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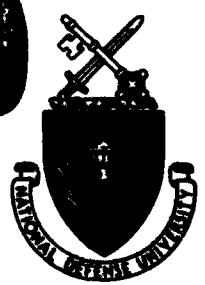
National Policy Implications of Storing Nuclear Waste in the Pacific Region

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William Lawrence Spicuzza

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NATIONAL POLICY IMPLICATIONS OF
STORING NUCLEAR WASTE
IN THE PACIFIC REGION

by

William Lawrence Spicuzza
Lieutenant Colonel, US Army
Adjunct Research Fellow

National Security Affairs Issue Paper 82-1

National Defense University
Research Directorate
Fort Lesley J. McNair
Washington, DC 20319



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This paper is one of a series of brief research studies on national security issues. The series supplements the National Security Affairs Monographs, which are lengthier studies of more general interest. Papers in both series generally are researched and written by the Research Fellows, faculty, students, and associates of the National Defense University and its component institutions, the National War College, the Industrial College of the Armed Forces, and the Armed Forces Staff College.

The purpose of this series is to contribute new insights and background materials to national security policymakers and to others concerned with the many facets of US national security.

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FOREWORD

This first national security affairs issue paper of 1982 contributes insights and background material for policymakers, and thereby fulfills the purpose of the National Defense University (NDU) Issue Paper Series. We are especially pleased to publish this Industrial College of the Armed Forces (ICAF) student research paper, the first published in this series. We will publish other outstanding student research from ICAF, the National War College, and NDU's newest addition, the Armed Forces Staff College.

While this paper focuses on a relatively narrow subject, it addresses an issue that, until recently, has eluded decision by the US Government. Previously, the United States opted not to reprocess spent nuclear fuel in order to reinforce nuclear nonproliferation risks. Now, the United States will reprocess spent fuel while still seeking to reduce nuclear proliferation risks. Important national questions transcend the reprocessing decision and create new issues: Even if the United States will now reprocess spent fuel, where will it and other nations obtain the storage space that will still be needed? Is establishing a regional storage site on a Pacific island the best course of action, in terms of both nuclear nonproliferation and overall US security interests?

This paper by Lieutenant Colonel William L. Spicuzza, USA, analyzes the proposal to store spent nuclear fuel on Palmyra Island, a US territory nearly a thousand miles south of Hawaii. The proposal has military, political, social, and technical implications. Would the Palmyra Island storage site best support US nonproliferation objectives? What would be the reaction of US allies, especially Japan? What are the implications for Pacific residents, many of whom endured the dislocations and radiation exposure of early atomic testing? Are there environmental considerations? Who would manage and control the site? What provisions would be made for site protection?

The author examines these vexing questions and analyzes alternative storage options and locations which might better reconcile US nonproliferation strategy with tactical and logistical realities. He concludes with several options which confront decisionmakers with the task of translating goals into workable policies.


FRANKLIN D. MARGIOTTA
Colonel, USAF
Director of Research

PREFACE

During an assignment with the Defense Nuclear Agency from 1972 to 1977, I became involved in the US project to clean up radiological debris and return Enewetak Atoll to its native owners.* I spent more than 13 months at Enewetak, and twice traveled to Ujilang Atoll where the Enewetak people had lived for almost 30 years. During my Pacific sojourns, I frequently visited Johnston and Kwajalein Atolls and made brief stops at Midway and Wake Islands. When the US Government announced plans to store spent nuclear fuel on a Pacific Island, I became puzzled about the rationale and concerned about the reactions of Pacific peoples. Also, being a nuclear energy advocate and suffering the agonies of Three Mile Island, I wanted to analyze US energy policies to see the direction we were heading, appraise alternate strategies, and examine nonproliferation issues. Analyzing policy implications for storing spent fuel on a Pacific island gave me this chance, while the Industrial College of the Armed Forces (ICAF) provided the opportunity and environment during its 1979-80 academic year.

I deeply appreciate the assistance provided by many people. Dr. Richard Scribner, US Department of State, and Mr. Roger Ray, US Department of Energy, were particularly helpful and supportive of my research efforts. Mrs. Eileen Huang and Mrs. Julia Mayo of the National Defense University library staff efficiently assisted in locating many source materials. Mrs. Helen Pahlke graciously applied her outstanding typing talents. Finally, Dr. Ralph Sanders, ICAF Director of Student Research, provided invaluable assistance in helping me formulate this report from an idea into reality. In spite of each person's greatly appreciated contributions, I must take full responsibility for all errors and omissions.

WILLIAM L. SPICUZZA

*Some readers may question the spelling of "Enewetak," believing that it should be spelled "Enewetok" as is done in many official charts and documents. Dr. Jack Tobin, District Anthropologist in the Marshall Islands from 1950-57, wrote in his 1967 dissertation that the accepted Marshallese spelling is "Enewetak." See Jack A. Tobin, The Resettlement of the Enewetak People: A Study of a Displaced Community (Ann Arbor, MI: Xerox University Microfilms, 68-5837, 1968), p. 9. In 1972, shortly after assuming responsibility for Enewetak cleanup operations, the Director of the Defense Nuclear Agency, Lt. Gen. Warren D. Johnson, USAF, directed that all future references to the atoll and its islands would be in accordance with the wishes of the Enewetak people.

ABOUT THE AUTHOR

Lieutenant Colonel William L. Spicuzza, US Army, was assigned to the Defense Nuclear Agency (DNA) from 1972 to 1977. His DNA assignments included Logistics Staff Officer (Washington headquarters), Logistics Plans Officer (Honolulu Pacific Support Office), and Military Commander (Enewetak Atoll, Marshall Islands). His other Pacific tours include Korea (1964-65) and South Vietnam (1967-68). He commanded a combat service support battalion in the 101st Airborne Division during 1977-78. A graduate of the Army Command and General Staff College and the Industrial College of the Armed Forces, Lt. Col. Spicuzza holds degrees in History (B.A.) from the Virginia Military Institute, and in Economics (M.A.) from the University of Virginia.

SUMMARY

The purposes of this study were to evaluate the US proposal to store spent nuclear fuel on a Pacific island; to determine if storing spent fuel furthers US nuclear nonproliferation objectives; and to analyze reasons why Pacific residents have become highly sensitive to the storage issue.

Until recently, the United States sought to reduce the risk of nuclear weapons proliferation by trying to persuade other nations to follow its example of not reprocessing spent fuel to obtain plutonium fuel. US decisionmakers felt that establishing a regional storage site would reduce reprocessing pressures in Japan and other Pacific nations, thereby supporting the nonproliferation objective. The recent decision to reprocess spent fuel has not altered the nonproliferation objective nor reduced needs for finding suitable storage sites to locate spent fuel and manage other nuclear wastes. Regional storage sites can support this purpose, and still reduce reprocessing pressures in Japan and other Pacific nations.

Palmyra Island has been suggested by US officials as the best candidate site, and Japan has agreed jointly to conduct a feasibility study of the storage proposal. Pacific residents strongly object to an island storage facility. The relocations of the Bikini and Enewetak peoples so that atomic tests could be conducted on their atolls; the high level radiation exposures and health problems of peoples on two other atolls, Rongelap and Utirik, which resulted from these tests; and subsequent problems and hardships endured by the Bikini and Enewetak peoples as the United States cleaned up their atolls, are cited as the probable causes for such sensitivity. Other candidate island sites and options for storing spent fuel and associated nuclear wastes in the United States are appraised to determine if they may be more acceptable to Pacific residents and also serve continuing nonproliferation objectives.

The major conclusions of the study follow:

1. Efforts of the United States to identify a regional waste storage site only to reduce reprocessing pressures will be looked upon with suspicion by nuclear nations which feel reprocessing provides a degree of energy independence. However, Japan is likely to support a regional storage proposal for moral, political, and economic reasons. Japanese support, as the major site user, is critical to US policy objectives.
2. A site in the United States best meets US objectives, but probably will not be supported by foreign owners fearful of losing control of their spent fuel assets.

3. A Japanese-owned island, Marcus Island, becomes a preferred site if decisionmakers feel US management and control is not essential to the nonproliferation objective. Resident objections and suspicions about US motives are reduced.

4. A US-owned island, Johnston Island, provides many advantages, and becomes the preferred site if decisionmakers feel the US must manage and control the site to meet proliferation objectives. Because of its association with nuclear and chemical activities, residents will not likely object as strongly to Johnston Island as a site.

CHAPTER I INTRODUCTION

This study addresses an issue facing the future of nuclear energy: the US proposal to store nuclear waste products on small Pacific islands. Although a seemingly simple proposal, broader regional, national, and international issues entwine and confound it. These issues concern long term nuclear power needs, safety and environmental questions, spent fuel reprocessing and nuclear proliferation, and unresolved waste management problems.

Waste management includes storing spent nuclear fuels. One ranking Government official describes the 30-year-old waste management problem as the Achilles heel of nuclear power: a bigger problem than even the March 1979 Three Mile Island accident.¹ An Interagency Review Group blames both Government and industry for not finding solutions. This group maintains that Government and industry failed to integrate waste management research with other fuel cycle research efforts.² No one expects early solutions, especially since President Carter announced a 15-year national research program. Meanwhile, nuclear waste storage problems grow more acute. Some power plants will run out of storage capacity by 1983 and may shut down unless they find more space at or away from the reactor site.

This study shows that a Pacific island storage site could reduce storage pressures in the United States and several Pacific nations. Also, an island site supports continuing US nonproliferation policies since it stores those nations' spent fuel accumulations which they otherwise might reprocess to extract plutonium. Pacific residents, however, object to using an island for storing spent fuel. Past experiences show many of the reasons for their feelings.

Two Japanese cities, Hiroshima and Nagasaki, felt instantaneous agony and destruction only a few weeks after the "Age of the Atom" began just before dawn on July 16, 1945, at a desolate spot near Alamogordo, New Mexico. For almost 30 years thereafter, nuclear and thermonuclear devices exploded in the Pacific atmosphere as first the United States, then France, developed nuclear weapons programs. Entire native populations became dislocated to make room for tests. Other populations tragically learned about radioactive fallout hazards and experienced persistent health problems from high exposure levels. Even today, muffled underground test sounds originate from Mururoa Atoll in French Polynesia as France continues its tests at a record pace.³ Thus much sensitivity to nuclear issues exists among Pacific peoples even when those issues hardly relate to nuclear weapons programs.

CHAPTER II ESTABLISHING A NATIONAL POLICY OBJECTIVE

Policy Goals

National objectives describe states of affairs and sets of conditions that a government desires to bring about by wielding its influence abroad to change or sustain the behavior of other nations.¹ Early in his Presidency, Jimmy Carter established a national objective aimed at preventing further proliferation of nuclear weapons. He deeply committed his administration and the Nation to accomplishing this objective by halting plans for constructing breeder reactors and reprocessing spent nuclear fuel.² Finding acceptable sites and means for storing spent fuel became essential ingredients of the plan for reducing reprocessing pressures.

President Reagan reversed the Carter policies regarding the domestic reprocessing of nuclear fuel. The United States will no longer inhibit civil reprocessing on the part of advanced nations where it does not constitute a proliferation risk.³ The government plans to proceed swiftly to begin to store and dispose of high-level radioactive wastes.⁴ Thus, finding acceptable storage sites for spent fuel and other waste products remains an essential ingredient of any plan or future US policy regarding reprocessing in nations without nuclear weapons.

Much disagreement evolved around each President's decision. While controversy usually surrounds the means for accomplishing any national objective, these decisions generated particularly intense debate. Domestically, many people saw Carter's decision causing the United States to lose its leadership in nuclear technology, especially if other nations failed to accept US policy. Other nuclear power nations felt the United States example will keep them highly dependent upon the United States for enriched uranium supplies, thereby preventing their desired energy independence. These attitudes and continuing independent development of nuclear programs by several nations presented a serious challenge to US policy. They became an important factor in President Reagan's decision to reverse the policy. Many people see the Reagan policy as having major implications for the proliferation of nuclear weapons. In the final analysis, viability of the continuing nonproliferation objective depends even more on finding suitable storage and management solutions.

The nuclear waste issue is charged with emotion. One writer suggests that the inevitable association of commercial nuclear energy with the atomic bomb--the "great equalizer"--colors all perceptions of nuclear matters.⁵ Another echoes this sentiment, stating that:

Plutonium, a radioactive element not found in nature but produced by both types of nuclear generators, is an incredibly deadly poison, far more poisonous than botulism and 35,000 times as poisonous as the cyanide used by the German Nazis for instant suicide. Plutonium is the explosive force in our nuclear weapons. Today, any gang of determined persons who have access to the waste of a fast breeder reactor can obtain by stealth or by violence a few small cans of plutonium to use as a poison or to make a bomb.⁶

Another commentator calls the waste problem the most botched up aspect of nuclear industry and argues that the problem's complexity should not excuse Government inaction and poor performance.⁷

Misunderstandings

To gain an understanding of this complex issue demands clarification of four specific points.

First, there is a tendency to misuse the term waste. Spent fuel rods contain valuable amounts of recoverable plutonium and uranium. Waste implies that no recoverable products of any value exists. Using the term waste interchangeably with spent nuclear fuel is common although it often clouds the issue. This paper principally addresses spent fuel storage, but does not exclude other nuclear waste products from consideration.

Second, there is confusion about the security needed to protect against theft. Spent fuel rods present unattractive targets to thieves because of their high radiation level. Although rods must be protected, major security risks occur not at the reactor site but at the reprocessing plant after plutonium is extracted.

Third, there is confusion about the amount of land needed for storage. A typical reactor produces about 30 metric tons of spent fuel each year⁸--by mass, only about 1 percent of

plutonium.⁹ One plant's annual accumulation reduces to an amount small enough to fit under most dining room tables.¹⁰ Looked at from another perspective, by the year 2000 all spent fuel from US reactors could fit in a water pool 30 feet deep and several hundred feet by several hundred feet, about half the area of the Reflecting Pool in Washington, DC.¹¹ Storage sites thus do not need large land areas. Decisionmakers instead must find areas that will protect future generations from exposure to toxins and high levels of radiation, as well as keep reprocessed plutonium away from potential weapons makers.

