H1-00011-BKS

Rec'd 11/15/91

DOE/EA-1991

KAUAI TEST FACILITY (KTF) ENVIRONMENTAL ASSESSMENT

SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NEW MEXICO

U.S. DEPARTMENT OF ENERGY
ALBUQUERQUE OPERATIONS
ALBUQUERQUE, NEW MEXICO

MARCH 1991

Review of the
Kauai Test Facility Environmental Assessment

Background: The Kauai Test Facility (KTF) Environmental Assessment (EA) was prepared by Sandia National Laboratories, operators of KTF. The EA's purpose is to evaluate the impact of continuing test operations at KTF on the environment. The EA does not evaluate or discuss any activities or impacts associated with the Navy's Pacific Missile Range Facility (PMRF) of which KTF is a part of. It discusses KTF/DOE activities and includes the SDIO/SDC activities by reference. Based on the EA, a Finding of No Significant Impact has been prepared. Three alternatives to the KTF were listed, but none were evaluated as they could not support the KTF mission.

When PMRF was transferred from the State of Hawaii to the Navy (1941), public access for fishing was to be maintained. Rocket Launches were not envisioned at that time.

There are only 14 permanent DOE staff assigned to the KTF. During test periods, TDY personnel live in motels away from KTF. They spend an average of $175/day with an average stays of three to five weeks.

Review Comments:

1. The EA evaluated three components to the continued operations of the Kauai Test Facility. These are : 1) Continuing the existing KTF facility and program, 2) constructing new roadways, fencing, fuel handling, and launch pad facilities, and 3) vertical launch and rail launch vehicles. Vertical Launch programs cited were the STARS and EDX programs. Information from these EAs were incorporated by reference.

2. Of interest, the EA contains a copy of the Interagency Agreement (IAG) between the Navy and DOE for operation of the KTF. The IAG is valid from 1 October 1987 to 30 September 1993. A separate review of the IAG can be accomplished if requested. It is a good model to use as a basis of similar SDIO required agreements.

3. There were no new environmental issues raised in this EA that SDIO is not already aware of. Primary Environmental Impacts involve the following:

a.) Endangered Sea Turtles are known to inhabit the area. Appropriate mitigation measures are required.

b.) PMRF is designated a "Major Ancient Burial Ground." Remains have been found in the dunes and along the coastline.

c.) Limitations on Land Use. Land use limitations involve reducing the amount of recreation use of the shore of Kauai (safety restrictions), limitations imposed on the sugar cane fields and their workers (safety restrictions again.) Land use is governed by the State of Hawaii Department of Land and Natural Resources. (Hawaii is the only state with statewide zoning laws.) Limitation hours for fishing and other water recreation are listed on page 38 of the EA.

d.) Migratory Birds. KTF has mitigation measures active in October/November (page F-7) for migrating Newell's Shearwater.

e.) Noise Impacts from rocket launches. KTF has adequate safety measures for employees to protect them from noise impacts. The safety concern is for the sugar cane workers who might not get adequate warning of an impending launch.

Other environmental concerns involve the hazardous nature of rocket launches, i.e. air pollution, explosions, accidental spills. KTF has in place operating procedures to minimize the risk of exposure.

4. A separate section for the construction of new facilities is provided (Section 2.1.2). It appears that the ODES construction activities (i.e., the holding pads) have been included, but comparison with the STARS and EDX EAs should be accomplished.

FINDING OF NO SIGNIFICANT IMPACT
KAUAI TEST FACILITY
SANDIA NATIONAL LABORATORIES
KAUAI, HAWAII

AGENCY: DEPARTMENT OF ENERGY

ACTION: FINDING OF NO SIGNIFICANT IMPACT

SUMMARY

The Department of Energy (DOE) has prepared an environmental assessment (EA) on the proposed continued launching of rockets with experimental payloads at the Sandia National Laboratories' (SNL's) Kauai Test Facility (KTF) on the island of Kauai, Hawaii. The KTF project includes (1) continuing the existing KTF facility and program, (2) constructing new roadways, fencing, fuel handling, and launch pad facilities, and (3) launching of vertical-launch as well as rail-launch vehicles. The facilities are needed to enable SNL to continue experimental rocket launches as mandated by Safeguard C of the 1963 Nuclear Test Ban Treaty.

Vertical-launch programs to be conducted at the KTF include the U.S. Army's Strategic Target Systems (STARS) and Exoatmospheric Discriminiation Experiment (EDX). Environmental assessments for each of these programs are incorporated by reference in the KTF EA. The Army has published a Finding of No Significant Impact (FONSI) for each program.

The EA examined the environmental impacts of existing and proposed KTF activities and discussed potential alternatives. Based on the analyses in the EA, the DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969. Therefore, the preparation of an Environmental Impact Statement (EIS) is not required and the Department is issuing this FONSI.

COPIES OF THE EA ARE AVAILABLE FROM:

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BACKGROUND

The KTF is located just south of Barking Sands within the U.S. Navy Pacific Missile Range Facility (PMRF) on the west coast of the island of Kauai, Hawaii. Development of the proposed KTF program will enable SNL to continue rail-type launches of rockets carrying experimental payloads which have been conducted at the complex since 1962. It will also enable the KTF to contribute to national security by making available facilities and technology to support vertical launches of rocket systems and conduct new test programs.

Proposed construction at the KTF will improve test support functions for the following weapons research and development (R&D) activities:

- Launching of rockets for observation by the Air Force Maui Optical Station located on Mount Haleakala
- Conducting suborbital coexperiments with launches from Vandenberg Air Force Base in California
- Performing ICBM-type launch simulations targeted to areas in the U.S. Army Kwajelein Atoll Region

- Conducting scientific experiments on phenomena occurring in the upper atmosphere over the mid-Pacific
- Implementing high-velocity water impact and underwater trajectory experiments in conjunction with U.S. Navy instrumentation capabilities.

PROPOSED ACTION

The three principal elements of the proposed action are: (1) the existing KTF facilities and vertical-launch programs which are proposed to be continued; (2) construction of roadways, fencing, fuel handling, and launch pad facilities; and (3) launching of vertical launch-type vehicles, including those associated with the Army's STARS and EDX programs.

There is also a KTF launching facility which occupies a two-acre area at Kokole Point, 6.5 miles south of the principal KTF complex.

The construction of roadways and a new launch pad, and fencing of a decontamination pad and fuel holding pads, are proposed to accommodate new vertical launch programs such as STARS and EDX.

ALTERNATIVES CONSIDERED

Three alternatives to the proposed action were considered:

- No action
- A new facility at an alternative location
- KTF decommissioning.

While each alternative was determined to be feasible from either a programmatic or cost standpoint, none was preferred in the context of national security. Therefore, each was dismissed from detailed analysis as summarized below.

No Action

The "no action" alternative would require that the existing functions and launch activities of the KTF be conducted within the present facilities. This alternative would seriously limit the KTF's capability to conduct new vertical-launch programs.

New Facility at An Alternative Location

Because of the KTF's unique attributes, an alternative location for a new facility is not feasible. The criteria for a rocket testing facility could be met only at the PMRF or some other location in the Hawaiian Islands.

KTF Decommissioning

This alternative would become feasible only if another facility could be found with scientific, technical, logistical, and strategic attributes equivalent to those of the KTF. Elimination of a test facility would violate Safeguard C of the Nuclear Test Ban Treaty.

ENVIRONMENTAL CONSIDERATIONS

The potential environmental impacts of the proposed action were evaluated in the EA. The effects of proposed new facilities to accommodate vertical launches were analyzed, as were cumulative effects. No significant environmental impacts associated with continued operation or proposed new activities at the KTF were indentified. This FONSI is based on the following factors which are supported by the information and analyses in the EA.

Occupational Safety and Health

Quantitative assessments were conducted to estimate potential exposures to KTF and PMRF workers of hazardous rocket motor propellants from routine and nonroutine operations. The following rocket motor exhaust constituents found in the STARS system were evaluated for routine operations: aluminum oxide (Al_2O_3); nitrogen dioxide (NO_2); hydrogen chloride (HCl); and carbon monoxide (CO). Estimated air concentrations of these constituents were compared to Threshold Limit Values (TLVs), nationally accepted standards for occupational exposure to chemicals. Modeling of air concentrations determined that the TLVs would not be exceeded for any of these constituents.

Nonroutine operations evaluated with respect to occupational health effects included post-launch rocket failure, accidental detonation during rocket assembly, and spills of hypergolic fuel [unsymmetrical dimethyl hydrazine (UDMH), and nitrogen textroxide]. Launch personnel would be protected by the Launch Operations Building (LOB) in the event of a post-launch rocket failure and all other personnel would be outside of a 10,000-foot (3,030-meter) ground hazard area (GHA). Accidental detonation during assembly, a highly unlikely event, would result in loss of human life in and near the Missile Assembly Building (MAB) and damage to other structures in the launching field. Other occupied facilities at the KTF would be protected from blast over pressure by revetment barriers and other structural features. If accidental spills of hypergolic fuel should occur, workers would be protected by personal protective equipment (PPE) and other SNL safety requirements. Air concentrations of spilled fuels would be well below the TLVs so that no adverse health effects would be expected.

An extensive soils sampling and analysis program at the KTF indicated that the quantities of lead and aluminum in soils do not represent any risk to workers. No beryllium was detected in KTF soils and aluminum was not found above background levels.

<u>Health and Safety Consequences of Hazardous Chemical Releases to the General Public</u>

No indications of potential risk to public health and safety from releases of rocket motor exhaust constituents or from post-launch rocket failure were identified during the assessment. The public is not at risk from soils contaminated by lead, aluminum, or beryllium.

<u>Environmental Consequences of Hazardous Chemical Releases</u>

Rocket motor exhaust emissions are concentrated at elevated levels for a very short time period during launches and are quickly dispersed. Concentrations of metallic oxides in soil are not elevated above background levels. Any spills of liquid fuels would be quickly contained by implementation of required spill control procedures. Potential impacts of unspent rocket fuel on the marine environment would be minor and limited in area. For these reasons, no major adverse environmental consequences are anticipated.

Physiography, Geology, and Soils

Measurable changes in the physiography and soils of the KTF area are not expected as a result of the proposed action.

Surface Water and Ground Water Hydrology

Site preparation and paving associated with the launch pads and roadways may slightly increase surface water runoff. However, runoff is not expected to have a consequential environmental effect because of the rapid permeability and high infiltration rates of the sandy soils. Ground water hydrology and drawdown will not be affected because water supplies will be obtained from an off-site water well supply system.

Air Quality

Air quality will not be significantly affected by construction or operations activities associated with the KTF project. Short-term, construction-related effects will include increased levels of particulates (fugitive dust) and other air pollutants generated by construction activities including topsoil disturbance/removal and emissions from construction equipment internal combustion engines. Short-term concentrations of some regulated pollutants emitted by rocket systems during launching will be high, temporarily, but will quickly dissipate. The proposed project will comply fully with the State of Hawaii ambient air quality standards.

Biological Resources

Construction of the KTF launch pad, roadways, and parking lot will result in the permanent removal of approximately 15 acres of topsoil. Some of the open scrub vegetation species will be removed. As a result, there will be minor habitat depletions for small mammals and birds. Wildlife species, such as feral dogs or cats, that might otherwise be affected are likely to migrate away from the areas of construction activity. There is one federally proposed Category 1 species of plant present near some construction sites: the *Ophioglossum concinnum* or adder's tongue fern. Mitigation measures, including avoidance of the plant and transplanting any colony(ies) after a wet period to a compatible habitat within the PMRF, will be implemented if the plant will be disturbed by construction activities.

The Pacific green sea turtle, a federal and State of Hawaii listed threatened species, is of concern at the KTF because of its presence in foraging, resting, and nesting areas along the coast of the PMRF. Because lights from construction or launch activities will not be directed at the beach area, any green sea turtle nesting areas will not be disrupted. Care will also be taken to report any turtle nests exposed to pedestrian or vehicle traffic. Since no wetland or riparian habitats are situated anywhere in the KTF construction area, sensitive ecological systems will not be affected.

Mitigation measures may or may not be required to protect the threatened Newell's shearwater, depending on whether its flight paths cross over the KTF. However, if mitigation is required, lights projected upward or laterally will not be used during critical October and November migration periods. Also, hoods or shields will be installed on launch pad lights when required, to the extent that human safety is not compromised.

Cultural Resources

Subsurface testing within the KTF produced evidence of subsurface cultural materials. The U.S. Navy considers the entire PMRF/KTF a culturally sensitive "major ancient burial ground" because human remains have been found at various locations along the dunes and coastline. Therefore, a monitoring program will be implemented during any ground-disturbing activities, as advised and approved by the State Historic Preservation Officer (SHPO). In addition, a Draft Burial Treatment Plan, as approved by the U.S. Navy, the SHPO, and the State of Hawaii Office of Hawaiian Affairs (OHA), will be followed should any human remains be uncovered during construction. If an archeological or historic artifact is discovered during construction, activity will be halted pending examination and classification of the artifact by a qualified archeologist working in cooperation with the Hawaii SHPO.

Land Use

Land use and recreational access to beach areas will be adversely affected when rocket boosters are on the launch pad and during launches. Recreational access could be affected a maximum of 238 days per year. The rocket boosters are on the pad for the 10 to 12 launches per year. The size of the area restricted from recreational use will vary considerably, depending on the type of vehicle being launched. With the maximum Ground Hazard Area (GHA) of 10,000 feet or 3,030 meters in effect, approximately 5.0 acres (2.0 hectares) would be temporarily closed to the public. However, these adverse effects cannot be considered as major in view of the alternative recreational access available along the western coast of Kauai.

