvertips (*C. albimarginatus*) are in deeper water and more difficult to spot, but they are attracted by the visit of the casual diver and come often to shallower depths. Tiger sharks (*Galeocerdo cuvier*) are also known to inhabit the lagoon of Bikini and to approach the shore at night or to swim by the decompression bars in the middle of the lagoon. The spotted eagle ray (*Aetobatus narinari*) is also a frequent sight in the lagoon waters (Pers. comm.).

The special abundance of sharks at Bikini Atoll is indicative of a healthy and diverse ecosystem. Many studies have proved that top predators are indicators of elevated biodiversity, individual density and ecosystem complexity and productivity (Sergio et al., 2006). A location capable of supporting a dense population of top predators is able to support populations of smaller species.

Vegetation

So dramatic was the impact of testing on the islands that a vegetation survey by Fosberg (1986) in 1985 reported that on all the islands of Bikini "no unaltered vegetation has survived" (p. 2), although the native species have survived. There are several stands of important species on some of the islands, including *Pisonia grandis*, a favorite nesting place for birds, and *Pemphis acidula*, which is a species of cultural importance in the RMI (Reimaanlok, 2008). Fosberg (1986) describes the islands of Eneu and Bikini as dominated by planted coconut palms "on a precisely laid-out 30 foot square grid system" (p. 3). These trees remain untended, and the physiognomy of the plantation varies from tall and luxuriant, with dense undergrowth, to stunted coconut palms with sparse undergrowth. Vegetation on other islands in 1985 showed a mixture of the usual atoll strand vegetation (*Scaevola* and *Tournefortia*) and exotic species. Fosberg (1986) was reluctant to predict the rates of succession and the resulting communities on Bikini Atoll, and there is a need to carry out a vegetation survey to understand how these atoll terrestrial systems have recovered from the testing and associated impacts.

Birds

The impressive feature of Bikini's birds are described by Vandervelde and Vandervelde (2003). Upon arriving on Eneu, one can observe boobies and terns. Mixed flocks of terns feed in front of the resort, but these are insignificant delights compared to visiting the bird nesting grounds on islands in the north and southwest of the atoll. Twenty-six species of birds are documented for Bikini Atoll, including 3 IUCN Red-listed species: Buller's Shearwater (*Puffinus bulleri*), Sooty Shearwater (*Puffinus griseus*) and the Bristle-thighed curlew (*Numenius tahitiensis*). It is thought that the birds of Bikini have benefited from the absence of humans, as they were traditionally eaten by the people of Bikini. The Red-tailed Tropicbird (*Phaeton rubricauda*) now nests on Bikini, but was unknown to Bikinians prior to the testing.

Figure 15. "Eerily perfect" rows of coconut trees (J.S. Davis, 2002)

Figure 14. Aerial view of the rows of coconut trees (Google Earth, 2008)

2.b History and Development

2.b.(i) The formation of Bikini Atoll

The geological development of Bikini is typical of many Pacific atolls, as described by Scott and Rotondo (1983) and Dickinson (2004), with coral reefs growing on a subsiding volcanic island. After volcanic activity ceased in the Miocene period, the rocks cooled and the original island subsided slowly below sea level, and was covered by a thick coral reef. In the Pleistocene (the last two million years) the atoll underwent erosion when exposed by low sea level during ice ages, and reef growth when sea level was close to its present level during warm periods. Drilling at Bikini and Enewetak Atolls showed that the coralline limestone caps on these atolls exceed 1,200 meters in depth, and provided the first subsurface evidence to support Darwin's subsidence theory of atoll formation. Although the form of the atoll is several million years old, the youngest islands only breached the surface between 2,000 and 4,000 years ago, amid a slight lowering of sea-level.

2.b.(ii) First settlement & traditional life on Bikini

In order to understand the significance of the loss of Bikini to its people, it is important to understand the history and traditional life of the Bikinians and the depth of connection to place that had developed over thousands of years and still persists. The lifestyle and culture described here survived largely intact up until the Bikinians left their island in 1946, at which point the way of life for this community was irrevocably changed.

It is thought that people began to populate the Marshall Islands shortly after the emergence of land, between 2,000 and 3,500 years ago (Rainbird, 1994). The oral history of the settlement of Bikini as related by Kilon Bauno (in Niedenthal, 2002) describes the journey of Larkelon, an "iroij" or chief, who brought his people from Wotje Atoll to Rongelap. There they intermarried with the Rongelap people, and then, looking for a new kingdom, sailed on to Bikini. People were already living on Bikini, led by the chief Laninbit. Faced with the bold Larkelon and his many people and canoes, Laninbit conceded the lands and waters of Bikini. Laninbit ordered his people to collect their belongings and in a matter of hours the original Bikinians sailed off to the south, resting only for a short moment on one of the southern islands in the atoll then continuing into the sunset never to be heard from again. It was if the great seas of the earth had swallowed their boats whole, and drowned the entire clan of people. Larkelon triumphantly began his reign as the chief of Bikini (pp. 15-20). Bikinians today trace their lineage directly to Larkelon; "King Juda," the chief at the time of the nuclear testing in 1946, was a direct descendant of Larkelon (Weisgall, 1994, p. 40).

Traditional life on Bikini was much like life elsewhere in the Marshalls and on other Micronesian atolls. Houses were small, simple thatched huts with woven pandanus mats covering the ground. The few tools and utensils were made only from the island's resources: wood, coral, shell and fibers from coconut and pandanus. Bikinians were accomplished seafarers who travelled between islands, and between atolls, in sturdy, double-prowed canoes lashed together from planks of breadfruit trees. These canoes, with an asymmetric hull balanced by an outrigger, are widely considered to be masterpieces of sailing technology. Likewise, fishing was a sophisticated activity using a range of tools from the simple hook and line to nets, traps, spears, clubs, rope and coconut fronds. Some methods involved the participation of many people, and some were practiced by the individual. Fishing was accompanied by complex taboos, procedures and magic chants that integrated the spiritual and social life with the methods for gathering food (Petrosian-Husa, 2004). The Bikinians were skilled agro-foresters, carefully cultivating several varieties of breadfruit and pandanus in the poor atoll soils and often difficult growing conditions. A wide range of plants and associated rituals were used in traditional medicine.

The relative isolation of the atoll created for the Bikinians a tightly integrated society bound together by close extended family association and tradition, where the amount of land you owned was a measure of your wealth. Unlike in the rest of the Marshall Islands, Bikinians identify a chief from among themselves and resist any claims to chief-status from others.

Marshallese traditional life incorporated sophisticated and well-adapted technologies, integrated with a spiritual and social life that was based on the interaction with the natural environment. Bikini Atoll forms the basis of identity for the Bikinians, in the same way that sea and country do for indigenous peoples around the world.

2.b.(iii) European contact, Germans and the copra trade, 16th century to 20th century

Hezel (1983) describes the first recorded contact between Marshallese and Europeans as the landing of the *Florida*, captained by Saavedra, on the islands of "Los Jardines"—thought to be either Bikini or Enewetak Atoll—on October 1, 1529. The meeting was mostly friendly and the islanders greeted the Spanish with

singing, dancing and a feast of fish, breadfruit and coconut. There was an incident where a musket was fired to demonstrate its function to the curious chief, at which "most of the Marshallese flew out of the house and dashed madly through the bush, most of them not stopping until they were in their canoes heading for safe refuge on another part of the atoll" (p.16). Although much of the rest of the Marshall Islands was "discovered" by Gilbert and Marshall in 1788, Bikini was not seen again by Europeans until almost 40 years later, in 1825, when Russian Otto von Kotzebue's ship sighted the atoll from the mast top 11 miles away. Kotzebue named the atoll Eschscholtz after the ship's scientist and doctor—a name that persisted even when the site was announced in the *New York Times* in 1946 as the location chosen for nuclear testing.

Wesigall (1994) records reports of a trading schooner calling at the atoll in 1834, a visit during which it is believed the captain and two crew were murdered, resulting in retaliation by the crew of a sister ship who are thought to have murdered some thirty Bikinians—one-third of the population. The first documented contact between Bikinians and non-Marshallese occurred in 1858 when Chramtschenko, Kotzebue's lieutenant, returned, locating a channel and entering the lagoon of Bikini. In 1957, a year prior to Chramtschenko's visit, American Protestant missionaries arrived on Ebon in the far south of the Marshalls to establish the first mission, having much success as Christianity spread throughout the archipelago. Missionaries did not travel to the northern parts of the Marshalls until much later and it was not until 1908 that a Marshallese pastor arrived to establish the first mission on Bikini.

German copra traders arrived in the Marshall Islands in the 1860s and established a trade centered on Jaluit and Likiep Atolls. Seeing an opportunity to expand colonial power in Micronesia, Germany signed a treaty with a paramount chief for access rights to several ports and, in 1885, declared the Marshalls a German protectorate with the approval of Britain. The fertile atolls in the southern Marshalls were attractive to the traders because they could produce a much larger quantity of copra. Thus, while the Bikinians engaged in a subsistence-level copra trade in order to buy rice, sugar and other goods, no Germans settled on Bikini. Bikinians maintained isolation, had their own dialect and, while people in the southern isles were more actively engaged in the copra trade and adopted western dress, the Bikinians wore traditional coconut and pandanus woven mats and skirts well into the 20th century. A chiefly system of rule had developed in the Marshalls with some chiefs having jurisdiction across several atolls, but Bikini maintained independence from this system until the late 19th century.

Figure 16. Bikinian woman and family prior to 1946 (unknown, n.d.)

Figure 17. King Juda (right), the chief of the Bikinians in 1946 (unknown, 1946)

2.b.(iv) The Japanese, militarization and World War II, 1915-1944

Japan took control of most German holdings in Micronesia at the outbreak of World War I and, in 1919, was awarded the Marshall Islands as a class "C" mandate of the League of Nations. Although fortification and militarization of the islands was banned under the mandate, in the 1930s Japan closed Micronesia to the rest of the world and commenced military build-up throughout the islands in anticipation of World War II. As Niedenthal (1991) explains, "Bikini and the rest of these peaceful, low-lying coral atolls in the Marshalls suddenly became strategic" (p. 1).

The Bikini Islanders' life of harmony drew to an abrupt close when, early in the Pacific conflict, the Japanese decided to build and maintain a watchtower on their island to guard against an American invasion of the Marshalls. Throughout the war the Bikini station served as an outpost for the Japanese military headquarters in the Marshall Islands at Kwajalein Atoll. Life under the Japanese military was difficult; young men were sent

to school to learn Japanese and put to work laboring, and often there were cruel beatings as punishment for resisting the Japanese soldiers ("Japanese on Bikini," 1990).

Toward the end of the war in the Pacific, February of 1944 saw a gruesome and bloody battle in which the American forces captured Kwajalein Atoll, effectively crushing the Japanese hold on the Marshall Islands. The battle involved 40,000 US troops and resulted in 372 Americans and 8,000 Japanese dead. The day after an airstrike aimed at the watchtower on Bikini, an American ship pulled into the lagoon. The five remaining Japanese soldiers, hiding in a foxhole, then killed themselves with a grenade. Bikini was liberated.

2.b.(v) The Nuclear Age arrives 1945-1946

The war in Europe ended on May 8, 1945 with the unconditional surrender of Nazi Germany. From July 16 to August 2, Josef Stalin, Winston Churchill (replaced later by Clement Attlee) and Harry S Truman met in Potsdam, Germany to determine the administration of post-Nazi Germany. The US and Britain were suspicious of Stalin's motives as communist governments had already been installed in the countries under Soviet influence. Not knowing if the Soviets knew about atomic bombs, during this meeting Truman mentioned an unspecified "powerful new weapon" to Stalin—a move widely seen as a subtle warning for the Soviets to regard the United States' might with respect.

During the Potsdam Conference, on July 26, Japan was given an ultimatum by the United States, Great Britain, and China to surrender, or meet "prompt and utter destruction" (Potsdam Declaration, 1945). Japan declared that it would ignore the ultimatum and Truman ordered the atomic bombing of Hiroshima on August 6 and of Nagasaki on August 9, 1945, killing as many as 140,000 people in Hiroshima and 80,000 in Nagasaki. The atom bomb had entered the world. Within a few weeks, Japan had surrendered and the war in the Pacific was over.

Establishment of the United Nations Atomic Energy Commission

Over the coming months a series of meetings was held by the Soviet Union, United States, China, France and the United Kingdom to try to determine peace agreements with defeated nations and settle territorial disputes outstanding at the end of World War II. At the center of this geopolitical maneuvering, particularly between the United States and the USSR, was the question of who owned atomic secrets, and who controlled atomic power. In the December Interim Meeting of Foreign Ministers in Moscow, at the instigation of US secretary of state, James F. Byrnes, it was agreed to establish a "commission to consider problems arising from the discovery of atomic energy and other related matters" under the United Nations (Soviet-Anglo-American Communiqué, 1945). The United Nations Atomic Energy Commission (UN AEC[2]) was established as the very first resolution of the first United Nations General Assembly on January 24, 1946, and called for the "elimination from national armaments of atomic weapons and all other major weapons adaptable to mass destruction" (United Nations General Assembly, 1946).

While American diplomacy was taking these steps, within the United States there was dissent about what to do with nuclear weapons. In 1945 the Americans were unsure how far the Soviets had proceeded in the development of the bomb. Truman considered the Moscow agreement a general commitment only, as his distrust of Stalin deepened. Congress and the public were not ready for an international body to take control of nuclear technology that was currently only in the hands of the United States (Weisgall, 1994, p. 59).

The Cold War begins

> *It is difficult to say precisely when the Cold War began. There were no surprise attacks, no declarations of war, no severing even of diplomatic ties. There was, however, a growing sense of insecurity at the highest levels in Washington, London and Moscow, generated by the efforts the wartime allies were making to ensure their own post-war security.*
>
> (Gaddis, 2007, p. 27)

Several events in the next few months brought tension in post-World War II relations to a head. After the defeat of Japan, Stalin had protested that the Soviet Union was offered little role in the occupation of post-war Japan. On February 9, 1946, in a speech to constituents, Stalin expressed hostility towards capitalism and declared a 5-year plan to double output of iron, steel, coal and oil (1946). On February 12, the Soviets announced that a new communist government had been formed in North Korea (Weisgall, 1994, p. 60), breaking an agreement reached at the Moscow conference the previous December to jointly assist Korea to become an independent democracy (Soviet-Anglo-American Communiqué, December 27, 1945). The next day George F. Kennan sent his famous "Long Telegram" from the

2 The acronym UN AEC is used here to distinguish the United Nations Atomic Energy Commission from the United States Atomic Energy Commission established in August 1946, and also known as the "AEC".

US embassy in Moscow to Washington, describing the Soviet outlook: "Soviet power," he wrote, is "impervious to the logic of reason and highly sensitive to the logic of force" (quoted in Weisgall, 1994, p. 60). This telegram confirmed for Washington the threat of Soviet expansion and galvanized hard-line policy towards Moscow. On March 2, the Soviet Union refused to withdraw troops from Azerbaijan in Iran, an area of "vital strategic and economic importance to the West" (Weisgall, 1994, p. 61), as had been agreed early in the war. Three days later, on March 5, 1946, Churchill delivered his "Sinews of Peace" address, reinforcing that the United Nations organisation was critical to peace, but that:

> It would nevertheless be wrong and imprudent to entrust the secret knowledge or experience of the atomic bomb, which the United States, Great Britain, and Canada now share, to the world organization, while it is still in its infancy. It would be criminal madness to cast it adrift in this still agitated and un-united world.

He further declared that "a shadow has fallen upon the scenes so lately lighted by the Allied victory. Nobody knows what Soviet Russia and its Communist international organization intends to do in the immediate future, or what are the limits, if any, to their expansive and proselytizing tendencies" (Churchill, 1946). Stalin saw this as an ultimatum, describing Churchill as a racist "warmonger" and likening him to Hitler ("Stalin compares," 1999). The Sinews of Peace address is considered by many to be the start of the Cold War.

Is the Navy obsolete? – Operation Crossroads is conceived

Meanwhile in the United States, public opinion expressed in the press and in Congress a "nearly universal belief that the atomic bomb had rendered navies obsolete" (Weisgall, 1994, p. 13). "It does seem to me…that atomic energy has driven ships off the surface of the sea," said Senator Edwin C. Johnson before the Senate's Special Committee on Atomic Energy, in December, 1945, "I don't see how a ship can resist the atomic bomb" (quoted in Weisgall, 1994, p. 13).

In a report reprinted in *Life* magazine in November 1945, Army Air Force Commanding General Henry H. Arnold wrote:

> The influence of atomic energy on Air Power can be stated very simply. It has made Air Power all-important… The only known effective means of delivering atomic bombs… is the very heavy bomber... Development of the air arm, especially with the concurrent development of the atomic explosive, guided missiles and other modern devices, will reduce the requirement for, or employment of mass armies and navies. (quoted in Weisgall, 1994, p. 13)

At this time, most military aviators flew in the Army Air Force. These discussions "represented one more chapter in the decades old rivalry and mistrust between the Army and the Navy and the culmination of the 25-year debate over the role of airplanes and ships" and furthered a push for an independent air force, separate from both army and navy (Weisgall, 1994, p. 18). This debate, combined with various recommendations to dispose of 38 captured Japanese vessels and a desire to better understand the effects of nuclear weapons, resulted in a plan for tests. A joint army-navy program of atomic tests was announced by Admiral Ernest J. King, commanding officer of the Navy, on October 27, 1945. The tests would involve 80 to 100 ships from captured Japanese and German fleets, and from surplus US vessels. Planning commenced in earnest and the tests were approved by Truman on January 10, 1946.

The "hole in the map"—Bikini is chosen

In the midst of vacillating US policy on control of nuclear weapons, Vice Admiral Blandy's first job upon his appointment as commander of Joint Task Force One, in January 1946, was to select a site for the tests of atomic weapons on a naval fleet. On January 15, Truman announced that the United States would insist on being the United Nations trustee of the Pacific islands captured from Japan during the war, although this was not formalized until April 2, 1947. Military planners had been working to select a site as early as October 1945, and more than a dozen locations had been considered in the Pacific, Atlantic and Caribbean. Serious consideration was given to: Ulithi in the Caroline Islands, to the west of the Marshalls; two northern Marshall Islands sites, Bokak and Bikar; and even to the Galapagos Islands in the eastern Pacific (Weisgall, 1994, p. 32-33). Weisgall outlines the criteria for selection of the site:

> The site had to meet numerous conditions: it had to be in an area controlled by the United States, in a climatic zone with predictable winds and free from storms and cold temperatures, and with a large sheltered area for anchoring target vessels and measuring radiation effects. It had to be located within 1,000 miles of a B-29 air base, as the first test was to be an air drop. The site had to be uninhabited or have a small population that could be easily relocated. As Blandy later wrote, 'It was important that the local population be small and cooperative so that they could be

moved to a new location with a minimum of trouble.' But most important, given the risk of radioactive contamination, the site had to be far away from population centers in the United States. As the AEC later stated to Congress, it felt that 'tests should be held overseas until it could be established more definitively that continental detonations would not endanger the public health and safety.' (1994, p. 31)

In the end, Bikini was selected, in part, for its proximity to Kwajalein Atoll to the south and Enewetak Atoll to the west—US military installations that could accommodate aircraft for the test. Comedian Bob Hope explained the selection process differently: "As soon as the war ended, we located the one spot that hadn't been touched by war and blew it to hell" (quoted in Weisgall, 1994, p. 33).

Test Atomic Bombs to Blast 100 Ships at Marshalls Atoll

Two Separate Attacks Set for May and July —20,000 Men to Take Part in Experiments —Special Recording Devices Ready

By SIDNEY SHALETT
Special to THE NEW YORK TIMES.

WASHINGTON, Jan. 24—The momentous tests of airborne atomic bombs against warships, which will decide the future of modern seapower, will be conducted at Bikini Atoll in the Marshall Islands next May and July.

Two of the devastating city-smashing bombs that were used against Japan will be dropped against 100 floating targets, of which thirty-five will be warships ranging from submarines to carriers and battleships. Twenty thousand personnel will take part in the tests.

"Crossroads" is the code name given by the United States Joint Chiefs of Staff to the tests, on which so many vital factors of future naval and military strategy depend.

Vice Admiral William H. P. Blandy, chosen by the Joint Chiefs as commander of Joint Task Force One, composed of the Navy, Army, Air Force and civilian scientific leaders who will direct the tests, gravely told the Senate Special Committee on Atomic Energy today that the name was deliberately chosen because of its "possible significance"—that seapower, airpower, and perhaps humanity itself—were at the crossroads.

Admiral Blandy, who is Deputy Chief of Naval Operations for Special Weapons [atomic bombs and guided missiles] appeared with the newly appointed Army, Navy and civilian members of his staff before the Atomic Energy Committee to make the first official disclosure of details of the coming tests.

Later, the same officials conducted a long press conference at the Navy Department, where they further unfolded the synopsis of the dramatic story in response to a barrage of specific questions.

The principal points revealed by

Continued on Page 4, Column 2

The New York Times
Published: January 25, 1946

Figure 18. Front page of the *New York Times,* January 25, 1946

On January 24, 1946, the very same day that the UN General Assembly established the Atomic Energy Commission with a goal of disarmament, Blandy announced to Congress that Bikini Atoll, in the Marshall Islands, was to be the site of this major atomic experiment. Blandy also announced the name of the tests—Operation Crossroads—"because seapower, airpower and perhaps humanity itself are at the crossroads" (quoted in Shalett, 1946).

Questions started to be asked about the purpose of the just-announced Operation Crossroads. Atomic scientists from the Los Alamos team who had developed the bomb strongly opposed the tests. Influential Senator Scott Lucas spoke on the Senate floor on January 31: "If we are to outlaw the use of the bomb for military purposes, why should we be making plans to display atomic power as an instrument of destruction?" (Weisgall, 1994, p. 73).

In February of 1946, Commodore Ben H. Wyatt, the military governor of the Marshalls, traveled to Bikini. On a Sunday after church, he assembled the Bikinians to ask if they would be willing to temporarily leave their atoll so that the United States could begin testing atomic bombs for "the good of mankind and to end all world wars." King Juda, then the leader of the Bikinian people, stood up after much confused and sorrowful deliberation among his people, and announced, "We will go, believing that everything is in the hands of God." The meeting was re-enacted for the film cameras on the Bikinians' last day on their homeland on March 6. Several takes were needed to convey the desired effect that the Bikinians were, indeed, happy to leave. (Weisgall, 1994, p. 113).

Figure 19. Filming the scene where Wyatt asks the Bikinians to leave their atoll "for the good of mankind" needed at least eight takes to convey the desired effect (US Government, 1946)

One hundred and sixty-seven Bikinians set sail for Rongerik on March 7. Emso Leviticus describes leaving Bikini Atoll:

> We left our island after loading everything we owned including our canoes, various kinds of food, bibles, dishes, tools and even some pieces of our church and Council house. We loaded it all onto one of the big ships…and then, after finding our places on the ship, we waved goodbye to our islands and sailed to Rongerik. (in Niedenthal, 2002, p. 52)

Bikinian Anthem

Written in 1946 by Lore Kessibuki (1914-1994) at the time of exodus from Bikini, this song remains the anthem of the displaced Bikinians even today.

I jab ber emol, aet, i jab ber ainmon
ion kineo im bitu
kin ailon eo ao im melan ko ie
Eber im lok jiktok ikerele
kot iban bok hartu jonan an elap ippa
Ao emotlok rounni im lo ijen ion
ijen ebin joe a eankin
ijen jikin ao emotlok im ber im mad ie

No longer can I stay; it's true.
No longer can I live in peace and harmony.
No longer can I rest on my sleeping mat and pillow
Because of my island and the life I once knew there.
The thought is overwhelming
Rendering me helpless and in great despair.
My spirit leaves, drifting around and far away
Where it becomes caught in a current of immense power
And only then do I find tranquility.

Box 2. The Bikinian Anthem

Figure 20. Bikinians load their possessions to leave Bikini (US Government, 1946)

Figure 21. Bikinian outrigger canoe being loaded for the trip to Rongerik. (US Government, 1946)

Figure 22. Bikinian women carrying their possessions to leave Bikini (unknown, 1946)

Within four days of the Bikinians' removal an immense military effort focused on making Bikini ready for the tests, scheduled for May 15. Preparations involved blasting channels, bulldozing large areas and erecting buildings and concrete bunkers, the placement of multi-tonned concrete mooring blocks to hold a test fleet of "target" ships in position in the lagoon, towers to mount test instruments and cameras, seven pontoon causeways, seaplane landing ramps, a water distillation and distribution system, power-generators, moorings for small boats, and huts to house technical equipment:

> By June, parts of Bikini looked like a huge playground. The island was equipped with five concrete basketball courts, ten volleyball courts, four base-ball fields, a 100-foot-square concrete athletic court, swim floats, life-guard platforms, swimming beaches, a beer garden, an archery range, courts for horseshoe pitching, paddle tennis courts, twenty-six dressing huts, and a trap-shooting range. The island even had its own local radio station, "Radio Bikini," which interviewed Crossroads participants and broadcast the comings and goings of various dignitaries. (Weisgall, 1994, pp. 148-149)

Tens of thousands of military personnel, scientists, and observers arrived as Bikini's various islands and lagoon were transformed into a massive military base and a test platform for three tests—an air burst and shallow and deep water tests. In stark contrast to what existed here for thousands of years, the entire landscape and culture of Bikini had been utterly, radically transformed in a remarkable few months. As Firth comments, "Bikini was changed almost beyond recognition" (1987, p. 6). "Bikini" was lost now as a homeland to its people and became, instead, part of the US's "Pacific Proving Ground."

Figure 23. The sign atop the Officers' Club at Bikini Atoll reading "Up and Atom" (1946, © Time Inc.)

The Acheson-Lilienthal Report and the Baruch Plan

In January 1946, as the Truman administration was trying to formulate international policy on the control of atomic weapons in support of the establishment of the UN Atomic Energy Commission, a special committee was established. Led by Dean Acheson, and assisted by a technical advisory group led by David E. Lilienthal, the special committee prepared a plan—the "Acheson-Lilienthal Report"—that laid out a policy by which "no nation would make atomic bombs or the materials for them" (Acheson and Bush radio address, quoted in Weisgall, 1994, p. 70) through careful control over the production of fissionable material by an international body. The report was publicly released on March 28, 1946 to widespread praise.

On March 22, Truman postponed the Operations Crossroads tests from May 15 to July 1, an act that provided some reassurance to the UN Security Council meeting held the following Monday. Days earlier Moscow radio had accused the United States of "brandishing the atomic weapon for purposes which have little in common with the peace and security of the nations" and Stalin had emphasized that the United Nations' strength was based on "the principle of equality of states and not of one state over others" (quoted in Weisgall, 1994, pp. 91-92). There was speculation that the tests would be cancelled altogether. The conflict between attempts at international atomic diplomacy and preparations for this massive atomic experiment were debated repeatedly in Congress.

On June 14, 1946 Bernard Baruch presented the "Baruch Plan"—adapted from the Acheson-Lilienthal Report—to the UN Atomic Energy Commission. The Soviets refused to sign it, and less than three weeks later, the United States detonated the world's first peace-time atomic bomb at Bikini Atoll.

2.b.(vi) Ground Zero: Bikini as a nuclear test site 1946-1958

Operation Crossroads

In all, 242 naval vessels sailed to Bikini, where approximately half would serve as "target ships" for the tests in the lagoon. Forty-two thousand men, 37 women nurses and 150 aircraft participated in what the *New York Times* called the "most stupendous single set of experiments in history" ("Star's Secrets", 1946). Two hundred pigs, 200 mice, 60 guinea pigs, 204 goats and 5,000 rats were exposed to the explosions to better understand the effects of an atom bomb on humans (Shurcliff cited in Weisgall, 1994, p. 120). More than 700 film and still cameras were set up to record the event, 328 of these airborne, manned by over 500 photographers. More than 10,000 instruments, including some developed specifically for the tests at Bikini, were placed on ships, aircraft and the surrounding islands. One hundred and seventy journalists set up "a floating newsroom" on the *Appalachian* (DeGroot, 2006, p. 119). According to Weisgall, "Operation Crossroads was above all else, an extravaganza. It was the grandest scientific experiment ever, more exhaustively photographed, reported, and measured than any previous event in history" (1994, p. 117).

The ninety-five ships assembled as "targets" for Operation Crossroads represented naval technology from the 1910s through the 1940s. Altogether, they formed the fifth or sixth largest "navy" in the world at that time and included every type of ship that had fought in the Second World War, as well as veterans from the First World War. Battleships, aircraft carriers, submarines, cruisers, destroyers, attach transports, landing craft—all were brought to Bikini. The majority of the ships were United States-built, although one German (the state-of-the-art *Prinz Eugen*) and two Japanese warships also filled out the test contingent.

Test Able was carried out on July 1, 1946. A bomb named "Gilda" was dropped from a B-29, and exploded 300m (1,000 feet) above the lagoon, and half a mile from the planned target. Five of the vessels moored in the lagoon sank immediately. However, observers were stationed far away from the explosion and there was a general disappointment expressed by witnesses and in the media that the bomb did not live up to its hype. Laurence, the *New York Times* reporter who had witnessed the Trinity explosion a year earlier, as well as the bombing of Nagasaki, described the Able test: "I saw a reddish-purple ball of fire, smaller than the one I had seen in New Mexico, shooting upward like a meteor going in the wrong direction. It was quickly surrounded by a gigantic spherical envelope of fog. The envelope collapsed with great violence, like a balloon punctured by an invisible hand. Out of it, like a monster hatched from a giant egg, emerged a mushroom-topped cloud" (quoted in Graybar, 1986, p. 901).

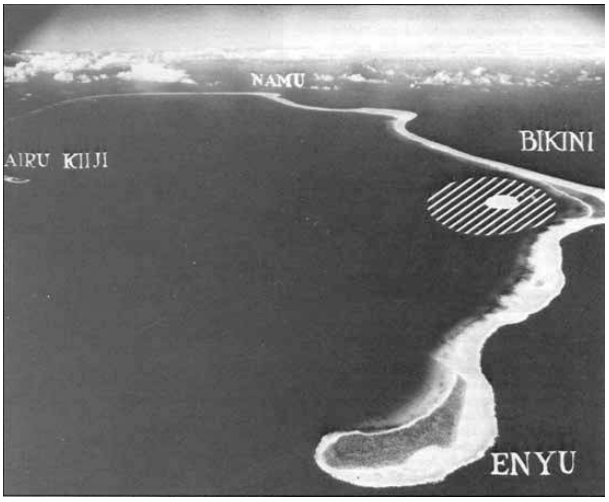


Figure 24. US Navy press release photo of the target area for Operation Crossroads (1946)

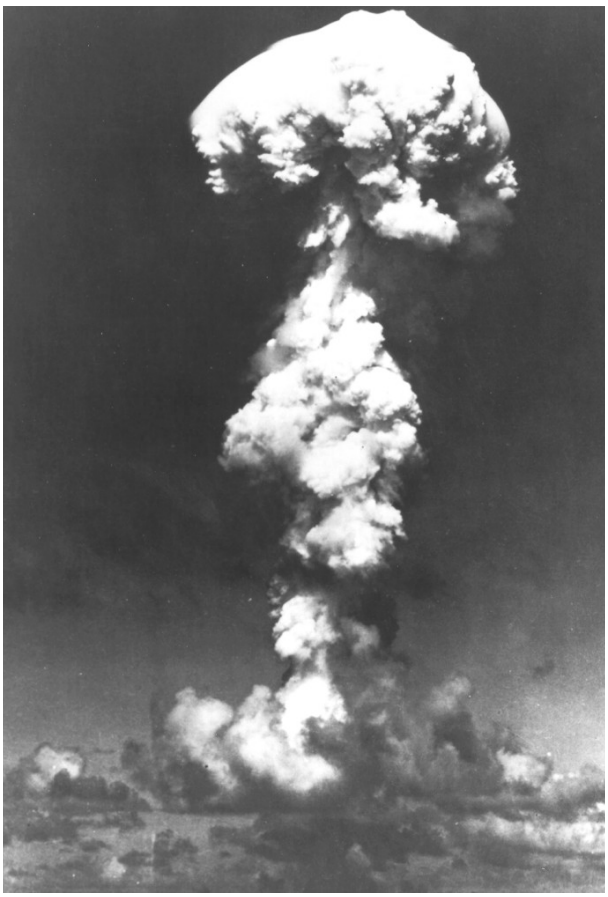


Figure 25. The Crossroads Able test (Photo: National Nuclear Security Administration / Nevada Site Office, 1946)

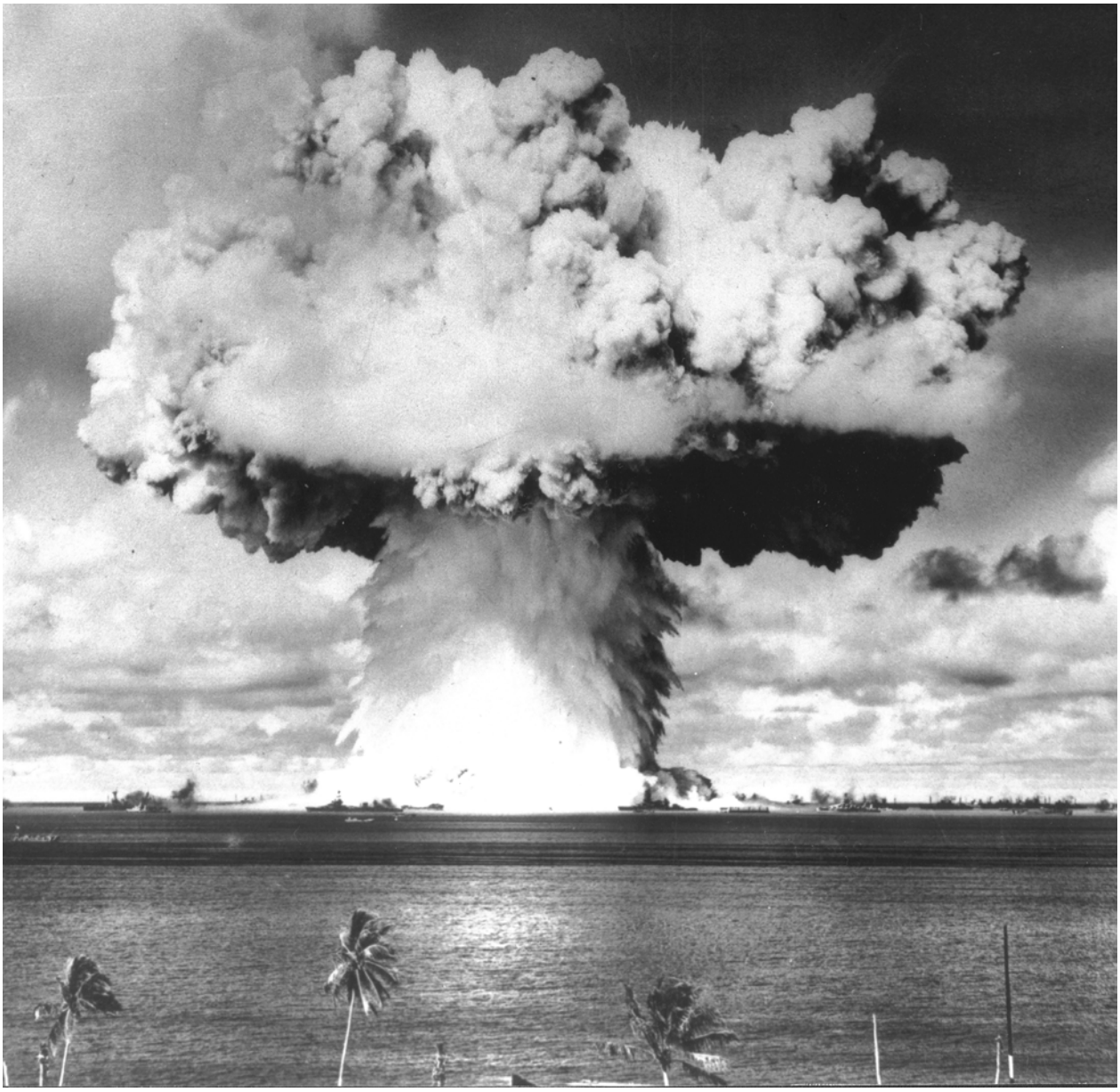


Figure 26. The Crossroads Baker test (Photo: National Nuclear Security Administration / Nevada Site Office, 1946)

The submarine Test Baker followed on July 25, suspended 30 meters below the surface of the water and detonated at 8:35 am. The countdown was broadcast worldwide. Weisgall (1994) imagines the scene:

> As they waited for the blast, many observers saw the test as a harbinger of push-button warfare. Men pushed buttons, an atomic bomb was set off, and to add a Wellsian touch, crewless drone boats and robotic pilotless planes would move through the lagoon and over the ghost fleet of abandoned ships. (p. 221)

The water column, holding 2 million tons of water, reached a mile high within one second. Shock waves hit the islands at speeds of over 5,000 kilometers per hour. A crater was carved in the lagoon floor moving 2 million cubic yards of material, and five ships and three other vessels were sunk. According to Weisgall, "the Baker shot unleashed the greatest waves ever known to humanity, with the possible exception of those produced by the 1883 explosion of the island of Krakatoa"[3] (1994, p. 224). While the spectacle of Baker created quite a different impression than that of Able, it was the radioactive fallout that was most significant. It was with surprise that the navy found the radioactive contamination could not be scrubbed away, and that ships would be ineffective at protecting their crews in nuclear warfare.

This submarine explosion elicited quite a different response from eyewitnesses to the previous Able explosion: *New York Times* journalist, Laurence, wrote that "the phenomenon itself was one of the most spectacular and awe-inspiring sights ever seen by man

3 The first wave was measured at 94 feet (30 meters) high.

on this planet," while the *New York Herald Tribune* correspondent, White, exclaims that it was an "explosion so fantastic, so mighty and so beyond belief that men's emotions burst from their throats in wild shouts" (quoted in Weisgall, 1994, p. 222).

The *New York Times* headline of July 25 summed up the extraordinary juxtaposition of a plan for international control of atomic energy with the display of nuclear thunder: "Atomic Bomb Sinks Battleships and Carriers; Four Submarines are Lost in Mounting Toll; Soviet Flatly Rejects Baruch Control Plan" (Weisgall, 1994, p.255). Soon after, the Soviet newspaper *Pravda* reported that "If the atomic bomb did not explode anything wonderful, it did explode something more important than a couple of out-of-date warships; it fundamentally undermined the belief in the seriousness of American talk about atomic disarmament" (quoted in Graybar, 1986, p. 902).

After Operation Crossroads the US moved all testing to Enewetak Atoll, 350 km (200 miles) west of Bikini, where a total of 43 devices were tested between 1948 and 1958. A comparison of Enewetak and Bikini is carried out in section 3.c Comparative Analysis. Bikini was not used again as a test site until the dramatic and deadly Operation Castle Bravo experiment nearly eight years later.

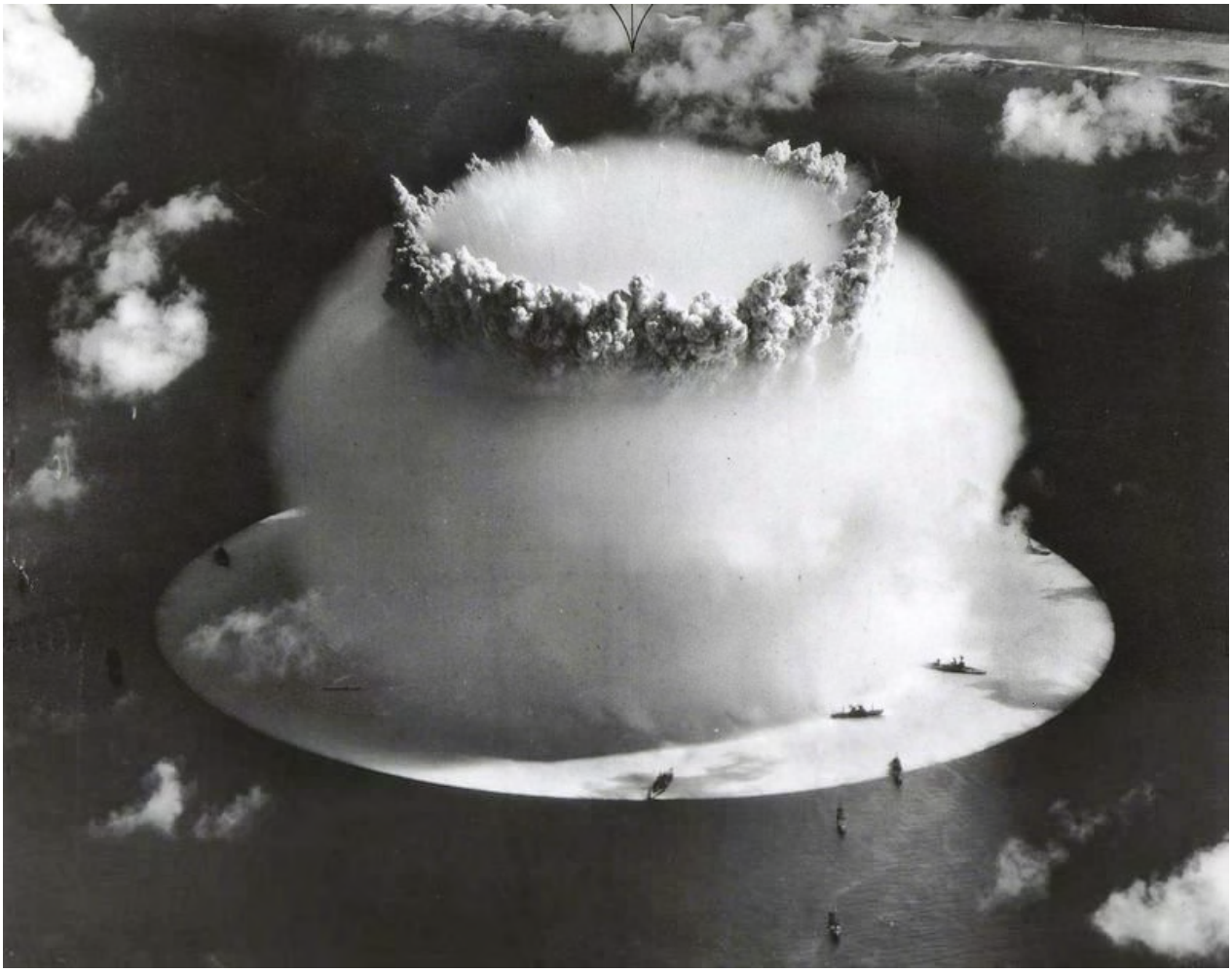


Figure 27. Aerial view of the Crossroads Baker test (Photo: National Nuclear Security Administration / Nevada Site Office, 1946)

Figure 28. Stamp cancellation for Operation Crossroads (US Navy, 1946)

Figure 29. Decontamination of ships after Operation Crossroads (National Archives, 1946)

Figure 30. USS *Skate* in the aftermath of Able, its superstructure crushed, conning tower bent, and "very radio-active" (National Archives, 1946)

Figure 31. The Castle Bravo bomb (1954, U.S. Airforce/ Defense Nuclear Agency)

Operation Castle Bravo

On March 1, 1954, for the people of Rongelap just 130 km east of Bikini Atoll, two suns rose. One in the east brought light, warmth and life, and the other brought unimaginable destruction that changed the world forever. The world's first deliverable hydrogen bomb test, Castle Bravo, was conducted at Bikini Atoll. Bravo introduced the world to horrors of nuclear weapons beyond those known from Hiroshima or Nagasaki—fallout and resulting radiation illness at a great distance from the explosion—and sowed the seeds of the global nuclear disarmament movement.

In preparation for the test, the US military weather station on Rongerik, a smaller atoll east of Rongelap, began regular observations to determine barometric conditions, temperature, and the velocity of the wind up to 30,000 meters above sea level. The weather briefing the day before the detonation stated that there would be no significant fallout for the populated Marshalls. A later briefing, however, stated that "the predicted winds were less favorable; nevertheless, the decision to shoot was reaffirmed, but with another review of the winds scheduled for midnight" (Martin & Rowland, quoted in Niedenthal, 2002, pp. 6-7). The midnight briefing "indicated less favorable winds at 10,000 to 25,000-foot levels," winds at 6,000meters (20,000 feet) "were headed for Rongelap to the east," and "it was recognized that both Bikini and Eneman Islands would probably be contaminated" (Martin & Rowland, quoted in Niedenthal, 2002, pp. 6-7).

Early in the morning on March 1, 1954 the device, code-named "Shrimp," was detonated on the surface of the reef in the northwestern corner of Bikini Atoll. The area was illuminated by a huge and expanding flash of blinding light. A raging fireball of intense heat that measured into the millions of degrees shot skyward at a rate of 500 kilometers (300 miles) an hour. Within minutes the monstrous cloud, filled with nuclear debris, shot up more than 35 kilometers (20 miles) and generated winds hundreds of kilometers per hour. These fiery gusts blasted the surrounding islands and stripped the branches and coconuts from the trees. Joint Task Force ships, stationed about 60 kilometers (40 miles) east and south of Bikini in positions enabling them to monitor the test, detected the eastward movement of the radioactive cloud from the 15 megaton blast. They recorded a steady increase in radiation levels that became so high that all men were ordered below decks, and all hatches and watertight doors were sealed. Millions of tons of sand, coral, plant and sea life from Bikini's reef, from three islands and the surrounding lagoon waters, were sent high into the air by the blast, leaving a crater more than 2 kilometers wide (over a mile wide) and 80 meters (250 feet) deep.

One-and-a-half hours after the explosion, 23 fishermen aboard the *Daigo Fukuryū-Maru* (*Lucky Dragon #5*), a Japanese fishing vessel, watched in awe as a "gritty white ash"—which the Japanese came to know as *shi no hai* (the ashes of death) ("Ashes to Ashes," 1954)—began to fall on them. The men aboard the ship were oblivious to the fact that the ash was the fallout from a hydrogen bomb test. Shortly after being exposed to the fallout their skin began to itch and they experienced nausea and vomiting. All 23 crew developed radiation sickness. The boat's return to Japan two weeks later and the death of one crew member within months, from acute radiation illness, was to have a resounding impact in Japan, as Saito describes:

> Japanese were in shock when *Yomiuri Shinbun* scooped on March 16, 1954 that the crew on the tuna fish boat *Lucky Dragon 5* had been exposed to the nuclear fallout in Bikini Atoll. After the tuna were unloaded and distributed to local markets all over Japan, it was discovered that they contained high levels of radiation. As tuna—part of the Japanese staple diet—were now exposed to nuclear pollution, people began to feel that the entire nation was threatened by nuclear weaponry. The fear of radioactive materials and their threat to Japanese everyday life was pervasive. Newspapers were relentless in reporting medical conditions of the crew of *Lucky Dragon 5* and objects contaminated by the H-bomb fallout, such as raindrops and vegetables. Groups of people flooded to Tokyo University Hospital to ask physicians for medical examination because they had eaten tuna; the so-called tuna horror, the fear of tuna exposed to radioactivity ("A-bomb tuna"), was widespread. Several episodes of people who mistook white substances like pollen as H-bomb fallout were also reported. Public arenas were saturated with narratives and images expressing fear of nuclear weapons. According to the opinion poll conducted by *Asahi Shinbun* (May 20, 1954), 70 percent of the population was afraid of exposure to radioactivity. (2006, p. 368)[4]

Meanwhile, on Rongelap Atoll, located about 150 km east of the test on Bikini, John Anjain, at his breakfast at the time, describes the event:

> On the morning of the 'bomb' I was awake and drinking coffee. I thought I saw what appeared to be the sunrise, but it was in the west. It was truly beautiful with many colors—red, green and yellow—and I was surprised. A little while later the sun rose in the east. Then some time later something like smoke filled the entire sky and shortly after that a strong and warm wind—as in a typhoon—swept across Rongelap. Then all of the people heard the great sound of the explosion. Some people began to cry with fright. (Dibblin, 1990, p. 25)

Three to four hours after the blast, the white, snow-like ash began to fall from the sky onto the 64 people living on Rongelap and also onto the 18 people residing on Ailinginae Atoll. The Rongelapese, not understanding what was happening, observed with amazement as the radioactive dust soon formed a layer on their island two inches deep, turning the drinking water a brackish yellow. Children played in the fallout; their mothers watched in horror as night came and they began to show the physical signs of exposure. Lomoyo Abon, living on Rongelap at the time, describes the experience:

> That night we couldn't sleep, our skin itched so much. On our feet were burns, as if from hot water. Our hair fell out. We'd look at each other and laugh—you're bald, you look like an old man. But really we were frightened and sad. (Dibblin, 1990, pp. 24-25)

The people experienced severe vomiting and diarrhea, and their hair began to fall out; the island fell into a state of terrified panic. Two days after the test the people of Rongelap were taken to Kwajalein for medical treatment.

On Bikini Atoll the radiation levels increased dramatically. In late March following the Bravo test, the off-limit zones were expanded to include the inhabited atolls of Rongelap, Utrik, Ujelang and Likiep. In the spring of 1954, the atolls of Bikar, Ailinginae, Rongelap and Rongerik, were all contaminated by the Yankee and Union weapons tests which were detonated on Bikini Atoll. They yielded the equivalent of 6.9 and 13.5 megatons of TNT respectively. The people of Rongelap did return to their homeland in 1957 but were evacuated again in 1985 by the Greenpeace *Rainbow Warrior*.

Bravo, at 15 megatons, was a thousand times more powerful than the Fat Man and Little Boy atomic bombs that were dropped on Nagasaki and Hiroshima. Its "success" was beyond the wildest dreams of the American scientists who were involved in the detonation—they thought that the blast would only carry a payload of approximately 5 megatons. Bravo is to this day the largest detonation ever conducted by the United States. As Weisgall (1994) describes:

4 See also Totten & Kawakami, 1964.

> The Bravo shot finally brought home to the American public and the world the realization that the killing power of radioactive fallout from a thermonuclear bomb greatly exceeds the fiery blast and heat of the direct explosion that causes it. Its impact and scope are mind-numbing…Hiroshima paled in comparison to Bravo, which represented as revolutionary advance in explosive power over the atomic bomb as the atomic bomb had over the conventional weapons of World War II. (pp. 306-307)

Other tests

While Operation Crossroads and the Castle Bravo tests were the most significant, 23 additional nuclear tests were carried out between 1946 and 1958 on Bikini, of a total of 67 tests in the Marshall Islands (see Annex 2 for a list of all tests). In 1958, the United States anticipated the acceptance of a call for suspension of atmospheric nuclear testing and assembled a large number of devices for testing before the moratorium came into effect. As a result, Operation Hardtack was a series of 35 tests carried out in the Pacific Proving Grounds in only five months between April and August, 1958; ten of these on Bikini.

While a radiological survey in 1947 had determined that within a few years the islands could be re-inhabited, the United States decided not to return the Bikinians. Instead, the islands were retained as a military testing ground with an additional twenty nuclear tests taking place between 1954 and 1958. As these additional tests occurred, further changes–the construction of additional, larger concrete bunkers, the placement of additional test equipment, and the laying of miles of undersea cables—continued the alteration of Bikini Atoll. At the end of the testing in 1958, Bikini's landscape, both above and below the surface of the water, reflected its transformation.

Bikini was and remains the world's first large-scale nuclear landscape—an area of the globe forever transformed by nuclear testing, and this landscape remains essentially untouched and unaltered. The physical legacy of the testing is inherent in the many bunkers and test equipment left on the islands, in the cables and sunken ships, in the various nuclear blast craters in the lagoon, and, markedly, in the vanished islands and the large "Bravo" crater that disrupts the atoll's chain of islands. These, as well as the fallout remaining in the islands' soil, all bear testimony to the enormous destructive power of the technology that was demonstrated here. The lonely rows of coconut palms, planted in the hope the Bikinians could return to their home and resume their way of life, now symbolize the loss of this way of life forever.

2.b.(vii) The "Nuclear Nomads" of Bikini

In 1946, the Bikinians had arrived on Rongerik Atoll to the east of Bikini, an atoll that had been previously uninhabited due to a lack of food and water resources, and a traditional belief that an evil spirit lived there and contaminated the fish. Within a short time the Bikinians began to suffer from food shortages and fish poisoning. In 1947, Ujelang was selected for the Bikinians' new home and a new village was constructed there in preparation. However, in December of that year the US decided to use Enewetak as an additional nuclear test site and to relocate the people of Enewetak to Ujelang, based on their traditional ties to that atoll.

On the verge of starvation, in March 1948, the Bikinians were moved to a tent city on Kwajalein Atoll while a new home was found for them. In June the Bikinians selected Kili Island—a single island with no lagoon or protected anchorage in the southern Marshall Islands—because the island was not ruled by a paramount king, or *iroij,* and was uninhabited. This choice ultimately doomed their traditional diet and lifestyle, which were both based on lagoon fishing.

In November, 1948, the Bikinians moved to Kili. Most of the year Kili is surrounded by 3 to 5 meter waves that deny the islanders the opportunity to fish and sail their canoes. After a short time on Kili—a place that the islanders believe was once an ancient burial ground for kings and is therefore overwrought with spiritual influence—they began to refer to it as a "prison" island. Because the island does not produce enough local food for the Bikinians to eat, the importation of US Department of Agriculture rice and canned goods and other purchased food had become an absolute necessity for their survival. In the following years rough seas and infrequent visits by the field trip ships caused food supplies to run critically low many times on the island and once even required an airdrop of emergency food rations. These difficult conditions continued for the people of Bikini over the next decade. (Note: Source of the above paragraphs: Micronitor, 1996; Niedenthal, 2002; Weisgall, 1994; Dibblin, 1990. For more information on the chronology of the "nuclear nomads" of the Marshall Islands see Annex 2).

2.b.(viii) Resettling Bikini

In 1967, US government agencies began considering the possibility of returning the Bikinian people to their homelands based on data on radiation levels on Bikini Atoll from the US scientific community. This scientific optimism stemmed directly from an US Atomic Energy Commission (AEC) report that stated "The exposures of radiation that would result from the repatriation of the Bikini people do not offer a significant threat to their health and safety" (Shields et al., 1967, p. 1).

Accordingly, in August of 1968 (the story appeared on the front page of the *New York Times*) President Lyndon B. Johnson promised the 540 Bikinians living on Kili and other islands that they would now be able to return to their homeland and ordered the atoll to rehabilitated and resettled ("US to let Bikinians back on A-test Isle," 1968; Bromley Smith draft memorandum to President Johnson cited in Weisgall, 1994, p. 314). A group of nine Bikinians visited Bikini Atoll on behalf of the Bikinians living on Kili and other islands. Upon seeing the landscape, one man murmured "It's all changed, it's not the same," while the others nodded silently in agreement ("9 Return to Bikini," 1968).

In August of 1969 an eight-year plan was prepared for the resettlement of Bikini Atoll. The first phase of the work involved the clearing of the radioactive debris on Bikini Island, accomplished by bulldozers being driven methodically between the trees in neat rows, and then pushing the debris into huge piles which were later removed. This operation created a massive grid pattern over the entire islands of Bikini and Eneu. By late 1969 the first cleanup phase was completed. The second phase of the reclamation included the replanting of the atoll, construction of housing and the resettlement of the community. During the year of 1971 this effort proceeded slowly as the US government withdrew their military personnel and equipment, and brought to an end the weekly air service that had been operating between Kwajalein Atoll and Bikini Atoll.

In late 1972 the planting of the coconut trees was finally completed. During this period it was discovered that as the coconut crabs grew older on Bikini Island they ate their sloughed-off shells. Those shells contained high levels of radioactivity; hence, the AEC announced that the crabs were still radioactive and could be eaten only in limited numbers. The conflicting information on the radiological contamination of Bikini supplied by the AEC caused the Bikini Council to vote not to return to Bikini at the time previously scheduled by American officials. The Council, however, stated that it would not prevent individuals from making independent decisions to return. Three extended Bikinian families, their desire to return to Bikini being great enough to outweigh the alleged radiological dangers, moved back to Bikini Island and into the newly constructed houses. They were accompanied by approximately 50 Marshallese workers who were involved in the construction and maintenance of the buildings.

The population of islanders on Bikini slowly increased over the next 5 years to about 100 people until in June of 1975, during regular monitoring of Bikini, radiological tests discovered "higher levels of radioactivity than originally thought." US Department of Interior officials stated that "Bikini appears to be hotter or questionable as to safety" and an additional report pointed out that some water wells on Bikini Island were also too contaminated with radioactivity for drinking. A couple of months later the AEC, on review of the scientists' data, decided that the local foods grown on Bikini Island, including pandanus, breadfruit and coconut crabs, were also too radioactive for human consumption. Medical tests of urine samples from the 100 people living on Bikini detected the presence of low levels of plutonium 239 and 240. (Note: Source of above three paragraphs: Niedenthal, 2002, pp. 10-12)

In October of 1975, after contemplating these new and confusing reports on the radiological condition of their atoll, the Bikinians filed a lawsuit in US federal court demanding that a complete scientific survey of Bikini and the northern Marshalls be conducted. As a result the US agreed to conduct an aerial radiological survey of the northern Marshalls, but meanwhile the Bikinians, unaware of the severity of the radiological danger, remained on their contaminated islands. In May of 1977 the level of radioactive strontium-90 in the well water on Bikini Island was found to exceed the US maximum allowed limits. A month later a Department of Energy study stated that "All living patterns involving Bikini Island exceed Federal guidelines for thirty year population doses." Later in the same year, a group of US scientists, while on Bikini, recorded an 11-fold increase in the cesium-137 body burdens of the more than 100 people residing on the island. Alarmed by these numbers, the DOE told the people living on Bikini to eat only one coconut per day and began to ship in food for consumption. In April of 1978 medical examinations performed by US physicians revealed radiation levels in many of the now 139 people on Bikini to be well above the US maximum permissible level. The very next month US Department of Interior officials described the 75% increase in radioactive cesium 137 as "incredible." The Interior Department then announced plans to move the people from Bikini within 75 to 90 days, and so in September of 1978, Trust Territory officials arrived on

Bikini to once again evacuate the people who were living on the atoll (Note: Source of above paragraph: Hamilton & Robison, 2004; Niedenthal, 2002; Lokan et al., 1998; Simon, 1995). The nuclear landscape of Bikini, which prior to the testing had been a treasured and productive homeland, had been rendered uninhabitable.

Since the aborted repatriation to Bikini in the 1970s, a number of scientific studies have been performed on Bikini Atoll. Beginning in the late 1970s through to the present day, Lawrence Livermore National Laboratory has studied the radiological conditions of Bikini, usually with two missions per year. In the early 1980s, the Bikini Atoll Rehabilitation Committee (BARC), a group of highly regarded American scientists, completed and submitted a report about the radiation on Bikini Atoll to the US Congress. In February of 1995 the Nationwide Radiological Study was completed by Dr. Steven Simon and a group of scientists from all over the world for the Marshall Islands government. In addition, the National Academy of Sciences also released a report about Rongelap Atoll in which Bikini Atoll cleanup options and radiological conditions were discussed. Beginning in the early 1990s, the Bikinians have had their own independent scientist reviewing these studies. In 1996 the International Atomic Energy Agency (IAEA) responded to requests from the Marshall Islands to comprehensively review and validate the radiological studies to date, which was reported on in 1998. (Note: Source of above paragraph: Niedenthal, 2002; Hamilton and Robison, 2004; Lokan et al., 1998)

2.b.(ix) Bikini as a tourist destination

In 1989 the US Navy and the US National Park Service Submerged Cultural Resource Unit conducted an assessment of the sunken ships of Operation Crossroads to determine potential hazards from leaking fuel, unexploded conventional ordnance, heritage value and tourism potential. The teams surveyed the lagoon, located most of the sunken ships, and conducted a series of dives, extensively documenting the USS *Saratoga*, HIJMS *Nagato*, USS *Arkansas*, and USS *Pilotfish* (Delgado et al., 1990).

Development of the infrastructure to support the clean-up and resettlement programs on Bikini Atoll started early in calendar year 1991. The program was concentrated at Eneu Island, which had been declared safe for habitation, and was the main support base for the clean-up activities. Warehouses, crew quarters and a power plant were constructed and potassium fertilizer was spread throughout Eneu Island as a safety measure.[5]

With the opening of the tourism program on Bikini Island in 1996, there were numerous upgrades and additions to the facilities. In 1998, cleanup activities began on Bikini Island with a 120 hectare (300 acre) land-clearing project. However, the adoption of a new 15 millirem EPA radiological cleanup standard in December of 1998 placed the cleanup of Bikini on hold pending further funding from the US government. Since 1996 Bikini has hosted up to around 250 tourists each year and provided the unparalleled experience of diving amidst the sunken vessels and abundant sharks, and relaxing in the beautiful surrounds of Bikini Island. Bikini has become a renowned dive location, consistently being reviewed as one of the premier diving experiences in the world (Note: see http://www.bikiniatoll.com/divetour.html for examples of reviews).

Figure 32. Diving on the wreck of the *Saratoga* (E. Hanauer, 2006)

5 The application of potassium on coral-soils has been found to reduce the uptake of radioactive Cesium-137 into plants, and thus into the human food chain.

Part 3. Justification for Inscription

3.a Criteria under which inscription is proposed, and justification for inscription under these criteria

Nuclear bomb tests at Bikini Atoll shaped the history of the people of Bikini, the history of the Marshall Islands and the history of the entire world. Bikini Atoll is nominated as a cultural site against criteria (iv) and (vi) as set out in Paragraph 77 of the *Operational Guidelines for the implementation of the World Heritage Convention.*

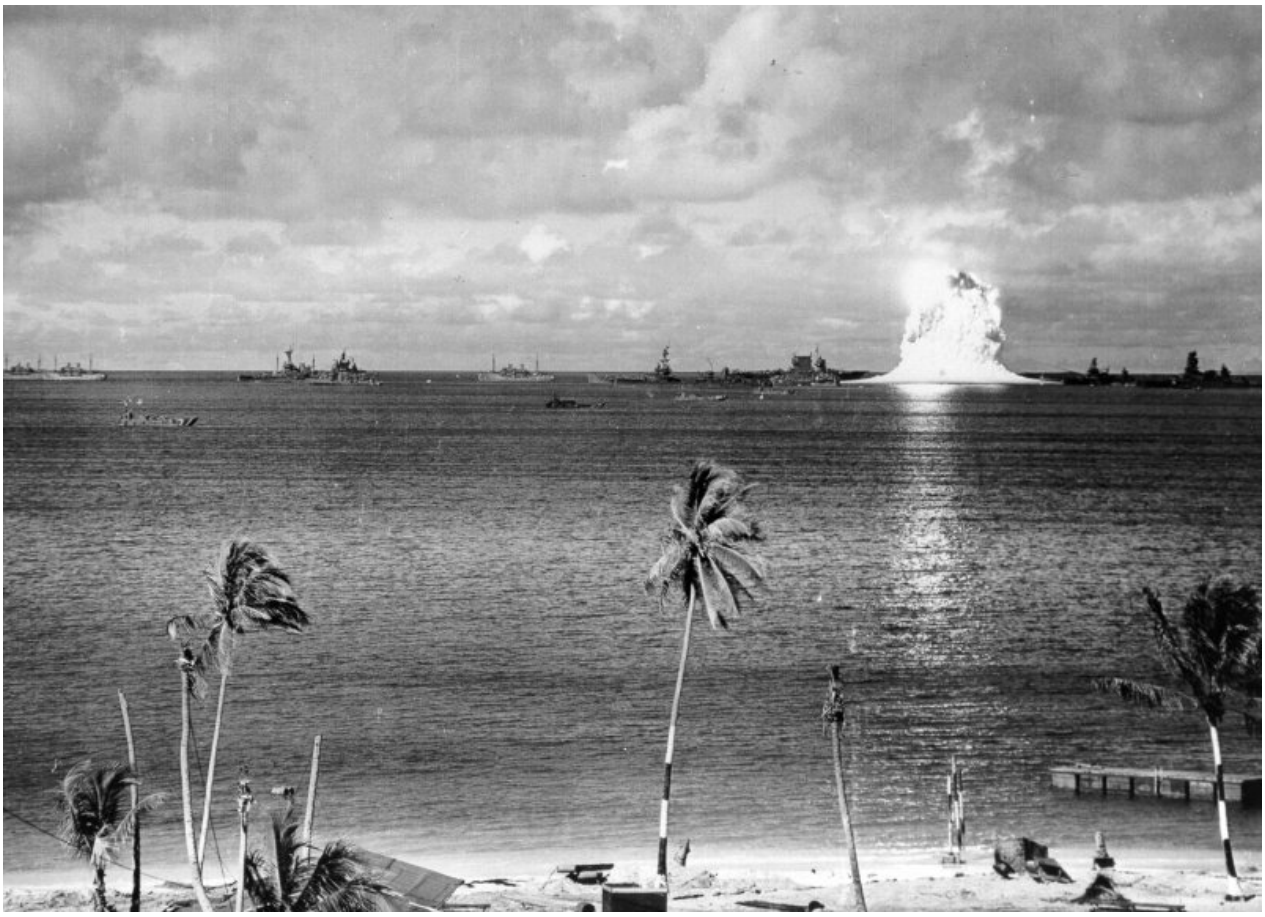


Figure 33. A view of the Baker shot showing the test fleet, with Bikini island in the foreground (US Navy, 1946)

3.a.(i) Criterion (iv): be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history;

Bikini Atoll is an outstanding example of a *nuclear test site*—both a technological ensemble and a landscape/seascape—bearing witness to the dawn of the nuclear age, the start of the Cold War and the era of nuclear colonialism. As a nuclear test site, Bikini Atoll is distinctly 20th century heritage. The World Heritage Committee and ICOMOS have acknowledged the need to include works of outstanding universal value from the heritage of the modern age, taking into account that the 20th century is now history (ICOMOS, 2004).