Fourth, there is confusion about the extent of Government action. Contrary to allegations, the Federal Government has sought solutions to the storage problem for at least 20 years.¹² President Carter felt that past Federal efforts were technically inadequate and politically flawed.¹³ His national nuclear waste program was designed to overcome these problems as well as to pull together past research efforts.¹⁴ Mr. Carter first spoke about ways for other nations to use storage facilities in early 1977; he did so again when signing the 1978 Nuclear Nonproliferation Act, at which time he announced administration plans to develop comprehensive management and storage policies, to include storing spent fuel of nations sharing common nonproliferation objectives.¹⁵ Finally, in his nuclear waste program, he proposed that the Department of Energy accept for storage "a limited amount of foreign spent fuel in cases where such action would further our nonproliferation objectives."¹⁶ President Reagan accelerated these efforts by recently instructing the Department of Energy to proceed swiftly toward deployment of means of disposing and storing nuclear waste in order to demonstrate that problems associated with waste management can be resolved.¹⁷

Japanese Attitudes

Since Japan ranks second in the world in nuclear generating capacity, its support seems essential to accomplish continuing US nonproliferation objectives. Japanese leaders traditionally have supported using nuclear energy for peaceful purposes while remaining politically sensitive to all nuclear questions.¹⁸ However, most feel that nuclear energy, and particularly an independent fuel cycle based on fast breeder reactors, are vital to Japan's survival as an economic power.¹⁹ Japanese feelings have been summarized as follows:

Believing that nuclear technology is safe and economical in an age of shrinking conventional fuel supplies, the Japanese

government is determined to develop nuclear power, particularly fast breeder reactors that produce more plutonium fuel than they consume and could therefore make Japan relatively independent not only in terms of oil but also in terms of natural uranium. The government's policy foresees an expansion of nuclear power plants and the independent development in Japan of related facilities for uranium enrichment, fuel reprocessing and waste disposal, all supported by Japan's own nuclear research and development and her ability to manufacture Japanese-designed plants.²⁰

Japan's nuclear policies were at odds with Carter nonproliferation objectives relating to fast breeder reactors and reprocessing spent fuel to extract plutonium. Japanese leaders felt US opposition to their breeder and reprocessing plans demonstrated distrust of the one nation unmistakably committed to nonmilitary uses of nuclear energy.²¹ Even in the aftermath of the Three Mile Island accident, they continued strongly to promote nuclear energy as the country's most promising alternate energy source.²²

The Japanese, however, did not completely reject Carter administration nonproliferation initiatives. They pursued at least one aspect of the program, agreeing in late 1979 to a joint feasibility study of the US proposal for a Pacific island storage site.²³ More recently Japan indicated it would study a suggestion to use Western Pacific islands already polluted by nuclear weapons testing as sites for radioactive wastes from nuclear power stations.²⁴

CHAPTER III STORAGE SITE PROPOSALS

The Department of Energy announced on October 18, 1977, that the administration would seek regional or international storage sites while encouraging other nations to expand their storage capacity.¹ Except for an informal review to determine whether any Pacific islands might serve as potential sites, no major activity occurred until President Carter signed the Nuclear Nonproliferation Act on March 10, 1978. Section 104(a) specifically directed the following Presidential actions:

. . . the President shall institute prompt discussions with other nations and groups of nations, including both supplier and recipient nations, to develop international approaches for meeting future worldwide nuclear fuel needs. In particular, the President is authorized and urged to seek to negotiate as soon as practicable with nations possessing nuclear fuel production facilities or material . . . , with a view toward the timely establishment of binding international undertakings providing for . . . the establishment of repositories for the storage of spent nuclear reactor fuel under effective international auspices and inspection; . . .²

Public law thus directs the President to seek storage sites, and the Reagan administration is obligated to carry on with its predecessor's initiatives in this area.

Possible Sites

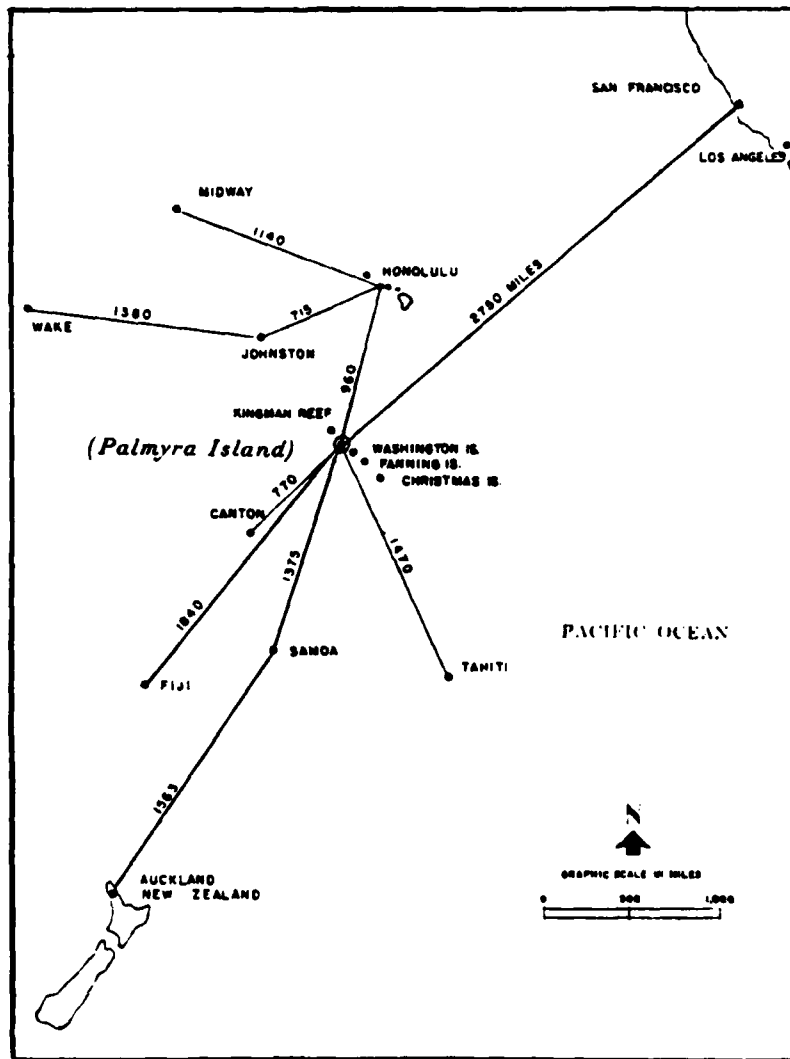
An Ad Hoc Nonproliferation Group within the National Security Council (NSC) originally conducted preliminary technical, environmental, and economic assessments of potential storage sites. Based upon criteria shown in table 1, this group narrowed candidates to Palmyra Atoll, Midway Island, and Wake Island (see map 1).

Midway and Wake Islands, even though offering some existing facilities and possible built-in security arrangements, appeared less acceptable than Palmyra for environmental, meteorological, and political reasons.³ Table 2 indicates how Palmyra conformed to established criteria. A State Department official ranked the three sites on a scale of 1 to 100, scoring Wake well below 10, Midway between 10 and 25, and Palmyra 50 and above.⁴ Palmyra became an overwhelming choice for further evaluation.

Table 1. Basic Pacific Island Site Criteria

- Accessible, but far from populous areas.
- Considerable distance from politically unfriendly or unstable areas.
- Unpopulated and not used for any commercial purpose at this time.
- Undisputed US territory; unquestioned ownership title.
- The legal impediments to acquisition or use not insurmountable.
- Out of the path of severe weather conditions.
- In an area of seismic quiescence.
- In an area of apparent long term geologic stability.
- Has high rainfall providing fresh water.
- Has rather well-protected dry land areas sufficient to allow storage space and habitation by support personnel.
- A protected lagoon suitable for modification into a harbor.
- Situated in a wind and ocean current pattern such that, in the unlikely event of an accident, any contamination would be carried a long distance before reaching any populated area.
- Environmental impacts to the site from development of the proposed facilities be amenable to accurate estimates and avoidable or mitigated through careful planning.

Source: US Department of State Briefing Papers.



Source: US Congress, Senate, Committee on Energy and Natural Resources, Pacific Spent Nuclear Fuel Storage, Hearing on S.1119. 96th Cong., 1st sess., June 5, 1979, p. 30.

Map 1. Palmyra Island Location Map.

Table 2. Palmyra Criteria Comparison

- Accessible from US territory, but far from populated areas.
- Considerable distance from politically unfriendly or unstable areas.
- Uninhabited and not used for any commercial purpose.
- Indisputedly a US territory; ownership title is unquestioned.
- For sale; legal impediments to procurement not insurmountable.
- Lies out of path of severe weather conditions.
- Lies in an area of seismic quiescence.
- In an area of apparent long term geologic stability.
- Has high rainfall providing ample fresh water.
- Has rather well-protected dry land areas and contains sufficient land area to allow habitation by support personnel.
- Has protected and large lagoon suitable for modification into a harbor.
- Is situated in wind and ocean current pattern such that, in unlikely event of an accident, any contamination would be carried a long distance before reaching any populated area.
- Environmental impacts to island from development of proposed facilities appear amenable to accurate estimates and can be avoided or mitigated through careful planning.

Source: US Congress, Senate, Committee on Energy and Natural Resources, Pacific Spent Nuclear Fuel Storage, Hearing on S.1119. 96th Cong., 1st sess., June 5, 1979, pp. 1819. It should be noted that the third statement is no longer correct. There are a few people now living on the atoll, and it is being used for a commercial purpose.

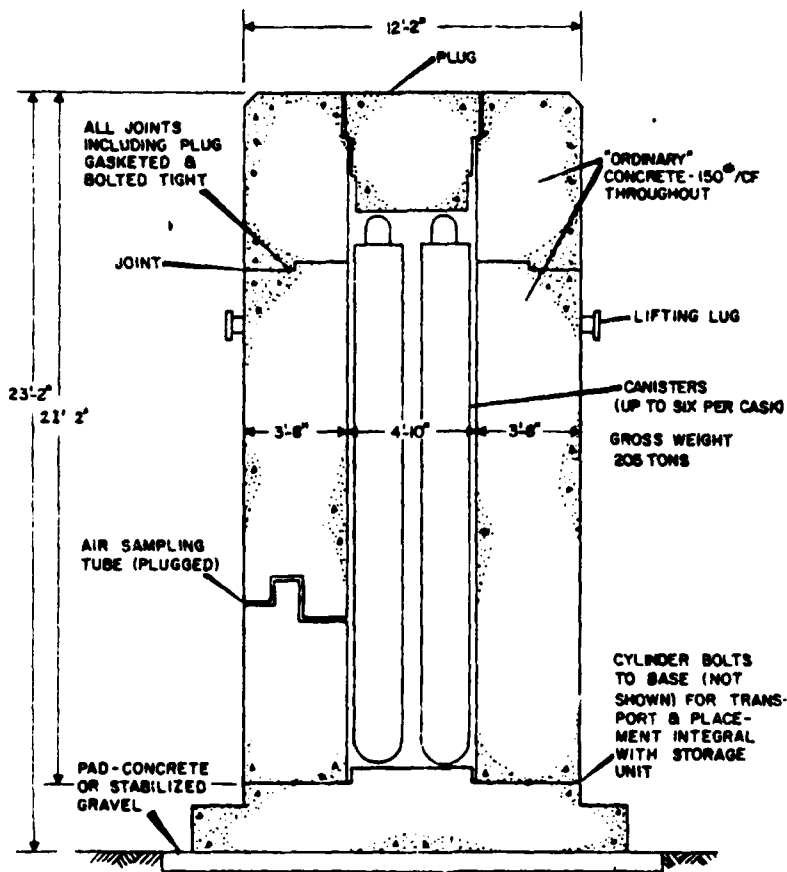
Three options for attacking the storage issue merit consideration. First, a government can treat spent fuel as waste and plan for its disposal at a permanent site. Second, spent fuel can be stored for an interim period from one to several decades while the government can decide to either reprocess the fuel or treat it as waste. Third, the government can decide to reprocess, but store the spent fuel until needed.⁵ The Pacific island plan favors each option. More importantly, an island plan provides flexibility for any government which must delay the reprocessing question for economic or political reasons.

Facility size depends on how much spent fuel its potential users--Japan, Korea, Taiwan, and the Philippines--generate. Production should total about 4,600 measurement tons, with Japan contributing most.⁶ Initial design called for a 10,000-ton capacity, enabling the United States to store 5,400 tons. This amount equals 2-1/2 years of US production. By varying only the storage configuration, capacity can be tripled to handle 10 additional years of US accumulations on the same 100 acres of land.⁷ Palmyra has more land that could be devoted to further increasing storage capacity.