Socioeconomic Conditions

Construction of the new KTF facilities will not result in an influx of new construction workers. During the construction period, additional revenues will be provided for local contractors with resulting benefits to the local tax base and economy. During KTF operations, 50 to 75 temporary professional or support personnel will be added to the existing KTF work force of 14 permanent staff personnel. There will be some increase in traffic volumes associated with the construction. Traffic volume increases during operations will be small and temporary in nature. The relative isolation of the KTF from population centers will mitigate against any potential social or economic disruption.

Noise

Noise emissions from the 320 rocket motors launched from the KTF from 1962 through 1990 were not measured or monitored. However, noise emitted by the Strypi/LACE Two Experiment Rocket Campaign was monitored in February 1991. In addition, a computer model developed by the National Aeronautics Space Administration (NASA) was used to estimate noise levels during rocket launches at eight different sensitive receptor locations. Maximum short-term (15 minutes or less) noise levels predicted by the model were then compared with Occupation Safety and Health Administration (OSHA) standards for noise exposure in the work place and with the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit valves (TLVs) applicable to DOE contractors. Predicted noise levels at various receptor locations were also compared to noise level goals established by the U.S. Department of Housing and Urban Development (HUD), the U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA).

Although workers at the main KTF launch complex and Kokole Point would be subjected to unacceptable short-term noise levels, these exposures will be successfully mitigated by the use of PPE such as earplugs and earmuffs. Sugar cane field workers, public spectators, and visitors to Polihale State Park would also be subjected to noise levels approaching or exceeding the 15-minute OSHA standard. (The OSHA workplace standard was used as a guide because there are no HUD, DOT, or EPA noise level goals for periods of 15 minutes or less.) These potential noise hazards would be mitigated by adequate notice to the public of planned launches and encouraging the taking of precautionary measures such as leaving the area or the use of PPE. Although only limited information exists on the effects of various noise levels on wildlife, available data indicate that mammals, birds, and marine life would not be severely affected.

Cumulative Effects

Impacts resulting from the proposed action will be direct, indirect, and cumulative. Cumulative effects result from the incremental impacts of the KTF when considered with other proposed actions which may have potentially significant effects. In the case of the KTF, negligible cumulative effects will be associated predominantly with increasing disturbance of soils and vegetation from construction activities associated with future launch pads, increased disturbances of cultural resources and wildlife habitat, and effects of temporary short-term increases in noise levels on humans and wildlife. Cumulative effects for the next 10 to 15 years can be expected to be about what they have been during the past 10 to 15 years.

Environmental Consequences of Alternatives

Three alternatives to continued operations, new construction, and new vertical-launch programs at the KTF are addressed in the EA. These are: "no action," constructing a new facility at an alternative location, and KTF decommissioning.

The "no action" alternative would preserve the status quo of continued capability of the KTF to launch rocket systems similar to those that have been launched previously. There would be minor cumulative effects, however insignificant, in terms of soils, vegetation, wildlife, noise, and cultural resources. However, unless there is a change in national defense policy, the "no action" alternative would only postpone or relocate the consequences of the proposed action to a later date or to another facility of the same type.

Since a feasible alternative location for a KTF-like facility has not been identified, an analysis of potential environmental consequences has not been conducted. However, it cannot be assumed that the environmental consequences at an alternative location would be either more or less adverse than at KTF.

KTF decommissioning would result in demolition of some buildings along with revegetation of disturbed areas. Generally, the overall environment would be enhanced.

Determination

The proposed continuation of rocket launch programs at the KTF and related new construction do not constitute a major federal action significantly affecting the quality of the human environment within the meaning of the NEPA. The environmental impacts resulting from new construction and continued operation of the KTF are deemed insignificant or minor. Therefore, based on the analyses in the EA, the preparation of an EIS is not required.

DOE/EA-1991

KAUAI TEST FACILITY (KTF) ENVIRONMENTAL ASSESSMENT

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MARCH 1991

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Al_2O_3	Aluminum trioxide
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
AEC	Atomic Energy Commission
AFB	Air Force Base
AICUZ	Air Installation Compatible Use Zone
AIRFA	American Indian Religious Freedom Act
AMOS	Air Force Maui Optical Station
ARPA	Archeological Resources Protection Act
AT&T	American Telephone and Telegraph
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
cm	centimeter
CO	Carbon monoxide
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	decibel
dBA	A-weighted decibel
DLNR	Department of Land and Natural Resources (State of Hawaii)
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	Department of Transportation
DRMO	Defense Reutilization and Marketing Office
EA	Environmental Assessment
EDX	Exoatmospheric Discrimination Experiment
EPA	Environmental Protection Agency
ESQD	Explosive Safety Quantity Distance
FEMA	Federal Emergency Management Administration
FONSI	Finding of No Significant Impact
gm	gram
GHA	Ground Hazard Area
HCl	Hydrogen chloride
HCRR	Hawaii Code of Rules and Regulations
HCZMP	Hawaii Coastal Zone Management Program
HRS	Hawaii Revised Statutes
HSWA	Hazardous and Solid Waste Amendments of 1984
HUD	Housing and Urban Development
ISA	Interagency Support Agreement
KTF	Kauai Test Facility
km	kilometer
kv	kilovolt
kw	kilowatt
l	liter
LACE	Low Altitude Compensation Experiment
LEPC	Local Emergency Planning Committee

Ldn	Equivalent day/night sound level
Leq	Equivalent sound level
LOB	Launch Operations Building
μg	microgram
MAB	Missile Assembly Building
mg	milligram
ml	milliliter
mph	miles per hour
N_2O_4	Nitrogen tetroxide
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NO_2	Nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRC	National Response Center
NRHP	National Register of Historic Places
OHA	Office of Hawaiian Affairs
ORV	Off-road vehicles
OSHA	Occupational Safety and Health Administration
PMRF	Pacific Missile Range Facility
PMTC	Pacific Missile Test Center
PPE	Personal Protective Equipment
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RQ	Reportable quantity
SARA	Superfund Amendments and Reauthorization Act
SCBA	Self-contained breathing apparatus
SCS	U.S. Soil Conservation Service
SDI	Strategic Defense Initiative
SDS	Strategic Defense System
SERC	State Emergency Response Commission
SHPO	State Historic Preservation Officer
SNL	Sandia National Laboratories
SOP	Safe Operating Procedure
SPCC	Spill Prevention, Control, and Countermeasures
STARS	Strategic Target Systems
TLV	Threshold Limit Value
TOL	Time-of-liftoff
TSP	Total suspended particulates
TWA	Time-weighted average
UDMH	Unsymmetrical (1,1)-dimethylhydrazine
USAKA	U.S. Army Kwajelein Atoll
USASDC	U.S. Army Strategic Defense Command
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

The Sandia National Laboratories (SNL) operates the Kauai Test Facility (KTF) on the western coast of Kauai in the Hawaiian Islands for the U.S. Department of Energy (DOE). The KTF, which is a tenant of the U.S. Navy's Pacific Missile Range Facility (PMRF), fulfills multiple purposes in support of DOE research and development activities including launching of rockets carrying experimental non-nuclear payloads. Most of these launches are targeted to various areas of the South Pacific including the U.S. Army Kwajelein Atoll (USAKA) in the Marshall Islands. Operation of the KTF is mandated by Safeguard C of the 1963 Nuclear Test Ban Treaty.

This environmental assessment (EA) analyzes the potential environmental consequences of the three principal elements of the proposed action associated with the KTF:

- Continuation of the existing KTF facility and rail launching of rockets with experimental paylods
- Construction of new roadway, fencing, fuel handling, and launch pad facilities
- Launching of vertical-launch rocket systems.

The new vertical-launch programs will include, but not limited to:

- The U.S. Army's Strategic Target Systems (STARS) which is part of the Strategic Defense Initiative (SDI)
- The U.S. Army's Strategic Defense Command's Exoatmospheric Discrimination Experiment (EDX) which is also part of the SDI program.

Separate EAs prepared by the Army for these two programs are incorporated by reference in the KTF EA.

The proposed action is described in detail in Subsection 2.1.

Three alternatives to the proposed action were developed in the process of preparing the EA:

- No action or preservation of the status quo
- Construction of a new facility at an alternative location
- Decommissioning of the KTF.

Environmental consequences (impacts) of the proposed action and alternatives are reported in EA Section 4.0 for the following environmental parameters:

- Occupational Health & Safety. Quantitative assessments were conducted to estimate potential exposures to KTF and PMRF workers of hazardous rocket motor propellants from both routine and nonroutine KTF operations. The following rocket motor exhaust constituents were evaluated: aluminum oxide, nitrogen dioxide, hydrogen chloride, and carbon monoxide. It was found that Threshold Limit Values (TLVs) would not be exceeded for any of these constituents. (See Subsection 4.6.)

  Nonroutine operations evaluated with respect to occupational health effects included post-launch rocket failure, accidental detonating during rocket assembly, and spills of hypergolic fuel (hydrazine and nitrogen textroxide). In the event of a post-launch rocket failure (detonation) shortly after launch, personnel involved in the launch would be protected by the Launch Operations Building (LOB) and other personnel would be situated outside of the Ground Hazard Area (GHA). Accidental detonation during rocket assembly would result in complete destruction of the Missile Assembly Building (MAB) and probable loss of life. Personnel not in the MAB area would not be affected. Any spills of hypergolic fuel would be safely contained. In the event of inadvertent releases, personnel would be protected by personal protective equipment (PPE) required by SNL safety procedures. Results of an extensive soils sampling and analysis program conducted in July 1990 indicate that quantities of lead and aluminum in soils do not represent any risk to workers. No beryllium was detected.

- Health and Safety Consequences of Hazardous Chemical Releases to the General Public. No indications of potential risks to public health and safety from releases of rocket motor exhaust constituents were identified during the assessment. No soils contaminated by lead, aluminum, or beryllium were discovered in areas frequented by the public.

- Environmental Consequences of Hazardous Chemical Releases. Rocket motor exhaust emissions are concentrated at elevated levels for a very short period during launches and are quickly dispersed. Concentrations of metallic oxides in soil are not elevated above background levels. With implementation of required spill control procedures, spills of liquid fuels would be quickly contained. Any potential effects of unspent rocket fuels released into the marine environment in event of a rocket failure would be minor and confined to a small area. For these reasons, no major adverse environmental consequences are anticipated.

- Physiography, Geology, and Soils. Measurable changes in the physiography of the KTF are not expected as a consequence of the proposed action. A comprehensive soil sampling and analysis program is in progress to determine whether past activities at the KTF have had an adverse effect on soil quality. New construction will occur primarily in previously disturbed areas.

- Surface Water and Ground Water Hydrology and Quality. There will not be any major changes in the hydrology or water quality at the KTF due to the proposed action. Site preparation for the EDX launch pad and construction associated with the STARS program may slightly increase surface water runoff. However, the effects will not be of any consequence because of rapid permeability and high infiltration rate of KTF soils.

- Air Quality. Constructed-related effects will be short-term and of no major consequence. They will consist of moderately increased levels of particulates (fugitive dust) and emissions from internal combustion engines used in construction equipment. There will be short-term concentrations of some regulated pollutants (carbon monoxide, nitrogen dioxide, total suspended particulates, and lead) emitted by rocket systems during launching. While some of these concentrations will be temporarily high, they will quickly dissipate as the rockets rapidly gain altitude. The maximum concentration of regulated pollutants at the perimeter of the 10,000-foot (3,030-meter) GHA will not exceed the Hawaii air quality standards.

- Biological Resources. While proposed KTF construction projects will disturb approximately 15 acres (6 hectares) of topsoil and accompanying vegetation, the majority of construction activities will take place within the heavily disturbed open scrub vegetation zone (EA Figure 5). The vegetation species most likely to be sensitive to potential construction impacts is the Adder's tongue or pololei fern (*Ophioglossum concinnum*), a Category 1 species not currently listed on the federal Endangered Species List. A second proposed endangered plant species, *Sesbania tomentosa*, has not been reported as occurring within the PMRF or the KTF.

  Nine federally listed threatened or endangered wildlife species are known to occur in the KTF area (EA Table 1, Subsection 3.4.3). With the implementation of appropriate mitigation measures discussed in EA Section 5.0, none of these species will be subjected to unacceptable adverse impacts due to KTF construction or operations.

- Cultural Resources. A 100 percent pedestrian survey of the KTF did not reveal any evidence of archeological surface features or artifacts. However, there is a potential for the presence of buried cultural resources at the site. The U.S. Department of the Navy considers the entire PMRF/KTF a "major ancient burial ground." Because of the potential for the existence of subsurface archeological or human remains, an Archeological Monitoring Plan has been submitted for approval by the Hawaii State Historic Preservation Officer (SHPO).

- Land Use and Recreation. Land use and recreational access to beach areas will be adversely affected when rocket motors on the launch pad and during launches. A maximum of seven percent of the otherwise accessible beach area could be restricted 48 percent of the time under the most conservative conditions. However, the availability of alternative beach areas along the PMRF and the western coast of Hawaii serves to adequately mitigate these adverse impacts.