The entire landscape and seascape of Bikini Atoll testifies to its history as a *nuclear test site*, from the ensemble of sunken ships—which lie in the positions where they were placed and subsequently sunk as "targets"—and the purpose-built bunkers and buildings, to the disappeared islands and the Bravo crater. Even the abandoned rows of coconut trees, planted in preparation for the failed resettlement, symbolize the fate of a nuclear test site—ongoing contamination making it unsuitable for human habitation.

Outstanding universal value under this criterion is demonstrated through recognition of Bikini Atoll as:

- A monument and memorial to the dawn of the nuclear age;
- A site bearing witness to nuclear testing events of global significance—turning points in the world's history;
- A testimony to nuclear colonialism.

A monument and memorial to the dawn of the nuclear age

A tiny island bears witness to survival, and to loss. It recalls the innocence of another age.

(Livingston & Rawlings, 1992).

Bikini Atoll is of outstanding universal value as a monument and memorial to the dawn of the nuclear age—the era that defined the second half of the 20th Century.

In its landscape, natural environment and in the artifacts of the testing, Bikini Atoll offers an opportunity to memorialize many of the contested meanings of the nuclear age for its different audiences. For the people of Bikini, the atoll is remembered as the abundant and beautiful homeland and remains the locus of their spiritual and cultural identity. For the people of Rongelap, Utrik and other affected atolls, Bikini is the source of their radiation illness and loss of their homelands. For victims of nuclear colonialism and testing around the world, Bikini speaks to their experiences, losses and grief, as it does for the servicemen of Bikini and other nuclear test sites who were exposed to radiation.

More than this, Bikini Atoll is a monument and memorial of global significance, for it reminds us of the world's lost innocence. At first glance we see the quintessential tropical paradise—white beaches, palm trees, turtles and sharks swimming on a vibrant reef in clear, turquoise waters—images beloved by modern culture, as well as by the islanders themselves. These are images that bring to mind an idyllic, peaceful, and simple world. In the abandoned, poisoned land, the sunken ships, the disappeared islands and the abundant photos and footage of the nuclear tests, we remember clearly the time where innocence was lost—when men held and wielded a power reserved for gods.

As a nuclear test site, Bikini has, in a way, stood as a monument and memorial to the loss of innocence from the moment it was chosen. Even prior to the testing, E.B. White (March 9, 1946) wrote in the New Yorker of this symbolic loss of innocence:

> Bikini Lagoon, although we have never seen it, begins to seem like the one place in the world we cannot spare… it grows increasingly valuable in our eyes—the lagoon, the low-lying atoll, the steady wind from the east, the palms in the wind, the quiet natives who live without violence. It all seems unspeakably precious, like a lovely child stricken with a fatal disease. (quoted in Weisgall, 1994, p. 152)

The trace, memory and spirit of the time—the *zeitgeist*—of Bikini Atoll as a nuclear test site is recorded in films, photos, journalism, technical reports, oral histories, memoirs and works of art. The mechanisms by which Bikini Atoll functions as a monument and a memorial is expanded from the tangible by the inclusion of symbols, works of art and representations of Bikini that have accompanied the process of its journey from a beloved, beautiful home to an abandoned nuclear test site. These are discussed in more detail below, in the justification under Criterion (vi).

A site bearing witness to nuclear testing events of global significance—turning points in the world's history

Bikini Atoll bears witness to individual events of global significance—in particular Operation Crossroads in 1946 and the Castle Bravo detonation in 1954. Both of these events represent turning points in the world's history. Operation Crossroads, the first peace-time nuclear detonations, was extensively documented and publicized, and was a prominent event contributing to the start of the Cold War. The Castle Bravo test, the first deliverable hydrogen bomb, introduced the world to the devastating, persistent and extensive nature of nuclear fallout, and sowed the seed of international action for nuclear disarmament.

Operation Crossroads: As discussed in Part 2b. History and Development, Operation Crossroads occurred at a time of awkward diplomacy between the Soviets and the Americans, and the display of power by the US conflicted with ongoing efforts to place nuclear weapons under the control of the United Nations, thus contributing significantly to the distrust and paranoia that characterized the start of the Cold War. Farrell (1987) suggests the significance was such that "at the crossroads of Bikini, the country [the US] opted for a diplomatic, military, political and cultural Cold War that has persisted, with minor variations, to this day" (p.65). The cover article for *Time* magazine, on July 1, 1946 speaks of the "Tremor of Finality" of Operation Crossroads:

> Against the peaceful backdrop of palm frond and pandanus, on this most "backward" of islands, the most progressive of centuries would write in one blinding stroke of disintegration the inner meaning of technological civilization: all matter is speed and flame. ("Crossroads," July 1, 1946)

Delgado (1991) explains the significance of the ships sunk during Operation Crossroads:

> The place of these ships in the history of naval development, their roles in naval history and their World War II combat records establish their significance only up to the moment they were selected for Operation Crossroads. From that point on their previous histories become secondary, for the pre-Crossroads significance of the ships is overshadowed by the social, political, and military decisions that brought them to Bikini, and the forces unleashed by the detonation of two atomic bombs that sent them to the bottom of the atoll's lagoon. Each of these vessels passed over a threshold at the "crossroads" between conventional and nuclear warfare, as did the world that had built and manned them. Regardless of type, age, or career, each vessel that now lies where it was sunk by the Able and Baker test blasts is of equal significance as the only uncompromised material record of the early, formative stages of nuclear weapons design and the development of a nuclear military policy. (p. 144)

The ships now lying at the bottom of Bikini Atoll in their shallow crater bear witness to this turning point in the history of the 20th Century.

Castle Bravo: The world's first deliverable hydrogen bomb was a landmark event in the history of the world. Just as the atomic weapons dropped on Hiroshima and Nagasaki had brought the theories of nuclear physicists into a terrible reality, this next major technological development was to shock the world and directly give rise to the nuclear disarmament movement. The Castle Bravo event, although conducted in great secrecy, was to be the US's greatest radiological disaster and would, very publicly, introduce the world to "fallout." In his definitive *History of the World Nuclear Disarmament Movement*, Wittner (1997) states the significance of the Bravo event:

> Although the US government had tested the world's first thermonuclear device in 1952 and the Soviet Union had made its own nuclear breakthrough the following year, not until 1954 did nuclear testing deeply impress itself on public consciousness. The turning point was the first US H-Bomb test, conducted by the Atomic Energy Commission [USAEC] on March 1, 1954. It occurred at Bikini Atoll. (p.1)

Boyer (1985) situates the cultural impact of the Bravo test at that time:

> In the mid-1950's the issue of nuclear weapons again surged dramatically to the forefront, once more becoming a central cultural theme. …The reason was fear… It was the United States' 1954 test series [the Castle Series] that really aroused alarm, spreading radioactive ash over seven thousand square miles of the Pacific, forcing the emergency evacuation of nearby islanders, and bringing illness and death to Japanese fishermen 80 miles away. (p. 352)

Ralph Lapp, a physicist on the Manhattan Project and author of the bestselling book about the incident, *Voyage of the Lucky Dragon* (1958) claims that:

> The true striking power [of nuclear weapons] was revealed on the deck of the Lucky Dragon. When men 100 miles from an explosion can be killed by the silent touch of the bomb, the world suddenly becomes too small a sphere for men to clutch the atom. For this knowledge, gained so strangely from the adventures of 23 men, the world may some day rank this voyage with that of Columbus. (p. 198)

The Bravo crater in the north-western corner of the atoll, along with the still-contaminated, uninhabited islands of Bikini, stand as testimony to the Castle Bravo event—the detonation of the world's first H-bomb. Aside from the bombs dropped on civilian populations of Hiroshima and Nagasaki, no other single nuclear weapons events have had this scale of impact on the world.

A testimony to nuclear colonialism

The effects of colonialism and military activity in the Pacific have been accepted as significant themes for Pacific World Heritage (Thematic Framework for World Cultural Heritage in the Pacific, 2005; Smith & Jones, 2007). The United States, the United Kingdom and France all tested nuclear devices in the Pacific between 1946 and 1996, enabled by their colonial histories in the region. The process of Pacific nuclear colonialism finally gave rise to the Nuclear Free and Independent Pacific Movement based on the understanding of Pacific peoples that nuclear tests could be halted only if their countries were decolonized and became sovereign nations. Due to similarities in landscape, culture and experience with other Pacific nuclear test sites, Bikini is presented as exemplary testimony to this significant phase in Pacific history—that of nuclear colonialism.

However, nuclear colonialism was not restricted to the Pacific and Bikini Atoll, now unpeopled, stands as exemplary testimony to a lost way of life, on behalf of all victims of nuclear colonialism. Over 2,050 nuclear devices have been detonated worldwide in the years since 1945. Major testing programs were carried out by the United States, the Soviet Union, France and Britain (in conjunction with Australia). Countries that carried out lesser programs are China, India, Pakistan and North Korea. Some test sites bear familiar names such as Nevada, Maralinga, Trinity and Moruroa. Other sites are less familiar to us: Semipalatinsk in Kazakhstan, Amchitka in the Aleutian Islands of Alaska, Kiritimati (Christmas Island) in Kiribati, Lop Nur in western China, and Novaya Zemlya in the Barents Sea. All the sites used for testing bear irreversible scars telling their powerful stories of lost lands, lost health, and lost cultures and ways of life. In all cases the people and institutions running the tests ignored the presence of local indigenous populations, or displaced them. In all cases local communities were involuntarily exposed to radiation and fallout from the tests. In all cases servicemen were exposed to radiation without information or choices. In the worst cases, people were used as human guinea pigs.

The Abolition 2000[6] Conference in 1997 recognized the burden that nuclear colonialism has placed on indigenous peoples by releasing the Moorea Declaration on Colonialism:

> This meeting, held in Te Ao Maohi a year after the end of French nuclear testing, has highlighted the particular suffering of indigenous and colonised peoples as a result of the production and testing of nuclear weapons. The anger and tears of colonised peoples arise from the fact that there was no consultation, no consent, no involvement in the decision when their lands, air and waters were taken for the nuclear build-up, form the very start of the nuclear era.
>
> Colonised and indigenous peoples have, in the large part, borne the brunt of this nuclear devastation - from the mining of uranium and the testing of nuclear weapons on indigenous peoples land, to the dumping, storage and transport of plutonium and nuclear wastes, and the theft of land for nuclear infrastructure. (Abolition 2000, 1997, paras.2,3)

Of enormous significance not only to the Bikinians, but to all indigenous peoples who were victims of nuclear colonialism, Bikini demonstrates what can happen when an idyllic society, living a quiet subsistence lifestyle, meets a global superpower with enormous wealth and military or industrial capability:

> A pattern of militarisation, environmental devastation and the displacement of Indigenous or local peoples is visible in the landscapes of many Cold War test sites, island and continental. However, in the Pacific Islands where all human behaviour is informed by the oceanic environment of fragile islands amid vast tracts of water, the archaeological expression of nuclear testing is unlike that found elsewhere. The tiny, remote islands affected by nuclear testing represent a large portion and in some cases the entire land surface on which particular peoples have lived or regularly visited for at least a millennium. Some of these archaeological landscapes are readily

6 Abolition 2000 is a network of over 2000 organizations in more than 90 countries world-wide working for a global treaty to eliminate nuclear weapons.

> characterised by material remains—military hardware, bunkers, concrete domes, shipwrecks, airstrips. More insidiously, some are recognisable only in the illnesses of those who have dwelt in these landscapes while others now exist only in the memories of those who once lived there (Smith, 2007, p. 52).

Bikini is isolated, remote and difficult to access—all reasons why it was chosen as a site for nuclear testing. This same inaccessibility means that relatively few people will actually experience Bikini, and much of its meaning as the world's heritage is contained in the *representations* of Bikini as a place, and the portrayal of the events of Bikini to the world. Davis (2005) discusses the role of representation in legitimizing nuclear colonialism:

> Representations are a means of transmitting certain conceptualizations of a place to other people. Since these representations emphasize some characteristics of a place at the expense of others… They 'do work' by reinforcing conceptualizations of a place that legitimize certain uses and prohibit others. In turn, the new form of landscape informs a new conceptualization. (p. 609)

What was to the Bikinians their homeland, a place of abundance and life, was represented to the world as a "deserted Isle" (Davis, 2005), a barren and uninhabited *terra nullius* distant from the home population of the testing nation and therefore a safe place for tests. Representations of Bikini were made in the form of films, radio broadcasts, magazines and leading newspapers such as the *New York Times*, thus legitimizing the use of Bikini as a test site. Bikini and Enewetok Atolls were renamed to the "Pacific Proving Grounds"—a name that removed any connotation that this was a real place and a real home for real people: "The 'hole in the map' was a pre-condition for a nuclear hole in the ground; it alone created the necessary marginality for experimentation to be deemed acceptable" (Cosgrove quoted in Davis, 2005, p. 613).

In January 1946, Bikini was the landscape of a small group of people living within the ecological carrying-capacity of the atoll, with technologies developed and adapted over two thousand years for life on an atoll: fishing, navigation, sailing canoes and agriculture. Just a few months later the homesick Bikinians were banished to inhospitable islands while Bikini was radically transformed to conduct the largest scientific and military experiment in history. Cameron (1970) describes the following:

> Bikini had been, after all, a place of human habitation, a homeland. When the atoll was acquired by the US Navy, it had about 150 inhabitants. It had, however, something even more important: geography. The trifling life of the little island could not reasonably share in a transcendental experience that was, when all was said and done, dedicated to death. The whole function of Bikini was to be remote, far away, and as inaccessible as possible from anything valued by man, because it was to be destroyed… A place had to be found where the principle of overkill could be examined, where nuclear bombs could be tested in the atmosphere without inconveniencing anyone, at least anyone much. The Micronesian people of the central Pacific are by definition nobody much. (p. 24)

This process of representation is exemplary of what subsequently happened elsewhere. Bikini was the first colonial nuclear test site and set the precedent for similar representations to be made of the homelands of other indigenous communities around the world subjected to nuclear colonialism, including in the tropical atolls of Kiribati and French Polynesia, the deserts of Australia and Algeria, the rocky islands of Aleutian Alaska and the vast and arid steppes of Kazakhstan. Bikini Atoll shares much in common with other test sites—places of nuclear colonialism—around the world, but is an outstanding example due to its resonating symbolism, integrity and authenticity as will be discussed in section 3.c. Comparative Analysis.

3.a.(ii) Criterion (vi): be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance

Ideas and beliefs of outstanding universal significance are directly and tangibly associated with nuclear testing on Bikini Atoll. Emanating from this narrow circle of tiny islands in the middle of a vast ocean is a myriad of symbolism that has permeated our global culture. Events at Bikini led directly to the creation of political and ideological movements that have shaped global society in the second half of the 20th century.

The outstanding universal value of Bikini Atoll under this criterion is demonstrated through recognition of Bikini as:

- A source of globally significant cultural symbols and icons of the 20th century, and
- The location of events giving rise directly to the globally significant nuclear disarmament movement.

A source of globally significant cultural symbols and icons

The events at Bikini Atoll have inspired various cultural symbols and icons of the 20th century. These symbols are of outstanding universal significance by virtue of their ubiquity, universal recognition, and for the meanings they carry. In the case of the mushroom cloud, the symbol creates a focal point for the values attributed to nuclear weapons—enormous power, fear of spectacular annihilation, and later, of radioactive fallout. Godzilla initially arose from the Pacific Ocean floor as the very embodiment of nuclear devastation and radioactivity, a manifestation of Japan's terror of the bomb. The bikini swimming costume and SpongeBob SquarePants are icons of popular culture, one created before the world truly understood nuclear weapons, and the other devised long after the threat of nuclear weapons was anything but a backdrop—a cultural wallpaper. In line with the high technology of the bomb testing, these icons are modern and technological themselves—truly late 20th century popular culture.

The Mushroom Cloud: Images of the mushroom cloud were the primary way that information about the atomic tests was conveyed. Initially, photographs of the mushroom clouds were shown to Bikinians living on Rongerik to explain what was happening on Bikini. In 1954 *Life* magazine issued a pictorial special about the hydrogen bomb tests (April 19, 1954). Spectacularisation of nuclear testing using images of the mushroom cloud was a deliberate ideological move designed to make the population (of the US in particular) comfortable with the bomb—to make it commonplace. Images from Nevada and Bikini, in particular, were used to do this (Rosenthal 1991, Kirsch 1997). It was through *images* of the mushroom clouds that information about nuclear tests was made available to the public.

The universally recognized and understood mushroom cloud became the primary symbol used in propaganda both by the military, and by the anti-nuclear movement. The mushroom cloud was "associated not only with possible annihilation, but also with actual radioactive fallout and controversies over genetic defects" (Kirsch, 1997, p. 246). Rosenthal (1991) describes the significance of the mushroom cloud as a cultural symbol:

> A quarter century after the nuclear mushroom cloud has been seen in real life, it remains the unchallenged symbol of the nuclear age because its name, shape, and size make it adequate to carry all the meanings we need for it to bear. Clearly a culmination of the scientific knowledge our century values supremely, the mushroom cloud stands as apt image of science's power over nature. Clearly a triumph of the technology our country claims as measure of its superiority, the mushroom cloud stands tall as image of "America first." Clearly both a product and a prophecy of war, the mushroom cloud stands as undisputed sign of military might. Clearly a power of life-and-death proportions, the mushroom cloud stands as appropriate symbol for our secular age's placing in human hands the judgment once assumed to be in God's. And in its remarkable receptivity to projections upon it of even vaguely congruent images, whether fetus or phallus or smiling face, brain or tree or globe, the mushroom cloud projects back the array of human responses to all that it stands for: responses of pride, parochial possessiveness, creative resistance, denial, despair. (p.88)

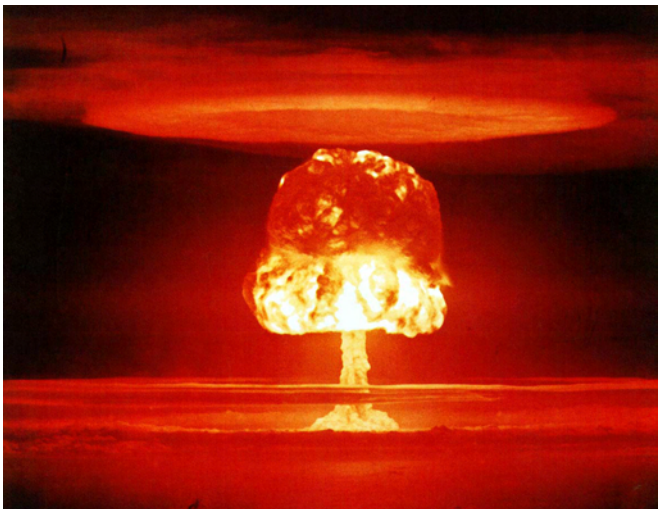


Figure 34. Mushroom cloud from the Castle Romeo bomb test (US Government, 1954) (left)

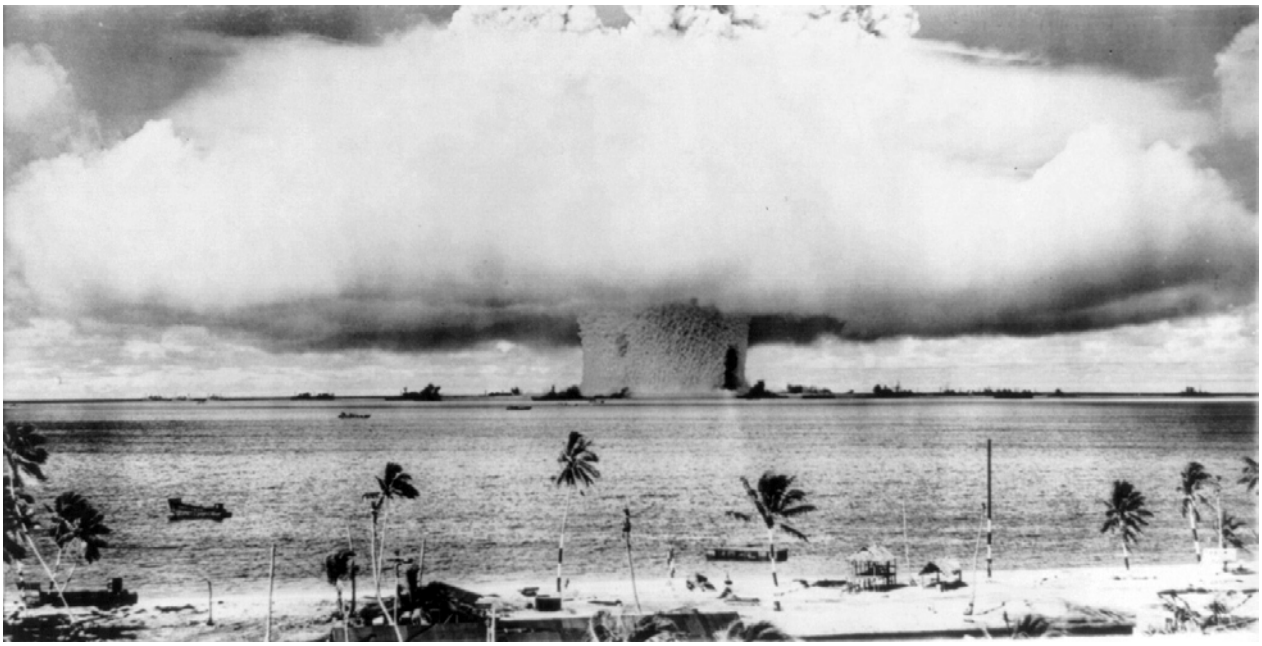


Figure 35. This classic photo of Crossroads Baker was reprinted in newspapers around the world, and remains the symbol of the bomb even today (US Government, 1946)

Figure 36. "The First Bomb at Bikini" by Charles Bittinger, official artist for the US Navy (Naval Historical Center, Washington DC, 1946)

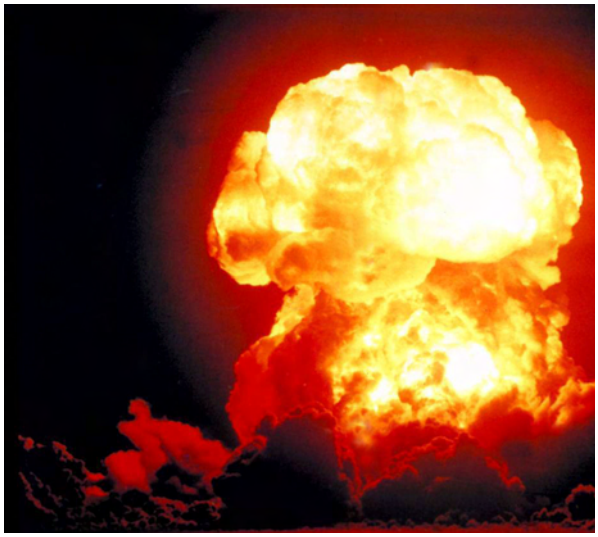


Figure 37. Fireball of H-bomb explosion after test blast over Bikini Atoll (1956, © Time Inc.)

The Bikini: The bikini swimming costume is a pop culture icon that has forever changed fashion. Originally named "le Atome" for its small size by its inventors—two French designers, Louis Réard and Jacques Heim,—it was launched upon the world as "le Bikini" on July 5, 1946, just days after the first test at Bikini Atoll. Political, social and fashion commentary conflated the meaning of the bikini at this time as Rosebush (n.d.) summarizes:

> Réard's famous fashion statement changes the world; like the bomb, the bikini is small and devastating. Vogue editor Diana Vreeland calls the bikini "the atom bomb of fashion," and a Paris fashion writer suggests it is the image of a woman emerging tattered from the blast. Perhaps the shock of seeing the Marshallese islanders in the nuclear age enable the Technologists to discover seeing themselves in the tribal age. And to enjoy it.

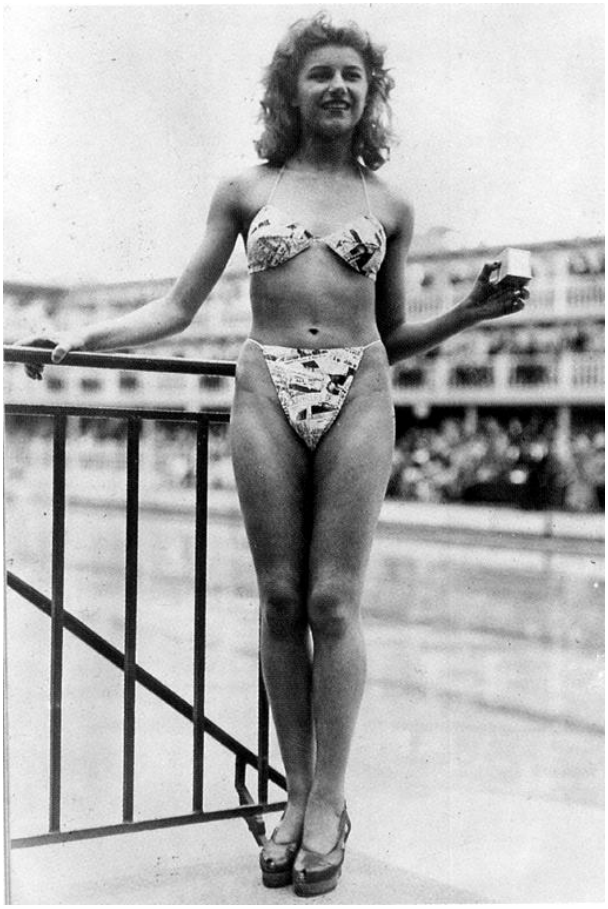


Figure 38. Michele Bernadini models the first Bikini in Paris, July 18, 1946 (unknown)

Figure 39. Godzilla (1946, © Toho Co. Ltd.)

Godzilla: Godzilla is the premier pop culture icon of Japan. The first Godzilla movie (*Gojira*, 1954) appeared just months after the Bravo test and the return of the irradiated *Daigo Fukuryū-Maru* and its crew to Japan. The movie refers overtly to the fishing boat and the US hydrogen-bomb tests at Bikini and Enewetak. In the film, American nuclear weapons testing in the Pacific awakens a seemingly unstoppable, radioactive dinosaur-like beast that attacks Tokyo, symbolizing the resurgent grief over Hiroshima and Nagasaki, and fear that these events would be repeated. Godzilla is now one of the world's most recognized monsters, having appeared in over 60 films, and his most well-known power is his atomic breath. Ryfle proposes that "*Godzilla*, then, is arguably the most important and enduring postwar monster movie—important because it attempted to address a global issue that still resonates 50 years later" (2007, p. 52).

Other works of art and culture: Works of art and culture that are directly inspired and touched by Bikini are too numerous to catalogue but some examples are presented here to show the breadth, diversity and global significance of Bikini's symbolic reach. Salvador Dali, in his 1947 painting "The Three Sphinxes of Bikini," presents us with images of the mushroom cloud mixed with images of trees and of the human head, suggesting the interaction of man, nature and atomic weapons. At the commencement of testing on Bikini in 1946, artist Laurence Hyde saw it as "a microcosm of the world-to-be if humanity, for the last time, failed to live up to its name. It would appear that Hiroshima and Nagasaki were not enough." Hyde developed a series of woodcuts that became the graphic novel *Southern Cross*, telling the story of both the testing, and the displacement and destruction of a Bikinian family. In the 1956 film *Moby Dick* (directed by John Huston and scripted by Ray Bradbury), Captain Ahab (Gregory Peck), when asked where he expects to find the whale, points on a chart to Bikini Atoll—a symbolic connection of the White Whale

to the bomb. A little more offbeat, in 1996 a cultivar of iris was officially named "No Bikini Atoll," possibly for its resemblance to the mushroom cloud. In 2002, critically acclaimed composer Steve Reich and artist Beryl Korot (2003) created the documentary video opera, "Three Tales" which tells the story of the Hindenberg disaster, the tests at Bikini Atoll and the cloning of Dolly the sheep, selected as three signposts of the 20th century. The music accompanying footage of the removal of the Bikinians and the detonations is described as "some of the saddest music Reich has composed" (Packett, 2002). *SpongeBob SquarePants*, a broadcasting phenomenon, is the most popular children's television program in the world, broadcast in 25 languages in 170 countries. SpongeBob SquarePants lives on Bikini Bottom, beneath the tropical isle of Bikini Atoll and episodes contain occasional references to the actual testing with footage of the bombs. In 2007, *Time* magazine named Sponge Bob Square Pants one of the "100 Best TV Shows of All Time" (Poniewozik, 2007). These are but a smattering of the works of art that are directly associated with Bikini.

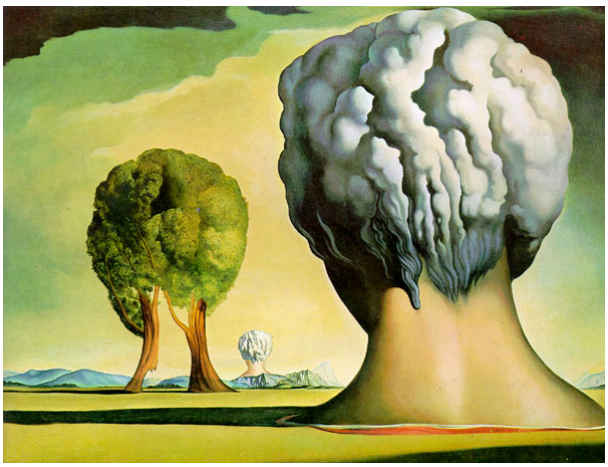


Figure 40. Salvador Dali's "The Three Sphinxes of Bikini" (1947) (top right)

Figure 41. Woodcut from Laurence Hyde's graphic novel about Bikini, Southern Cross (1951) (right)

Figure 42. Captain Ahab points to Bikini Atoll as the likely location of the White Whale in the 1956 film, Moby Dick (lower right)

Figure 43. A cultivar of Iris, officially recognized in 1996 named "No Bikini Atoll" (Cooley's Iris Garden, n.d.) (left)

Figure 44. Scene from staged version of Three Tales by Steve Reich and Beryl Korot (W. Bergmann, 2002)

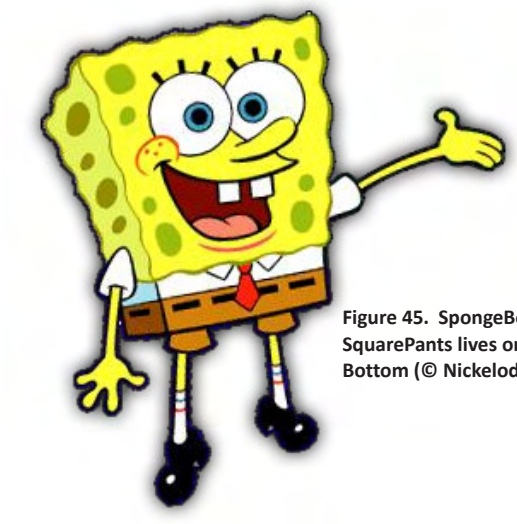


Figure 45. SpongeBob SquarePants lives on Bikini Bottom (© Nickelodeon)

Events giving rise directly to the globally significant nuclear disarmament movement

Events at Bikini were the seed from which grew movements (expressions of values) demonstrating the global significance of the nuclear age in the late 20th century: the nuclear disarmament movement.

The very same month of the return of the *Daigo Fukuryū-Maru* to Japan, a group of middle-class housewives from Tokyo began the "Suginami Appeal"—a campaign against the hydrogen bomb. In his definitive history of nuclear disarmament movements around the world, Wittner (1997) describes that the campaign "blossomed into a nationwide movement and, by the following year, had attracted the signatures of 32 million people—about a third of the Japanese population" (p. 8). Between March 18 and October 22, 1954, all of the 46 prefectural parliaments passed anti-nuclear resolutions (Hiroshima City in Saito, p.369).

In August 1955, the First World Conference against Atomic and Hydrogen Bombs was held in Hiroshima, leading directly to the establishment of Gensuikyo: The Japan Council against Atomic and Hydrogen Bombs in September of the same year (Introducing the Japan Council against Atomic and Hydrogen Bombs (Gensuikyo), n.d.). Wittner states that "Gensuikyo became one of Japan's most important and enduring mass movements" (1997, p. 9). The reach and significance of the Gensuikyo organization in the anti-nuclear movement is demonstrated by the petition of over 100 million signatures presented in 2000 to the UN Office for Disarmament Affairs in support of the "Appeal from Hiroshima and Nagasaki for a Total Ban and Elimination of Nuclear Weapons" (Dhanapala, 2000).

The *Daigo Fukuryū-Maru* has been retained as a monument of the events at Bikini Atoll and is now on display at the Tokyo Metropolitan *Daigo Fukuryū-Maru* Exhibition Hall which receives over 300,000 visitors every year, and educates on the devastating effects of nuclear weapons (*Daigo Fukuryū-Maru* Exhibition Hall, 2005; Kennedy, 1999).

The horror experienced by Japan, and the exposure of the Marshallese to fallout, quickly gave rise to anti-nuclear sentiment in direct response to the Bravo shot on Bikini in 1954. Prime Minister Jawarlal Nehru of India was the first to propose a ban on nuclear testing—shortly after the US Bravo test in April 1954. The Bravo shot at Bikini provoked Bertrand Russell and Albert Einstein to write the Russell-Einstein Manifesto, launched at the first Pugwash conference in July 1955. The manifesto was signed by the leading scientists at the time. The influential Pugwash movement was awarded the Nobel Peace Prize in 1995.

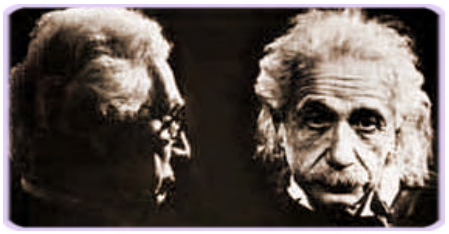


Figure 47. Bertrand Russell and Albert Einstein wrote the Russell-Einstein manifesto as a response to the Bravo test on BIkini.

The Castle Bravo detonation resonates around the world even today as the blast, and its consequences are commemorated in a peace march held each year in Shizuoka Prefecture in Japan. This march calls for the abolition of nuclear weapons and commemorates the death of Aikichi Kuboyama, the radio operator of the *Daigo Fukuryū-Maru* who has become a symbol of the test in Japan ("Peace march", 2008). In the Pacific Islands, the "Nuclear Free and Independent Pacific Day" is celebrated on the same day. In the Marshall Islands, the day is commemorated by the Bikinians. All these commemorations refer to this day—March 1, the anniversary of the Castle Bravo—as "Bikini Day."

(Note: An in-depth discussion of the early days of the nuclear disarmament movement, galvanized to action by the Castle Bravo detonation, can be found in Wittner, 1997).

Figure 46. The Tokyo Metropolitan *Daigo Fukuryū-Maru (Lucky Dragon #5)* Exhibition Hall receives over 300,000 visitors each year (anonymous, n.d.)

3.b Proposed Statement of Outstanding Universal Value

Nuclear bomb tests at Bikini Atoll shaped the history of the people of Bikini, the history of the Marshall Islands and the history of the entire world. Bikini Atoll is distinctly 20th century heritage, standing testimony to the dawn of the nuclear age, the start of the Cold War and the era of nuclear colonialism – stages in human history of global significance.

Bikini Atoll is an outstanding example of a nuclear test site. The entire landscape and seascape of Bikini testifies to its history as a nuclear test site, from the ensemble of sunken ships and the purpose-built bunkers, to the disappeared islands and the Bravo crater. The lonely rows of coconut trees, placed in preparation for a failed resettlement, and the conspicuous absence of humans speak to the fate of a nuclear test site rendered uninhabitable.

Bikini Atoll stands as a monument and memorial to the dawn of the nuclear age. At Bikini, the quintessential tropical paradise, beloved by our modern culture as a place of peace and simplicity, is juxtaposed with the artifacts of nuclear bomb testing, evoking a remembrance of a time of lost innocence—when men held and wielded a power reserved for gods.

Bikini Atoll played host to events of global significance which are illustrated in the landscape and seascape. The sunken vessels bear witness to Operation Crossroads—the first peacetime atomic bomb tests, implicated in the start of the Cold War. The Bravo crater is evidence of the Castle Bravo test—the first deliverable hydrogen bomb, and the event that introduced the world to fallout. Aside from the bombs dropped on Hiroshima and Nagasaki, few, if any, other nuclear weapons events have had this scale of impact on the world.

The process of nuclear colonialism around the world is exemplified by Bikini, from the selection of Bikini as a remote site, distant from the population of the testing nations, to the representation of Bikini as a *terra nullius*, to the displacement of the Bikinians and the irradiation of Marshallese and military personnel. Bikini was the first site of nuclear colonialism and remains the outstanding illustration of this significant stage in human history.

Ideas and beliefs of outstanding universal significance are directly and tangibly associated with Bikini Atoll. Emanating from this narrow circle of tiny islands in the middle of a vast ocean is a myriad of symbolism that has permeated our global culture, including the universally recognized and understood mushroom cloud, the bikini swimming costume, and the radioactive pop-culture icon, Godzilla. The breadth, diversity and global significance of Bikini's symbolic reach is evidenced in the innumerable works of art, music, film and literature that have been touched and inspired by the events at Bikini, illustrating the profound impact of events at Bikini on the global culture and psyche.

Events at Bikini led directly to the creation of political and ideological movements that have shaped global society in the second half of the 20th century, mostly connected with the Castle Bravo test on March 1, 1946. The return of the irradiated *Daigo Fukuryū-Maru* and her ill crew in March 1946 led to the momentous "Suginami" petition, which in turn led to the establishment of Gensuikyo: the Japan Council Against Atomic and Hydrogen Bombs, an enormously significant mass movement in Japan. The Bravo shot led Albert Einstein and Russell Bertrand to write the Russell-Einstein Manifesto, which in turn led to the establishment of the Pugwash movement of influential scholars and public figures concerned with reducing the danger of armed conflict and seeking cooperative solutions for global problems. The anniversary of the Bravo test continues to be celebrated as "Bikini Day" in Japan, and as the "Nuclear Free and Independent Pacific Day" throughout the Pacific.

3.c Comparative analysis (including state of conservation of similar properties)

Bikini Atoll is being presented for World Heritage nomination as an outstanding example of a nuclear test site. In comparing Bikini Atoll with several other key atomic test sites, the primary purpose is to show that the powerful symbolism, the remembrance of events and the integrity of Bikini's nuclear landscape uniquely position Bikini Atoll to stand testament to all the nuclear test sites of the world, and to tell the story of all the peoples who have suffered at the hands of nuclear colonialism. Due to the significance of the nuclear age for humanity, the specific heritage values expressed by Bikini leave opportunity for other sites expressing different values of the nuclear age, such as technological achievement, to be added to the World Heritage list at a later time.

The following discussion compares Bikini with a small number of nuclear test sites from around the world, and also with Hiroshima Peace Memorial (Genbaku Dome). The comparative analysis is carried out thematically, on the basis of the values presented in section 3.a:

(i) monuments and memorials to the dawn of the nuclear age;

(ii) sites of nuclear testing events of global significance;

(iii) sites bearing testimony to nuclear colonialism;

(iv) sources of nuclear-related globally significant cultural symbols and icons; and

(v) the location of events giving rise directly to the nuclear disarmament movement.

In addition we compare Bikini and other sites on the basis of the overall expression of attributes of a nuclear test site based on the integrity and authenticity of these attributes and the state of conservation.

On the basis of the expression of nuclear weapons values and on its role as a nuclear test site, the sites selected for comparison include: the Hiroshima Peace Memorial (Genbaku Dome)—already inscribed on the World Heritage List, Trinity—the site of the world's first nuclear detonation, Enewetak Atoll in the Marshall Islands, and several other key nuclear test sites in the Pacific region and around the world. The table below summarizes the framework for the comparative analysis, which is discussed in more detail under each theme.

	Bikini Atoll	Hiroshima Peace Dome (Genbaku), Japan	Trinity, USA	Enewetak Atoll, Marshall Islands	Moruroa and Fangataufa, French Polynesia	Maralinga and Emu Field, Australia	Kiritimati (Christmas Island), Kiribati	Nevada, United States	Semipalatinsk, Kazakhstan
Monument and memorial to the dawn of the nuclear age	+++	+++	++	+	-	-	-	-	-
Nuclear testing events of global significance	+++	+++	+++	+	+	+	+	+	+
Expression of nuclear colonialism	+++	-	-	++	++	++	+	-	++
Symbolism of global significance	+++	+++	++	+	+	-	-	+	-
Giving rise directly to the nuclear disarmament movement	+++	+++	-	-	+++	+	-	-	-
Expression of nuclear attributes in the landscape	+++	+++	+++	+++	+	+	+	+++	+
Authenticity	+++	+++	+++	+++	+	+	?	+++	?
Integrity of the site	+++	+	+	+	+	-	?	-	-
State of Conservation	+++	+++	+	+	++	-	?	?	-

Sites are rated for Outstanding Universal Value against the attributes above as: +++ exceptional, ++ considerable, + some, - insignificant, and ? not known

3.c.(i) Monuments and memorials to the dawn of the nuclear age

Delgado (1991) emphasizes that "the effort to memorialize and celebrate the impact of the bomb began at the same time the new age dawned" (p. 144). The site of Trinity was proposed as an "Atomic Bomb National Monument" in 1946, and was declared a National Historic Landmark in 1965. The Peace Park at Hiroshima was established under a law in 1949 that aimed to have all of Hiroshima rebuilt as a "Peace Memorial City." To date only one site representing the nuclear age is listed on the World Heritage List—Genbaku, the Hiroshima Peace Memorial.

These sites of Hiroshima, in Japan, and Trinity in New Mexico, along with Bikini Atoll, are the three outstanding sites representing the dawn of the nuclear age; however, they each carry unique meanings and symbolism. The Trinity Site was proposed as a national monument as a celebration of technological achievement—a symbol of American national pride in the skill and investment that resulted in the detonation of the "world's first nuclear device" on July 16, 1945 (National Park Service, n.d.). In stark contrast, the Genbaku Dome, the Hiroshima Peace Memorial, is the pre-eminent symbol of the first use of nuclear weapons on a civilian population. It was inscribed on the World Heritage list in 1996 and has been conserved in the state it was after the bombing of Hiroshima on August 6, 1945 as the only building remaining standing in the vicinity of ground zero. The Peace Dome and the Peace Park that surrounds it form a "locus of contested memory and contested values" (Beazley, 2007, p.33) commemorating the 140,000 lives that were lost, and at the same time, the peace that nuclear weapons have brought to the world. Bikini is an exceptional monument to the dawn of the nuclear age as it has a different and unique meaning from these sites of comparison at Trinity and Hiroshima – Bikini stands as a monument and memorial to the ushering in of the Cold War and the era of nuclear colonialism, and, as discussed in section 3.a, evokes remembrance of humanity's loss of innocence.

Figure 48. A monolith marking the position of the Trinity explosion, the "world's first nuclear device" in 1945 at White Sands, New Mexico (Anonymous, n.d.)

Figure 49. The World Heritage-listed, Hiroshima Peace Memorial (Genbaku Dome) (Anonymous, n.d.)

3.c.(ii) Nuclear testing events of global significance

Of the more than 2,000 nuclear testing events since 1945, only a few are truly globally significant, most notably the following:

- Trinity—the first detonation of a nuclear device on July 16, 1945.
- Operation Crossroads Able and Baker on July 1 and July 25, 1946 – the most public of all the tests, with international press and observers present, and the globally significant contribution to the start of the Cold War at this time.
- Ivy Mike on Enewetak—the world's first thermonuclear (hydrogen) device and significant as a key technological development.
- Castle Bravo on March 1, 1954—the world's first deliverable hydrogen device but more importantly, the contamination of the *Daigo Fukuryū-Maru* and the fallout across the Marshall Islands introduced the world to radioactive fallout from such a weapon.
- "Big Ivan" (known as "Tsar Bomba" in the west), tested by the Soviets on October 31, 1961–significant as the largest thermonuclear weapon ever tested at 50 megatons.

The Little Boy dropped on Hiroshima on August 6, 1945 and Fat Man dropped on Nagasaki on August 9, 1945 are not compared here as they were not experiments, but were weapons deliberately used against a population in wartime.

Thus Bikini was host to two of the world's most significant nuclear testing events, however the significance and impact of these tests was distinct from other nuclear testing events, particularly the role that Crossroads played in the start of the Cold War, and the global resonance of the Bravo test as described in section 3a.

3.c.(iii) Expression of nuclear colonialism

The ultimate expression of nuclear colonialism is either the displacement of people to make way for the testing, or their exposure to the effects of nuclear testing. In both cases, these events have catastrophic effects on the lives of individuals, their cultural identity, economic situation, health and way of life. Bikini Atoll is the strongest expression of nuclear colonialism due to:

- The forced displacement of the Bikinians, and the catastrophic health concerns and displacement of other Marshall Islanders resulting from radioactive contamination of a swathe of these islands and their people;
- The extensive documentation of the entire process of nuclear colonisation, as part of the development of the Bikini Atoll nuclear test site; and
- The representation of Bikini as a "deserted isle" in order to legitimise the testing—representation that was unprecedented, and that established the form for representation of other sites of nuclear colonialism.

The sites of Enewetak and Moruroa have similarly strong expressions of nuclear colonialism. Enewetak's history is similar to Bikini's with the people of Enewetak being displaced to make way for the testing. The experience of nuclear colonialism in French Polynesia, while not displacing people from the atolls, which were initially uninhabited, did transform the local economy and culture and gave rise to a strong domestic struggle against the French colonialists, eventually leading to the regionally-significant Nuclear Free and Independent Pacific Movement (Danielsson & Danielsson, 1986; Smith, 2007). However, the entire process of nuclear colonialism, as it happened in other places around the world, is exemplified by Bikini, from the selection of Bikini as a remote site distant from the population of the testing nations, to the representation of Bikini as a *terra nullius*, to the displacement of the Bikinians, the irradiation of Marshallese and military personnel and the resulting uninhabitable lands. Bikini was the first site of nuclear colonialism and remains the outstanding example, in part because every phase of the process was documented. In presenting Bikini Atoll as the strongest expression of nuclear colonialism, it is not intended in any way to diminish the experience of other victims of nuclear colonialism. Instead, it is suggested that Bikini can stand as a particularly evocative example; a testimony for all victims of nuclear colonialism.

3.c.(iv) Source of symbols and icons of global significance

While the preeminent symbol of the nuclear age, the mushroom cloud, is associated with all atmospheric nuclear test sites as well as with Hiroshima and Nagasaki, images that have propagated this symbol are sourced mainly from the Bikini and Nevada test sites (Rosenthal 1991, Kirsch 1997). Other key symbols and icons of the age of nuclear weapons readily come to mind: the peace symbol which made its first appearance on the first Aldermaston march in 1958, shortly after Britain conducted its first nuclear tests in the Pacific; and the Greenpeace *Rainbow Warrior*, sunk by French intelligence agents in Auckland Harbour in 1985 while preparing to travel to Moruroa to protest French nuclear testing. However, both of these important symbols are only tangentially connected to place. Bikini stands out from all other nuclear test sites as the place which is the single source of an array of diverse and iconic symbols representing different and conflated meanings of the nuclear age, and as the source of the works of art and culture that are inspired directly by Bikini.

3.c.(v) Giving rise directly to the nuclear disarmament movement

The global significance of events at Bikini, and the role they played in the early establishment of the nuclear disarmament movement worldwide, starting in 1954, is described in section 3a. Bikini played a particular role in the 1950s during the phase in which the movement became established and organized as a mass movement, most significantly in Japan. Later on, the movement gained momentum as public outcry against proposed British tests on Kiritimati (Christmas Island) became more vocal, leading to the establishment of the powerful Campaign for Nuclear Disarmament (CND) in 1958. Similar mass movements developed in America and across Western Europe from 1957, related in general to the fallout events from testing in the Pacific and leading to the US and USSR moratorium on atmospheric testing in 1958 (Wittner, 1997). It was the testing on Moruroa and Fangataufu in French Polynesia starting in 1966, along with the experience of the Marshall Islands, which provided the impetus for the nuclear disarmament mass movement in the Pacific and Australasia. The "Conference for a Nuclear-Free Pacific" was convened in Fiji in 1975, initiating the Nuclear Free and Independent Pacific Movement. This movement played a profoundly important social, cultural and political role in the region, recognizing the need for independence of Pacific colonies and setting the tone for the public's attitude towards not only nuclear weapons, but nuclear technologies in general. The movement led directly to the establishment of the *South Pacific Nuclear Free Zone Treaty* ratified by 16 state parties in the region. Thus, while other test sites (Kiritimati, Moruroa and Fangataufu) played significant roles in the nuclear disarmament movement in later times, it is events at Bikini Atoll which gave rise to the early days of the movement.

3.c.(vi) Authenticity, integrity and state of conservation

Bikini Atoll is exemplary of other nuclear test sites, however Bikini stands out from all these sites in the degree of documentation and publicity that was given to these sites. The removal of the Bikinians was scripted and filmed (several times), much effort went into portraying the post-war military site and the biology and geography was surveyed extensively both before and after the tests as well as the very detailed and specific records of the tests themselves. Nowhere else in the Pacific or in other distant-nation test sites were the activities so well documented or publicized; most were carried out in utmost secrecy (and information on some is still unavailable or was never collected). The integrity, authenticity, well documented cultural history and the well-preserved artifacts of the testing, including the ships, along with the accessibility of the site to tourists who can explore firsthand these material remains of the testing era, make Bikini an outstanding example of a nuclear test site.

Trinity and Hiroshima: Delgado (1991) has compared the artifacts of Bikini to those of Trinity and the Japanese target cities:

> The ships of Operation Crossroads, lying where they were sunk by two nuclear blasts, are the last "vestigial" remnants of that time and place. Substantially unchanged, they are the only essentially unmodified museum of the dawn of the era of the atomic bomb—unlike the picked-over, filled-in, and fenced ground zero of the Trinity Site, or the rebuilt Hiroshima and Nagasaki. (Delgado et al., 1991, p. 143)

Enewetak Atoll: At the close of testing in 1958 Enewetak continued to be used for US military purposes until the start of a cleanup and rehabilitation program in 1977. An estimated 73,000 cubic meters of contaminated soil as well as debris from the testing was removed from the islands, mixed with cement, placed in a bomb crater on Runit Island, and capped with a concrete dome now known as the "Runit Dome." Enewetak Atoll was declared safe for habitation and people returned to the southern islands of their atoll in 1980, while the northern part of

the atoll around the Runit Dome remains off-limits. The Runit Dome in itself is a remarkable artifact of nuclear testing, and in itself forms a monument to the nuclear era. However, Bikini Atoll stands out from Enewetak as a nuclear test site due to the fact that it has not been used for other purposes (except small-scale tourism) since the testing, and so the entire atoll, rather than one island as for Enewetak, retains the authenticity and integrity of a nuclear test site.

Figure 50. Runit Dome on Enewetak (Defense Special Weapons Agency, n.d.)

Nevada Test Site (NTS), United States: The enormous Nevada site, as the primary testing location for US nuclear devices, is clearly a significant nuclear test site, having seen more than four decades of nuclear testing, but it differs fundamentally from Bikini in that it is continental, and on the homeland of the testing nation and was host to over 900 tests—an order of magnitude greater than Bikini. A further difference is that the NTS remains today an active site for various other activities such as hazardous chemical spill testing, emergency response training, conventional weapons testing, and waste management and environmental technology studies. (Source: Nevada Test Site, 2008)

Semipalatinsk Test Site (STS), Kazakhstan: The Semipalatinsk Test Site was the primary venue for Soviet nuclear weapons testing, witnessing over 450 tests between 1949 and 1989. STS was the largest underground nuclear test site in the world; however, between 1997 and 2000 a joint US-Kazakhstan program—the "Weapons of Mass Destruction Elimination Initiative"—destroyed key testing infrastructure including the extensive tunnel network, and the site is not fenced, allowing animals and people free access to the site. Three nuclear research reactors are now housed on the site and there are reports of scrap metal collection and mining on the site. The STS differs substantially from Bikini in that it is a continental site, was devoted primarily to underground testing, and is today used for many different purposes. (Source: Loukianova et al., 2008)

Moruroa and Fangataufa, French Polynesia: In French Polynesia, Fangataufa atoll is abandoned but Moruroa remains guarded by French Legionnaires (Smith, 2007, p. 62). Both atolls were host to atmospheric testing from 1966 to 1974, and then underground testing from 1975 to 1996. The underground blasts involved drilling down into the basalt geological structures supporting the reefs. Moruroa exhibits a highly modified landscape with roads, quarries, blockhouses and towers—all artifacts from the nuclear testing. However, strict military secrecy by the French means that much less is known about the testing at Moruroa and so there is a far lesser degree of authenticity and documentation than for Bikini.

Maralinga and Emu Fields, Australia: The evidence and artifacts left from nuclear tests in Maralinga and Emu Fields differ from Bikini in several ways. The tests themselves were relatively fewer, and were a mixture of atomic weapons and what were called "minor trials"–conventional explosives used to disperse radioactive plutonium. Subsequent cleanup efforts are now thought to have dispersed this waste even further thus these sites have little integrity as former nuclear test sites.

3.c.(vii) Summary statement of comparative analysis

Bikini Atoll is shown to have a different and unique meaning when compared to existing monuments and memorials of the dawn of the nuclear age, Hiroshima Peace Memorial and the Trinity Site. Bikini was host to two of the world's most significant nuclear testing events, the significance and impact of which are distinct from other nuclear testing events. Bikini Atoll is an exemplary expression of the entire process of nuclear colonialism from the selection of the site, the displacement and irradiation of people, to the resulting uninhabitable lands, thus being able to represent this process for all sites of nuclear colonialism. Bikini Atoll stands out from all other nuclear test sites as the single source of a diverse array of globally significant, iconic symbols related to the nuclear age. Events at Bikini, in particular the Bravo shot, gave rise to the establishment of the nuclear disarmament movement in the 1950s, with other sites playing a role in later stages of the movement. The authenticity, integrity and the state of conservation of the nuclear attributes of Bikini make it an internationally outstanding example of a nuclear test

site.

3.d Integrity and Authenticity

3.d.(i) Statement of Authenticity:

The authenticity of Bikini Atoll as a place, and in its various cultural meanings, is extensively documented and expressed in a wide range of ways. Many of these information sources are readily accessible primary sources of documentation, either from the period of nuclear testing itself, or from more recent times. Because of the relatively recent nature of the historic events at Bikini (less than 70 years ago), there remain people in the Marshall Islands, United States, Japan and throughout the world who remember the events at Bikini.

The significant attributes of Bikini Atoll include:

- the physical artifacts and the landscape, including the sunken vessels, remnant structures of bunkers and monitoring stations, the craters in the reef, the grids of planted coconuts, and the radiation;
- the natural ecosystems, both marine and terrestrial, and changes in these ecosystems during and since the nuclear tests;
- the representation of Bikini, and the symbolism and meaning that emanates from Bikini throughout global culture; and
- the meaning of Bikini as a homeland lost to its people.

The tangible expressions of nuclear testing at Bikini Atoll are documented in scientific and descriptive studies of the physical artifacts. The ships were documented in an archaeological survey (Delgado et al., 1991) and have been written about and photographed in a wide range of respected publications, including *National Geographic* (Eliot, 1992). The landscape and technological assemblage was extensively filmed and photographed during the testing and the current remnants are easily identifiable against this documentation. Radiation, although unseen, is clearly a physical attribute of the site and has been documented in several studies during and since the testing.

The authenticity of Bikini and of the significance of events at Bikini was well-documented through US media, and this has been greatly supported in more recent years by the release of military and government documents and film footage through the Freedom of Information Act. In presenting the universal significance of Bikini Atoll, it is difficult to ascertain, for example, the degree to which the events at Bikini impacted the Soviet's approach to the negotiations at the start of the Cold War. As Graybar states, "In the absence of documents from the Kremlin one can never be sure what impact the tests had on the talks at the United Nations" (1980, p. 122).

The integrity of the site has not been compromised. The artifacts from the testing, and the physical condition of the natural environment are authentic in that they have not been modified or rebuilt since the testing events and the subsequent clean-up efforts. The results of the clean-up efforts (the bulldozed land and the untended grids of coconut trees) are themselves part of the evolution of a nuclear test site, as they demonstrate a growing understanding of the persistent nature of radiation from nuclear bombs.

Hines (1963) states that "Operation Crossroads unquestionably was the most thoroughly documented, reported, and publicized peacetime military exercise in history" (p. 32) while Weisgall (1994) places it as "the grandest scientific experiment ever, more exhaustively photographed, reported, and measured than any previous event in history" (p. 117). The events of the actual tests, between 1946 and 1958, are captured in the plethora of reports, radio recordings, photos, films and documentaries of the period. Most of this information, originally recorded by the US military, is now in the public domain.

The global political climate at the time of the testing, and Bikini's role in it, is documented in newspaper articles, letters, speeches, petitions, records of meetings, and in manifestos. Bikini's importance in all of this is evidenced by the many articles in the *New York Times* and *Washington Post*, both on the front page and in special reports. The Soviet newspaper, *Pravda*, reported on both Operation Crossroads and on the Bravo shot, and the Bravo test was covered closely by the *Yomiuri Shimbun* (Saito, 2006), Japan's largest circulation daily newspaper. All these are primary sources that attest to the authenticity of Bikini Atoll's global significance. The resonance of Bikini as a source of nuclear symbolism has made its way into art, film, television, literature and a plethora of commentaries on global culture and the nuclear bomb in the second half of the 20th century. In fact, the wide range of information sources that present and interpret Bikini's symbolism illustrates beautifully the profound social, psychological and cultural impact the events of Bikini have had on generations of humans, all over the world. Many of these sources are referenced throughout this document.

The spiritual connection of the Bikinians with their islands, and their experience of forced migration as

subjects of nuclear colonialism, is recorded in interviews and transcribed into books, as well as being captured by the cameras of the US military. The history of the people of Bikini is retained in their culture as an oral tradition.

3.d.(ii) Statement of Integrity:

The Bikini property is a holistic single atoll system surrounded by open ocean. It has a very high degree of integrity for two reasons: the first being the reason for selection as a nuclear test site—its remoteness; the second being the unintended effects of testing—persistent environmental radiation that has prevented people from returning here to live. It is now a place that is far from man-made disturbances and is impacted only by a very small number of tourists and residents.

Artifacts of the nuclear testing:

Artifacts, buildings and submerged ships related to testing are in good condition, given the usual natural processes of deterioration. Bikini, in its totality, is a protected and managed "archaeological park" with its various components creating a vast and whole "nuclear landscape" above and below the water. The archaeological integrity of the site has been protected by its isolation and by its "off limits" nature, as well as radioactive contamination. Very few materials have been removed, and those which have been removed have been part of the ongoing process of nuclear site management as weapons and the equipment evolved during the active use of Bikini as a test site. Bikini evolved as a nuclear landscape, and within this context, the shifting of platforms, the erecting of new bunkers, even the planting of rows of trees and the construction of homes for the failed resettlement reflect the evolution of Bikini.

Archaeological assessment of the ships was undertaken in 1989-1990 by the US National Park Service. The ships and the surrounding landscape were determined to be eligible, were they in the US, for designation as a National Historic Landmark district, and potentially, again if in the US, as a unit of the national park system because of the unique nature of the site and its archaeological integrity. In addition to the ships, artifacts observed and documented included test equipment and items left inside and on the ships, as well as material lying on the lagoon floor. In the case of the aircraft carrier USS *Saratoga*, for example, the archaeological integrity of the ship as a contributing element to the entire site included small arms such as pistols in small arms lockers, the ship's silver service in the galley, shells in ready ammunition lockers, aircraft in the hangar, fire- fighting equipment, test towers on the flight deck, scattered lead sheets from test gauges, a field artillery piece on the flight deck, and vehicles and aircraft washed off the deck and lying alongside the carrier on the lagoon floor. In the case of the aircraft, their cockpits still held 50-gallon fuel cans strapped empty in the seats to simulate a pilot's chest cavity during the blasts, and 500-lb. bombs in the bomb bays. A pair of thick protective goggles to allow observers to gaze at the "Able" surface test detonation was observed lying on the carrier's navigation bridge. The ships in particular demonstrate a high level of archaeological integrity reflecting the events of July 1 and July 25, 1946.

The processes of deterioration, especially in the ships, are irreversible and directly related to the atomic tests. In the case of the ships, blast damage introduced micro-fractures and may have turned steel into the isotope of steel, accelerating the deterioration of the ships. As such, the unnatural processes at work, and the ultimate disintegration of the ships over the next century is demonstrative of the legacy of the tests, and an integral and key aspect of this landscape—as such, these processes and the ongoing changes in the ships and structures should be monitored, assessed and documented. Even in a deteriorated form the ships are a highly significant archaeological site.

Natural environment

The terrestrial environment of Bikini has been very much disturbed from its natural state by the construction of the test site, the bomb blasts that stripped away vegetation and the rehabilitation efforts to reduce contaminated soil and replant coconut trees. These disturbances are clearly physical, but another more insidious result is the invasive plants and animals that arrived on the many vessels and aircraft that came and went from Bikini. Thus, the integrity of Bikini's natural terrestrial system is not intact, but these impacts further illustrate the fate of a nuclear test site.

The marine environment has recovered remarkably from the testing and the reef system has a very high biodiversity, showing the range of species, including endemic biota, apex predators (sharks) and migratory species such as turtles, that demonstrate the system is functioning well. The buffer zone of the site extends 5 nautical miles out, affording the atoll ecosystems additional integrity. It is thought that neighboring Rongelap Atoll, some 150 kilometers to the east, has played a role in re-colonizing the coral reefs of Bikini Atoll. Rongelap Atoll also enjoys a high level of conservation management and protection by its owners, thus further enhancing the integrity of Bikini's natural marine system.

Part 4. State of Conservation and Factors Affecting the Property

4.a Present state of conservation

4.a.(i) Decomposition of the sunken vessels

The natural processes of corrosion and deterioration inherent in all sunken vessels appears to be accelerated at Bikini. There are two theories currently being evaluated. The first is that the nuclear blasts introduced consistent micro-fractures throughout the structure of the steel of each ship, that this nuclear effect has resulted in a higher level of chloride absorption and subsequent accelerated corrosion, and that the steel, as it deteriorates, is subject to larger scale fracturing. Another possibility is that the radiation from the two bursts converted elements in the steel into isotopes. The isotope of steel is said to have a half life of seven years, and several generations of half lives have further weakened the steel. Deterioration is most apparent on USS *Saratoga*, where the flight deck is collapsing, interior spaces with overheads are collapsing, and the "island" superstructure has tilted and begun to collapse inward and to the port (left) side of the ship (Delgado et al., 1991). It was recently reported that the gun director on top of the *Saratoga* bridge had collapsed into the elevator shaft (J. Niedenthal, pers. comm., January 2008).

The gradual loss of structural integrity of the ships does not represent a loss of archaeological integrity, nor does it represent a loss of heritage value. The Bikini test ships are representative of more than historic shipwrecks. They are large test instruments exposed to the effects of nuclear blasts, and the deterioration of the vessels is a long-term effect of the blasts, and as such is a representative and significant feature of the site.

Figure 51. Divers on the Apogon conning tower. The ships at Bikini Atoll appear to demonstrate accelerated corrosion as a result of the atomic tests (E. Hanauer, 2006)

4.a.(ii) Deterioration of buildings

The few buildings from the testing period that remain on Bikini, Eneu and Aemon are in a general state of disrepair. The construction of reinforced concrete is subject to deterioration in the salty environment as the reinforcing bars rust and expand, cracking the concrete. As for the ships, the natural deterioration process of these few buildings is illustrative of the long-term fate of an abandoned nuclear test site and as such, the current state of conservation is a part of the characteristic of the site as a whole.

4.b Factors affecting the property

4.b.(i) Development pressures

None of these pressures applies at Bikini. There are no plans to resettle or develop Bikini except for the potential for small-scale tourism development.

4.b.(ii) Environmental pressures

Climate change and illegal fishing discussed here are not expected to have an impact on the cultural artifacts, but are discussed here with relation to Bikini's natural attributes.

Climate change

As with all low-lying atolls, Bikini Atoll is threatened by climate change; however, it is as yet unknown how this will impact the atoll in the long-term. Climate change is predicted to result in sea-level rise, and increased exposure to storm surge and rising tides that are known to wash over entire islands. As this deposits salt in the soil, existing terrestrial flora may change or degrade, potentially leading to desertification. In addition, climate change is predicted to result in warmer sea temperatures and changes in the major oceanic currents that currently provide climate regulation. This leads to unpredictable impacts, but we could expect to see an increase in coral bleaching events and possibly a shift in species assemblages within coral reefs to those species with higher temperature tolerance. Ocean acidification is predicted to seriously impact the ability of corals to grow and form skeletons.