The concept calls for placing spent fuel rod assemblies in steel canisters after a period of cooling at reactor sites. The canisters are then placed in steel-reinforced concrete silos about 22 feet high and 12 feet in diameter with walls 4 to 6 feet thick.⁸ Figures 1 and 2 show concept drawings. A test silo is being evaluated at the Department of Energy Nevada Test Site; spent fuel assemblies are placed in a stainless steel storage canister which is then emplaced in the silo.⁹

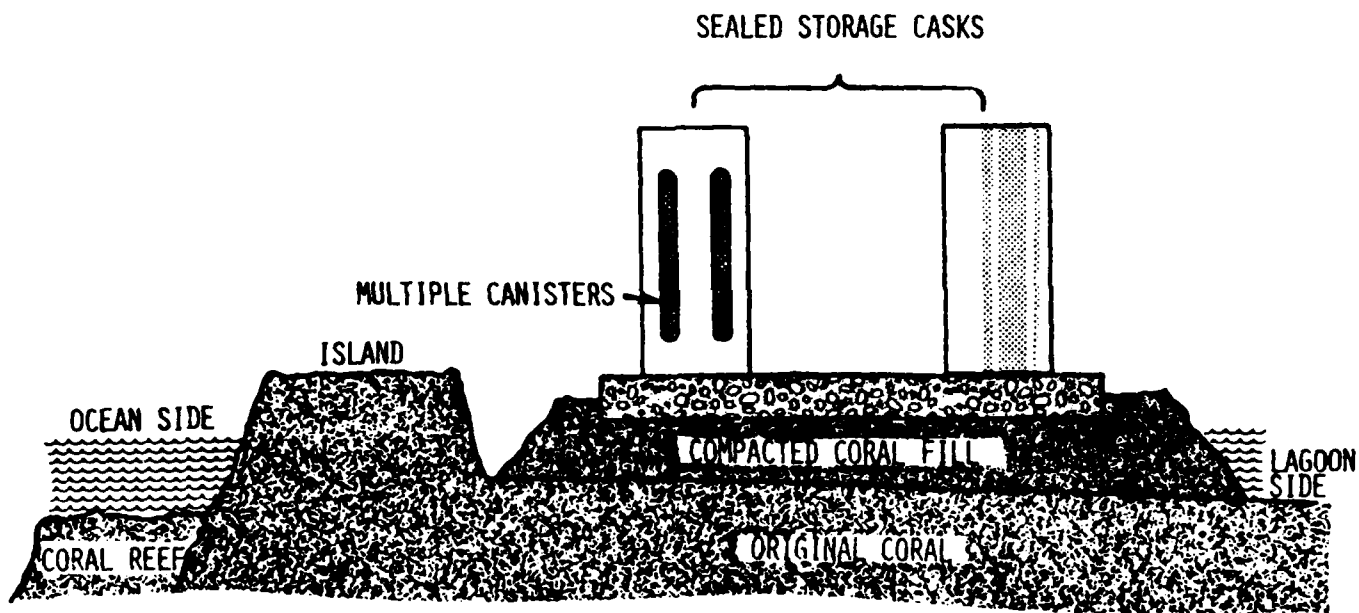
A small self-supporting community of about 350 persons would reside at the atoll to operate facilities. This number includes base engineering support, dependent schools, and medical, recreational, and security personnel. Support facilities already exist at Wake and Midway Islands. Palmyra was last used as a military installation during World War II when 6,000 troops manned a small air base and submarine station there.¹⁰ Its air strip is mostly overgrown, the buildings are rotted, and utilities are a rusty ruin.¹¹

Palmyra was annexed to the United States as part of Hawaii in 1898. An Australian family living in Hawaii purchased it in 1922 for \$15,000.¹² Although considered a part of the Territory of Hawaii, the atoll was excluded when statehood boundaries were drawn. Palmyra thus remains US territory but not part of the State of Hawaii.¹³ During World



Source: Hearing on S.1119, p. 34

Figure 1. Sealed Storage Cask Concept for Spent Fuel (Multiple Canister).



Source: Hearing on S.1119, p. 35

Figure 2. Sealed Storage Cask Concept for Island Storage.

War II, naval facilities were constructed on the island, which is now a scrap of land 3 miles long and 1-1/2 miles across, totaling about 14,000 acres.¹⁴ Family owners allegedly want to sell the atoll for between \$15 and \$18 million.¹⁵ However, they are unwilling to sell it for use as a spent fuel storage facility.¹⁶

No one has worked out exactly how spent fuel would get to Palmyra or to any other storage site. The preliminary plan envisions ships proceeding directly from pickup to the island without stopping in Hawaii. Whether the spent fuel would be encased in cement blocks at or near the port of embarkation or be put in large steel shipping casks and carried to the island for encasing also remains to be determined. Questions of health, environment, safety, and economics will eventually determine the method selected.¹⁷ One type of shipping cask which has been used to transport spent fuel assemblies to the Nevada Test Site is a leakproof steel cask that can withstand destruction from a locomotive going 80 miles per hour.¹⁸

The Question of Jurisdiction

Another question concerns who would operate the storage site and whether US regulatory and licensing procedures would apply. Three options are available: the United States can operate the storage site; it can cede jurisdiction of the site to another nation; or it can cede jurisdiction to an international body such as the International Atomic Energy Commission. Only if the United States operated the site would its regulatory and licensing procedures apply.¹⁹

Many nations participating in the 2-year (1978-1980) International Nuclear Fuel Cycle Evaluation (INFCE) Conference favored some type of regional or international management arrangement. Regional or international facilities alleviate concerns of countries with small nuclear programs or in which suitable storage sites do not exist; benefit storage operating costs from economies of size; and reduce diversion risks since there would be fewer storage sites. Such facilities, however, require lengthy negotiations to answer such matters as membership, financing, voting arrangements, conditions of access, dispute settlement methods, and handling host nation status and potential interference. Because these matters most likely would take a very long time to resolve, nationally-operated facilities appear more realistic for the near future.²⁰

Another facility operator could be a public or private corporation or consortium, either with mixed private or public shareholding. A purely private service corporation organized for profit could also perform this operation.²¹

Table 3 summarizes the four possible site management models: corporate, national, regional, and international. Although the corporate model provides the quickest and easiest means of operating storage sites, ethical, social, legal, political, institutional, and technical reasons make it the least acceptable. For these reasons, governments and international agencies will probably demand at least the level of involvement offered by the national model.²² Regional or international models, as INFCE nations noted, seem too difficult to negotiate and establish in the near future but should become the ultimate objective.

Security Considerations

Site security is a concern regardless of the management model selected. Assuming that the United States hosted or sponsored the site, security arrangements could require the Department of Defense (DOD) to expend considerable personnel and equipment resources. Security becomes more important the longer spent fuel remains stored, since heat and radioactivity losses make fuel more attractive for diversion or theft.²³

A potential problem could arise if an island close to the storage site shifted its loyalties to the Soviet Union. This problem probably would not prove overly serious. Although such a shift might adversely affect US relationships in the region, the Soviet Union would have little interest in the spent fuel because it has enough of its own.²⁴

A serious concern, which any plan must address, is the threat of intrusion, theft, or diversion by an aspiring nuclear weapons state (e.g., Libya). Any nation obtaining spent fuel by such means still faces great difficulty in producing a weapon. First, it must deal with relatively high radiation levels. Second, it must be able to reprocess the fuel to extract plutonium. Third, the plutonium obtained is extremely unsatisfactory for nuclear weapons, although it can be made to work if one has the technical capability and experience. Finally, such actions could hardly go undetected. Pirating a vessel on the high seas en route to the site could be less risky, thereby posing a tougher security problem for spent fuel owners.²⁵

Table 3. Possible Management Models for Spent Nuclear Fuel

Model 1: Corporate

Largely corporate characteristics with significant governmental regulation if exclusively a private corporation.

Model 2: National

Characteristics dominated by individual national governments: minimal direct regional/international influence.

Model 3: Regional

Joint financing, development, and regulation coordinated by regional (international) organization(s); regulatory and institutional aspects influenced directly by international organizations.

Model 4: International

Use of political and geographic international regions to coordinate broad international development, regulation, and control of the storage program; strong possibility of incorporation into broader international waste management or nonproliferation programs.

Source: Adapted from Table 7-2, "Possible Management Models for the Sub-Seabed Disposal of Radioactive Waste," in David A. Deese, Nuclear Power and Radioactive Waste (Lexington, Mass.: D.C. Heath, 1978), p. 157.

Other security problems include terrorist threats or passive activities by antinuclear groups. These activities might be similar to demonstrations, sleep-ins, and sit-ins which have occurred at the Navy's Kahoolawe Island bombing range near Maui and at the Army's Kwajalein Missile Range in the Marshall Islands. The NSC site selection group considered such problems and looked for isolated islands away from heavy air and sea traffic;²⁶ but, as the following description shows, even a remote island like Palmyra, with its nearly unusable airstrip, occasionally receives unannounced visitors.

I was walking down the airstrip . . . when an airplane motor sounded in the lonely, boundless sky.

A little twin-engine Cessna, up from Fiji to scout a sunken ship at nearby Washington Atoll for salvage, banked and landed as casually as if the pilot were going to the bathroom.

All this means that Palmyra would be about as secure a storage depot for nuclear wastes as a barge anchored in the ocean.²⁷

Several types of organizations can deal with security problems. US military forces in Hawaii or other Pacific locations could afford protection on a contingency basis or actually serve as site security forces. An "International Brinks" contract force with its own vehicles, vessels, guards, and security reaction forces might effectively perform the security functions.²⁸ A combination of military and contract security forces offers another possibility. In the final analysis, the security threat at an island or atoll should be less than at an operating reactor site. Forces can be designed to handle these threats.²⁹

Natural Threats

Nature itself poses more serious threats to Pacific islands storing spent fuel. Wave erosion, high humidity, and salt spray must be engineered against. Although seismic sea waves (tsunami) pose little threat to most small coral islands and atolls, wind-generated surface waves resulting from storms--even those far away--can cause serious damage to facilities.³⁰ Consequently, providing adequate protection from natural threats may be the greatest obstacle to using an island or atoll. Small islands, on the other hand, have delicate ecological balances which must be protected. Environmental

assessments must focus early on providing such protection to avoid long and costly legal delays.

Assessment

Let us assume that: storage sites can be protected with high degrees of confidence from natural threats; the environment can be protected; appropriate security measures can be taken against human threats of diversion, theft, or terrorist attack; storage sites can be economically built and operated; potential using nations can be persuaded that they gain by storing spent fuel at such a facility; and most people favor nonproliferation principles. Why then do Pacific peoples adamantly oppose nuclear fuel storage sites? The answer lies in the Bikini, Enewetak, and other Marshall Islander misfortunes resulting from US nuclear testing programs.

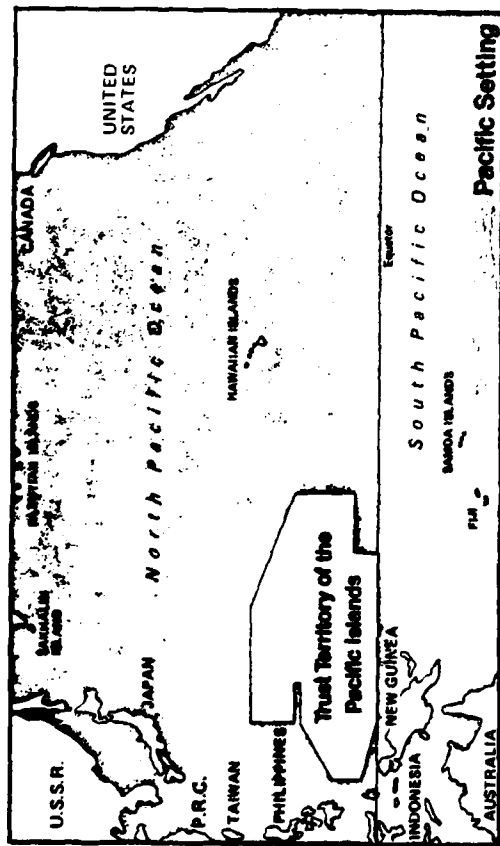
CHAPTER IV THE BIKINI AND ENEWETAK CASES

Following World War II, the United States began searching for possible places to further develop and test the fledgling nuclear arsenal. Certain Pacific islands, which had been captured from the Japanese, had special appeal because of their remoteness and small populations. In 1946, this country chose Bikini Atoll, located in the Marshall Islands of the Western Pacific, as a suitable site.¹ Map 2 shows its general location within this expansive and remote region. The Bikinians, who then numbered 166 people, were informed and quickly agreed to move, firmly believing the US Military Governor's statement that these tests were "for the good of mankind and to end all world wars."²

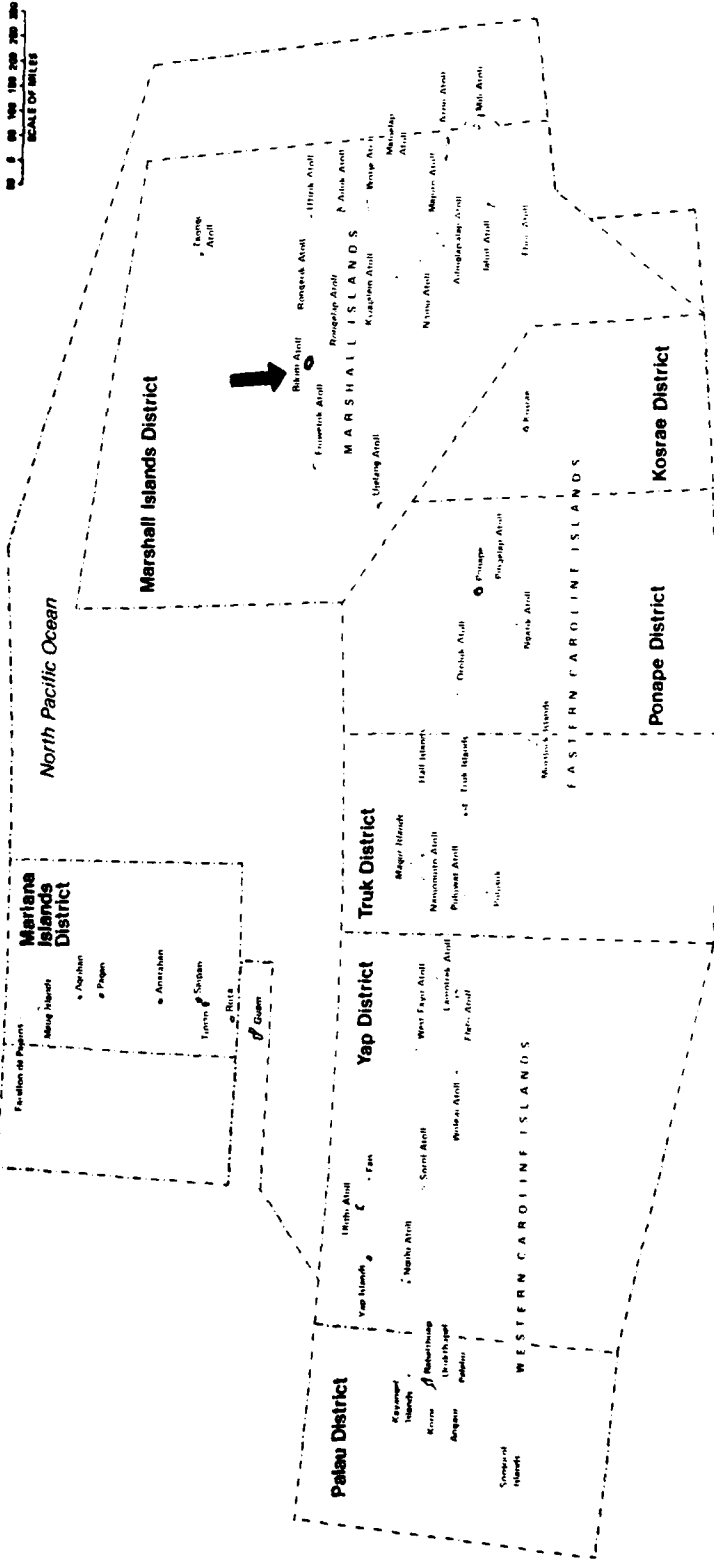
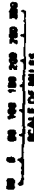
Their initial relocation was accomplished swiftly and with little planning. In less than 1 month, the US Navy moved the Bikinians to Rongerik Atoll, arriving there on March 8, 1946.³ News media covered the resettlement extensively. In fact, the relocation effort has been described as unquestionably the most thoroughly documented, reported, and publicized peacetime military exercise in history. Due to such attention, the move took on the quality of a spectacular.⁴ The whole Pacific region, and indeed much of the world, became privy to the Bikini resettlement effort, part of which was staged two and three times for the benefit of the news agencies.⁵