- Noise. Noise emissions from the 320 rockets launched from the KTF from 1962 through 1990 were not monitored. However, noise emissions resulting from the Strypi/LACE Two Experiment Rocket Campaign were monitored in February 1991. In addition, a computer model developed by the National Aeronautics and Space Administration (NASA) was used to estimate noise levels at eight different senstive receptor locations. Predicted maximum short-term (15 minutes or less) noise levels for these locations were then compared with Occupational Safety and Health Administration (OSHA) bearing conversation standards and the threshold limit values (TLVs) established by the American Conference of Governmental Industrial Hygienists as required by DOE 5480.10.

  It was found that workers at the main KTF launch complex and Kokole Point will be subject to unacceptable maximum short-term noise levels generated by the loudest rocket systems. However, these exposures will be mitigated by situating workers inside the launch bunker and by use of PPE including earplugs or earmuffs. It was also found that public spectators, sugar cane field workers, and visitors to Polihale State Park will be subjected to unacceptable short-term noise levels. These exposures will be mitigated by adequate advance notice of launches and encouraging the taking of precautionary measures including use of PPE. Although limited information exists on the effects of various noise levels on wildlife, available data indicate that mammals, birds, and marine life will not be severely affected.

Compliance by the KTF with applicable environmental laws and regulations at the federal, State, and local level is addressed in EA Section 6.0. Environmental parameters discussed include:

- Air Emissions
- Waste Management and Spill Control
- Reporting of Releases of Hazardous Substances
- Wastewater Discharges
- Threatened and Endangered Species
- Cultural Resources
- Coastal Zone Management
- Noise.

Mitigation measures to be implemented for the proposed action are summarized in EA Section 5.0. These include, but are not limited to:

- Establishment of an air quality monitoring plan
- Protection of a Category 1 candidate threatened or endangered plant species, the *Ophioglossum concinnum* or Adder's tongue
- Protection, if required, of the Newell's shearwater, a federally listed threatened bird species
- Implementation of an Archeological Monitoring Plan and a Burial Treatment Plan in the event of the discovery of subsurface archeological artifacts or human remains
- Implementation of engineering controls, enforcement of safety measures required by SNL for workers, and use of PPE for protection against short-term maximum noise levels
- Prior notification to the public of planned launches to avoid potential adverse noise effects.

1.0 PURPOSE AND NEED FOR ACTION

The Sandia National Laboratories (SNL) is one of the largest research and development (R&D) entities in the United States. It is operated solely for the U.S. Department of Energy (DOE) by Sandia Corporation, a wholly owned subsidiary of American Telephone & Telegraph Company (AT&T). The SNL has major research and development responsibilities for nuclear weapons, arms control, energy, environment, and other areas of strategic importance to national security. The primary mission of the SNL is the design and development of new nuclear weapons systems as well as the maintenance and upgrading of the existing weapons stockpile which must meet the highest standards of safety, security, control, and military performance.

The SNL operates for the DOE a rocket launching test facility at Kauai, Hawaii. The Kauai Test Facility (KTF) is located on the western coast of Kauai just south of Barking Sands and is situated within the U.S. Navy's Pacific Missile Range Facility (PMRF) (Figures 1 and 2) under a 1987 PMRF/DOE interagency support agreement (ISA) (Appendix A). The KTF is bordered on the north and east by sugar cane fields, on the northwest and southwest by the Pacific Ocean, and on the south by the PMRF. There is also a KTF launch complex which occupies a two-acre (0.8-hectare) area at Kokole Point, 6.5 miles (10.4 kilometers or km) south of the principal KTF complex (Figure 2).

The KTF's existence and operation is mandated by Safeguard C of the 1963 "Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water" (Nuclear Test Ban Treaty) which provides that the signatory nations (including the United States) may maintain the capability necessary to resume nuclear testing if deemed essential to their national security. Nuclear weapons have never been launched from the KTF and there are no plans to launch them in the future.

The KTF fulfills multiple purposes in support of DOE weapons research and development activities including:

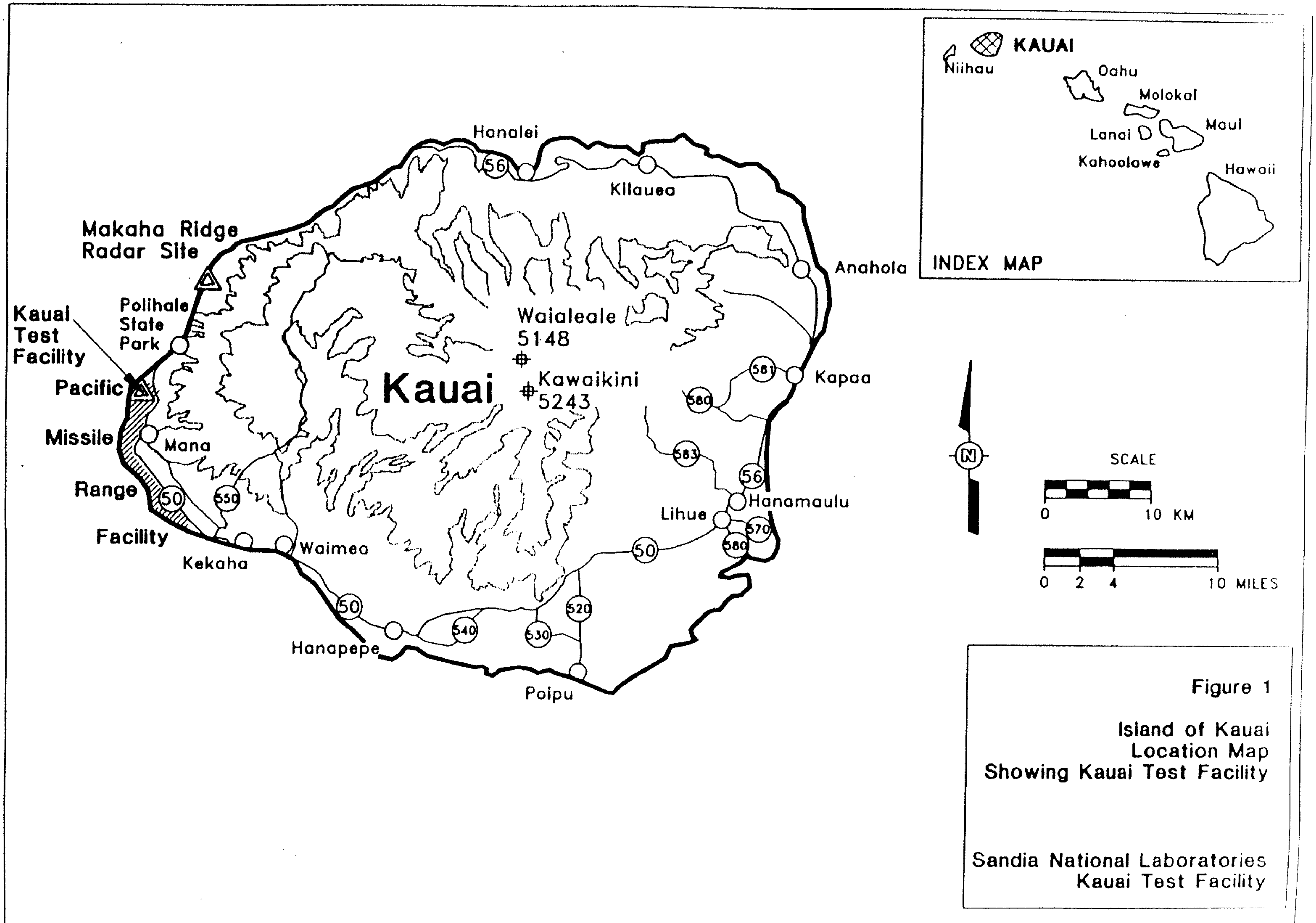


Figure 1

Island of Kauai
Location Map
Showing Kauai Test Facility

Sandia National Laboratories
Kauai Test Facility

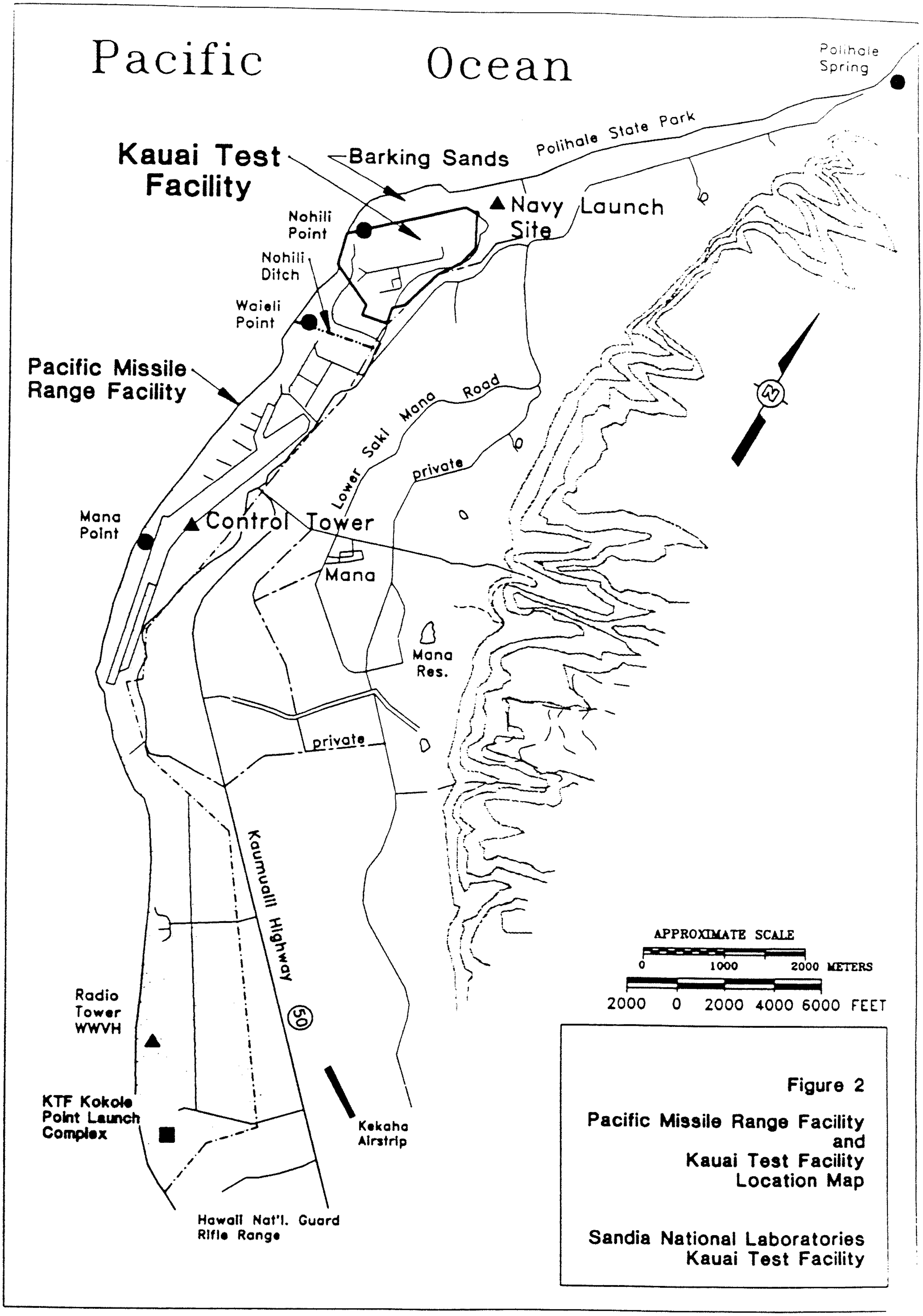


Figure 2

Pacific Missile Range Facility and Kauai Test Facility Location Map

Sandia National Laboratories
Kauai Test Facility

- Launching of rockets carrying experimental payloads for observation by the Air Force Maui Optical Station (AMOS) located on Mount Haleakala
- Conducting suborbital co-experiments with launches from Vandenberg Air Force Base (AFB) in California
- Performing ICBM-type launch simulations targeted to areas in the U.S. Army Kwajelein Atoll (USAKA) region in the Republic of the Marshall Islands
- Conducting scientific experiments on phenomena occurring in the upper atmosphere over the mid-Pacific
- Implementing high-velocity water impact and underwater trajectory experiments in conjunction with U.S. Navy instrumentation capabilities.

Combined facilities at PMRF and KTF also feature extensive radar tracking and telemetry receiving and recording capabilities as well as radio communication system access to worldwide facilities of the Department of Defense (DoD). Together, they provide a high quality, integrated capability for conducting a wide range of test operations. These operations support R&D testing of materials, components, and advanced reentry vehicle technologies. Experiments are conducted in the upper atmosphere, the ionosphere, in space, and under water.

National security imperatives require that current test support and associated experimental activities at the KTF be continued, that some new construction be undertaken to improve KTF test support functions, and that the needs of new test programs for vertical launch-type vehicles be accommodated. The new vertical launch programs are proposed to include, but not be limited to:

- The U.S. Army's Strategic Target Systems (STARS) which will provide critical information for the Strategic Defense Initiative (SDI).
- The U.S. Army Strategic Defense Command's Exoatmospheric Discrimination Experiment (EDX) which is also part of the SDI program.

The STARS and EDX launch programs are briefly described in Section 2.0. Their environmental impacts are discussed in detail in the "Strategic Target System (STARS) Environmental Assessment" of July 1990 (U.S. Department of Army, 1990b) and the

"Exoatmospheric Discrimination Experiment (EDX) Environmental Assessment" of September 1990 (U.S. Department of Army, 1990a), which were prepared in compliance with the National Environmental Policy Act (NEPA). These documents are incorporated by reference in this KTF Environmental Assessment (EA).