Illegal fishing pressure

Illegal fishing of Bikini sharks can be a serious threat to richness and the ecological balance of this atoll. Reef shark fins are highly valued by the Asian market and some illegal longline fishing has happened in the near-shore waters of a few atolls including Bikini. A shark-finning boat found fishing off Bikini in 2002 was successfully prosecuted and no major incidents have been reported since. This threat is not only detrimental to the tourism industry, sharks being one of the main attractions of the atoll, but could greatly damage the functioning of the reef trophic web, naturally dominated by sharks. One of the challenges of protecting the natural values of the atoll will be the monitoring and enforcement of illegal fishing activities.

4.b.(iii) Natural disasters and risk preparedness

Bikini Atoll only experiences the occasional storm, as the Marshall Islands rarely experiences typhoons. The entire area of the Marshall Islands is very geologically stable and does not experience earthquakes. With climate change, there is an expectation of increased incidence of storm surges, but it is unlikely these would significantly affect the residential quarters on the leeward side of Bikini Island.

4.b.(iv) Visitor/tourism pressures

The current and expected future levels of tourism to Bikini Atoll remain very low, mainly due to the relative inaccessibility of the atoll. At present, there are less than 10 resident workers and no more than 12 tourists there at any one time. The total number of tourists per year historically has been 200-250. This might be expected to increase to a total of 400 with developments in tourism.

Divers on the sunken vessels pose some threat through damage to the vessels and unauthorized removal of artifacts. Two other activities available on Bikini are diving and snorkeling of the reef, and sport fishing. Both of these activities will have negligible impact on Bikini, again due to the low numbers. General movement of visitors walking or driving on the islands does not impact the site due to the highly disturbed nature of the terrestrial environment.

4.b.(v) Number of inhabitants within the property and the buffer zone

Estimated population located within:

Area of nominated property 25

Buffer zone N/A

Total 25

Year 2008

Part 5. Protection and Management of the Property

5.a Ownership

As in the rest of the Marshall Islands, land on Bikini Atoll is held under customary tenure through traditional clan relationships. Land is divided into parcels, called 'weto', under specific customary ownership. Bikini Atoll has a recognized 'Iroij' or chief, and each parcel of land also has 'Alaps' (caretakers of the land) and 'Dri-jerbal' (workers).

Under Marshall Islands law, all marine areas (lagoon and ocean) below the mean high water mark are legally owned by the people of the Marshall Islands, through the Government of the Marshall Islands, with the recognition of traditional and customary rights of landowner, clan and municipality to control the use of and materials in marine areas (Public Lands and Resources Act, 1996).

Local governments have the power to make any ordinances over the area of local government jurisdiction, so long as they are not inconsistent with any other legislative instrument that has the force of law in the Marshall Islands (including regulations from national agencies but not including other municipal ordinances). local government jurisdiction is to a distance of 5 miles from the mean low water line (Constitution of the Republic of the Marshall Islands). In effect, this means that the ownership and control of resources in Bikini Atoll comes under both customary landowners, and the Kili-Bikini-Ejit Local Government.

All rights, title and interest to the ships sunk by the nuclear tests in 1946 in Bikini Atoll's lagoon were transferred from the Government of the United States to the people of Bikini under Section 177 of the Compact of Free Association of 1985. This agreement is significant because it is the only place in the world where the United States has ceded its rights to its sunken naval vessels (Agreement Between the Government of the United States and the Government of the Marshall Islands for the Implementation of Section 177 of the Compact of Free Association, Article VI, 1985).

5.b Protective designation

Legislation, regulations and ordinances have been established at national and local level to ensure the legal protection of the artifacts and natural environment at Bikini Atoll.

5.b.(i) Protection of historic and cultural resources

The property currently has a high degree of protection through local ordinances and strictly controlled access.

The Historic and Cultural Preservation Act (1991) and its subsidiary regulations protect historic and cultural resources including governing access to submerged resources, the export of historic and cultural artifacts and control over land modification activities. The act provides for fines of up $10,000 or six months imprisonment for violations (The Historic and Cultural Preservation Act: Title 45, Ch 2, 1991; Regulations Governing The Taking And Export Of Artifacts, 1991; Regulations Governing Access To Prehistoric And Historic Submerged Resources, 1991; Regulations Governing Land Modification Activities, 1991).

In addition, Kili-Bikini-Ejit Local Government established ordinances in 1988 prohibiting entry to Bikini Atoll or diving on ships without a permit issued by KBE Local Government, and prohibiting removal of any object from Bikini lagoon (Ordinance No. 14-1988). These were updated in 1996 to additionally require that all divers be accompanied by the official Bikini dive operation (Ordinance No. 2-1996). All divers and yachts visiting Bikini Atoll are required to gain permission from KBE Local Government (through the Tourism Manager) and to sign a liability waiver confirming that they understand their responsibilities (Yacht Liability Waiver, 2008).

5.b.(ii) Protection of biological resources

Bikini has a high level of biodiversity protection, based on a decree (July 30, 1997) from the KBE Local Government that it is illegal to fish for sharks or turtles in the lagoon, or to use gill nets or throw nets within the lagoon area. All bird habitats are preserved by this same decree. All fishing around the area of the sunken ships is prohibited. Additionally, at national level, licensed pelagic fishing vessels are prohibited from fishing within the 12 nautical mile territorial seas of any atoll.

5.c Means of implementing protective measures

Access to Bikini is restricted to recreation and tourism visitors, and to scientific survey teams. All people wishing to visit Bikini by aircraft must obtain prior permission from the Kili-Bikini-Ejit Local Government through an established permitting procedure.

Divers on the sunken vessels must be accompanied by a diver employed by Bikini. Divers that visit Bikini are usually very experienced and well-certified to dive on, and to penetrate, the sunken vessels without causing damage. Divers are required to sign waivers and are prohibited from removing artifacts from the ships. This may be enforced by bag checks upon departure. Yachts are able to visit Bikini but must gain permissions from Bikini Atoll Local Government, and are not permitted to dive the wrecks unless accompanied by a diver employed by Bikini.

Nationally, licensed fishing boats are required to be part of the Vessel Monitoring System (VMS), which allows the Marshall Islands Marine Resources Authority (MIMRA) to track the position of vessels and if they are found within 12 nautical miles of any atoll, to pass this information on to the Sea Patrol operation (an arm of the Marshall Islands Police) and support apprehension and prosecution for any illegal fishing.

When the dive operation is running on Bikini, staff there can observe unauthorized vessels in or near the lagoon. They can then approach the vessel using one of the boats on Bikini Atoll and collect evidence, such as photos, to support prosecution. They can radio the Marshall Islands Sea Patrol to pursue the unauthorized vessel. Bikini Atoll has successfully pursued one prosecution of an unauthorized vessel fishing for shark fins in 2002.

All of these protective measures are more difficult to implement when the regular dive operation is not running. An option is being developed to install a radar system at the western end of the atoll to notify staff on Bikini Island of any unauthorized vessel in the vicinity, which can then be reported to Sea Patrol.

5.d Existing plans related to municipality and region in which the proposed property is located

No existing relevant plans.

5.e Property management plan or other management system

Bikini Atoll Conservation Management Plan—DRAFT. (See Annex 3).

5.f Sources and levels of finance

The Bikini Atoll Tourism Operation is financed from three different sources. The maintenance, fuel costs, and some of the operations costs of the tourism operation are funded from the Resettlement Trust Fund for the People of Bikini (US Public Law 100-446). For the calendar year 2007 the amount funded by the trust was $624,000. The second source of funding is from the revenues of the tourism operations. In calendar year 2007, the gross revenue from the operation amounted to $529,062. The third and final source of revenue is from the US Department of Energy for fuel and water charges for the operation of their field station that amounted to $32,202 in 2007. As the day-to-day aspects of conservation and management of the site will be integrated with the tourism operation, this funding should cover the infrastructure, operating costs and personnel.

Finance for conservation assessments and interpretation of the site will need to be sought externally, in the form of international assistance. It is expected that international expert partners will assist in project development and fundraising to achieve the necessary financing.

5.g Sources of expertise and training in conservation and management techniques

The Kili-Bikini-Ejit Local Government has had the benefit of internationally renowned expertise in the assessment and management of both cultural and natural resources of Bikini Atoll, and is in the process of developing new partnerships to enhance this capacity.

James P. Delgado is the President of the Institute of Nautical Archaeology and one of the world's leading maritime archaeologists. He is the author or editor of some thirty books, including the *British Museum Encyclopaedia of Underwater and Maritime Archaeology* and host of the international TV documentary series *The Sea Hunters*. Since leading the initial resource assessment of the sunken vessels at Bikini, Delgado has advised Bikini Atoll on management and interpretation of these artifacts.

William Jeffery of James Cook University and Vickie Richards of the Western Australian Maritime Museum

recently carried out a state of conservation assessment of the sunken vessels in Chuuk Lagoon, in the Federated States of Micronesia. Bikini Atoll is in the early stages of developing a partnership with these experts and their institutions to carry out a baseline assessment of the state of conservation and establish a monitoring protocol.

Charles D. Beeker is the Director of the Office of Underwater Science at Indiana University. This group's focus is on the research and interpretation of submerged cultural and biological resources emphasizing park development and sustainable use. Bikini Atoll is in the early stages of developing a partnership with Indiana University to develop interpretation and field guides for the artifacts at Bikini, and to enhance the management of visitation to the site.

Zoe Richards of James Cook University, Maria Beger of the University of Queensland and Silvia Pinca of the Secretariat of the Pacific Community, form a core of marine biologists who have carried out biological resources assessments on several atolls in the Marshall Islands, and who have made recommendations for the conservation management of these sites. These experts conducted a biological survey of Bikini Atoll in 2002 and have an established partnership with Bikini Atoll.

5.h Visitor facilities and statistics

5.h.(i) Organized diving tourism

The main visitors to Bikini Atoll over the past several years have been as part of the dive tourism program run by Bikini Atoll Divers, a business owned by the Kili-Bikini-Ejit Local Government. To date, tourism on Bikini has mainly been focused on the sunken vessels which are considered one of the premier SCUBA diving experiences in the world (see http://www.bikiniatoll.com/divetour2.html for articles, reviews and testimonials of the tourism-diving experience of Bikini Atoll). While the vessels sunk during Operation Crossroads in 1946 are the premier attraction, there is also the opportunity to go sport fishing and to dive or snorkel some of the beautiful coral reef, or to walk on and explore some of the islands.

The current and expected future levels of tourism to Bikini Atoll remain very low, mainly due to the relative inaccessibility of the atoll and the associated high costs. In the history of the tourism operation, there have been no more than 12 tourists on Bikini at any one time. The total number of tourists per year has been between 200 and 250.

With the difficulties encountered in air travel within the Marshall Islands resulting in the stranding of visitors on a couple of occasions in 2007 and 2008, the Kili-Bikini-Ejit Local Government has reluctantly closed the organized tour operation on Bikini until the domestic airline problems are resolved. The facilities described below are maintained on Bikini until the dive operation can resume.

It is understood that World Heritage listing has the potential to greatly increase tourism interest in Bikini; however, tourism will continue to be constrained by transport issues. Thus, even with World Heritage listing the number of tourists might be expected to increase to a total of only 400 per year.

Diving facilities: A typical visit to Bikini over a week includes 12 deep decompression dives—these are dives that are below normal recreational diving limits and require the use of staged decompression stops prior to surfacing. Facilities for divers include tanks, two dive boats, a tank filling station for both air and nitrox (decompression gas), oxygen generation equipment, and dive equipment repair shop. Decompression stops are facilitated by a decompression station that is hung from the dive boat.

Figure 52. One of Bikini's boats in preparation for a dive on the sunken ships. (Bikini Atoll Divers, n.d.)

Accommodation and dining: Visitors to Bikini sleep in private, air-conditioned comfort with 24 hour power and hot running water, on one of the most beautiful beaches in the Pacific. A dining hall provides an "all you can eat" buffet style selection for breakfast, lunch and dinner.

Figure 53. Bikini Atoll accommodation on one of the most beautiful beaches in the Pacific (J. Niedenthal, 1996)

Interpretation and explanation: Over the course of the week-long dive tour of Bikini historical documentary films are shown, complete briefings about each of the ships and their respective histories are given, and there is a tour of the island and the atoll. The Bikinians feel this to be important because this allows their story to be taken away by tourists and retold to their families and friends. In short, the tourism program helps perpetuate a story the islanders want the world to remember. Before each dive the divemasters give a full briefing about the vessel's history and unique characteristics, and a comprehensive dive plan. Most visitors to Bikini access the official website, http://www.bikiniatoll.com/ and its wealth of information before making the journey to Bikini.

Figure 54. A breifing is given before each dive giving the history of the sunken ships (Bikini Atoll Divers, n.d.)

Visiting yachts and private vessels: Yachts and private vessels may visit Bikini, as long as they meet requirements for safety and are able to manage decompression diving. All boats wishing to visit must obtain a permit from the Kili-Bikini-Ejit Local Government.

5.i Policies and programmes related to the presentation and promotion of the property

Bikini Atoll Website: Aside from the on-site interpretation program run as part of the dive operation, the Bikini Atoll official website http://www.bikiniatoll.com/ presents detailed information about the site, tourism, the history of the atoll and the people of Bikini.

Marshall Islands Peace Museum: A project is under development to establish a Peace Museum on Majuro that would present the nuclear history of the Marshall Islands in order to promote the cause of world peace.

Youth Conservation Theatre Program: A proposal has been developed for a travelling youth theatre program to promote the natural and cultural values of the Marshall Islands with a particular focus on the values of the proposed World Heritage sites, Bikini and Ailinginae. Significant start-up funding and technical assistance is required for this program and is being sought.

5.j Staffing levels (professional, technical, maintenance)

A small number of professional and technical staff are employed for the management of the Bikini Atoll site and the dive operation. When the organized dive tourism is operational, the following job roles are in place:

Staff Position	Location	Number
Tourism Manager	Majuro	1
Tourism Assistant and Reservation Manager	Majuro	1
Head Divemaster - Bikini	Bikini	1
Assistant Divemasters- Bikini	Bikini	2
Dive guides	Bikini	2
Cook, housekeeping	Bikini	3
Maintenance	Bikini	6

Responsibilities for monitoring the state of conservation, and for surveillance of the atoll for violations of any rules will be assigned to existing staff roles.

Figure 55. Bikini Island sunset (E. Hanauer, 2006)

Part 6. Monitoring

6.a Key indicators for measuring State of Conservation

6.a.(i) Cultural resources

The state of conservation of the site mainly refers to the condition of the sunken vessels and the few buildings remaining as part of the landscape. Bikini Atoll is developing a program in partnership with maritime archaeologists and conservation scientists at James Cook University, and at the Western Australian Maritime Museum. This program will conduct a baseline assessment of the state of conservation of the vessels and buildings, and develop a protocol and indicators for a regular assessment of the state of conservation of these artifacts. Local staff divers of Bikini Atoll will be trained in how to conduct a regular state of conservation assessment. Monitoring protocol will likely involve taking photographs at fixed monitoring points and comparing these photographs over the years.

Other features of the site that contribute to the overall character of an abandoned nuclear test site include the rows of coconut trees and the generally low level of buildings and construction. The *Bikini Atoll Conservation Management Plan* outlines the need to assess any proposed demolition, construction, land-clearing, earthmoving etc. in light of its impact on the attributes of Bikini Atoll as a former nuclear test site. Thus an indicator for the state of conservation of the site will relate to the presence or absence of these activities and the impact of such activities on artifacts of the testing era and on the overall landscape.

6.a.(ii) Natural resources

A team of scientists carried out a baseline survey of the marine environment Bikini Atoll in 2002, establishing a set of indicators for monitoring the condition of the marine environment. These indicators include:

- Coral and fish biodiversity: presence/absence and semi-qualitative abundance in timed swims
- Macroalgae target species and genera semi-quantitative abundance
- Percent cover of substrate, coral and algae
- Reef health including counts of *Acanthaster planci* (crown-of-thorn starfish), dead and bleached coral
- Counts of target species of invertebrates
- Fish size and abundance of commercially and ecologically important species

While the survey established a baseline in 2002, there is no ongoing program of monitoring due to lack of available resources. There is a need to carry out baseline assessment of avifauna and vegetation on the island and to develop monitoring indicators.

6.b Administrative arrangements for monitoring property

Responsible Agency:

Jack Niedenthal, Trust Liaison for the People of Bikini

Kili-Bikini-Ejit Local Government

Post Office Box 1096

Republic of the Marshall Islands, MH 96960

Phone: +692 625-3177

Fax: +692 625-3330

Email: bikini@ntamar.net

Website: www.bikiniatoll.com

6.c Results of previous reporting exercises

The most recent archeological assessment occurred in 1991 (Delgado et al., 1991), revealing the historical and archaeological significance of the artifacts at Bikini Atoll, and leading to the development of interpretation materials and the opening of Bikini Atoll to dive tourism. The most recent assessment of the marine biodiversity (Pinca et al., 2002) revealed the remarkable recovery of the coral reef ecosystem at Bikini and the impressive biodiversity, presence of threatened species and health of the marine environment.

Part 7. Documentation

7.a Photographs, slides, image inventory and authorization table and other audiovisual materials

7.a.(i) List of multi-media items accompanying nomination in CD/ DVD format

Maps of the site and buffer zone in PDF and JPEG format (Annex 1).

Images including photographs and artwork catalogued in table below (Annex 5).

Operation Crossroads Parts I and II [Motion Picture] (1946). (Annex 6).

Joint Task Force 7 Operation Castle Commander's Report. [Motion picture] (1954). (Annex 6).

Bikini: Forbidden Paradise [Motion picture] (1992). 30 copies on DVD included with submission of nomination to the World Heritage Centre (separate DVD).

7.a.(ii) Internet resources

The official Bikini Atoll website is at www.bikiniatoll.com. The website includes a wealth of information on the site, the history of the Bikinian people and of the nuclear testing, cultural significance of Bikini Atoll and information for tourists.

Many more resources related to Bikini Atoll and the nuclear testing on Bikini can be found on the internet. The US Government and its various agencies have made many documents, images and photos available on the internet through publicly available and searchable archives. Other groups interested in the history of nuclear weapons, or the prevention of their use in the future also have material on Bikini Atoll. These resources can be best located through a "Google" search.

7.a.(iii) Image Inventory and Photograph and Audiovisual Authorization Form

Id. No	Format (slide/ print/ video)	Caption	Date of Photo (mo/yr)	Photographer /Director of the video	Copyright owner (if different than photographer/ director of video)	Contact details of copyright owner(Name, address, tel/fax, and email)	Non exclusive cession of rights
001	jpeg	Bikinian Outrigger	1946	US Government	Public domain		Yes
002	jpeg	Coconut trees- before testing	1946	US Government	Public domain		Yes
003	jpeg	Traditional house	1946	US Government	Public domain		Yes
004	jpeg	King Juda	1946	US Government	Public domain		Yes
005	jpeg	Bikinian Woman and Family pre-1946	1946	US Government	Public domain		Yes
007	jpeg	Women carrying- leaving Bikini	1946	US Government	Public domain		Yes
008	jpeg	Leaving Bikini 1946	1946	US Government	Public domain		Yes
009	jpeg	Bikinian Church	1946	US Government	Public domain		Yes
010	jpeg	Live Coral 1946	1946	US Government	Public domain		Yes
011	jpeg	Giant Clam 1946	1946	US Government	Public domain		Yes
012	jpeg	Filming of Wyatt and Juda with Bikinians	March 6, 1946	US Government	Public domain		Yes
013	jpeg	Church	1946	US Government	Public domain		Yes
014	jpeg	Canoe being loaded on ship	1946	US Government	Public domain		Yes
020	jpeg	Operation Crossroads- Able	July 1, 1946	US Government	Public domain		Yes
022	jpeg	Operation Crossroads-Baker	July 25, 1946	US Government	Public domain		Yes
023	jpeg	Operation Crossroads-Baker	July 25, 1946	US Government	Public domain		Yes
024	jpeg	Operation Crossroads-Baker	July 25, 1946	US Government	Public domain		Yes
025	jpeg	Operation Crossroads-Baker	July 25, 1946	US Government	Public domain		Yes
026	jpeg	Radio Bikini	June 1946	US Government	Public domain		Yes
027	jpeg	Saratoga going down	July 1946	US Government	Public domain		Yes
028	jpeg	Cleaning ship after crossroads	July 1946	US Government	Public domain		Yes
029	jpeg	Goats during Operation Crossroads	July 1946	US Government	Public domain		Yes
030	jpeg	Bravo explosion	March 1954	US Government	Public domain		Yes
031	jpeg	Bravo	March 1954	US Government	Public domain		Yes
032	jpeg	H-bomb from LIFE magazine	March 1954	Unknown	Time Inc.		No
036	jpeg	Castle Romeo	March 1954	US Government	Public domain	National Nuclear Security Administration / Nevada Site Office	Yes
040	jpeg	Bikinians' tent city on Kwajalein	n.d.	US Government	Public domain		Yes
051	jpeg	Resort on Bikini Island	1996	Jack Niedenthal		bikini@ntamar.net Post Office Box 1096 Marshall Islands, MH 96960 Phone: +692 625-3177	Yes

052	jpeg	Bunker	2006	Eric Hanauer		ehanauer@san.rr.com 7151 Rock Valley Court, San Diego CA 92122. Ph: +1 858 558-7278.	No
053	jpeg	Rows of coconut trees- aerial view	2008	Google Earth		For usage permission requests go to: http://www.google.com/permissions/geoguidelines.html	No
054	jpeg	Gazebo at resort	1998	Jack Niedenthal	-	As above	Yes
055	jpeg	Hammerhead dive boat	n.d.	unknown			No
056	jpeg	Bravo crater	2006	Eric Hanauer	-	As above	No
057	jpeg	Helmet on Saratoga	2006	Eric Hanauer	-	As above	No
059	jpeg	Saratoga bridge	2006	Eric Hanauer	-	As above	No
060	jpeg	Saratoga elevation drawing	1991	L. Nordby and J. Livingston/ US Government	Public domain		Yes
061	jpeg	Saratoga island	2006	Eric Hanauer	-	As above	No
062	jpeg	Rows of coconut trees	2002	Jeffery Sasha Davis	-	sashadavis@yahoo.com	No
064	jpeg	Bravo crater- Google Earth	2008	Google Earth	-	For usage permission requests go to: http://www.google.com/permissions/geoguidelines.html	No
065	jpeg	Sunset on Bikini	2006	Eric Hanauer	-	As above	No
066	jpeg	Apogon conning tower	2006	Eric Hanauer	-	As above	No
067	gif	Bikinian Flag	?		KBE Local Government	As above	Yes
M1	mpeg	Operation Crossroads Part I	1946	Handy (Jam) Organization (Producer)	Public Domain - Creative Commons License	from http://www.archive.org/details/Operatio1946	Yes
M2	mpeg	Operation Crossroads Part II	1946	Handy (Jam) Organization (Producer)	Public Domain - Creative Commons License	http://www.archive.org/details/Operatio1946_2	Yes

7.b Texts relating to protective designation and management of property

Bikini Atoll Conservation Management Plan- DRAFT (as of December 2008). A management plan under development to protect and conserve the site, and to interpret and communicate the heritage values of Bikini Atoll. Annex 3.

Marine Resource Ordinance (Dated July 28, 1997): Ordinance passed in 1997 with the object of conserving the marine and wildlife resources of Bikini Atoll. Annexed on DVD.

Ordinance No. 14-1988 (October 8, 1988): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was created soon after the ships were made the property of the Bikinians under Section 177 of the Compact of Free Association in 1986. Annexed on DVD.

Ordinance No. 2-1996 (May 30, 1996): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was developed soon after the establishment of a commercial dive operation on Bikini Atoll and required that all divers be supervised by the authorized dive operation. Annexed on DVD.

Liability Release Form and Express Assumption of Risk for Diving at Bikini Atoll: All tourist divers at Bikini are required to sign a liability release form that also informs them of the rules regarding removal of artifacts. During times when the dive operation is active, each diver is required to sign this form. Visiting yachts are required to sign this form also. Annexed on DVD.

The Historic and Cultural Preservation Act (Title 45, Ch 2) (1991) Available at http://marshall.csu.edu.au/Marshalls/html/RMILAW/HPA1991.html

Regulations Governing The Taking And Export Of Artifacts 1991 Available at http://marshall.csu.edu.au/Marshalls/html/RMILAW/RMI_HPO_Law.html

Regulations Governing Access To Prehistoric And Historic Submerged Resources 1991 Available at http://marshall.csu.edu.au/Marshalls/html/RMILAW/RMI_HPO_Law.html

Regulations Governing Land Modification Activities 1991 Available at http://marshall.csu.edu.au/Marshalls/html/RMILAW/RMI_HPO_Law.html

7.c Form and date of most recent records or inventory of property

Submerged Cultural Resources Survey, 1991: The most recent assessment of the sunken vessels on Bikini Atoll was carried out in 1991 by a US National Park Service Team. The assessment was carefully documented in a report and an illustrated book, as listed below.

Delgado, J.P., Lenihan, D.J, & Murphy, L.F. (1991). *The Archaeology of the Atomic Bomb: A Submerged Cultural Resources Assessment of the Sunken Fleet of Operation Crossroads at Bikini and Kwajalein Atoll Lagoons, Republic of the Marshall Islands*. Santa Fe, N.M.: US Department of the Interior, National Park Service, Submerged Cultural Resources Unit. Note: an online version can be found at http://www.nps.gov/history/history/online_books/swcrc/37/contents.htm

Delgado, J. P. (1996). *Ghost Fleet: the Sunken Ships of Bikini Atoll.* Honolulu: University of Hawaii Press.

Marine Biodiversity Survey, 2002: A survey of the health and biodiversity of marine life was carried out by a team of scientists on Bikini in 2002. The report was published in print form only, a copy of which is held in the Kili-Bikini-Ejit Local Government office.

Pinca, S., Beger., M., Richards, Z., & Peterson, E. (2002). *Coral Reef Biodiversity: Community-based Assessment and Conservation Planning in the Marshall Islands: Baseline surveys, capacity building and natural protection and management of coral reefs of the atolls of Bikini and Rongelap*. Report to the Rongelap Government, Republic of the Marshall Islands.

Radiological Surveys, ongoing: The last complete survey was done by the RMI by Dr. Steve Simon. This was the Marshall Islands Radiological Survey of Bikini Atoll, part of the Marshall Islands Nationwide Radiological Study in February of 1995. All of the scientific findings regarding Bikini Atoll were reviewed by a panel of scientists put together by the International Atomic Energy Agency (IAEA) in 1996 and released in 1998. Lawrence Livermore National Laboratories, in conjunction with the US Department of Energy, has ongoing studies monitoring the environment of Bikini Atoll. This includes soil and water sampling to measure the rate of radiological decay. A 2004 report provides an overview of the history and current radiological conditions at Bikini.

Lokan, K., Gonzalez, A.J., Linsley, G., Robinson, W. , Simon, S.L., Gnugnoli, G., Stegnar, P. & Delves, D. reviewed by G. Webb and G. C. Mason. (1998). *Radiological Conditions at Bikini Atoll: Prospects for Resettlement, Report of an Advisory Group of the International Atomic Energy Agency*. Vienna, Austria: IAEA.

Hamilton, T.F & Robison, W.L. (2004). *Overview of Radiological Conditions on Bikini Atoll UCRL-MI-208228.* Livermore, CA: Lawrence Livermore Laboratory, University of California.

7.d Address where inventory, records and archives are held

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Website: www.bikiniatoll.com

7.e Bibliography

The following Bibliography is a list of references used in the preparation of this nomination.

Books

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Danielsson, B. & Danielsson, M. (1986). *Poisoned Reign: French nuclear colonialism in the Pacific*. Melbourne: Penguin.

DeGroot., G. J. (2006). *The Bomb: A Life*. Cambridge, Massachusetts: Harvard University Press.

Delgado, J.P., Lenihan, D.J. & Murphy, L.F. (1991). *The Archaeology of the Atomic Bomb: A Submerged Cultural Resources Assessment of the Sunken Fleet of Operation Crossroads at Bikini and Kwajalein Atoll Lagoons, Republic of the Marshall Islands*. Santa Fe, N.M: US Department of the Interior, National Park Service, Submerged Cultural Resources Unit. Note: an online version can be found at http://www.nps.gov/history/history/online_books/swcrc/37/contents.htm

Delgado, J. P. (1996). *Ghost Fleet: The Sunken Ships of Bikini Atoll*. Honolulu, Hawai'i: University of Hawai'i Press.

Dibblin, J. (1990). *Day of Two Suns: US Nuclear Testing and the Pacific Islanders*. New York: New Amsterdam Books.

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Kili-Bikini-Ejit Local Government Yacht Liability Waiver, 2008

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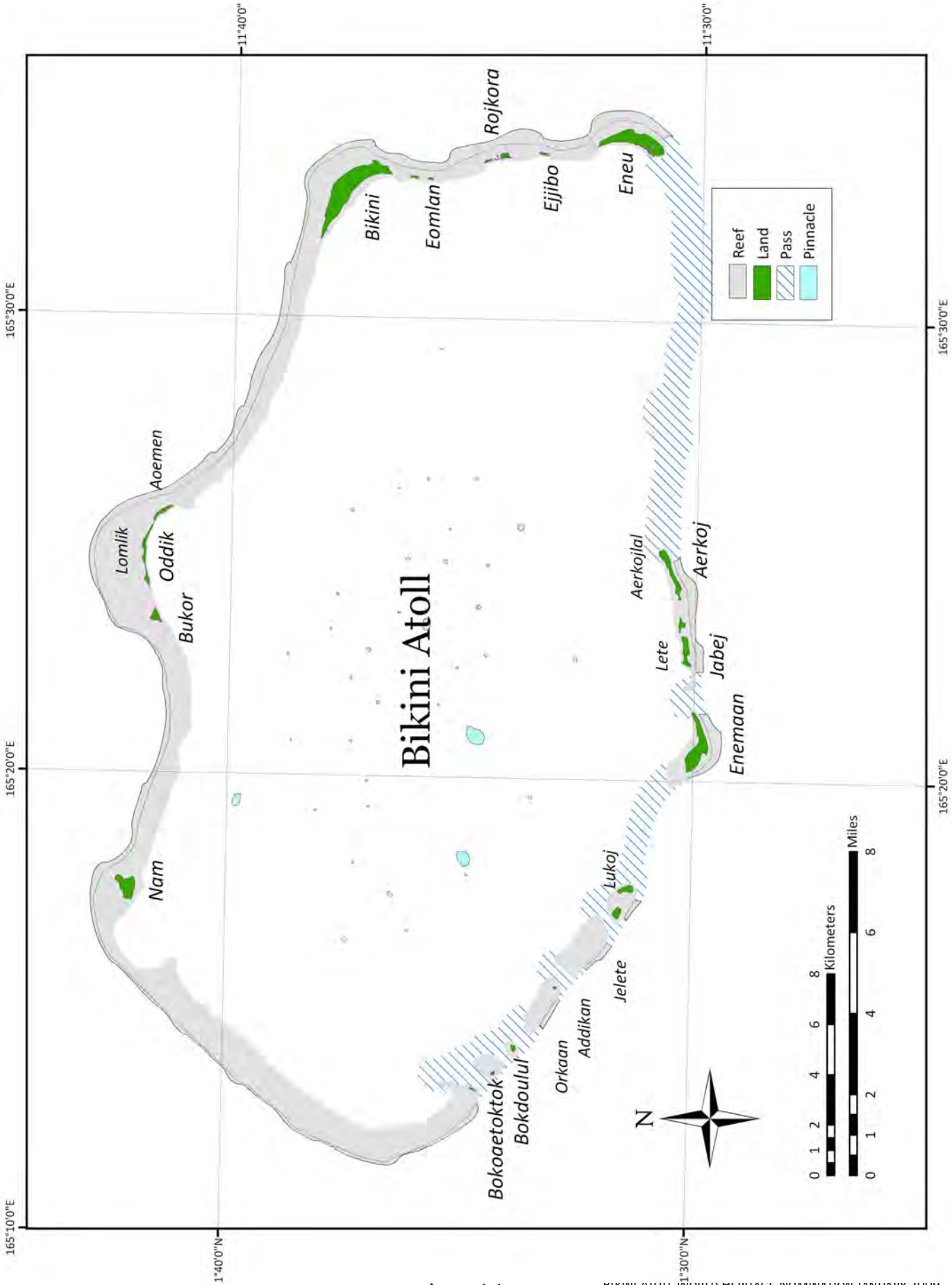
"Remember your humanity, and forget the rest."

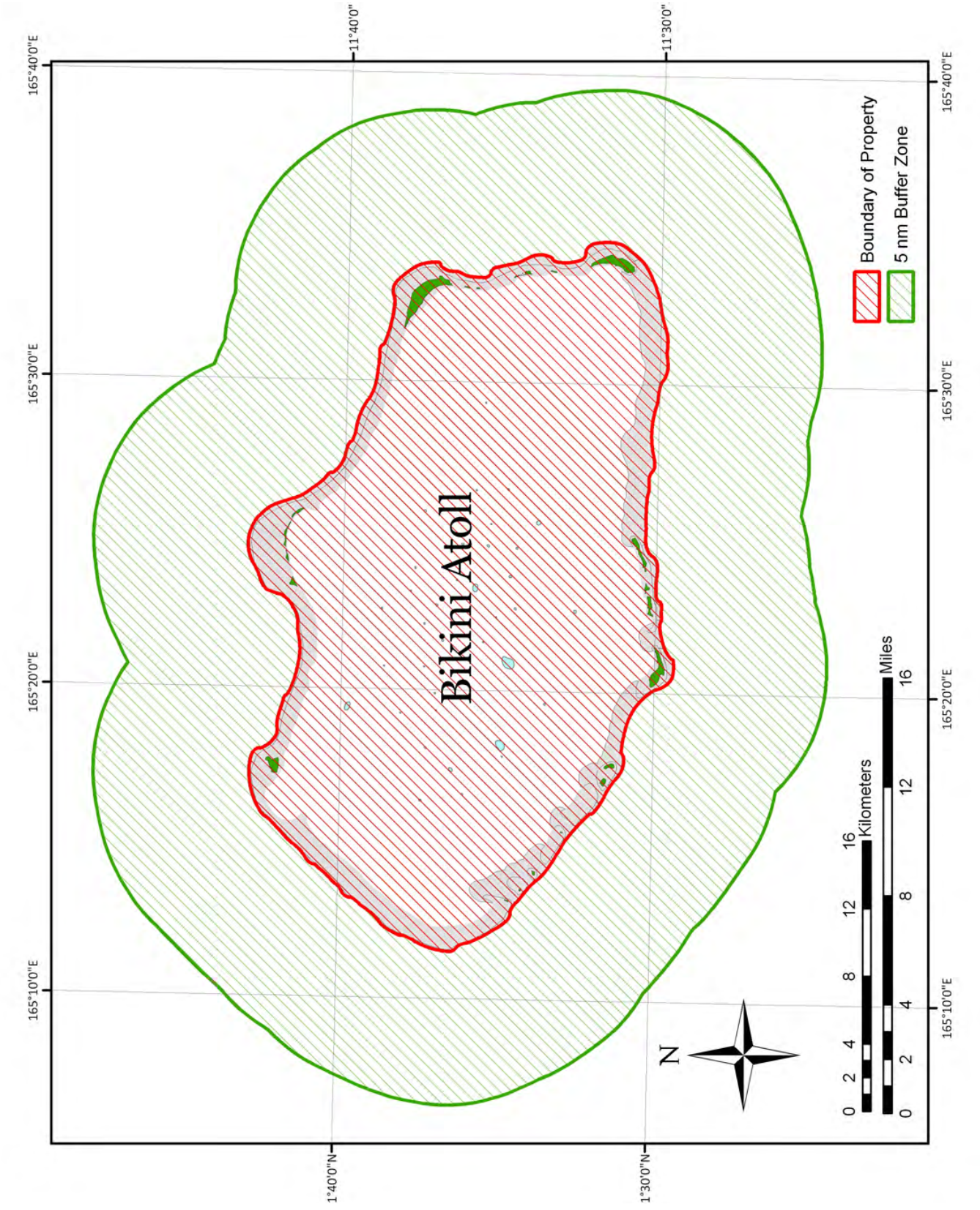
Annex 1 – Maps

(A4 Size)

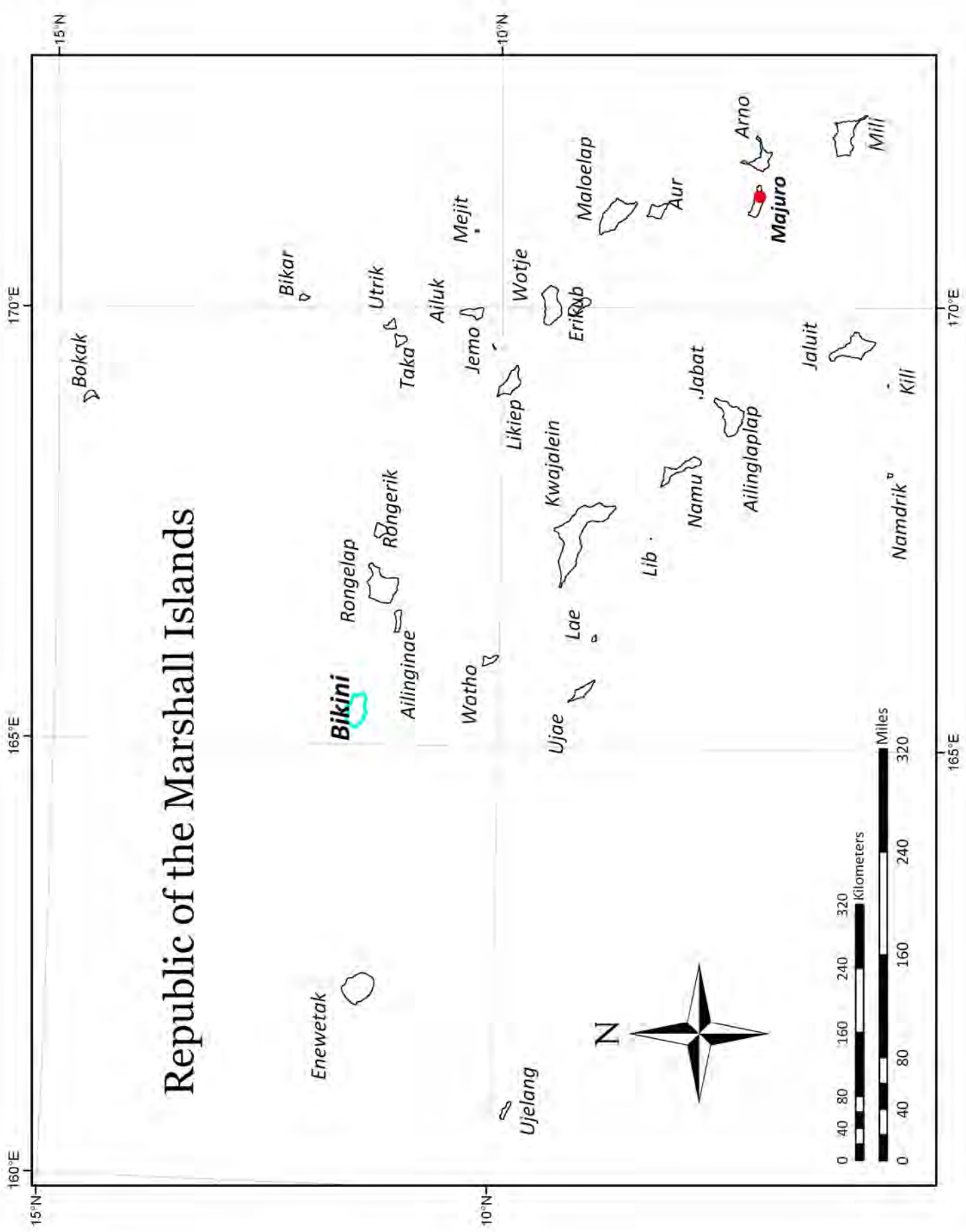
(i) Map of Bikini Atoll showing reef and land



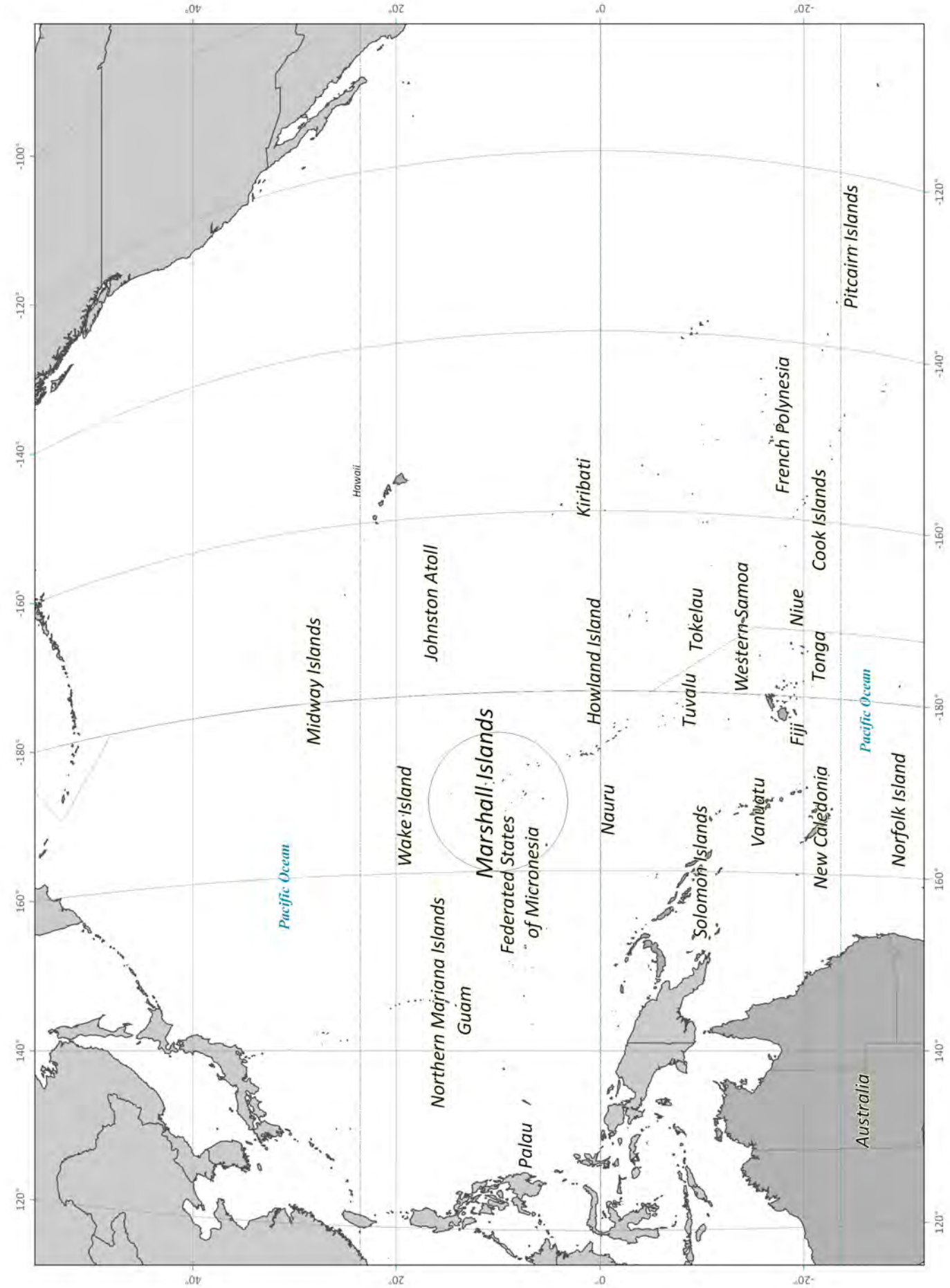
(ii) Map of Bikini Atoll showing boundary of property (red) and of buffer zone (green)



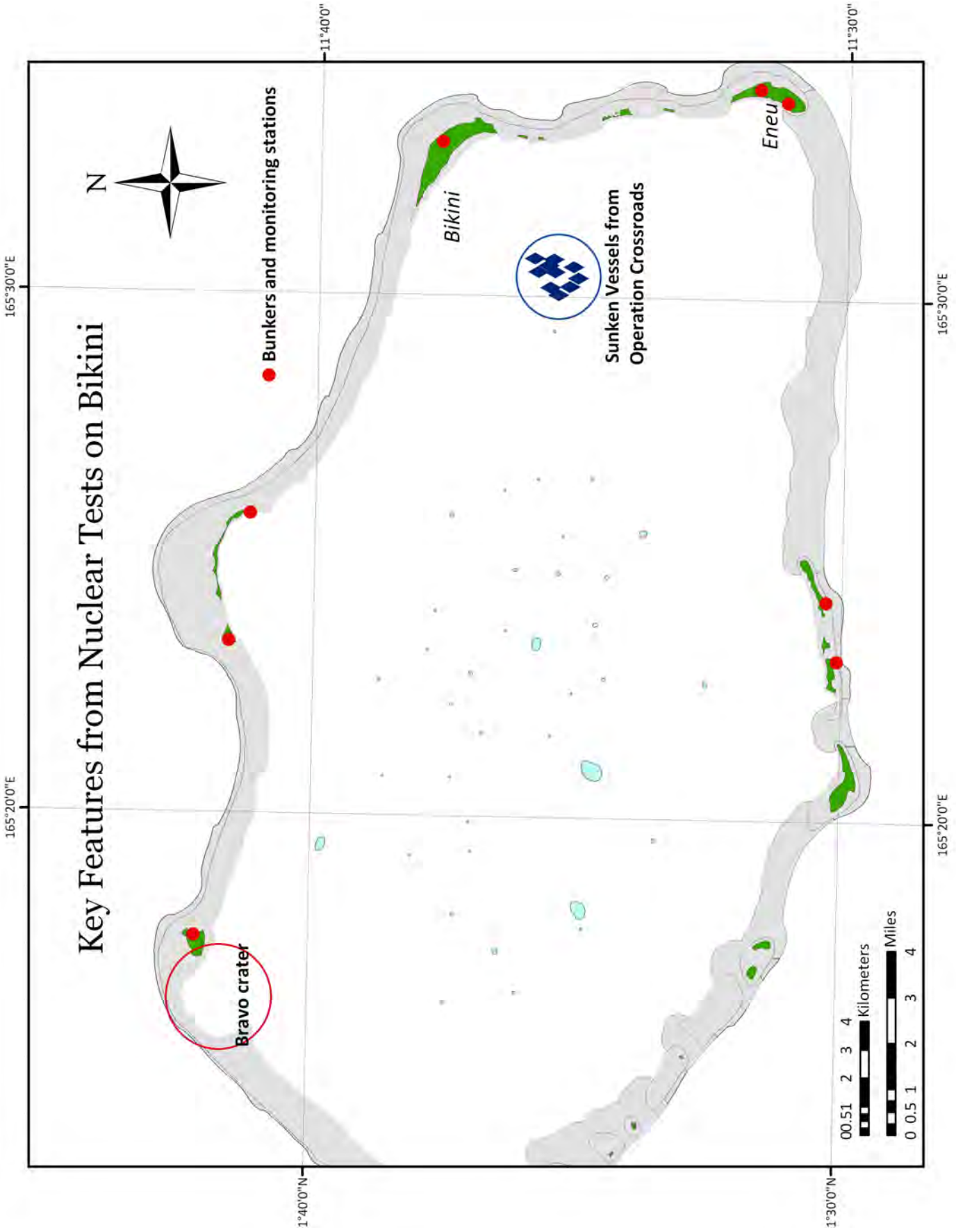
(iii) Map showing the location of Bikini Atoll within the Marshall Islands



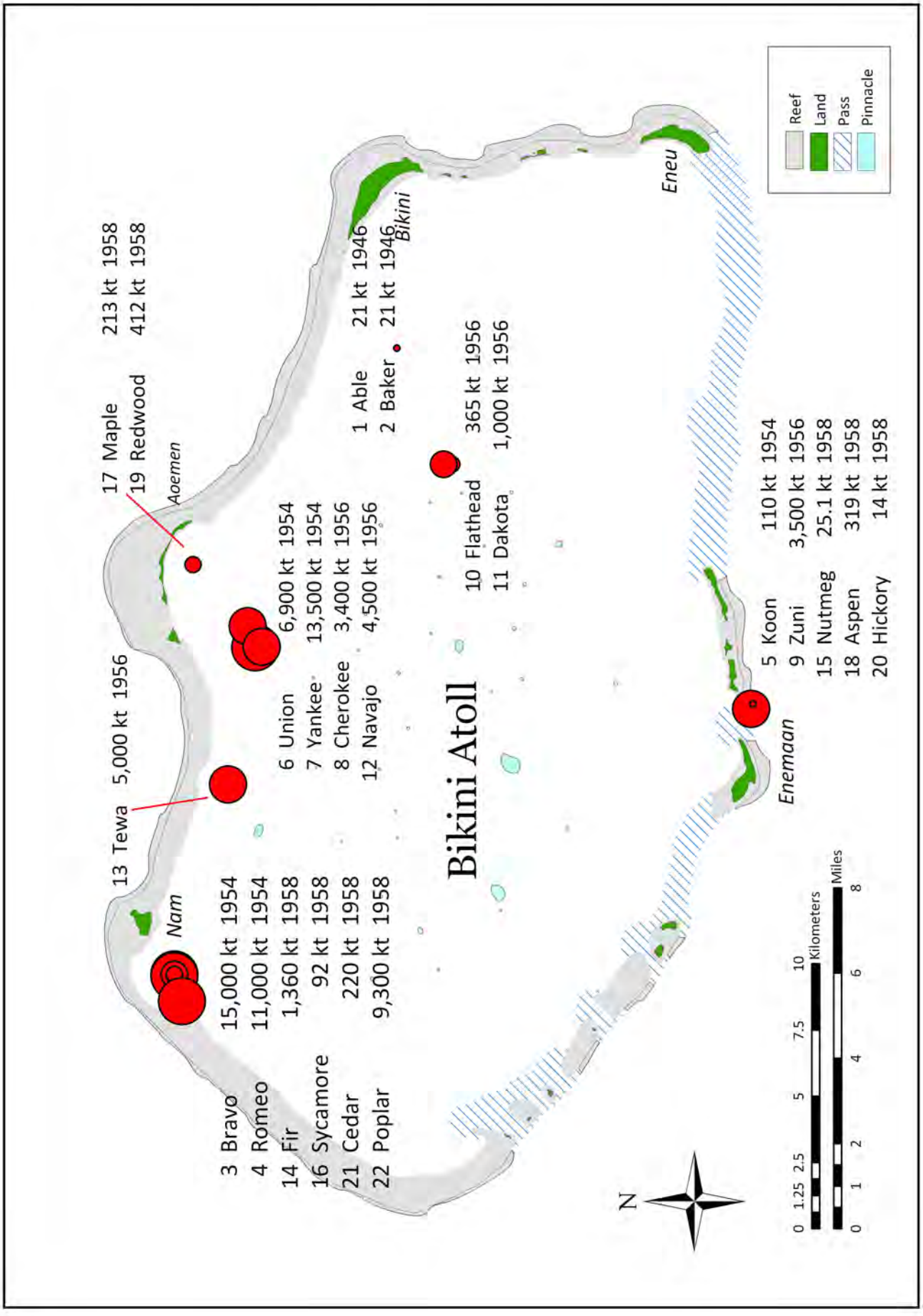
(iv) Map showing location of the Marshall Islands in the Pacific region



(v) Map showing locations of key features from nuclear tests on Bikini Atoll



(vi) Map showing locations of nuclear detonations on Bikini Atoll



Annex 2 – A Brief Chronology of Nuclear Testing in the Marshall Islands

Nuclear Nomads –A Brief Chronology of Marshallese in the Nuclear Age

(Source: Micronitor, 1996; Niedenthal, 2002; Weisgall, 1994; and Dibblin, 1990)

1946	**March** US Navy moves 167 Bikinians to Rongerik Atoll, 200 km (125 miles) to the east, to make way for the first peace-time nuclear tests. Rongerik has been previously uninhabited due to a lack of food and water resources, and a traditional belief that it is a home for an evil spirit that contaminated the fish. As the food supply on Rongerik quickly runs out, the Bikinians begin to suffer from starvation and fish poisoning due to the lack of edible fish in the lagoon. Within two months after their arrival they ask U.S. officials to move them back to Bikini. **May** As a safety measure, islanders from Enewetak, Rongelap and Wotho atolls are relocated for the duration of Operation Crossroads. **July** Operation Crossroads is conducted with "Able" and "Baker" tests—both the size of the Hiroshima "Little Boy" weapon.
1947	**July** The Marshall Islands and the rest of Micronesia became a United Nations strategic Trust Territory administered by the United States. Among other obligations, the US undertakes to "promote the economic advancement and self-sufficiency of the inhabitants, and to this end...protect the inhabitants against the loss of their lands and resources." A medical officer from the U.S. visits the island finding the Bikinian people to be suffering from malnutrition. A team of U.S. investigators determined in the fall, after a visit to Rongerik, that the island had inadequate supplies of food and water and that the Bikini people should be moved from Rongerik without delay. **November** The Bikinians work with Navy Seabees to construct a new community on Ujelang Atoll. **December** The US Navy selects Enewetak Atoll for a second series of nuclear tests and immediately moves the people of Enewetak to Ujelang Atoll, leaving the Bikinians again without their chosen home.
1948	**March** On the verge of starvation, the Bikinians are moved from Rongerik Atoll to a temporary camp on Kwajalein while a new home is found for them. **April** Operation Sandstone begins on Enewetak Atoll. **June** Bikinians choose Kili Island—a single island with no lagoon or protected anchorage—in the southern Marshalls because the island is not ruled by a paramount king, or iroij, and is uninhabited. This choice ultimately dooms their traditional diet and lifestyle, which were both based on lagoon fishing. **November** The Bikinian people are moved to Kili Island. Most of the year Kili is surrounded by 10 to 20 foot waves that deny the islanders of the opportunity to fish and sail their canoes. After a short time on Kili--a place that the islanders believe was once an ancient burial ground for kings and therefore overwrought with spiritual influence--they began to refer to it as a "prison" island. Because the island does not produce enough local food for the Bikinians to eat, the importation of USDA rice and canned goods, and also food bought with their supplemental income, has become an absolute necessity for their survival. In the following years rough seas and infrequent visits by the field trip ships caused food supplies to run critically low many times on the island and once even required an airdrop of emergency food rations.
1951	**April** Operation Greenhouse is conducted at Enewetak
1952	**November** Operation Ivy begins at Enewetak, and includes the first test of a staged hydrogen device. The Mike test vaporizes Elugelap Island, leaving a vast crater. The King test contaminates Ujelang Atoll, over 200km away with radioactive fallout.

1954	**1 March 1954** Bravo is detonated at Bikini, despite winds blowing towards Rongelap, Rongerik, Utrik and other inhabited atolls. At 15 megatons, Bravo is 1,000 times the strength of the Hiroshima bomb. Rongelap islanders are evacuated 48 hours later, and Utrik is evacuated 72 hours later. Both groups were taken to Kwajalein for observation where they suffered radiation illness and burns. The *Daigo Fukuryū-Maru* (Lucky Dragon #5) returned to Japan with its crew also suffering from radiation illness. **April** Rongelap, Rongerik, Ailinginae are again contaminated from the Union test at Bikini. **May** These atolls as well as Bikar are again showered with fallout from the Yankee test at Bikini. The Rongelap people are moved to Ejit Island in Majuro as Rongelap is still highly contaminated. The people of Utrik are told their atoll is safe, and are returned and told not to eat the local food.
1956	**May** Operation Redwing begins at Enewetak and Bikini.
1957	**July** Rongelap is now declared safe for rehabitation and the people of Rongelap return to their home. Brookhaven National Laboratory Scientists report that: “Even though the radioactive contamination of Rongelap is considered perfectly safe for human habitation, the levels of activity are higher than those found in other inhabited locations in the world. The habitation of these people on the island will afford most valuable ecological radiation data on human beings.”
1958	**May** Operation Hardtack, consisting of 32 nuclear tests is carried out on Enewetak and Bikini and continues until August. Ujelang, Ailinginae and Wotho Atolls are all exposed to fallout. In August, after exploding 23 nuclear devices on Bikini and 43 nuclear devices on Enewetak, the US announces that it is concluding atmospheric testing in the Pacific.
1963	The first thyroid tumours begin to appear among the Rongelap people exposed to the fallout from Bravo.
1968	**June** President Lyndon B. Johnson promises the 540 Bikinians living on Kili and other islands that they would now be able to return to their homeland. The President states that, "It is our goal to assist the people of Bikini to build, on these once desolated islands, a new and model community." He then ordered Bikini to be resettled "with all possible dispatch."
1969	**October** Bikini Atoll is declared safe for rehabitation by US officials.
1972	**October** The Bikini Council votes not to return the entire community to Bikini, but several families move back into newly built homes on Bikini Atoll.
1975	**June** Radiological monitoring at Bikini shows “higher levels of radioactivity than originally thought” and it “appears to be hotter or questionable as to safety”. August AEC surveys suggest groundwater is too radioactive for use and suggest prohibiting consumption of pandanus, breadfruit and coconut crabs.
1976	**July** A Brookhaven National Laboratory report shows that 69 percent of Rongelap people who were under 10 at the time of exposure to Bravo have developed thyroid tumours. Utrik people begin to show an even higher rate of thyroid cancer.

1977	**May** Nuclear cleanup on Enewetak begins. 100,000 cubic yards of radioactive soil and debris are dumped in a bomb crater on Runit Island, sealed with a cap of cement. **June** A Department of Energy study reports: "All living patterns involving Bikini Island exceed Federal (radiation) guidelines for 30 year population doses." More than 100 Bikinians continue living on Bikini.
1978	**May** Interior Department officials describe the 75 percent increase in radioactive cesium found in the people living on Bikini as "incredible". Plans are announced to move the people within 90 days. **August** A radiological survey revises the list of atolls exposed from Bikini, Enewetak, Rongelap and Utrik to include 10 other atolls and islands, including inhabited atolls of Ailuk, Likiep, Mejit, Ujelang and Wotho. **September** The 139 people on Bikini are evacuated.
1980	**March** US Defense Nuclear Agency declares the Enewetak cleanup complete and Enewetak islanders begin to return home to the southern part of the atoll. Runit Island is off limits forever. Six months later 100 people return to Ujelang reporting that Enewetak's trees are not bearing fruit.
1985	**May** People of Rongelap are evacuated by the Greenpeace boat, *Rainbow Warrior*. They move to a small island, Mejatto, on Kwajalein Atoll. In July, en route from the Marshall Islands to protest French testing at Moruroa, the *Rainbow Warrior* is sunk by French intelligence agents in Auckland Harbour.

List of US Nuclear Tests on Bikini and Enewetak Atolls in the Marshall Islands

Test No	Date of Test	Site of Test	Type	Yield in Kilotons	Operation Code Name	Test Code Name
1	6/30/46	Bikini	Airdrop	21.00	CROSSROADS	ABLE
2	7/24/46	Bikini	Underwater	21.00	CROSSROADS	BAKER
3	4/14/48	Enewetak	Tower	37.00	SANDSTONE	XRAY
4	4/30/48	Enewetak	Tower	49.00	SANDSTONE	YOKE
5	5/14/48	Enewetak	Tower	18.00	SANDSTONE	ZEBRA
6	4/7/51	Enewetak	Tower	81.00	GREENHOUSE	DOG
7	4/20/51	Enewetak	Tower	47.00	GREENHOUSE	EASY
8	5/8/51	Enewetak	Tower	225.00	GREENHOUSE	GEORGE
9	5/24/51	Enewetak	Tower	45.50	GREENHOUSE	ITEM
10	10/31/52	Enewetak	Surface	10,400	IVY	MIKE
11	11/15/52	Enewetak	Air Drop	500.00	IVY	KING
12	2/28/54	Bikini	Surface	15,000	CASTLE	BRAVO
13	3/26/54	Bikini	Barge	11,000	CASTLE	ROMEO
14	4/6/54	Bikini	Surface	110.00	CASTLE	KOON
15	4/25/54	Bikini	Barge	6,900	CASTLE	UNION
16	5/4/54	Bikini	Barge	13,500	CASTLE	YANKEE
17	5/13/54	Enewetak	Barge	1,690	CASTLE	NECTAR
18	5/4/56	Enewetak	Surface	40.00	REDWING	LACROSSE
19	5/20/56	Bikini	Air Drop	3800.00	REDWING	CHEROKEE
20	5/27/56	Bikini	Surface	3,500	REDWING	ZUNI
21	5/27/56	Enewetak	Tower	0.19	REDWING	YUMA
22	5/30/56	Enewetak	Tower	14.90	REDWING	ERIE
23	6/6/56	Enewetak	Surface	13.70	REDWING	SEMINOLE
24	6/11/56	Bikini	Barge	365.00	REDWING	FLATHEAD
25	6/11/56	Enewetak	Tower	8.00	REDWING	BLACKFOOT
26	6/13/56	Enewetak	Tower	1.49	REDWING	KICKAPOO
27	6/16/56	Enewetak	Air Drop	1.70	REDWING	OSAGE
28	6/21/56	Enewetak	Tower	15.20	REDWING	INCA
29	6/25/56	Bikini	Barge	1,100	REDWING	DAKOTA
30	7/2/56	Enewetak	Tower	360.00	REDWING	MOHAWK
31	7/8/56	Enewetak	Barge	1,850	REDWING	APACHE
32	7/10/56	Bikini	Barge	4,500	REDWING	NAVAJO
33	7/20/56	Bikini	Barge	5,000	REDWING	TEWA
34	7/21/56	Enewetak	Barge	250.00	REDWING	HURON
35	4/28/58	Near Enewetak	Balloon	1.70	HARDTACK I	YUCCA
36	5/5/58	Enewetak	Surface	18.00	HARDTACK I	CACTUS
37	5/11/58	Bikini	Barge	1,360	HARDTACK I	FIR
38	5/11/58	Enewetak	Barge	81.00	HARDTACK I	BUTTERNUT
39	5/12/58	Enewetak	Surface	1,370	HARDTACK I	KOA

40	5/16/58	Enewetak	Underwater	9.00	HARDTACK I	WAHOO
41	5/20/58	Enewetak	Barge	5.90	HARDTACK I	HOLLY
42	5/21/58	Bikini	Barge	25.10	HARDTACK I	NUTMEG
43	5/26/58	Enewetak	Barge	330.00	HARDTACK I	YELLOWWOOD
44	5/26/58	Enewetak	Barge	57.00	HARDTACK I	MAGNOLIA
45	5/30/58	Enewetak	Barge	11.60	HARDTACK I	TOBACCO
46	5/31/58	Bikini	Barge	92.00	HARDTACK I	SYCAMORE
47	6/2/58	Enewetak	Barge	15.00	HARDTACK I	ROSE
48	6/8/58	Enewetak	Underwater	8.00	HARDTACK I	UMBRELLA
49	6/10/58	Bikini	Barge	213.00	HARDTACK I	MAPLE
50	6/14/58	Bikini	Barge	319.00	HARDTACK I	ASPEN
51	6/14/58	Enewetak	Barge	1,450	HARDTACK I	WALNUT
52	6/18/58	Enewetak	Barge	11.00	HARDTACK I	LINDEN
53	6/27/58	Bikini	Barge	412.00	HARDTACK I	REDWOOD
54	6/27/58	Enewetak	Barge	880.00	HARDTACK I	ELDER
55	6/28/58	Enewetak	Barge	8,900	HARDTACK I	OAK
56	6/29/58	Bikini	Barge	14.00	HARDTACK I	HICKORY
57	7/1/58	Enewetak	Barge	5.20	HARDTACK I	SEQUOIA
58	7/2/58	Bikini	Barge	220.00	HARDTACK I	CEDAR
59	7/5/58	Enewetak	Barge	397.00	HARDTACK I	DOGWOOD
60	7/12/58	Bikini	Barge	9,300	HARDTACK I	POPLAR
61	7/14/58	Enewetak	Barge	LOW	HARDTACK I	SCAEVOLA
62	7/17/58	Enewetak	Barge	255.00	HARDTACK I	PISONIA
63	7/22/58	Bikini	Barge	65.00	HARDTACK I	JUNIPER
64	7/22/58	Enewetak	Barge	202.00	HARDTACK I	OLIVE
65	7/26/58	Enewetak	Barge	2,000	HARDTACK I	PINE
66	8/6/58	Enewetak	Surface	FIZZ	HARDTACK I	QUINCE
67	8/18/58	Enewetak	Surface	0.02	HARDTACK I	FIG

Source: U.S. Department of Energy. United States Nuclear Tests: July 1945 through September 1992. Document No. DOE/NV-209 (Rev. 14), December 1994. Cited on http://www.bikiniatoll.com/BombYields.html

Bikini Atoll Conservation Management Plan

Working Draft v 2.0

January 20, 2009

Prepared by: Nicole Baker

Contents

Purpose and Scope of this Plan

This plan is prepared for the management of Bikini Atoll as a proposed World Heritage site. As a former US nuclear test site, Bikini Atoll is home to a remarkable assemblage of wartime technology in the form of sunken vessels, and the atoll's depopulated and scarred landscape and seascape bear witness to the destructive capacity of nuclear weapons and the persistent nature of radiation. As a tropical coral atoll which is not subject to the usual human pressures, Bikini Atoll hosts significant populations of endangered species, and offers important insights to science on how coral reefs can recover from a major trauma.