The occasion was not an unhappy one. As the people departed Bikini Lagoon aboard the Navy ship, some sang songs of farewell; most were simply silent; and some wept. Most considered their relocation to be a temporary inconvenience and strongly felt that someday they would return.⁶ As one Atomic Energy Commission (AEC) official stated: "The Bikinians were promised the return of their atoll when it was no longer needed as a testing site."⁷

The US attempt to settle the Bikinians at Rongerik failed due to Rongerik's small size in comparison to Bikini. After examining the problem, a Naval Board of Investigation recommended moving the people from Rongerik. US Government officials looked at several other atolls. For a time, Ujilang Atoll seemed a likely candidate as a temporary home, but Ujilang became a resettlement locale for Enewetak Atoll natives when Enewetak was also chosen as a future test site. Thus the Bikinians settled at a temporary tent city at Kwajalein Atoll where they lived from March to November of



Trust Territory of the Pacific Islands



Map 2. Trust Territory of the Pacific Islands: Northern Mariana, Caroline, and Marshall Islands

1948. The Bikinians then selected Kili Island as their new home.⁸

The Bikini people faced many problems in moving to Kili. Kili is a low single coral island about 1-1/2 miles long and only 3/4 of a mile wide at its widest point; its land area covers only .36 square miles compared to 2.32 square miles at Bikini; and Kili has no lagoon, while Bikini has 229.40 square miles of lagoon plus a large reef area.⁹ The absence of a lagoon, combined with a normally heavy surf, prevented ships from approaching Kili except during 3 months of each year. Without a lagoon or reef, the Bikinians were forced to turn from being fishermen to farmers. They grew and traded copra for essential food products, but trade ships out of the District Center at Majuro seldom called at Kili because of its rough surf. Copra rotted and there were often food shortages. As they languished at Kili, the Bikinians began to refer to the island as "their prison."¹⁰

In 1967, the AEC conducted preliminary surveys at Bikini, showing that the atoll was habitable and represented no major threat to health and safety.¹¹ Thus President Johnson, in 1968, ceremoniously announced that the Bikinians would return to their atoll.

A cleanup effort began in early 1969 with the DOD taking the lead in conjunction with the AEC. Bikini soil was combed inch by inch for dangerous debris which was picked up and either buried or dropped into the ocean. Test buildings were torn down and paved areas bulldozed and broken into tiny pieces. Engineers and architects consulted with the Bikinians and developed an island master plan detailed right down to floor plans for individual houses.¹²

One hundred Bikinians returned to Bikini Atoll during the period 1971 to 1973. This group served as an advance party, assisting in building new homes and community facilities and planting crops and coconut trees. Very little fanfare greeted their return. About 400 people remained at Kili while houses were built and the coconut, breadfruit, and pandanus trees matured to sustain them. This group realized that their wait might take 6 to 8 years.¹³ The Trust Territory Commissioner told them they could return by May 1, 1974.¹⁴

Rumors persisted, however, that the Bikinians might not return by 1974, or even much later.¹⁵ The Bikini people wanted all their houses finished before they returned, but only one-half (40 to 80 units) were completed.¹⁶ They wanted

their other houses built away from the lagoon in the interior of Bikini Island. The AEC conducted a new ground radiological survey in the interior in 1975 and found that the interior remained too radioactive for safe occupancy. The survey also discovered that breadfruit and pandanus trees (but not coconut trees) contained too much radioactivity.¹⁷

For the next 2 years, the US Energy Research and Development Administration (ERDA), the successor to the AEC, sent health teams (composed of specialists in the assimilation of radionuclides into plants, animals, and people) to Bikini. They checked the resident Bikinians and tested everything. Unfortunately, they found high concentrations of radionuclides in human bodies, plants, and even coconuts.

By March 1978, major newspapers were publishing alarming accounts about Bikini's radiation levels. Government officials announced that the first group of returnees must again be moved off Bikini Island, since their strontium 90 intake was reaching the danger level.¹⁸ This announcement received front page coverage. Finally, in late May, after reviewing results of further tests, the Bikinians were formally told that they must depart their atoll within 3 months, not to return for at least 30 more years.¹⁹ Bikini islanders had again lost their atoll to radiation, and many major newspapers gave this headline coverage.²⁰

History seemed to repeat itself. So many reporters covered the event that one entire ship was needed to carry them to Bikini. They came from the United States, Italy, France, West Germany, the United Kingdom, and Japan.²¹ Horrified at the repeat spectacle, one newspaper proclaimed to its Pacific island readers that "in fifty years time or so when it is alleged that another attempt at resettlement will be possible, we may very well have a chance to do this crap again . . . to watch the resettlement group removed (by force, if necessary) from Bikini and sent back to 'temporary' exile again on Kili Island."²²

Reporters perceived little joy in the group's departure from Bikini. They saw much sadness and even despair. This time, newscasters and reporters sympathized with the Bikinians, no longer referring to them as "primitives" from a "feudal society."²³

Again, there were expressions that the people of Bikini might again return to Bikini or at least to another similar atoll. Six representatives even visited Hawaii to ask if a temporary

home could be found for their people on the island of Hawaii.²⁴ Some Bikinians feared a repeat of their 1940's resettlement woes. A few families refused to move back to Kili, preferring instead temporary resettlement at Jaluit, another of the 34 atolls and islands of the Marshall's twin archipelagoes.²⁵

Most Bikinians returned to Kili where 28 new plywood and tin-roofed homes specially built for the relocation awaited them. Although there were joyful reunions of long-separated families, there still was sadness. One returnee remarked to a reporter: "I think this is real sad, so sad about our homeland." "But," he added, "I think this time I don't want to go back to Bikini because too danger for me."²⁶ One Bikinian, appearing before members of Congress, compared the Bikini people "to the children of Israel whom the Lord saved from their enemy and led into the Promised Land." "We are," he said, "sadly more akin to the Children of Israel when they left Egypt and wandered through the desert for 40 years. We left Bikini and have wandered through the ocean for 32 years and we will never return to our promised land."²⁷

The plight of the Bikinians was further complicated by their exposure to nuclear radiation. Some media reports suggested that the initial Bikini resettlement group had been purposely used as a human experiment to determine the effects of ingesting plutonium into the body: a charge that the Government vehemently denied.²⁸ For the first time, other reports began to tie the Bikinian's plight to nuclear energy issues. One reporter wrote that he had developed a firm conviction on the nuclear power question. Bikini, he said, may mean that all people will be affected by the scars and cancers that have started to infect humans from the scientific studies done on this once habitable Pacific island.²⁹

The Bikini people were not the only islanders affected by nuclear detonations. On March 1, 1954, the United States exploded a 15-megaton hydrogen bomb at Bikini. The "Bravo" test severely contaminated 22 Japanese fishermen aboard the "Lucky Dragon" (which was illegally fishing in nearby waters), as well as more than 200 Marshallese living on Rongelap and Ufirik atolls (see Map 4).³⁰ Rongelap, about 125 miles from the blast site, experienced "snowlike" fallout. Its 82 inhabitants were exposed to 175 rems of gamma radiation (300 to 500 rems is considered lethal without intensive medical care).³¹ Fallout formed a layer on the ground 3.75 centimeters thick. It fell into drinking water tanks; children played in it; and an old man with vision problems rubbed it into his eyes to see if his

sight might be helped.³² Twenty-four hours later the Navy evacuated the people to Kwajalein.

Utirik Atoll, 180 miles east of Rongelap, also received fallout from the Bravo test. Its 157 inhabitants were not removed until 3 days later. They too went to Kwajalein, where many from both atolls soon experienced the effects of severe radiation poisoning. Although Utirik islanders returned to their atoll in 2 months, 3 years passed before the Rongelap people could return home.³³

Since 1954, the people of both atolls have had medical problems which have received widespread publicity. Critics have charged the United States with being more interested in studying radiation effects than in treating the people.³⁴ The Japanese displayed considerable interest in radiation victims' problems. At the invitation of a Marshallese legislator, left-wing Japanese scientists and observers visited the islanders in 1972, supporting the legislator's claim that the people had become handy objects for American study of radiation effects.³⁵ More publicity followed a 1977 visit by seven members of the Japanese Antinuclear Congress (Gensuiken) group. This group visited the Marshalls to underscore and reiterate their continued opposition to nuclear power.³⁶

In November 1972, atomic fallout from the 1954 test may have claimed its first victim when a 19-year-old boy from Rongelap died of leukemia.³⁷ Then, in 1974, two Rongelap natives required operations for thyroid abnormalities, bringing to 25 the number needing such treatment.³⁸ By early 1977, cancer rates among the exposed Utirik people also began to soar. Fears began to rise concerning radiation effects on future generations after this sudden increase 22 years after the fallout occurred. Government experts had originally informed the fallout victims that their radiation doses were too low to cause harmful effects and now had to admit their predictions were wrong.³⁹ Pacific islanders couldn't help but wonder how many other predictions would turn out wrong and how many additional radiation-related problems would arise in the future.⁴⁰

The US Government announced in December 1947 that Enewetak Atoll had been selected as a new test site. Bikini lacked sufficient land area not only for conducting these tests but also for constructing airstrips to handle huge transport planes delivering needed materials.⁴¹ On the other hand, Enewetak offered sufficient space, was isolated with hundreds of miles of open ocean to catch fallout, and had fewer

inhabitants to relocate than other atolls under consideration.⁴² The US Government advised the United Nations that it had selected Enewetak because no other territory under its jurisdiction existed where these tests could be safely conducted.⁴³

The Navy moved the Enewetak people to Ujilang Atoll at the end of 1947 with little publicity. Conflicting stories about the people's reaction to the move were given. Some say that the Enewetak people seemed quite happy and eagerly rushed ashore at Ujilang to their newly built homes. Others counter that the people went ashore in tears.⁴⁴ There was little or no opposition to the move, with the decision process consisting of conferences with native leaders and a preliminary inspection trip with naval officials at Ujilang.⁴⁵

Ujilang Atoll, although much smaller than Enewetak, had several islands and a small lagoon. Thus while conditions on Ujilang have been far from idyllic for the Enewetak people, their life style and situation have always been more favorable compared to the Bikinians at Kili Island.⁴⁶ The Enewetak people, however, also suffered hardships from living on a much smaller atoll with a rapidly increasing population, as well as the psychological hardship of being forced from their traditional land. This latter hardship may have been the greater burden since land is so important to Marshallese culture for subsistence, social status, and family unity.⁴⁷

In the late 1960's, as population increased and living conditions deteriorated, problems appeared at Ujilang. A well publicized sit-in strike took place on a Trust Territory supply ship to protest living conditions and food shortages.⁴⁸ The United States made an effort to correct some of these problems, yet the people were beginning to pressure for returning to Enewetak, a feeling certainly reinforced by their knowledge that Bikini was being rehabilitated. In 1972, it appeared that the Enewetak people too might get their wish when the United States announced its intention to transfer the administration of Enewetak to the Government of the Trust Territory of the Pacific Islands.

The AEC and DOD conducted radiological and engineering surveys in 1972-73 to determine the extent of possible cleanup operations. A draft environmental impact statement was presented to representatives of the Enewetak people in September 1974. They agreed to work with US officials to develop rehabilitation and resettlement plans. Although disagreements and disappointments occurred, it appeared that

the atoll could be cleaned up and returned to the Enewetak people for about \$40 million. The US Congress, however, thought the price was too high and turned down funding requests for fiscal years 1975 and 1976. Congressmen pointed out that the estimated project cost amounted to \$100,000 for each of the 450 Enewetak people and thought a cash settlement of \$25,000 each, and a \$150,000 trust fund, should suffice.⁴⁹ The people turned it down.⁵⁰

One defense official, Lt. Gen. Warren D. Johnson, head of the Defense Nuclear Agency (DNA), became absolutely convinced that the United States had a moral commitment to return the atoll to its rightful owners.⁵¹ He felt the cost was small when compared to that of just one atomic test. He persevered, and the Military Construction Act of 1977 appropriated \$20 million for the DOD to accomplish the project. Congress also appropriated \$12.4 million to enable the Department of Interior to accomplish its portion of the rehabilitation and resettlement program. The appropriations act enjoined the DOD to achieve every possible economy through maximum use of military resources.⁵²

With the DNA as Program Manager, the Army, Navy, and Air Force began developing service plans for accomplishing the project. The Department of Energy, which was assigned responsibility for providing technical data and advice on all radiological matters, and the Department of Interior, which was assigned rehabilitation and resettlement responsibility, also prepared detailed plans in coordination with DNA and the service components.