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The DOE is proposing to continue operations at the KTF, from which rocket systems with experimental payloads have been launched since 1962. Continued KTF operations will provide for rail launches which have historically occurred at the facility as well as vertical launches of the type associated with the STARS and EDX programs. However, STARS and EDX are not part of the proposed action addressed in this EA because separate EAs have been prepared for each of these programs.

This section briefly describes the three principal elements of the proposed action:

1. Continuation of the existing KTF facility and rail-launch program
2. Addition of new roadway, fencing, fuel handling, and launch pad facilities
3. Launching of vertical-launch vehicles of the type associated with the Army's STARS and EDX programs.

This section also describes three alternatives to the proposed action:

- No action
- A new facility at an alternative location
- KTF decommissioning.

2.1 PROPOSED ACTION

The three components of the proposed action are described in this section. Alternatives are discussed in EA Subsection 2.2.

2.1.1 Continuation of the Existing KTF Program

The KTF commenced operations in 1962 in support of the high altitude nuclear testing program then in existence. It became a permanent part of the Test Readiness Program in 1963. From 1962 through 1990, 320 rockets were launched from the facility. Current average launch activity consists of approximately one Strypi (consisting of one Castor and two Recruit boosters), two Nike, and two Terrier-boosted rocket systems per year. Table 1 lists all of the rocket motors currently used in KTF operations.

TABLE 1

ROCKET MOTORS USED IN KTF OPERATIONS

NAME	PROPELLANT WEIGHT (LBS)
Alcor 1B	916
Antares II	2,440
Antares IIIA	1,235
Apache Mod 1	131
BE-3	191
Cajun Mod I	118
Castor I	7,313
Genie	327
Honest John	2,050
Malemute	1,115
Nike	750
Polaris A3 1st Stage	20,778
Polaris A3 2nd Stage	8,847
Orbus 1	911
Recruit	264
Sandhawk	1,106
Star 13B	90
Star 26	508
Star 27	735
Talos	2,803
Terrier	1,220
Tomahawk	387

Operations at KTF include the following:

- Operations planning support
- Prelaunch operations support
- Range instrumentation support
- Launch operations (rocket launches, command, control, communications, and data processing)
- Post-launch support.

The KTF consists of the following elements:

1. Forty-two launch pad sites with developed facilities at 18 sites (Figure 3); five sites are currently active [pads 1, 15, 19, 41 (at Kokole Point), and 42]
2. Three missile assembly buildings (MABs)
3. A Launch Operations Building (LOB) for operations control and data gathering
4. A trailer compound for housing administrative and technical support activities and personnel
5. Two 300-kilowatt (kw) diesel electric generators
6. Miscellaneous facilities (e.g., security fencing, electric substations, fuel storage, antenna towers, and septic systems).

Other facilities at the KTF include a wind radar site, a crafts building for maintenance operations, a warehouse/shipping-receiving building, and a covered area for vehicles and machinery. Except for minor building modifications and upgrades, KTF facilities have remained essentially unchanged until recently. In 1986, construction was initiated at KTF to support vertical-launch rocket systems of the type used in the STARS program.

Water for domestic consumption is supplied to the KTF by the PMRF. The water source is the Mana well, owned and maintained by the Kekaha Sugar Company, which supplies the KTF and the northern portion of the PMRF via two miles of large-diameter pipeline.

The Mana well is a high-level water tunnel located at Kamakala Ridge in the mountainous area east of the former village of Mana (Figure 2).

Water consumption for the KTF is estimated at 300 gallons [1,140 liters (l)] per day during nonoperational periods and 1,200 gallons (4,600 l) per day during operational periods. Ground water at the PMRF (and KTF) is too brackish for domestic purposes; no ground water is pumped at these facilities (see EA Subsection 3.2.3).

Solid, municipal-type waste is collected weekly by a PMRF contractor and hauled to the Kekaha landfill immediately south of the PMRF for disposal. The KTF occasionally hauls solid waste to the landfill. The KTF does not presently store, treat, transport, or dispose of hazardous waste (see EA Section 6.0 on Waste Management and Spill Control).

During nonoperational periods (when no launches take place), electric power is supplied to the KTF by the Kauai Electric Company. Primary commercial distribution is via a 12,470 volt [12.47 kilovolt (kv)] line. When the KTF is operational, power is supplied by two 300-kilowatt (kw) diesel electric generators (Figure 3). Electric distribution to launch pads is via underground cable.

There are three septic tank and leaching field systems that are registered with the State of Hawaii at the KTF (Figure 3). No wastewaters are discharged from any point source that would require a National Pollutant Discharge Elimination System (NPDES) permit (see EA Section 6.0 on Wastewater Discharges).

With respect to all activities related to rocket launches and fuel handling and storage, the KTF complies with Department of Energy (DOE, 1988b), Department of Defense (DoD, 1984), and U.S. Navy (U.S. Department of Navy, 1989a) safety requirements. Among these requirements are rules that establish safe separation distances for both missile technicians and the general public as a function of the type and quantity of ordnance present at a location. As defined by these requirements, an Explosive Safety Quantity Distance (ESQD) has been established which defines approach access limits by members

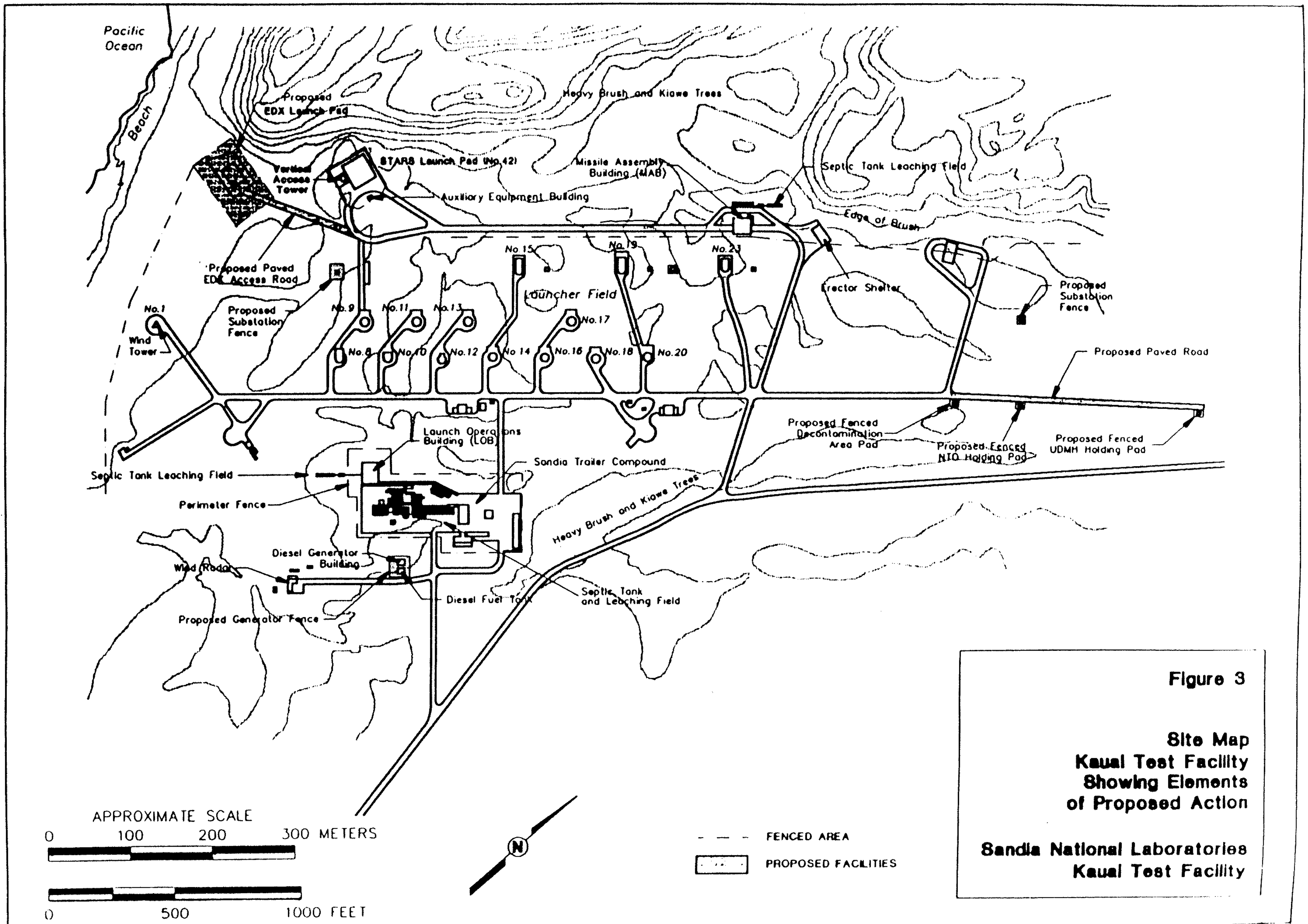


Figure 3

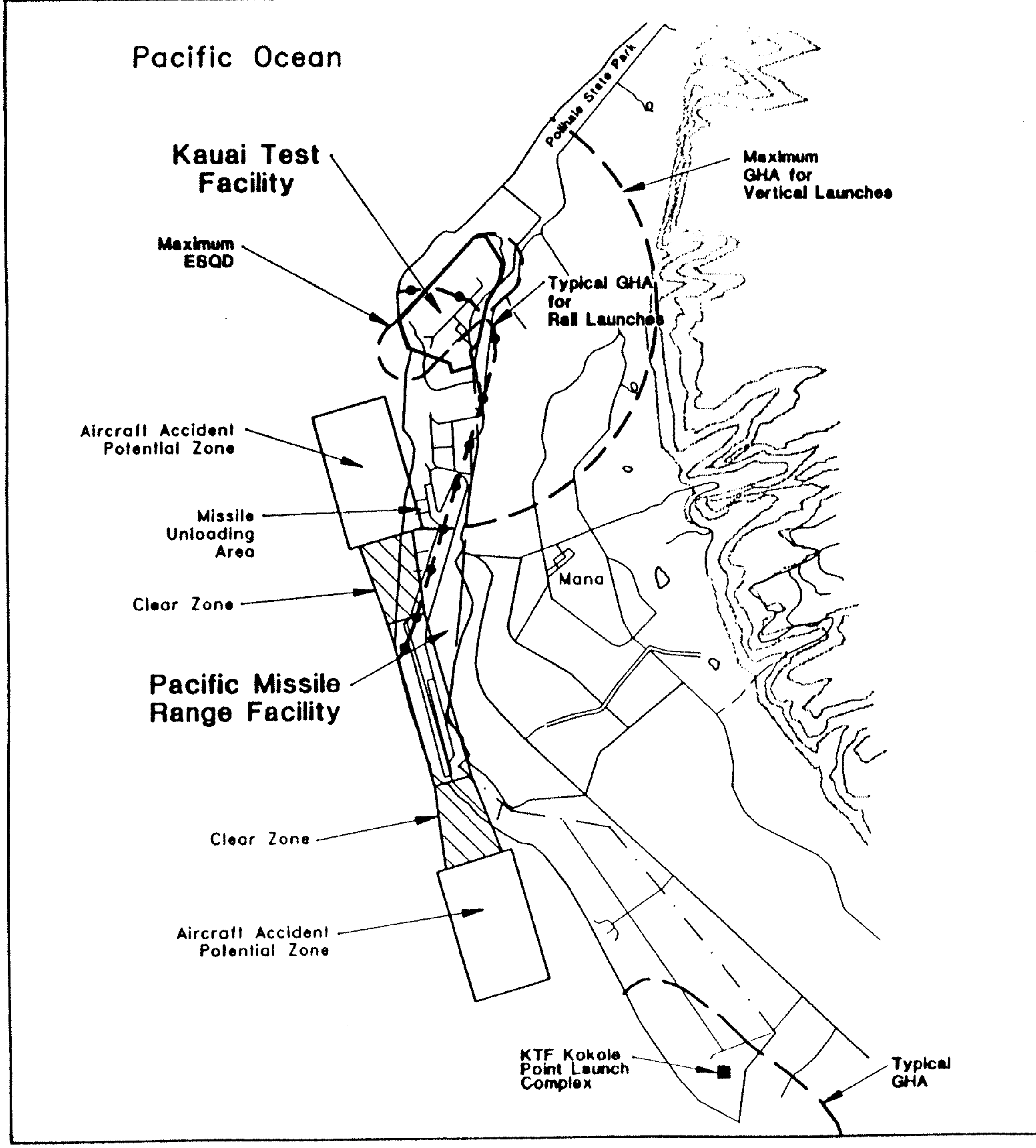
Site Map
Kauai Test Facility
Showing Elements
of Proposed Action

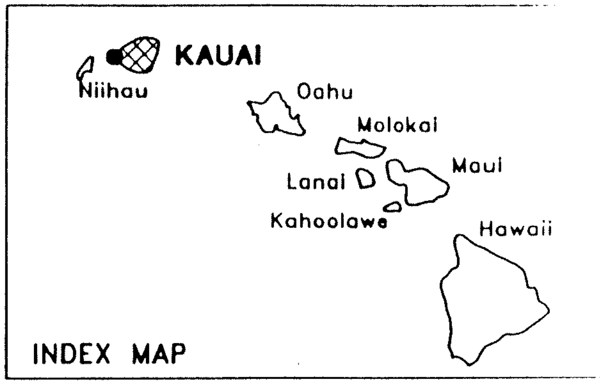
Sandia National Laboratories
Kauai Test Facility

of the general public (Figure 4). ESQD radii of 1,250 feet (379 meters) for inhabited buildings or general public access, and 750 feet (227 meters) for public traffic routes, have been established for the maximum quantity of explosives permitted on any launch pad or at any rocket assembly building at the KTF. ESQDs are in effect for the length of time a rocket motor is on the launch pad.