This management plan covers the protection of the cultural and natural heritage values of Bikini and compatible use of the atoll for tourism, research, cultural use and education.

Recent work on the recovery of corals at Bikini, and the possibility of World Heritage listing of Bikini for its cultural attributes has increased the interest from experts in both fields on the effective study, conservation and interpretation of Bikini Atoll. At present, preliminary discussions are underway with experts mentioned in this document and in the Bikini World Heritage Nomination Dossier to develop a program of work. These discussions will continue to inform the development of this plan, which is presented here as a working draft. Future developments will include specific assessment, monitoring and reporting protocols and interpretation of the site both for visitors to Bikini, and for presentation through websites, publications and other means of conveying the globally significant values of Bikini.

In addition, effort is required to discuss the elements of the management plan with the local government, leaders and community of Bikini Atoll and to adapt the plan according to their input.

Part 1. Background

1.1 Bikini Atoll and World Heritage

In 2005 the Marshall Islands included Bikini Atoll in the Tentative List of possible sites for inclusion on the World Heritage List. In 2006 work began to develop the nomination dossier for Bikini Atoll to be considered for listing by the World Heritage Committee for its cultural values as a nuclear test site. The Republic of the Marshall Islands is submitting its nomination for Bikini in 2009 for consideration by the World Heritage Committee in 2010.

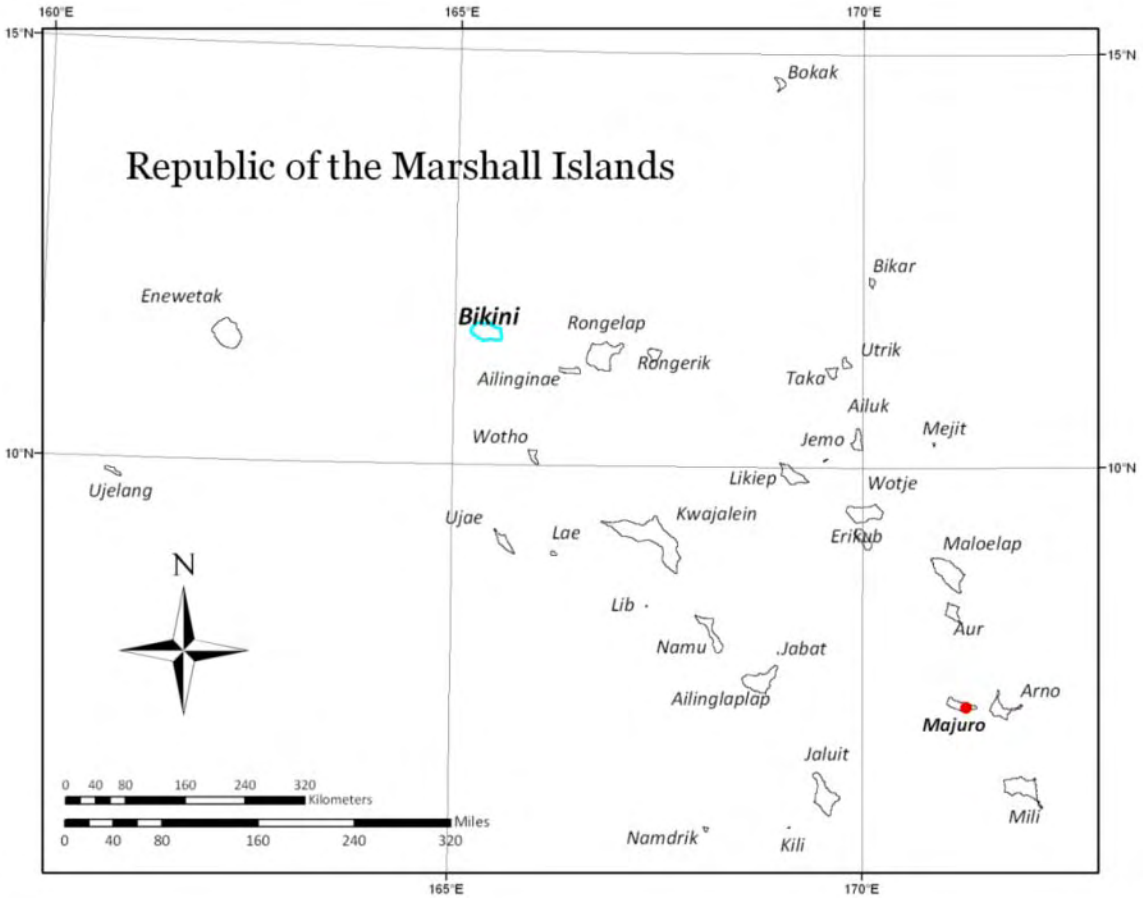
While Bikini Atoll is being nominated to World Heritage on the basis of cultural values only, it has globally significant natural values in terms of biodiversity conservation and the scientific study of coral reef systems.

1.2 A Brief History of Bikini Atoll

Bikini Atoll is thought to have been first settled by humans between 2000 and 3000 years ago. The people of Bikini lived a quiet, subsistence lifestyle well into the 20th century when, during the build-up to the Pacific War in World War II, the Japanese military established an outpost on Bikini. In 1945, at the end of the war, the Marshall Islands was captured by the Americans and the people of Bikini were released from a difficult time under Japanese martial rule. In 1946 Bikini Atoll was selected by the US to be the site of the first peace-time nuclear weapons tests. The people of Bikini reluctantly agreed to leave their treasured homeland "for the good of mankind and to end all world wars" and commenced their many years of unhappy displacement within the Marshall Islands. Within months the traditional villages were gone and a huge military installation hosting 42,000 personnel had changed the face of Bikini Atoll forever. In July 1946 the first of 23 nuclear tests to be held on Bikini was conducted. Operation Crossroads was the bombing of a fleet of over 90 retired naval vessels, 16 of which today lie on the bottom of Bikini lagoon. In 1954 another enormously significant testing event occurred: the Castle Bravo, the world's first deliverable hydrogen device, which destroyed 3 islands and left a crater a mile wide. Fallout from the Castle Bravo was distributed across the Marshall Islands, having particular impact on the people of Rongelap and Utrik, and on the crew of a Japanese tuna boat. In the meantime, 43 nuclear tests were carried out on the neighboring atoll of Enewetak. Nuclear testing on Bikini finished in 1958, and after some attempts to clean-up the radioactive site, the Bikinians were allowed to return home in the 1970s. Within a couple of years, however, monitoring revealed the levels of radiation in their bodies was unacceptably high and Bikini was again abandoned. In 1985 the US Government handed over ownership of the sunken vessels to the people of Bikini, and these became the basis of a small-scale tourism operation. The population of Bikini today remains restricted to a few people monitoring the radiation, employees of the dive operation, and the visiting tourists. The people of Bikini, although now living elsewhere retain strong links of identity to their lost homeland.

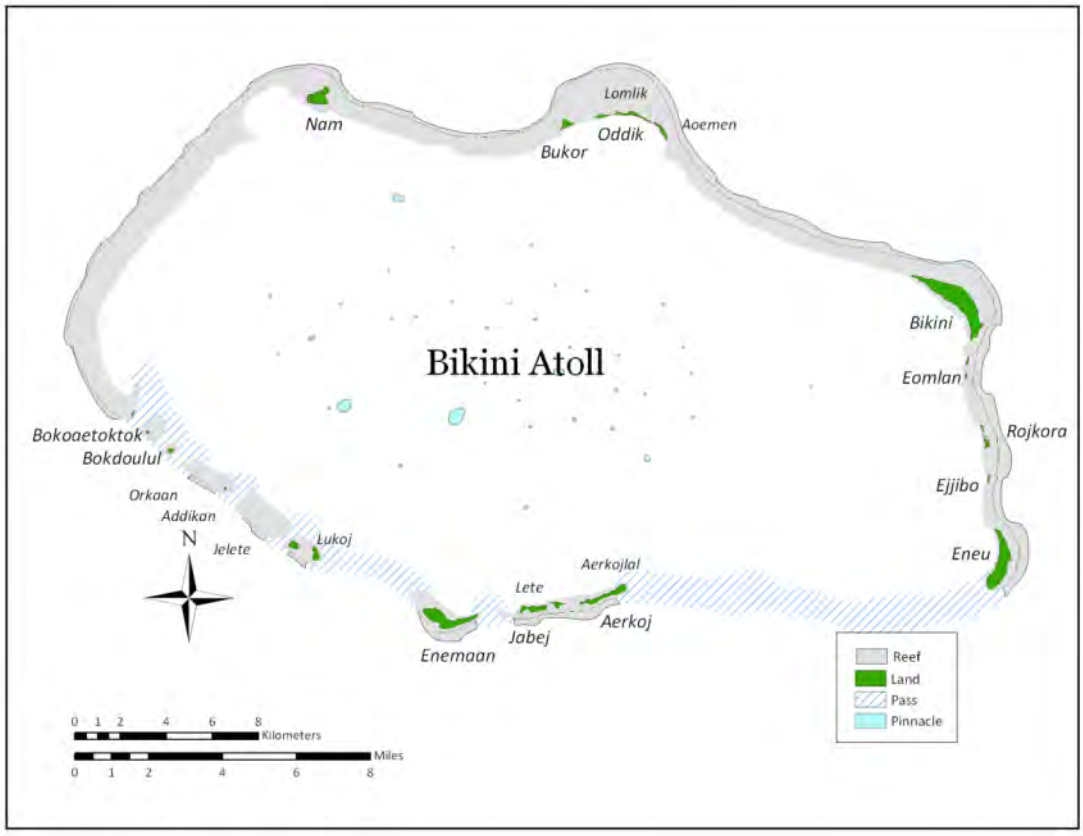
1.3 Location, Access and Geography

Bikini Atoll is the northern-most atoll in the western, *Ralik*, chain of atolls—one of 29 low-lying coral atolls that rise over 6,000 meters from the abyssal plain to no more than a couple of meters above sea level, and comprise the Marshall Islands, known to the Marshallese as *Aelōñ Kein.* The atolls consist of biotic limestone on a deep basalt core, built over millions of years by living coral organisms that grew as the basalt core slowly subsided, creating a marine environment extremely rich in productivity, diversity and complexity.



The entirety of the Marshall Islands lies in the central-western part of the Conservation International Polynesia/Micronesia Hotspot and the northern Marshall Islands form the Key Biodiversity Area, Kabin Meto. Bikini Atoll lies in this drier, northern part of the Marshall Islands. Air and water temperatures hover around 28 degrees Centigrade (82 Fahrenheit) year round, varying little from this. Annual rainfall is an average of 1500mm (60 inches).

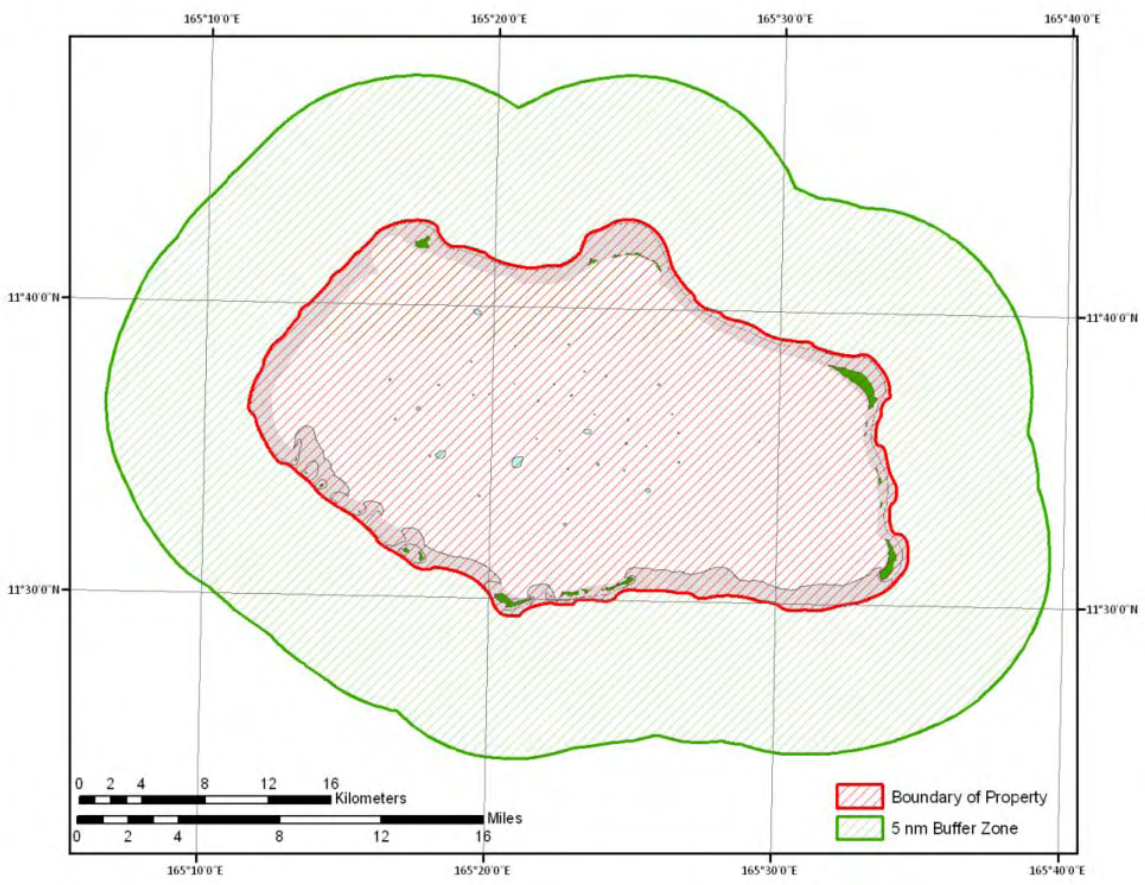
Bikini Atoll is 800 kilometers (500 Miles) from the main centre of Majuro, and an international airport. Access to Bikini is by the national domestic airline, Air Marshall Islands, or by boat. Weekly flights are scheduled to Bikini Atoll however during 2007 and 2008 Air Marshall Islands has been experiencing severe operational problems and so access to Bikini by aircraft is extremely limited and unpredictable at this time.



Bikini's 23 islands, a total land area of only 720 hectares (1780 acres), encircle an elongated and irregular lagoon which extends 40 kilometers (26 miles) long, east to west, 22 kilometers (15 miles) wide, north to south, and is around 60 meters (200 feet) at its deepest. Most of these islands are joined by a shallow reef, with several deep channels on the southern side of the lagoon. Eneu Channel, the largest, is 15 kilometers (9 miles) wide. Most of the islets on Bikini are small; Bikini Island is the largest with a total area of 212 hectares (524 acres) and Eneu the next largest at 115 hectares (284 acres).

1.4 Boundary of the Proposed World Heritage Site

The boundary of the core proposed World Heritage site of Bikini Atoll is clearly delineated by the outer visible reef of the atoll. A buffer zone extends 5 nautical miles from the baseline (basically the outer reef edge). No unauthorized vessels are to enter waters within 5 nautical miles of Bikini except as required for passage by international law. A further protective zone is established by fishing license conditions in the Marshalls Islands preventing any licensed boat from fishing within the territorial seas (12 nautical miles) surrounding each atoll.



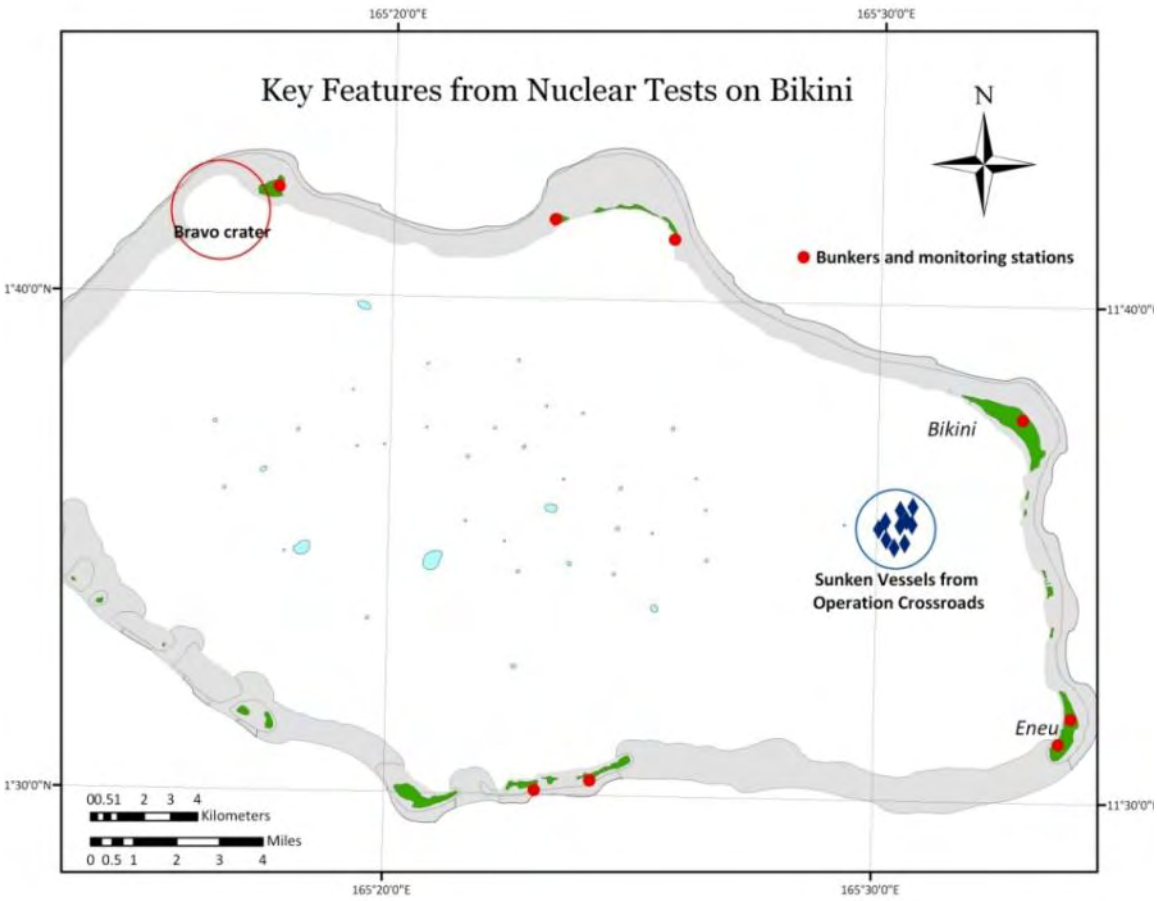
1.5 Cultural Resources

The Sunken Vessels

Five kilometers from Bikini Island, in 60 meters of water, lays the *Saratoga*, victim of Bikini's second bomb, Crossroads Baker; upright on the lagoon floor, her mast-top just below the water line. Three Helldiver planes and an Avenger torpedo bomber sit on her deck, with 500 pound bombs stacked on nearby racks and her anti-aircraft guns facing skyward. Nearby lays the flagship of the Japanese fleet, the *Nagato.* These are but two of the sixteen ships that lie on the bottom of Bikini lagoon; the most prominent remnants of the nuclear testing on Bikini. Most of these vessels are clustered in and around the shallow crater formed by the Crossroads Baker test of July 25, 1946.

Bunkers

On Eneu Island of Bikini Atoll there are two structures from the testing period: the remains of the cement Communications Station, and the cement Monitoring Bunker. On Bikini Island there is a small cement bunker at the back of the island. On several of the outer islands of Bikini Atoll there are cement monitoring stations that are still intact.



1.6 Natural Resources

Marine Environment

Because it is essentially uninhabited, Bikini Atoll has been able to experience a remarkable recovery from the devastation caused by the bomb testing program. It is of immense interest to science for studying the effects on, and recovery of, marine ecosystems following major disruption. The Bravo crater is of particular interest as the Bravo explosion created new lagoonal space and new opportunities for reef development and colonization.

Approximately 50 of the 183 species of coral recorded at Bikini Atoll (Richards et al. 2008) fall within an IUCN threatened category. Given Bikini Atoll reef ecosystems are relatively pristine (Pinca et al. 2002) in comparison to reefs occurring in more populated regions, Bikini provides some of the most significant reef habitat in the northern Pacific and in effect a refuge that may support the recovery in other more heavily impacted parts of the world such as South East Asia and the "Coral Triangle". Surveys of coral biodiversity carried out in 2002 (Richards et al. 2008) revealed eleven species of coral occur at Bikini Atoll despite never before being recorded in the Marshall Islands. Four of these species are considered, on current records, to be regionally restricted to Bikini Atoll—*Acanthastrea hillae*, *Acropora bushyensis*, *Montipora cocosensis*, *Polyphyllia talpina*. Two species (*Acanthastrea brevis* and *Montastrea salebrosa*) were found to be locally abundant and distributed widely at Bikini Atoll indicating Bikini Atoll provides significant habitat for the conservation of these species.

The rare and threatened species of giant clam *Tridacna gigas* appear to be particularly abundant in Bikini lagoon compared to other atolls of the Marshall Islands. This species is literally disappearing from the Pacific region and is found freely growing in Bikini as well as in the nearby atolls of Rongelap and Ailinginae. The locations where it is mostly found in Bikini are the lagoonal sites in the northwest (near Bravo crater) and central northern areas (in front of Aomoen island). At this latter site, many *Hyppopus hyppopus* are similarly found.

Fish fauna in Bikini is very diverse (species richness is 359) due to the high variability of habitats offered by lagoon, pass and ocean environments. The southern and eastern walls of Bikini sustain a high biomass of carnivores (*Lutjaunidae, Lethrinidae, Sphyraenidae, Carangidae*), while the lagoon is rich in invertebrate feeders and herbivores (*Mullidae, Ephinephelidae, Caesionidae*).

One special characteristic of Bikini that differentiates it from other atolls in the Marshalls and from many reefs in the world is the particularly high concentration of several shark species that are considered threatened including gray reef shark (*Charcharhinus amblyrhyncos,)* reef whitetip shark (*Trienodon obesus),* reef blacktip shark *(C. melanopterus)* and silvertip shark (*C. albimarginatus)*. The highest concentration is found at the so-called Shark Pass in the south where hundreds of *C. amblyrhyncos* swim inoffensively and undisturbed along the inner wall and at the pass itself. Tiger sharks (*Galeocerdo cuvier*) are also known to inhabit the lagoon of Bikini and to approach the shore at night or to swim by the decompression bars in the middle of the lagoon. The spotted eagle ray (*Aetobatus narinari*) is a frequent sight in the lagoon waters.

The Bikini property is a holistic single atoll system surrounded by open ocean. The location provides natural isolation from neighboring systems and from human intervention. This provides sufficient size for the ongoing functioning of the natural marine systems. While the terrestrial environment has been significantly disturbed, the marine environment reef system has a very high biodiversity, showing the range of species that demonstrate the system is functioning well including endemic biota, apex predators (sharks) and migratory species such as turtles.

Terrestrial Vegetation

So dramatic was the impact of testing on the islands that a vegetation survey by Fosberg in 1985 reported that on all the islands of Bikini "no unaltered vegetation has survived" (1988: 2) although the native species have survived. There are several stands of important species on some of the islands, including *Pisonia grandis*, a favorite nesting place for birds, and *Pemphis acidula*, which is a species of importance in the RMI (Reimaanlok: 2008). The islands of Eneu and Bikini are dominated by planted coconut palms "on a precisely laid-out 30 foot square grid system" (Fosberg 1988: 3). These trees remain untended and the physiognomy of the plantation varies from tall and luxuriant, with dense undergrowth, to stunted coconut palms with sparse undergrowth. Vegetation on other islands in 1985 was a mixture of the usual atoll strand vegetation (*Scaevola* and *Tournefortia*) and exotic species. There is a need to carry out a vegetation survey to understand how these atoll terrestrial systems have recovered from the testing and associated impacts.

Birds

Bikini Atoll is seeing an increase in avifauna, probably due to the absence of human hunting pressure. Twenty-six species of birds are documented for Bikini Atoll, including 3 IUCN Red-listed species: Buller's Shearwater (*Puffinus bulleri*), Sooty Shearwater (*Puffinus griseus*) and the Bristle-thighed curlew (*Numenius tahitiensis*). The Red-tailed Tropicbird (*Phaeton rubricauda*) now nests on Bikini, but was unknown to Bikinians prior to the testing. (Vander Velde and Vander Velde 2003).

1.7 Radiation

The residual radioactivity on Bikini is higher than on other atolls in the Marshall Islands, however there is no radiological risk from visiting the lagoon or the islands. It is safe to walk on the islands, swim in the lagoon and the drinking water is safe also – that is, the residual radioactivity is lower than the natural radioactivity occurring in many places in the world. It is also deemed safe to eat marine life. The main radiation risk is from eating food grown locally on Bikini, including coconuts and breadfruit, over a long period of time. This includes coconut crabs which are known to bio-accumulate the radioactive cesium remaining in the soil and plants.

1.8 The People of Bikini

The Bikinians left Bikini in 1946 and after many years as nuclear nomads, the main populations of Bikinians now reside on Ejit, a small islet of Majuro Atoll, and on Kili, an inhospitable island in the south-west reaches of the Marshall Islands. While the Bikinians that left Bikini Atoll in 1946 numbered only 167, the number of people that identify as Bikinian today is over 4,000. The people of Bikini are still active in the governance and management of Bikini Atoll through the Kili-Bikini-Ejit Local Government. This plan will establish a further mechanism for involvement through the establishment of the Bikini Atoll Conservation Management Board.

1.9 Ownership and Management of the Site

Ownership

As in the rest of the Marshall Islands, land on Bikini Atoll is held under customary tenure through traditional clan relationships. Land is divided into parcels, called 'weto', under specific customary ownership. Bikini Atoll has a recognized 'Iroij' or chief, and each parcel of land also has 'Alaps' (caretakers of the land) and 'Dri-jerbal' (workers).

Under Marshall Islands law, all marine areas (lagoon and ocean) below the mean high water mark are legally owned by the people of the Marshall Islands, through the Government of the Marshall Islands, with the recognition of traditional and customary rights of landowner, clan and municipality to control the use of and materials in marine areas. (Public Lands and Resources Act, 1996)

Local governments have the power to make any ordinances over the area of local government jurisdiction, so long as they are not inconsistent with any other legislative instrument that has the force of law in the Marshall

Islands (including regulations from national agencies but not including other municipal ordinances). Local Government jurisdiction is to a distance of 5 miles from the mean low water line (Constitution of the Republic of the Marshall Islands). In effect, this means that the ownership and control of resources in Bikini Atoll comes under both customary landowners, and the Kili-Bikini-Ejit Local Government.

All rights, title and interest to the ships sunk by the nuclear tests in 1946 in Bikini Atoll's lagoon were transferred from the Government of the United States to the people of Bikini under Section 177 of the Compact of Free Association of 1985. This agreement is significant because it is the only place in the world where the United States has ceded its rights to its sunken naval vessels (Agreement Between the Government of the United States and the Government of the Marshall Islands for the Implementation of Section 177 of the Compact of Free Association, Article VI, 1985).

Management

The management of Bikini Atoll, including all cultural heritage resources, is the responsibility of the Kili-Bikini-Ejit Local Government.

1.10 Existing Uses

Tourism

The existing use of Bikini is limited to a small dive tourism operation, visiting yachts, ongoing radiation monitoring activities of the US Department of Energy and occasional visits by the people of Bikini.

More recent construction was carried out to develop facilities for tourism on Bikini. Also on Eneu Island there is a crushed coral runway that allows for the landing of aircraft ranging from large propeller planes to small Lear jets. Eneu Island has a small airport terminal, several warehouses, crew quarters, a pier and dock, repair shops, a power plant, and several unfinished buildings that were at one time going to be utilized for tourism until it was decided by the Local Government to use Bikini Island for this purpose.

On Bikini Island there are two buildings used to house tourists that are situated along the beach, a large structure utilized as a dining hall and warehouse for supplies, a dive shop and tank filling station, a garage that also houses a water making complex, a TV/briefing room and office used for the tourism program, several buildings used by the US Department of Energy for their ongoing monitoring program, a dock facility, a fuel farm, a power plant, and several buildings used as repair shops for routine maintenance work on the facilities.

Traditional uses, rights and management practices

(to be completed)

1.11 Key Challenges and Threats

Deterioration of nuclear testing artifacts

The processes of deterioration, especially in the ships, are irreversible and directly related to the atomic tests. In the case of the ships, blast damage introduced micro-fractures and may have produced isotopes of steel, accelerating the deterioration of the ships. Similarly deterioration of the concrete structures remaining on land is inevitable due to the harsh, salty environment. These processes at work, and the ultimate disintegration of the ships and bunkers is demonstrative of the legacy of the tests, and an integral and key aspect of this landscape—as such, these processes and the ongoing changes in the ships and structures should be monitored, assessed and documented.

Removal of artifacts

There are reports of unauthorized visitation and removal of artifacts in the early 90It is important to ensure the ongoing integrity of the site by preventing unauthorized removal of artifacts. This is addressed through

restricted access to the site, supervised diving and visitation and a provision to allow for inspection of visitors bags upon departure from Bikini Atoll, or from the Marshall Islands.

Risks to divers

The ships at Bikini are at depths of up to 60 meters (200 feet) which is well below recommended recreational diving depths. Diving at these depths involves extended periods below water to allow for decompression before surfacing. In addition, penetration of the wrecks themselves requires a good level of skill, experience and comfort in diving. All these factors mean that divers must be well qualified and experienced, and must be aware of the risks prior to undertaking diving at Bikini Atoll. This requires good information and briefing to visitors prior to arriving at Bikini and prior to each dive, and also requires the signing of a waiver form acknowledging this information and releasing Bikini Atoll from liability.

Illegal, Unreported and Unregulated Fishing

Several fishing vessels have been caught in recent years fishing illegally in the atolls of Bikini, Ujelang, Jaluit and Mili. In 2002 a vessel was found fishing for sharks at Bikini Atoll and was successfully prosecuted. The current extent of illegal fishing is not known due to difficulties in surveillance and monitoring, however effective surveillance and enforcement and the prevention of illegal fishing is an objective of this management plan.

Overfishing or overharvesting

Atoll ecosystems were traditionally carefully managed to prevent overfishing and depletion of fish stocks, or other species. While the level of harvesting pressure is expected to remain low due to the isolation of Bikini, the ability for the people of Bikini and other visitors to carry out some harvest is important, as is occasional sport fishing for tourists on Bikini. This management plan and the correlating regulations will place restrictions on different species, or seasons and fishing methods to protect and maintain the current healthy populations of fish and other species at Bikini.

Local government ordinances placing restrictions on harvesting levels and sport-fishing

Climate change and sea-level rise

Climate change is a major threat to the low-lying Marshall Islands. The islands are at risk from storm surge in the short to medium term, and complete inundation in the future. Rises in sea temperature will likely cause coral bleaching – the extent and impact of which is unpredictable. Ocean acidification is predicted to seriously impact the ability of corals to grow and form skeletons. Bikini Atolll will best retain some resilience to climate change through maintaining the health and protection of its coral ecosystems.

Invasive species

Many land and marine invasive species, both plants and animals, are threatening the biodiversity of the Marshall Islands. Once an invasive species becomes established it can be extremely difficult and expensive to control or eradicate. Invasive species can cause the extinction of native and endemic species by taking over their positions in the ecosystem, or through predation. Bikini Atoll has many invasive exotic plant and animal species, particularly apparent in the terrestrial environment, due to the huge military and clean up operations here carried out over many years. At this point there are no plans to take particular measures to address either the introduction of new species or the eradication of established invasives due to the scale of the existing problem. With further assessment of the terrestrial environment and bird populations, however, it may be desirable in the future to establish a program to address invasive species.

1.12 Existing Legal Framework

Legislation, regulations and ordinances have been established at national and local level to ensure the legal protection of the artifacts and natural environment at Bikini Atoll.

Protection of Historic and Cultural Resources

The property currently has a high degree of protection through local ordinances and strictly controlled access.

The Historic and Cultural Preservation Act (1991) and its subsidiary regulations protect historic and cultural resources including governing access to submerged resources, the export of historic and cultural artifacts and control over land modification activities. The Act provides for fines of up $10,000 or six months imprisonment for violations. (The Historic and Cultural Preservation Act: Title 45, Ch 2, 1991; Regulations Governing The Taking And Export Of Artifacts, 1991; Regulations Governing Access To Prehistoric And Historic Submerged Resources, 1991; Regulations Governing Land Modification Activities, 1991)

In addition, Kili-Bikini-Ejit Local Government established ordinances in 1988 prohibiting entry to Bikini Atoll or diving on ships without a permit issued by KBE Local Government, and prohibiting removal of any object from Bikini lagoon (Ordinance No.14-1988). These were updated in 1996 to additionally require that all divers be accompanied by the official Bikini dive operation (Ordinance No.2-1996). All divers and yachts visiting Bikini Atoll are required to gain permission from KBE Local Government (through the Tourism Manager) and to sign a liability waiver confirming that they understand their responsibilities (Yacht Liability Waiver, 2008).

Protection of Biological Resources

Bikini has a high level of biodiversity protection also, based on a decree (July 30, 1997) from the KBE Local Government that it is illegal to fish for sharks or turtles in the lagoon, or to use gill nets or throw nets within the lagoon area. All bird habitats are preserved by this same decree. All fishing around the area of the sunken ships is prohibited. Additionally, at national level, licensed pelagic fishing vessels are prohibited from fishing within the 12nmile territorial seas of any atoll.

List of Ordinances

Marine Resource Ordinance (Dated July 28, 1997): Ordinance passed in 1997 with the object of conserving the marine and wildlife resources of Bikini Atoll.

Ordinance No. 14-1988 (October 8, 1988): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was created soon after the ships were made the property of the Bikinians under Section 177 of the Compact of Free Associated (year? And ref).

Ordinance No. 2-1996 (May 30, 1996): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was developed soon after the establishment of a commercial dive operation on Bikini Atoll and required that all divers be supervised by the authorized dive operation.

Liability Release Form and Express Assumption of Risk for Diving at Bikini Atoll: All tourist divers at Bikini are required to sign a liability release form that also informs them of the rules regarding removal of artifacts. During times when the dive operation is active, each diver is required to sign this form. Visiting yachts are required to sign this form also.

Updating the Local Government Ordinances

Due to the evolving nature of the activities on Bikini Atoll, there is a need to consolidate all these ordinances, ensure consistency and make copies available to all visitors and to all Bikinians. These regulations are to be updated to reflect the rules laid out in this management plan, upon approval by the KBE Local Government of the management plan.

2. The Plan

2.1 Goals and Objectives

Goal

To identify, protect, conserve, present and transmit the cultural heritage values of Bikini in relation to the World Heritage Listing, and to protect the biodiversity of Bikini Atoll.

Cultural Heritage Objectives

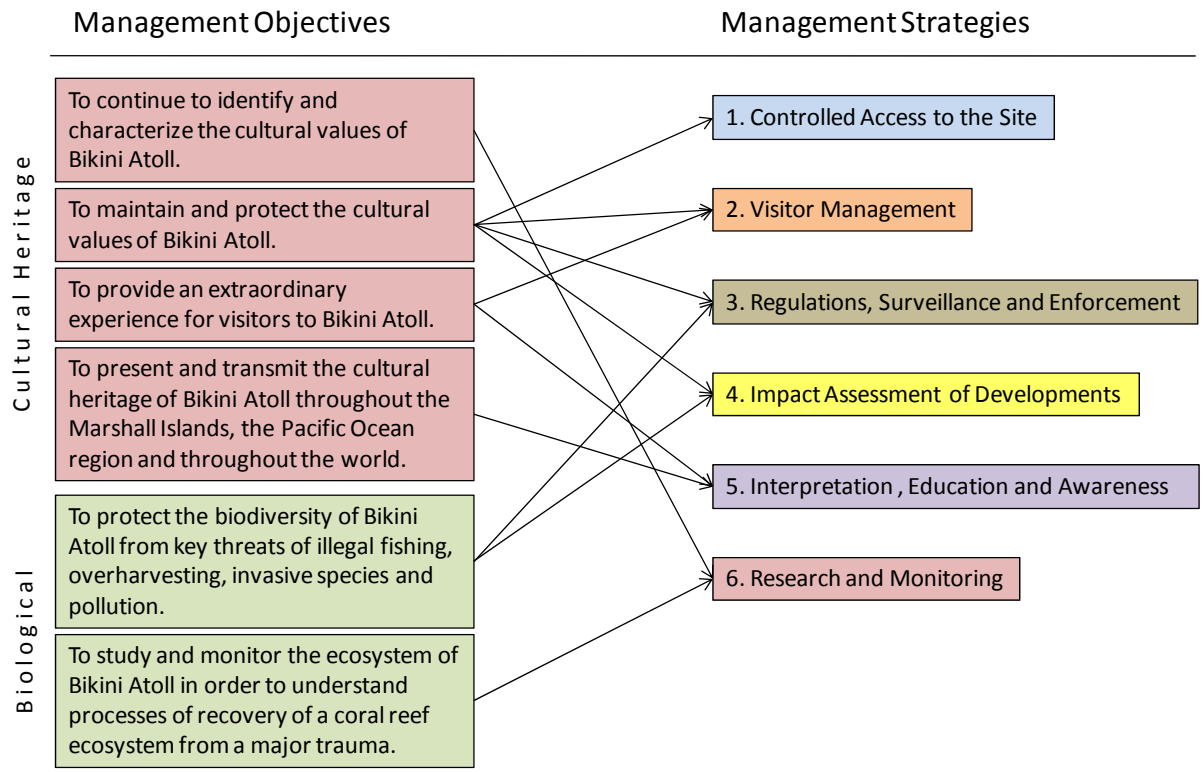
- To continue to identify and characterize the cultural values of Bikini Atoll.
- To maintain and protect the cultural values of Bikini Atoll.
- To provide an extraordinary experience for visitors to Bikini Atoll.
- To present and transmit the cultural heritage of Bikini Atoll throughout the Marshall Islands, the Pacific Ocean region and throughout the world.

Biological Objectives

- To protect the biodiversity of Bikini Atoll from key threats of illegal fishing, overharvesting, invasive species and pollution.
- To study and monitor the ecosystem of Bikini Atoll in order to understand processes of recovery of a coral reef ecosystem from a major trauma.

2. 2 Management Strategies

The diagram below indicates how the key management strategies outlined in this plan link to the achievement of the objectives for the site.



Strategy 1. Controlled Access to the Site

Access to Bikini Atoll is restricted to recreation and tourism visitors, and to scientific survey teams. All people wishing to visit Bikini by aircraft must obtain prior permission. All vessels wishing to enter Bikini Atoll must obtain prior permission from the KBE Local Government through the permitting procedure. Yachts and boats may visit Bikini (with a permit) but, if diving, must be accompanied by a diver and an observer in the employ of the Kili-Bikini-Ejit Local Government.

Key Actions	***Timing***	***Responsibility***	***Partners and Additional Resources Required***
Document and formalize permitting procedure for access to Bikini Atoll.	Jun 2009	Jack Niedenthal	-

Strategy 2. Visitor Management

The visitor experience of Bikini is very closely managed due to the remoteness of the atoll, controlled access to the site, the depth of the dives and the need to protect the ships and artifacts. Visitors to Bikini can expect an amazing experience due not only to the spectacular location and activities, but the professionalism and hospitality of the Bikini Atoll staff, and the comfortable facilities on offer.

Bikini Atoll has been open to tourists since 1996 and is considered one of the World's premier dive destinations. Visitors to Bikini Atoll generally come as part of the dive tourism program run by Bikini Atoll Divers, a business owned by the Kili-Bikini-Ejit Local Government. To date, tourism on Bikini has mainly been focused on the sunken vessels which are considered one of the premier SCUBA diving experiences in the world (see http://www.bikiniatoll.com/divetour2.html for articles, reviews and testimonials of the tourism-diving experience of Bikini Atoll). While the vessels sunk during Operation Crossroads in 1946, are the premier attraction, there is also the opportunity to go sport fishing and to dive or snorkel some of the beautiful coral reef, or to walk on and explore some of the islands.

The current and expected future levels of tourism to Bikini Atoll remain very low, mainly due to the relative inaccessibility of the atoll and the associated high costs. A restricted number of divers visit the site each year for diving the wrecks of the sunken ships. To date this has been a maximum of 12 per week during the dive season from March to November, a total of between 200 and 250 per year. In the future, depending on transport options to Bikini, the number may expand to around 20 visitors per week, or 400 per year.

Unfortunately 2008 has seen the temporary closure of the Bikini Atoll Divers operation due to the unreliable nature of Air Marshall Islands, the national airline servicing Bikini. The failure of the airline to fly scheduled routes throughout 2007 and 2008 left visitors to Bikini Atoll stranded for weeks at a time. During the 2008 season Bikini Atoll Divers and the KBE Local Government made the difficult decision to cancel the remainder of the season and to close the dive operation for 2009.

The facilities described below are maintained on Bikini until the dive operation can resume.

DIVING FACILITIES

A typical visit to Bikini over a week includes 12 deep decompression dives—these are dives that are below normal recreational diving limits and require the use of staged decompression stops prior to surfacing. Facilities for divers include tanks, two dive boats, a tank filling station for both air and nitrox (decompression gas), oxygen generation equipment, dive equipment repair shop. Decompression stops are facilitated by a decompression station that is hung from the dive boat.

ACCOMMODATION AND DINING

Visitors to Bikini sleep in private, air-conditioned comfort with 24 hour power and hot running water, right on one of the most beautiful beaches in the Pacific. A dining hall provides an "all you can eat" buffet style selection for breakfast, lunch and dinner.

INTERPRETATION AND EXPLANATION DURING THE VISIT

Over the course of the week's dive tour historical documentary films are shown, complete briefings about each of the ships and their respective histories are given, and there is a tour of the island and the atoll. The Bikinians feel this to be important because this allows their story to be taken away by tourists and retold to their families and friends. In short, the tourism program helps perpetuate a story the islanders want the world to remember. Before each dive the divemasters give a full briefing about the vessel's history and unique characteristics, and a comprehensive dive plan.

VISITING YACHTS AND PRIVATE VESSELS

Yachts and Private Vessels may visit Bikini, as long as they meet requirements for safety and being able to manage decompression diving. The conditions of this visit are that they are accompanied by a diver and by an observer affiliated with the KBE Local Government to ensure there is no damage to or removal or artifacts.

Strategy 3. Regulations, Surveillance and Enforcement

Access to Bikini is restricted to recreation and tourism visitors, and to scientific survey teams. All people wishing to visit Bikini by aircraft must obtain prior permission from the Kili-Bikini-Ejit Local Government through an established permitting procedure.

Divers on the sunken vessels must be accompanied by a diver employed by Bikini. Divers that visit Bikini are usually very experienced and well-certified to dive on, and to penetrate, the sunken vessels without causing damage. Divers are required to sign waivers and are prohibited from removing artifacts from the ships. This may be enforced by bag checks upon departure. Yachts are able to visit Bikini but must gain permissions from Bikini Atoll Local Government, and are not permitted to dive the wrecks unless accompanied by a diver employed by Bikini.

Nationally, licensed fishing boats are required to be part of the Vessel Monitoring System (VMS), which allows the Marshall Islands Marine Resources Authority (MIMRA) to track the position of vessels and if they are found within 12 nautical miles of any atoll, to pass this information on to the Sea Patrol operation (an arm of the Marshall Islands Police) and support apprehension and prosecution for any illegal fishing.

When the dive operation is running on Bikini, staff there can observe unauthorized vessels in or near the lagoon. They can then approach the vessel using one of the boats on Bikini Atoll and collect evidence, such as photos, to support prosecution. They can radio the Marshall Islands Sea Patrol to pursue the unauthorized vessel. Bikini Atoll has successfully pursued one prosecution of unauthorized shark finning in 2002.

All of these protective measures are more difficult to implement when the regular dive operation is not running. An option is being developed to install a radar system at the western end of the atoll to notify staff on Bikini Island of any unauthorized vessel in the vicinity, which can then be reported to Sea Patrol who can then pursue and prosecute.

Strategy 4. Impact Assessment of Proposed Developments on Bikini

Features of Bikini Atoll that contribute to the overall character of an abandoned nuclear test site include the rows of coconut trees and the generally low level of buildings and construction. There is a need to assess any proposed demolition, construction, land-clearing, earthmoving or similar activity in light of its impact on the attributes of Bikini Atoll as a former nuclear test site. There are established permitting requirements for this that assess the impact of a development against impacts on environmental and heritage resources. Any

earthmoving or construction activity must gain a permit from the Republic of the Marshall Islands Environmental Protection Authority (RMIEPA) and from the Historic Preservation Office (HPO). In addition to this, the Bikini Atoll Conservation Management Board must consider any proposal to carry out works on Bikini in light of the effects the work may have on the outstanding universal value of the site. In this respect they shall also seek advice from ICOMOS and the World Heritage Centre, and from other international experts.

Key Actions	***Timing***	***Responsibility***	***Partners and Additional Resources Required***
Ensure proper assessment of any proposed works on Bikini including consultation with international experts and ICOMOS.	Ongoing	Chair, Bikini Atoll Conservation Management Board	Access to international experts will be required.

Strategy 5. Interpretation, Education and Awareness

Education and awareness about Bikini is to be designed for three key target audiences. The first is the people of the Marshall Islands and the people of Bikini Atoll living on Kili, Majuro and elsewhere. The second is foreign visitors and tourists to Bikini and the Marshall Islands. The third is more generally people around world. Several programs are under development that will contribute greatly to the transmission of the World Heritage values of Bikini Atoll including the following:

BIKINI ATOLL WEBSITE

The official website of Bikini Atoll http://www.bikiniatoll.com/ has been developed and maintained by Jack Niedenthal for several years and contains a wealth of information about Bikini Atoll. This website will continue to be developed to incorporate more information about the World Heritage values of Bikini, and to present them to a global audience.

ON-SITE INTERPRETATION

Bikini Atoll will continue to deliver and develop its on-site interpretation program for visitors, as described in *Strategy 2.Visitor Management*, above. This will be done with the assistance of international experts in submerged heritage.

ENVIRONMENT AND HERITAGE YOUTH THEATRE PROJECT

Youth to Youth in Health (Y2Y) is a community-based NGO that supports at-risk youth to develop and deliver peer-to-peer education programs. Y2Y specialize in using the medium of theatre and music to positively impact young people's lives by exploring issues such as sexual health, alcohol and drugs, and family life. Inspired by the World Heritage project and other conservation activities in the Marshalls, Y2Y propose to develop a theatre program that focuses specifically on the issues of natural and cultural heritage of the Marshall Islands, starting with the nuclear heritage of Bikini Atoll as a proposed World Heritage site, and the natural and cultural values of Ailinginae Atoll. While a proposal has been developed, the project needs substantial technical assistance and funding to become established.

MARSHALL ISLANDS PEACE MUSEUM

A project is currently under development as a partnership between the Marshall Islands government and interested parties in Japan to establish a Peace Museum in Majuro, commemorating the nuclear history of the Marshall Islands, with the intention of promoting peace throughout the world. The Peace Museum will include exhibits on nuclear tests in the Marshalls and the impacts on the Marshallese people, including the events and people of Bikini Atoll.

Key Actions	*Timing*	*Responsibility*	*Partners and Additional Resources Required*
Maintain and upgrade Bikini Atoll website to present material on Bikini's proposed World Heritage values	Dec 2010	Jack Niedenthal	Consider support from a web-design and/or heritage management faculty as a graduate project.
Upgrade interpretive materials on the sunken vessels and other site to enhance visitor experience	Dec 2010	Jack Niedenthal	Partnership with Charles Beeker at Indiana University
Establishment of Environment and Heritage Youth Theatre Program	Dec 2010	Youth to Youth in Health	Dependent on recruitment of theatre professional and raising $250k.
Development of exhibit for proposed Peace Museum in Majuro	Dec 2010	Peace Museum	In partnership with experts helping to establish the Peace Museum

Strategy 6. Research and Monitoring

SCIENTIFIC STUDY, MONITORING AND INTERPRETATION OF CULTURAL HERITAGE RESOURCES

The most recent archeological assessment carried out 1991 (Delgado et al., 1991) by the US National Parks Service revealed the historical and archaeological significance of the artifacts at Bikini Atoll, and led to the development of interpretation materials and the opening of Bikini Atoll to dive tourism. There is a need to develop partnerships with universities and research institutions to enable the ongoing identification and characterization of the cultural heritage resources at Bikini.

Bikini Atoll is in the early stages of developing a program in partnership with maritime archaeologists and conservation scientists at the Institute of Nautical Archaeology, James Cook University, and at the Western Australian Maritime Museum. This program will conduct a baseline assessment of the state of conservation of the vessels and buildings, and develop a protocol and indicators for a regular assessment of the state of conservation of these artifacts. Local staff divers of Bikini Atoll will be trained in how to conduct a regular state of conservation assessment. The monitoring protocol will likely involve taking photographs at fixed monitoring points and comparing these photographs over the years. A partnership with Charles Beeker's Underwater Science group at Indiana University is also being developed which will lead to the development of interpretation materials for the site. These partners will help to develop the funding and expert resources required to carry out these activities.

SCIENTIFIC STUDY AND MONITORING OF MARINE ENVIRONMENT

Bikini Atoll provides as unique opportunity to study the recovery of a coral reef system, and a terrestrial system, after the major disturbance of nuclear testing and persistent radiation. Scientific study and monitoring of Bikini Atoll will allow increased understanding of the ecosystem and processes of Bikini, and therefore of other atolls and coral reef systems. It will enable the study of the impacts of climate change and other remote impacts on coral reef systems in the absence of pollution and over-harvesting of resources. A scientific program should be managed in a way that that benefits the people of the Marshall Islands.

Partnerships with scientific research organizations are to be sought and established to enable long-term monitoring of the condition and biodiversity of the site. Zoe Richards of James Cook University, Maria Beger from the University of Queensland and Silvia Pinca of the Secretariat of the Pacific Community form a core of marine biologists who have carried out biological resources assessments on several atolls in the Marshall Islands, and who have made recommendations for the conservation management of these sites.

A team of scientists (including the three mentioned above) carried out a baseline survey of the marine environment Bikini Atoll in 2002, establishing a set of indicators for monitoring the state of conservation of the marine environment. These indicators include:

- Coral and fish biodiversity: presence/absence and semi-qualitative abundance in timed swims
- Algae diversity and abundance
- Percent cover of substrate, coral and algae
- Reef health including counts of *Acanthaster planci* (crown-of-thorn starfish), dead and bleached coral
- Counts of target species of invertebrates
- Fish size and abundance of commercially and ecologically important species.

While the survey established a baseline in 2002, there is no ongoing program of monitoring due to lack of available resources, however, with recent interest in a scientific paper on Bikini in 2008, (Richards et al. 2008) it is expected that more resources will become available for research and monitoring on Bikini. There is a need to carry out baseline assessment of avifauna and vegetation on the island and to develop monitoring indicators.

Key Actions	***Timing***	***Responsibility***	***Partners and Additional Resources Required***
Carry out baseline assessment of state of conservation of artifacts	Dec 2010	Jack Niedenthal	James Cook University and Western Australian Maritime Museum
Develop interpretation materials for the sunken vessels	Dec 2010	Jack Niedenthal	Charles Beeker at Indiana University
Continuation of partnership with marine scientists to carry out monitoring of biodiversity on Bikini Atoll.	Ongoing	Jack Niedenthal	Experts from various international research institutions, MIMRA and the College of the Marshall Islands.

2.3 Management, Administration and Reporting

Roles and Responsibilities

KILI-BIKINI-EJIT LOCAL GOVERNMENT

Kili-Bikini-Ejit (KBE) Local Government is the elected local government for the community of Bikini, now living on Ejit Islet in Majuro and on Kili Island. The Bikini Atoll Local Government is responsible for the management of the site.

BIKINI ATOLL CONSERVATION MANAGEMENT BOARD

Under this management plan, The Bikini Atoll Conservation Management Board (BACMB) will be established under the auspices of the KBE Local Government, and will meet at least every three months. The Bikini Atoll Conservation Management Board membership will consist of:

- Bikini Liaison Officer/ Tourism Manager
- Head Divemaster of the Bikini Atoll Dive Operation (when running)
- Conservation Project Manager (see below)
- Traditional leader representative
- Elected council representatives
- Youth representative
- Women's representative.

The role of the Management Board is to:

- Carry out management planning;
- Recommend rules, regulations and procedures;
- Ensure the effective implementation of the Bikini Atoll Conservation Management Plan.

EXPERT HERITAGE ADVISORS

International experts in marine archaeology or cold war heritage and conservation will be recruited to provide advice on an as-needs basis, either on a volunteer basis or with the support of their institutions. It is expected that this pool of experts will include individuals with an established knowledge of Bikini, such as James P. Delgado (maritime archaeologist), Jeffrey Sasha Davis (cultural geographer), Anita Smith (archaeologist) as well as experts established in their fields such as Charles Beeker of Indiana University, Vickie Williams of the Western Australian Maritime Museum and William Jeffery of James Cook University, as discussed earlier.

The role of the Expert Heritage Advisor/s will be to:

- Advise on conservation actions for the artifacts;
- Assist in developing proposals and grant applications for the ongoing study and interpretation of the site;
- Carry out assessments and assist in the development of interpretation materials; and
- Advise on the impact of proposed developments on Bikini—whether they will affect the heritage values.

CONSERVATION PROJECT MANAGER

The Conservation Project Manager will be based in Majuro with regular visits to Bikini to work with conservation officers there. The Conservation Project Manager role is not expected to be full-time, but could be combined with an existing role under the KBE Local Government. The role of the Conservation Project Manager will be to:

- Work with stakeholders at local, national and international level to implement the Bikini Atoll Conservation Management Plan;
- Develop partnerships, funding sources for implementation of the Bikini Atoll Conservation Management Plan;
- Oversee day-to-day management of the conservation area: develop work plans, ensure staff carry out the activities stated in their job descriptions and work plans;
- Conduct regular education and awareness, community consultations;
- Identify training and capacity-building needs for staff and ensure staff receive this training;
- Provide reports to meet the requirements of donors and grant contracts;
- Monitor the implementation of the plan and adapt the management of the site as appropriate.

BIKINI ATOLL DIVERS

Bikini Atoll Divers is the dive operation owned by the KBE Local Government. The staff of Bikini Atoll Divers will play an active role in the day-to-day management, monitoring and surveillance of the site. They will also be trained to conduct monitoring of the state of conservation of the sunken vessels and buildings.

Location

The Majuro-based staff will be located in the KBE Local Government Offices. The Bikini-based staff will be located at the dive tourism facilities on Bikini Island.

Key Equipment and Materials

The dive operation on Bikini Atoll is equipped with two boats for dive tourism. These boats will be used also for the surveillance of the atoll in the case that an unauthorized vessel is in the vicinity. Due to the distance from Bikini Island on the eastern side of the atoll where the operations are based, and the uninhabited western side of the atoll, it is not possible to visually see unauthorized vessels. It is intended to install a radar-

based remote surveillance system which would transmit a signal to a station at Bikini Island. It is expected that a basic installation will cost of the order of $100,000.

Marshall Islands and the implementation of the World Heritage Convention

In general the Marshall Islands, as a small island developing state, has very limited technical capacity. To compound this, the Marshall Islands is party to various international conventions, due in large part to the efforts of these conventions to include small island developing states and so limited resources are further stretched in order to meet the considerable obligations of such conventions. The management, interpretation, presentation and conservation of Bikini Atoll will require ongoing support and assistance from the World Heritage Centre, the Advisory Bodies and other state parties to the convention.

Periodic Reporting to the World Heritage Centre

In the case that Bikini is included on the World Heritage List, periodic reporting to the World Heritage Centre will be required. Monitoring and reporting on the state of conservation of the property will be the responsibility of the Kili-Bikini-Ejit Local Government and reporting on general issues of implementation of the convention will be the responsibility of the focal point of the convention, which at this time is the Alele Museum. Both responsible agencies are likely to require assistance and support from the World Heritage Centre and the Advisory Bodies in the preparation of periodic reports.

Appendices:

A.1 Selected References

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Vander Velde, Nancy and Brian Vander Velde. 2003. *A Review of the Birds of Bikini Atoll, Marshall Islands with Recent Observations.* Unpublished report for Bikini Atoll Local Government: Majuro.

A.2 Existing Local Government Ordinances

Marine Resource Ordinance (Dated July 28, 1997): Ordinance passed in 1997 with the object of conserving the marine and wildlife resources of Bikini Atoll. ***Attached.***

Ordinance No. 14-1988 (October 8, 1988): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was created soon after the ships were made the property of the Bikinians under Section 177 of the Compact of Free Association in 1986. ***Attached.***

Ordinance No. 2-1996 (May 30, 1996): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was developed soon after the establishment of a commercial dive operation on Bikini Atoll and required that all divers be supervised by the authorized dive operation. ***Attached.***

Liability Release Form and Express Assumption of Risk for Diving at Bikini Atoll: All tourist divers at Bikini are required to sign a liability release form that also informs them of the rules regarding removal of artifacts. During times when the dive operation is active, each diver is required to sign this form. Visiting yachts are required to sign this form also. ***Attached.***

KILI/BIKINI/EJIT
LOCAL GOVERNMENT COUNCIL

Tomaki Juda
Mayor

P.O. Box 3007
Majuro, MH 96960
Telephone 011 692 625 3177
Fax 011 692 625 3330

July 30, 1997

To Whom It May Concern:

The following regulations were passed by the Kili/Bikini/Ejit Local Government Council on July 28, 1997 regarding our marine resources on Bikini Atoll:

1) No gill-nets shall be used in any part of the atoll, both lagoon and oceanside.

2) Throw-nets or fishing rods shall be the sole method of gathering fish.

3) No commercial fishing is permitted within the 12 nautical miles claimed by the Kili/Bikini/Ejit Local Government Council Constitution: This includes dynamite, cyanide, drift-net or any form of shark fishing.

4) Important sports-fish species such as trevally and bonefish are protected: These species shall be released alive and unharmed unless a potential world record or other circumstances dictates such to be unwise.

5) All wildlife on and around islands between Bikini, Aoemen and Eneu shall be protected: This includes all birds and nesting turtles and their eggs.

6) All turtles are protected and shall not be taken unless there is written authorization from the Mayor.

7) All natural resources not mentioned in these regulations on and around the atoll shall be preserved in such a way that they are not exploited.

8) The quadrants encompassed by the following longitudes and latitudes, 165• 30' E longitude, 11• 35' N latitude, the area of the buoyed ships, shall be protected from any form of fishing and is considered a marine sanctuary by the Kili/Bikini/Ejit Local Government Council.

Mayor Tomaki Juda

Protected Fishes at Bikini Atoll

ALL Bonefish shall be released IMMEDIATELY.

ALL Trevally of any species shall be released if caught within 300 yards of any land structure, or of any reef flats surrounding land.

NO "snappers" can be taken off any reef flats (reef on ocean side of islands and at either end)

A MINIMUM SIZE of 12 INCHES applies to ALL species of fish roughly classed as "GROUPERS" and "SNAPPERS". Fish smaller than this must be released, and if the hook has been swallowed then the line should be cut as close to the hook as possible to aid survival. DO NOT try to cut or pull out a swallowed hook as it may kill the fish. A fish hook is inexpensive to lose, and you CANNOT keep these fish even if they die!

The use of BARBLESS hooks (Barb squashed down with pliers) aids in releasing fish easily upon capture, and does not significantly reduce the catch rate!

No fish or lobsters can be taken with spears, Hawaiian slings etc.

This does not mean that you cannot catch these fish, it just means that they must be released so that somebody else can also catch that fish later on. The reason for these regulations is to maintain the great fishing we have here for future guests to these islands, and all regulations are very, very reasonable to anyone who has lived in USA or elsewhere in the developed world.

Rules for lobster.

The only method allowed for taking lobster is by hand. NO lobsters can be taken with spears.

ALL female lobsters with eggs shall be immediately released unharmed.

The minimum size for lobsters should be 14 inches from eyes to tip of tail, or about 1 ½-2 lbs.

The lobster caught here should be for local consumption, and definitely not for sale in Majuro.

Rules for Birds

No "Frigate Birds"or "Hawks" shall be taken for consumption, or sent to Majuro.

No birds will be sent to Majuro without written permission from the Bikini Council.

Bird "harvesting" shall be LIMITED to 1 bird per person, with an ABSOLUTE MAXIMUM of 10 birds per party

NO adult birds will be taken.

Only one harvest of birds every 6 months.

Birds can only be taken from the "Bird Islands", and are completely protected on all islands from and including Enue over to Aoemen, where NO birds shall be taken.

These rules are to reduce the over-exploitation of these animals, and will help to make it possible to take SOME of these animals EVERY year without severely disturbing the population numbers. It is called a SUSTAINABLE HARVEST, and is a widely adopted attitude around the world. This way neither side "suffers".

All regulations were passed by the Kili/Bikini/Ejit Council on July 28, 1997.

Thank you for your co-operation

KILI/BIKINI/EJIT LOCAL COUNCIL
KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO.14-1988

Ordinance No. 14-1988 has been created by the Kili/Bikini/Ejit Local Council for Bikini Atoll:

Section 1. Title:

This is an ordinance to prevent recreational diving within the Bikini Atoll lagoon in general and specifically on the ships, cables and any other nuclear weapons testing artifacts on the bottom of the Bikini Atoll lagoon.

Section 2. Purpose for Ordinance:

1. **Unauthorized vessels have been sighted within the confines of Bikini Atoll lagoon.**

2. **Persons diving on the ships and cables in the lagoon had not retained the correct permits and legal waivers to do so.**

3. **Diving on the ships of Bikini lagoon remains dangerous due to the unexploded war ordnance still on and around the ships. Artifacts, that are the property of the Bikini Atoll Local Government according to the Compact of Free Association, have been pilfered from the ships by these divers.**

Section 3. Measures to be taken to correct situation:

1. **No vessel is permited to enter the lagoon of Bikini Atoll without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

2. **No person/persons are permited to dive within the confines of Bikini Atoll lagoon without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

Section 4. Result if ordinance 14-1988 is defied:

1. **The cost of a diving permit is $ 125.00 per day/per vessel and can be obtained at the KBE Local Government office along with necessary legal waiver forms and entry permits for the Bikini Atoll lagoon.**

2. **Any person/persons convicted of diving within the confines of Bikini Atoll Lagoon without permission shall be subject to a fine of $ 2,000.00 or subject to a six month jail term.**

3. **Any person convicted of taking any object from the bottom of the Bikini Atoll lagoon, whether natural or related to the testing of nuclear weapons, shall be fined $ 5,000.00 per object or subject to a six month jail term.**

4. **Unauthorized vessels entering Bikini Atoll lagoon will be confiscated by the KBE Local Government.**

Section 5. Effective Date:

1. **After being passed and approved by the Kili/Bikini/Ejit Local Council this ordinance will become effective:**

Date introduced: 10/6/88
Dated Public Hearing: 10/6/88

Approved:* /s/ _____
Tomaki Juda, Mayor Date
Kili/Bikini/Ejit Local Council

Witness:* /s/ _____
Andy Bill, Clerk Date
Kili/Bikini/Ejit Local Council

* (See attached for signatures on Marshallese version).

KILI/BIKINI/EJIT LOCAL COUNCIL

KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO. 14

Ordinance No. 14 ej kio ejak jen Kili/Bikini/Ejit Council einwot in,

Section 1. Title:

Juon kien nan kamo tulok im jibwe jabrewot men ko ilo wa im cables ko ilo maloan Bikini Atoll.

Section 2. Kin Un Kein:

1. Elon ro rej lo ir ilo maloan Bikini.
2. Elon ro rej ilok ilo an ejelok permit.
3. Elon ro rej ilok im tuloki wa ko kab cable eo.

Section 3. Bwe en jimwe im Emonlok:

1. Jabrewot armij ejab melim aer lolok Bikini ilo an ejelok melim ko jen Office eo an KBE Local Govermment.
2. Jabrewot armij ejab melim aer tuloki wa ko im cable ko ne ejelok aer melim jen Office eo an KBE Local Government.

Section 4. Non jab Bokake:

1. Jabrewot eo enaj ilok im tuloki wa ko ej aikuj wor an permit jen Office eo an KBE Local Government kin jonan in $125.00
2. Jabrewot eo enaj ilok im tulok ilo an ejelok an permit en ilok kaje nan e kin jonan in $2,000.00 dollars fine 6 alling kalbuij.
3. Jabrewot eo ejelok an permit ak ej ebok jabrewot jen Wa ko inem ej aikuij fine $ 5,000.00 ak 6 alling kalbuij.
4. UNAUTHORIZED VESSELS WILL BE CONFISCATED BY KBE LOCAL GOVERNMENT

Date Introduced: 10/8/88

Date Public Hearing: 10/8/88

Kamol: Tomaki Juda 10/8/88
Tomaki Juda, Mayor Ran
Kili/Bikini/Ejit
Local Council

Iman Meja: Andy Bill 10/8/88
Andy Bill, Clerk Ran
Kili/Bikini/Ejit
Local Council

KILI/BIKINI/EJIT LOCAL COUNCIL
KILI/BIKINI/EJIT LOCAL GOVERNMENT
ORDINANCE NO. 2 -1996

Ordinance No. 2 -1996 has been created by the Kili/Bikini/Ejit Local Council for **Bikini Atoll**

Section 1. Title:
Regulation of Scuba Diving on Bikini Atoll.