A dream of almost 30 years came true for the Enewetak people on March 15, 1977. Officially 50, but in reality closer to 70, people returned to live on Japtan Island during the cleanup operation. Although the return was a festive occasion, certain fears and anxieties remained. For example, the military commander, recalling the troubles the people experienced at Ujilang, assured them that if the Trust Territory ship failed to supply them with food he would have food sent over to Japtan Island.⁵³ Sensing concerns about potential radiation hazards, a Department of Energy official assured them that they would not be exposed to any significant amounts and that their food would be all right if they did not eat any from the northern islands.⁵⁴

The cleanup project at Enewetak was completed in April 1980, with 175 people officially resettled.⁵⁵ However, the resettlement occurred amid continuing controversy about

whether the atoll was safe from harmful radiation.⁵⁶ Unresolved questions exist about courses of action to be taken should the people receive excessive doses of radiation; the specifics concerning followup radiological surveys; and methods for monitoring the health of the resettled people and radioactivity in the environment.⁵⁷ These questions may not be completely answered for many years. In the meantime, the general public, and especially Pacific residents, will continue to pay close attention to Marshallese radiation effects and health problems. With such awareness will go a growing sensitivity to all nuclear issues including that of nuclear power generation and its associated spent fuel and waste disposal problems.

Should these sensitivities foreclose all nuclear waste storage options on Pacific islands--even in the Marshalls--if governments believe it is in their national interest? Decisionmakers from concerned nations must appraise carefully the various alternatives before making their choice. The final decision will not be arbitrary on the part of the United States. As one Pacific journal editorialized, "the day has long passed when the United States could arbitrarily decide on which islands to bomb and which islands would be laden with nuclear waste."⁵⁸

CHAPTER V ALTERNATIVE STORAGE OPTIONS

Three other Pacific islands--Marcus, Johnston, and Runit Islands--have unique characteristics which make them attractive alternatives to Palmyra, Wake, and Midway Islands.

Marcus Island

Marcus Island lies 1,000 miles southeast of Tokyo and 700 miles west of Wake Island. Twenty-six US and twenty-eight Japanese citizens live on this 740-acre island, which once housed 4,500 Japanese military personnel.¹ No permanent residents have ever inhabited the island. The United States occupied the island late in World War II but returned it to Japan in 1968.² The island offers the following advantages as a spent fuel storage site.

Isolation--Said to be one of the most isolated islands in the Pacific, Marcus lies much closer to Japan, South Korea, Taiwan, and the Philippines, than other potential sites.

Japanese ownership--Pacific residents may find using a Japanese-owned island more politically acceptable. Such ownership removes suspicions about "devious" US motives for wanting an island storage site. The United States, however, could serve as a regional partner and help plan and finance the operation.

Existing operations--Japan and the United States have existing operations at Marcus Island. The 26 US Coast Guardsmen man a station on one side of the island; the Japanese operate a small naval and meteorology station on the other. A US Air Force C-130 plane from Yokota, Japan, resupplies the island once weekly.³ These operations provide a basis for future cooperation between the two governments should the island become a storage site.

Disadvantages to using Marcus Island include the following.

Japanese ownership--United States influence over the operation and management of the storage site would be diminished.

Weather conditions--Marcus receives only 40 inches of rainfall annually; seawater distillation plants must provide fresh water.

Johnston Island

This island lies 717 miles southwest of Honolulu and 821 miles southeast of Midway Island. Approximately 350 US military and civilian Government and contract personnel live on the 625-acre island. Engineering projects have expanded its land area almost 10 times its original size. In 1934, the Secretary of the Navy assumed jurisdiction of the island because of its considerable strategic value as an air and seaplane base.⁴ Since World War II, Johnston has been continually used for military purposes. The DNA currently manages the island, using a Department of Energy contractor for base support operations. The island offers the following advantages as a spent fuel storage site.

Isolation--Although not as removed from main air and shipping lanes as Palmyra Island, its remoteness is enough to provide security and not pose a danger to populated areas. Because of its current utilization and proximity to Hawaii, excellent security and logistics support exist.

US ownership--Although Pacific residents might not find Johnston as acceptable politically as Marcus, the island's long association with nuclear and chemical weapons activities probably makes it more acceptable than other US islands. In addition, because of the US ownership, no lease or purchase becomes necessary.

Current and past operations--More than any other Pacific island, Johnston has an aura of secretiveness and mysticism about it. Because of past nuclear programs, Pacific people might view its use as a storage site as a mere extension of previous activities. The Army has long stored chemical munitions (hardly any less dangerous and controversial items than nuclear waste). Thousands of herbicide Orange defoliant drums removed from South Vietnam by the US Air Force were deposited there (and only recently disposed of by incineration in the furnace of a specially-designed ship). Furthermore, the island supported atmospheric nuclear tests including the rocketing of nuclear devices from island firing pads (one of which had to be destroyed upon launch, thereby contaminating part of the island with plutonium).⁵ Johnston also served as a temporary storage facility for fuel rods removed from an experimental South Vietnamese reactor before that country fell into Communist hands.

Excellent support facilities--Johnston Island can support several thousand people. Navy families once lived in

still-serviceable houses. Many of the support facilities, including those for handling aircraft and boats are still usable. These facilities have been kept in good condition because the United States elected to maintain a capability to resume nuclear testing in the atmosphere should the 1962 limited test ban become abrogated.⁶ However, serious questions have been raised whether this capability will ever be used again. Advances in underground testing have made atmospheric testing unlikely and it would take up to 2 years to place state-of-the-art scientific equipment for gathering test data.⁷ Thus Johnston Island's usefulness in the country's nuclear testing program has declined during the past two decades.

Disadvantages to using Johnston Island include the following.

Weather conditions--Although infrequent, violent storms hit the island. In the early 1970's one storm necessitated evacuating personnel and damaged buildings.

Current operations--Although use of the island might be viewed by Pacific residents as a continuation of past practices, converting the island to nuclear waste storage could require relocating chemical munitions. Not only costly, such a move would force the United States to find an acceptable alternate storage site. As one option, the United States could further expand the island area by additional dredging and filling.

Runit Island

This island, one of 40 islands making up Enewetak Atoll, lies approximately 2,380 miles southwest of Honolulu, and 550 miles southwest of Wake Island. Enewetak Atoll is the most northwestern atoll in the Western (Ralik) Chain in the Marshall Islands which form the northern part of the US Trust Territory of the Pacific Islands (Micronesia) in the central Pacific Ocean.⁸ Runit, which lies about 12 miles northeast of Enewetak Island, served as the depository for contaminated debris and soil that was removed from other islands during the Enewetak cleanup operation. Cactus Crater at the northern end of Runit holds more than 5,600 cubic yards of radioactive contaminated debris and 104,000 cubic yards of contaminated soil mixed with cement and attapulgite additive. An aerial view (looking south toward Enewetak Island) of Runit Island reveals the massive crater of encapsulated material at the northern end. Because of the contaminated material stored on Runit Island, the Enewetak people have agreed that they will

not use its 91.25 acres for any domestic purposes.⁹ Appendix A contains an outline of steps that might be taken to transform Runit Island into a spent fuel storage site.

The major advantages associated with Runit Island are that it already stores radioactive debris and materials and additional storage would bring the Government of the Marshall Islands and the people of Enewetak economic benefits. The major disadvantages relate to the morality of denying to the Enewetak people the use of their land and potentially exposing them to additional radiation hazards. In the final analysis, the moral questions may make Runit politically unacceptable for the governments of either the United States, Japan, or Marshall Islands. Appendix B provides a detailed discussion of factors associated with using Runit Island as a storage site.

Comparative Advantages and Disadvantages

Table I (Chapter III) listed Pacific island site criteria that the NSC Ad Hoc Nonproliferation Group used to narrow the choice of island sites to Palmyra, Midway, and Wake. These criteria, however, seem vague, contain built-in biases, and suggest irrelevant requirements. In fact, one might speculate that the islands may have been selected first and the criteria later developed to fit their best features. For example, the criterion that an island must be accessible, but far from populated areas, appears contradictory. There is no definition of "accessible" and "how far." Criteria also call for an island at considerable distance from politically unfriendly or unstable areas. Yet, the terms "unfriendly," "unstable," and "considerable distance" are left obscure. Mandating that the island be undisputed US territory with unquestioned ownership title seems to prejudice the case. If the United States does not plan to use the facility, then Japan--the principal user--has a right to choose a suitable island if it so desires. Finally, requiring an island to enjoy a high rainfall in order to provide fresh water appears unnecessary because desalination plants, already operating on many Pacific islands, could meet demands. Marcus, Johnston, and Runit Islands, while possessing some of the features falling within table I criteria, accordingly must also be considered in light of their unique features.

Assuming that the United States sees little advantage serving as host or taking sole responsibility for the site, Marcus Island offers the preferred site. Its remoteness, yet proximity to potential users, supports such a conclusion. Its Japanese ownership should help remove suspicions that the United States

seeks to create a monopoly over nuclear fuel (as OPEC does in the case of oil). Pacific residents might object much less to using a Japanese-owned island.

Should US decisionmakers conclude that only a US-owned island would prove secure enough, then Johnston Island becomes the attractive candidate. The nuclear waste storage function seems like a logical extension of past and current operations. The DNA manager and base support contractor (both long associated with nuclear testing and cleanup programs at Johnston, Bikini, and Enewetak) already have considerable experience with the island, avoiding the need to incur another time-consuming and expensive learning task. The United States could expand the island's acreage to avoid disrupting existing national security programs or requiring relocation of chemical munitions. Although critics might protest the selection, their opposition might be less effective because people already perceive the island as a site of nuclear and chemical activities.

Whether Pacific residents accept Marcus, Johnston, or Runit Islands depends greatly on Japan's attitude. Because Japan would store most of the waste products, its failure to participate fully in a regional effort would kill any island proposal. Japan's desire for energy independence (thus requiring a reprocessing capability) remains the key question that eventually will decide the storage issue. By agreeing to study the feasibility of using an island site, Japan has taken a significant step toward cooperation with the United States. Also, the Japanese government recently indicated its willingness to study the suggestion that Western Pacific islands already contaminated by weapons testing be used as sites for storing radioactive waste from nuclear power stations.¹⁰

The United States, however, must continue considering other options, especially since it is not likely to store its spent fuel on a Pacific island. One or two away-from-reactor (water pool) sites in the United States will reduce storage problems facing several power companies. These sites could also receive some foreign spent fuel. Another option would be development of a site in the Western States, such as the Nevada Test Site, to store spent fuel either above or below the ground in canisters and silos like those proposed for an island site. The United States offers the following advantages.

Choice of location--A number of potential sites exist in various parts of the country. Some tests have already been conducted at several locations.

Operating costs--All costs, except shipping costs for foreign spent fuel, would be less than for an island site.

Security and safety--A US site, even though more accessible than an island, will have better security arrangements and safety conditions than a remote island. In an emergency, response time is greatly reduced.

Control--US officials can control more closely and manage a site's operation to assure it is operated in accordance with US laws and regulations.

Disadvantages to using sites in the United States include the following.

Foreign attitudes--Foreign owners will believe such a site advances US commercial interests while only pretending to serve as a check on nuclear proliferation. Their spent fuel will be subject to US laws and regulations, making it difficult for them to manage their assets.

Domestic attitudes-- State and local governments will strongly object to storing radioactive waste, receiving it at a port, or having it transported over public roads. Strong protests have already been voiced on interstate shipments to US commercial and Government nuclear wastes.

Costs--Although less expensive for US users, transportation costs for foreign fuel will be greater than if it were moved to a Pacific island site.

Storing spent fuel in the United States is the preferred option if US management and control are essential to accomplishing this country's continuing nonproliferation objective. Security and safety would be enhanced and cost reduced for US users primarily supported by the sites. If the policy goal is to gain broader regional support for US nonproliferation objectives (by storing rather than reprocessing spent fuel), then an island site becomes the preferred option. US control would likely be diminished; security and safety more difficult to provide; and costs higher, since the United States would not be a primary user and must still provide its own sites in the United States. Strong objections will be raised by Pacific residents. Decisionmakers therefore must weigh the political and moral implications of final site selection against nonproliferation objectives.

CHAPTER VI CONCLUSIONS

From the foregoing discussion the following conclusions on the nuclear waste storage issue appear valid.

The Reagan decision to reprocess spent fuel has not changed US nuclear nonproliferation policy. The reprocessing decision does not reduce pressures for finding suitable storage sites for spent fuel and other nuclear waste products. For some nations, storage sites will serve as a means of depositing excesses already generated; for others, storage sites can be used until reprocessing begins; and for some, the sites may serve as a bank for future use when a decision is made to reprocess or even sell the products to others.

Japan will likely support regional efforts to store nuclear waste on a Pacific island. Since the United States indicates that it will now reprocess spent fuel, Japan will no longer be suspicious of US nonproliferation policy objectives. For Japan, the storage sites will handle excesses and spent fuel rods until they can be reprocessed.

US decisionmakers must continue to recognize the danger of proliferation risks in any decision pertaining to handling and managing nuclear waste products. Recent decisions to reprocess spent fuel and proceed with developing breeder technology were made to ensure that nuclear power makes an essential contribution to the nation's future energy needs. These decisions will not change overall US nonproliferation objectives. However, decisionmakers must find suitable means for managing the building waste problem to reduce proliferation risks.