As an additional safety measure, a Ground Hazard Area (GHA) (Figure 4) is established for each launch to designate the outer limit of allowable dispersion of debris in the event that a rocket must be destroyed following launch. The GHA is in effect only during the actual launch operation. It is an area that must be cleared of nonparticipants prior to a launch taking place. The GHA varies considerably depending upon the type of launcher being used, the rocket system being launched, the payload involved, and other factors. For the KTF, the land portion of a GHA may take in areas from 300 to 10,000 feet (91 to 3,030 meters) from the launch point. Only the STARS vertical launch systems at the KTF currently require a GHA extending out to 10,000 feet (3,030 meters); most KTF-launched systems require a GHA extending 2,000 feet (606 meters) or less. The maximum GHA at Kokole Point is 1,200 feet (364 meters). Figure 4 illustrates the maximum ordnance quantity ESQD perimeter for the KTF, the typical GHA at Kokole Point, and the typical and maximum GHAs at the KTF.

All operations at the KTF are governed by stringent occupational safety and health requirements of various DOE orders, the SNL "Environment, Safety and Health Manual" (SNL, 1988), and the SNL policy for environment, safety and health protection. The KTF also functions under the requirements of the SNL "General Safe Operating Procedure for Operations at Kauai Test Facility" (SNL, 1990) which addresses operations, responsibilities, hazards, precautions, and emergency procedures at the principal KTF complex and at Kokole Point. A separate safe operating procedure (SOP) has been established for handling and storage of hydrazine-fueled propulsion systems (SNL, 1990). Additional SOPs are specific to various systems, subsystems, and components. Safe operating procedures for all KTF activities are evaluated in the "Safety Assessment for Missile Launch Complex at Barking Sands, Kauai," (SNL/Holmes & Narver, 1988).





EXPLANATION:

ESQD = (Maximum) EXPLOSIVE SAFETY QUANTITY DISTANCE {1,250 feet (379 meters) for public access limit}

GHA = GROUND HAZARD AREA {300 to 10,000 feet (91 to 3,030 meters) from the launch point}

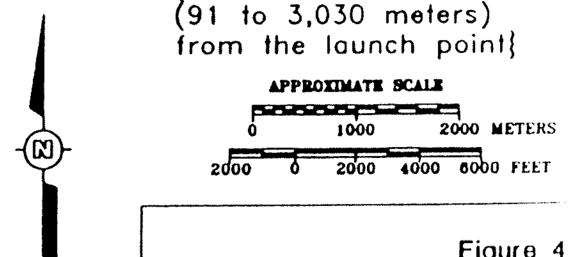


Figure 4

Conceptual Diagram of Explosive Safety Quantity Distance (ESQD) and Ground Hazard Areas (GHA)

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Kauai Test Facility

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A summary of representative DOE orders, the table of contents of the "Environment, Safety and Health Manual," and the SNL policy is included in Appendix B. In addition, the Occupational Safety and Health Administration (OSHA) standards applicable to federal facilities and contained in 29 CFR Parts 1910 and 1960 are adhered to at the KTF, although DOE contractor facilities are not directly regulated by OSHA.

Flight safety operations are governed by existing Pacific Missile Test Center (PMTC) and PMRF practices and procedures. Movement of explosive and hazardous assemblies and materials between PMRF and KTF facilities is under the control of PMRF personnel, according to established PMRF procedures, and with the aid of PMRF ordnance, emergency, and security forces.

In order to minimize risks to the public (and KTF and PMRF personnel not essential to a launch), PMRF security forces on the ground or in boats or aircraft ensure that all areas of land or water within a GHA are cleared of people before a launch occurs. Following a successful launch, the public is allowed to re-enter the previously cleared area.

2.1.2 Construction of New Facilities

Some new construction is proposed to accommodate vertical launch programs such as STARS and EDX as well as other rocket launching programs that may be developed in the future (Figure 3). Construction elements associated with KTF operations are as follows:

- Fencing of a 10,000-gallon (38,000-liter) fuel storage tank and diesel generator substation
- Fencing of electrical transformer units as needed.

The following construction elements are associated with the STARS and EDX programs and are addressed in the EAs incorporated by reference in Section 1.0. All facilities initially constructed for these programs could eventually be used for other vertical-launch programs.

- Launch pad consisting of a 100-foot (30-meter) by 100-foot (30 meter) concrete slab, blast plate, missile launch ring, and umbilical mast

- A paved access road 12 feet (3.6 meters) wide and totaling 500 feet (152 meters) in length

- A decontamination pad (10 x 20 feet, 3 x 6 meters) with fence; a hydrazine holding pad (8 x 10 feet, 2.4 x 3 meters) with fence; and a nitrogen tetroxide (N_2O_4) holding pad (8 x 10 feet, 2.4 x 3 meters) with fence

- A paved road extension to the decontamination and fuel holding pads approximately 1,000 feet (303 meters) long and 12 feet (3.6 meters) wide.

The proposed holding pads for hydrazine, nitrogen tetroxide, and decontamination materials will be open, concrete structures with shade covers to protect the materials from direct solar radiation. The pads will also be designed with catchment basins to contain any possible spills. A paved road (Figure 3) will be extended to each site and the area will be protected by security fencing.

The new construction areas, including those associated with STARS and EDX, will occupy approximately 15 acres (6 hectares) of land, most of which has previously undergone major disturbances from earlier operations and construction activities.

2.1.3 Launching of Vertical Launch Vehicles

Vertical-launch programs, proposed as part of KTF's future operations, are exemplified by the Army's STARS and EDX. Environmental assessments and Findings of No Significant Impact (FONSIs) have been prepared for both programs in compliance with NEPA (U.S. Department of Army, 1990a, 1990b). Both documents are incorporated by reference in this EA. These programs are associated with the SDI, an extensive research program designed to determine the feasibility of developing an effective anti-ballistic missile defense system. The STARS and EDX programs are summarized below as examples of vertical-launch programs that will utilize the KTF.

Strategic Target Systems (STARS)

As part of its R&D efforts for the SDI, the U.S. Army Strategic Defense Command (USASDC) is developing the STARS program to replace the diminishing number of Minuteman I systems available to launch test vehicles. The program will provide the capability to launch rockets with instrument platforms to support technology development and the testing and evaluation of candidate SDI operational systems. STARS will use a three-stage, solid propellant booster to launch non-nuclear payloads. STARS activities will occur at eight different locations including the KTF. The proposed holding pads and access road discussed in EA Subsection 2.1.2 and shown in Figure 3 will initially be related to the STARS program. However, they can be used for other vertical-launch programs in the future.

EDX Program

The EDX is a U.S. Army Strategic Defense Command program that will function as an integrated experiment designed to gather and analyze optical and radar phenomenology data on target systems launched to the exoatmosphere. The program will use a government-supplied Aries booster to launch an optical sensor which will observe target vehicles during the mid-course phase of their trajectory. The EDX program will be conducted at seven different sites and would be implemented over a three-year period beginning October 1, 1993. A series of three flights per year are planned from the KTF for a total of nine flights. Thus, the proposed action affecting the KTF involves nine launches of the sensor payload vehicle. These will be accomplished in conjunction with the launch of target vehicles on Minuteman I missiles from Vandenberg Air Force Base, California.

2.2 ALTERNATIVES

This subsection examines alternatives to the proposed action including the "no action" alternative. Alternatives eliminated from detailed analysis, and the reasons for their elimination, are briefly discussed. Three alternatives to the proposed action described in EA Subsection 2.1 were identified in the process of preparing this assessment.

2.2.1 No Action

The "no action" alternative would preserve the status quo. It would consist of continuing the existing functions of the KTF but without additional construction or the initiation of new vertical-launch programs.

2.2.2 New Facility at An Alternative Location

The selection of any new launch location is constrained by a number of criteria including:

- Mid-course siting between Vandenberg AFB and the USAKA
- Close proximity to a superior tracking, recovery, logistic, and underwater capabilities such as those available at the PMRF
- Close proximity to a large optical data system with the same capabilities of the Air Force Maui Optical Station (AMOS)
- Availability of nearby space tracking radar equivalent to the FPO-14 at Kaena Point on the island of Oahu
- Location within a large area of relatively unoccupied land to minimize impacts on human populations
- Availability at appropriate down-range locations of sites that can be scheduled, occupied, and controlled to support rocket testing operations (e.g., Johnston Island)
- Availability of required DOE and DoD security safeguards.

These criteria can be met only by locating a rocket testing facility at the PMRF or some other location in the Hawaiian Islands. No other locations under the jurisdiction of the United States would meet these criteria. Thus, this alternative was eliminated as being impractical and unfeasible.

2.2.3 KTF Decommissioning

Under this alternative, operations at the existing KTF facility would be discontinued and the facility decommissioned. While this alternative is theoretically feasible, it is unacceptable because of the unique multipurpose capabilities of the KTF in terms of the research and development role of the DOE. Also, decommissioning would violate the Safeguard C provision of the Nuclear Test Ban Treaty.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

This section describes the physical setting, the biological and archeological/historical characteristics, the air quality and noise conditions, and the land use and socioeconomic conditions at the KTF site and its immediate environs. It provides the background information and basis for the assessment of environmental consequences in EA Section 4.0. Available literature (e.g., EAs, natural resources plans, biological assessments, base master plans, etc.) was reviewed, telephone and written contacts were made with local, state, and federal agencies, and site visits were conducted to gather the information presented below.

3.1 PHYSIOGRAPHY, GEOLOGY, AND SOILS

Kauai, with a total area of 627 square miles (1,630 square km), is the fourth largest of the eight main islands of the Hawaiian archipelago. The island is a single great shield volcano, similar to Mauna Loa on the island of Hawaii (The Traverse Group, 1988). Formation of the island of Kauai was probably completed before the end of the Pliocene period.

Kauai's varied geography includes Waimea Canyon and the Na Pali Coast with its cliffs; Mount Kawaikini (elevation 5,243 feet; 1,589 meters) and Mount Waialeale (elevation 5,148 feet; 1,560 meters), twin peaks at the summit of the old volcano; the Alakai Swamp, extending almost 10 miles (16 km) northwest of the summit peaks; the flat-lying coastal Mana Plain; and the Barking Sands dune field (University of Hawaii, 1983).

The PMRF stretches eight miles (13 km) along the western coastal edge of the Mana Plain from Kokole Point on the south to Nohili Point on the north (Figure 2). Its maximum width is 0.7 miles (1.1 km) at Nohili and Kokole and its minimum width is 0.2 miles (0.3 km) at Waiokapua Bay in the mid-portion of the coastal reach.

3.1.1 Physiography

The PMRF and the KTF are situated on the peripheral extension of the Mana Plain in a relatively flat, open park-like setting with a northeast to southwest orientation. The topography at the site consists of gentle to moderately sloping, broad-based hills with large level areas. Elevations range from 15 to 30 feet (4.5 to 9 meters) above mean sea level.

The Mana Plain begins, along its eastern edge, at the base of old sea cliffs approximately two miles (3.2 km) inland from the coast. Elevation at the cliff base is approximately 50 feet (15 meters). The plain is flat with elevations ranging from 10 to 15 feet (3 to 4.5 meters). Dunes within the facility are usually at elevations below 20 feet (6 meters). However, the dunes in the northern portion of the PMRF near the KTF (the Barking Sands) range in elevation from 40 feet to 100 feet (12 to 30 meters).

3.1.2 Geology

Geologically, Kauai is the oldest of the main Hawaiian Islands. The centers of volcanic activity have shifted to the southeastern part of the chain. The volcanoes were formed along a line, probably a series of cracks, extending in a northwest-southeast direction across the ocean floor (University of Hawaii, 1983). Volcanic eruptions to the southeast have been preceded and accompanied by many small earthquakes. The quakes were small in magnitude and very few did any damage. Currently, tectonic activity (which causes most earthquakes in the continental regions) is nearly absent in Kauai and the island is considered to be in Seismic Zone 0, a region which can be expected to receive little or no damage from earthquakes (SNL/Holmes & Narver, 1988).

The Hawaiian Islands are almost wholly volcanic. Sedimentary rocks form only a narrow fringe around island perimeters. Most of the volcanic rocks are products of lava flows formed by outpouring of liquid magma. Only a small percentage is pyroclastic rocks, formed of fragments thrown out by volcanic explosions (Helgeson, 1990).

The Mana Plain is composed of a wedge of terrestrial and marine sediments overlying a volcanic basement consisting of the Napali Formation of the Waimea volcanic series. The basement rock crops out at the edge of the Plain above an elevation of about 40 feet (12 meters). The steep bedrock slope formed a sea cliff during a former higher stand of the sea.

The volcanic basement plunges below the Mana Plain at a dip of about five degrees until, at the coast, its contact with the overlying sediments is approximately 400 feet (121 meters) below sea level. The shallowest portion of the volcanic basement under the PMRF is approximately 200 feet (61 meters) below sea level.

Recently deposited sand along the PMRF beach is medium- to coarse-grained in contrast to the fine texture of the dunes. Fronting the beach in some reaches are strata of cemented sand which may be remnants of consolidated old dunes. The beach berm is about 10 feet (3 meters) high and is breached only where drainage canals have been excavated at Nohili and Kawaiele.