Section 2. Purpose for Ordinance:
WHEREAS, pursuant to Article IV, Section 2 of the Compact of Free Association Section 177 Agreement, the people of Bikini hold title to the sunken vessels in Bikini Lagoon; and

WHEREAS, the Kili/Bikini/Ejit Local Government Council ("Council") has entered into an exclusive agreement with Marshalls Dive Adventures, Inc. ("MDA") to develop, market, manage and operate a scuba/sports divers destination and dive shop on Bikini Atoll; and

WHEREAS, the Council wishes to prevent unauthorized diving within Bikini Atoll; and

WHEREAS, unsupervised diving on the sunken ships in Bikini Atoll remains dangerous due to the remote sire, the depth of the ships, and unexploded ordnance on and around the ships;

NOW, THEREFORE, BE IT RESOLVED, THAT:

Section 3

1. No person may dive at Bikini Atoll except under the supervision of MDA. Such person(s) must also first inform MDA, sign a Liability Release and Express Assumption of Risk form, and pay relevant fees.

2. It shall be unlawful for any person to take any object from the waters of Bikini Atoll lagoon (except fish), whether natural or man-made. This section specifically makes it unlawful for any person to take any object whatsoever off any sunken ship in Bikini Atoll lagoon.

3. Any person who violates Section 3, part 2, above, shall be fined $5,000.00 per object or be subject to a six-month jail term.

4. Any person intending to dive at Bikini Atoll lagoon is hereby put on notice that his/her luggage will be searched prior to departure from Bikini Atoll in order to ensure compliance with Section 3, part 2, above.

5. Any vessel carrying diver(s) in Bikini lagoon who have failed to comply with the terms of Section 3, part 1, above, will be subject to confiscation by the Council.

6. Any person or persons who dive within Bikini Atoll lagoon without complying with Section 3, part 1, above, shall be subject to a fine of $3,000.00 or subject to a six-month jail term.

7. This ordinance shall become effective upon final passage by the Council as indicated below.

Section 4. Effective Date:

Final and passed by the Kili/Bikini/Ejit Local Council on the 30TH day of MAY, 1996, at a meeting on Majuro, Marshall Islands.

Approved: _____ 30th MAY 1996
Tomaki Juda, Mayor — Date
Kili/Bikini/Ejit Local Council

Witness: _____ 5/30/96
Date

LIABILITY RELEASE AND EXPRESS ASSUMPTIONS OF RISK FOR DIVING AT BIKINI ATOLL

This Is a release of my rights to sue Bikini Atoll Divers, the People of Bikini, the Kili/Bikini/Ejit Local Government Council, and/or any of their employees, agents and assigns, and any entity that exists for the benefit of the People of Bikini for personal injuries or wrongful death that may occur during your forthcoming dive activities at Bikini as a result of the inherent risks associated with scuba diving/snorkeling and the unique environment at Bikini Atoll.

_____ 1. I acknowledge that I am a certified scuba diver trained in safe diving practices. I have been trained in the proper use of skin and scuba diving equipment and certified through:

_____

agency name card # date certified

Note: Please indicate your highest level of certification and include a photocopy of the front and back of your certification card.

_____ 2. I understand that diving with compressed air involves certain inherit risks, including decompression sickness, embolism, or other hyperbaric injuries. I further understand that even though I follow all the appropriate dive practices, there is still some risk of sustaining these injuries, and I expressly assume the risk and responsibility of said injuries.

_____ 3. I understand that there is no recompression chamber at Bikini Atoll, that Bikini Atoll is a remote site, that the closest recompression chamber is several hundreds miles away and that it could take as long as 24 hours for me to obtain access to such recompression chamber. I still choose to proceed with diving at Bikini Atoll in spite of the absence of the recompression chamber in proximity to Bikini's dive sites.

_____ 4. I understand that most of the dives I will conduct at Bikini are well beyond suggested recreational limits. Specifically, I understand that most dives will be between 60 and 180 feet. I hereby acknowledge that I have received the proper training or have the necessary skills and experience to safely conduct dives at these depths.

_____ 5. Because of the extreme depth involved in diving at Bikini, I understand that I may be engaging in "staged decompression diving." I understand that this is a specialized procedure, and I hereby acknowledge that I am experienced in and comfortable with the procedures associated with staged decompression diving.

_____ 6. I have made _____ dives.

_____7. My certification level is _____.

_____8. The approximate date of my last dive was _____.

_____9. I carry adequate private insurance to handle any medical problems may develop in connection with my upcoming dive and stay at Bikini.

Insurance Company: _____

Number: _____.

Contact-Information:

_____.

_____10. I certify that I am in good physical and mental health.

_____11. I understand that the United States Government conducted twenty-three(23) atomic and hydrogen bomb experiments at Bikini Atoll between 1946 and 1958 and that the ships I will dive on at Bikini received radiation from two (2) 1946 atomic tests. I acknowledge that I have received and read a ten (10) page report by W.L. Robinson of Lawrence National Laboratory entitled Estimates of Radiological Dose to People Living on Bikini Island for Two weeks While Diving in and Around the Sunken Ships in Bikini Lagoon. I have also read the summary of this report, which states: "The potential dose to a person swimming in the Bikini Lagoon around or through the sunken ships is so low from both the activation products originally induced in the ships and from radionuclides in the lagoon's sediment that it can be considered essentially zero." I further understand that 25% of the world's population dies of cancer. Nevertheless, I expressly assume the risk (however low it may be) that I may contract cancer or any other radiation-induced disease or illness as a result of my visit to Bikini.

_____ 12. I understand that safe practices of skin and scuba diving include but are not limited to the following:

a) I will not skin or scuba dive at Bikini while under the influence of alcohol, drugs and/or any other controlled substance.
b) I will not dive alone or with a person with whom I have not thoroughly discussed the dive plan. Each of us will review one another's diving equipment and emergency procedures before each dive.
c) I will dive with a buoyancy control device that has a power inflation system, a depth gauge, a submersible pressure gauge and a timing device.
d) I will adjust weights to maintain neutral buoyancy with no air in my buoyancy control device at the surface of the water and position weights to keep the quick-release buckle centered and accessible at all times.
e) I will not dive in conditions in which I do not feel comfortable or that I believe exceed my physical abilities.
f) I will surface with at least 300-500 psi in my air tank and will not stay underwater until my air supply is exhausted.
g) I am proficient with the use of a dive table and/or a dive computer.
h) I understand that the boat captain and divemaster(s) will make the final selection of a dive location, based upon weather and water conditions, and I will abide by their selections.
i) I understand that, in the event of a diving accident or other emergency, I will be responsible for using my own vessel's communications equipment to call for any kind of rescue vessel or airplanes, if one is available. I also understand that it is unlikely that Air Marshalls will be able to send a rescue airplane to Bikini Atoll because Air Marshalls is unreliable and is frequently unable to fly airplanes on their regular schedules due to ongoing maintenance problems.

_____ 13. I understand that it is illegal, under an ordinance passed by the Kili/Bikini/Ejit Local Government Council, to take any artifact or artifacts from any of the sunken ships at Bikini Atoll or to accept any artifact or artifacts from any employee of Bikini Atoll Divers. I also understand that pursuant to this ordinance I will be subject to a fine of $10,000 for each artifact taken, or, in the case of an artifact worth more than $10,000, a fine equivalent to be double the appraised value of the artifact taken. By signing this Liability Release and Express Assumption of Risk, I hereby grant to the boat captain and/or divemaster(s) permission to search my belongings if he/she has reasonable grounds to believe that I have acted in violation of this ordinance.

_____ 14. I understand that skin diving and scuba diving are physically strenuous activities and that I will be exerting myself during my diving at Bikini. If I am injured at Bikini as a result of a heart attack, panic attack, hyperventilation or other injury/illness related to diving, I expressly assume the risk of said injuries.

_____ 15. I understand that there are no buoys on the sunken ships at Bikini Lagoon, and I further understand the risk and safety issues, which I shall assume, if my own vessel is not properly anchored.

_____ 16. I have made all payments owed Bikini Atoll Divers prior to my arrival at Bikini Atoll.

_____ 17. I understand that my vessel will be held strictly liable, under Marshallese law, for any environmental damages to Bikini's lagoon and or its surroundings.

_____ 18. I assume all responsibility for any damage to my aircraft that is associated with landing on or taking off from the airstrip on Eneu Island at Bikini Atoll. I understand that this runway is made of crushed coral, which can sometimes result in small rocks being thrown up onto parts of airplanes that land and take off at Eneu Island, and that such rocks could result in damage to my aircraft.

_____ 19. I state that I am at least twenty-one (21) years of age and legally competent to sign this Liability Release and Express Assumption of Risk.

_____ 20. I am signing this form at least forty-five (45) days prior to my departure for Bikini Atoll.

_____ 21. I understand that this Liability Release and Express Assumption of Risk constitutes a contract between myself and the released parties listed above and that I have signed this document of my own free will.

I HAVE FULLY INFORMED MYSELF OF THE CONTENTS OF THIS LIABILITY RELEASE AND EXPRESS ASSUMPTION OF RISK BY READING IT BEFORE I SIGNED IT ON BEHALF OF MYSELF, AND HEIRS AND MY ESTATE.

IT IS ADVISED THAT THIS RELEASE BE CONSIDERED AND SIGNED BEFORE PURCHASING AIRFARE AS SOME AIRFARES MAY NOT BE REFUNDABLE.

Signature of Diver _____ Date _____.

Printed Name of Diver _____

Signature of Boat Owner or his appointed representative:

_____ Date _____.

Printed Name of Owner _____

KILI/BIKINI/EJIT
LOCAL GOVERNMENT COUNCIL

Tomaki Juda
Mayor

P.O. Box 3007
Majuro, MH 96960
Telephone 011 692 625 3177
Fax 011 692 625 3330

July 30, 1997

To Whom It May Concern:

The following regulations were passed by the Kili/Bikini/Ejit Local Government Council on July 28, 1997 regarding our marine resources on Bikini Atoll:

1) No gill-nets shall be used in any part of the atoll, both lagoon and oceanside.

2) Throw-nets or fishing rods shall be the sole method of gathering fish.

3) No commercial fishing is permitted within the 12 nautical miles claimed by the Kili/Bikini/Ejit Local Government Council Constitution: This includes dynamite, cyanide, drift-net or any form of shark fishing.

4) Important sports-fish species such as trevally and bonefish are protected: These species shall be released alive and unharmed unless a potential world record or other circumstances dictates such to be unwise.

5) All wildlife on and around islands between Bikini, Aoemen and Eneu shall be protected: This includes all birds and nesting turtles and their eggs.

6) All turtles are protected and shall not be taken unless there is written authorization from the Mayor.

7) All natural resources not mentioned in these regulations on and around the atoll shall be preserved in such a way that they are not exploited.

8) The quadrants encompassed by the following longitudes and latitudes, 165• 30' E longitude, 11• 35' N latitude, the area of the buoyed ships, shall be protected from any form of fishing and is considered a marine sanctuary by the Kili/Bikini/Ejit Local Government Council.

Mayor Tomaki Juda

Protected Fishes at Bikini Atoll

ALL Bonefish shall be released IMMEDIATELY.

ALL Trevally of any species shall be released if caught within 300 yards of any land structure, or of any reef flats surrounding land.

NO "snappers" can be taken off any reef flats (reef on ocean side of islands and at either end)

A MINIMUM SIZE of 12 INCHES applies to ALL species of fish roughly classed as "GROUPERS" and "SNAPPERS". Fish smaller than this must be released, and if the hook has been swallowed then the line should be cut as close to the hook as possible to aid survival. DO NOT try to cut or pull out a swallowed hook as it may kill the fish. A fish hook is inexpensive to lose, and you CANNOT keep these fish even if they die!

The use of BARBLESS hooks (Barb squashed down with pliers) aids in releasing fish easily upon capture, and does not significantly reduce the catch rate!

No fish or lobsters can be taken with spears, Hawaiian slings etc.

This does not mean that you cannot catch these fish, it just means that they must be released so that somebody else can also catch that fish later on. The reason for these regulations is to maintain the great fishing we have here for future guests to these islands, and all regulations are very, very reasonable to anyone who has lived in USA or elsewhere in the developed world.

Rules for lobster.

The only method allowed for taking lobster is by hand. NO lobsters can be taken with spears.

ALL female lobsters with eggs shall be immediately released unharmed.

The minimum size for lobsters should be 14 inches from eyes to tip of tail, or about 1 ½-2 lbs.

The lobster caught here should be for local consumption, and definitely not for sale in Majuro.

Rules for Birds

No "Frigate Birds"or "Hawks" shall be taken for consumption, or sent to Majuro.

No birds will be sent to Majuro without written permission from the Bikini Council.

Bird "harvesting" shall be LIMITED to 1 bird per person, with an ABSOLUTE MAXIMUM of 10 birds per party

NO adult birds will be taken.

Only one harvest of birds every 6 months.

Birds can only be taken from the "Bird Islands", and are completely protected on all islands from and including Enue over to Aoemen, where NO birds shall be taken.

These rules are to reduce the over-exploitation of these animals, and will help to make it possible to take SOME of these animals EVERY year without severely disturbing the population numbers. It is called a SUSTAINABLE HARVEST, and is a widely adopted attitude around the world. This way neither side "suffers".

All regulations were passed by the Kili/Bikini/Ejit Council on July 28, 1997.

Thank you for your co-operation

LIABILITY RELEASE AND EXPRESS ASSUMPTIONS OF RISK FOR DIVING AT BIKINI ATOLL

This Is a release of my rights to sue Bikini Atoll Divers, the People of Bikini, the Kili/Bikini/Ejit Local Government Council, and/or any of their employees, agents and assigns, and any entity that exists for the benefit of the People of Bikini for personal injuries or wrongful death that may occur during your forthcoming dive activities at Bikini as a result of the inherent risks associated with scuba diving/snorkeling and the unique environment at Bikini Atoll.

_____ 1. I acknowledge that I am a certified scuba diver trained in safe diving practices. I have been trained in the proper use of skin and scuba diving equipment and certified through:

_____

agency name card # date certified

Note: Please indicate your highest level of certification and include a photocopy of the front and back of your certification card.

_____ 2. I understand that diving with compressed air involves certain inherit risks, including decompression sickness, embolism, or other hyperbaric injuries. I further understand that even though I follow all the appropriate dive practices, there is still some risk of sustaining these injuries, and I expressly assume the risk and responsibility of said injuries.

_____ 3. I understand that there is no recompression chamber at Bikini Atoll, that Bikini Atoll is a remote site, that the closest recompression chamber is several hundreds miles away and that it could take as long as 24 hours for me to obtain access to such recompression chamber. I still choose to proceed with diving at Bikini Atoll in spite of the absence of the recompression chamber in proximity to Bikini's dive sites.

_____ 4. I understand that most of the dives I will conduct at Bikini are well beyond suggested recreational limits. Specifically, I understand that most dives will be between 60 and 180 feet. I hereby acknowledge that I have received the proper training or have the necessary skills and experience to safely conduct dives at these depths.

_____ 5. Because of the extreme depth involved in diving at Bikini, I understand that I may be engaging in "staged decompression diving." I understand that this is a specialized procedure, and I hereby acknowledge that I am experienced in and comfortable with the procedures associated with staged decompression diving.

_____ 6. I have made _____ dives.

_____7. My certification level is _____.

_____8. The approximate date of my last dive was _____.

_____9. I carry adequate private insurance to handle any medical problems may develop in connection with my upcoming dive and stay at Bikini.

Insurance Company: _____

Number: _____.

Contact-Information:

_____.

_____10. I certify that I am in good physical and mental health.

_____11. I understand that the United States Government conducted twenty-three(23) atomic and hydrogen bomb experiments at Bikini Atoll between 1946 and 1958 and that the ships I will dive on at Bikini received radiation from two (2) 1946 atomic tests. I acknowledge that I have received and read a ten (10) page report by W.L. Robinson of Lawrence National Laboratory entitled Estimates of Radiological Dose to People Living on Bikini Island for Two weeks While Diving in and Around the Sunken Ships in Bikini Lagoon. I have also read the summary of this report, which states: "The potential dose to a person swimming in the Bikini Lagoon around or through the sunken ships is so low from both the activation products originally induced in the ships and from radionuclides in the lagoon's sediment that it can be considered essentially zero." I further understand that 25% of the world's population dies of cancer. Nevertheless, I expressly assume the risk (however low it may be) that I may contract cancer or any other radiation-induced disease or illness as a result of my visit to Bikini.

_____ 12. I understand that safe practices of skin and scuba diving include but are not limited to the following:

a) I will not skin or scuba dive at Bikini while under the influence of alcohol, drugs and/or any other controlled substance.
b) I will not dive alone or with a person with whom I have not thoroughly discussed the dive plan. Each of us will review one another's diving equipment and emergency procedures before each dive.
c) I will dive with a buoyancy control device that has a power inflation system, a depth gauge, a submersible pressure gauge and a timing device.
d) I will adjust weights to maintain neutral buoyancy with no air in my buoyancy control device at the surface of the water and position weights to keep the quick-release buckle centered and accessible at all times.
e) I will not dive in conditions in which I do not feel comfortable or that I believe exceed my physical abilities.
f) I will surface with at least 300-500 psi in my air tank and will not stay underwater until my air supply is exhausted.
g) I am proficient with the use of a dive table and/or a dive computer.
h) I understand that the boat captain and divemaster(s) will make the final selection of a dive location, based upon weather and water conditions, and I will abide by their selections.
i) I understand that, in the event of a diving accident or other emergency, I will be responsible for using my own vessel's communications equipment to call for any kind of rescue vessel or airplanes, if one is available. I also understand that it is unlikely that Air Marshalls will be able to send a rescue airplane to Bikini Atoll because Air Marshalls is unreliable and is frequently unable to fly airplanes on their regular schedules due to ongoing maintenance problems.

_____ 13. I understand that it is illegal, under an ordinance passed by the Kili/Bikini/Ejit Local Government Council, to take any artifact or artifacts from any of the sunken ships at Bikini Atoll or to accept any artifact or artifacts from any employee of Bikini Atoll Divers. I also understand that pursuant to this ordinance I will be subject to a fine of $10,000 for each artifact taken, or, in the case of an artifact worth more than $10,000, a fine equivalent to be double the appraised value of the artifact taken. By signing this Liability Release and Express Assumption of Risk, I hereby grant to the boat captain and/or divemaster(s) permission to search my belongings if he/she has reasonable grounds to believe that I have acted in violation of this ordinance.

_____ 14. I understand that skin diving and scuba diving are physically strenuous activities and that I will be exerting myself during my diving at Bikini. If I am injured at Bikini as a result of a heart attack, panic attack, hyperventilation or other injury/illness related to diving, I expressly assume the risk of said injuries.

_____ 15. I understand that there are no buoys on the sunken ships at Bikini Lagoon, and I further understand the risk and safety issues, which I shall assume, if my own vessel is not properly anchored.

_____ 16. I have made all payments owed Bikini Atoll Divers prior to my arrival at Bikini Atoll.

_____ 17. I understand that my vessel will be held strictly liable, under Marshallese law, for any environmental damages to Bikini's lagoon and or its surroundings.

_____ 18. I assume all responsibility for any damage to my aircraft that is associated with landing on or taking off from the airstrip on Eneu Island at Bikini Atoll. I understand that this runway is made of crushed coral, which can sometimes result in small rocks being thrown up onto parts of airplanes that land and take off at Eneu Island, and that such rocks could result in damage to my aircraft.

_____ 19. I state that I am at least twenty-one (21) years of age and legally competent to sign this Liability Release and Express Assumption of Risk.

_____ 20. I am signing this form at least forty-five (45) days prior to my departure for Bikini Atoll.

_____ 21. I understand that this Liability Release and Express Assumption of Risk constitutes a contract between myself and the released parties listed above and that I have signed this document of my own free will.

I HAVE FULLY INFORMED MYSELF OF THE CONTENTS OF THIS LIABILITY RELEASE AND EXPRESS ASSUMPTION OF RISK BY READING IT BEFORE I SIGNED IT ON BEHALF OF MYSELF, AND HEIRS AND MY ESTATE.

IT IS ADVISED THAT THIS RELEASE BE CONSIDERED AND SIGNED BEFORE PURCHASING AIRFARE AS SOME AIRFARES MAY NOT BE REFUNDABLE.

Signature of Diver _____ Date _____.

Printed Name of Diver _____

Signature of Boat Owner or his appointed representative:

_____ Date _____.

Printed Name of Owner _____

BIKINI ATOLL DIVERS

PO Box 1096
Majuro, Marshall Islands 96960
Phone: 011-692-625-3177 e-mail: bikini@ntamar.net
Fax: 625-3330 web: www.bikiniatoll.com
Dive Operations Manager: Jack Niedenthal

August 23, 2008

To Whom It May Concern,

The Kili/Bikini/Ejit Local Government Council met for several days during August, 2008, to consider its fiscal year 2009 budget. It was decided at this meeting that Bikini Atoll would remain closed for normal tourism operations during 2009. The Council made this decision due to the ongoing reliability issues with our local airline, Air Marshall Islands, the rise in the world price of fuel, and the decline in the stock market and the impact that this has had on our trust funds (which were used to subsidise our dive program): Together, all of these issues have caused our operating expenses to rise beyond our means.

Currently, the Council is engaged in negotiations with several entities which are interested in taking over the Bikini tourism operation. It is unknown how long these negotiations will last, or if they will prove fruitful, but, if there is an update regarding the tourism operation, it will be posted on this website.

Bikini is allowing certain types of vessels to visit Bikini Atoll and dive on the wrecks provided definitive prior arrangements are made with Bikini Atoll Divers.

These vessels or yachts must be completely self-contained, and must include:

*adequate international communications equipment

*housing, dining facilities, and supplies (all food, water, medical equipment, etc)

*all equipment needed to fill tanks and take care of divers, including any nitrox, oxygen or specialized medical equipment

*preferably have a helicopter for medical evacuation purposes

During such visits our local government will send along a diver and up to two Local Government Council representatives--at the vessel owner's expense--to make sure that no artifacts are removed from the ships.

If you want more information regarding this kind of expedition, please contact: bikini@ntamar.net.

Sincerely,

Jack Niedenthal
Dive Operations Manager
For the People of Bikini

Cc: Lani Kramer

KILI/BIKINI/EJIT LOCAL COUNCIL
KILI/BIKINI/EJIT LOCAL GOVERNMENT
ORDINANCE NO. 2 -1996

Ordinance No. 2 -1996 has been created by the Kili/Bikini/Ejit Local Council for **Bikini Atoll**

Section 1. Title:
Regulation of Scuba Diving on Bikini Atoll.

Section 2. Purpose for Ordinance:
WHEREAS, pursuant to Article IV, Section 2 of the Compact of Free Association Section 177 Agreement, the people of Bikini hold title to the sunken vessels in Bikini Lagoon; and

WHEREAS, the Kili/Bikini/Ejit Local Government Council ("Council") has entered into an exclusive agreement with Marshalls Dive Adventures, Inc. ("MDA") to develop, market, manage and operate a scuba/sports divers destination and dive shop on Bikini Atoll; and

WHEREAS, the Council wishes to prevent unauthorized diving within Bikini Atoll; and

WHEREAS, unsupervised diving on the sunken ships in Bikini Atoll remains dangerous due to the remote sire, the depth of the ships, and unexploded ordnance on and around the ships;

NOW, THEREFORE, BE IT RESOLVED, THAT:

Section 3

1. No person may dive at Bikini Atoll except under the supervision of MDA. Such person(s) must also first inform MDA, sign a Liability Release and Express Assumption of Risk form, and pay relevant fees.

2. It shall be unlawful for any person to take any object from the waters of Bikini Atoll lagoon (except fish), whether natural or man-made. This section specifically makes it unlawful for any person to take any object whatsoever off any sunken ship in Bikini Atoll lagoon.

3. Any person who violates Section 3, part 2, above, shall be fined $5,000.00 per object or be subject to a six-month jail term.

4. Any person intending to dive at Bikini Atoll lagoon is hereby put on notice that his/her luggage will be searched prior to departure from Bikini Atoll in order to ensure compliance with Section 3, part 2, above.

5. Any vessel carrying diver(s) in Bikini lagoon who have failed to comply with the terms of Section 3, part 1, above, will be subject to confiscation by the Council.

6. Any person or persons who dive within Bikini Atoll lagoon without complying with Section 3, part 1, above, shall be subject to a fine of $3,000.00 or subject to a six-month jail term.

7. This ordinance shall become effective upon final passage by the Council as indicated below.

Section 4. Effective Date:

Final and passed by the Kili/Bikini/Ejit Local Council on the 30TH day of MAY, 1996, at a meeting on Majuro, Marshall Islands.

Approved: _____ 30th MAY 1996
Tomaki Juda, Mayor — Date
Kili/Bikini/Ejit Local Council

Witness: _____ 5/30/96
Date

KILI/BIKINI/EJIT LOCAL COUNCIL
KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO.14-1988

Ordinance No. 14-1988 has been created by the Kili/Bikini/Ejit Local Council for Bikini Atoll:

Section 1. Title:

This is an ordinance to prevent recreational diving within the Bikini Atoll lagoon in general and specifically on the ships, cables and any other nuclear weapons testing artifacts on the bottom of the Bikini Atoll lagoon.

Section 2. Purpose for Ordinance:

1. **Unauthorized vessels have been sighted within the confines of Bikini Atoll lagoon.**

2. **Persons diving on the ships and cables in the lagoon had not retained the correct permits and legal waivers to do so.**

3. **Diving on the ships of Bikini lagoon remains dangerous due to the unexploded war ordnance still on and around the ships. Artifacts, that are the property of the Bikini Atoll Local Government according to the Compact of Free Association, have been pilfered from the ships by these divers.**

Section 3. Measures to be taken to correct situation:

1. **No vessel is permited to enter the lagoon of Bikini Atoll without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

2. **No person/persons are permited to dive within the confines of Bikini Atoll lagoon without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

Section 4. Result if ordinance 14-1988 is defied:

1. **The cost of a diving permit is $ 125.00 per day/per vessel and can be obtained at the KBE Local Government office along with necessary legal waiver forms and entry permits for the Bikini Atoll lagoon.**

2. **Any person/persons convicted of diving within the confines of Bikini Atoll Lagoon without permission shall be subject to a fine of $ 2,000.00 or subject to a six month jail term.**

3. **Any person convicted of taking any object from the bottom of the Bikini Atoll lagoon, whether natural or related to the testing of nuclear weapons, shall be fined $ 5,000.00 per object or subject to a six month jail term.**

4. **Unauthorized vessels entering Bikini Atoll lagoon will be confiscated by the KBE Local Government.**

Section 5. Effective Date:

1. **After being passed and approved by the Kili/Bikini/Ejit Local Council this ordinance will become effective:**

Date introduced: 10/6/88
Dated Public Hearing: 10/6/88

Approved:* /s/ _____
Tomaki Juda, Mayor Date
Kili/Bikini/Ejit Local Council

Witness:* /s/ _____
Andy Bill, Clerk Date
Kili/Bikini/Ejit Local Council

* (See attached for signatures on Marshallese version).

KILI/BIKINI/EJIT LOCAL COUNCIL

KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO. 14

Ordinance No. 14 ej kio ejak jen Kili/Bikini/Ejit Council einwot in,

Section 1. Title:

Juon kien nan kamo tulok im jibwe jabrewot men ko ilo wa im cables ko ilo maloan Bikini Atoll.

Section 2. Kin Un Kein:

1. Elon ro rej lo ir ilo maloan Bikini.
2. Elon ro rej ilok ilo an ejelok permit.
3. Elon ro rej ilok im tuloki wa ko kab cable eo.

Section 3. Bwe en jimwe im Emonlok:

1. Jabrewot armij ejab melim aer lolok Bikini ilo an ejelok melim ko jen Office eo an KBE Local Govermment.
2. Jabrewot armij ejab melim aer tuloki wa ko im cable ko ne ejelok aer melim jen Office eo an KBE Local Government.

Section 4. Non jab Bokake:

1. Jabrewot eo enaj ilok im tuloki wa ko ej aikuj wor an permit jen Office eo an KBE Local Government kin jonan in $125.00
2. Jabrewot eo enaj ilok im tulok ilo an ejelok an permit en ilok kaje nan e kin jonan in $2,000.00 dollars fine 6 alling kalbuij.
3. Jabrewot eo ejelok an permit ak ej ebok jabrewot jen Wa ko inem ej aikuij fine $ 5,000.00 ak 6 alling kalbuij.
4. UNAUTHORIZED VESSELS WILL BE CONFISCATED BY KBE LOCAL GOVERNMENT

Date Introduced: 10/8/88

Date Public Hearing: 10/8/88

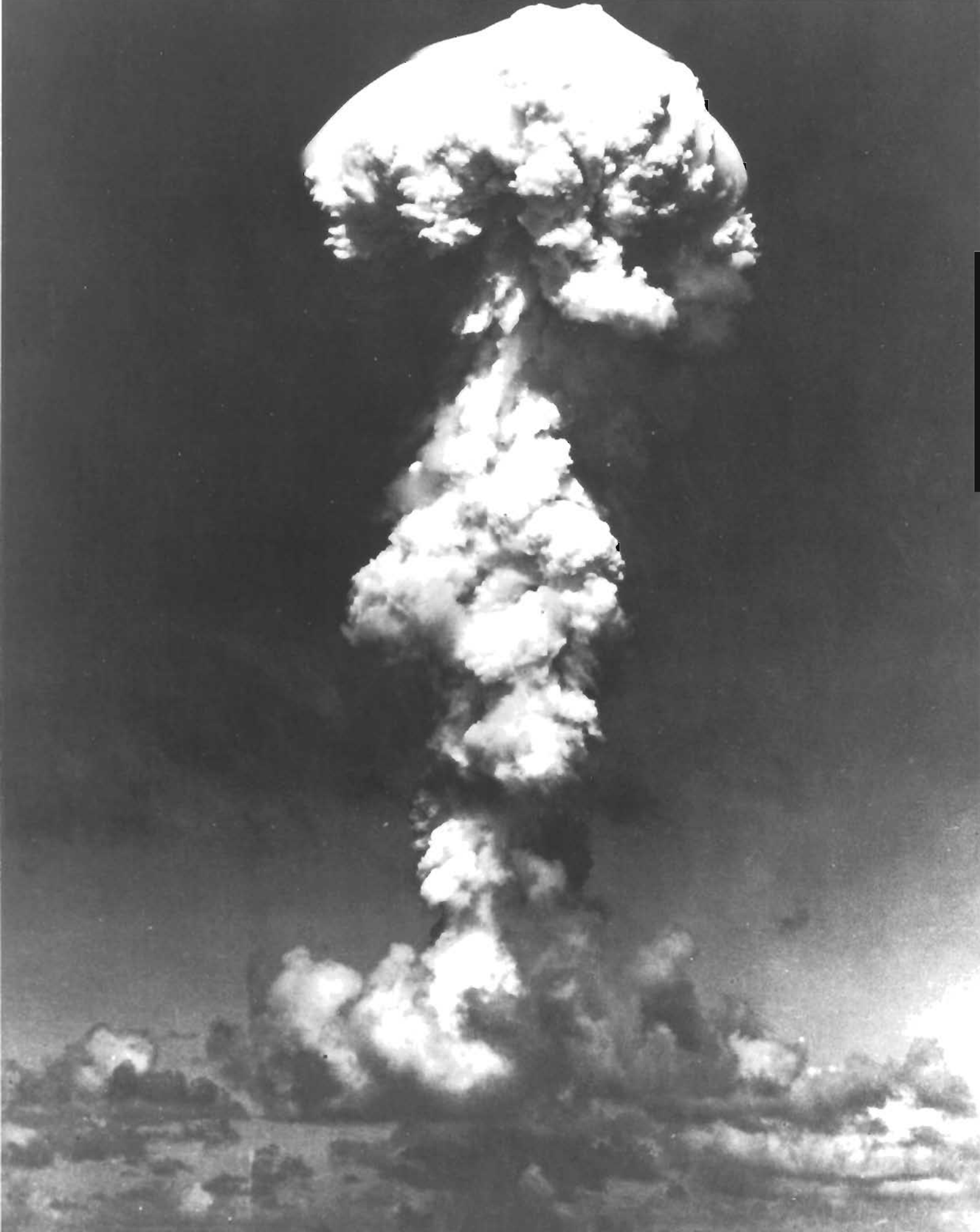
Kamol: Tomaki Juda 10/8/88
Tomaki Juda, Mayor Ran
Kili/Bikini/Ejit
Local Council

Iman Meja: Andy Bill 10/8/88
Andy Bill, Clerk Ran
Kili/Bikini/Ejit
Local Council


ABLR-5046-11


KSFO


ATTENTION VISITORS
NO SMOKING
NO SOUVENIRS

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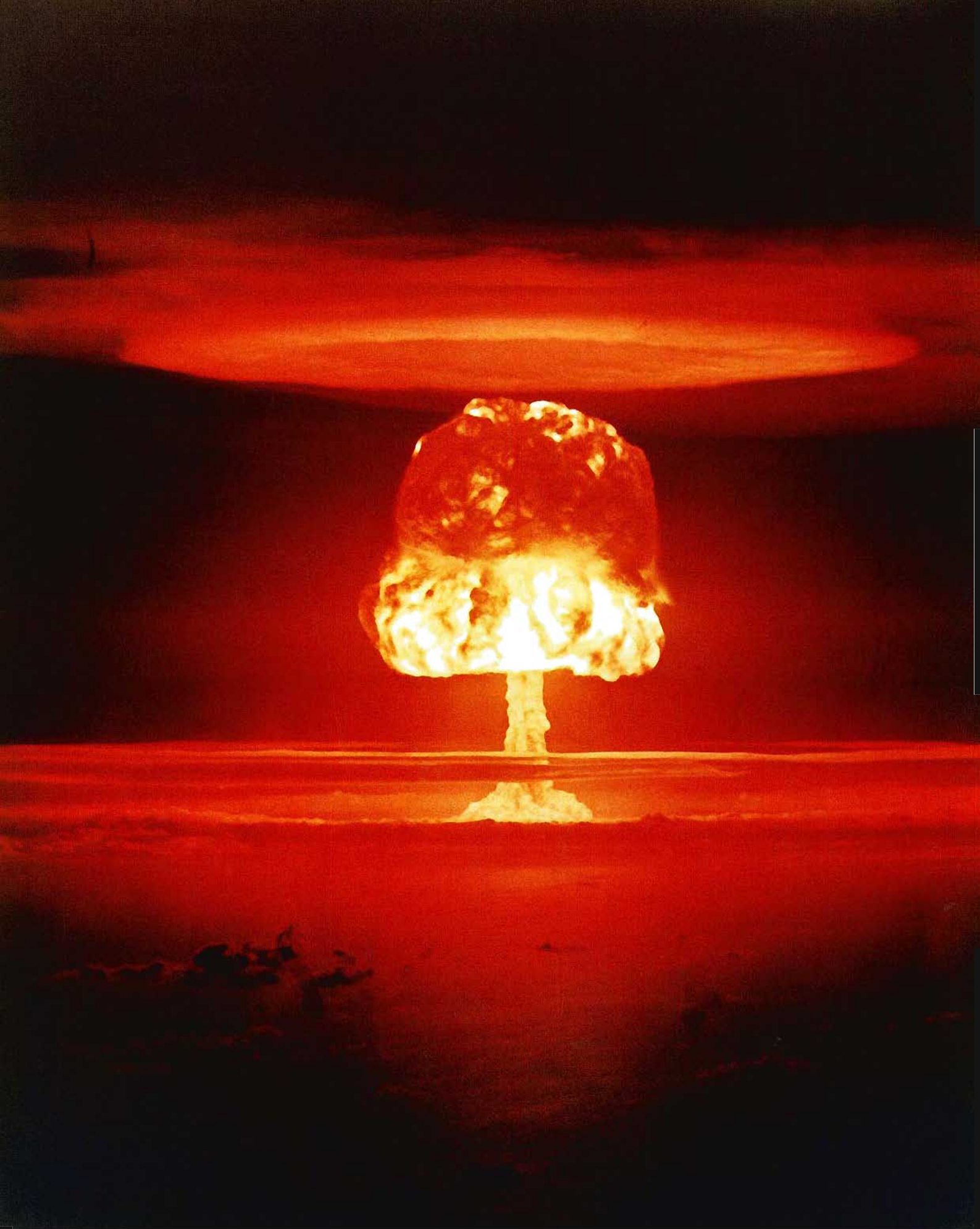

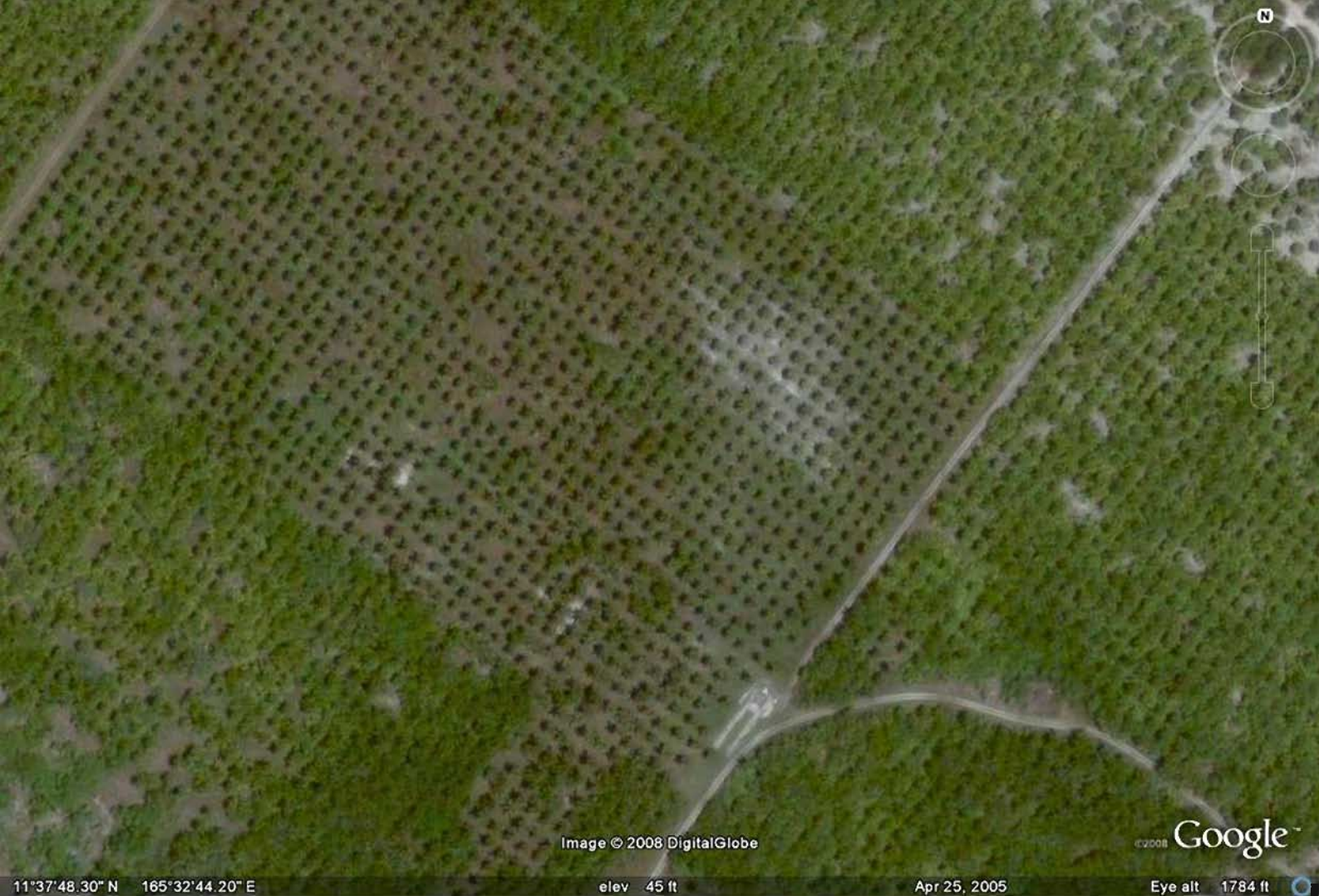
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Image © 2008 DigitalGlobe
©2008 Google
11°37'48.30" N 165°32'44.20" E
elev 45 ft
Apr 25, 2005
Eye alt 1784 ft


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Image © 2008 DigitalGlobe
©2008 Google
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Jan 12, 2005
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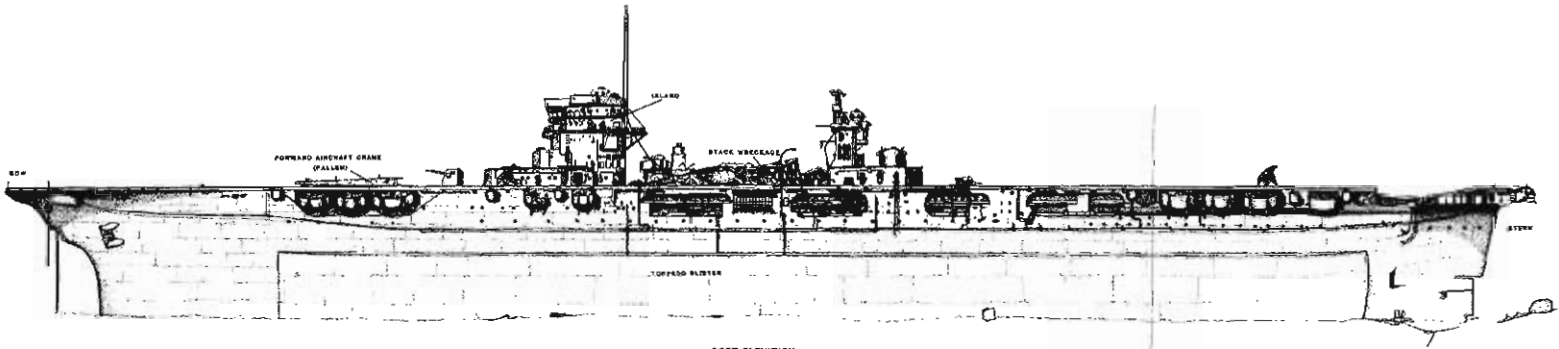
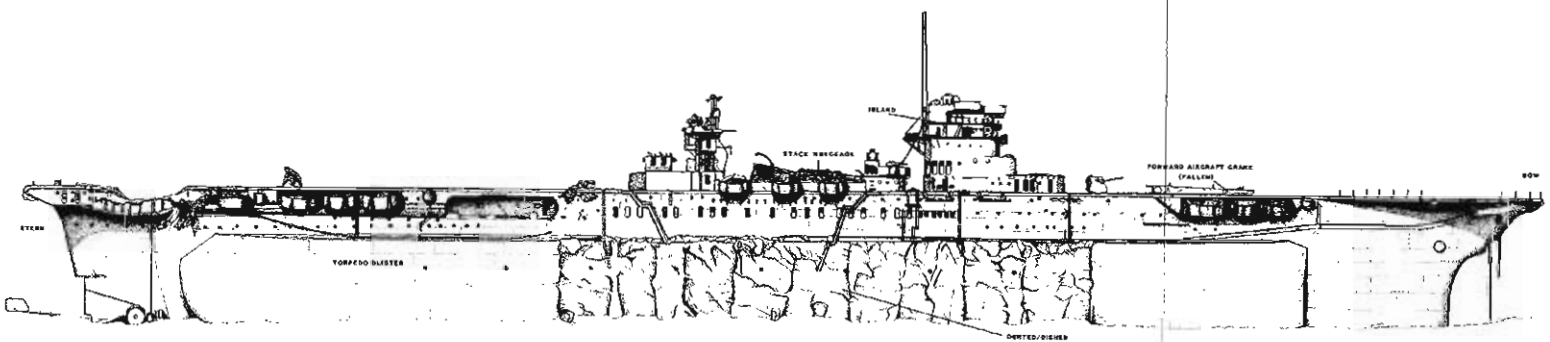


PORT ELEVATION



STARBOARD ELEVATION

SCALE (FEET)

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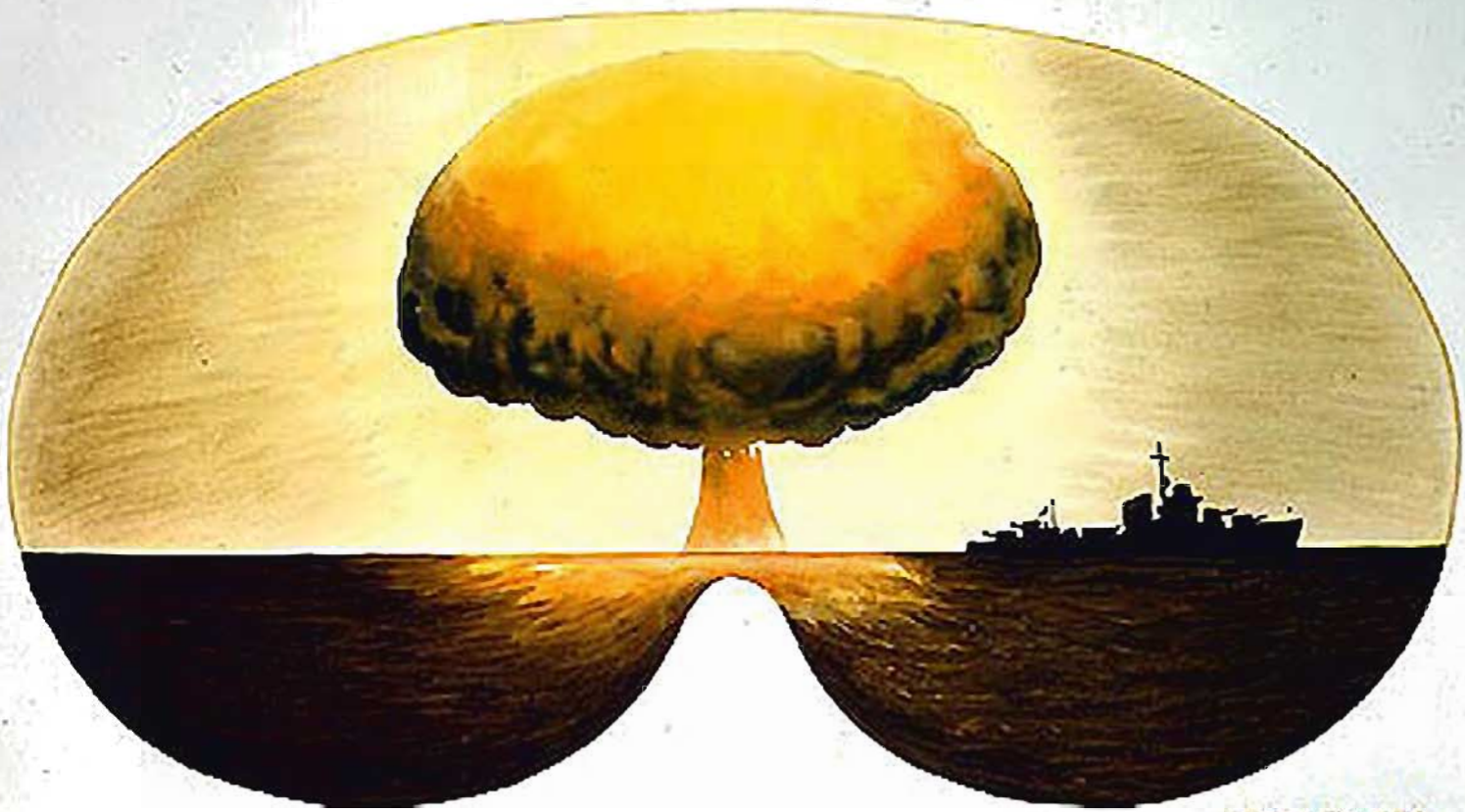
Profile views of Saratoga. (NPS, Larry Nordby and Jerry Livingston)


MEN OTEMJEJ REJ ILO BEIN ANIJ



GRANT POWERS
U.S.N.R.

0300...THROUGH PROTECTIVE
GOGGLES ON THE...
U.S.S. APPALACHIAN.


69
57
GRANT POWERS
U.S.M.C.

ICOMOS

INTERNATIONAL COUNCIL ON MONUMENTS AND SITES
CONSEIL INTERNATIONAL DES MONUMENTS ET DES SITES
CONSEJO INTERNACIONAL DE MONUMENTOS Y SITIOS
МЕЖДУНАРОДНЫЙ СОВЕТ ПО ВОПРОСАМ ПАМЯТНИКОВ И ДОСТОПРИМЕЧАТЕЛЬНЫХ МЕСТ

Our Ref. GB/MA 1339

Paris, 17 December 2009

Mr. Wilfred I. Kendall
Marshall Islands National Commission for UNESCO
Ministry of Education
Post Office Box 3
MH 96960 MAJURO
MARSHALL ISLANDS

World Heritage List 2010: Request for information - Bikini Atoll (Marshall Islands)

Dear Sir,

ICOMOS is currently assessing the nomination of "Bikini Atoll" as a World Heritage site, and we thank you for your assistance with the recent Mission to the property.

As part of our evaluation process, the ICOMOS World Heritage Panel has now reviewed this nomination and identified a few areas where it considers that further information is needed.

Therefore, we would be grateful if the State Party could consider the following points and additional information:

1. Confirm that the national conservation authorities of the Marshall Islands (i.e. the MI Historic Preservation Office) are supporting and involved in the conservation and management of the property;

2. Provide updated information on the draft Conservation Management Plan and on the establishment of the Bikini Atoll Conservation Management Board, including a timeframe for its implementation;

3. Provide a risk assessment study of the unexploded ordnance and remaining fuel stocks on a number of the sunken ships and aircrafts.

4. Confirm that the Bikini people are aware of the implications of World Heritage Listing, including the need to retain the evidence of the nuclear testing which forms part of the attributes of the potential Outstanding Universal Value.

5. Consider to change the name of the property to reflect its values to: "Nuclear testing sites of Bikini Atoll".

We look forward to your responses to these points which will be of great help in our evaluation process.

ICOMOS has no obligation to contact States Parties during the evaluation process. However, with a view to being as transparent as possible, ICOMOS has agreed to approach States Parties in specific cases. This does not prejudice the ICOMOS recommendation on the nomination and should be considered as preliminary information. It also does not prejudice the World Heritage Committee's decision.

We would be grateful if you could provide ICOMOS and the World Heritage Centre with the above information by **28 February 2010**.

We thank you in advance for your kind cooperation.

Yours faithfully

Regina Durighello
Director
World Heritage Programme
ICOMOS

Copy to Jack Niedenthal, Trust Liaison for the People of Bikini
Clary Makroro, Alele Museum
UNESCO World Heritage Centre, Paris

Republic of the Marshall Islands
Ministry of Internal Affairs
HISTORIC PRESERVATION OFFICE
P.O. Box 1454
Majuro, MH 96960
Phone/Fax (692) 625-4476
Email: rmihpo@ntamar.net

Ms. Regina Durighello
Director
World Heritage Program
ICOMOS

January 25, 2010

Dear Ms. Durighello,

Please accept this letter as a sign of the Republic of the Marshall Islands Historic Preservation Office's (RMIHPO) support and involvement in Bikini Atoll becoming a World Heritage site. Bikini is truly one of the most important historical period sites in the Marshall Islands, and beyond, and our office looks forward to ensuring the preservation, and highlighting, of this invaluable resource.

Our office has an active program which includes the surveying and recording of the cultural, historical, and archaeological resources of all of the RMI's atolls and islands. We have a staff that includes professionals meeting United States qualified staff requirements set forth at 36 CFR Part 61, who steer our research and preservation programs. The Republic of the Marshall Islands also abides by the Historic Preservation Act and Regulations of 1992 which directs our office and the nation in how to study, manage, and protect the RMI's cultural resources. Our officers and staff work hard to ensure these laws are understood and carried out throughout the islands, including at Bikini Atoll.

In reaffirmation of this commitment to Bikini Atoll's nomination, our office has been asked and has accepted a seat on the Bikini Atoll Conservation Management Board.

If you should have any further questions or concerns please contact our office.

Sincerely,

Wilbur Heine
Secretary of Internal Affairs
Historic Preservation Officer
Republic of the Marshall Islands

RESOLUTION NUMBER 2010 – 012
OF THE KILI/BIKINI/EJIT LOCAL GOVERNMENT COUNCIL

WHEREAS, the people of Bikini Atoll and their governing body, the Kili/Bikini/Ejit Local Government Council ("Council"), wish to establish our homeland as a World Heritage site because we are aware of the Outstanding Universal Value of retaining and conserving for future generations those remnants of the nuclear testing era currently present on Bikini Atoll; and

WHEREAS, the International Council on Monuments and Sites (ICOMOS), which is assessing the nomination of Bikini Atoll as a World Heritage site, has required additional information;

NOW, THEREFORE, be it resolved that:

1. The site shall be entitled "Bikini Atoll Nuclear Test Site".

2. The Council hereby adopts the attached "Conservation and Management Plan for Bikini Atoll," which will take effect immediately. It is understood that this management plan is a work in progress and will be updated and adapted when appropriate.

3. In order to further the conservation and management of Bikini Atoll as a World Heritage site, the Council hereby establishes the Bikini Atoll Conservation Management Board, the role of which will be to carry out management planning; recommend rules, regulations and procedures; and ensure the effective implementation of the Bikini Atoll Conservation Management Plan.

4. The Bikini Atoll Conservation Management Board shall consist of the following members:

    - The Mayor, the Senator and the Executive Committee of the Kili/Bikini/Ejit Local Government Council;
    - Bikini Liaison Officer;
    - Bikini Tourism Representative/Bikini Atoll Conservation Manager;
    - Resort Manager of the Bikini Atoll Tourism Operation (when in operation);
    - Bikini Project Manager or his her representative;
    - Traditional leader representative from Bikini Atoll;
    - Youth representative;
    - Women's representative; and
    - Member to be appointed by the RMI Historical Preservation Office.

APPROVED by the Kili/Bikini/Ejit Local Government Council this 21 th day of January, 2010 by:

Alson Kelen, Mayor

Clerk Frederick Aitap

Senator Tomaki Juda

Council

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Bikini Atoll Conservation Management Plan

January 21, 2010

Contents

Purpose and Scope of this Plan

This plan is prepared for the management of Bikini Atoll as a proposed World Heritage site. As a former US nuclear test site, Bikini Atoll is home to a remarkable assemblage of wartime technology in the form of sunken vessels, and the atoll's depopulated and scarred landscape and seascape bear witness to the destructive capacity of nuclear weapons and the persistent nature of radiation. As a tropical coral atoll which is not subject to the usual human pressures, Bikini Atoll hosts significant populations of endangered species, and offers important insights to science on how coral reefs can recover from a major trauma.

This management plan covers the protection of the cultural and natural heritage values of Bikini and compatible use of the atoll for tourism, research, cultural use and education.

Recent work on the recovery of corals at Bikini, and the possibility of World Heritage listing of Bikini for its cultural attributes has increased the interest from experts in both fields on the effective study, conservation and interpretation of Bikini Atoll. At present, preliminary discussions are underway with experts mentioned in this document and in the Bikini World Heritage Nomination Dossier to develop a program of work. These discussions will continue to inform the development of this plan, which we view as an ongoing process. Future developments will include specific assessment, monitoring and reporting protocols and interpretation of the site both for visitors to Bikini, and for presentation through websites, publications and other means of conveying the globally significant values of Bikini.

Part 1. Background

1.1 Bikini Atoll and World Heritage

In 2005 the Marshall Islands included Bikini Atoll in the Tentative List of possible sites for inclusion on the World Heritage List. In 2006 work began to develop the nomination dossier for Bikini Atoll to be considered for listing by the World Heritage Committee for its cultural values as a nuclear test site. The Republic of the Marshall Islands is submitting its nomination for Bikini in 2009 for consideration by the World Heritage Committee in 2010.

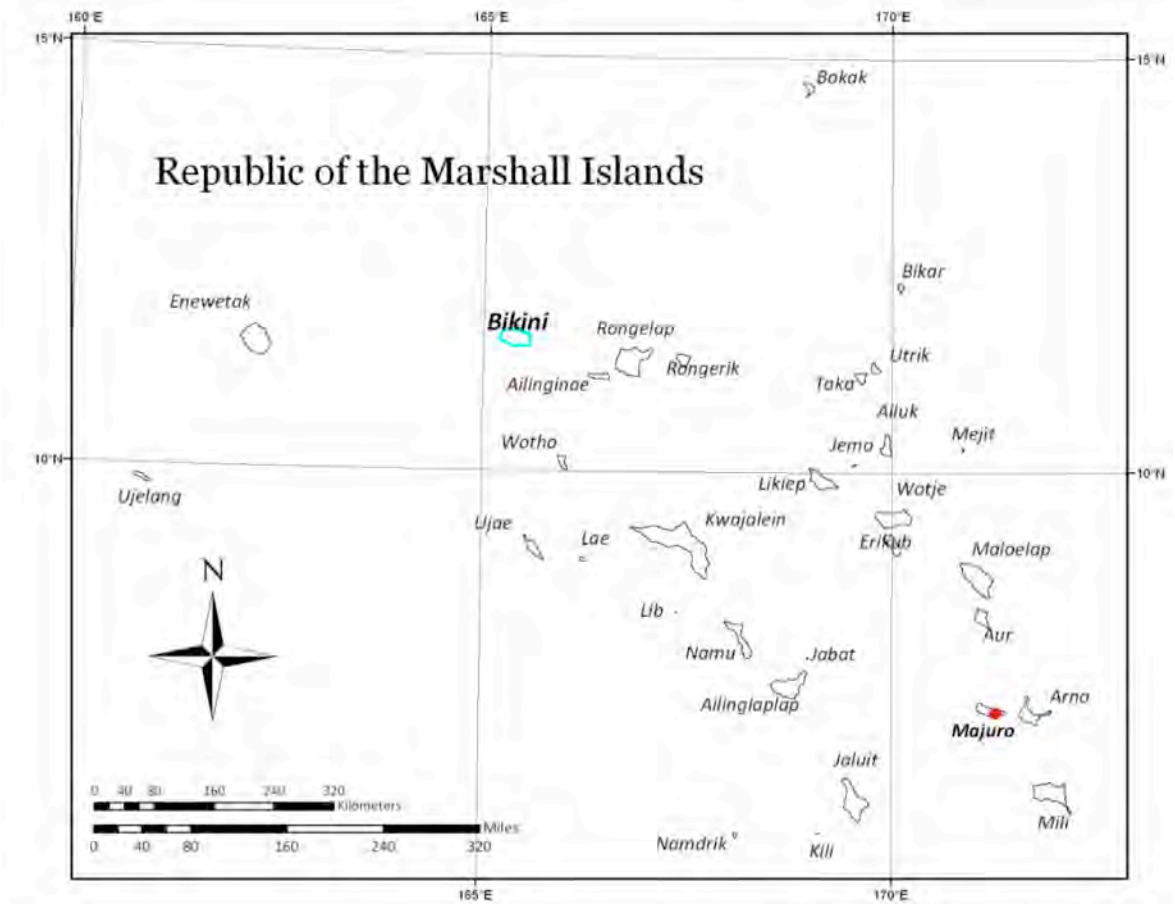
While Bikini Atoll is being nominated to World Heritage on the basis of cultural values only, it has globally significant natural values in terms of biodiversity conservation and the scientific study of coral reef systems.

1.2 A Brief History of Bikini Atoll

Bikini Atoll is thought to have been first settled by humans between 2000 and 3000 years ago. The people of Bikini lived a quiet, subsistence lifestyle well into the 20th century when, during the build-up to the Pacific War in World War II, the Japanese military established an outpost on Bikini. In 1945, at the end of the war, the Marshall Islands was captured by the Americans and the people of Bikini were released from a difficult time under Japanese martial rule. In 1946 Bikini Atoll was selected by the US to be the site of the first peace-time nuclear weapons tests. The people of Bikini reluctantly agreed to leave their treasured homeland "for the good of mankind and to end all world wars" and commenced their many years of unhappy displacement within the Marshall Islands. Within months the traditional villages were gone and a huge military installation hosting 42,000 personnel had changed the face of Bikini Atoll forever. In July 1946 the first of 23 nuclear tests to be held on Bikini was conducted. Operation Crossroads was the bombing of a fleet of over 90 retired naval vessels, 16 of which today lie on the bottom of Bikini lagoon. In 1954 another enormously significant testing event occurred: the Castle Bravo, the world's first deliverable hydrogen device, which destroyed 3 islands and left a crater a mile wide. Fallout from the Castle Bravo was distributed across the Marshall Islands, having particular impact on the people of Rongelap and Utrik, and on the crew of a Japanese tuna boat. In the meantime, 43 nuclear tests were carried out on the neighboring atoll of Enewetak. Nuclear testing on Bikini finished in 1958, and after some attempts to clean-up the radioactive site, the Bikinians were allowed to return home in the 1970s. Within a couple of years, however, monitoring revealed the levels of radiation in their bodies was unacceptably high and Bikini was again abandoned. In 1985 the US Government handed over ownership of the sunken vessels to the people of Bikini, and these became the basis of a small-scale tourism operation. The population of Bikini today remains restricted to a few people monitoring the radiation, employees of the dive operation, and the visiting tourists. The people of Bikini, although now living elsewhere retain strong links of identity to their lost homeland.

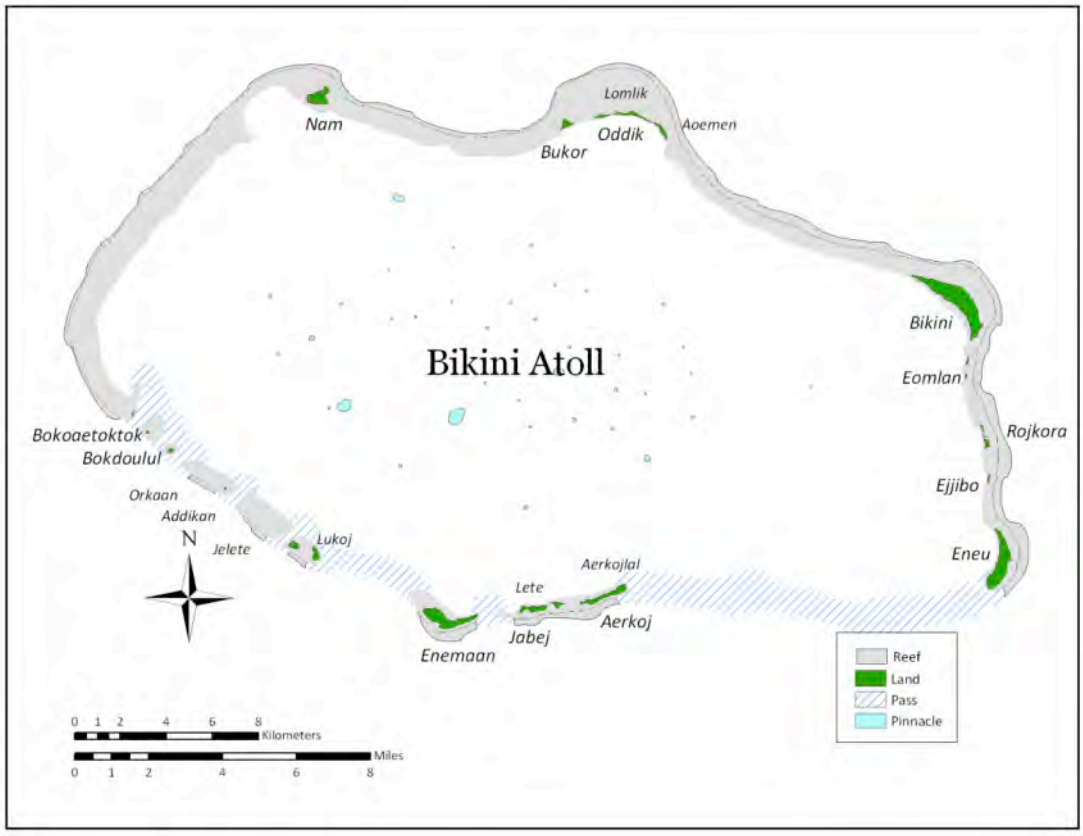
1.3 Location, Access and Geography

Bikini Atoll is the northern-most atoll in the western, *Ralik*, chain of atolls—one of 29 low-lying coral atolls that rise over 6,000 meters from the abyssal plain to no more than a couple of meters above sea level, and comprise the Marshall Islands, known to the Marshallese as *Aelōñ Kein.* The atolls consist of biotic limestone on a deep basalt core, built over millions of years by living coral organisms that grew as the basalt core slowly subsided, creating a marine environment extremely rich in productivity, diversity and complexity.



The entirety of the Marshall Islands lies in the central-western part of the Conservation International Polynesia/Micronesia Hotspot and the northern Marshall Islands form the Key Biodiversity Area, Kabin Meto. Bikini Atoll lies in this drier, northern part of the Marshall Islands. Air and water temperatures hover around 28 degrees Centigrade (82 Fahrenheit) year round, varying little from this. Annual rainfall is an average of 1500mm (60 inches).