In summary, the US national interest in reducing nuclear proliferation risks demands that decisionmakers pursue alternative methods for resolving the nuclear waste storage problem. The most attractive alternative is to offer sites in the United States: this poses the least difficult political and resource problems. Should decisionmakers determine an island storage in the Pacific, Marcus Island becomes the preferred candidate because of its location and greater acceptability to people in the region. If they determine that the United States should own the storage site, Johnston Island offers the most promise because it already is viewed as a nuclear and chemical site.

APPENDIX A
STORING SPENT NUCLEAR FUEL ON RUNIT ISLAND
(ENEWETAK ATOLL)

The following scenario outlines how Runit Island might be transformed into a spent fuel storage site. In this scenario, either the US Government, Japanese Government, or the Government of the Marshall Islands (GMI) could serve as the initiator. Also, in this scenario, Runit Island's size does not become a consideration. To gain acceptance, the United States must not store its own spent fuel at Runit, and then sufficient space will exist for storing that of others.

Step One: Assuming that the GMI cannot initiate the project, either the United States or Japan would do so. The United States should approach the GMI and people of Enewetak in a very low key manner, presenting the basic reasons for them to consider such a proposal. The Enewetak people and their government may then recognize the economic advantages, and formally announce their willingness to serve as the host for a regional storage site.

Step Two: The GMI, the United States, and perhaps Japan, could initiate the project as a regional cooperative effort. Agreements would have to be developed concerning host nation (GMI) responsibilities, reimbursement arrangements for land use and support, and mechanisms for operating and managing the storage site. If successful, one of history's great ironies would be set in motion. Enewetak Atoll, in the remote Pacific Ocean, once part of a United Nations Strategic Trust, a witness to the birth of the hydrogen bomb, and the site of numerous atomic tests, would become a storage site for nuclear materials in hope of avoiding further proliferation of nuclear weapons.

Step Three: The third step becomes a logical extension of the second. It involves developing detailed local procedures relating to leasing and renting base support facilities on Enewetak or other islands of the atoll, renovating or constructing new facilities, securing employment rights for Enewetak people and other Marshallese, and devising atoll security procedure. The people of Enewetak and the GMI should enjoy full partnership in the regional storage facility except for the authority to remove (or precluding a user from removing) spent fuel.

Step Four: Actual construction could then begin. (It is assumed that engineering and environmental studies would have been completed during the first three steps.) The facility

probably could receive its first spent fuel shipment about 18 months later. Assuming that each step would take approximately 24 months, the operational date would be late 1987 or early 1988.

APPENDIX B
FACTORS PERTAINING TO THE USE OF
RUNIT ISLAND AS A STORAGE SITE

Enewetak Atoll is probably the most geologically and environmentally studied atoll in the Pacific Ocean.

Enewetak Atoll does not lie in the traditional typhoon paths. Storms have infrequently hit the atoll, even necessitating evacuation as a safety precaution. Damage from such storms has generally been light.

Enewetak Atoll population numbers about 500, with the majority living on Ujilang Atoll since the United States resettled them there in 1948. However, most people can be expected to return to Enewetak as the atoll again becomes more self-sustaining. Except for a small *ex gracia* payment from the United States for its use of the atoll as a test site, the only income and source of exchange is copra. Cleanup operations from 1970 to May 1980, brought in some revenue. A small Department of Energy marine biology laboratory remains but makes an insignificant monetary contribution to the economy. Some manual and mechanical skills exist among the population from recent work experience with cleanup contractor and military work forces.

Enewetak Atoll's remote location assists in security to some extent but, because people have returned and reside on islands near Runit Island, security is also a problem. A joint GMI, Japanese, and US civilian guard force would seem appropriate to insure security of the material and spent fuel on Runit Island.

Enewetak Island facilities could support some of the work force at the atoll to operate, maintain, and secure the spent fuel being stored. These facilities supported about 1,000 personnel during cleanup operations. Unless an early decision is made about any future use of these facilities, they will deteriorate rapidly. An excellent runway remains, as well as piers for docking small ships and barges.

Socioeconomic disruption of the traditional life style of the Enewetak people is a potentially serious problem. However, the Enewetak people have grown more accustomed to outside influences during recent years as cleanup operations were accomplished. In fact, loss of income and scheduled contact (through aircraft and ship arrivals) with outside interests could be a major reason for wanting the storage site at Runit Island.

Environmentally, it becomes difficult to understand how a passive storage facility (assuming all possible protective measures are built into the storage silos) can be any more environmentally disrupting than other activities that have occurred at Enewetak Atoll, including the cleanup project. However, great care must be taken to protect both the environment and the people of Enewetak.

Radioactivity should not be a problem due to the design features of the storage containers and silos. Although some people will work on Runit Island, no permanent resident would live within 3 to 4 miles. Although close monitoring must be done for those working on Runit Island, radioactivity monitoring requirements should not otherwise greatly increase.

Gaining political acceptance may become the biggest issue and problem. Pacific residents will certainly voice strong objections to such a proposal unless they believe the Enewetak people and other Marshallese want it and would somehow greatly benefit by hosting the storage site. Even the Enewetak people will not be supportive if it looks like the United States is again trying to use Marshallese islands for doing something that they feel the United States could more safely do on its own territory. The Enewetak people have previously rejected purely monetary settlements as compensation for not returning to their atoll. Thus they must see other than economic benefits to storing spent fuel, and this may be the most difficult problem of all.

Competition from other atolls (particularly the Bikinians) might become a problem since other atoll people may feel they should have the storage site. Except for Bikini--which should be ruled out because of its levels of radioactivity causing the Bikinians to be removed for a second time--such claims should be turned down since none have a Runit Island where radioactive debris is already stored. This does not mean other atolls could not share in revenues from the Enewetak operation, since distribution of tax revenues would be a GMI responsibility.

CHAPTER I ENDNOTES

1. Remarks made during a meeting with Industrial College of the Armed Forces students participating in the Nuclear Weapons Defense Industry Analysis program, 1979-80.
2. Report to the President by the Interagency Review Group on Nuclear Waste Management (Washington, DC: US Department of Energy, March 1979), p. 2.
3. The Baltimore Sun. February 12, 1980, p. 2. The Sun reported that France conducted nine underground tests at Mururoa Atoll during 1979, the most it has ever held in one year. France began testing in the South Pacific in 1966, and continued atmospheric tests through 1974. United States atmospheric testing ended in 1962. For information on French tests, see Keesing's Contemporary Archives (Keynsham Bristol: Keesing's Publications, 1973), pp. 26045-26049.

CHAPTER II ENDNOTES

1. Harold J. Clem and Stanley L. Falk, The Environment of National Security (Washington: The National Defense University, 1977), p. 35.

2. On April 7, 1977, President Carter announced his seven-point nuclear program. The first two points were (1) indefinite deferral of domestic reprocessing and recycling on the grounds they were not essential to a viable nuclear power economy; (2) deferral of the introduction of fast breeder reactors into commercial use and the restructuring of the breeder program to give greater priority to more proliferation-resistant breeder technologies. See Weekly Compilation of Presidential Documents (Washington: Office of Federal Register, April 11, 1977), pp. 502-504. For a general discussion of the Carter Administration's nuclear policies see Charles K. Ebinger, International Politics of Nuclear Energy. The Washington Papers, VI, 57 (Beverly Hills and London: Sage Publications, 1978).

3. On October 8, 1981, President Reagan announced a series of nuclear energy policy initiatives. One point lifted the indefinite ban placed on commercial reprocessing activities in the United States, while ensuring adequate safeguards. Another point directed that government agencies proceed with the demonstration of breeder reactor technology to ensure the US preparedness for longer-term nuclear power needs. Another of the five points instructed the Energy Secretary to proceed swiftly toward deployment of means of storing and disposing of commercial, high-level nuclear waste. See Weekly Compilation of Presidential Documents (Washington: Office of Federal Register, October 12, 1981), pp. 1101-1102. Also see Don Oberdorfer, "U.S. Shifts on A-Fuel Processing," The Washington Post, October 9, 1981, p. A1.

4. Remarks on President's Nuclear Policy Statement by Secretary of Energy James B. Edwards. Secretary Edwards remarked that the President had instructed him to proceed swiftly, in cooperation with state governments, to begin to store and dispose of high-level radioactive waste. The statement, according to Secretary Edwards, recognizes the crucial importance of nuclear power in the Nation's mix of energy sources, and the policy will allow native American creativity that has made the US the world's leader in technology to flower once more. See United States Department of Energy release S-81-013, October 8, 1981.

5. Michael Brenner, "Carter's Nonproliferation Strategy Fuel Assurances and Energy Security," Orbis, Summer 1978, p. 353.
6. Carroll Quigley, "America's Future in Energy," Current History, July-August 1975, p. 5.
7. Remarks made by George Pickering, Associate Professor of Ethics, University of Detroit, at a public lecture, "Nuclear Energy: What Are the Ethical Issues?", Smithsonian, Washington, October 16, 1979.
8. "Energy Policy," Congressional Quarterly, April 1979, p. 116.
9. Gene I. Rochlin, Plutonium, Power and Politics (Berkeley: University of California Press, 1979), p. 83.
10. Bernard L. Cohen, "A Tale of Two Wastes," Commentary, November 1978, p. 1.
11. Remarks made by Bertram Wolfe, Vice President of General Electric and General Manager of GE's Nuclear Fuel and Services Division, at a public National Academy of Science Forum entitled "Nuclear Waste: What to Do with It?", Washington, DC, November 1979.
12. Wendell D. Weart, Evaluation of the Proposed WIPP Site in Southeast New Mexico (Albuquerque: Sandia Laboratories, August 1979), p. 1.
13. David Burnham, "Carter Urges Drive to Perfect Storage of Nuclear Wastes." The New York Times, February 13, 1980, p. A1.
14. On February 12, 1980, President Carter sent a six-page message to Congress seeking permanent storage sites for nuclear waste and spent nuclear fuel. He intended to establish a repository for spent fuel by 1983. By 1985, he wanted to select at least one permanent burial ground for radioactive wastes. See Thomas O'Toole, "President Seeking Permanent Sites to Store Atomic Waste, Spent Fuel," The Washington Post, February 12, 1980, p. A1. The President's message called for about 5 years of additional research on a variety of different possible storage sites, with the first full-scale one being selected by 1985, and in operation by 1995. See David Burnham, "Carter Urges Drive to Perfect Storage of Nuclear Wastes" The New York Times, February 13, 1980, p. A1. Both the Post and Times supported the President's proposals. The Post felt it struck a "sensible balance" of approach, recognizing

that nuclear waste disposal is a real and tough problem with political and social barriers as great--if not greater than--technical ones. See The Washington Post, "Nuclear Debris: Who Will Take It?", February 14, 1980, p. A18. The Times felt that the "proposal offers a sound way to bury the complex, emotional nuclear waste issue without sweeping it under the rug." See The New York Times, "Good Sense on Nuclear Waste," February 13, 1980, p. A26.

15. US Department of State, Bulletin, April 1968, p. 60.

16. Weekly Compilation of Presidential Documents (Washington: Office of Federal Register, February 18, 1980), p. 299.

17. Weekly Compilation of Presidential Documents (Washington: Office of the Federal Register, October 12, 1981), p. 1102.

18. "Japan's Commitment," The Honolulu-Star Bulletin, September 26, 1979, p. A16.

19. Margaret A. McKean, "Japan's Beleaguered Ruling Party," Current History, November 1978, p. 182.

20. *Ibid.*, p. 163.

21. Hideo Sato, "Japanese-American Relations," Current History, November 1978, p. 145. Some people, of course, tend to worry about Japan's ultimate use of plutonium. For example, it was claimed in 1975 that Japan's plutonium production was sufficient to make 2,400 nuclear weapons of the Nagasaki type. The potential growth is disturbing to those who do not relish a reappearance of Japan's military-industrial complex transformed into a modern nuclear one. See Henri Hymans, "The Japanese March to Nuclear Power," Far Eastern Economic Review, October 10, 1975, p. 41. A year after this article appeared, Japan ratified the Nuclear Nonproliferation Treaty and accepted International Atomic Energy Commission (IAEC) safeguards.

22. "Japan's Commitment," The Honolulu-Star Bulletin, September 26, 1979, p. A16.

23. US Department of State, US-Japanese Joint Communique, September 22, 1979.

24. "President Proposes Atoll for Nuclear Waste," and "Japanese Consider Proposal," The Marshall Islands Journal, September 11, 1981, p. A1. This is an interesting event which may have had its origin from the initial distribution of this paper to US decisionmakers, or informal discussions with Marshall Islands officials after its release. This information could have then passed to Marshall Islands President Amata Kabua. President Kabua is credited with making the suggestion at the third annual conference of the Association of Chief Executives of the Pacific Islands. He sees the idea as a source of revenue for the Marshall Islands--a concept pointed out in detail by this paper. As expected, and for reasons later explored in this paper, opposition developed, such as that expressed by Senator Ishmael John of Enewetak, whose reaction was "No! Once is enough."