3.1.3 Soils

Because of the single rock type that underlies the soils and the uniform climate over the area, a single soil classification, the Jaucas-Mokuleia association, applies to all of the PMRF including the KTF. The U.S. Soil Conservation Service (SCS) describes this association as unique to Kauai. It consists of excessively drained and well-drained soils in dunes and on former beach areas. These soils developed in coral or basaltic sand and are nearly level to moderately sloping (The Traverse Group, 1988).

The dominant soil is Jaucas loamy fine sand (JfB) of the Jaucas series. The SCS describes this soil as occurring on old beaches and on windblown sand. It is pale brown to very pale brown, sandy, and in some cases more than five feet (1.5 meters) deep. In many places, the surface layer is dark brown as a result of accumulated organic matter and alluvium. The soil is neutral to moderately alkaline throughout its profile. It has an available water capacity of 0.05 to 0.07 inches per inch of soil [0.05 to 0.07 centimeters (cm) per cm of soil] (USDA, 1972). The soils are permeable and infiltration is rapid. Wind erosion is severe when vegetation has been removed.

Also included at the PMRF are areas of dune land and beaches. Dune land consists of hills and ridges of sand drifted and piled by the wind. The hills and ridges are actively shifting or are so recently fixed or stabilized that no soil horizons have developed. The sand is derived predominantly from coral and seashells.

The fossil dunes within the KTF consist of fine sand which is loose at the surface but weakly to strongly indurated several feet below. The indurated sands are bedded as laminae a few inches thick, typical of windblown deposits, as is the fine grain size and the admixture of silty sand. Clay is also part of the mixture but appears primarily where the dunes fade and are replaced by alluvium.

The depth of the dunes has not, as yet, been established. They are, however, estimated to be at least 60 feet (18 meters) deep. A single shallow well was drilled within the installation at the Kokole Point housing area to a depth of 42 feet (13 meters) below sea level without fully penetrating the sand (Botanical Consultants, 1985).

At the northern end of PMRF, adjacent to the KTF, the sand is being blown into dunes. The rather fine-grained calcareous beach sand in this area contains a small proportion of grains of basaltic lava rock. The area is known as Barking Sands because, with just the right degree of wetness, it makes a peculiar squeaking or yapping noise when it is walked on or squeezed sharply between the hands (McDonald et al., 1983).

3.2 HYDROLOGY AND WATER QUALITY

This subsection addresses surface water and ground water hydrology as well as water quality. It is assumed that the information available for the PMRF also applies to the KTF.

3.2.1 Surface Water Hydrology

A natural drainage network does not exist at the PMRF or the KTF because the sand is too permeable for rainwater to accumulate and travel laterally. Artificial drainage from the alluvial portion of the Mana Plain crosses the sand zone in two drainage canals, one at Nohili and the other at Kawaiele. These deep canals were excavated to dewater marshes and, thus, permit sugar cane cultivation. Pumps are required to lift the water from the alluvial plain to the slightly higher dune zone for passage to the sea. The drainage water is muddy and brackish (Botanical Consultants, 1985). Currently, these canals are the only surface water in the area of the KTF (U.S. Department of Army, 1990b).

In predevelopment time, flood runoff from the volcanic highlands flowed onto the Mana Plain, causing temporary flooding. Permanent marshes, created by upward seepage of ground water, covered parts of Nohili and Kawaiele. Water which accumulated on the plain moved as ground water through the sand dunes to discharge at the coast. When the plain was reclaimed for agriculture, the natural mode of drainage was modified by a network of small ditches and several large canals.

If the drainage canals are kept free of obstructions, flooding does not take place. However, the canals may become clogged with debris and mud, causing them to overflow onto the non-sandy part of the plain. The last episode of flooding occurred in the fall of 1982.

The PMRF's coastal location and low elevation make the area susceptible to wave damage. Several tsunamis have occurred at the PMRF in the last 45 years. The most serious was in 1946 when wave runup reached the 11-foot (3.3-meter) elevation and inundated an area almost as far inland as Kaumualii Highway or Route 50 (Figure 1) (The Traverse Group, 1988).

3.2.2 Ground Water Hydrology

The three geological formations (bedrock, alluvium, dunes) at the PMRF constitute three different but hydraulically connected aquifers. The aquifer in the basement rock of the Napali Formation is typical of highly permeable basaltic aquifers elsewhere in Hawaii. Hydraulic conductivity is on the order of 1,000 feet (303 meters) per day and effective porosity is about 10 percent. Salinity is high, in excess of 1,000 milligrams per liter (mg/l) chloride. Nowhere in the PMRF does the basalt aquifer carry either potable or irrigation grade water. The nearest fresh water sources are in the Napali Formation at the inland edge of the coastal plain.

The overlying sediments act as a caprock because of their low overall permeability, although individual layers, such as buried fossil coral reefs, may be as permeable as basalt. However, the hydraulic effect of these layers is local. The column of sediments is saturated but is not exploitable as an aquifer because of unfavorable hydraulic characteristics. The ground water in the sediments is recharged from the basalt aquifer, especially where the sediments are thin near the inner margin of the Mana Plain, due to irrigation percolation and rainfall. The ground water in the sediments is brackish. To keep the water table below the root zone of sugar cane, thousands of feet of drainages have been excavated.

In the PMRF area, the dune sand aquifer has a moderate hydraulic conductivity, probably 50 to 100 feet (15 to 30 meters) per day, and an effective porosity of about 20 percent. At the water table, brackish groundwater floats on sea water. Recharge originates with storm rainfall and as seepage from the caprock sediments. The only record of an attempt to exploit this ground water is of a well drilled for the Navy in 1974, four to five miles (6 to 8 km) south of the KTF in the present Kokole Point housing area (Botanical Consultants, 1985). It was dug to a total depth of 42 feet (13 meters), encountering only fine sand and coral gravel. Tested at 300 gallons per minute (gpm), it initially yielded water having 2,800 mg/l chloride, which is too brackish for irrigation. This well is not used.

3.2.3 Water Quality

The freshest water in the region of the Mana Plain is surface flow brought to the sugar cane fields from higher elevations and ground water from the Napali basalt aquifer where the volcanic slope begins at the edge of the Plain. Further seaward, ground water in the Napali aquifer becomes progressively brackish until beneath the PMRF it exceeds several thousand mg/l chloride. The sand dune and caprock water is brackish everywhere.

Plantation wells and infiltration galleries yield water from potable (less than 250 mg/l chloride) to more than 2,000 mg/l which is not potable. Moderately salt-tolerant plants such as sugar cane can survive with water up to 1,000 mg/l chloride. Truck crops are considerably less tolerant, although some grasses are even more tolerant.

3.3 CLIMATE AND AIR QUALITY

This subsection addresses both regional and local climatology. Existing air quality is also briefly summarized.

3.3.1 Regional Climatology

Hawaii is located at the edge of the Tropical Zone within the belt of cooling northeasterly tradewinds. The climate is mild throughout the year. Northeasterly tradewinds prevail over Kauai during all months of the year (The Traverse Group, 1988).

Between October and April, occasional surges of cold air invade the Hawaiian area from the north. The cold fronts, which mark the leading edges for these cold air masses, are frequently accompanied by widespread clouds, heavy rain, and thunderstorms. Severe fronts may be preceded by strong southwesterly winds and followed by gusty northerly winds. As many as 20 fronts may pass through Kauai in a winter.

Hurricanes (called typhoons west of 180° longitude) are uncommon in Hawaii. Hurricanes and lesser tropical cyclones that affect Hawaii usually originate off Mexico or Central America. Almost all of them dissipate before reaching the island or pass westward to the south.

3.3.2 Local Meteorology

The tradewinds are split by the island of Kauai so that they flow around both sides of the island. Thus, the surface winds at Barking Sands are generally light and vary in direction as the zone of convergence of the trade wind flow shifts to the north or south of the KTF. However, any weather pattern that creates a tight pressure gradient along the high terrain to the northeast of the KTF can result in strong, gusty northerly or south-southeasterly winds with speeds in excess of 30 knots (57 km) per hour.

The mean annual air temperature on the Mana Plain is 75°F (24°C). The absolute recorded extremes have been 95°F (35°C) and 48°F (9°C), which are among the warmest and coldest temperatures experienced at sea level in Hawaii. In the warmest month, August, the mean is 78°F (26°C). In the coolest month, January, it is 70°F (21°C).

The Mana Plain lies in the rain shadow of Mounts Kawaikini and Waialeale. This part of the island is sheltered from the predominant northeast tradewinds and, therefore, is one of the most arid regions in the State of Hawaii. Its median annual rainfall is 20 inches (50 centimeters or cm). The northern sector of the Mana Plain, with a median annual rainfall of 23 inches (58 cm), is slightly wetter than the southern part where the median is just 18 inches (45 cm). Most of the rain falls between October and April. In no month of the year does rainfall exceed pan evaporation (Botanical Consultants, 1985).

Thunderstorms occur infrequently at Barking Sands. Only a dozen thunderstorm days were reported in the 1968 through 1973 period; all occurred during October through January. Funnel clouds, incipient waterspouts, and small hail have been reported in the vicinity of the PMRF but these are even more infrequent than thunderstorms.

3.3.3 <u>Air Quality</u>

The air at the KTF meets all air quality standards promulgated by the EPA and the State of Hawaii. The normal air flow is on-shore and is not subject to off-site pollutant sources. The on-shore trade winds serve to maintain air quality. When the trade winds are not present, air quality may be affected by on-shore pollutant sources. The on-shore pollutant sources immediately east of the KTF are agricultural and affect air quality intermittently, primarily from burning of agricultural wastes. There are no other major sources of air pollutants off site. On-site pollutant sources are diesel-powered generators and the exhausts from rocket launches. Currently, the KTF and the Island of Kauai are in attainment for all air quality standards (Sano, 1989).

3.4 BIOLOGICAL RESOURCES

This subsection describes vegetation, wildlife, threatened and endangered species, and wetlands/floodplains. Although the discussion focuses on the PMRF, it is specific to the KTF where indicated.

3.4.1 Vegetation

The KTF is in the "kiawe and lowland scrub" zone of Hawaii (Mueller-Dombois and Gagne', 1975; Fosberg, 1967). This classification is used to identify areas below 1,000 feet (303 meters) elevation where the annual rainfall is less than 20 inches (50 cm). The vegetation of these coastal lowlands is largely made up of introduced species such as kiawe (*Prosopis pallida*) and koa-haole (*Leucaena leucocephala*), both of which are summer deciduous. Based on a botanical survey conducted at the KTF and environs during July 1990, there are basically four vegetation zones with minor variations of each (Botanical Consultants, 1990a). There is the kiawe/koa-haole scrub zone, the open scrub zone, the coastal dunes zone, and the coastal strand (ocean shoreline) zone. The understory in each zone is made up of various native and introduced forbs and grasses (Botanical Consultants, 1990a). A combined plant species checklist is provided for the four communities in Appendix C.1. A general vegetation map for the KTF is provided in Figure 5.

The composition of the kiawe/koa-haole community can vary from pure stands of kiawe to pure stands of koa-haole, or any combination of the two. The kiawe trees often attain a height of 45 feet (13.6 meters) or more, depending on the degree of disturbance. The understory is commonly koa-haole except where it forms the canopy. The height of the koa-haole depends to a large degree on the presence or absence of the kiawe. The ground cover varies and may consist of pure stands of Guinea grass (*Panicum maximum*), Lantana (*Lantana camara*), or wild basil (*Ocimum gratissimum*). However, the most common ground cover is mixed forbs and grasses (Botanical Consultants, 1985).