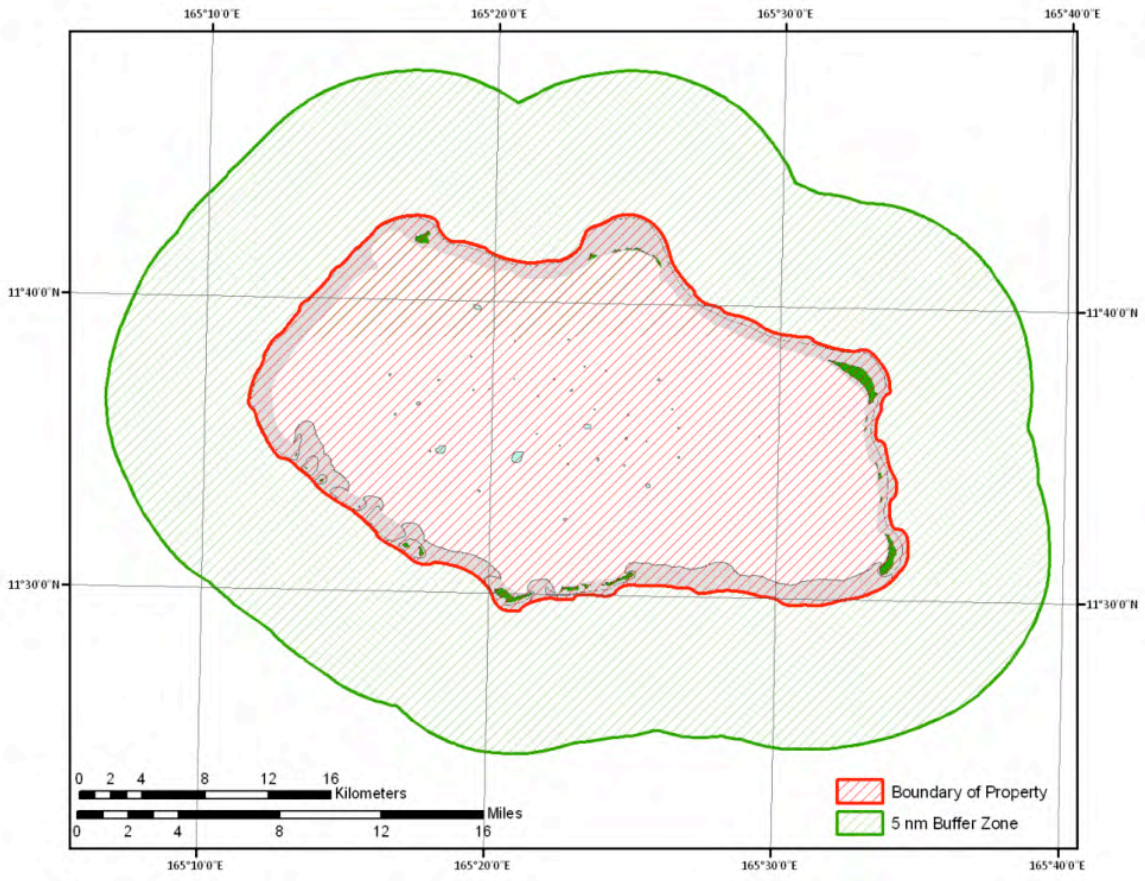
Bikini Atoll is 800 kilometers (500 Miles) from the main centre of Majuro, and an international airport. Access to Bikini is by the national domestic airline, Air Marshall Islands, or by boat. Weekly flights are scheduled to Bikini Atoll however during 2007 and 2008 Air Marshall Islands has been experiencing severe operational problems and so access to Bikini by aircraft is extremely limited and unpredictable at this time.



Bikini's 23 islands, a total land area of only 720 hectares (1780 acres), encircle an elongated and irregular lagoon which extends 40 kilometers (26 miles) long, east to west, 22 kilometers (15 miles) wide, north to south, and is around 60 meters (200 feet) at its deepest. Most of these islands are joined by a shallow reef, with several deep channels on the southern side of the lagoon. Eneu Channel, the largest, is 15 kilometers (9 miles) wide. Most of the islets on Bikini are small; Bikini Island is the largest with a total area of 212 hectares (524 acres) and Eneu the next largest at 115 hectares (284 acres).

1.4 Boundary of the Proposed World Heritage Site

The boundary of the core proposed World Heritage site of Bikini Atoll is clearly delineated by the outer visible reef of the atoll. A buffer zone extends 5 nautical miles from the baseline (basically the outer reef edge). No unauthorized vessels are to enter waters within 5 nautical miles of Bikini except as required for passage by international law. A further protective zone is established by fishing license conditions in the Marshalls Islands preventing any licensed boat from fishing within the territorial seas (12 nautical miles) surrounding each atoll.



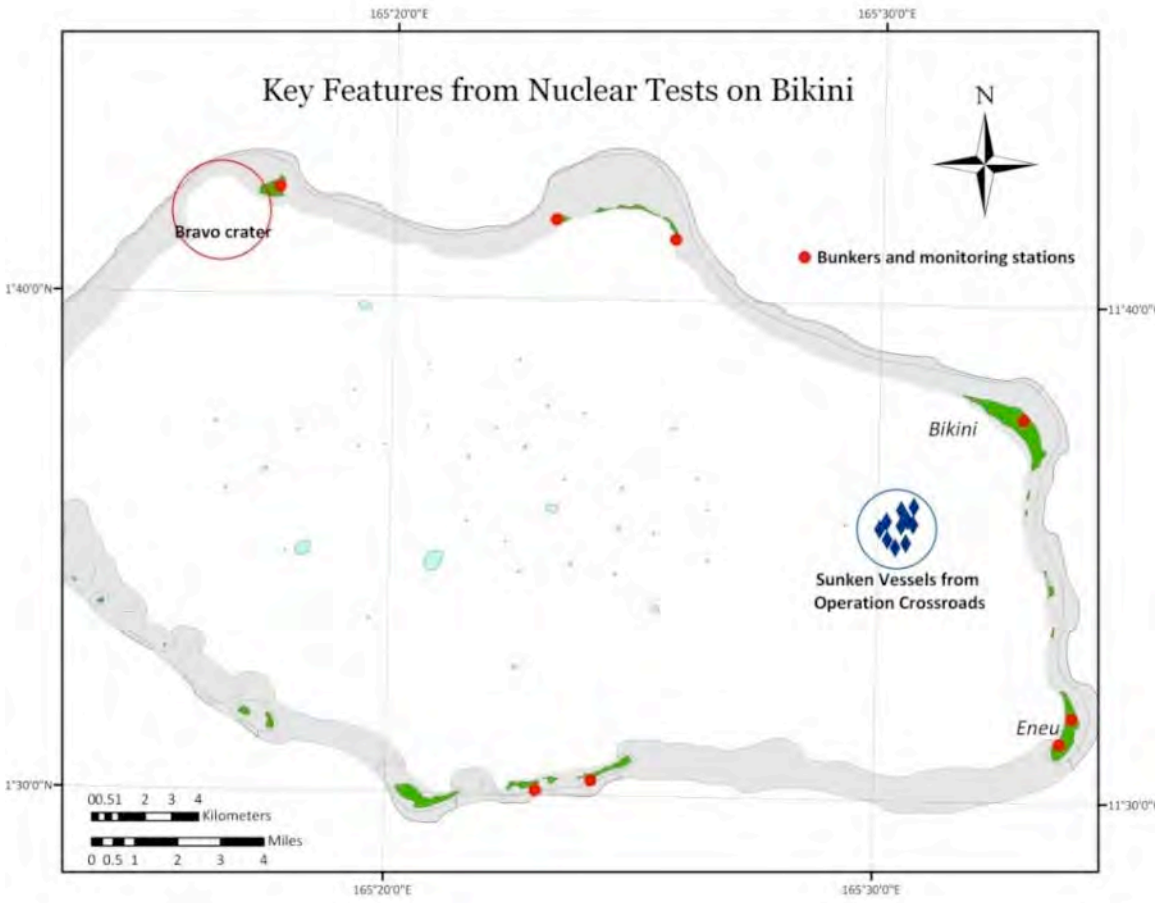
1.5 Cultural Resources

The Sunken Vessels

Five kilometers from Bikini Island, in 60 meters of water, lays the *Saratoga*, victim of Bikini's second bomb, Crossroads Baker; upright on the lagoon floor, her mast-top just below the water line. Three Helldiver planes and an Avenger torpedo bomber sit on her deck, with 500 pound bombs stacked on nearby racks and her anti-aircraft guns facing skyward. Nearby lays the flagship of the Japanese fleet, the *Nagato.* These are but two of the sixteen ships that lie on the bottom of Bikini lagoon; the most prominent remnants of the nuclear testing on Bikini. Most of these vessels are clustered in and around the shallow crater formed by the Crossroads Baker test of July 25, 1946.

Bunkers

On Eneu Island of Bikini Atoll there are two structures from the testing period: the remains of the cement Communications Station, and the cement Monitoring Bunker. On Bikini Island there is a small cement bunker at the back of the island. On several of the outer islands of Bikini Atoll there are cement monitoring stations that are still intact.



1.6 Natural Resources

Marine Environment

Because it is essentially uninhabited, Bikini Atoll has been able to experience a remarkable recovery from the devastation caused by the bomb testing program. It is of immense interest to science for studying the effects on, and recovery of, marine ecosystems following major disruption. The Bravo crater is of particular interest as the Bravo explosion created new lagoonal space and new opportunities for reef development and colonization.

Approximately 50 of the 183 species of coral recorded at Bikini Atoll (Richards et al. 2008) fall within an IUCN threatened category. Given Bikini Atoll reef ecosystems are relatively pristine (Pinca et al. 2002) in comparison to reefs occurring in more populated regions, Bikini provides some of the most significant reef habitat in the northern Pacific and in effect a refuge that may support the recovery in other more heavily impacted parts of the world such as South East Asia and the "Coral Triangle". Surveys of coral biodiversity carried out in 2002 (Richards et al. 2008) revealed eleven species of coral occur at Bikini Atoll despite never before being recorded in the Marshall Islands. Four of these species are considered, on current records, to be regionally restricted to Bikini Atoll—*Acanthastrea hillae*, *Acropora bushyensis*, *Montipora cocosensis*, *Polyphyllia talpina*. Two species (*Acanthastrea brevis* and *Montastrea salebrosa*) were found to be locally abundant and distributed widely at Bikini Atoll indicating Bikini Atoll provides significant habitat for the conservation of these species.

The rare and threatened species of giant clam *Tridacna gigas* appear to be particularly abundant in Bikini lagoon compared to other atolls of the Marshall Islands. This species is literally disappearing from the Pacific region and is found freely growing in Bikini as well as in the nearby atolls of Rongelap and Ailinginae. The locations where it is mostly found in Bikini are the lagoonal sites in the northwest (near Bravo crater) and central northern areas (in front of Aomoen island). At this latter site, many *Hyppopus hyppopus* are similarly found.

Fish fauna in Bikini is very diverse (species richness is 359) due to the high variability of habitats offered by lagoon, pass and ocean environments. The southern and eastern walls of Bikini sustain a high biomass of carnivores (*Lutjaunidae, Lethrinidae, Sphyraenidae, Carangidae*), while the lagoon is rich in invertebrate feeders and herbivores (*Mullidae, Ephinephelidae, Caesionidae*).

One special characteristic of Bikini that differentiates it from other atolls in the Marshalls and from many reefs in the world is the particularly high concentration of several shark species that are considered threatened including gray reef shark (*Charcharhinus amblyrhyncos,)* reef whitetip shark (*Trienodon obesus),* reef blacktip shark *(C. melanopterus)* and silvertip shark (*C. albimarginatus)*. The highest concentration is found at the so-called Shark Pass in the south where hundreds of *C. amblyrhyncos* swim inoffensively and undisturbed along the inner wall and at the pass itself. Tiger sharks (*Galeocerdo cuvier*) are also known to inhabit the lagoon of Bikini and to approach the shore at night or to swim by the decompression bars in the middle of the lagoon. The spotted eagle ray (*Aetobatus narinari*) is a frequent sight in the lagoon waters.

The Bikini property is a holistic single atoll system surrounded by open ocean. The location provides natural isolation from neighboring systems and from human intervention. This provides sufficient size for the ongoing functioning of the natural marine systems. While the terrestrial environment has been significantly disturbed, the marine environment reef system has a very high biodiversity, showing the range of species that demonstrate the system is functioning well including endemic biota, apex predators (sharks) and migratory species such as turtles.

Terrestrial Vegetation

So dramatic was the impact of testing on the islands that a vegetation survey by Fosberg in 1985 reported that on all the islands of Bikini "no unaltered vegetation has survived" (1988: 2) although the native species have survived. There are several stands of important species on some of the islands, including *Pisonia grandis*, a favorite nesting place for birds, and *Pemphis acidula*, which is a species of importance in the RMI (Reimaanlok: 2008). The islands of Eneu and Bikini are dominated by planted coconut palms "on a precisely laid-out 30 foot square grid system" (Fosberg 1988: 3). These trees remain untended and the physiognomy of the plantation varies from tall and luxuriant, with dense undergrowth, to stunted coconut palms with sparse undergrowth. Vegetation on other islands in 1985 was a mixture of the usual atoll strand vegetation (*Scaevola* and *Tournefortia*) and exotic species. There is a need to carry out a vegetation survey to understand how these atoll terrestrial systems have recovered from the testing and associated impacts.

Birds

Bikini Atoll is seeing an increase in avifauna, probably due to the absence of human hunting pressure. Twenty-six species of birds are documented for Bikini Atoll, including 3 IUCN Red-listed species: Buller's Shearwater (*Puffinus bulleri*), Sooty Shearwater (*Puffinus griseus*) and the Bristle-thighed curlew (*Numenius tahitiensis*). The Red-tailed Tropicbird (*Phaeton rubricauda*) now nests on Bikini, but was unknown to Bikinians prior to the testing. (Vander Velde and Vander Velde 2003).

1.7 Radiation

The residual radioactivity on Bikini is higher than on other atolls in the Marshall Islands, however there is no radiological risk from visiting the lagoon or the islands. It is safe to walk on the islands, swim in the lagoon and the drinking water is safe also – that is, the residual radioactivity is lower than the natural radioactivity occurring in many places in the world. It is also deemed safe to eat marine life. The main radiation risk is from eating food grown locally on Bikini, including coconuts and breadfruit, over a long period of time. This includes coconut crabs which are known to bio-accumulate the radioactive cesium remaining in the soil and plants.

1.8 The People of Bikini

The Bikinians left Bikini in 1946 and after many years as nuclear nomads, the main populations of Bikinians now reside on Ejit, a small islet of Majuro Atoll, and on Kili, an inhospitable island in the south-west reaches of the Marshall Islands. While the Bikinians that left Bikini Atoll in 1946 numbered only 167, the number of people that identify as Bikinian today is over 4,000. The people of Bikini are still active in the governance and management of Bikini Atoll through the Kili-Bikini-Ejit Local Government. This plan will establish a further mechanism for involvement through the establishment of the Bikini Atoll Conservation Management Board.

1.9 Ownership and Management of the Site

Ownership

As in the rest of the Marshall Islands, land on Bikini Atoll is held under customary tenure through traditional clan relationships. Land is divided into parcels, called 'weto', under specific customary ownership. Bikini Atoll has a recognized 'Iroij' or chief, and each parcel of land also has 'Alaps' (caretakers of the land) and 'Dri-jerbal' (workers).

Under Marshall Islands law, all marine areas (lagoon and ocean) below the mean high water mark are legally owned by the people of the Marshall Islands, through the Government of the Marshall Islands, with the recognition of traditional and customary rights of landowner, clan and municipality to control the use of and materials in marine areas. (Public Lands and Resources Act, 1996)

Local governments have the power to make any ordinances over the area of local government jurisdiction, so long as they are not inconsistent with any other legislative instrument that has the force of law in the Marshall

Islands (including regulations from national agencies but not including other municipal ordinances). Local Government jurisdiction is to a distance of 5 miles from the mean low water line (Constitution of the Republic of the Marshall Islands). In effect, this means that the ownership and control of resources in Bikini Atoll comes under both customary landowners, and the Kili-Bikini-Ejit Local Government.

All rights, title and interest to the ships sunk by the nuclear tests in 1946 in Bikini Atoll's lagoon were transferred from the Government of the United States to the people of Bikini under Section 177 of the Compact of Free Association of 1985. This agreement is significant because it is the only place in the world where the United States has ceded its rights to its sunken naval vessels (Agreement Between the Government of the United States and the Government of the Marshall Islands for the Implementation of Section 177 of the Compact of Free Association, Article VI, 1985).

Management

The management of Bikini Atoll, including all cultural heritage resources, is the responsibility of the Kili-Bikini-Ejit Local Government.

1.10 Existing Uses

Tourism

The existing use of Bikini is limited to a small dive tourism operation, visiting yachts, ongoing radiation monitoring activities of the US Department of Energy and occasional visits by the people of Bikini.

More recent construction was carried out to develop facilities for tourism on Bikini. Also on Eneu Island there is a crushed coral runway that allows for the landing of aircraft ranging from large propeller planes to small Lear jets. Eneu Island has a small airport terminal, several warehouses, crew quarters, a pier and dock, repair shops, a power plant, and several unfinished buildings that were at one time going to be utilized for tourism until it was decided by the Local Government to use Bikini Island for this purpose.

On Bikini Island there are two buildings used to house tourists that are situated along the beach, a large structure utilized as a dining hall and warehouse for supplies, a dive shop and tank filling station, a garage that also houses a water making complex, a TV/briefing room and office used for the tourism program, several buildings used by the US Department of Energy for their ongoing monitoring program, a dock facility, a fuel farm, a power plant, and several buildings used as repair shops for routine maintenance work on the facilities.

1.11 Key Challenges and Threats

Deterioration of nuclear testing artifacts

The processes of deterioration, especially in the ships, are irreversible and directly related to the atomic tests. In the case of the ships, blast damage introduced micro-fractures and may have produced isotopes of steel, accelerating the deterioration of the ships. Similarly deterioration of the concrete structures remaining on land is inevitable due to the harsh, salty environment. These processes at work, and the ultimate disintegration of the ships and bunkers is demonstrative of the legacy of the tests, and an integral and key aspect of this landscape—as such, these processes and the ongoing changes in the ships and structures should be monitored, assessed and documented.

Removal of artifacts

There are reports of unauthorized visitation and removal of artifacts in the early 90s. It is important to ensure the ongoing integrity of the site by preventing unauthorized removal of artifacts. This is addressed through restricted access to the site, supervised diving and visitation and a provision to allow for inspection of visitors bags upon departure from Bikini Atoll, or from the Marshall Islands.

Risks to divers

The ships at Bikini are at depths of up to 60 meters (200 feet) which is well below recommended recreational diving depths. Diving at these depths involves extended periods below water to allow for decompression before surfacing. In addition, penetration of the wrecks themselves requires a good level of skill, experience and comfort in diving. All these factors mean that divers must be well qualified and experienced, and must be aware of the risks prior to undertaking diving at Bikini Atoll. This requires good information and briefing to visitors prior to arriving at Bikini and prior to each dive, and also requires the signing of a waiver form acknowledging this information and releasing Bikini Atoll from liability.

Illegal, Unreported and Unregulated Fishing

Several fishing vessels have been caught in recent years fishing illegally in the atolls of Bikini, Ujelang, Jaluit and Mili. In 2002 a vessel was found fishing for sharks at Bikini Atoll and was successfully prosecuted. The current extent of illegal fishing is not known due to difficulties in surveillance and monitoring, however effective surveillance and enforcement and the prevention of illegal fishing is an objective of this management plan.

Overfishing or overharvesting

Atoll ecosystems were traditionally carefully managed to prevent overfishing and depletion of fish stocks, or other species. While the level of harvesting pressure is expected to remain low due to the isolation of Bikini, the ability for the people of Bikini and other visitors to carry out some harvest is important, as is occasional sport fishing for tourists on Bikini. This management plan and the correlating regulations will place restrictions on different species, or seasons and fishing methods to protect and maintain the current healthy populations of fish and other species at Bikini.

Local government ordinances placing restrictions on harvesting levels and sport-fishing have been passed (see attached KBE Ordinance 2010-02).

Climate change and sea-level rise

Climate change is a major threat to the low-lying Marshall Islands. The islands are at risk from storm surge in the short to medium term, and complete inundation in the future. Rises in sea temperature will likely cause coral bleaching – the extent and impact of which is unpredictable. Ocean acidification is predicted to seriously impact the ability of corals to grow and form skeletons. Bikini Atolll will best retain some resilience to climate change through maintaining the health and protection of its coral ecosystems.

Invasive species

Many land and marine invasive species, both plants and animals, are threatening the biodiversity of the Marshall Islands. Once an invasive species becomes established it can be extremely difficult and expensive to control or eradicate. Invasive species can cause the extinction of native and endemic species by taking over their positions in the ecosystem, or through predation. Bikini Atoll has many invasive exotic plant and animal species, particularly apparent in the terrestrial environment, due to the huge military and clean up operations here carried out over many years. At this point there are no plans to take particular measures to address either the introduction of new species or the eradication of established invasives due to the scale of the existing problem. With further assessment of the terrestrial environment and bird populations, however, it may be desirable in the future to establish a program to address invasive species.

1.12 Existing Legal Framework

Legislation, regulations and ordinances have been established at national and local level to ensure the legal protection of the artifacts and natural environment at Bikini Atoll.

Protection of Historic and Cultural Resources

The property currently has a high degree of protection through local ordinances and strictly controlled access.

The Historic and Cultural Preservation Act (1991) and its subsidiary regulations protect historic and cultural resources including governing access to submerged resources, the export of historic and cultural artifacts and control over land modification activities. The Act provides for fines of up $10,000 or six months imprisonment for violations. (The Historic and Cultural Preservation Act: Title 45, Ch 2, 1991; Regulations Governing The Taking And Export Of Artifacts, 1991; Regulations Governing Access To Prehistoric And Historic Submerged Resources, 1991; Regulations Governing Land Modification Activities, 1991)

In addition, Kili-Bikini-Ejit Local Government established ordinances in 1988 prohibiting entry to Bikini Atoll or diving on ships without a permit issued by KBE Local Government, and prohibiting removal of any object from Bikini lagoon (Ordinance No.14-1988). These were updated in 1996 to additionally require that all divers be accompanied by the official Bikini dive operation (Ordinance No.2-1996). All of these ordinances were combined and updated with the passing of KBE Ordinance 2010-02 (attached). All divers and yachts visiting Bikini Atoll are required to gain permission from KBE Local Government (through the Tourism Manager) and to sign a liability waiver confirming that they understand their responsibilities (Yacht Liability Waiver, 2008).

Protection of Biological Resources

Bikini has a high level of biodiversity protection also, based on a decree (July 30, 1997) from the KBE Local Government that it is illegal to fish for sharks or turtles in the lagoon, or to use gill nets or throw nets within the lagoon area. All bird habitats are preserved by this same decree. All fishing around the area of the sunken ships is prohibited. Additionally, at national level, licensed pelagic fishing vessels are prohibited from fishing within the 12 mile territorial seas of any atoll.

List of Ordinances

Marine Resource Ordinance (Dated July 28, 1997): Ordinance passed in 1997 with the object of conserving the marine and wildlife resources of Bikini Atoll.

Ordinance No. 14-1988 (October 8, 1988): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was created soon after the ships were made the property of the Bikinians under Section 177 of the Compact of Free Associated (year? And ref).

Ordinance No. 2-1996 (May 30, 1996): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was developed soon after the establishment of a commercial dive operation on Bikini Atoll and required that all divers be supervised by the authorized dive operation.

Ordinance No. 2-2010 (January 21, 2010)): Ordinance that combines and updates all of the above Ordinances (Marine Resource Ordinance, Ordinance No. 14-1988 and Ordinance 2-1996).

Liability Release Form and Express Assumption of Risk for Diving at Bikini Atoll: All tourist divers at Bikini are required to sign a liability release form that also informs them of the rules regarding removal of artifacts. During times when the dive operation is active, each diver is required to sign this form. Visiting yachts are required to sign this form also.

2. The Plan

2.1 Goals and Objectives

Goal

To identify, protect, conserve, present and transmit the cultural heritage values of Bikini in relation to the World Heritage Listing, and to protect the biodiversity of Bikini Atoll.

Cultural Heritage Objectives

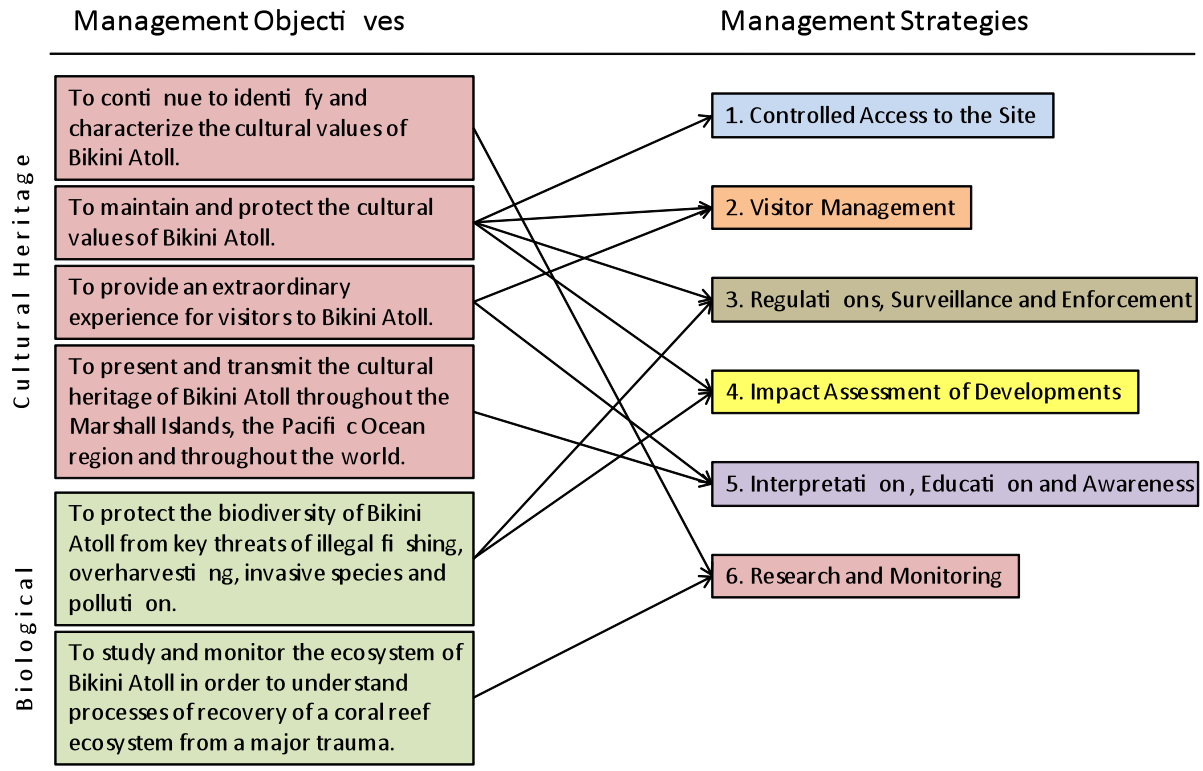
- To continue to identify and characterize the cultural values of Bikini Atoll.
- To maintain and protect the cultural values of Bikini Atoll.
- To provide an extraordinary experience for visitors to Bikini Atoll.
- To present and transmit the cultural heritage of Bikini Atoll throughout the Marshall Islands, the Pacific Ocean region and throughout the world.

Biological Objectives

- To protect the biodiversity of Bikini Atoll from key threats of illegal fishing, overharvesting, invasive species and pollution.
- To study and monitor the ecosystem of Bikini Atoll in order to understand processes of recovery of a coral reef ecosystem from a major trauma.

2. 2 Management Strategies

The diagram below indicates how the key management strategies outlined in this plan link to the achievement of the objectives for the site.



Strategy 1. Controlled Access to the Site

Access to Bikini Atoll is restricted to recreation and tourism visitors, and to scientific survey teams. All people wishing to visit Bikini by aircraft must obtain prior permission. All vessels wishing to enter Bikini Atoll must obtain prior permission from the KBE Local Government through the permitting procedure. Yachts and boats may visit Bikini (with a permit) but, if diving, must be accompanied by a diver and an observer in the employ of the Kili-Bikini-Ejit Local Government.

Key Actions	***Timing***	***Responsibility***	***Partners and Additional Resources Required***
Document and formalize permitting procedure for access to Bikini Atoll.	Jun 2009	Jack Niedenthal	-

Strategy 2. Visitor Management

The visitor experience of Bikini is very closely managed due to the remoteness of the atoll, controlled access to the site, the depth of the dives and the need to protect the ships and artifacts. Visitors to Bikini can expect an amazing experience due not only to the spectacular location and activities, but the professionalism and hospitality of the Bikini Atoll staff, and the comfortable facilities on offer.

Bikini Atoll has been open to tourists since 1996 and is considered one of the World's premier dive destinations. Visitors to Bikini Atoll generally come as part of the dive tourism program run by Bikini Atoll Divers, a business owned by the Kili-Bikini-Ejit Local Government. To date, tourism on Bikini has mainly been focused on the sunken vessels which are considered one of the premier SCUBA diving experiences in the world (see http://www.bikiniatoll.com/divetour2.html for articles, reviews and testimonials of the tourism-diving experience of Bikini Atoll). While the vessels sunk during Operation Crossroads in 1946, are the premier attraction, there is also the opportunity to go sport fishing and to dive or snorkel some of the beautiful coral reef, or to walk on and explore some of the islands.

The current and expected future levels of tourism to Bikini Atoll remain very low, mainly due to the relative inaccessibility of the atoll and the associated high costs. A restricted number of divers visit the site each year for diving the wrecks of the sunken ships. To date this has been a maximum of 12 per week during the dive season from March to November, a total of between 200 and 250 per year. In the future, depending on transport options to Bikini, the number may expand to around 20 visitors per week, or 400 per year.

Unfortunately 2008 has seen the temporary closure of the Bikini Atoll Divers operation due to the unreliable nature of Air Marshall Islands, the national airline servicing Bikini. The failure of the airline to fly scheduled routes throughout 2007 and 2008 left visitors to Bikini Atoll stranded for weeks at a time. During the 2008 season Bikini Atoll Divers and the KBE Local Government made the difficult decision to cancel the remainder of the season and to close the dive operation for 2009 and 2010.

The facilities described below are maintained on Bikini until the dive operation can resume.

DIVING FACILITIES

A typical visit to Bikini over a week includes 12 deep decompression dives—these are dives that are below normal recreational diving limits and require the use of staged decompression stops prior to surfacing. Facilities for divers include tanks, two dive boats, a tank filling station for both air and nitrox (decompression gas), oxygen generation equipment, dive equipment repair shop. Decompression stops are facilitated by a decompression station that is hung from the dive boat.

ACCOMMODATION AND DINING

Visitors to Bikini sleep in private, air-conditioned comfort with 24 hour power and hot running water, right on one of the most beautiful beaches in the Pacific. A dining hall provides an "all you can eat" buffet style selection for breakfast, lunch and dinner.

INTERPRETATION AND EXPLANATION DURING THE VISIT

Over the course of the week's dive tour historical documentary films are shown, complete briefings about each of the ships and their respective histories are given, and there is a tour of the island and the atoll. The Bikinians feel this to be important because this allows their story to be taken away by tourists and retold to their families and friends. In short, the tourism program helps perpetuate a story the islanders want the world to remember. Before each dive the divemasters give a full briefing about the vessel's history and unique characteristics, and a comprehensive dive plan.

VISITING YACHTS AND PRIVATE VESSELS

Yachts and Private Vessels may visit Bikini, as long as they meet requirements for safety and being able to manage decompression diving. The conditions of this visit are that they are accompanied by a diver and by an observer affiliated with the KBE Local Government to ensure there is no damage to or removal or artifacts.

Strategy 3. Regulations, Surveillance and Enforcement

Access to Bikini is restricted to recreation and tourism visitors, and to scientific survey teams. All people wishing to visit Bikini by aircraft must obtain prior permission from the Kili-Bikini-Ejit Local Government through an established permitting procedure.

Divers on the sunken vessels must be accompanied by a diver employed by Bikini. Divers that visit Bikini are usually very experienced and well-certified to dive on, and to penetrate, the sunken vessels without causing damage. Divers are required to sign waivers and are prohibited from removing artifacts from the ships. This may be enforced by bag checks upon departure. Yachts are able to visit Bikini but must gain permissions from Bikini Atoll Local Government, and are not permitted to dive the wrecks unless accompanied by a diver employed by Bikini.

Nationally, licensed fishing boats are required to be part of the Vessel Monitoring System (VMS), which allows the Marshall Islands Marine Resources Authority (MIMRA) to track the position of vessels and if they are found within 12 nautical miles of any atoll, to pass this information on to the Sea Patrol operation (an arm of the Marshall Islands Police) and support apprehension and prosecution for any illegal fishing.

When the dive operation is running on Bikini, staff there can observe unauthorized vessels in or near the lagoon. They can then approach the vessel using one of the boats on Bikini Atoll and collect evidence, such as photos, to support prosecution. They can radio the Marshall Islands Sea Patrol to pursue the unauthorized vessel. Bikini Atoll has successfully pursued one prosecution of unauthorized shark finning in 2002.

All of these protective measures are more difficult to implement when the regular dive operation is not running. An option is being developed to install a radar system at the western end of the atoll to notify staff on Bikini Island of any unauthorized vessel in the vicinity, which can then be reported to Sea Patrol who can then pursue and prosecute.

Strategy 4. Impact Assessment of Proposed Developments on Bikini

Features of Bikini Atoll that contribute to the overall character of an abandoned nuclear test site include the rows of coconut trees and the generally low level of buildings and construction. There is a need to assess any proposed demolition, construction, land-clearing, earthmoving or similar activity in light of its impact on the attributes of Bikini Atoll as a former nuclear test site. There are established permitting requirements for this that assess the impact of a development against impacts on environmental and heritage resources. Any

earthmoving or construction activity must gain a permit from the Republic of the Marshall Islands Environmental Protection Authority (RMIEPA) and from the Historic Preservation Office (HPO). In addition to this, the Bikini Atoll Conservation Management Board must consider any proposal to carry out works on Bikini in light of the effects the work may have on the outstanding universal value of the site. In this respect they shall also seek advice from ICOMOS and the World Heritage Centre, and from other international experts.

Key Actions	***Timing***	***Responsibility***	***Partners and Additional Resources Required***
Ensure proper assessment of any proposed works on Bikini including consultation with international experts and ICOMOS.	Ongoing	Chair, Bikini Atoll Conservation Management Board	Access to international experts will be required.

Strategy 5. Interpretation, Education and Awareness

Education and awareness about Bikini is to be designed for three key target audiences. The first is the people of the Marshall Islands and the people of Bikini Atoll living on Kili, Majuro and elsewhere. The second is foreign visitors and tourists to Bikini and the Marshall Islands. The third is more generally people around world. Several programs are under development that will contribute greatly to the transmission of the World Heritage values of Bikini Atoll including the following:

BIKINI ATOLL WEBSITE

The official website of Bikini Atoll http://www.bikiniatoll.com/ has been developed and maintained by Jack Niedenthal since 1997 (the longest running website involving the Marshall Islands) and contains a wealth of information about Bikini Atoll. This website will continue to be developed to incorporate more information about the World Heritage values of Bikini, and to present them to a global audience.

ON-SITE INTERPRETATION

Bikini Atoll will continue to deliver and develop its on-site interpretation program for visitors, as described in *Strategy 2.Visitor Management*, above. This will be done with the assistance of international experts in submerged heritage.

ENVIRONMENT AND HERITAGE YOUTH THEATRE PROJECT

Youth to Youth in Health (Y2Y) is a community-based NGO that supports at-risk youth to develop and deliver peer-to-peer education programs. Y2Y specialize in using the medium of theatre and music to positively impact young people's lives by exploring issues such as sexual health, alcohol and drugs, and family life. Inspired by the World Heritage project and other conservation activities in the Marshalls, Y2Y propose to develop a theatre program that focuses specifically on the issues of natural and cultural heritage of the Marshall Islands, starting with the nuclear heritage of Bikini Atoll as a proposed World Heritage site, and the natural and cultural values of Ailinginae Atoll. While a proposal has been developed, the project needs substantial technical assistance and funding to become established.

MARSHALL ISLANDS PEACE MUSEUM

A project is currently under development as a partnership between the Marshall Islands government and interested parties in Japan to establish a Peace Museum in Majuro, commemorating the nuclear history of the Marshall Islands, with the intention of promoting peace throughout the world. The Peace Museum will include exhibits on nuclear tests in the Marshalls and the impacts on the Marshallese people, including the events and people of Bikini Atoll.

Key Actions	*Timing*	*Responsibility*	*Partners and Additional Resources Required*
Maintain and upgrade Bikini Atoll website to present material on Bikini's proposed World Heritage values	Dec 2010	Jack Niedenthal	Consider support from a web-design and/or heritage management faculty as a graduate project.
Upgrade interpretive materials on the sunken vessels and other site to enhance visitor experience	Dec 2010	Jack Niedenthal	Partnership with Charles Beeker at Indiana University
Establishment of Environment and Heritage Youth Theatre Program	Dec 2010	Youth to Youth in Health	Dependent on recruitment of theatre professional and raising $250k.
Development of exhibit for proposed Peace Museum in Majuro	Dec 2010	Peace Museum	In partnership with experts helping to establish the Peace Museum

Strategy 6. Research and Monitoring

SCIENTIFIC STUDY, MONITORING AND INTERPRETATION OF CULTURAL HERITAGE RESOURCES

The most recent archeological assessment carried out 1991 (Delgado et al., 1991) by the US National Parks Service revealed the historical and archaeological significance of the artifacts at Bikini Atoll, and led to the development of interpretation materials and the opening of Bikini Atoll to dive tourism. There is a need to develop partnerships with universities and research institutions to enable the ongoing identification and characterization of the cultural heritage resources at Bikini.

Bikini Atoll is in the early stages of developing a program in partnership with maritime archaeologists and conservation scientists at the Institute of Nautical Archaeology, James Cook University, and at the Western Australian Maritime Museum. This program will conduct a baseline assessment of the state of conservation of the vessels and buildings, and develop a protocol and indicators for a regular assessment of the state of conservation of these artifacts. Local staff divers of Bikini Atoll will be trained in how to conduct a regular state of conservation assessment. The monitoring protocol will likely involve taking photographs at fixed monitoring points and comparing these photographs over the years. A partnership with Charles Beeker's Underwater Science group at Indiana University is also being developed which will lead to the development of interpretation materials for the site. These partners will help to develop the funding and expert resources required to carry out these activities.

SCIENTIFIC STUDY AND MONITORING OF MARINE ENVIRONMENT

Bikini Atoll provides as unique opportunity to study the recovery of a coral reef system, and a terrestrial system, after the major disturbance of nuclear testing and persistent radiation. Scientific study and monitoring of Bikini Atoll will allow increased understanding of the ecosystem and processes of Bikini, and therefore of other atolls and coral reef systems. It will enable the study of the impacts of climate change and other remote impacts on coral reef systems in the absence of pollution and over-harvesting of resources. A scientific program should be managed in a way that that benefits the people of the Marshall Islands.

Partnerships with scientific research organizations are to be sought and established to enable long-term monitoring of the condition and biodiversity of the site. Zoe Richards of James Cook University, Maria Beger from the University of Queensland and Silvia Pinca of the Secretariat of the Pacific Community form a core of marine biologists who have carried out biological resources assessments on several atolls in the Marshall Islands, and who have made recommendations for the conservation management of these sites.

A team of scientists (including the three mentioned above) carried out a baseline survey of the marine environment Bikini Atoll in 2002, establishing a set of indicators for monitoring the state of conservation of the marine environment. These indicators include:

- Coral and fish biodiversity: presence/absence and semi-qualitative abundance in timed swims
- Algae diversity and abundance
- Percent cover of substrate, coral and algae
- Reef health including counts of *Acanthaster planci* (crown-of-thorn starfish), dead and bleached coral
- Counts of target species of invertebrates
- Fish size and abundance of commercially and ecologically important species.

While the survey established a baseline in 2002, there is no ongoing program of monitoring due to lack of available resources, however, with recent interest in a scientific paper on Bikini in 2008, (Richards et al. 2008) it is expected that more resources will become available for research and monitoring on Bikini. There is a need to carry out baseline assessment of avifauna and vegetation on the island and to develop monitoring indicators.

Key Actions	***Timing***	***Responsibility***	***Partners and Additional Resources Required***
Carry out baseline assessment of state of conservation of artifacts	Dec 2010	Jack Niedenthal	James Cook University and Western Australian Maritime Museum
Develop interpretation materials for the sunken vessels	Dec 2010	Jack Niedenthal	Charles Beeker at Indiana University
Continuation of partnership with marine scientists to carry out monitoring of biodiversity on Bikini Atoll.	Ongoing	Jack Niedenthal	Experts from various international research institutions, MIMRA and the College of the Marshall Islands.

2.3 Management, Administration and Reporting

Roles and Responsibilities

KILI-BIKINI-EJIT LOCAL GOVERNMENT

Kili-Bikini-Ejit (KBE) Local Government is the elected local government for the community of Bikini, now living on Ejit Islet in Majuro and on Kili Island. The Bikini Atoll Local Government is responsible for the management of the site.

BIKINI ATOLL CONSERVATION MANAGEMENT BOARD

Under this management plan, The Bikini Atoll Conservation Management Board (BACMB) will be established under the auspices of the KBE Local Government, and will meet at least every three months. The Bikini Atoll Conservation Management Board membership will consist of:

- The Mayor, the Senator and the Executive Committee of the Kili/Bikini/Ejit Local Government Council;
- Bikini Liaison Officer;
- Bikini Tourism Representative/Bikini Atoll Conservation Manager;
- Resort Manager of the Bikini Atoll Tourism Operation (when in operation);
- Bikini Project Manager or his her representative;
- Traditional leader representative from Bikini Atoll;
- Youth representative;
- Women's representative; and

- Member to be appointed by the RMI Historical Preservation Office.

The role of the Management Board is to:

- Carry out management planning;
- Recommend rules, regulations and procedures;
- Ensure the effective implementation of the Bikini Atoll Conservation Management Plan.

EXPERT HERITAGE ADVISORS

International experts in marine archaeology or cold war heritage and conservation will be recruited to provide advice on an as-needs basis, either on a volunteer basis or with the support of their institutions. It is expected that this pool of experts will include individuals with an established knowledge of Bikini, such as James P. Delgado (maritime archaeologist), Jeffrey Sasha Davis (cultural geographer), Anita Smith (archaeologist) as well as experts established in their fields such as Charles Beeker of Indiana University, Vickie Williams of the Western Australian Maritime Museum and William Jeffery of James Cook University, as discussed earlier.

The role of the Expert Heritage Advisor/s will be to:

- Advise on conservation actions for the artifacts;
- Assist in developing proposals and grant applications for the ongoing study and interpretation of the site;
- Carry out assessments and assist in the development of interpretation materials; and
- Advise on the impact of proposed developments on Bikini—whether they will affect the heritage values.

CONSERVATION PROJECT MANAGER

The Conservation Project Manager will be based in Majuro with regular visits to Bikini to work with conservation officers there. The Conservation Project Manager role is not expected to be full-time, but could be combined with an existing role under the KBE Local Government. The role of the Conservation Project Manager will be to:

- Work with stakeholders at local, national and international level to implement the Bikini Atoll Conservation Management Plan;
- Develop partnerships, funding sources for implementation of the Bikini Atoll Conservation Management Plan;
- Oversee day-to-day management of the conservation area: develop work plans, ensure staff carry out the activities stated in their job descriptions and work plans;
- Conduct regular education and awareness, community consultations;
- Identify training and capacity-building needs for staff and ensure staff receive this training;
- Provide reports to meet the requirements of donors and grant contracts;
- Monitor the implementation of the plan and adapt the management of the site as appropriate.

BIKINI ATOLL DIVERS

Bikini Atoll Divers is the dive operation owned by the KBE Local Government. The staff of Bikini Atoll Divers will play an active role in the day-to-day management, monitoring and surveillance of the site. They will also be trained to conduct monitoring of the state of conservation of the sunken vessels and buildings.

Location

The Majuro-based staff will be located in the KBE Local Government Offices. The Bikini-based staff will be located at the dive tourism facilities on Bikini Island.

Key Equipment and Materials

The dive operation on Bikini Atoll is equipped with two boats for dive tourism. These boats will be used also for the surveillance of the atoll in the case that an unauthorized vessel is in the vicinity. Due to the distance from Bikini Island on the eastern side of the atoll where the operations are based, and the uninhabited western side of the atoll, it is not possible to visually see unauthorized vessels. It is intended to install a radar-based remote surveillance system which would transmit a signal to a station at Bikini Island. It is expected that a basic installation will cost of the order of $100,000.

Marshall Islands and the implementation of the World Heritage Convention

In general the Marshall Islands, as a small island developing state, has very limited technical capacity. To compound this, the Marshall Islands is party to various international conventions, due in large part to the efforts of these conventions to include small island developing states and so limited resources are further stretched in order to meet the considerable obligations of such conventions. The management, interpretation, presentation and conservation of Bikini Atoll will require ongoing support and assistance from the World Heritage Centre, the Advisory Bodies and other state parties to the convention.

Periodic Reporting to the World Heritage Centre

In the case that Bikini is included on the World Heritage List, periodic reporting to the World Heritage Centre will be required. Monitoring and reporting on the state of conservation of the property will be the responsibility of the Kili-Bikini-Ejit Local Government and reporting on general issues of implementation of the convention will be the responsibility of the focal point of the convention, which at this time is the Alele Museum. Both responsible agencies are likely to require assistance and support from the World Heritage Centre and the Advisory Bodies in the preparation of periodic reports.

Appendices:

A.1 Selected References

Delgado, J.P., Lenihan, D.J, & Murphy, L.F. (1991). *The Archaeology of the Atomic Bomb: A Submerged Cultural Resources Assessment of the Sunken Fleet of Operation Crossroads at Bikini and Kwajalein Atoll Lagoons, Republic of the Marshall Islands*. Santa Fe, N.M.: US Department of the Interior, National Park Service, Submerged Cultural Resources Unit. Note: an online version can be found at http://www.nps.gov/history/history/online_books/swcrc/37/contents.htm

Fosberg, F. Raymond. 1988. Vegetation of Bikini Atoll, 1985. *Atoll Research Bulletin* 315: 1-28. National Museum of Natural History, The Smithsonian Institution: Washington, D.C.

Pinca, S., Beger., M., Richards, Z., and Peterson, E. 2002. Coral Reef Biodiversity Community-based Assessment and Conservation Planning in the Marshall Islands: Baseline surveys, capacity building and natural protection and management of coral reefs of the atolls of Bikini and Rongelap. Report to the Rongelap Government, Republic of the Marshall Islands.

Reimaanlok National Planning Team. 2008. *Reimaanlok: National Conservation Area Plan for the Marshall Islands.* N. Baker: Melbourne.

Richards, Z. T., M. Beger, S. Pinca, and C. C. Wallace. (2008). Bikini Atoll coral biodiversity resilience revealed; five decades after nuclear testing. *Marine Pollution Bulletin. 56*, 503-515.

Vander Velde, Nancy and Brian Vander Velde. 2003. *A Review of the Birds of Bikini Atoll, Marshall Islands with Recent Observations.* Unpublished report for Bikini Atoll Local Government: Majuro.

A.2 Existing Local Government Ordinances

Marine Resource Ordinance (Dated July 28, 1997): Ordinance passed in 1997 with the object of conserving the marine and wildlife resources of Bikini Atoll. ***Attached.***

Ordinance No. 14-1988 (October 8, 1988): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was created soon after the ships were made the property of the Bikinians under Section 177 of the Compact of Free Association in 1986. ***Attached.***

Ordinance No. 2-1996 (May 30, 1996): Ordinance to prevent unauthorized diving in Bikini Atoll lagoon and to prevent removal of artifacts from ships. This ordinance was developed soon after the establishment of a commercial dive operation on Bikini Atoll and required that all divers be supervised by the authorized dive operation. ***Attached.***

Ordinance No. 2-2010 (January 21, 2010)): Ordinance that combines and updates all of the above Ordinances (Marine Resource Ordinance, Ordinance No. 14-1988 and Ordinance 2-1996).***Attached.***

Liability Release Form and Express Assumption of Risk for Diving at Bikini Atoll: All tourist divers at Bikini are required to sign a liability release form that also informs them of the rules regarding removal of artifacts. During times when the dive operation is active, each diver is required to sign this form. Visiting yachts are required to sign this form also. ***Attached.***

Special thanks to Nicole Baker for preparing this plan.

KILI/BIKINI/EJIT
LOCAL GOVERNMENT COUNCIL

Tomaki Juda
Mayor

P.O. Box 3007
Majuro, MH 96960
Telephone 011 692 625 3177
Fax 011 692 625 3330

July 30, 1997

To Whom It May Concern:

The following regulations were passed by the Kili/Bikini/Ejit Local Government Council on July 28, 1997 regarding our marine resources on Bikini Atoll:

1) No gill-nets shall be used in any part of the atoll, both lagoon and oceanside.

2) Throw-nets or fishing rods shall be the sole method of gathering fish.

3) No commercial fishing is permitted within the 12 nautical miles claimed by the Kili/Bikini/Ejit Local Government Council Constitution: This includes dynamite, cyanide, drift-net or any form of shark fishing.

4) Important sports-fish species such as trevally and bonefish are protected: These species shall be released alive and unharmed unless a potential world record or other circumstances dictates such to be unwise.

5) All wildlife on and around islands between Bikini, Aoemen and Eneu shall be protected: This includes all birds and nesting turtles and their eggs.

6) All turtles are protected and shall not be taken unless there is written authorization from the Mayor.

7) All natural resources not mentioned in these regulations on and around the atoll shall be preserved in such a way that they are not exploited.

8) The quadrants encompassed by the following longitudes and latitudes, 165• 30' E longitude, 11• 35' N latitude, the area of the buoyed ships, shall be protected from any form of fishing and is considered a marine sanctuary by the Kili/Bikini/Ejit Local Government Council.

Mayor Tomaki Juda

Protected Fishes at Bikini Atoll

ALL Bonefish shall be released IMMEDIATELY.

ALL Trevally of any species shall be released if caught within 300 yards of any land structure, or of any reef flats surrounding land.

NO "snappers" can be taken off any reef flats (reef on ocean side of islands and at either end)

A MINIMUM SIZE of 12 INCHES applies to ALL species of fish roughly classed as "GROUPERS" and "SNAPPERS". Fish smaller than this must be released, and if the hook has been swallowed then the line should be cut as close to the hook as possible to aid survival. DO NOT try to cut or pull out a swallowed hook as it may kill the fish. A fish hook is inexpensive to lose, and you CANNOT keep these fish even if they die!

The use of BARBLESS hooks (Barb squashed down with pliers) aids in releasing fish easily upon capture, and does not significantly reduce the catch rate!

No fish or lobsters can be taken with spears, Hawaiian slings etc.

This does not mean that you cannot catch these fish, it just means that they must be released so that somebody else can also catch that fish later on. The reason for these regulations is to maintain the great fishing we have here for future guests to these islands, and all regulations are very, very reasonable to anyone who has lived in USA or elsewhere in the developed world.

Rules for lobster.

The only method allowed for taking lobster is by hand. NO lobsters can be taken with spears.

ALL female lobsters with eggs shall be immediately released unharmed.

The minimum size for lobsters should be 14 inches from eyes to tip of tail, or about 1 ½-2 lbs.

The lobster caught here should be for local consumption, and definitely not for sale in Majuro.

Rules for Birds

No "Frigate Birds"or "Hawks" shall be taken for consumption, or sent to Majuro.

No birds will be sent to Majuro without written permission from the Bikini Council.

Bird "harvesting" shall be LIMITED to 1 bird per person, with an ABSOLUTE MAXIMUM of 10 birds per party

NO adult birds will be taken.

Only one harvest of birds every 6 months.

Birds can only be taken from the "Bird Islands", and are completely protected on all islands from and including Enue over to Aoemen, where NO birds shall be taken.

These rules are to reduce the over-exploitation of these animals, and will help to make it possible to take SOME of these animals EVERY year without severely disturbing the population numbers. It is called a SUSTAINABLE HARVEST, and is a widely adopted attitude around the world. This way neither side "suffers".

All regulations were passed by the Kili/Bikini/Ejit Council on July 28, 1997.

Thank you for your co-operation

KILI/BIKINI/EJIT LOCAL COUNCIL
KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO.14-1988

Ordinance No. 14-1988 has been created by the Kili/Bikini/Ejit Local Council for Bikini Atoll:

Section 1. Title:

This is an ordinance to prevent recreational diving within the Bikini Atoll lagoon in general and specifically on the ships, cables and any other nuclear weapons testing artifacts on the bottom of the Bikini Atoll lagoon.

Section 2. Purpose for Ordinance:

1. **Unauthorized vessels have been sighted within the confines of Bikini Atoll lagoon.**

2. **Persons diving on the ships and cables in the lagoon had not retained the correct permits and legal waivers to do so.**

3. **Diving on the ships of Bikini lagoon remains dangerous due to the unexploded war ordnance still on and around the ships. Artifacts, that are the property of the Bikini Atoll Local Government according to the Compact of Free Association, have been pilfered from the ships by these divers.**

Section 3. Measures to be taken to correct situation:

1. **No vessel is permited to enter the lagoon of Bikini Atoll without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

2. **No person/persons are permited to dive within the confines of Bikini Atoll lagoon without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

Section 4. Result if ordinance 14-1988 is defied:

1. **The cost of a diving permit is $ 125.00 per day/per vessel and can be obtained at the KBE Local Government office along with necessary legal waiver forms and entry permits for the Bikini Atoll lagoon.**

2. **Any person/persons convicted of diving within the confines of Bikini Atoll Lagoon without permission shall be subject to a fine of $ 2,000.00 or subject to a six month jail term.**

3. **Any person convicted of taking any object from the bottom of the Bikini Atoll lagoon, whether natural or related to the testing of nuclear weapons, shall be fined $ 5,000.00 per object or subject to a six month jail term.**

4. **Unauthorized vessels entering Bikini Atoll lagoon will be confiscated by the KBE Local Government.**

Section 5. Effective Date:

1. **After being passed and approved by the Kili/Bikini/Ejit Local Council this ordinance will become effective:**

Date introduced: 10/6/88
Dated Public Hearing: 10/6/88

Approved:* /s/ _____
Tomaki Juda, Mayor Date
Kili/Bikini/Ejit Local Council

Witness:* /s/ _____
Andy Bill, Clerk Date
Kili/Bikini/Ejit Local Council

* (See attached for signatures on Marshallese version).

KILI/BIKINI/EJIT LOCAL COUNCIL

KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO. 14

Ordinance No. 14 ej kio ejak jen Kili/Bikini/Ejit Council einwot in,

Section 1. Title:

Juon kien nan kamo tulok im jibwe jabrewot men ko ilo wa im cables ko ilo maloan Bikini Atoll.

Section 2. Kin Un Kein:

1. Elon ro rej lo ir ilo maloan Bikini.
2. Elon ro rej ilok ilo an ejelok permit.
3. Elon ro rej ilok im tuloki wa ko kab cable eo.

Section 3. Bwe en jimwe im Emonlok:

1. Jabrewot armij ejab melim aer lolok Bikini ilo an ejelok melim ko jen Office eo an KBE Local Govermment.
2. Jabrewot armij ejab melim aer tuloki wa ko im cable ko ne ejelok aer melim jen Office eo an KBE Local Government.

Section 4. Non jab Bokake:

1. Jabrewot eo enaj ilok im tuloki wa ko ej aikuj wor an permit jen Office eo an KBE Local Government kin jonan in $125.00
2. Jabrewot eo enaj ilok im tulok ilo an ejelok an permit en ilok kaje nan e kin jonan in $2,000.00 dollars fine 6 alling kalbuij.
3. Jabrewot eo ejelok an permit ak ej ebok jabrewot jen Wa ko inem ej aikuij fine $ 5,000.00 ak 6 alling kalbuij.
4. UNAUTHORIZED VESSELS WILL BE CONFISCATED BY KBE LOCAL GOVERNMENT

Date Introduced: 10/8/88

Date Public Hearing: 10/8/88

Kamol: Tomaki Juda 10/8/88
Tomaki Juda, Mayor Ran
Kili/Bikini/Ejit
Local Council

Iman Meja: Andy Bill 10/8/88
Andy Bill, Clerk Ran
Kili/Bikini/Ejit
Local Council

KILI/BIKINI/EJIT LOCAL COUNCIL
KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO.14-1988

Ordinance No. 14-1988 has been created by the Kili/Bikini/Ejit Local Council for Bikini Atoll:

Section 1. Title:

This is an ordinance to prevent recreational diving within the Bikini Atoll lagoon in general and specifically on the ships, cables and any other nuclear weapons testing artifacts on the bottom of the Bikini Atoll lagoon.

Section 2. Purpose for Ordinance:

1. **Unauthorized vessels have been sighted within the confines of Bikini Atoll lagoon.**

2. **Persons diving on the ships and cables in the lagoon had not retained the correct permits and legal waivers to do so.**

3. **Diving on the ships of Bikini lagoon remains dangerous due to the unexploded war ordnance still on and around the ships. Artifacts, that are the property of the Bikini Atoll Local Government according to the Compact of Free Association, have been pilfered from the ships by these divers.**

Section 3. Measures to be taken to correct situation:

1. **No vessel is permited to enter the lagoon of Bikini Atoll without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

2. **No person/persons are permited to dive within the confines of Bikini Atoll lagoon without obtaining first the official permits and legal waiver forms from the KBE Local Government Office.**

Section 4. Result if ordinance 14-1988 is defied:

1. **The cost of a diving permit is $ 125.00 per day/per vessel and can be obtained at the KBE Local Government office along with necessary legal waiver forms and entry permits for the Bikini Atoll lagoon.**

2. **Any person/persons convicted of diving within the confines of Bikini Atoll Lagoon without permission shall be subject to a fine of $ 2,000.00 or subject to a six month jail term.**

3. **Any person convicted of taking any object from the bottom of the Bikini Atoll lagoon, whether natural or related to the testing of nuclear weapons, shall be fined $ 5,000.00 per object or subject to a six month jail term.**

4. **Unauthorized vessels entering Bikini Atoll lagoon will be confiscated by the KBE Local Government.**

Section 5. Effective Date:

1. **After being passed and approved by the Kili/Bikini/Ejit Local Council this ordinance will become effective:**

Date introduced: 10/6/88
Dated Public Hearing: 10/6/88

Approved:* /s/ _____
Tomaki Juda, Mayor Date
Kili/Bikini/Ejit Local Council

Witness:* /s/ _____
Andy Bill, Clerk Date
Kili/Bikini/Ejit Local Council

* (See attached for signatures on Marshallese version).

KILI/BIKINI/EJIT LOCAL COUNCIL

KILI/BIKINI/EJIT LOCAL GOVERNMENT ORDINANCE NO. 14

Ordinance No. 14 ej kio ejak jen Kili/Bikini/Ejit Council einwot in,

Section 1. Title:

Juon kien nan kamo tulok im jibwe jabrewot men ko ilo wa im cables ko ilo maloan Bikini Atoll.

Section 2. Kin Un Kein:

1. Elon ro rej lo ir ilo maloan Bikini.
2. Elon ro rej ilok ilo an ejelok permit.
3. Elon ro rej ilok im tuloki wa ko kab cable eo.

Section 3. Bwe en jimwe im Emonlok:

1. Jabrewot armij ejab melim aer lolok Bikini ilo an ejelok melim ko jen Office eo an KBE Local Govermment.
2. Jabrewot armij ejab melim aer tuloki wa ko im cable ko ne ejelok aer melim jen Office eo an KBE Local Government.

Section 4. Non jab Bokake:

1. Jabrewot eo enaj ilok im tuloki wa ko ej aikuj wor an permit jen Office eo an KBE Local Government kin jonan in $125.00
2. Jabrewot eo enaj ilok im tulok ilo an ejelok an permit en ilok kaje nan e kin jonan in $2,000.00 dollars fine 6 alling kalbuij.
3. Jabrewot eo ejelok an permit ak ej ebok jabrewot jen Wa ko inem ej aikuij fine $ 5,000.00 ak 6 alling kalbuij.
4. UNAUTHORIZED VESSELS WILL BE CONFISCATED BY KBE LOCAL GOVERNMENT

Date Introduced: 10/8/88

Date Public Hearing: 10/8/88

Kamol: Tomaki Juda 10/8/88
Tomaki Juda, Mayor Ran
Kili/Bikini/Ejit
Local Council

Iman Meja: Andy Bill 10/8/88
Andy Bill, Clerk Ran
Kili/Bikini/Ejit
Local Council

ORDINANCE NUMBER 2010 – 02
OF THE KILI/BIKINI/EJIT LOCAL GOVERNMENT COUNCIL

WHEREAS, the people of Bikini Atoll and their governing body, the Kili/Bikini/Ejit Local Government Council ("Council"), wish to establish our homeland as a World Heritage site to retain and conserve for future generations whose remnants of the nuclear testing era currently present on Bikini Atoll; and

WHEREAS, in order to further the conservation and management of Bikini Atoll as a World Heritage site, the Council has adopted a "Conservation and Management Plan for Bikini Atoll;" and

WHEREAS, as part of the "Conservation and Management Plan for Bikini Atoll," the Council wishes to consolidate and bring up to date its rules, regulations, surveillance and enforcement measurements concerning access to Bikini Atoll, diving, and marine resources;

NOW, THEREFORE, be it resolved that:

1. Access to Bikini is restricted to recreation and tourism visitors and to scientific survey teams.
2. All people wishing to visit Bikini Atoll by aircraft must obtain prior written permission from the Kili-Bikini-Ejit Local Government.
3. Divers on the sunken vessels at Bikini Atoll lagoon must be accompanied by a diver employed by the Council or under contract to the Council.
4. No vessel is permitted to enter Bikini Atoll lagoon without first obtaining official permits and legal waiver forms from the Council.
5. No person is permitted to dive within the confines of Bikini Atoll lagoon without first obtaining official permits, liability release, waiver, express assumption of risk, and other relevant legal forms from the Council.
6. It is unlawful for any person to take any object from the water of Bikini Atoll lagoon (except fish), whether natural or manmade. This section specifically makes it unlawful for any person to take any object whatsoever off of any sunken vessel in Bikini Atoll lagoon.
7. Any person intending to dive at Bikini Atoll lagoon is hereby put on notice that his/her luggage will be searched prior to departure from Bikini Atoll in order to ensure compliance with Section 6, above.
8. Any person who violates Section 6, above, shall be fined $5,000.00 per object and/or be subject to a maximum imprisonment of six months in prison in the Marshall Islands.
9. Any vessel carrying diver(s) in Bikini Atoll lagoon who have failed to comply with the terms of Sections 3, 4, and/or 5, above, shall be subject to confiscation by the Council.
10. No vessel may engage in any fishing operation of any kind within 12 miles of Bikini Atoll without express written permission from the Council. This includes dynamite, cyanide, drift-net or any form of shark fishing.

11. Except as provided in paragraph 12, below, any individual, corporation or other entity found to be in violation of Section 10, above, shall be subject to fine of $50,000 per day for each violation.
12. Any individual, corporation or other entity found to be in violation of Section 10, above, in the course of fishing for sharks of any kind shall be subject to fine of $75,000 per day for each violation.
13. No grill-nets shall be used in any part of Bikini Atoll, both lagoon and oceanside.
14. Throw-nets or fishing rods shall be the sole method of gathering fish at Bikini Atoll.
15. Sports-fish species such as trevally and bonefish shall be released alive and unharmed.
16. All wildlife on and around islands between Bikini, Aoemen and Eneu shall be protected. This includes all birds and nesting turtles and their eggs.
17. All turtles are protected and shall not be taken without prior permission from the Mayor.
18. All natural resources not mentioned in these regulations on and around Bikini Atoll shall be preserved in such a way that they are not exploited.
19. The quadrants encompassed by the following longitudes and latitudes, 165° 30'200 longitude, 11° 35'040 N latitude and 165° 30'937 longitude, 11° 35'734 N latitude, the area of the buoyed ships, shall be protected from any form of fishing and is considered a marine sanctuary by the Council.
20. The Council instructs the trust liaison for the People of Bikini to publish this ordinance in the Marshall Islands Journal, post it prominently in public areas in and around the Kili/Bikini/Ejit Local Government Council office, post it in public areas at Bikini Atoll, and provide a copy to the Office of the Attorney General of the Marshall Islands Government.

APPROVED by the Kili/Bikini/Ejit Local Government Council this 21 day of January, 2010 by:

Alson Kelen, Mayor

Clerk Frederick Aitap

Senator Tomaki Juda

Council

Council

Council

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INSTITUTE OF NAUTICAL ARCHAEOLOGY
P.O. Drawer HG
College Station, Texas 77841-5137
Phone: (979) 845-6694
Fax: (979) 847-9260

January 15, 2010

Regina Durighello
Director
World Heritage Programme
ICOMOS
Paris, France

Dear M. Durighello:

I am writing to address one question raised by you in your letter of 17 December 2009 to Wilfred Kendall, in regard to the World Heritage nomination for Bikini Atoll, namely the question of a risk assessment of the remaining fuel stocks and any unexpended ordnance in the sunken vessels in Bikini Atoll's lagoon.