CHAPTER III ENDNOTES

1. "Energy Policy," p. 121.
2. US Department of State, Foreign Affairs Memorandum, Preliminary Studies of Interim Spent Fuel Storage in the Pacific Basin Area (Draft), October 1979, p. 3.
3. US Congress, Senate, Committee on Energy and Natural Resources, Pacific Spent Nuclear Fuel Storage, Hearings Before the Committee on Energy and Natural Resources on S.1119, 96th Cong., 1st sess., June 5, 1979, p. 13.
4. Ibid., p. 54. Wake and Midway Islands house DOD facilities. The Navy operates Midway and the Air Force operates Wake. Both islands are in a phase-down or caretaker mode. Thus some base support facilities such as utilities, airstrip, port handling, and housing may be available. Both have liabilities. Midway, although not belonging to Hawaii, has a geographical attachment as part of the Hawaiian Islands chain and is of much interest to Hawaii residents and elected officials. Hawaii residents will be highly sensitive to environmental issues, especially as they impact on Midway's bird populations, sea life, and mammals. The Navy's experiences at its Kahoolawe bombing range during the mid-1970's demonstrate how sensitive and politically active islanders are to such issues. Wake presents another problem. Marshall Islanders have a historic interest and potential claim to it because of its close geographical presence. US Micronesian Status negotiators originally considered Wake's status so sensitive that it was the reason cited for not informing the public about Pacific spent fuel plans. (See Hearings on S.1119, pp. 26-27.)
5. Rochlin, Plutonium, Power and Politics, p. 81.
6. Hearings on S.1119, p. 40.
7. The United States produces about 2,000 tons of spent fuel per year from 70 operating reactors. (See Hearings on S.1119, p. 39.) The planned site has 5,400 tons excess capacity, which equals about a 2-year US accumulation. Assuming tripled capacity (see Hearings on S.1119, p. 53), about 25,000 tons capacity would be available, which equals about 12 years at current production rates. As additional reactors become operational, more spent fuel needs storage space, so that this capacity reduces to 8 or 10 years.

8. Bob Kraus, "Plans for Storing N-Waste Explained," Honolulu Advertiser, September 28, 1979, p. A9.

9. More detailed information on tests currently underway at the Nevada Test Site since mid-FY 1978 is available from the Department of Energy Nevada Operations Office, Las Vegas, Nevada.

10. Bob Kraus, "Palmyra," Honolulu Advertiser, September 17, 1979, p. A1.

11. Ibid. According to Mr. Kraus, 22 people now live at Palmyra. They operate the Palmyra Plantation, a company which leased the atoll for copra and fishing rights for 30 years from the Fullard-Leo family owners.

12. Bob Kraus, "Palmyra Holds Its Secrets Hidden in the Jungle Lushness," Honolulu Advertiser, September 19, 1979, p. A1. Except for World War II activity, very little else has occurred at Palmyra. The atoll may have been considered as a supporting or instrumentation base for 1962 nuclear tests near Johnston and Christmas Islands. It was once considered for an Ocean Thermal Energy Conversion (OTEC) demonstration facility by the Department of Energy (DOE). According to the Offices of Technology Assessment, the Pacific Power and Protein Company (PPP) once had a 75-year lease and planned to practice lagoon mariculture. The DOE Project Manager's office advised that PPP had abandoned its efforts. This office, at the time of interview, was not aware of using Palmyra for storing spent fuel. An OTEC demonstration facility could supply some electricity if Palmyra becomes a site, particularly since operational time frames are almost the same. OTEC could also support other Pacific sites. (For information on OTEC, see US Congress, Office of Technology Assessment, Renewable Ocean Energy Sources, Parts I & II, May 1978).

13. Hearings on S.1119, pp. 28-29.

14. Bob Kraus, "Palmyra," p. A1. According to Mr. Kraus, great dredges during World War II turned the atoll of 52 tiny islands into 35, and three natural lagoons became two. (See Bob Kraus, "Nature Reigns on Palmyra's Beaches." Honolulu Advertiser, September 18, 1979, p. A1). Encyclopedia Americana describes the atoll as consisting of 50 uninhabited low islets having a land area of 4 square miles. (See Encyclopedia Americana, Vol. 21, 1979, p. 218.) Formally classified Naval Intelligence records of 1942 describe the atoll as consisting of 55 small islets arranged in a horseshoe

enclosing three lagoons with a total land area of about 250 acres. Pictures tend to confirm this description. The naval records show that a construction party sailed from Honolulu on November 14, 1939, to accomplish removal of reefs separating the lagoons, as well as other improvements to make Palmyra an "excellent sea-air base." (See Office of Naval Intelligence, Field Monograph of Island on Northward and Eastward of Samoa, ONI-52(A), Washington, DC: 1942, pp. 22-27.)

15. Hearings on S.1119, p. 50.

16. Bob Kraus, "Palmyra: Pushed into Nuclear Age," Honolulu Advertiser, September 16, 1979, p. A6. The Energy Daily reported that the Fullard-Leo family sent President Carter a cable saying they were not prepared to sell. (See Energy Daily, September 12, 1979, p. 3.) One paper called Palmyra a preposterous storage site, but hoped US-Japan studies would go forward. (See Honolulu Star-Bulletin, September 26, 1979, p. A16.) Mr. Kraus reported expressions of concern and howls of protest in Hawaii and in many Pacific nations. (See Honolulu Advertiser, September 28, 1979, p. A9.)

17. Hearings on S.1119, p. 46.

18. Information provided by the Department of Energy Nevada Operations Office Project Manager for Nevada Nuclear Waste Storage Investigations, February 14, 1980. Speaking before a National Academy of Sciences Forum, one panel member (Mr. Bertram Wolfe) stated that "DOE has performed tests where such casks were, for example, put on locomotives traveling 80 miles per hour that were crashed into concrete abutments. There were other tests in which a train crashed into casks on a truck. The casks survived those kinds of incidents." (See "Nuclear Waste: What to Do With It?" Academy Forum, Washington, DC: National Academy of Sciences, November 19, 1979, p. 37.)

19. Hearings on S.1119, pp. 56-58.

20. International Nuclear Fuel Cycle Evaluation, INCFE Summary Volume (Austria: International Atomic Energy Commission, January 1980), pp. 47-48.

21. Rochlin, Plutonium, Power and Politics, pp. 240-242.

22. David A. Deese, Nuclear Power and Radioactive Waste (Lexington, Massachusetts and Toronto: D.C. Heath, 1978), p. 157

23. Hearings on S.1119, p. 50.
24. Ibid., p. 51. Some people suggest that American firms would like to give their spent fuel to the Soviets to get rid of it.
25. Rochlin, Plutonium, Power and Politics, pp. 255-256.
26. Hearings on S.1119, p. 51.
27. Bob Kraus, "Palmyra: Pushed into Nuclear Age," p. A6.
28. Rochlin, Plutonium, Power and Politics, p. 256.
29. The Department of Energy's PANTEX Plant at Amarillo, Texas, fabricates chemical explosives and assembles nuclear weapons. This Government-owned contractor-operated plant has its own contractor security force. It is difficult to conceive of any threats more serious for a spent fuel site on a remote island than might occur at this plant. (For a description of PANTEX operations, see US Department of Energy, Story of Albuquerque Operations, AL Pamphlet 3100-2, 1978.) Johnston Island stores highly toxic Army chemical munitions. The island has military and contract security forces and is used as a refueling stop by a major Pacific passenger airline. Security procedures and safeguards used at Johnston could serve as a model for an island or atoll spent fuel facility.
30. A 1957 storm caused severe wave damage at Palmyra. (See Bob Kraus, "Palmyra: Pushed into Nuclear Age," p. A1). Even storms far at sea generate wave action which can cause considerable damage to unprotected areas. For example, Majuro Atoll in the Marshall Islands was hit twice by such wave action within a few days in late 1979, leaving 5,500 people homeless. One resident stated, "It's all very strange. . . . I do not recall any old folks talking about an event like this one." (See Kwajalein Hourglass, December 6, 1979, p. 2.) A storm passing close to Johnston Island in the early 1970's caused considerable wind damage to facilities. Indeed, no atoll or island should be considered completely immune. Even Palmyra, according to a 1942 Navy report, has considerable unfavorable weather and is the "only Equatorial Island at which fresh Westerlies occur." (See Office of Naval Intelligence, Field Monograph, p. 26.)

CHAPTER IV ENDNOTES

1. An excellent summary of the initial selection of Bikini as an atomic test site and the subsequent relocation of its people can be found in Robert C. Kiste, The Bikinians: A Study in Forced Migration (Menlo Park: Cummings Publishing, 1974), pp. 26-28.
2. Kiste, The Bikinians, p. 28. An interesting question with several differing perceptions is why the Bikinians took only a short period to deliberate such an important decision. The decision was made following a Sunday morning church service. Kiste attributes it in some part to their Christianity, which the islanders had accepted from the Americans. The American Military Governor had, in fact, drawn upon the Bible—comparing the Bikinians to the children of Israel—in his initial exhortations about the scientific experiments planned for their islands. Kiste also feels that the Bikinians were still greatly impressed by the United States' decisive defeat of Japan. This, and the exhortations of both the American Military Governor and their paramount chief that it was the right thing to do, may have left the decisionmakers with the feeling that they had no other alternative. Dr. Jack A. Tobin, Community Development Advisor, Marshalls District, stated in 1974 in a background memorandum to the District Administrator of the Marshalls District that the Bikini people were "asked" to leave and, "as might have been expected of a people of their historical conditioning to obedience, especially after more than a quarter of a century of autocratic Japanese rule, they agreed to leave their ancestral home." (Information from a Jack A. Tobin memorandum to the Marshalls District Administrator, subject: Background Information Paper, Bikini Situation, dated April 5, 1974, p. 2).
3. Kiste, pp. 27, 34.
4. Kiste, p. 31.
5. Kiste, pp. 33-34.
6. Kiste, pp. 33-34.
7. Tommy F. McCraw, "Levels of Environmental Radioactivity in Bikini Atoll," US Atomic Energy Commission document, WASH-1289, July 1974, p. 1.
8. Tobin, "Background Information Paper, Bikini Situation," pp. 4-5.

9. Tobin, p. 8.
10. Kiste, p. 110.
11. McCraw, p. 10.
12. "28 Years After Atom Blast, the Bikinians Return Home," US News & World Report, December 16, 1974, p. 52.
13. Tobin, p. 15.
14. Tobin, p. 18.
15. Ibid.
16. Ibid.
17. Walter Pincus, "The US Errs: Bikini Island Still Isn't Safe," The Washington Post, March 19, 1978, p. A1.
18. Pincus, "US to Relocate Bikinians, Cites Radiation Effect," The Washington Post, April 13, 1978, p. A1.
19. Pincus, "Bikinians Must Quit Island for at Least 30 Years, Hill Told," The Washington Post, May 23, 1978, p. A10.
20. Jerry Belcher, "Bikini Islanders Lose Again to Radiation," Los Angeles Times, July 23, 1978, p. 1.
21. US Department of the Interior, Trust Territory of the Pacific Islands 1978 Annual Report, p. 8.
22. "Stop It (Or It Will Stop You!)," Micronesian Independent, September 1-8, 1978, p. 1.
23. Time, April 1, 1946, p. 28.
24. "Bikinians Look to Hawaii for Help," Pacific Islands Monthly, August 1979, p. 16.
25. Kay Lynch, "Radiation Danger Forces Bikinians from Island Home," The Washington Post, September 1, 1978, p. A12. One Bikinian is reported to publicly vow, for example: "I will send out my children and family if that is necessary. Bikini is my home, my freedom, my happiness. You can take my life now, bury me beside my home, but I will never return to Kili." This statement was read throughout the Pacific area in the Pacific Islands Monthly, November 1978 issue, p. 20.

26. "Nuclear Refugees from Bikini Start Life Anew," The Washington Post, September 4, 1978, p. B4. For a general description of the atolls and islands making up Micronesia, see Robert Wenkam and Bryon Baker, Micronesia: The Breadfruit Revolution (Honolulu: University Press of Hawaii, 1971), pp. 9-10.

27. Pincus, May 23, 1978, p. A10.

28. "Bikini - Enewetak," Pacific Islands Monthly, August 1979, as reprinted from the Bulletin of Atomic Scientists, February 1979, p. 17. The claim was made following a 1976 Lawrence Livermore Laboratory scientist's statement that "Bikini is probably the best available source of data for evaluating the transfer of plutonium across the gut wall after being incorporated into biological systems." Department of Energy officials admit that this summary reads too callously, blaming it on the zeal of technical types who are anxious to learn about the transfer of radioactive elements. See Walter Pincus, "Bikini Islanders Want to Remain There," The Washington Post, April 3, 1978. Having been associated with several DOE officials and scientists who have worked closely with the Marshallese people in monitoring their health and radiation exposure, allegations that these people have been used as guinea pigs are difficult to believe. These scientists, and particularly one high-ranking DOE official who has devoted more personal and official time than perhaps any single Government employee, have always seemed to be genuinely concerned about the health and welfare of these peoples. Still, it is difficult to deny that much valuable scientific and medical information had evolved from their studies over the years.

29. Joe Murphy, "Why So Much Coverage? . . .," Micronesian Independent, September 1-8, 1978, p. 4.

30. Pacific Islands Monthly, August 1979, p. 13.

31. Ibid.

32. Ibid.

33. Ibid.

34. Jerry Burris, "'Human Guinea Pig' Charges Broil US-Micronesian Relations." Honolulu Advertiser, April 28, 1972, p. 1.

35. Ibid.

36. "Japanese Bomb Victims Visit TT Counterparts, " Micronesian Independent, November 5-11, 1977, p. 1.

37. The New York Times, November 21, 1972, p. 26, Also Newsweek, November 30, 1972, p. 114.

38. Walter Sullivan, "Radiation from H-Test in '54 Still Taking Toll," The New York Times, June 3, 1974, p. 19.

39. Micronesian Support Committee Bulletin, July 1977, p. 1, as reprinted from the Los Angeles Times Service of June 12, 1979.

40. Ibid. In March 1978, Department of Interior officials estimated that 33 of Ronelap's 82 inhabitants at the time of the Bravo shot, and 8 of Utirik's 157 inhabitants had developed thyroid tumors. See Walter Pincus, "Thyroid Cases from '54 H-Test Increase." The Washington Post, March 27, 1978.

41. Starek and Anderson, Blue Reef, p. 57.

42. Michael D. Cooley, "Enewetak: An Inquiry Into Who Gives a Damn about What and Why" (MS thesis, Wesleyan University, 1974), p. 50.