The majority of the KTF, which is regularly mowed, is occupied by an open, woody scrub or "ruderal" community of plants (Figure 5). This open scrub community is made up of mostly introduced species, although there are some Hawaiian taxa to be found along the

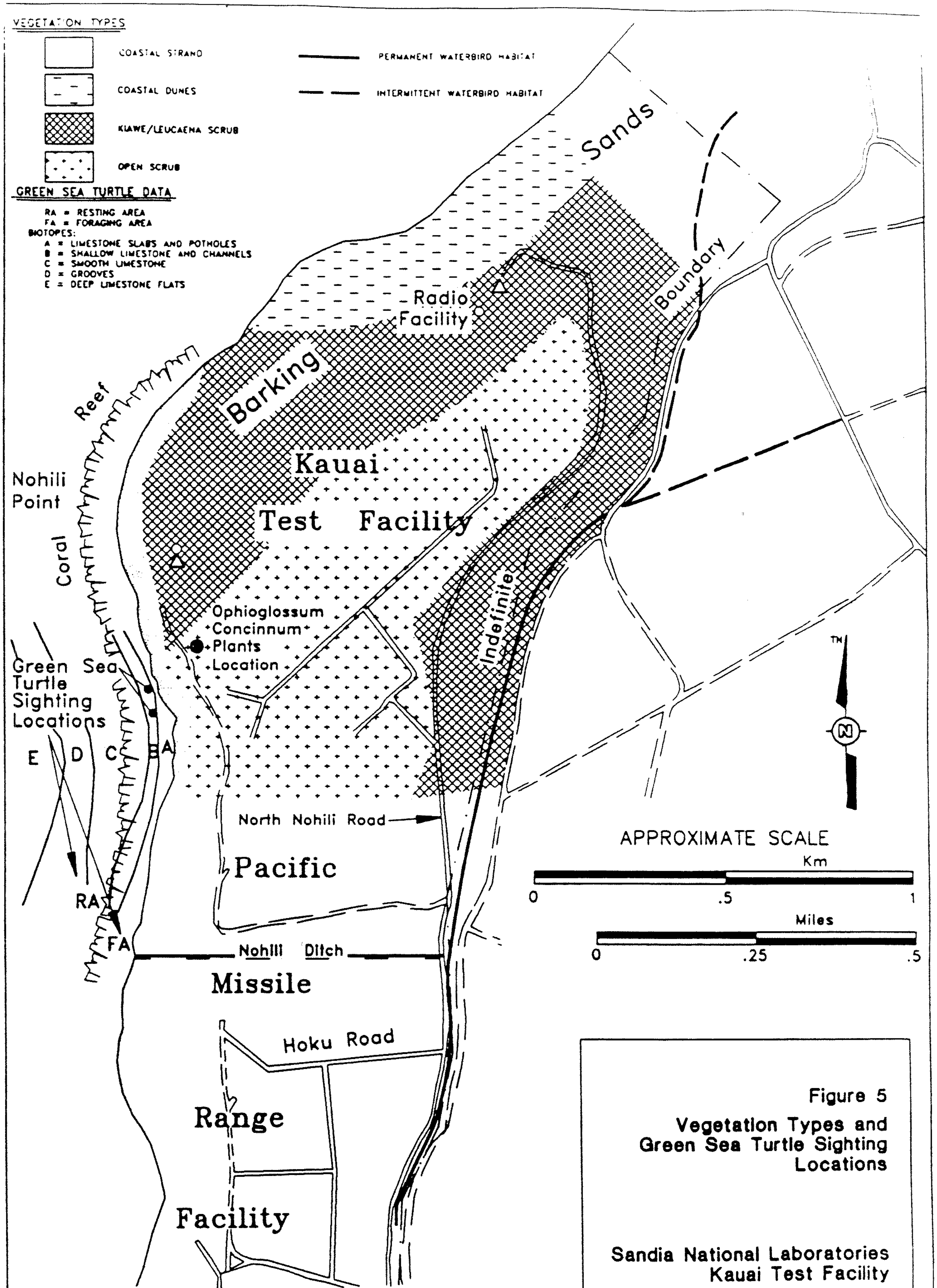

Figure 5
Vegetation Types and Green Sea Turtle Sighting Locations

Sandia National Laboratories
Kauai Test Facility

REFERENCE: U.S.G.S. Mokoho Point Quad., Hawaii–Kauai Co. Island of Kauai 7.5' Minute Topographic Series 1983.

roads. These are worthy of mention because, even in such highly disturbed areas, the native plants can and do persist. Taken together, the open scrub communities occupy most of the land area.

The coastal area contains two zones of vegetation. The coastal dunes zone occupies the area between the beach and the start of the level plain where open scrub exists. It would be expected that an extensive strand community would be flourishing on this site; this is not the case. The strand vegetation is limited to the western edge of the KTF vegetation. Because of the interest in strand vegetation, a species list is incorporated into Appendix C.1. Kauai County has designated the strand community in the dunes area as a Special Treatment District termed a "Scenic Ecological Area" (The Traverse Group, 1988) (Figure 5).

Vegetation at the Kokole Point Launch Complex is comprised of a mixture of bermuda grass (*Cynodon dactylon*), *Portulaca pilosa*, and buffelgrass (*Cencherus ciliaris*) (ASI, 1990).

3.4.2 Wildlife

Forty species of birds have been identified in the general PMRF area (although not specifically at the KTF) (The Traverse Group, Inc., 1988). Six of these species are native to Kauai: the American (Hawaiian) coot (*Fulica americana alai*), black-necked (Hawaiian) stilt (*Himantopus mexicanus knudseni*), common moorhen (*Gallinula chloropus sandvicensis*), Hawaiian duck (*Anas wyvilliana*), Newell's shearwater (*Puffinus auricularis newelli*), and Hawaiian short-eared owl (*Asio flammeus sandwichensis*). The remaining 34 species include 24 exotic (introduced), four migratory, and six indigenous species. No rookeries or raptor nest sites have been sighted within the PMRF (Botanical Consultants, 1985). The only native terrestrial species that may occur in the area is the Hawaiian short-eared owl (U.S. Department of Army, 1990a).

During a survey of birds and mammals conducted at the KTF in July 1990, 20 species of birds were observed at ten stations located throughout the facility (Botanical Consultants, 1990b). In addition, several species of waterfowl may be present on the site during some portion of the year, even though they were not observed during the survey (Botanical Consultants, 1990b). Other species known to exist within or near the KTF are: the wedge-tailed shearwater (*Puffinus pacificus chlororyncus*), the American golden plover (*Pluvialis dominica*), the wandering tattler (*Heteroscelus incanus*), the sanderling (*Calidris alba*), and the barn owl (*Tyto alba*) (DLNR, 1990). Appendix C.2 lists the species of birds and wildlife observed during the July 1990 survey at the KTF.

Thirteen species of mammals are known to occur on the island of Kauai. Eleven of these species are exotic (The Traverse Group, Inc., 1988). During a species survey in July 1990, three species of mammals were observed within the KTF study units: one dog, two cats, and mice (Botanical Consultants, 1990b). At least four species of rodents are expected to be present at the KTF: House Mouse (*Mus musculus*), Norway Rat (*Rattus norvegicus*), Roof Rat (*Rattus rattus*), and Pacific Rat (*Rattus exulans*) (Botanical Consultants, 1985). Feral dogs are also likely to inhabit the areas around the KTF.

3.4.3 Threatened and Endangered Species

The Endangered Species Act defines "endangered species" as any species which is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. "Critical habitat" is defined as: (1) the specific area, within the geographic area occupied by a listed species, in which features essential to the conservation of the species or requiring special management or protection are found, or (2) specific areas outside of the geographic area of a listed species which are essential to the conservation of the species. The State of Hawaii Department of Land and Natural Resources (DLNR) defines "endangered species" and "threatened species" as all species, subspecies, or sub-population of wildlife or plants that have been officially listed by the federal government as endangered or threatened and any species, subspecies, or sub-population of indigenous wildlife or plants listed in Chapter 124 of the DLNR's "Rules Regulating the Management and Protection of Indigenous Wildlife and Plants, and Introduced Wild Birds."

A DLNR federal and/or State list of endangered or threatened species with a known breeding range or area of distribution on the island of Kauai is contained in Appendix C.3. Appendix C.4 contains a list of those species which the U.S. Navy protects as federal or State threatened or endangered species with known occurrence at the PMRF naval installation.

Plants

Adder's tongue or pololei fern (*Ophioglossum concinnum*) is a small ephemeral fern, three to four inches in height, which is usually found one to two weeks after heavy rains. It had been collected previously on the Islands of Maui, Lanai, Oahu, and Hawaii. Its discovery on Kauai during a flora and fauna survey of the PMRF in 1985 (Botanical Consultants, 1985) is notable as an island record. *O. concinnum* is considered a Category 1 species, defined by the U.S. Fish and Wildlife Service (USFWS) as having "substantial information on biological vulnerability and threats to support the proposal to list them as endangered or threatened." However, the species is not currently listed on the federal endangered or threatened species list.

Several colonies of *O. concinnum* were found within the KTF during the January and February 1990 reconnaissance of the EDX launch pad and the STARS project area (Figure 5) (U.S. Department of Army, 1990a, 1990b). The plants occurred in either clearings in kiawe/koa-haole scrub or in ruderal vegetation at the EDX launch pad site at the western end of the KTF (Figure 5). As a mitigative measure, 70 individual plants which could not be avoided by the project were transplanted from the EDX launch pad site to the southern end of the PMRF. The site of the original *O. concinnum* colony was located during the July 1990 floral survey of the KTF (Figure 5). However, no plants were visible because of the dry conditions (Botanical Consultants, 1990a).

A second proposed endangered or threatened plant species, *Sesbania tomentosa* or 'ohai, has been reported north of the PMRF in Polihale State Park (Figure 2) and is suspected to occur in or near the coastal area of the KTF/PMRF (Botanical Consultants, 1985; The

Traverse Group, 1988). However, none of the floral reconnaissances conducted within the PMRF and/or the KTF has reported *S. tomentosa* (U.S. Department of Army, 1990c).

<u>Wildlife</u>

The Biological Assessment for the EDX project lists nine sensitive wildlife species which are federally listed as threatened or endangered and which are potentially present or confirmed within or near the KTF area (U.S. Department of Army, 1990c). These species are listed in Table 2.

TABLE 2
FEDERALLY LISTED THREATENED OR ENDANGERED WILDLIFE SPECIES IN THE KTF AREA

Common Name	Scientific Name	Federal Status
Hawaiian duck	*Anas wyvilliana*	Endangered
American (Hawaiian) coot	*Fulica americana* ssp. *alai*	Endangered
Hawaiian gallinule (common moorhen)	*Gallinula chloropus* ssp. *sandvicensis*	Endangered
Hawaiian black-necked stilt	*Himantopus mexicana* ssp. *knudseni*	Endangered
Newell's shearwater	*Puffinus auricularis newelli*	Threatened
Humpback whale	*Megaptera novaeangliae*	Endangered
Hawaiian monk seal	*Monachus schauinslandi*	Endangered
Hawaiian hoary bat	*Lasiurus cinereus* ssp. *semotus*	Endangered
Pacific green sea turtle	*Chelonia mydas*	Threatened

The Hawaiian duck, the American (Hawaiian) coot, the Hawaiian gallinule (moorhen), and the Hawaiian black-necked stilt utilize wetlands habitat (such as the Nohili Ditch system, ditch systems along the eastern edge of the KTF, and several reservoirs on the Mana Plain) for breeding, nesting, and feeding (DLNR, 1990). In general, loss or degradation of wetlands habitat, predators, and adverse impacts from toxic chemicals are the main reasons for the decline of these species in the Hawaiian Islands.

The Newell's shearwater is a pelagic (open sea) species that once nested on all of the major Hawaiian islands. However, it has become extinct on the islands of Hawaii, Maui, Molokai, and Oahu due to the introduction of the mongoose in the late 1800s (DLNR, no date). Kauai provides the last Hawaiian habitat for this federally listed threatened species.

Newell's shearwaters nest during the Spring and Summer months (April to November) in the interior mountains of Kauai. When the nestlings become hungry within a week or two of abandonment by the adults, in October and November, they leave the nesting grounds by themselves shortly after nightfall and head for the open ocean. Being inexperienced and natually attracted to bright lights, they have a tendency to collide with trees, utility lines, buildings, and automobiles. Although most young shearwaters are only stunned by such mishaps, about 10 percent of them die each year (DLNR, no date). The most critical periods for shearwaters lighting accidents is one week before and one week after the new moon in October and November.

According to a DLNR brochure on "The Newell's Shearwater Light Attraction Problem" (no date), the shearwaters' probable flight paths to the sea from the Kauai interior would not take them over the western coastal areas where the PMRF and the KTF are situated. However, the Traverse Group (1988) reported that the birds may occasionally fly over the PMRF. A seabird salvage project conducted by the DLNR did find fallen birds in the Barking Sands-Kekaha area although they accounted for only three precent of the total number of fallen birds on the island of Kauai (Telfer, 1989). [According to the EDX Biological Assessment (U.S. Department of Army, 1990c), any potential adverse impacts on the shearwater are mitigable (see EA Subsection 5.3)].

The protected migratory Laysan albatross (*Diomedea immutabilis*) utilizes the lawn-like ruderal vegetation areas for courtship and nesting. During the field reconnaissance of the STARS site, six pairs of Laysan albatross were observed in the KTF area (U.S. Department of Army, 1990b). None were observed during the July 1990 survey because the albatross are absent during the summer months (DLNR, 1990).

The humpback whale is a migratory species that winters in tropical waters near coasts and islands and spends summers in temperate or subtropical waters (Tomich, 1986). Over-exploitation by the whaling industry has depleted the world-wide population. The Hawaiian stock of humpback whales is part of an eastern Pacific stock, which is part of the larger Northern Pacific population (Johnson and Wolman, 1984). Increased human activity, such as industry, fishing, resort development, and shipping traffic, have the potential to impact the whales' winter breeding and birthing patterns in Hawaiian waters.

The Hawaiian monk seal is Hawaii's only indigenous mammal. Monk seals utilize sandy beaches to give birth and utilize vegetation behind beaches for shelter. Exploitation by sealers and human habitation and development has led to the decline in population (Tomich, 1986). Monk seals are only occasionally reported around the main Hawaiian Islands (USFWS, 1984) although they have been observed at the PMRF (The Traverse Group, 1988).

The Hawaiian hoary bat is most common in regions between sea level and 4,000 feet (1,212 meters) which receive 20 to 90 inches (50 to 225 cm) of rain per year (Baldwin, 1950). The bats use trees or, possibly, rock shelters for roosting. The Hawaiian hoary bat has not been recorded at the PMRF (The Traverse Group, 1988) although it is known to feed offshore (DLNR, 1990) and to occur at the Polihale State Park north of the KTF (Figure 2). No bats were observed during the July 1990 floral and faunal survey.

The Pacific green sea turtle inhabits benthic (deep sea) habitat around all of the Hawaiian Islands (Forsythe and Balazs, 1989). Adult turtles are known to rest along ledges and in caves and to forage in shallow intertidal and subtidal waters around the main Islands (Brock, 1990). The turtles utilize sandy beaches for nesting during the summer months. Hatchlings emerge between July and October (Balazs, et al., 1987). Human exploitation, human activity and development, commercial fishing operations, marine debris, and predation of eggs are detrimental to the existence of this species. One green sea turtle nest was found on the beach at the southern end of the PMRF (The Traverse Group, 1988) and another was reported approximately 1.4 miles (2.2 km) north of Kokole Point in 1989 (Heacock, 1990).