I am the primary author of the 1991 U.S. National Park Service report on the sunken fleet at Bikini from Operation Crossroads, and was a participant in two years of study (1989-1990) of those ships. Those studies assessed the very questions you are raising in advance of heritage management and controlled dive tourism at Bikini. I subsequently traveled to Bikini and participated in additional field work and observations on the ships in the 1990s. Based on both detailed research in the declassified military records from the atomic tests and archaeological observations, the study is comprehensive.

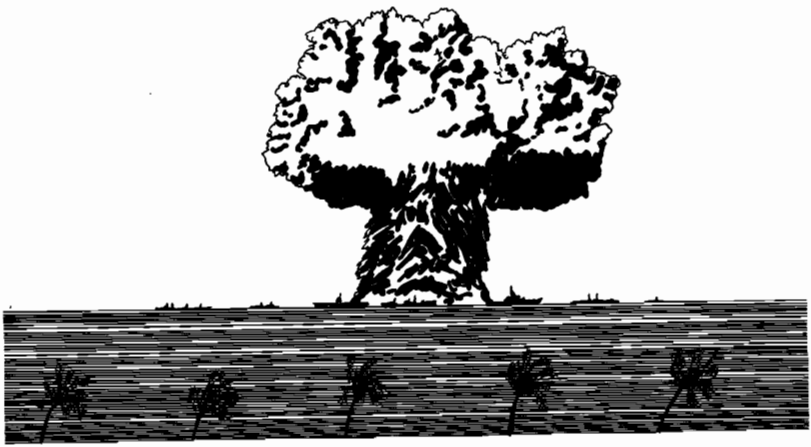
Our study, therefore, which is being forwarded to you, provides the detailed risk assessment you are seeking in both regards. Should you have any questions after reviewing the study, please do not hesitate to contact me.

Sincerely,

James P. Delgado, PhD
President

THE ARCHEOLOGY OF THE ATOMIC BOMB:

A Submerged Cultural Resources Assessment of the Sunken Fleet of Operation Crossroads at Bikini and Kwajalein Atoll Lagoons



U.S. NATIONAL PARK SERVICE
SUBMERGED CULTURAL RESOURCES UNIT
NATIONAL MARITIME INITIATIVE

THE ARCHEOLOGY OF THE ATOMIC BOMB:

A SUBMERGED CULTURAL RESOURCES ASSESSMENT OF THE SUNKEN FLEET OF OPERATION CROSSROADS AT BIKINI AND KWAJALEIN ATOLL LAGOONS

REPUBLIC OF THE MARSHALL ISLANDS

Prepared for:

The Kili/Bikini/Ejit Local Government Council

By:

James P. Delgado
Daniel J. Lenihan
(Principal Investigator)
Larry E. Murphy

Illustrations by:

Larry V. Nordby
Jerry L. Livingston

Submerged Cultural Resources Unit
National Maritime Initiative

United States Department of the Interior
National Park Service

Southwest Cultural Resources Center Professional Papers

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1991

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THE SECRETARY OF THE INTERIOR

WASHINGTON

July 8, 1991

FOREWORD

This assessment report compiled by a special team of National Park Service underwater archaeologists sheds light on the historical importance of the sunken ships in Bikini Lagoon.

The information provided here will assist the people of Bikini to make informed decisions concerning these sunken ships. I hope that it will also serve to open new areas of interest and increase awareness to inform readers the world over of the importance of events at this historic place.

Manuel Lujan Jr.

ACKNOWLEDGEMENTS

Foremost, we wish to thank the Bikini Council for inviting the National Park Service (NPS) to work at Bikini.

Jonathan Weisgall, attorney for the Bikinians, has conducted considerable research on Bikini; his voluminous files made research a much easier task. We are grateful for his and his research associate Alison MacDonald's hard work. Jack Niedenthal served as liaison for the Bikini Council during the period NPS operations took place.

William Livingston and Lee McEachern are preparing a documentary on Bikini for ABC television. Lee shared his research, including footage of the tests that provided a clearer understanding of the effects of the blast on *Saratoga*.

The field operations at Bikini Atoll were in part funded by the United States Department of Energy (DOE), Pacific Area Support Office, J. H. Dryden, Director. Holmes and Narver, Inc., DOE's contractors and managers of the Bikini Field Station, coordinated and hosted the National Park Service (NPS) team. Kent Hiner, Project Manager; Dr. Catherine Courtney, Project Coordinator; John "Alan" Brown, Holmes and Narver representative on Kwajalein, and his assistant Lance Yamaguchi tackled and ultimately removed every obstacle, from transporting equipment to arranging flights and making arrangements. In the field, the staff of the Bikini Field Station provided one of the most comfortable working environments the team has ever had. Richard Giles, the station manager, Stephen Notarianni, Eric Hanson, Wayne Olival, Edward Maddison, John Lajuan, Roger Joel, Thompson Johnson, Harry Nashon, Wilma Riklon, and Kane Janer provided invaluable assistance. The captain and crew of the DOE research vessel *G. W. Pierce* provided logistical support which was critical to the success of the project.

The Office of the Assistant Secretary of the Interior for International and Territorial Affairs supported the project; we particularly wish to thank Larry Morgan of the Assistant Secretary's office. In the National Park Service, present Director James M. Ridenour, former Director William Penn Mott, Southwest Regional Office Director John Cook, Western Regional Director Stan Albright, Associate Director Jerry L. Rogers, Associate Director Rick Smith, Pacific Area Director Bryan Harry, Deputy Associate Director Rowland T. Bowers, Chief Anthropologist Doug Scovill, and Chief Historian Edwin C. Bearss lent their support and released the team for work at Bikini.

The United States Navy, through the auspices of the Supervisor of Salvage and Mobile Diving and Salvage Unit One (MDSU 1), provided logistical support. Help was provided by the Commander-In-Chief, Pacific Fleet; by Capt. Dave McCampbell, commander of Mobile Diving and Salvage Unit One; and by Lt. Dave Rattay, commander of the Explosive Ordnance Disposal Unit One, Detachment 63, at Pearl Harbor, as well as by the men of MDSU 1 and EOD Mobile Unit One in locating the target ships, buoying them, safing ordnance, and providing detailed coverage of the ships through dive observations and remote operated vehicle surveys.

The issue of radiation was a concern for the team. Dr. W. L. (Bill) Robison of the University of California, Lawrence Livermore Laboratory, provided data on radiation levels at Bikini, as well as an appendix to this report. Jim Sprinkle, a lab specialist in radiation monitoring and detection, also provided a personal assessment of the radiation hazards--an independent source second opinion--to project director Lenihan. Cdr. Roger Chatham, Director of the U.S. Navy's Nuclear Survivability Program at the Pentagon also provided an assessment and opinion of the radiation hazards associated with the Crossroads ships.

Considerable information about Operation Crossroads and the ships involved in the tests

was provided by a number of persons. Informative discussions were held with several staff members of the Los Alamos National Laboratory (LANL). Roger Meade, Historian and Archivist at the Los Alamos National Laboratory provided archival sources, photographs, and helped us contact Los Alamos veterans of Operation Crossroads. Interviews with Crossroads participants Robert W. "Bob" Henderson, Albuquerque, New Mexico, the chief engineer of the Los Alamos Group at Crossroads; Leon D. Smith, also of Albuquerque, the "Able" weaponeer; and Woody P. Swancutt of San Antonio, Texas, the pilot of "Dave's Dream," were very helpful in answering questions not addressed by the written record.

The generosity of Battleship Cove in Fall River, Massachusetts, particularly Mark Newton, is especially appreciated. Mr. Newton provided historical references, photographs, and technical manuals for radar, ordnance, and armament and was present in spirit at Bikini as a valued member of the team. Russell Booth, manager of USS *Pampanito* (SS-383) in San Francisco, California, provided information on Mark 13 torpedoes and shipboard radar systems and gave an informative tour of his submarine that answered many questions about *Apogon* and *Pilotfish*. B. J. Dorman, Museum Director, and Jeffrey L. Crawford, Assistant Museum Director for the Pacific Fleet Submarine Memorial Association, provided material on *Pilotfish*, *Parche*, *Balao*-class submarines, JP sonar, and 20 and 40mm weapons, as well as an informative tour of USS *Bowfin* (SS-287) in Honolulu, Hawaii. Sue Moss and Carolyn Scheffer of the Texas Department of Parks, Fish, and Wildlife, provided a tour of USS *Texas* while the battleship was in the drydock in the Todd Shipyard in Galveston, Texas. That tour was invaluable in providing a better understanding of *Arkansas*. Mark Pinsel provided a tour of USS *Cabot* (CVL-28) in New Orleans, Louisiana, that served as an excellent orientation of carrier operations and characteristics. Ironically, *Cabot*, sole survivor of the *Independence*-class carriers, shares a common origin with *Saratoga*--both were built at the same yard, and more importantly, were carriers converted from cruiser hulls. Timothy Rizzuto, curator of USS *Kidd* (DD-661) in Baton Rouge, Louisiana, provided a tour of his destroyer that greatly assisted our understanding *Anderson* and *Lamson*; among the bonuses of the tour was a greasy but informative foray into the Mark 37 director atop the bridge. John Smith, Vice President of Merchant Marine Veterans of WWII, Inc., gave an excellent tour of SS *Lane Victory* in San Pedro, California, that helped us better understand *Gilliam* and *Carlisle*. Dennis Ditmanson, Superintendent, White Sands National Monument, Nancy S. Dumas, Public Affairs Officer, and Robert J. Burton, Archaeologist, White Sands Missile Range, provided a tour of Trinity Site that proved to be very helpful in understanding the development of the bomb and early test instrumentation.

Linda Jackman of the Navy's Naval Sea System Command's Shipbuilding Support Office provided a listing of the Crossroads ships and their fates as well as other information. The staff of the Naval Historical Center in Washington, D.C., were as usual a tremendous help; among those who provided support and assistance were John Reilly of the Ships History Branch, Mike Walker in Operational Archives, and Charles Haberlein, the photographic archivist in the Curatorial Branch. Henry Vadnais, the Navy's Chief Curator, helped track down items removed from the ships prior to the tests, such as *Saratoga*'s bell and *Lamson*'s homeward bound pennant, which is on display in the Navy Memorial Museum at the Washington Navy Yard. Paul Stillwell at the United States Naval Institute, Annapolis, Maryland, provided access to oral histories that included reminiscences of Operation Crossroads. Paul also provided the address of Capt. Dick Laning, former Commanding Officer of *Pilotfish*, who put us in touch with the other skippers of the target submarines at Bikini. Joe Fetherston, one of *Saratoga*'s ship's photographers, loaned his postwar "mugbook" and history of *Saratoga* and several original photographs of *Sara*'s trying hours off Iwo Jima. Roy Alton, president of the USS *Arkansas* (BB-33) Association, loaned his "mugbook" and arranged for a meeting with *Arkansas*' crew at the ship's fourth annual reunion. Kevin Foster, formerly with the National Maritime Initiative, provided considerable information on the tests and faxed needed documents to the team in the Pacific.

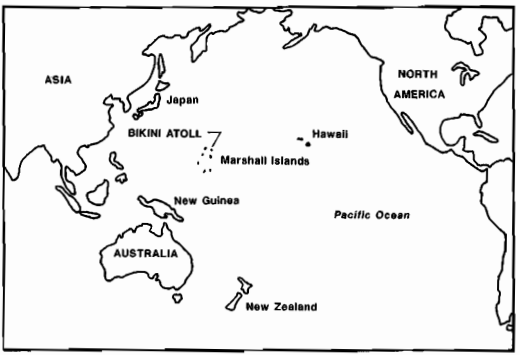
Lawrence E. Wilson, Research Technician at the National Air and Space Museum, Smithsonian Institution, identified three of the aircraft in the hangar of USS *Saratoga* as Helldivers before the BuAer report was located and provided reference materials on the SB2C/SBF Helldiver for this report. Norman Polmar read the text, made many critical suggestions, and provided information from his files. This report also was reviewed by Betty Perkins and Roger Meade of LANL. Their assistance and review is appreciated.

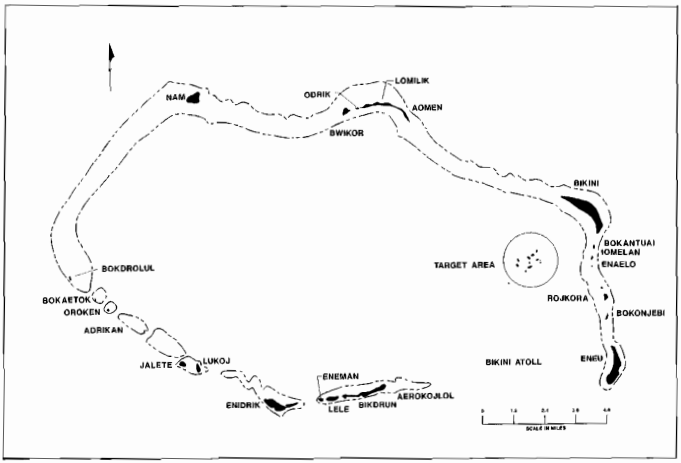
Linda Cullen of the U.S. Naval Institute opened her photographic files on the Crossroads ships and tests. The staff at the Philadelphia Maritime Museum, particularly curator Jane E. Allen and librarian Ann Wilcox, provided access to the photographic archives of the New York Shipbuilding Corporation, which assisted the task of assessing *Saratoga* and *Arkansas*, both products of that shipyard. Steve Haller, archivist at San Francisco Maritime National Historical Park, directed our attention to the recently processed San Francisco *Call-Bulletin* photographic archives, which included a few dozen invaluable views of *Saratoga*, including photographs of the ship being prepared for the tests and underway to Bikini. Bruce McElfresh and Alice Hall, National Geographic Society, are gratefully thanked for arranging underwater photography by Bill Curtsinger for *National Geographic* in August 1990. Mr. Curtsinger is thanked for the use of selected photos in this report.

The staffs of the following organizations and institutions are also here acknowledged: Los Alamos National Laboratory, Los Alamos, New Mexico; Military History Branch and Still Pictures Branch, National Archives, Washington, D.C.; Naval Historical Center, Washington, D.C.; Pacific Fleet Submarine Memorial Museum, Honolulu, Hawaii; J. Porter Shaw Library, San Francisco Maritime National Historical Park, San Francisco; USS *Arizona* Memorial, Honolulu, Hawaii; War in the Pacific National Historical Park, Agana, Guam; U.S. Naval Institute, Annapolis, Maryland; United States Naval Academy Museum, Annapolis; National Air and Space Museum, Smithsonian Institution; Philadelphia Maritime Museum.

Robbyn Jackson of the NPS Historic American Buildings Survey/Historic American Engineering Record, redrafted the Able and Baker arrays and plotted and drafted the sunken ship position chart from data supplied by the U.S. Navy. Tom Freeman granted permission, with all rights reserved, to publish his painting of *Saratoga* on the bottom. The painting was first published in the U.S. Naval Institute *Proceedings* in October 1990.

Drafts of this document were prepared by the National Maritime Initiative with the assistance of Fran Day of the Submerged Cultural Resources Unit. Design, layout, and final production of the camera-ready text was undertaken by J. Candace Clifford of the National Maritime Initiative staff.





Bikini Atoll, (NPS)

CHAPTER ONE: INTRODUCTION

Daniel J. Lenihan

In June 1988, while returning from a cooperative NPS/Navy diving operation in Palau, Dan Lenihan, Chief of the National Park Service Submerged Cultural Resources Unit (SCRU) was approached regarding a potential sunken ship survey at Bikini Atoll. Dr. Catherine Courtney of Holmes and Narver, representing her client, the Department of Energy (DOE), described the nature of the research problem in a presentation at the headquarters of U.S. Navy Mobile Diving and Salvage Unit One in Honolulu. Cdr. David McCampbell, Unit Commander, had been in communication with Dr. Courtney about the project for some time and recommended a joint effort using NPS and Navy personnel--a combination that had proved effective in numerous prior operations known collectively as Project SeaMark.

As formal requests for assistance were initiated and arrangements were made for a field operation in the summer of 1989, the NPS underwater team began preparations for one of the most challenging and compelling projects it has ever been asked to undertake. The ships of Operations Crossroads lying at the bottom of Bikini Atoll Lagoon and Kwajalein Lagoon are the remains of a fascinating event in American history, an event with international dimensions, including implications for the restructuring of geopolitical alliances in the latter part of the 20th century.

The notion that these ships might be considered as the focus for a marine park, which is the specific forte of SCRU, only further fueled the team's interest. Efforts to evaluate the ships as historical, archeological, and recreational resources for disposition by the Bikinian people began in August 1989 and resulted in the completion of this report in March 1991.

Although "ghost fleets" related to World War II exist at Truk Lagoon, etc., nowhere in the world is there such a collection of capital warships, augmented by a largely intact aircraft carrier, USS *Saratoga*, and the flagship of the Japanese Navy at the time of the attack on Pearl Harbor, *Nagato*. Through chance or intent, vessels of great symbolic importance to the history of World War II were included in the test array and now reside at the bottom of the lagoon. These ships, all within a few hundred yards of each other, comprise an incomparable diving experience.

During the course of the project the team members, without exception, were impressed not only with the extraordinary cultural and natural resources of Bikini but with the compelling human dimension of the problem of displacement and resettlement of the Bikinian people. We hope the discussions in this report will help expand the range of options available to the Marshall Islanders in reestablishing their community on Bikini and other islands impacted from nuclear testing.

PROJECT MANDATE AND BACKGROUND

Under the terms of the Compact of Free Association between the Government of the United States and the Governments of the Marshall Islands and the Federated States of Micronesia (Public Law 99-239), the United States, in Section 177, accepted responsibility for compensating the citizens of the Marshall Islands, the Federated States of Micronesia, or Palau, for "any losses or damages suffered by their citizens' property or persons resulting from the U.S. nuclear testing program in the northern Marshall Islands between June 30, 1946, and August 18, 1958." The U.S. and the Marshall Islands also agreed to set forth in a separate agreement provisions for settlement of claims not yet compensated, for treatment programs, direct radiation-related medical surveillance, radiological monitoring, and for such additional programs and activities as may

be mutually agreed. (99 Stat. 1812) In section 234, the United States transferred title to U.S. Government property in the Marshall Islands to the government of the Marshall Islands except for property which the U.S. Government determined a continuing requirement. (99 Stat. 1819)

Based on section 177, an agreement between the U.S. and the Government of the Marshall Islands relating to the nuclear testing programs was reached. Under the terms of this agreement, the U.S. Government reaffirmed its commitment to provide funds for the resettlement of Bikini Atoll by the people of Bikini, who were relocated during the first nuclear weapons tests in the Pacific, Operation Crossroads in 1946. Since then, studies that have focused on the eventual resettlement of Bikini have been and continue to be undertaken.

In July-August 1989 and April-May 1990, a team from the U.S. National Park Service traveled to Kwajalein and Bikini atolls to document ships sunk during the Operation Crossroads atomic bomb tests. The team was invited by the Bikini Council, the United States Department of Energy, Pacific Region, and Holmes and Narver, DOE's primary contractor in the Pacific and operator of DOE's Bikini Field Station.

The sunken ships at Bikini are the property of the people of Bikini. Title was transferred in the U.S. Marshall Islands agreement in accord with Article 177 of the Compact of Free Association; according to Article VI, Section 2 of the agreement:

> Pursuant to Section 234 of the Compact, any rights, title and interest the Government of the United States may have to sunken vessels and cable situated in the Bikini lagoon as of the effective date of this Agreement is transferred to the Government of the Marshall Islands without reimbursement or transfer of funds. It is understood that unexpended ordnance and oil remains within the hulls of the sunken vessels, and that salvage or any other use of these vessels could be hazardous. By acceptance of such right, title and interest, the Government of the Marshall Islands shall hold harmless the Government of the United States from loss, damage and liability associated with such vessels, ordnance, oil and cable, including any loss, damage and liability that may result from salvage operations or other activity that the Government of the Marshall Islands or the people of Bikini take or cause to be taken concerning such vessels or cable. The Government of the Marshall Islands shall transfer, in accordance with its constitutional processes, title to such vessels and cable to the people of Bikini.

Under the Agreement, the U.S. Department of Energy conducted a study of the sunken ships in Bikini Atoll, in particular assessing leaking fuel and oil that may pose long-term environmental impacts that would result from the sudden rupture of tanks containing oil or fuel. Recommendations for the final disposition of the ships depended on assessments of their structural integrity and historic significance. The DOE requested the assistance of the U.S. Navy, Mobile Diving and Salvage Unit One, headquartered at Pearl Harbor, Hawaii, to (1) determine the geographic location (latitude and longitude) of each ship; (2) mark the bow, stern, and midships section of each ship with spar buoys; (3) make a preliminary description of the condition of each ship; and (4) determine if the condition of the ships warranted an assessment of historical significance.

The U.S. Navy deployed MDSU 1 at Bikini between August 5-17, 1988. This activity, as well as general footage of Bikini and the ships, was filmed by Scinon Productions, which produced a special for PBS and for KGO-TV, San Francisco. Following this exercise and the concurrence of the Bikini Council, on December 21, 1988, the Department of Energy requested the services of the National Park Service to conduct an evaluation of the historical significance, marine park potential, and diving hazards associated with the sunken

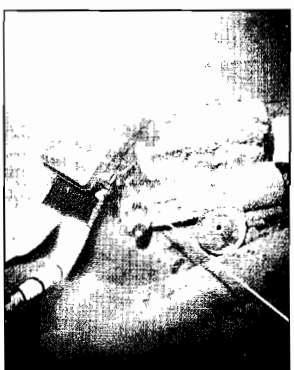
Commander David McCampbell, USN (left), led the Navy effort to locate and plot the wreck locations. (NPS, Larry Murphy)

fleet at Bikini. Because the ships and test equipment submerged in Bikini Lagoon are an immensely valuable cultural resource deserving thorough study, and the Service's Submerged Cultural Resource Unit is the only U.S. Government program with experience in this work, the National Park Service agreed to assist DOE. At the same time, MDSU 1 was redeployed at Bikini with EOD Mobile Unit One to continue marking wrecks and to assess and safe live ordnance in, on, and around the ships.

The National Park Service team was led by Daniel J. Lenihan, Chief of the Submerged Cultural Resource Unit, and included as team members NPS Maritime Historian James P. Delgado, Head of the National Maritime Initiative; SCRU Archeologist Larry E. Murphy; Archaeologist Larry V. Nordby, Chief of the Branch of Cultural Research, Southwest Regional Office; and Scientific Illustrator Jerry L. Livingston of the Branch of Cultural Research. The same team assembled in Honolulu, Hawaii, in early August 1989 and from there traveled to Bikini by way of Kwajalein. The team returned for a second and final field season in late April-early May 1990.

Of the original array of target vessels, 21 ships (counting eight smaller landing craft) were sunk in Bikini Lagoon during the Able and Baker atomic bomb tests of July 1 and 25, 1946. A number of the remaining vessels, among them the former German heavy cruiser *Prinz Eugen* (IX-300), which "survived" the tests, were towed to Kwajalein Atoll for decontamination and offloading of munition. Progressive flooding from leaks, however, led to the capsizing and sinking of *Prinz Eugen* in shallow waters in Kwajalein Atoll Lagoon in 1946. Another target vessel, LCI-327, was stranded and "destroyed" on Bascombe (Mek) Island in Kwajalein Atoll in 1947. These two vessels comprise a secondary deposition of Crossroads target ships that are accessible for study.

The NPS team was able to visit nine of these 23 vessels and document them to varying



The Navy's Explosive Ordnance Demolition Unit One safed a 350-lb. depth bomb by "gagging" its live fuse. (NPS, Larry Murphy)

degrees. The team subsequently evaluated two other vessels utilizing the Navy's Remote Operated Vehicle (ROV) video coverage of them. The major focus of the documentation was the aircraft carrier *Saratoga* (CV-3) at Bikini; a lesser degree of documentation was achieved for the battleships *Nagato* and *Arkansas* (BB-33), the submarines *Pilotfish* (SS-386) and *Apogon* (SS-308), YO-160, LCT-1175, LCM-4, and the attack transports *Gilliam* (APA-57) and *Carlisle* (APA-69) at Bikini, as well as the cruiser *Prinz Eugen* at Kwajalein. In every case, the NPS found sufficient cause to determine that these vessels are indeed historically and archeologically significant.

This report documents the pre-sinking characteristics of each of the vessels, as well as an assessment of their careers and participation in Operation Crossroads. In the case of the nine vessels visited by the NPS team and the two ROV-dived vessels, a site description based on the assessment dives and documentation efforts is included. The report includes the results of several weeks of research that provided more concise information pertaining to target vessel characteristics, specifically Crossroads modifications and outfitting. Among the more interesting archival discoveries was that the firing assemblies for some test ordnance on the test ships were incomplete, with inert elements (plaster) replacing either the main or booster charges.

METHODOLOGY

Background Research

In preparation for the project, background material on Operation Crossroads and the individual target ships included in the tests was obtained by historian James Delgado through several sources. Historical information about each vessel's characteristics, history, participation in the tests, and the circumstances of its sinking were obtained, as were materials pertaining to test planning, logistics, and results.

In preparation for field activities, the plans most likely to reflect the final configuration of armament and deck features present on *Saratoga* were sought. A set of microfilmed plans showing *Saratoga*'s last pre-Crossroads refit at Bremerton Naval Shipyard in May 1945 was obtained. From these and published plans of the ship, a deck plan and starboard elevation of the carrier as it was configured at the end of the Second World War were available. The scale of these drawings was too small to serve as a basis for field work, so they were expanded using a Map-O-Graph machine to a final scale of 1/8-inch per foot (1:96). This selection was based on the preference of illustrators, who found this scale ideal when mapping *Arizona* and other ships of similar size.

Finally, scale drawings of ordnance and radar equipment were gleaned from naval manuals. Drawings of aircraft known to be aboard *Saratoga* were obtained from books. These were mechanically reproduced and the scale changed to match the deck plan. The result was a rough approximation of what the vessel would have looked like on the eve of Operation Crossroads, expressed in drawings of the deck plan and starboard elevation, each more than nine feet long. Mylar tracings of small sections of their conjectural drawings were carried on each dive by the illustrators and altered to fit the archeological reality of the ship's present appearance.

Site Description and Analysis

To develop a narrative presentation of findings from the research, archeologists Dan Lenihan and Larry Murphy, and historian James Delgado, swam through each site and recorded observations or notes after the dive or on videotape during the dive. To permit filming, a special experimental hookup was designed before the project to connect a full face mask (AGA) to a small underwater video camera. The mask was installed with a microphone that permitted the diver to speak directly onto a videotape as he panned the site with the camera. This permitted onsite recording of field observations and also permitted much easier referencing of the viewer to the location of the image on the site. On large sites, recording the location of the camera image has been a consistent problem.

In addition to personal observation on the site, the Navy's Bureau of Ships 1946 description of

some of the vessels helped separate primary deposition from later site formation processions. Information on biological communities now present on the site was obtained through video imaging for examination both at Bikini and on return to Santa Fe.

Information generated in this manner was also used for assessing recreational potential. Although the team was well equipped to assess normal sport diving hazards (given the extensive shipwreck diving backgrounds of the members), it was not qualified to evaluate the volatility or status of live ordnance in the vessels or address the issue of residual radiation hazards without help from specialists. Cooperation with U.S. Navy Explosive Ordnance Demolition (EOD) personnel on site was very useful in gaining such an understanding of the former, and Lawrence Livermore Labs provided extensive insights into the latter.

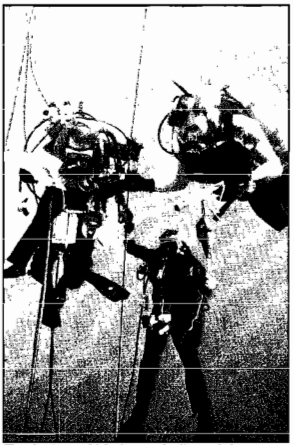
"Imaging the Ships"

Information for drawings that are part of the report was generated through sketching the sites and comparing the results to plans obtained through the archival research. Some videotape obtained in the dives was taken primarily as an aid to illustration. Unlike most other situations in which physical baselines have been used by SCRU to map sites, there was enough integrity to the vessel fabric that features of the ships themselves could be used as integral reference points.

Operational Diving Procedures

Given the 180-foot maximum depth of the ships and the intensity of the diving operations needed to accomplish the objectives of assessing and documenting the ships at a working depths usually well over 100 feet, if not deeper, certain deep diving procedures were implemented. Special dual manifolds which permitted total redundancy of first and second stages of breathing systems were transported to the job site from Santa Fe. These were used to arrange cylinders supplied by DOE into double tank configurations. The diving day was divided into two dives per team with staged decompression anticipated on both dives. The first dive of the day was always planned to be deeper or as deep as the second dive.

An in-water oxygen decompression system was also brought from Santa Fe to allow a large margin of safety in decompression profiles. Standard U.S. Navy air tables were used in decompression, but oxygen was substituted as the breathing gas for 30-, 20-, and 10-foot stops. Emergency evacuation procedures were established and after the Navy arrived on the scene during the first field session, a routine system for accident management was established that involved the use of their Diving Medical Officer and recompression chamber. During the 1990 field session no Navy medical facilities or chamber were available, so evacuation to Kwajalein would have been necessary.



The depth at which the wrecks lie, and the amount of time required for meaningful observation and documentation compelled lengthy oxygen decompression stops. (NPS, Larry Murphy)

Boat launching by front-end loader. The NPS team prepares to depart for a day's diving. Eric Hanson is at the helm, while Edward Maddison prepares to release the boat.

A routine was also established that every fourth day of operation there would be a 24-hour period during which no diving took place, e.g., from "up" time of last dive on day 4 to beginning of the first dive on day 5. This was to help mitigate effects of "Safari Syndrome" in which the 12-hour decompression model of the U.S. Navy tables is pushed past its design limits for multi-day repetitive diving. These special precautions were deemed particularly important when no chamber was available on site.

After diving LCT-1175, Daniel Lenihan, Larry Nordby, and Jerry Livingston compare notes on the sketches and measurements made by the scientific illustrators. (NPS, James P. Delgado)

ACTIVITIES

1989 Field Season

August 8-10: The team traveled from their duty stations in Santa Fe, New Mexico, and Washington, D.C., to Kwajalein, Marshall Islands.

August 11: Layover in Kwajalein. Team traveled around Kwajalein with public affairs liaison officer visiting WWII sites.

August 12: Prepared for departure to Bikini, but Air Marshall Islands came in overbooked and would not take the team to Bikini. Obtained access to a boat during latter part of the day and snorkeled the wreck of *Prinz Eugen*.

August 13: The plane did not come, so the Holmes and Narver representative arranged for team to dive on *Prinz Eugen*. The team conducted a reconnaissance survey of the site, obtaining video footage, photographs, and a sketch. It was discovered that the description of the ship in *Jane's Fighting Ships* was incorrect in that it stated the ship had four screws rather than the three it has. On the basis of this dive, a section on *Prinz Eugen* was included in the results section of this report and specific management recommendations will be made for transmission to the Base Commander.

August 14: Once again Air Marshall Islands (AMI) decided not to fly. Kent Hiner, Holmes & Narver's project manager, radioed an AMI plane en route to Kwajalein from some other point and negotiated a flight to Bikini before they took their scheduled return flight to Majuro in the Marshall Islands. After lunch, a first assessment dive was made on the wreck of *Saratoga* to a maximum depth of 100 feet.

August 15: During the first full day of dive operations at Bikini, the team made an assessment dive on *Saratoga* and commenced taking observations for the site plan and starboard profile of the ship. The starboard side was reconnoitered at 140 feet; the elevator was entered and its immediate area investigated, as was the forward section of the ship, particularly the 5-inch gun mount.

August 16: Dives on *Saratoga* focused on assessments of the island, including the penetration of the flag plot and bridge, a survey of the port side of the ship, and the penetration of the hangar.

August 17: Mapping of the after area of the ship disclosed the first major damage to *Saratoga* from the tests. A reconnaissance of the bottom of the lagoon at the stern and additional penetration of the bridge were completed.

August 18: Additional dives were made on *Saratoga* to continue the mapping of the wreck.

August 19: *Saratoga*'s island was more thoroughly investigated.

August 20: Dives on *Saratoga* began to focus on mapping the starboard side of the ship for the profile drawing.

August 21: Dives completed the preliminary mapping of *Saratoga*, focusing on the forward section, midships area, and island.

August 22: Entire team dived on *Arkansas*, resulting in video and a sketch of the wreck. The dive assessed the more intact port side of the battleship at the 160-foot level and the keel at the 140-foot level.

August 23: A dive was made on *Pilotfish*, using for the first time the experimental AGA-video hookup. Delgado narrated his notes on the dive directly onto a tape at 150 feet, accompanied by Lenihan, while the other team members sketched and photographed the boat. The second dive of the day, with Delgado again in the AGA, visited *Nagato*, exploring the after section of the ship.

August 24: The only dive of the day was made to *Gilliam*, the accidental zeropoint ship for the Able Test bomb's detonation. The team swam the length of the ship, sketching and photographing it. Larry Murphy departed with the majority of the equipment to catch a Military Air Command (MAC) flight to Honolulu in order to assure loading of that equipment for another operation in the Aleutians.

August 25: The team made the last dive of 1989 on *Saratoga*, penetrating the hangar and more extensively documenting the aircraft inside. That afternoon, remaining equipment was packed for departure.

August 26: The team made an early afternoon departure from Bikini, flying via AMI to Kwajalein. From Kwajalein, the team members separated--Lenihan and Nordby to Santa Fe; Livingston and Delgado to Guam.

1990 Field Season

April 25-27: The team travelled from their duty stations in Santa Fe, and Washington, D.C., to Honolulu, and then to Kwajalein.

April 28: Layover in Kwajalein. The team made a dive on *Prinz Eugen* and obtained additional photos and information for a map of the wreck.

April 29: The team boarded the DOE research vessel *G. W. Pierce* and sailed from Kwajalein for Bikini.

April 30: At sea most of the day. Bikini was sighted at 4:00 p.m., and at 5:20 p.m., anchor was dropped off the island. The team was shuttled ashore.

May 1: First dives were made with team members working on the island and in the hangar of *Saratoga*.

May 2: Mapping *Saratoga* continued. Lenihan and Murphy penetrated the hangar to its aft bulkhead, locating additional torpedoes, rockets, and homing torpedoes (depth of 130 feet). Five-inch shells in the handling rooms and the open twin 5-inch/38 mount were explored aft of the stack by Delgado. Afternoon dives focused on the bow; the windlass and emergency radio compartments were penetrated. Delgado and National Geographic Society writer John Eliot dove on a shallow water inshore wreck, which proved to be LCT-1175.

May 3: Documentation of *Saratoga* continued. *Arkansas* was dived on and port casemate penetrated by Lenihan and Murphy at a depth of 170 feet. Wreck of LCM-4 snorkeled and

The Bikini Council sent a dive team to participate in the documentation of the ships. Here, the team takes measurements to the corner of the blast gauge tower next to Saratoga's elevator. (NPS, Larry Murphy)

The system of trilateration used to map the wrecks is being discussed by Edward Maddison, Wilma Riklon, and Larry Nordby. (NPS, Larry Murphy)

identified near that of LCT-1175 by Delgado.

May 4: Lenihan, Delgado, and Murphy swam under *Nagato* from stern to the aft end of the bridge (depth of 170 feet). Nordby and Livingston continued mapping operations on *Saratoga*, and Lenihan and John Eliot dived on YO-160 in afternoon, videotaping deck machinery.

May 5: Lenihan, Murphy, and Delgado continued documentation of *Nagato*, videotaping and photographing upturned bridge, forward turrets, and stern. Livingston and Nordby continued mapping operations on *Saratoga* (portside). Entire team worked on *Saratoga* in afternoon.

May 6: Entire team worked on documentation of LCT-1175.

May 7: Lenihan and Murphy worked on *Nagato* bow; Delgado, Livingston, and Nordby worked on port bow of *Saratoga*.

May 8: Entire team conducted "blitz" dive on *Nagato* stern (depth of 170 feet) obtaining sketches, video, and photography. In afternoon, focus shifted back to completion of work on *Saratoga*.

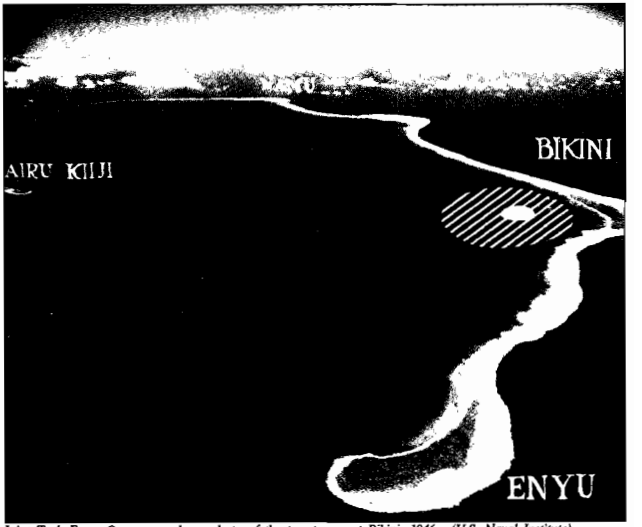
May 9: Murphy conducted training dive for Bikinians, teaching them underwater oxyarc cutting techniques using car battery and oxygen. Lenihan was able to meet briefly with Bikinian elders and Jack Niedenthal (Bikini Liaison) during layover of AMI flight on Enyu. Some of the project results including drawings were reviewed.

CHAPTER TWO: OPERATION CROSSROADS

James P. Delgado

The end of the Pacific War, and hence World War II, was brought about by the surrender of Japan following the dropping of atomic bombs on the cities of Hiroshima and Nagasaki. These were, respectively, the second and third nuclear detonations on the surface of the planet. The first bomb was detonated at Alamagordo, New Mexico, on July 16, 1945, at 5:30 a.m. The second bomb was detonated over Hiroshima on August 6, 1945, at 8:15 a.m. The third bomb was detonated over Nagasaki on August 9, 1945, at 10:58 a.m. The fourth and fifth bombs were detonated during the atomic tests at Bikini Atoll in the Marshall Islands.

The first large-scale atomic weapons effects tests conducted by the United States, the "Able" test detonation of July 1, 1946, at 9:00 a.m. local time at Bikini, and the "Baker" test



Joint Task Force One press release photo of the target area at Bikini, 1946. (U.S. Naval Institute)

detonation of July 25, 1946, at approximately 8:35 a.m. local time, were the first two of the three-part "Operation Crossroads" tests. (The third detonation, the "Charlie" test, was cancelled.) Formulated at the war's end and approved by President Harry S Truman on January 10, 1946, Operation Crossroads was not only the first of more than 850 publicly announced atomic weapons tests. It was a major demonstration of the power of the bomb and of the nation that had produced and used it, the United States. The name was selected because the atomic bomb represented a "crossroads"--from conventional to nuclear war.

The tests involved assembling a fleet of 242 ships, 42,000 men, 156 airplanes, and tens of thousands of tons of equipment, ordnance, and material at Bikini, as well as relocating the 162 residents of the atoll--beginning an odyssey that has earned for these displaced people the sobriquet of "nuclear nomads" of the Pacific. Observers from Congress, from other nations (including the Soviet Union), and representatives of "U.S. press, radio, pictorial services, magazines, etc." made these tests the most public and the most reported of any nuclear weapons tests.[1] The inherent message of nuclear weapons was underscored at Bikini, and has since become increasingly the subject of public debate and concern as the progeny of the Manhattan project multiplied until by 1986, according to one nonofficial estimate, the United States had manufactured 60,000 warheads of 71 types for 116 different weapons systems.[2]

Initially, the development and use of atomic weapons was welcomed and celebrated in the United States because the destruction of two Japanese cities had brought a fierce enemy to his knees through the fear of rapid annihilation. The toll of fighting at Palau, Iwo Jima, and Okinawa was still vividly recalled. Many thousands of American lives would have been lost in a bloody invasion of the Japanese home islands. Consciences were salved when the death toll at Hiroshima and Nagasaki, while terrible, was less than the number of Japanese civilians killed in the B-29 fire-bombing raids on Tokyo, Nagoya, and Kobe. Soon, however, as historian Paul Boyer has noted, a grim realization set in. Moral implications of the use of the atomic bomb troubled some observers. More pragmatically, many realized that the bomb was a world-threatening weapon. The spectre of nuclear armageddon overshadowed the globe, and in the United States, the understanding that the bomb could also someday be used against the United States brought the first chills to the Cold War. General H. H. "Hap" Arnold, head of the U.S. Army Air Forces, was the first to publicly prophesize that World War III would not last as long as World War II; World War III would be over in hours, with no one left to determine who had won.

Widespread comprehension of the bomb's grim reality was not immediate. It took many years, the detonation of a nuclear bomb by the Soviet Union, and the development of vast arsenals of more potent nuclear weapons with the capacity to kill every living thing on earth several times over, for fear to set in. Yet until then, people accepted the bomb as a deadly and powerful beneficial force. At the very beginning, though, the message was clear. In 1946, a press report noted that while "a large number of scientists are looking forward to the forthcoming explosion... [the] least curious...are the atomic scientists. They take a poor view of the entire operation, maintaining that the explosions at Hiroshima and Nagasaki have perfectly well demonstrated the basic fact that the atomic bomb is too powerful a weapon to leave outside the confines of international control and that Operation Crossroads will simply underline this truth...."[3] The commander of Joint Task Force One which conducted Operation Crossroads was Vice Adm. William Henry Purnell Blandy. Blandy, writing in the foreword to *Bombs at Bikini*, the "official" public report on the tests, noted "the atomic bomb is definitely not 'just another weapon;' its destructive power dwarfs all previous weapons. Observers at Bikini saw the bomb sink great steel warships and, with its penetrating nuclear radiation, reach into ships' interiors to kill test animals. The explosions in air and underwater were very different spectacles, but their end results mean the same: death and destruction on an enormous scale."[4]

Admiral W. H. P. Blandy, commander of Joint Task Force One. (National Archives)

Operation Crossroads was interpreted as a defensive measure to the American public. Testing the effect of the atomic bomb on warships and their crews would specifically "improve our Navy." According to *Bombs at Bikini*,

> We want ships which are tough, even when threatened by atomic bombs; we want to keep the ships afloat, propellers turning, guns firing; we want to protect the crews so that, if fighting is necessary, they can fight well today and return home unharmed tomorrow....the unequalled importance of the atomic bomb....shakes the very foundations of military strategy.[5]

However, the concept of the bomb's deployment against ships was as an offensive weapon. Admiral Blandy told the Senate Committee on Atomic Energy on January 24, 1946, "The ultimate results of the tests, so far as the Navy is concerned, will be their translation into terms of United States sea power. Secondary purposes are to afford training for Army Air Forces personnel in attack with the atomic bomb against ships and to determine the effect of the atomic bomb upon military installations and equipment."[6]

The history of the war, beginning with the surprise attack on the fleet at Pearl Harbor, and a hard four-year fight at a tremendous cost instilled a strong sense of the best defense being offense. The atomic bomb provided the strongest offensive capability available, and nuclear deterrence and the Cold War invocation of the necessity of nuclear capability were first aired for Operation Crossroads:

> The tests stand out clearly as a defensive measure. We are seeking to primarily learn what types of ships, tactical formations and strategic dispositions of our own naval forces will best survive attack by the atomic weapons of other nations, should we ever have to face them. By no stretch of the imagination can such steps of caution and economy be taken as a threat of aggression. If, because of such a false assumption, we failed to carry out these experiments, to learn the lessons which they can teach us, our designers of ships, aircraft and ground equipment, as well as our tacticians, strategists and medical officers would be groping their way along a dark road which might lead to another and worse Pearl Harbor.[7]

In April 1946, Admiral Blandy, reporting that "some of our leading scientists" agreed that "other nations with even a moderate degree of industrialization can manufacture atomic bombs in a few years....our Armed Forces must be kept modern, and one of the first steps in modernizing them is to learn the full capabilities of any new weapon which may be brought against them."[8] Among the more interesting aspects of Operation Crossroads was the inclusion of foreign observers from 11 countries, among them the Soviet Union, a rival for global influence.

THE CONCEPT OF A NAVAL TEST EVOLVES

The news of the atomic bombing of Hiroshima started discussions among naval circles as to the new weapon's effect on ships; this question was posed on the floor of the Senate on August 25, 1945, when Senator Brien McMahon of Connecticut stated:

> In order to test the destructive powers of the atomic bomb against naval vessels, I would like...Japanese naval ships taken to sea and an atomic bomb dropped on them. The resulting explosion should prove to us just how effective the atomic bomb is when used against the giant naval ships. I can think of no better use for these Jap ships.[9]

The idea of using the bomb against ships was not new; "even in 1944, Los Alamos scientists were looking into the possibilities of eventually atomic-bombing Japanese fleet concentrations," specifically the Japanese naval base at Truk Lagoon, but by that late date the Imperial Japanese Navy was already decimated by conventional warfare.[10] American submarines waged a terrible war of attrition: disastrous sea battles and bombing raids sank most Japanese capital ships, leaving a pitiful remnant of the once formidable fleet at war's end.

The destruction of the 48 surviving surface warships of the Imperial Japanese Navy surrendered at war's end was guaranteed regardless of whether or not the atomic bomb was used.[11] The new Japan would be demilitarized and its remaining vessels sunk or scrapped. On August 28, 1945, Fleet Adm. Ernest J. King, Commander in Chief of the U.S. Fleet, recommended that the remaining Japanese vessels be destroyed. Lt. Gen. B. M. Giles, on MacArthur's staff in Tokyo, followed Senator McMahon's lead and proposed on September 14, 1945, that atomic bombs be used to sink the Japanese ships. The proposal was supported by Maj. Gen. Curtis LeMay, architect of the fire-bombing raids on Japan. Gen. H. H. "Hap" Arnold concurred, and asked the Navy on September 18 that "a number of the Japanese vessels be made available to the Army Air Forces for use in tests involving atomic bombs and other weapons."[12]

This proposal met with a positive response from the Navy. As early as June 1945, the Navy's Bureau of Ships (BuShips) and Bureau of Ordnance (BuOrd) had recommended a "comprehensive program for testing high explosives against merchant and warship hulks, captured enemy vessels, and United States Navy combatant ships about to be stricken from the active list."[13] The Underwater Explosion Program had been approved by the Chief of Naval Operations, but the deployment of the atomic bomb changed the scope of the effort. On August 28, the same day Admiral King recommended destroying the Japanese ships, the Chief of the Bureau of Ships, Vice Adm. E. L. Cochrane, informed the Underwater Explosion Program staff that they "must be prepared to undertake broad-scale experiments with the atomic bomb to clear up its major influence on naval warfare" as their first priority. The Chief of Naval Operations was notified by BuShips and BuOrd that "full-scale testing...both underwater and above water, against ships of various types" using the atomic bomb was imperative.[14] At the same time, the United States Navy, which had built a formidable fleet of more than 1,200 ships during the war, was scaling down.

At the end of August 1945, Secretary of the Navy James Forrestal suggested that the Navy would be reduced to a 400-ship force with 8,000 aircraft, with the remaining ships held in reserve. This situation provided the Navy with a large number of potentially expendable ships for weapons testing. Questioned about the atomic bomb, Forrestal strongly underscored the fact that the bomb would ultimately be put to use at sea, noting that "control of the sea by whatever weapons are necessary is the Navy's mission." The next day, *The New York Times*, reporting on the Navy's opposition to merging the War and Navy Departments, noted that the Navy was probably amenable to joint operations regarding "scientific developments," and prophesized that "it would not at all be surprising" within the next six months for a proposal "to test the effects of the new atomic

bomb against warships. There has been speculation...whether the atomic bomb...might cause the bottoms of steel ships to disintegrate and thus sink the entire fleet...some Navy authorities say they would like to see such a test conducted against some of our old battleships, for, if the atomic bomb works this way, they want to know it."[15]

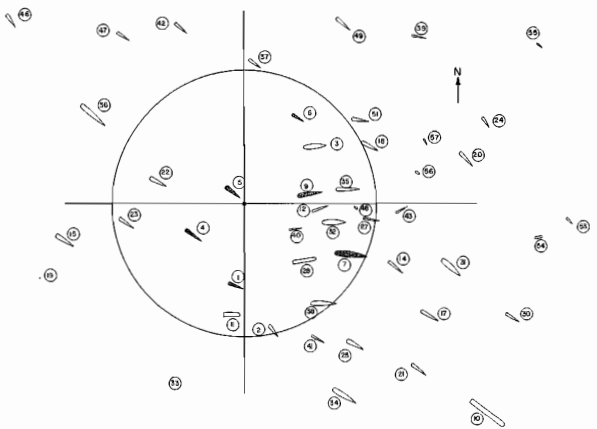
Given the Navy's strong interest in the bomb and its commitment to the Underwater Explosion Program and that program's priority being atomic testing, and with the Army Air Forces' proposal in hand, Admiral King agreed on October 16, 1945, to atomic bombing of the Japanese ships as a coordinated action of the Army and Navy under the control of the Joint Chiefs of Staff, with "a few of our own modern naval vessels...included in the target array" for air and underwater detonations, following the advice and plans of the Underwater Explosion Program staff.[16] On October 24, *The New York Times* reported that the Navy was to test the bomb to assess its effect on ships both dispersed and "massed at anchorage as in Pearl Harbor on Dec. 7, 1941."[17] It was not until December 10, 1945, however, that an official announcement of joint Army-Navy tests of the bomb was made. *The New York Times*, covering the announcement, stated that the details had yet to be worked out, specifically noting that the Army Air Forces "have been working aggressively to get a leading role in the experiment to make sure it would not be an all-Navy affair."[18] While hotly denied, the issue of Army-Navy competition was continually raised throughout the tests; a July 30, 1946, article in *The New York Times* quoted an unnamed Army officer's attacks on the "battleship mentality" of "die-hard" naval officers, noting "in the event of a future war...a Navy as we know it now will be utterly helpless on either side."

The concept of the tests was appealing for more than technical reasons; while "it is indeed routine to test each new weapon in all major applications," including against naval targets, "the novelty of the proposed test of the atomic bomb against naval vessels would lie in the unprecedented scale and world-wide importance of the tests."[19] Even more attractive was the overt symbolism of the atomic bomb destroying the surviving capital ships of the Japanese Navy; one early 1946 newspaper account, accompanied by an Associated Press photograph of 24 battered-looking submarines and destroyers, crowed "Trapped Remnants of Jap Fleet Face Destruction in United States Navy Atom-Bomb Tests." Another symbolic and significant aspect of the tests was a demonstration that the United States was now the world leader; it alone possessed the secret of nuclear power, it had a stockpile of atomic bombs capable of being used again, and it was sufficiently wealthy to expend three (the original number of planned detonations) of these bombs and nearly a hundred ships in the most costly and elaborate weapons tests performed on earth up to that time.

Considerable interest in the tests by scientists assessing the weapon's effects was publicly touted. In July 1946, *Life* magazine reported that "a large number of scientists are looking forward to the forthcoming explosion....never having had a chance to test the effects of atomic energy in their own areas of knowledge," because they would have "a laboratory example of what may happen to the world and the animate and inanimate things on it in the event that war comes again."[20] Throughout Operation Crossroads, and well after, "scientific benefits" of the tests were stressed. These benefits were for the military, which learned from Crossroads and the hundreds of tests that followed to make stronger, deadlier nuclear weapons:

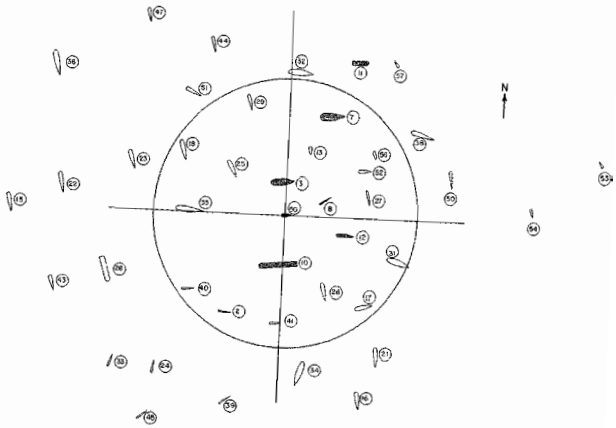
> At Hiroshima and Nagasaki a few photographs and pressure measurements were made of the explosions, but almost nothing of value to physicists was learned. Physicists wanted actual values of the following: pressure, impulse, accelerations, shock-wave velocity, ranges and intensities of gamma radiation, decrease of the gamma radiation during the first few hours. And medical men, arriving at the scene late, found it difficult to tell what the early symptoms of the injured persons had been, and whether the injuries resulted primarily from flash burn, gamma radiation, or

(1) DD *Anderson*
(2) SS *Apogon*
(3) BB *Arkansas*
(4) APA *Carlisle*
(5) APA *Gilliam*
(6) DD *Lamson*
(7) BB *Nagato*
(8) SS *Pilotfish*
(9) CL *Sakawa*
(10) CV *Saratoga*
(11) ARDC-13
(12) YO-160
(13) LCT-1114
(14) APA *Banner*
(15) APA *Barrow*
(16) APA *Bracken*
(17) APA *Briscoe*
(18) APA *Brule*
(19) APA *Butte*
(20) APA *Carteret*
(21) APA *Catron*
(22) APA *Crittenden*
(23) APA *Dawson*
(24) SS *Dentuda*
(25) APA *Fallon*
(26) APA *Gasconade*
(27) DD *Holmes*
(28) CVL *Independence*
(29) DD *Mayrant*
(30) DD *Mustin*



The Able Target Array, showing the actual point of detonation. Shaded vessels sank as a result of the blast.

(31) BB *New York*
(32) BB *Nevada*
(33) SS *Parche*
(34) BB *Pennsylvania*
(35) CA *Pensacola*
(36) IX *Prinz Eugen*
(37) DD *Rhind*
(38) CA *Salt Lake City*
(39) SS *Searaven*
(40) SS *Skate*
(41) SS *Skipjack*
(42) DD *Stack*
(43) DD *Talbot*
(44) DD *Trippe*
(45) SS *Tuna*
(46) DD *Wainwright*
(47) DD *Wilson*
(48) LCM-1
(49) LST-52
(50) LSM-60
(51) YOG-83
(52) LST-133
(53) LCT-327
(54) LCT-332
(55) LCT-674
(56) LCT-816
(57) LCT-818



The Baker Target Array, showing the actual point of detonation. Shaded vessels sank as a result of the blast. Both illustrations were redrawn by Robbyn Jackson of the NPS Historic American Engineering Record from ITF-1 sketches.

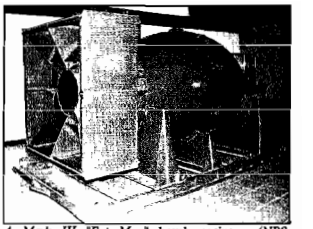
from secondary factors such as fires, and floods, and lack of food, over-exertion, and lack of medical attention.[21]

The Trinity detonation at the Alamagordo Air Base Range (now White Sands Missile Range) in July 1945 was a weapons proof shot; Hiroshima and Nagasaki were combat uses that had to be scrupulously analyzed after the fact for effect determinations. Operation Crossroads was of particular importance to the military; it was an opportunity for weapons scientists to assess, under a controlled environment, the effects of the bomb.

The bombs for Crossroads were delivered by the Los Alamos scientists who had also provided the bombs used for Trinity and against Japan. According to one report, the Crossroads bombs were drawn from the U.S. stockpile of nine implosion-type core devices; these weapons were nearly identical to the Mk III "Fat Man" bomb dropped on Nagasaki.[22] These weapons reportedly yielded a 23-kiloton effect, equal to 23,000 tons of TNT. ("Official" yield credited at the time was 20 kilotons.) The bombs "contained a proximity-fuze system of extremely great reliability, sensitivity, and absolute accuracy. The detonation system was set for an altitude of 515 feet."[23]

Initially three tests were planned in order to assess the effects of pressure, impulse, shock-wave velocity, optical radiation, and nuclear radiation particular to the bomb. The air burst was reportedly to duplicate the conditions of the drop on Hiroshima, this time over water. The second shallow underwater blast was to simulate an attack on a fleet at anchor. The third test (cancelled) was to take place in the lee of Oruk Island, off the atoll, in 1,000 to 2,000 feet of water, with a small number of vessels moored above the blast solely to test the underwater effect of the bomb.

A variety of preparations were made to handle logistics, relocation of the Bikinians, and the various scientific studies and tests that were performed at the atoll. The 242 vessels involved in Operation Crossroads were the subject of the most preparation: organized in



A Mark III "Fat Man" bomb casing. (NPS, Candace Clifford)

three groups--target ships (combatant), target ships (auxiliaries), and support ships. These vessels were placed "in the best possible material condition" at Pearl Harbor, Bremerton, Terminal Island, Hunter's Point, Philadelphia, and at Bikini.[24]

PREPARING FOR THE TESTS

Preparations for the tests involved surveys of structural and watertight integrity, installation of test equipment, stripping of armament and other items not required as test equipment, the removal of "certain items of historical interest or of a critical nature" from each ship--usually bells, nameplates, commemorative plaques, ship's silver sets--and their transfer to "the Curator of the Navy Department" in Washington, D.C.[25] The target ships were then loaded "with specified amounts of ammunition, fuel oil, gasoline, water....Ships were loaded as closely as possible to the battle or operating displacement of the ships. Varying percentages of the wartime allowance of ammunition and of the normal capacity of fuel oil and gasoline were carried in the ships' magazines and bunker tanks. All gasoline drums, airplanes loaded with gasoline, and similar items were placed in pans with coamings approximately 18 inches high to prevent dispersal of the gasoline."[26] In some cases emergency repairs were made to battle-damaged ships for the tests. USS *Pennsylvania* (BB-38), for example, had a cofferdam patch on the hull where a

torpedo had holed the ship in August 1945. This patch was reinforced and tightened, and a special watertight box was built around a steam steering engine shaft which, if flooded, would be damaged if the shaft bearings were immersed in salt water.[27] Other preparations included the establishment of vertical and horizontal reference lines for list and twist determination, installation of deck compression gauges, installation of special boarding ladders on the shell plating from waterline to deck edge, and painting of frame numbers on the hull and decks. A full photographic record was made of all "special installations."[28]

Factors involved in selecting the ships ranged from specific types and methods of construction to specific materials. In its enabling directive, Joint Task Force One was instructed to include not only captured enemy vessels in the target array but to also test vessels "representative of modern U.S. naval and merchant types...." However, "it was not feasible to include vessels of all U.S. naval types--especially the most modern types." A range of vessels were selected to include welded and riveted construction and the evolution of ship compartmentalization; "although the older vessels have extensive subdivision, recent ships have more complete transverse water-tightness to high-level decks and incorporate principles of longitudinal framing."[29] Therefore, the final target array included for the most part vessels that were "over-age or of obsolete design--which would otherwise have been decommissioned and sold for scrap. However, a modern aircraft carrier and several modern heavy-hulled submarines were included also."[30] Five battleships were selected, one being the Japanese *Nagato*, which was presumably included solely to sink it. The U.S. battleships, all of a type made obsolete by the newer classes, were included because "although not of most modern design [they] possessed great resistance to battle damage" because of heavy hulls, torpedo-protection systems of multiple longitudinal bulkheads, heavy armor, double or triple bottoms, and some 600 watertight compartments.[31]

Four cruisers--two U.S., one German (*Prinz Eugen*), and one Japanese (*Sakawa*)--were included. The American-built ships were "excellent examples of prewar riveted construction, with structure somewhat heavier than any cruisers up to the latest 8-in. cruisers built during the war." *Sakawa* and *Prinz Eugen* were selected because "they represented the latest in cruiser design of Germany and Japan."[32] *Sakawa* was intended to sink, as was *Nagato*; both vessels were moored within a 1,000-yard perimeter of the designated zeropoint for both tests, while *Prinz Eugen* was moored outside of the immediate blast area. *Saratoga* and *Independence*, the two carriers, were selected to include an old, pre-war carrier and a modern, but less than satisfactory light carrier. (The *Independence* class, a wartime necessity, were light, hastily constructed ships.) *Saratoga*'s selection was justified as follows:

> Subdivision of the *Saratoga* was unusually complete; she had approximately 1000 watertight compartments. There were 22 main transverse bulkheads and two continuous longitudinal bulkheads extended 70 percent of the length. Two watertight platforms extended fore and aft of the machinery spaces. The underwater protection was very similar in arrangement to that of modern battleships and large carriers. An inner bottom above the bottom shell was fitted between the innermost torpedo bulkheads for about 80 percent of the length.[33]

The 12 target destroyers selected represented three immediate prewar types--the *Mahan*, *Gridley*, and *Sims* classes. The attack transports were "typical of modern merchant-ship practice, with good transverse subdivision.... These vessels were designed and built during the war and were essentially of all-welded construction, with very few riveted joints."[34] Target landing craft were included "more for the purpose of determining the effects of wave action than for determining direct effects of pressure on the hulls."[35]

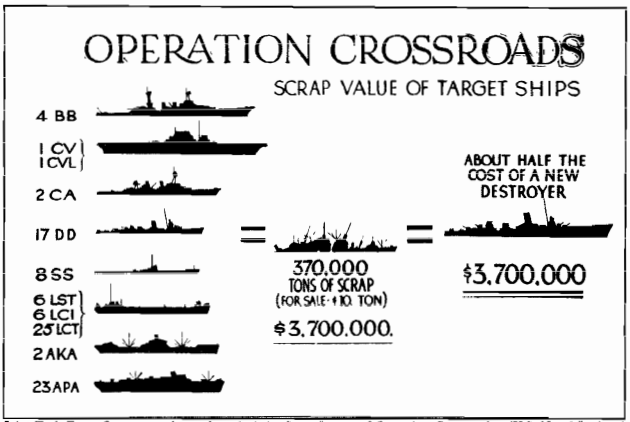
Three reinforced concrete vessels were used--ARDC-13, YO-160, and YOG-83. These three vessels were selected for dispersal within the target array from a group of craft scheduled for disposal to satisfy the Navy's

Bureau of Yards and Docks' interest "in the damage to reinforced concrete structures at Hiroshima and Nagasaki.... The lack of suitable land areas at Bikini made construction of similar installations impractical, even if there had been time."[36] The eight target submarines were "selected from those scheduled for the reserve fleets or for disposal by scrapping. They represented the two major types [the *Gato* and *Balao* classes], light and heavy hull construction, built in recent years by [among others] the three submarine building yards of the Electric Boat Company and the naval shipyards at Portsmouth and Mare Island."[37] Some vessels were individually selected because of age, previous battle damage, and, occasionally, to replace ships selected but not available. LCT-705 and LCT-1013 were placed in the Able target array to serve as "catchers to collect samples of any fission products which might fall out of the atomic cloud."[38] The selection of 35 "major" vessels--from the battleships and carriers to the submarines--was publicly announced on January 24, 1946, at the first Crossroads press conference in Washington.[39]

Opposition to the tests surfaced for a variety of reasons, among them the destruction of the ships. One objection was to the cost of the various target ships: in March 1946, Admiral Blandy testified before the Senate Naval Affairs Committee that the construction costs for the target ships totaled $450 million, but noted that all the ships were obsolescent except for five submarines and the light carrier *Independence*.[40] Senator Scott Lucas of Illinois criticized the tests as a "grandiose display of atomic destruction" and argued that the target ships, if no longer useful for naval purposes, could be converted "into temporary homes for veterans."[41] One citizen, writing to protest the tests, was angry not over the loss of ships, but of valuable steel, and noted that airplane engineers tested models in wind tunnels and thus "do not need to destroy full size planes to see just what the planes will do under certain conditions.... Scientists do not need to kill elephants to determine the reaction of chemicals and drugs. They use small mice."[42]

In response to criticism over the cost, Blandy responded on April 16 that the total costs of the tests would probably not exceed the total cost of "one large new ship," since the obsolete targets had been declared surplus and even if sunk "the cost for at least 90 percent would be only their scrap value," which the admiral estimated at $100 million.[43] In response to letters protesting the use of the target ships, Joint Task Force One's form letter response was that the ships were either obsolescent or "in excess of the number required to keep our post-war Navy at its proper strength." The letter emphasized that not all ships would be destroyed; even "those badly damaged...may be towed back to the United States and sold as scrap. Still others may be placed back into service...."[44] One letter writer wanted to place target ships in personal service: 11-year-old Max Ladewasser "and gang" wanted some of the ships presented to the children of the country; specifically "I would like to have a real P.T. boat which we could run on Lake Michigan."[45]

Some protests focused on the selection of individual ships as targets, specifically the battleships *New York* and *Pennsylvania*. When *New York* sailed from its namesake city in January 1946 for Bikini, the loss of the ship was lamented as veterans' groups and the state chamber of commerce lobbied to save it. "New York may lose forever its most useful and fitting war memorial unless something is done to prevent destruction of our century's Old Ironsides as an atom bomb target. This ship should be permanently on display in New York...." An unnamed officer stated that "I don't see why she couldn't have been given to the State, just as her sister ship, the Texas, was given to that State."[46] The response from Joint Task Force One was that while "it is regretted that such ships as the *New York* cannot be spared and exhibited as memorials, it is felt that this gallant battleship could perform no more valuable or distinguished service for our post-war Navy than it will render in the historic tests...."[47] It was also noted that "many other ships of the target group have equally glorious battle records and are similarly



Joint Task Force One press release chart depicting "scrap" costs of Operation Crossroads. (U.S. Naval Institute)

distinguished historically in their respective classes. It is sincerely regretted that such ships which have served with distinction in our Navy for so many years cannot be spared...."[48]

The criticism by some nuclear scientists that the tests would add little or nothing to the understanding of the bomb was in part based on their assertion that ships, as mechanically stronger structures than buildings, would remain afloat and undamaged, lessening fear of the bomb by people who expected the total destruction of the fleet prophesized by the press, thus creating a "feeling of false security." Two explosive weapons had already been detonated--Able and Baker's bombs were identical to the Nagasaki weapon. The "greatest weakness" of the tests, however, was that as of early February 1946,

> no provisions are indicated for studying the effects of the bomb's radiation on ships' crews. What might happen in a real case, is that a large ship, about a mile away from the explosion, would escape sinking, but the crew would be killed by the deadly burst of radiations from the bomb, and only a ghost ship would remain, floating unattended on the vast waters of the ocean. If not killed outright, the crew may well suffer such strong radiation damage, as to become critically ill a few days later.[49]

This prescient comment's various implications were in part answered by the decision to place animals on the target ships to study the bomb's effects on them. Protests against the use of the animals were numerous; among the letters received were a few that grimly reflected on the use of enemy vessels as targets, with the addition of "Germans and Japanese who have been condemned to death by proper courts of jurisdiction."[50] One writer suggested that "in

Considerable protest arose over the exposure of animals aboard the target ships. Two goats aboard USS Niagara. (National Archives)

lieu of the 4000 innocent animals...a like or greater number of war criminals be used instead. It would seem to me to be more in keeping with the principles of justice and humanity to punish those responsible for the agonies the world was plunged into through their actions rather than to cause suffering to creatures whose only sin is existence at a lower biological level than our own."[51]

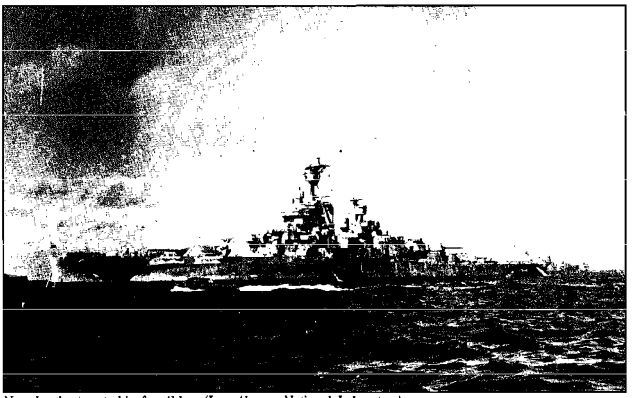
The target vessels were assembled at Bikini between May and June, 1946. They were moored at numbered berths, carefully arranged around the projected surface or ground zeropoint so that graduated scales of damage would be inflicted on the ships. A large number of vessels were required "in order to gain the greatest amount of useful information...and...determine the complete relationship between ship damage and distance from the explosion." The necessity of a large target fleet for Able test "was especially clear after it had been decided to drop the bomb from an airplane...it was clear that there would be uncertainty as to the point of detonation."[52] Ninety-five naval vessels, representing the products of U.S., Japanese, and German shipyards, were selected as the target fleet for Operation Crossroads. This fleet consisted of two aircraft carriers, five battleships, four cruisers, twelve destroyers, eight submarines, nineteen attack transports (APAs), six LCVPs, five LSTs, one LSM, sixteen LCTs, seven LCIs, six LCMs, and three auxiliary barges, namely one YO, one YOG, and one ARDC.[53] It is important to note that 88 vessels, not the full number of target ships, were deployed in the Able target array. The number of U.S. combatant vessels used as targets was limited to 33 ships by Congressional legislation (H. Res. 307) authorizing the tests; "considerable public feeling developed to the effect that valuable vessels were going to be destroyed; Congress reacted by putting an upper limit to the number of U.S. combatant ships."[54] Though the landing craft and auxiliaries were naval vessels, they were not commissioned and hence were not counted; nor were the attack transports, which arguably were also not "combatant" ships, making 28 American-built "combatant ships" counting only the carriers, cruisers, battleships, destroyers, and submarines. Disappointment not withstanding, the press proudly reported at Bikini that the target fleet formed the world's fifth or sixth largest navy, with only the navies of the U.S., Great Britain, the Soviet Union, France, "and perhaps Sweden" surpassing it.[55]

THE ABLE TEST

The target arrays were selected "to provide the best instrumentation possible, rather than be placed in a tactical formation. This policy was approved for both tests."[56] The vessels were closely grouped together near the center of the array "because of the...decrease of pressure with increase in distance from the zeropoint."[57] The test array for the Able test included 24 vessels within the 1,000-yard radius of *Nevada*, the designated zeropoint, while 21 vessels were placed within the 1,000-yard radius of the point of detonation for the Baker test.