43. Ibid., pp. 50-51. In November 1946, President Truman had announced that the United States was prepared to place Micronesia under strategic trusteeship. The trusteeship agreement was approved by the United Nations Security Council on April 2, 1947, and approved by joint congressional resolution and signed the same day, July 18, 1947, by the President. See John C. Dorrance, "Micronesian Crosscurrents and the US Role in the Western Pacific" (Individual Research Paper, The National War College, 1975), pp. 37-39. Bikini, it should be noted, was selected and utilized as a test site before the trusteeship agreement was initiated. Enewetak was announced after the agreement was in effect. Mr. Dorrance's detailed and fascinating research effort fully covers the legalities and interesting aspects as they apply to Enewetak and Bikini. A more recent study on the relationship of the agreement to activities at Enewetak, Bikini, and the Marshalls is contained in Ambassador Philip W. Manhard's "The United States and Micronesia in Free Association: A Chance to do Better?" (National Defense University, National Security Affairs Monograph Series 79-4, 1979), pp. 29-30. Ambassador

Manhard illustrates the difficulty experienced by the United States in reconciling its security interests with its political trusteeship responsibilities. He cites a specific example in 1958 when the DOD was planning a test at Enewetak, and how the AEC chairman fought to have the tests moved to Johnston Island since he thought these tests were a violation of the agreement unless the safety and protection of the people could be guaranteed.

44. Cooley, "Enewetak, Who Gives a Damn," p. 51.

45. Tobin, Resettlement of the Enewetak People, p. 30.

46. Cooley, "Enewetak, Who Gives a Damn," p. 75.

47. US General Accounting Office, Enewetak Atoll--Cleaning Up Nuclear Contamination, PASD-79-54, May 8, 1979, p. 1.

48. Cooley, "Enewetak, Who Gives a Damn," p. 75.

49. Paul F. Kavanaugh, "Disposal of Radiological Contamination at Enewetak Atoll" (Air War College Research Report No. 102, 1977), p. 4.

50. The Washington Post, December 10, 1975, p. 1. In February 1977, as military commander at Enewetak, I was directed to accompany a Defense Nuclear Agency photographer, Trust Territory (TT) official, and a member of the Micronesian Legal Services to Ujilang. The Assistant Manager of the Mid-Pacific Marine Laboratory at Enewetak accompanied us on the small two-engine seaplane at the invitation of the TT official. The visit was, I understood, for the purpose of taking pictures to support a further Department of the Interior Congressional appropriations hearing. The plane deposited us in the lagoon and returned to Enewetak until the following day when it was to pick us up. Pictures were taken, and the people seemed very happy to assist us. That night, we were honored at a dinner and by much singing in the community hall, and it seemed that almost every family member was present for the occasion. The real purpose of the assembly, however, was to take one final vote on whether they wanted to take the money or return to Enewetak. The TT official, himself a native of Enewetak, ran this part of the meeting and he requested the vote. The old chief seemed to indicate that he wanted to take the money, which confirmed rumors that I had heard; but the people, as far as I could tell, said no: they wanted to return to their home at Enewetak. This, then, was their final decision to return!

51. Honolulu Sunday Star-Bulletin and Advertiser, May 18, 1975, p. D4.
52. GAO, Enewetak Atoll, p. 3.
53. John Noble Wilford, "US Resettles 75 on Pacific Atoll Evacuated for Bomb Tests in 40's," The New York Times, April 11, 1977, p. 1.
54. Ibid.
55. "175 Officially Resettled on Atoll after 33 Years," The New York Times, April 10, 1980, p. A18.
56. Walter Pincus, "Islanders Return to Atomic Test Area Amid Controversy," The Washington Post, April 7, 1980, p. A18.
57. GAO, Enewetak Atoll, p. iii.
58. Jonathan M. Weisgall, "The Nuclear Nomads of Bikini," Foreign Policy, Summer 1980, p. 98.

CHAPTER V ENDNOTES

1. Robert Trumbull, "At Most Isolated Inhabited Place, Sunburned Chin is Memorable," The New York Times, January 14, 1980, p. A8.
2. Ibid.
3. Ibid.
4. Office of Naval Intelligence, Field Monograph of Islands on Northward and Eastward of Samoa, ONI-52(a), Washington, DC: 1942, p. 3.
5. Monitoring and cleanup operations from this incident occur at Johnston Island even today.
6. US Energy Research and Development Administration, The Nevada Operations (Las Vegas: Nevada Operations Office, 1975), p. 37.
7. Information gained during discussions held during the Industrial College of the Armed Forces Defense Industry Analysis (Nuclear Weapons) field studies, February 1980.
8. US Defense Nuclear Agency, Enewetak Atoll Orientation Guide (Kirtland Air Force Base, New Mexico: DNA Printing Plant, November 1976), p. 1.
9. Bruce Benson, "'Hottest' Isle at Enewetak Is No Place for Cold Feet," Honolulu Advertiser, June 22, 1977, p. A1. Basic agreements were first signed concerning restrictions on Runit Island as early as January 3, 1975. See, for example, "Agreement Between the Defense Nuclear Agency and the Department of the Interior to Provide for Dri-Enewetak Settlement at Japtan Island, Enewetak Atoll, M.I.," p. 2.
10. "Japanese Consider Proposal," Marshall Islands Journal, September 11, 1981, p. A1.

BIBLIOGRAPHY

Books

Clem, Harold J. and Stanley L. Falk. The Environment of National Security. Washington, DC: The National Defense University, 1977.

Deese, David A. Nuclear Power and Radioactive Waste. Lexington, Massachusetts and Toronto: D.C. Heath, 1978.

Ebinger, Charles K. International Politics of Nuclear Energy, The Washington Papers, VI, 57. Beverly Hills: Sage Publications, 1978.

Kiste, Robert C. The Bikinians: A Study in Forced Migration. Menlo Park: Cummings Publishing, 1974.

Manhard, Philip W. The United States and Micronesia in Free Association: A Chance to Do Better? National Security Affairs Monograph Series 79-4. Washington, DC: National Defense University, June 1978.

Rochlin, Gene I. Plutonium, Power and Politics. Berkeley: University of California Press, 1979.

Starek, Walter, and Alan Anderson, Jr. The Blue Reef. New York: Alfred A. Knopf, 1979.

Stenbaugh, Robert and Daniel Yergin, ed. Energy Future. New York: Random House, 1979.

Tobin, Jack A. The Resettlement of the Enewetak People: A Study of a Displaced Community. Ann Arbor: Xerox University Microfilms, 68-5847, 1968.

Weart, Wendell D. Evaluation of the Proposed WIPP Site in Southwest New Mexico. Albuquerque: Sandia Laboratories, August 1979.

Periodical and Newspaper Articles

Belcher, Jerry. "Bikini Islanders Lose Again to Radiation." Los Angeles Times, July 23, 1978.

Benjamin, Milton R. "Growth of Plutonium Supply Forecast." The Washington Post, February 25, 1980.

- Benson, Bruce. "'Hottest' Isle at Enewetak Is No Place for Cold Feet." Honolulu Advertiser, June 22, 1977.
- "Bikini - Enewetak." Pacific Islands Monthly, August 1979.
- "Bikinians Look to Hawaii for Help." Pacific Islands Monthly, August 1979.
- Brenner, Michael. "Carter's Nonproliferation Strategy, Fuel Assurances and Energy Security." Orbis, Summer 1978.
- Burnham, David. "Carter Urges Drive to Perfect Storage of Nuclear Wastes." The New York Times, February 13, 1980.
- Burris, Jerry. "'Human Guinea Pig' Charges Broil US-Micronesian Relations." Honolulu Advertiser, April 28, 1972.
- Cohen, Bernard L. "A Tale of Two Wastes." Commentary, November 1978.
- "Energy Policy." Congressional Quarterly, Contemporary Affairs Report, 1979.
- "Good Sense on Nuclear Waste." The New York Times, February 13, 1980.
- Hymans, Henri. "The Japanese March to Nuclear Power." Far Eastern Economic Review, October 10, 1975.
- "Japanese Bomb Victims Visit TT Counterparts." Micronesian Independent, November 5-11, 1977.
- "Japanese Consider Proposal." Marshall Islands Journal, September 11, 1981.
- "Japan's Commitment." Honolulu-Star Bulletin, September 26, 1979.
- Kraus, Bob. "Nature Reigns on Palmyra's Beaches." Honolulu Advertiser, September 18, 1979.
- Kraus, Bob. "Palmyra." Honolulu Star Bulletin, September 17, 1979.
- Kraus, Bob. "Palmyra Holds Its Secrets--Hidden in the Jungle Lushness." Honolulu Advertiser, September 19, 1979.
- Kraus, Bob. "Palmyra: Pushed into Nuclear Age." Honolulu Advertiser, September 16, 1979.

- Kraus, Bob. "Plans for Storing N-Waste Explained." Honolulu Advertiser, September 28, 1979.
- Lynch, Kay. "Radiation Danger Forces Bikinians from Island Home." The Washington Post, September 1, 1978.
- McKean, Margaret A. "Japan's Beleaguered Ruling Party." Current History, November 1978.
- Murphy, Joe. "Why So Much Coverage? . . ." Micronesian Independent, September 1-8, 1978.
- "Nuclear Debris: Who Will Take It?" The Washington Post, February 14, 1980.
- Oberdorfer, Don. "US Shifts on A-Fuel Processing." The Washington Post, October 9, 1981.
- O'Toole, Thomas. "President Seeking Permanent Sites to Store Atomic Waste Spent Fuel." The Washington Post, February 12, 1980.
- Pincus, Walter. "Bikini Islanders Want to Remain There." The Washington Post, April 3, 1978.
- Pincus, Walter. "Islanders Return to Atomic Test Area Amid Controversy." The Washington Post, April 7, 1980.
- Pincus, Walter. "Thyroid Cases from '54 H-Test Increase." The Washington Post, March 27, 1978.
- Pincus, Walter. "The US Errs: Bikini Island Still Isn't Safe." The Washington Post, March 19, 1978.
- Pincus, Walter. "US to Relocate Bikinians, Cites Radiation Effect." The Washington Post, April 13, 1978.
- "President Proposes Atoll for Nuclear Waste." Marshall Islands Journal, September 11, 1981.
- Quigley, Carrel. "America's Future in Energy." Current History, July-August 1975.
- Sato, Hideo. "Japanese-American Relations." Current History, November 1978.
- Sullivan, Walter. "Radiation from H-Test in '54 Still Taking Toll." The New York Times, June 3, 1974.

Trumbull, Robert. "At Most Isolated Inhabited Place, Sunburned Chin Is Memorable." The New York Times, January 14, 1980.

Weisgall, Jonathan M. "The Nuclear Nomads of Bikini." Foreign Policy, Summer, 1980.

Wieck, Paul R. "Domenici Criticizes Proposed Council to Deal with N-Waste." Albuquerque Journal, January 24, 1980.

Wilford, John Noble. "US Resettles 75 on Pacific Atoll Evacuated for Bomb Tests in 40's." The New York Times, April 11, 1977.

"28 Years After Atom Blast, the Bikinians Return Home." US News & World Report, December 16, 1974.

"175 Officially Resettled on Atoll After 33 Years." The New York Times, April 10, 1980.

US Government Documents and Publications

US Congress. Senate. Committee on Energy and Natural Resources. Pacific Spent Nuclear Fuel Storage, Hearings before the Committee on Energy and Natural Resources on S.1119, 96th Congress, 1st Session, June 5, 1979.

US Defense Nuclear Agency. Enewetak Atoll Orientation Guide. Kirtland Air Force Base: DNA Printing Plant, November 1976.

US Department of Energy. Report to the President by the Interagency Review Group on Nuclear Waste Management. Springfield, Virginia: National Technical Information Center, March 1979.

US Department of Energy. Secretary of Energy James B. Edwards Remarks on President's Nuclear Policy Statement. October 1, 1981.

US Department of Energy. Story of Albuquerque Operations, AL Pamphlet 3100-2. Albuquerque: Albuquerque Operations Office, 1978.

US Department of State. Foreign Affairs Memorandum, Preliminary Studies of Interim Spent Fuel Storage in the Pacific Basin Area (Draft). October 1979.

- US Department of State. US - Japanese Joint Communiqué. September 22, 1979.
- US Energy Research and Development Administration. The Nevada Operations. Las Vegas: Nevada Operations Office, 1975.
- US General Accounting Office. Enewetak Atoll--Cleaning Up Nuclear Contamination. PASD-79-54, Washington, DC: US General Accounting Office, May 8, 1979.
- US Nuclear Regulatory Commission. Annual Report 1978. Washington, DC: US Government Printing Office, 1979.
- US Office of Naval Intelligence. Field Monograph of Islands on Northward and Eastward of Samoa, ONI-52(a). Washington, DC 1942.
- US Office of the Federal Register. Weekly Compilation of Presidential Documents (Administration of Jimmy Carter). Washington, DC: US Government Printing Office, 1977-1980.
- US Office of the Federal Register. Weekly Compilation of Presidential Documents (Administration of Ronald Reagan). Washington, DC: US Government Printing Office, 1981.
- McCraw, Tommy F. Levels of Environmental Radioactivity in Bikini Atoll, WASH-1289. Washington, DC: US Atomic Energy Commission, July 1974.

Miscellaneous Published Documents

- Bureau of Public Affairs. Trust Territory of the Pacific Islands, Annual Report, 1978. Saipan: Office of the High Commissioner, 1978.
- International Nuclear Fuel Cycle Evaluation Conference, INCFE Summary Volume. Austria: International Atomic Energy Commission, January 1980.
- National Academy of Sciences. Nuclear Waste: What to Do with It? Academy Forum. Washington, DC: National Academy of Sciences, November 19, 1979.

Miscellaneous Unpublished Reports and Papers

Cooley, Michael D. "Enewetak: An Inquiry Into Who Gives a Damn about What and Why." Unpublished thesis, Wesleyan University, 1974.

Dorrance, John C. "Micronesian Crosscurrents and the US Role in the Western Pacific." Unpublished Individual Research Project. National War College, 1975.

Kavanaugh, Paul F. "Disposal of Radiological Contamination at Enewetak Atoll." Unpublished Air War College Research Report No. 102, 1977.