Additionally, the Joint Chiefs of Staff required the target arrays to graduate the level of damage; "this involved dispersing the target fleet so that individual ships of each major type would be placed in positions ranging from close...for major damage...to appreciable distances...for light damage."[58] Since sufficient numbers of each type of vessel were not available, the best layout, geometric lines, bow and stern on, and broadside to the blast, was adhered to only for those ships that were present in large quantities--landing craft, destroyers, and attack transports. These ships were berthed at regular intervals along a single, curved (to keep one ship from partially shielding another) line extending radially from the designated zeropoint, which was 5,400 yards off the beach of Bikini Island. The battleship *Nevada* was selected as the zeropoint "target" for Able because it was "the most rugged ship available."[59]

The target arrays were different for each test. The Able target array consisted of 78 vessels; the Baker array consisted of 75. After the several vessels sank in the Able test, some of the ships in the "fringes" of the test area were shifted closer to the zeropoint to replace the lost vessels. Additionally, other vessels were placed farther out in the Able array to spare them from major damage since they were to be the primary targets in the Baker test; among these ships was the carrier *Saratoga*.[60] The Able test detonation, originally scheduled for May 15, was postponed six weeks to allow,



Nevada, the target ship for Able. (Los Alamos National Laboratory)

according to some opinions, for Congressional observers to be on the scene. The Able test bomb, nicknamed "Gilda" for the recent Rita Hayworth motion picture of that name, and stencilled with the likeness of Miss Hayworth, was dropped from the B-29, "Dave's Dream," on the morning of July 1, 1946. The bomb missed the designated zeropoint, *Nevada*, probably because of, according to some experts, poor aerodynamics caused by its high-drag tail fin structure, detonating instead 2,130 feet from the target and 518 feet directly above and 50 yards off the bow of the attack transport *Gilliam*.[81]

The Able burst sank five vessels: the attack transports *Gilliam* and *Carlisle*, closest to the detonation, sank almost immediately. Two nearby destroyers, *Anderson* and *Lamson*, were also severely damaged and sank within hours, followed by the Japanese light cruiser *Sakawa*, which sank on July 2. Other vessels were severely damaged, the most dramatic damage occurring to the light carrier *Independence* and the submarine *Skate*, both of which were for all intents and purposes wrecked. Six ships were immobilized, and 23 small fires were started on various ships. The badly damaged ships were all within a 1000-yard radius of the zeropoint along with *Hughes* (DD-410), which was among the more damaged destroyers and later required beaching to avoid its sinking, the battleships *Arkansas* and *Nagato*, ARDC-13, and YO-160, all badly burnt and battered. The fears of the physicists opposed to the tests--that contrary to expectations the results would be less than cataclysmic, thus creating a false sense of security--were realized. *The New York Times*' account of Able noted that while the bomb had exploded with a flash "ten times brighter than the sun" over the target ships, "only two were sunk, one was capsized, and eighteen were damaged."[82] The foreign observers were unimpressed, reported the press; the Russian observers shrugged their shoulders and the Brazilian observer said he felt "so so"

Journalists aboard LCT-52 inspect USS Independence after Able. (National Archives)

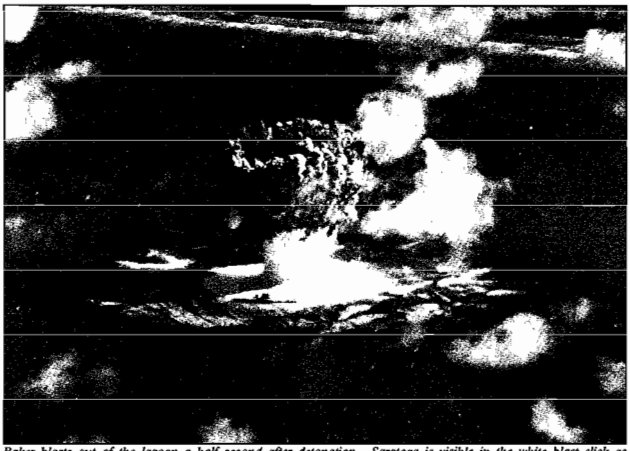
Able's mushroom cloud towers over Bikini Atoll. (National Archives)

Able, from Bikini Island. USS Saratoga's deck burst into flame at the far left. (National Archives)

about the blast.[63] Of the 114 press representatives at Bikini, only 75 stayed for the Baker test.

Following the Able detonation, Navy teams moved in to fight fires, reboard the ships, and tow sinking vessels to Enyu for beaching. As this work progressed, diving commenced on the sunken ships for "a full assessment of the damage done by the air blast."[64] The first dives were made on July 7, when *Gilliam* was dived on, followed by *Carlisle*, *Anderson*, and *Lamson*. Inspection of the ships, recovery of test gauges (particularly from *Gilliam*, which was the highest priority for instrumentation recovery because the ship was the accidental zeropoint for the blast), and underwater photography continued until July 14, when attention turned to the preparations for the Baker test.[65] Expectations for greater damage during the Baker test were high; Secretary of the Navy James Forrestal, touring the target ships after Able, when asked why the first detonation had not sunk the entire fleet, remarked that "heavily built and heavily armored ships are difficult to sink unless they sustain underwater damage."[66] News reports and military and public interest focused on blast effect. The effect of radiation was for the most part ignored; a short news item filed by the Associated Press on July 15 noted that the test animals were "dying like flies.... Animals that appear healthy and have a normal blood count one day, 'drop off the next day,' an officer said...."[67] This scarcely noted account was a harbinger of the future.

LSM-60 suspended the bomb detonated during Baker. (U.S. Naval Institute)



Baker blasts out of the lagoon a half second after detonation. Saratoga is visible in the white blast stick as the column forms nearby. (U.S. Naval Historical Center)

THE BAKER TEST

The Baker test bomb, nicknamed "Helen of Bikini," was placed in a steel caisson manufactured by Los Alamos from the conning tower of USS *Salmon* (SS-182) which had been scrapped in April 1946. With "Made in New Mexico" chalked on its side by Carl Hatch, U.S. Senator from New Mexico and an observer at the tests, the caisson was suspended 90 feet below the well in the steel landing ship LSM-60.[68] The bomb was detonated on the morning of July 25, 1946. The blast displaced 2.2 million cubic yards and created a 25-foot deep crater with a maximum diameter of 1,100 yards and a minimum diameter of 600 yards; the segment of the crater deeper than 20 feet covered an area 250 to 700 yards in diameter. It was estimated that about 500,000 cubic yards of material fell back into the crater, with the remainder dispersed throughout the lagoon. "A layer of sand and mud several feet thick was deposited on the bottom..." and a diver working on the port side of *Arkansas* after the blast reportedly sank into soft, pulverized coral and mud up to his armpits.[69] The Baker blast--or the two million tons of displaced water from the cloud that fell back into the lagoon--sank an additional nine vessels, some almost immediately. LSM-60 was destroyed; except for a few fragments of the ship that fell on other vessels, no trace of the landing ship was ever found. The bomb's detonation point was within 500 yards of the location of the sunken *Lamson* and *Sakawa*. The failure to locate these vessels during subsequent dive surveys of the lagoon indicates the bomb, moored at a depth of 90 feet in a 180-foot deep lagoon, probably did considerable damage, or possibly completely destroyed them, depending on each wreck's exact location.

Arkansas, the submarines *Apogon*, *Pilotfish*, and *Skipjack*, and the auxiliaries YO-160 and ARDC-13 sank almost immediately. The badly damaged carrier *Saratoga*, listing but too radioactive to be boarded by salvage teams, sank within hours, followed by the Japanese battleship *Nagato*, and LCT-1114. Within the next few days, five other landing craft that were damaged in the Baker test were scuttled in Bikini lagoon; another was taken outside of the atoll and sunk. The destroyer *Hughes* and the attack transport *Fallon*, badly damaged and sinking, were taken in tow and beached. The detonation effect of Baker was greater than Able; reports and interest were rekindled, although total destruction by the bomb had once more been averted. One reporter, William L. Laurence, the "dean" of atomic reporters who had witnessed the detonation of the Trinity test bomb, the Nagasaki bomb drop, and the two Bikini blasts, described a new public attitude as a result of Operation Crossroads. Returning to the United States, Laurence found that while "before Bikini the world stood in awe of this new cosmic force...since Bikini this feeling...has largely evaporated and has been supplanted by a sense of relief unrelated to the grim reality of the situation." Laurence felt this was because of the desire of the average citizen "to grasp the flimsiest means that would enable him to regain his peace of mind. He had expected one bomb to sink the entire Bikini fleet, kill all the animals...make a hole in the bottom of the ocean and create tidal waves. He had even been told that everyone participating in the test would die. Since none of these happened, he is only too eager to conclude that the atomic bomb is, after all, just another weapon."[70]

Laurence himself, as well as nearly everyone else involved in the tests, failed to realize or report the insidious effect of the bomb. Far deadlier than the actual blast, in that time of "limited yield" nuclear weapons, was the lasting effect of radiation, confirming once again the fears and prophecies of the nuclear scientists that even seemingly "undamaged" vessels could and would suffer from radioactive contamination. Decontamination by scrubbing the ships "clean" was only partially successful. The effort to decontaminate the target battleship *New York* was a case in point:

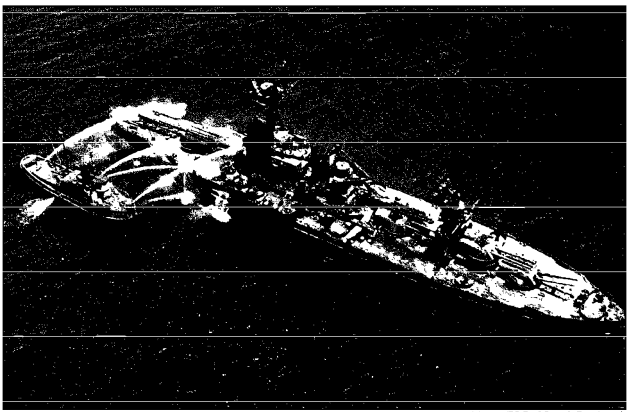
> The main deck forward had not been touched as yet....I made a careful survey of the deck, finding the intensity to vary a great deal in a matter of feet. One gets the impression that fission products have become most fixed in the tarry caulking of the planking and in rusty spots in the metal plates. When the survey was complete the Chief turned his booted, sweating, profane and laughing crew loose with brushes, water, and a barrel of lye. Yet when the hydraulics were done and the deck rinsed clean again, another survey showed the invisible emanations to be present.... The portly Chief stood watching the dial of my Geiger counter, completely bewildered. The deck was clean, anybody could see that, clean enough for the Admiral himself to eat his breakfast off of. So what was all this goddam radioactivity?[71]

While no extensive deposit of long-life radioactive materials were found on the target ships after the Able test, the Baker test detonation generated more radiation; even the salt in the water, for example, was transformed into a short-lived radioactive material. However, plutonium and other long-lived fission products that emitted beta and gamma rays were the major problem. The reboarding of ships after Able was undertaken after a few hours in some cases. After Baker, only five vessels at the extreme ends of two vessel strings could be boarded. Access to the rest of the target array was denied. By July 26 and 27, crews were able to beach *Hughes* and *Fallon*, which were sinking, "but both vessels were radioactive to the extent that taking them in tow...required fast work. The forecastle of *Hughes*, for example, had a tolerance time of about eight minutes."[72] By July 27 and 28, surveys of all remaining target vessels were made from distances of 50 to 100 feet.

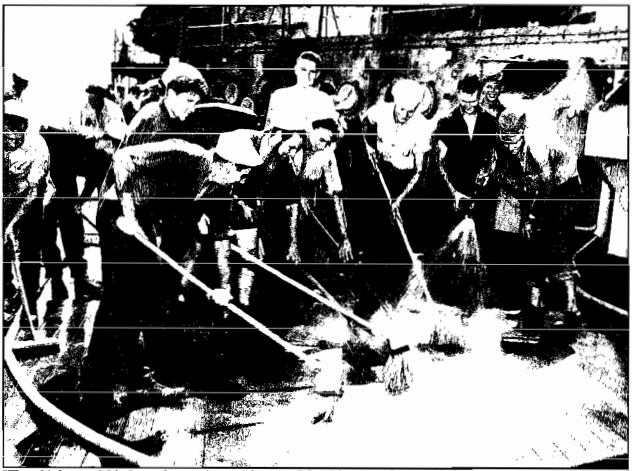
DECONTAMINATION EFFORTS

Initial efforts to decontaminate the ships were hampered by the fact that no plans had been prepared for organized decontamination; "the nature and extent of the contamination of the targets was completely unexpected."[73] The first efforts, with the beached *Hughes*, employed Navy fireboats to wash down the exteriors of the ships because "water might take up some of the radioactive materials in solution." Washing down reduced the radioactivity some fifty percent on *Hughes*, bringing the exposure Roentgens rates on it down to 9.6 R/day on the forecastle and 36 R/day at the stern! Subsequent washings had no measurable effect. Foamite, a water-mixed firefighting foam, was applied and washed off; two washings on *Hughes* reduced the radiation to levels varying between 2.0 to 8.5 R/day.[74]

Radioactive material adhered to the ships' wooden decks, paint, tar, canvas, rust, and grease; while some of it could be washed off, the only effective means of removal was sandblasting the ships to bare metal, stripping off every piece of planking, and bathing brass and copper with nitric acid. Washing, as the experience with *New York* demonstrated, did not significantly reduce radiation levels, particularly with crews limited to short periods of exposure. Only complete removal of the contaminated surface area reduced the radiation. The Navy discovered, too, that "painting over the surface produced no reduction in [beta gamma] activity...."[75] The problem of decontamination was serious; the Navy required a reduction of radiation intensity to allow reboarding for instrument recovery and inspection for periods of at least two hours. At the same time, it was hoped that in two-hour shifts crew members could "apply detailed scrubbing, abrasive, and paint removal action as necessary to reduce the radioactivity sufficiently to permit continuous habitation of the ships."[76] "Lightly" contaminated ships--*Conyngham*,



A Navy tug sprays down USS New York after Baker to decontaminate the battleship. (U.S. Naval Institute)



"The chief turned his booted, sweating, profane, and laughing crew loose with brushes, water, and a barrel of lye." Decontamination efforts aboard Prinz Eugen. (National Archives)

Wainwright, *Carteret*, and *Salt Lake City*--were the first vessels subjected to "detailed decontamination" on July 30.

By August 5, several ships were being pumped out and "secondary decontamination" of others followed. On August 24, inspection efforts commenced on several target ships, including dives made on *Saratoga*, *Arkansas*, and *Pilotfish* that continued until August 30. The submarine *Skipjack* was successfully raised by divers on September 2, and some instruments were recovered from the sunken ships, but work time was limited by radiation hazards. On August 10, orders were issued to cease decontamination efforts at Bikini and prepare the target ships for towing to Kwajalein. The decision was reached when it was discovered that decontamination generally was not working and was extremely hazardous; the final straw was "the discovery of alpha emitters from samples inside *Prinz Eugen*" which were not detectable with the monitoring instruments in use at Bikini. Further investigation showed "probable widespread presence of the alpha emitters...even in spaces not obviously contaminated. Since no alpha detectors for general field use were available and the alpha emitters are one of the most poisonous chemicals known, their presence was considered a serious and indeterminate menace...."[77] The priority of work shifted "toward recovery of instruments and clearance of those ships designated for use in Test Charlie."[78] This ten-vessel test (five submarines and five capital ships) at the southwestern end of the atoll and seaward of Oruk Island, scheduled for March 1947, was later cancelled by the President.

The "severe" contamination problem was kept as quiet as possible; according to an August 10 memorandum from the Manhattan Engineer District of the Army Corps of Engineers observer, Col. A. W. Betts, to his boss, Brig. Gen. Kenneth D. Nichols, "the classification of this memo can only be explained by the fact that the Navy considers this contamination business the toughest part of Test Baker. They had no idea it would be such a problem and they are breaking their necks out here to find some solution."[79] Gross decontamination efforts continued that enabled the Navy to complete the removal of test instruments and records, technical inspections, and salvage operations; however, the report on radiological decontamination concluded that these efforts, "although successful to a certain extent in the limited application they received, revealed conclusively that removal of radioactive contamination of the type encountered in the target vessels in Test Baker cannot be accomplished satisfactorily...."[80] On August 25, 1946, the Navy's Director of Ship Material, in charge of the inspections, "felt that all significant information had been recorded and reported that the technical inspection phase at Bikini was complete." That day he and his staff departed for Kwajalein "to establish facilities there for continued examination and radiological re-checks of the target ships."[81] Some of the vessels had departed as early as August 19, and now the other ships followed; by August 29, only 19 target vessels--the destroyer *Mustin*, YOG-83, and 16 landing craft, were left at Bikini, along with 18 salvage vessels.

THE LEGACY OF CROSSROADS

Thirteen target ships were sent to Pearl Harbor or to the West Coast "for further study of damage and for development of radiological decontamination and safety techniques by the Navy....it is the policy of the Navy to carry out an aggressive active program of radiological and atomic defense research to apply the lessons of Crossroads."[82] The study of the ships led to certain modifications in the construction of new naval vessels, though after World War II the United States built few large vessels. Rounding of ship surfaces and wash-down systems to spray a vessel subjected to fallout and facilitate the rinsing off of the ship were the only Crossroads-induced changes for passive defense against nuclear weapons. The primary naval modifications after Crossroads were measures to take the bomb to sea as a weapon, leading to nuclear-capable carriers, guided missile cruisers, and submarines. Additionally, there was a demand for new designs of nuclear weapons suitable for carrying in these vessels. In an atmosphere of no adequate defense against nuclear deployment, the Navy, like the rest of the military, embraced nuclear deterrence through the adoption of and subsequent escalation of use of nuclear weapons at sea as a defense.

Decontamination efforts at Kwajalein ceased in September 1946; work after that focused on removing ammunition aboard the ships. On one such detail, the light carrier *Independence* was visited and described:

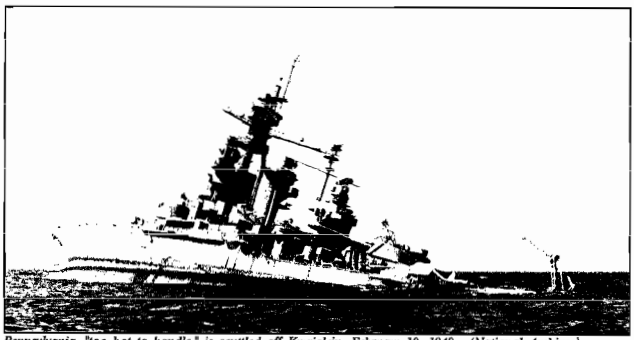
> The *Independence* is a ghost ship--its flight deck blown up, leaving the thick oak planks broken like so much boxwood; its hangar deck blasted down and only the skeleton of its sides remaining. Gun turrets and gangways, twisted, crushed, dangle oversides, grating and creaking with the roll of the ship. Doors are smashed in and jammed tight against the bulkheads, or blown out altogether, and the rusty water sloshes aimlessly back and forth across the rusty decks. For the most part the radiation is not particularly high, although sometimes these rusty pools will set your earphones singing and shoot your indicator needles off scale.[83]

A confidential memorandum from the Commander in Chief, Pacific Fleet, (CINCPAC), dated September 4, 1946, authorized the sinking of contaminated vessels at Kwajalein.[84] The same day, Admiral Blandy, back in Washington, reported that "only 9 of 92 ships escaped at Bikini," noting that "all but nine...were either sunk, damaged or contaminated by radioactivity," naming the submarines *Tuna, Searaven, Dentuda*, and

Parche, and the transports *Cortland*, *Niagara*, *Bladen*, *Fillmore*, and *Geneva* as the nine undamaged ships. The report named 45 vessels that had been decommissioned after the tests. Blandy also reported he had sought and received permission to sink "a number of the small landing craft damaged in the experiments, pointing out the dangers of possible lingering radioactivity and also...the cost of repairs and movement from the Marshall Islands...."[65]

The target ships at Kwajalein remained there for two years in a caretaker status. Soon after the tests, on December 22, 1946, one vessel, the German cruiser *Prinz Eugen*, capsized and sank and was left in place. Another target vessel, LCI-327, stranded on Bascombe (Mek) Island in Kwajalein Atoll; it could not be freed and was "destroyed" in place on October 30, 1947. Some of the ships--the submarines, for the most part, and some of the landing craft--were sufficiently "cool" to return to duty as training vessels. The other vessels, contaminated by the tests, were subjected to additional analysis but for the most part were simply left as a ghost fleet that was literally too hot to handle. In June 1947, Chief of Naval Operations (CNO) established a policy for handling and control of "radiologically contaminated material from Crossroads." Noting the "real and ever present hazard," the CNO dictated that materials were to be removed only for carefully considered testing, that they be carefully controlled and handled, and they not be "retained indefinitely...but shall be disposed of, when the tests are completed, by sinking at sea or by replacement aboard the target vessel."[66]

Eventually, this policy was adhered to for the ships themselves. On August 30, 1947, the Chief of Naval Operations reiterated CINCPAC's September 1946 dictate that all ships "found radiologically unsafe" were to be sunk at sea in deep water.[67] By this time decisions had been made to separate the target ships, as well as some contaminated support vessels, into groups. The majority of ships, too hot to be decontaminated, were left at Kwajalein, while 13 others were taken to Pearl Harbor, Seattle, and San Francisco for decontamination studies; the three ships towed to San Francisco were *Independence*, *Crittenden*, and *Gasconade*. The six surviving



Pennsylvania, "too hot to handle," is scuttled off Kwajalein, February 10, 1948. (National Archives)

submarines--*Dentuda*, *Tuna*, *Parche*, *Searaven*, *Skate*, and *Skipjack* were sent to Mare Island Naval Shipyard and the San Francisco Naval Shipyard at Hunter's Point. *Dentuda* and *Parche* were considered only "radiologically suspect" and were cleared for preservation and reuse. Four of the submarines could not be decontaminated; *Skipjack*, *Searaven*, *Skate*, and *Tuna* were sunk as targets off San Clemente, California, in 1948.

Pearl Harbor received the battleships *Nevada* and *New York*. Puget Sound Naval Shipyard received the destroyer *Hughes* and the cruisers *Pensacola* and *Salt Lake City*. In 1948 all three were towed to sea and sunk as targets in deep water.[88] Fifty of the target vessels were sunk as targets for conventional weapons (surface bombardment and aerial attack); 36 were sunk in the vicinity of Kwajalein. *New York* and *Nevada* were sunk off Hawaii in deep water; *Hughes* and *Pensacola* were sunk off the Pacific coast of Washington, and *Independence*, *Crittenden*, *Gasconade*, *Salt Lake City*, and the four submarines previously mentioned were sunk off California. Nine ships are known to have escaped scuttling or sinking: two submarines, *Dentuda* and *Parche*; two LCIs were sold for scrap along with one LCM; and four attack transports--*Cortland*, *Fillmore*, *Geneva*, and *Niagara* were transferred to the Maritime Commission and ultimately scrapped by them. The fate of 13 landing craft (five LCIs, three LCMs, and five LCVPs) is unknown.[89] If they were scrapped later, this would raise the number of "survivors" of the target fleet to 22 vessels. Although a fourth of the total fleet numerically, these ships included only two combatant ships and a small fraction of the total tonnage assembled at Bikini for the two blasts. The contaminated or "suspect" support vessels present better statistics; by the beginning of 1947, 80 of the 159 support ships were granted "final radiological clearance." By the end of the year, every one of the 159 was cleared, though some, like the destroyer *Laffey*, required drydocking in floating drydocks (to avoid contaminating permanent onshore facilities), sandblasting and repainting of all underwater surfaces, and acid washing and partial replacement of salt-water piping and evaporators in the ship.[90]

The message of Bikini, while not understood by the public at the time, and only grasped later in hindsight, was clear to the military, which had seen a fleet survive physically but nonetheless lost forever to radioactive contamination. Blast effect, while impressive, paled next to radiation effect: "From a military viewpoint, the atomic bomb's ability to kill human beings or to impair, through injury, their ability to make war is of paramount importance. Thus the overall result of a bomb's explosion upon the crew...is of greater interest...." Therefore, it followed that,

> If used in numbers, atomic bombs not only can nullify any nation's military effort, but can demolish its social and economic structure and prevent their re-establishment for long periods of time. With such weapons, especially if employed in conjunction with other weapons of mass destruction, as, for example, pathogenic bacteria, it is quite possible to depopulate vast areas of the earth's surface, leaving only vestigial remnants of man's material works.[91]

Ironically, the vestigial remnants of man's material works in the form of the target ships were the first tangible demonstrations of the power of the atomic bomb and the futility of defense against it; as Paul Boyer notes, an awakening slowly resulted from "the navy's determined, frustrating, and ultimately futile efforts to decontaminate the surviving ships by scrubbing, scraping, and sandblasting...the pariah fleet of ghostly radioactive ships...."[92]

Public awareness and wariness began to surface in 1948. That year, David Bradley, M.D., a member of the radiological safety team at Bikini, published his diary, written during the tests as the book, *No Place to Hide*, which was syndicated in a pre-publication release by the *Atlantic Monthly*, condensed by *The Reader's Digest*, made into a Book-of-the-Month Club release, and stayed on *The New York Times* best sellers list for ten weeks. *No Place to Hide* was a forceful book that subtly told the real message of Bikini; Bradley felt that the Crossroads tests, "hastily planned and hastily carried out...may have only sketched in gross

outlines...the real problem; nevertheless, these outlines show pretty clearly the shadow of the colossus which looms behind tomorrow."[93] Bradley also was drawn to the analogy of the target ships at Kwajalein, including "the beautiful *Prinz Eugen*, once the pride of the German fleet and as sleek and cavalier a ship as ever sailed the seas," intact and unbroken by the blasts but "nevertheless dying of a malignant disease for which there is no help."[94] The cure was sinking the ships. In February 1949, *The Washington Post* published a column by Drew Pearson that termed the test results a "major naval disaster." Pearson reported that as of 1949, "of the 73 ships involved in the Bikini tests, more than 61 were sunk or destroyed. This is an enormous loss from only two bombs.... The aircraft carrier *Independence*...is now anchored off San Francisco, permanently destroyed--usable only as a testing ground to determine the possibility of removing radioactivity. This is still dangerous two years after the ship was attacked."[95]

It is strangely prophetic that almost all of the target ships were ultimately taken to sea and scuttled in deep water, joining their sisters sunk in the more shallow waters of Bikini. Once too radioactive to visit, these vessels, with the beta or gamma activity reduced due to radionuclide decay are now the focus of a new look at them and at Crossroads.

Ironically, the "nuclear nomads" of the Pacific, presently the absentee owners and managers of many of the vessels from the sunken fleet of Operation Crossroads, were, like the ships themselves, harbingers of a nuclear future. In 1948, David Bradley wrote of his 1946 visit to the displaced Bikinians on Rongerik Island. They "are not the first, nor will they be the last, to be left homeless and impoverished by the inexorable bomb. They have no choice in the matter, and very little understanding of it. But in this perhaps they are not so different from us all."[96] In 1978, Tomaki Juda, leader of the Bikinians, testified before Congress that his people had been relocated on the premise that the tests were for the good of mankind and that they were to be like "the Children of Israel, whom the Lord led into the Promised Land." Juda noted, sadly, that the Bikinians "were naive then.... We are, sadly, more akin to the Children of Israel when they left Egypt and wandered through the desert for 40 years."[97] Now, 44 years later, the Bikinians and the rest of the world more fully understand the meaning and legacy of Operation Crossroads, a legacy that is reflected in twenty-three vessels that lie accessible to divers at two Pacific atolls.

THE 1947 SCIENTIFIC RESURVEY

In early 1947, plans for a scientific resurvey of Bikini during that summer were drafted by the Joint Crossroads Committee. Adm. W. S. Parsons, the Navy's Director of Atomic Defense, forwarded a proposal to the Joint Chiefs of Staff on April 9, 1947. A program of biological study was necessary "in order to determine the long-term effects of Test Baker on fish and other marine organisms including corals and calcareous algae...and to obtain data on which to base a decision relative to possible resettlement of the native population."[98] At the same time, diving on some of the sunken target ships was proposed to "make additional diving observations" and retrieve test data from Crossroads instruments abandoned in 1946. Specifically mentioned as high priorities for reassessment were *Saratoga*, *Nagato*, *Pilotfish*, *Arkansas*, and *Apogon*.[99]

The plan was approved, and a group of scientists and technicians from the Navy, Army, the Smithsonian Institution, the U.S. Fish and Wildlife Service, and other unnamed institutions was placed under the command of Capt. Christian L. Engleman, USN, the Project Director at Bikini. Overall command of the resurvey ships was given to Capt. H. Henry Hederman, USN. Both men were Crossroads veterans. While a classified operation, the resurvey was publicly announced because of a strong desire by the Joint Chiefs to stress "the story of cooperation that exists between civilian and military agencies in the Bikini resurvey work. Proper handling of the Bikini Resurvey story can do much to acquaint the American public with the long-range value of Operation Crossroads."[100]

The Bikini Scientific Resurvey team lands at Bikini, 1947. (U.S. Naval Institute)

The Bikini Resurvey task group steamed from Pearl Harbor to Bikini on the transport USS *Chilton* (APA-38), the submarine rescue vessel USS *Coucal* (ASR-8), LSM-382, and LCI(L)-615 on July 1, 1947, arriving on July 15 and remaining until the first of September. The operations plan that they sailed under included an effort, directed by Lieut. Cmdr. F. B. Ewing, USN, to make detailed observations of *Saratoga*, *Nagato*, *Gilliam*, and *Apogon*. "Other vessels, including *Arkansas* and *Pilotfish* will be inspected if time permits." The inspection plans called for extensive underwater photography and structural inspections "in an effort to determine the exact cause of sinking."[101] The only specific instrument recovery noted was from *Nagato*. Four instruments, an ionization gage, two linear time pressure recorders, and a diaphragm gage, "the exact locations of which are known," were to be recovered at the discretion of Lieut. Cmdr. Ewing. Additionally, "it is believed that a portion of LSM-60 has been located. If time permits, an attempt will be made by divers to locate this portion and inspect it thoroughly for type of rupture, heat effects, and radioactivity. If practicable, an attempt will be made to raise this section for an inspection on the surface."[102]

More than 600 dives were made to study blast effects and damage on the wrecks of *Saratoga*, *Apogon*, and *Pilotfish*. "In addition, a cursory inspection was made of the ex-Japanese battleship *Nagato*."[103] The first dives made were on *Saratoga* on July 17, two days after the resurvey team arrived. The Navy divers reported visibility to be from 15 to 30 feet on the wrecks. However, "divers on the bottom...did have difficulty in seeing clearly because of fogs of sand and mud which were easily stirred up...."[104] Radiation levels were carefully monitored. Divers wore pencil dosimeters and three film badges--on the chest, abdomen, and leg--and when hoisted from the water, each diver was "washed down by hose before being hoisted aboard ship."[105] Radiation levels recorded ranged from "two times background (gamma) to .1 R/24 hr. (gamma), and up to .6 R/24 hr. (beta and gamma)."[106] Dive equipment was found to be lightly contaminated; however, "some of the diving equipment was contaminated prior to the resurvey, which can be attributed to the fact that this equipment was used during Operation Crossroads." The source of contamination was found to be "due to contamination by coral powder from the sunken ships and sand from the lagoon bottom."[107]

Only observations were made of the ships at Bikini. Instrument recovery was not attempted since "after Baker day, recovery operations were carried on with unabated vigor and very considerable success, so that perhaps 80 percent of the instruments were recovered."[108] Instruments left behind were presumed buried on the bottom or were "by now [1947] so corroded that their readings would be useless...." A spring chronogram in the crew space, "port side, main deck, frame 16 [of *Nagato*] "might contain a valid record on magnetic tape. It is believed, however, that recovery of this instrument would not add materially to the information at hand concerning the air blast in shot Baker."[109]

Other work accomplished by the resurvey team included detailed geological assessments of reef structures by drilling. Cores and samples were taken of the bottom of the lagoon. Scientists

Divers prepare to descend on an unidentified sunken ship during the 1947 resurvey. (U.S. Naval Institute)

collected samples on the reefs to determine the "existing degree of radioactivity, or [conducted] studies concerned with habitats, food chains, and taxonomic relationships." Algae, sea urchins and other marine invertebrates, insects, birds, and mammals were collected and studied for "possible radiological or blast effects upon structure, physiological processes, fertility or normal processes of development." A radiological survey group made "a comprehensive survey of radioactivity on the reefs and islands...."[110]

At the end of August, packing of equipment began for departure. Laboratories ashore were closed and packed by August 27, and the buildings ashore were cleared and locked on August 29. A final inspection was made before the resurvey ships sailed on the 29th. The flagship of the group, USS *Chilton*, arrived at Pearl Harbor on September 3. The task group was dissolved on the 4th.[111] The production of the final reports was completed at the end of the year, and the three-volume *Technical Report, Bikini Scientific Survey* was published in December 1947 by the Armed Forces Special Weapons Project.

NOTES

1
W. A. Shurcliff, *Bombs at Bikini: The Official Report of Operation Crossroads* (New York: Wm. H. Wise & Co., Inc., 1947) p. 36.

2
Chuck Hansen, *U.S. Nuclear Weapons: The Secret History* (Arlington, Texas: AeroFax, Inc., 1988) p. 5.

3
Eugene Kinkaid, "Bikini: The Forthcoming Atomic Bomb Test in the Marshalls Will Determine the Future of Man, Animals, Birds, Fish, Plants, and Microorganisms," *Life*, XX (1), July 1, 1946, p. 41. Paul Boyer, in *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age* (New York: Pantheon Books, 1985) analyzes the response to the bomb.

4
Shurcliff, *Bombs at Bikini*, p. ix.

5
Ibid., p. 2.

6
Director of Ship Material, Joint Task Force One, "Historical Report: Atomic Bomb Tests Able and Baker Operation Crossroads," (1947) Operational Archives, Naval Historical Center, Vol. 1, p. xiii. Hereafter cited as Director of Ship Material, "Historical Report."

7
Vice Admiral W. H. P. Blandy, "Operation Crossroads Background Material," distributed to U.S. Naval Forces in Europe by the Public Information Section, JTF 1. Cited in Thomas N. Daly, "Crossroads at Bikini," U.S. Naval Institute *Proceedings*, Vol. 42, No. 7 (July 1986), p. 68.

8
Blandy appeared on CBS radio youth forum broadcast sponsored by the New York *Herald-Tribune* on April 13, 1946. Cited in Daly, *Ibid.*, p. 70.

9
Shurcliff, *Bombs at Bikini*, p. 10. Brian McMahon, junior senator from Connecticut, was chairman of the Senate's Special Committee on Atomic Energy. McMahon's committee held public hearings in Washington, and on December 20, 1945, McMahon introduced his Atomic Energy Act bill. Public hearings followed, and on April 19, 1946, the bill was reported to the Senate. Passed on June 1, 1946, the bill was sent to the House Military Affairs Committee, which referred it to the House on June 13. The House passed the bill with amendments on June 20; subsequently most changes were removed in a joint conference. The bill was signed into law by President Harry S. Truman on August 1,

1946, as the Atomic Energy Act of 1946 (Public Law 585, 79th Congress, 1st Session). The bill passed control of atomic energy from the Manhattan Engineer District, and hence the military, to the newly created Atomic Energy Commission, created a military liaison committee, and instituted security provisions to protect against the release of "classified" nuclear secrets. See Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*: The United States Army in World War II, Special Studies (Washington, D.C.: Center of Military History, 1985), pp. 576-578.

10
Shurcliff, *Bombs at Bikini*, p. 9. A dispatch by Hanson W. Baldwin to *The New York Times*, published in the paper's July 25, 1946 edition, reported that the target array for Baker, a "tactical situation of the fleet in harbor...was frankly patterned after an opportunity in the past war that was never realized," namely an atomic bombing of Truk. Baldwin noted the bomb was not used because of the Japanese fleet's near destruction and "no concentration of enemy ships sufficiently large enough to warrant the use of the atomic bomb was ever detected." p. 2. Trinity, Hiroshima, and Nagasaki came as soon as active material and other components were ready--no earlier detonation was ever possible.

11
According to Paul S. Dull, *A Battle History of the Imperial Japanese Navy (1941-1945)* (Annapolis: Naval Institute Press, 1978), Appendix A, "Name, Date of Completion, and Fate of Major Ships of the Imperial Japanese Navy," pp. 343-350. The remaining ships, some of them half-sunk at Kure or practically inoperable (such as *Nagato* at Yokosuka) were one battleship, two carriers, two light carriers (CVLs), two heavy cruisers, two light cruisers (CLs), and thirty-eight destroyers.

12
Shurcliff, *Bombs at Bikini*, pp. 10-11.

13
Director of Ship Material, "Historical Report," Volume 1, p. viii.

14
Ibid., pp. ix-x.

15
The New York Times, August 25, 1945, p. 2.

16
Shurcliff, *Bombs at Bikini*, p. 11.

17
The New York Times, October 24, 1945, p. 4.

18
The New York Times, December 11, 1946, pp. 1, 3.

19
Shurcliff, *Bombs at Bikini*, p. 9.

20
Kinkaid, "Bikini," p. 41.

21
Shurcliff, *Bombs at Bikini*, p. 7.

22
Hansen, *U.S. Nuclear Weapons*, p. 50.

23
W. A. Shurcliff, "Technical History of Operation Crossroads," Vol. 1, (1946) copy on file at the National Technical Information Service, p. 5.3. Hereafter cited as Shurcliff, "Technical History."

24
Director of Ship Material, "Historical Report," Vol. 1, pp. 68-69.

25
Ibid., p. 67.

26
Ibid., p. 68.

27
Ibid., p. 69. Also see Vice Admiral E. L. Cochrane, USN, "Crossroads and Ship Design," *Shipmate*, (September 1946) pp. 9-10.

28
Ibid., pp. 74-75.

29
Shurcliff, "Technical History," p. 6.3.

30
Ibid., p. 6.4.

31
Ibid.

32
Shurcliff, "Technical History," p. 6.5.

33
Ibid.

34
Shurcliff, "Technical History," p. 6.6.

35
Ibid.

36
Director of Ship Material, "Historical Report," pp. 72-73.

37
Ibid., p. 71.

38
Ibid., p. 21.

39
The New York Times, January 25, 1946, pp. 1, 4.

40
The New York Times, March 20, 1946, p. 10. The Bureau of Ships, when totalling the costs of the target ships, was ordered *not* to include the cost of armament. Also untallied were modernization, modifications, and repair costs.

41
The New York Times, March 24, 1946, p. 4.

42
Letter, John P. Howe to the President, April 16, 1946, filed in Protest Answers, Joint Task Force One, Records of the Defense Atomic Support Agency, National Archives Record Group 374.

43
The New York Times, April 17, 1946, p. 5.

44
Letter, Brig. Gen. T. J. Betts, USA, to Alexander Wilde, April 2, 1946, filed in Protest Answers, National Archives Record Group 374.

45
Letter, Max Ladowasser and Gang to the President, April 14, 1946, filed in Protest Letters, National Archives Record Group 374.

46
The New York Times, January 26, 1946, p. 1.

47
Letter, Brig. Gen. T. J. Betts, USA, to Peter Brambir, March 21, 1946, filed in Protest Answers, National Archives Record Group 374.

48
Letter, Brig. Gen. T. J. Betts, USA, to Lt. Herbert B. Leopold, February 11, 1946, filed in Protest Answers, National Archives Record Group 374.

49
"The Effect of the Atomic Bomb on Naval Power," *Bulletin of the Atomic Scientists of Chicago*, Vol. 1, No. 5 (February 15, 1946), p. 1.

50
Letter, R. Lee Page to George Lyons, Commissioner of Atomic Research, Navy Department, March 15, 1946, filed in Protest Letters, National Archives Record Group 374.

51
Letter, Jeanne Robinson to Adm. W. H. P. Blandy, May 1, 1946, filed in Protest Letters, National Archives Record Group 374.

52
Shurcliff, "Technical History," p. 6.7.

53
Shurcliff, "Technical History," p. 6.4 lists 94 vessels, but neglects to include LSM-60, the bomb-carrying ship for Baker, as well as one landing craft.

54
Ibid., p. 6.7.

55
The New York Times, July 1, 1946, p. 3.

56
Shurcliff, "Technical History," p. 6.7.

57
Ibid., p. 6.8.

58
Ibid.

59
Shurcliff, "Technical History," p. 6.10.

60
Ibid., p. 6.11.

61
Hansen, *U.S. Nuclear Weapons*, p. 31, 38n.7. General Paul Tibbets, then commander of the Composite 509th Group, which dropped the bomb, blamed the Able miss on crew error. See Paul Tibbets, *The Tibbets Story* (New York: Stein and Day, 1978). In a telephone interview on December 20, 1990, the pilot, Woody P. Swancutt stressed the high level of training he and his crew had received, the considerable experience of the bombardier, Harold Wood, and post-Able tests with the same crew and bomb sight that consistently dropped "Fat Man" casings close to the target.

62
The New York Times, July 1, 1946, p. 1.

63
Ibid., p. 3.

64
Director of Ship Material, "Historical Report," Vol. 1, p. 44.

65
Ibid., pp. 44-45.

66
The New York Times, July 2, 1946, p. 3.

67
The New York Times, July 15, 1946, p. 3.

68
See "Helen of Bikini," *Time* Magazine, August 5, 1946, p. 27. The naming of the two Bikini bombs is a further indication of the need to "humanize" the bomb through a mechanopomorphic process that began with the "Fat Man" and "Little Boy" weapons dropped on Japan. The female names for the Bikini bombs, particularly "Gilda" and its reference to Rita Hayworth, are part of what Paul Boyer terms the "complex psychological link between atomic destruction and Eros" that was evidenced by burlesque houses advertising "Atomic Bomb dancers" in August 1945, the "unveiling" by Hollywood of scantily-clad starlet Linda Christian at poolside as the "atomic bomb" in *Life* Magazine in September 1945, the French bathing suit "Atome" (quickly dubbed the "Bikini" when introduced in 1946) and the 1947 pop song "Atom Bomb Baby," which Boyer notes made the Bomb a metaphor for sexual arousal. See Boyer, *By the Bomb's Early Light*, pp. 11-12.

69
Shurcliff, "Technical History," p. 28.7. Also see the *Washington Star*, August 22, 1946.

70
The New York Times, August 4, 1946, p. 3.

71
David J. Bradley, *No Place to Hide, 1946/1984* (Hanover and London: University Press of New England, 1983), pp. 109-110.

72
Director of Ship Material, "Technical Inspection Report: Radiological Decontamination of Target and Non-Target Vessels," Vol. I, p. 4. Hereafter cited as "Radiological Decontamination of Target and Non-Target Vessels." For a summary of the radiological decontamination effort, also see C. Sharp Cook, "The Legacy of

Crossroads," *Naval History*, Vol. II, No. 4, Fall 1988, p. 28.

73
"Radiological Decontamination of Target and Non-Target Vessels," Vol. I, p. 4.

74
Ibid., p. 5.

75
Ibid., p. 6.

76
Ibid., p. 8.

77
Ibid., p. 13.

78
Director of Ship Material, "Historical Report," p. 55.

79
Memorandum, Col. A. W. Betts, USACOE, to Brig. Gen. K. D. Nichols, MED, USACOE, August 10, 1946. F-3-5, Test Baker Results, Box 26, National Archives Record Group 377, Records of the Manhattan Engineer District.

80
"Radiological Decontamination of Target and Non-Target Vessels," Vol. I, p. 17.

81
Director of Ship Material, "Historical Report," p. 57.

82
Memorandum, CNO to CINCPAC, "Removal of Equipment and Supplies from Contaminated CROSSROADS Target Ships," February 18, 1947, Serial 034P36, Operational Archives, Naval Historical Center.

83
Bradley, *No Place to Hide*, pp. 143-144.

84
Cited in "Radiological Decontamination of Target and Non-Target Vessels," Vol. III, p. 14.

85
The New York Times, September 5, 1946, p. 7.

86
Memorandum, CNO to Chiefs of the Bureau of Ships, Bureau of Ordnance, Bureau of Aeronautics, Bureau of Medicine and Surgery, Bureau of Yards and Docks, Bureau of Supplies and Accounts, "Handling and Control of Radiologically Contaminated Material from CROSSROADS," June 10, 1947, Serial 0138P36, Operational Archives, Naval Historical Center.

87
Cook, "The Legacy of Crossroads," p. 29.

88
A. G. Nelson, Capt. USN, "Crossroads Target Ships," Memorandum, NNTPR #24-78, May 25, 1978, Department of the Navy, Office of the Chief of Naval Operations; NAVSEA Shipbuilding Support Office, "US Vessels Involved in Operation Crossroads," NAVSEASHPSO, Philadelphia, n.d.; and James L. Mooney, ed. *Dictionary of American Naval Fighting Ships*, eight volumes (Washington, D.C.: Government Printing Office, 1959-1981).

89
See, for example, "Atom Bombed Ship Undergoes Study," in *The New York Times*, May 11, 1947, p. 19, which discusses the sinking of *New York* as a conventional weapons target as the battleship's probable fate. *Parche*'s conning tower is now on display at the Pacific Fleet Submarine Memorial Museum at Pearl Harbor.

90
Cook, "The Legacy of Crossroads," pp. 31-32.

91
"The Evaluation of the Atomic Bomb as a Military Weapon: The Final Report of the Joint Chiefs of Staff Evaluation Board for Operation Crossroads," (June 30, 1947), CCS 471.6, 10-15-46, Section 9, Part 1, p. 60, 73 (top quote). National Archives Record Group 218.

92
Boyer, *By the Bomb's Early Light*, p. 92.

93
Bradley, *No Place to Hide*, pp. 165-166.

94
Ibid., p. 147.

95
Drew Pearson, "Bikini Naval Losses Disaster," *The Washington Post*, February 18, 1949.

96
Bradley, *No Place to Hide*, p. 163.

97
Cited in Jonathan M. Weisgall, "The Nuclear Nomads of Bikini," *Foreign Policy*, Vol. XXVIV (Summer 1980), p. 98. Also see William S. Ellis, "A Way of Life Lost: Bikini," *National Geographic* (June 1986), pp. 813-834.

98
Memorandum to Op-36 from Op-33 and Op-38 (Parsons), April 9, 1947. Serial 106P36, Operational Archives, Naval Historical Center.

99
Ibid., attached draft memorandum from the Joint Crossroads Committee to the Joint Chiefs of Staff, the Secretary of the Navy, and the Secretary of War.

100
"Bikini Resurvey Operation Plan 1-47, Annex L, Public Information Plan," National Archives Record Group 374, Entry 4B, Box 156, Folder A4.

101
Ibid., Annex D, "Sunken Ship Inspection Plan."

102
Ibid.

103
"Bikini Backtalk," 10 September 1947, Vol. I, No. 16. Copy on file in RG 374, Box 28, Folder 212.

104
"Report of the Director Ship Material," in "Technical Report, Bikini Scientific Resurvey" (Washington, D.C.: Armed Forces Special Weapons Project, 1947) Vol. III,

p. 1. Hereafter cited as "Report of Director of Ship Material."

105
Ibid., p. 2.

106
Ibid.

107
Ibid.

108
Memorandum, Bureau of Ordnance to Chief of Naval Operations, 15 June 1947, Serial F141-6(49). Copy published in "Report of Director of Ship Material."

109
Ibid.

110
"Operations," in "Technical Report, Bikini Scientific Resurvey," Vol. I, p. 67.

111
Ibid., pp. 71-73.

TABLE ONE: SHIPS LOST DURING OPERATION CROSSROADS TESTING AT BIKINI ATOLL LAGOON

AIRCRAFT CARRIERS

BAKER TEST: USS ***Saratoga*** **(CV-3)**, *Lexington* Class

BATTLESHIPS

BAKER TEST: USS ***Arkansas*** **(BB-33)**, *New York* Class
HIJMS *Nagato*, *Nagato* Class

CRUISERS

ABLE TEST: HIJMS *Sakawa*, *Agano* Class*

DESTROYERS

ABLE TEST: USS *Anderson* **(DD-411)**, *Sims* Class*
USS *Lamson* **(DD-367)**, *Mahan* Class*

SUBMARINES

BAKER TEST: **USS *Apogon* (SS-308)**, *Balao* Class
USS *Pilotfish* (SS-386), *Balao* Class

TRANSPORTS

ABLE TEST: ***Gilliam*** **(APA-57)**, *Gilliam* Class
Carlisle **(APA-69)**, *Gilliam* Class

AUXILIARIES AND LANDING CRAFT

BAKER TEST: ARDC-13
LCM-4
LCT-414 (scuttled after)
LCT-812 (scuttled after)
LCT-1114
LCT-1175
LCT-1187 (scuttled after)
LCT-1237 (scuttled after)
LCVP-10
LSM-60 (completely destroyed)
YO-160

TABLE TWO: VESSELS LOST INSIDE KWAJALEIN ATOLL LAGOON IMMEDIATELY AFTER THE CROSSROADS TESTS CURRENTLY AT DEPTHS ACCESSIBLE TO SCUBA

CRUISERS

USS Prinz Eugen **(IX-300)**, ex-KMS *Prinz Eugen*

LANDING CRAFT

LCI-327

Boldface indicates this vessel was documented by NPS SCRU during August 1989 and/or May 1990 Survey (includes analysis of USN ROV Survey).

*At the time this report went to press, the remains of three additional vessels were discovered at Bikini. They have not been evaluated but it is probable based on descriptions that they are the two destroyers and *Sakawa*.

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联合国教育、
科学及文化组织

The Culture Sector

His Excellency Hon. Nidel Lorak
Minister of Education
P. O. Box 3
Majuro
Marshal Islands

WHC/74/MR/APA/10/370

06 OCT 2010

Subject: Inscription of the *Bikini Atoll Nuclear Test Site* (C 1339) (Marshall Islands) on the World Heritage List

Dear Sir,

I have the pleasure to inform you that the World Heritage Committee, at its 34th session (Brasilia, Brazil, 25 July – 03 August 2010), examined the nomination of the ***Bikini Atoll Nuclear Test Site*** and decided to **inscribe** the property on the World Heritage List. Please find below the Decision **34 COM 8B.20** adopted by the Committee.

I am confident that your government will take the necessary measures for the proper conservation of this new World Heritage property. The World Heritage Committee and its Secretariat, the World Heritage Centre, will do everything possible to collaborate with you in these efforts.

The *Operational Guidelines for the Implementation of the World Heritage Convention* (paragraph 168), request the Secretariat to send to each State Party with a newly inscribed property a map of the area(s) inscribed. Please examine the attached map and inform us of any discrepancies in the information by and not later that **15 December 2010**.

The inscription of the property on the World Heritage List is an excellent opportunity to draw the attention of visitors to, and remind local residents of, the *World Heritage Convention* and the outstanding universal value of the property. To this effect, you may wish to place a plaque displaying the World Heritage and the UNESCO emblems at the property. You will find suggestions on this subject in the *Operational Guidelines for the Implementation of the World Heritage Convention.*

In many cases States Parties decide to hold a ceremony to commemorate the inscription of a property on the World Heritage List. Upon request to the World Heritage Centre by the State Party, a World Heritage Certificate can be prepared for such an occasion.

I would be grateful if you could provide me with the name, address, telephone and fax numbers and e-mail address of the person or institution responsible for the management of the property so that we may send them World Heritage publications.

7, place de Fontenoy
75352 Paris 07 SP, France
Tél. : +33 (0)1 45 68 10 00
Fax : +33 (0)1 45 67 16 90

www.unesco.org

Please find attached the brief descriptions of your site, prepared by ICOMOS and the World Heritage Centre, in both English and French. As these brief descriptions will be used in later publications, as well as on the World Heritage website, we would like to have your full concurrence with their wording. Please examine these descriptions and inform us, by and not later that **15 December 2010**, whether there are any changes that should be made. If we do not hear from you by this date, we will assume that you are in agreement with the text as prepared.

Furthermore, as you may know, the World Heritage Centre maintains a website at http://whc.unesco.org/, where standard information about each property on the World Heritage List can be found. Since we can only provide a limited amount of information about each property, we try to link our pages to those maintained by your World Heritage property or office, so as to provide the public with the most reliable and up-to-date information. If there is a website for the newly inscribed property, please send us its web address.

As you know, according to paragraph 172 of the *Operational Guidelines for the Implementation of the World Heritage Convention*, the World Heritage Committee invites the States Parties to the *Convention* to inform the Committee, through the World Heritage Centre, of their intention to undertake or to authorize in the area protected under the *Convention* major restorations or new constructions which may affect the outstanding universal value of the property.

The full list of the Decisions adopted by the 34th session is available online at http://whc.unesco.org/en/sessions/34COM/.

May I take this opportunity to thank you for your co-operation and for your support in the implementation of the *World Heritage Convention*.

Please accept, Sir, the assurances of my highest consideration.

Francesco Bandarin
Director a.i.
World Heritage Centre

cc: National Commission of the Marshall Islands for UNESCO
ICOMOS
UNESCO Office Apia

BRIEF DESCRIPTION

In the wake of World War II, in a move closely related to the beginnings of the Cold War, the United States of America decided to resume nuclear testing in the Pacific Ocean, on Bikini Atoll in the Marshall archipelago. After the displacement of the local inhabitants, 67 nuclear tests were carried out from 1946 to 1958, including the explosion of the first H-bomb (1952). Bikini Atoll has conserved direct tangible evidence that is highly significant in conveying the power of the nuclear tests, i.e. the sunken ships sent to the bottom of the lagoon by the tests in 1946 and the gigantic Bravo crater. Equivalent to 7,000 times the force of the Hiroshima bomb, the tests had major consequences on the geology and natural environment of Bikini Atoll and on the health of those who were exposed to radiation. Through its history, the atoll symbolizes the dawn of the nuclear age, despite its paradoxical image of peace and of earthly paradise. This is the first site from the Marshall Islands to be inscribed on the World Heritage List.

BREVE DESCRIPTION

Au lendemain de la Seconde guerre mondiale, en étroite relation avec les débuts de la guerre froide, les Etats-Unis décidèrent de reprendre leurs essais nucléaires dans l'océan Pacifique sur l'atoll de Bikini dans l'archipel des Marshall. Une fois les habitants déplacés, 67 tirs nucléaires furent réalisés entre 1946 et 1958, dont celui de la première bombe H (1952). La flotte coulée dans le lagon par les essais de 1946 ou le gigantesque cratère Bravo constituent des témoignages directs des tirs nucléaires. D'une puissance totale 7000 fois supérieure à celle d'Hiroshima, ils eurent des conséquences importantes sur la géologie de Bikini, son environnement naturel et la santé des populations irradiées. Par son histoire, l'atoll symbolise l'entrée dans l'âge nucléaire malgré une image paradoxale de paix et de paradis terrestre. Il s'agit du premier site des Iles Marshall à être inscrit sur la Liste du patrimoine mondial.

Extract of the Decisions adopted by the 34th session of the World Heritage Committee (Brasilia, 2010)

Decision: 34 COM 8B.20

The World Heritage Committee,

1. Having examined Documents WHC-09/34.COM/8B and WHC-09/34.COM/INF.8B1,

2. Inscribes the **Bikini Atoll Nuclear Test Site,** Marshall Islands on the World Heritage List on the basis of criteria **(iv)** and **(vi)**;

3. Adopts the following Statement of Outstanding Universal Value:

   Brief synthesis:
   In the wake of World War II, in a move closely related to the beginnings of the Cold War, the United States of America decided to resume nuclear testing. They choose Bikini Atoll in the Marshall archipelago in the Pacific Ocean. After the displacement of the local inhabitants, 23 nuclear tests were carried out from 1946 to 1958. The cumulative force of the tests in all of the Marshall Islands was equivalent to 7,000 times that of the Hiroshima bomb.
   Following the use of nuclear bombs at Hiroshima and Nagasaki, the Bikini tests confirmed that mankind was entering a "nuclear era". The many military remains bear witness to the beginnings of the Cold War, the race to develop weapons of mass destruction and a geopolitical balance based on terror.
   The violence exerted on the natural, geophysical and living elements by nuclear weapons illustrates the relationship which can develop between man and the environment. This is

reflected in the ecosystems and the terrestrial, marine and underwater landscapes of Bikini Atoll.
The nuclear tests changed the history of Bikini Atoll and the Marshall Islands, through the displacement of inhabitants, and the human irradiation and contamination caused by radionuclides produced by the tests.
The Bikini Atoll tests, and tests carried out in general during the Cold War, gave rise to a series of images and symbols of the nuclear era. They also led to the development of widespread international movements advocating disarmament.

Criterion (iv): Bikini Atoll is an outstanding example of a nuclear test site. It has many military remains and characteristic terrestrial and underwater landscape elements. It is tangible testimony of the birth of the Cold War and it bears testimony to the race to develop increasingly powerful nuclear weapons. In the wake of the Hiroshima and Nagasaki bombs, the Bikini Atoll site confirmed that mankind was entering a nuclear era. It also bears witness to the consequences of the nuclear tests on the civil populations of Bikini and the Marshall Islands, in terms of population displacement and public-health issues.

Criterion (vi): The ideas and beliefs associated with the Bikini nuclear test site, and more generally with the escalation of military power which characterized the Cold War, are of international significance. These events gave rise to a large number of international movements advocating nuclear disarmament; they gave rise to powerful symbols and to many images associated with the "nuclear era", which characterized the second part of the 20th century.

Integrity and authenticity
The integrity of the property is acceptable, in view of the simultaneous presence of the remains of human artifacts and the process of natural recomposition which has followed the use of the nuclear bombs. In a very exceptional way, the degradation of the human artifacts by the natural elements forms part of the cultural process illustrated by the property. The integrity of the testimony of the property must be strengthened by the appropriate use of the considerable mass of documentary material associated with the site and its history.

The site has not undergone any substantial reconstruction; human presence there has remained very limited because of the radionuclide produced by the explosions. The authenticity of the material elements constituting the property is unquestionable.

Protection and management measures required
The main threats to the property are the effects of climate change and the presence of stocks of bombs and fuel in the underwater part of the property. The property is protected by the Historic and Cultural Preservation Act (1991). The legal protection and traditional protection in place are appropriate, but they must be reinforced to include the protection of the land-based military remains. In view of the changeable nature of the property, which is slowly returning to a natural state, conservation takes on a specific meaning in this case, and it may be considered therefore that no specific program to preserve tangible remains is necessary. However, it is essential to ensure safety by dealing with any remaining military risks, to draw up a detailed inventory and to ensure regular monitoring of the constituent parts of the property. The management system is adequate, but it must be confirmed, and must be strengthened in several areas, particularly as regards the Bikini Divers Group, visitor reception and interpretation, the Peace Museum and the documentation centre.

4. Requests the State Party to, within two years,

   a) Draw up an inventory of the land-based properties that contribute to the value of the property; inscribe the most important of these on the national historic sites list; monitor their conservation, specifying the frequency for monitoring to be carried out and the organization that will take charge of monitoring.

   b) Set up the Divers Group at Bikini;

   c) Give consideration to the importance and value of the documentation relating to the history of the Bikini nuclear tests, and consider its management and its use, for example, in connection with the project for a Peace Museum and with regard to the interpretation of the property;

   d) Provide details on the number of inhabitants of the atoll, and the prospects for future development;

   e) Provide details on Bikini's marine surveillance system;

   f) Strengthen the visitor reception and the presentation of the property's cultural values in connection with the Peace Museum project;

5. Also recommends the constitution of a coordinated international mission by the State Party dealing with the presence of bombs and fuel oil in the wrecks of the sunken vessels and recognizes that this is a threat to the property which could make visiting the wrecks dangerous and increase the risk of pollution of the lagoon.
6. Further recommends that a technical evaluation of these threats and a review of possible solutions be considered without delay.

Surface and coordinates of the property inscribed on the World Heritage List by the 34th session of the World Heritage Committee (Brasilia, 2010) in accordance with the *Operational Guidelines.*

State Party	Name	ID N	Area	Buffer Zone	Centre points Coordinates
Marshall Islands	Bikini Atoll Nuclear Test Site	1339	73500 ha	130425 ha	N11 36 0 E165 22 50

A4 size map of the nominated property showing boundaries and buffer zone