During an August 1990 survey of the shoreline at the KTF, at least 32 green sea turtles were observed at up to five locations on two subsequent days (Brock, 1990). Some of the individual turtles were undoubtedly recorded more than once as they moved from foraging areas to rest areas and out to open water. Nine turtles were observed foraging near the mouth of Nohili Ditch, and fifteen turtles were observed at a resting area further offshore at the same point along the coast. No green sea turtles were observed along the coast near Kokole Point. Figure 5 shows the proximity of the observed turtles and habitat to the KTF.

3.4.4 Wetlands/Floodplains

Two wetlands areas exist along parts of the coastline west of the KTF (The Traverse Group, 1988). The USFWS has classified these areas as Marine System, Subtidal Subsystem, Reef Class, Coral Subclass, Subtidal. There is also a wetlands area to the south of the KTF along Nohili Ditch which is classified as Riverine System, Lower Perennial Subsystem, Open Water/Unknown Bottom Class, Permanent Non-Tidal, Excavated. There is potential for aquatic vegetation types and accompanying waterbird species to be present on or near the KTF property during wet periods. Ditches along the eastern edge of the KTF and several reservoirs on the Mana Plain, including the Mana "Base" Pond near the entrance to the PMRF, serve as waterbird habitats and sanctuaries (see Figure 5).

The coastal location and low elevation of the KTF make the area susceptible to tsunamis (tidal waves). Several tsunamis have occurred within the last 45 years. The most damaging was in 1946 when the wave inundated an area of the PMRF almost as far inland as the Kaumaulii Highway (The Traverse Group, 1988). The KTF is located in two flood-plain zones: AE, a 100-year flood zone, and VE, a 100-year flood zone from wave velocity in a coastal area. The base flood elevation is generally 13 feet (3.9 meters) (Flood Insurance Rate Map, Panel 100, March 4, 1987).

3.5 CULTURAL RESOURCES

All of the Hawaiian Islands are thought to have been occupied between AD 500 and AD 1200. An early radiocarbon date of AD 350 has been confirmed for the Haena area of northwestern Kauai (ASI, 1990). Kauai is differentiated from other islands of the Hawaiian archipelago in that it presents evidence of prehistoric connections with the southern islands of Central Polynesia through stone implements, *heiau* (religious site or temple) style, language, and mythologies (Joesting, 1984).

The PMRF (and, therefore, the KTF) is located within an ethnographically sensitive area of Kauai. This region, known as Mana (Figure 6), has been identified in traditional Hawaiian religious cosmology as *leina-a-ka-u'hane* (Han et al., 1986). This term refers to the cliffs or seacoast promontories from which the spirits of the dead were believed to plunge in order to enter the spiritual realm (Han et al., 1986). These places were avoided, as it was believed that malevolent wandering spirits would lead travelers astray (AECOS, Inc., 1982). References to this area of Mana, and to burial of the dead there, have been found in recorded Hawaiian oral literature (Fornander, 1917, 1969). There is evidence that prehistoric wet taro farming was conducted at the northern end of the Mana marsh.

Up until the mid-1880s, the great Mana swamp to the east of the plain covered large areas of the lowlands (Figure 6). Its connected brackish lakes allowed natives from the Mana village to paddle as far as Waimea. One of the first European settlers, Valdemar Knudsen, drained a portion of the Mana swamp by excavating a ditch through to the sea at Waiele (Von Holt, 1985). The first sugar cane was planted in Kekaha in 1878. By the 1930s, nearly all of the Mana swamp had been filled in and planted in cane. Rice was planted in the drained swamplands from the mid-1860s to 1922. The areas where the PMRF and the KTF are presently situated were utilized for cattle grazing (Wall et al., 1903).

In 1923, the Territorial Governor of Hawaii set aside 142.7 acres (57 hectares) as Mana Park, located on the northern portion of the coastal landspit. The park occupied most of the land on which the KTF is presently situated (Territory of Hawaii, 1923). In 1941,

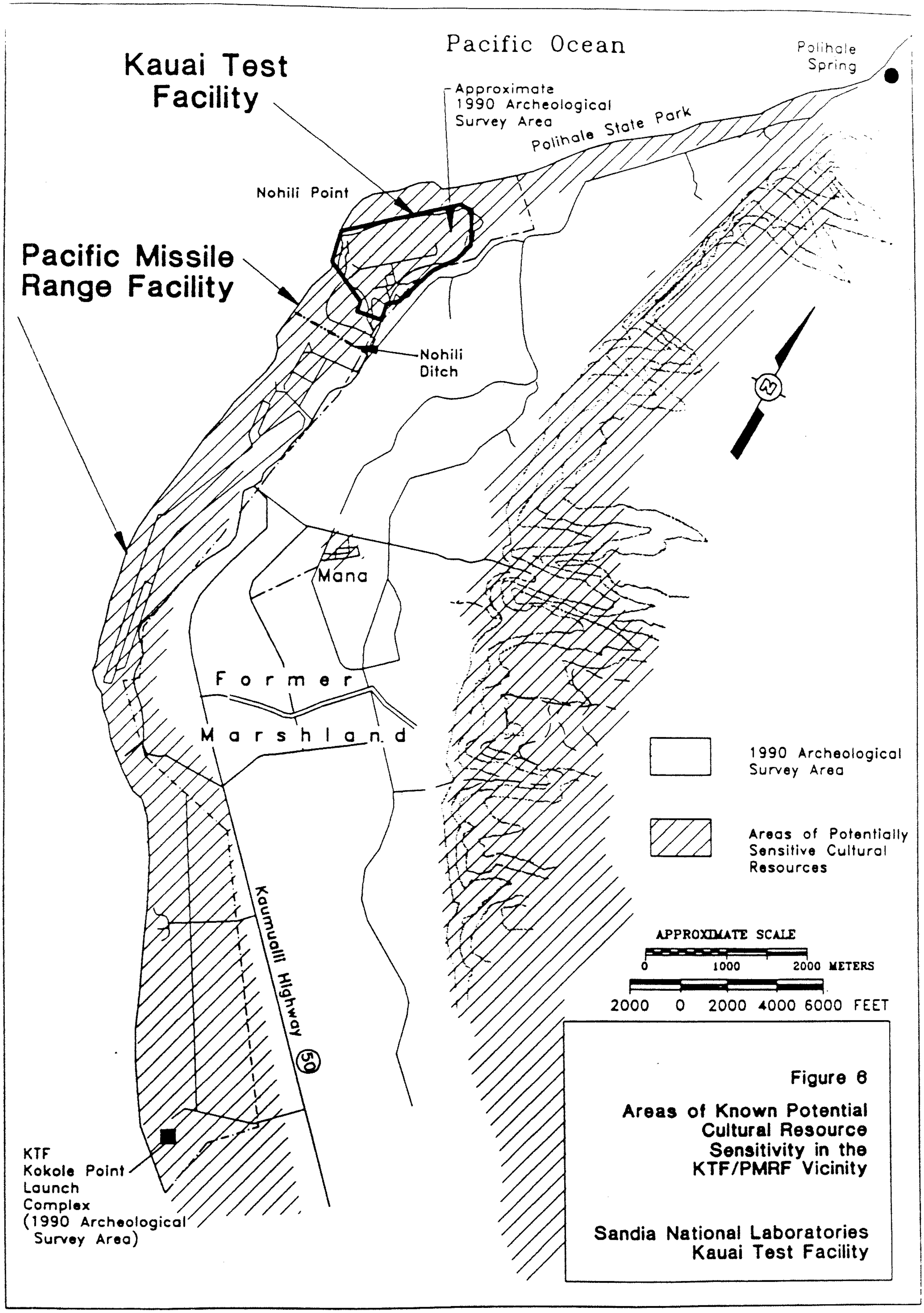

Figure 6

Areas of Known Potential Cultural Resource Sensitivity in the KTF/PMRF Vicinity

Sandia National Laboratories Kauai Test Facility

Mana Park was withdrawn in order to expand the Mana Airport Military Reservation northward. The area was used for military runways during World War II and ascommercial runways after the war. The installation, established as the U.S. Air Force Bonham Airfield in 1954, was transferred to Navy jurisdiction in 1964. Between 1962 and 1966, the Atomic Energy Commission (AEC) (the predecessor to the DOE) constructed the KTF within the PMRF boundaries.Site types reflected in the areas surrounding the KTF include *heiaus*, traditional house foundations, taro terraces, beach encampments, and burials (Bennett, 1931; Ching, 1974). Historic site types include the remnants of the Mana townsite, sites associated with the railway system that once served the local sugar cane industry, and a historic Japanese cemetery (Cleeland, 1975). The U.S. Navy archeological map files for the PMRF show that a major portion of the KTF is situated within a "major ancient burial ground" (U.S. Department of Navy, no date). Numerous human burial sites have been found and verified within the boundaries of the PMRF.

In 1979, an archeological survey of the mouth of the Nohili Ditch, an area approximately 400 feet by 400 feet (121 meters by 121 meters), was conducted (Kikuchi, 1979). The Nohili ditch area is less than 2,000 feet (606 meters) south of KTF. The only cultural resources were modern, stationary fishing pole jigs. However, some evidence of previous human occupation was noted within the southern wall of the profile of the ditch.

A 100 percent archeological survey of the KTF (approximately 133 acres or 53 hectares) and the Kokole Point Launch Complex site (approximately two acres or 0.8 hectares) was conducted in February 1990. The report of the archeological survey (ASI, 1990) indicated the following:

- A pedestrian survey of the KTF (and Kokole Point) project area revealed no evidence of archeological surface features or artifacts.
- Boreholes in the project area produced minimal cultural material which included some charcoal, *Nerita* shell fragments, porcelain sherd, bottle glass, and plastic. The full report summarizes the minimal significance of such finds. No certain evidence of human activity was discovered.

To date, no sites included in or eligible for inclusion in the National Register of Historic Places (NRHP) have been recorded within the KTF.

3.6 LAND USE AND RECREATION

The KTF and PMRF location and physiography are described in EA Subsection 3.1 on Physiography, Geology, and Soils. The PMRF occupies approximately 1,925 acres (770 hectares) of State-owned land which was transferred to the United States for military purposes in 1940 and 1941 under State Executive Orders Nos. 887 and 945. The transfer was made on the condition that public access to the PMRF "for the purpose of fishing" be maintained except when "bombing is actually in progress or about to commence." The PMRF land transfer did not contemplate rocket launches.

Land use on the island of Kauai is regulated under both State and Kauai County land use controls. Hawaii is the only state in the nation to have adopted a general land use plan and enacted a state-wide zoning law. Established in 1961, the State Land Use Commission classifies and regulates the use of all lands in the State. Under its land use law, the State classifies lands into four categories or districts: urban, rural, agriculture, and conservation.

The PMRF has been designated as a "conservation district" in the State land use plan. Conservation districts embrace lands in existing forest and water reserves, lands in national and state parks, lands with a general slope of 20 percent or more, and marine waters and offshore islands. In conservation districts, land uses are governed solely by the State of Hawaii DLNR. However, the County of Kauai has designated the PMRF as "Public Facilities" on its general land use plan. Adjacent county designations include: "Agriculture" and "Open" to the east and "Open" to the north and south. In addition, the State has designated areas in the mountains to the east of the PMRF as "Hawaiian Homelands" (U.S. Department of Army, 1990b). The dune area on the northern portion of the PMRF, from Nohili Point to the north boundary, supports a well developed native strand community and has been designated as a "Scenic Ecological Area" by Kauai County (Figure 5) (EA Subsection 3.4.1).

A 1986 Master Plan for the PMRF supports, among others, the following objectives:

- Enhance the quality of life (on the PMRF) through provision of amenities in a well planned physical environment.
- Minimize environmental impact by preserving areas with highly valued environmental or cultural resources.
- Locate planned facilities on level or gently sloping land where possible to minimize site work.
- Enhance safety by planning for new facilities in conformance with current air field safety and public health and safety criteria.
- Ensure continued protection and enhancement of the sand dune area on the northern portion of PMRF, native vegetation, and the habitats of indigenous birds.

In addition to the PMRF master plan, a comprehensive "Natural Resources Management Plan" was prepared in 1988 to provide a "multiple-use program for the management, conservation, and protection of renewable natural resources including forests, fish, wildlife, soil, water, grasslands, and natural areas" (The Traverse Group, 1988). The plan is intended to provide opportunities for public outdoor recreation that are compatible with the military mission of the facility.

In order to maintain public access for fishing and other recreation, the PMRF has divided its coastline [approximately 100 feet (30 meters) wide and 8 miles (13 km) long] into three designated recreation areas: No. 1, No. 2, and No. 3 (Figure 7). Recreation Area No. 1 includes the Barking Sands dunes area adjacent to the KTF. Except when closed for hazardous operations, Recreation Area No. 1 is open Monday through Friday from 4:00 pm to 6:00 am. All three recreation areas are open 24 hours a day on weekends and holidays. Closure times, when public access is not allowed, currently average six days per year for KTF operations near Recreation Area No. 1.

During the period from November 1987 through August 1989, there were 43,678 recreational user accesses provided to the three recreational areas at the PMRF. Of these,

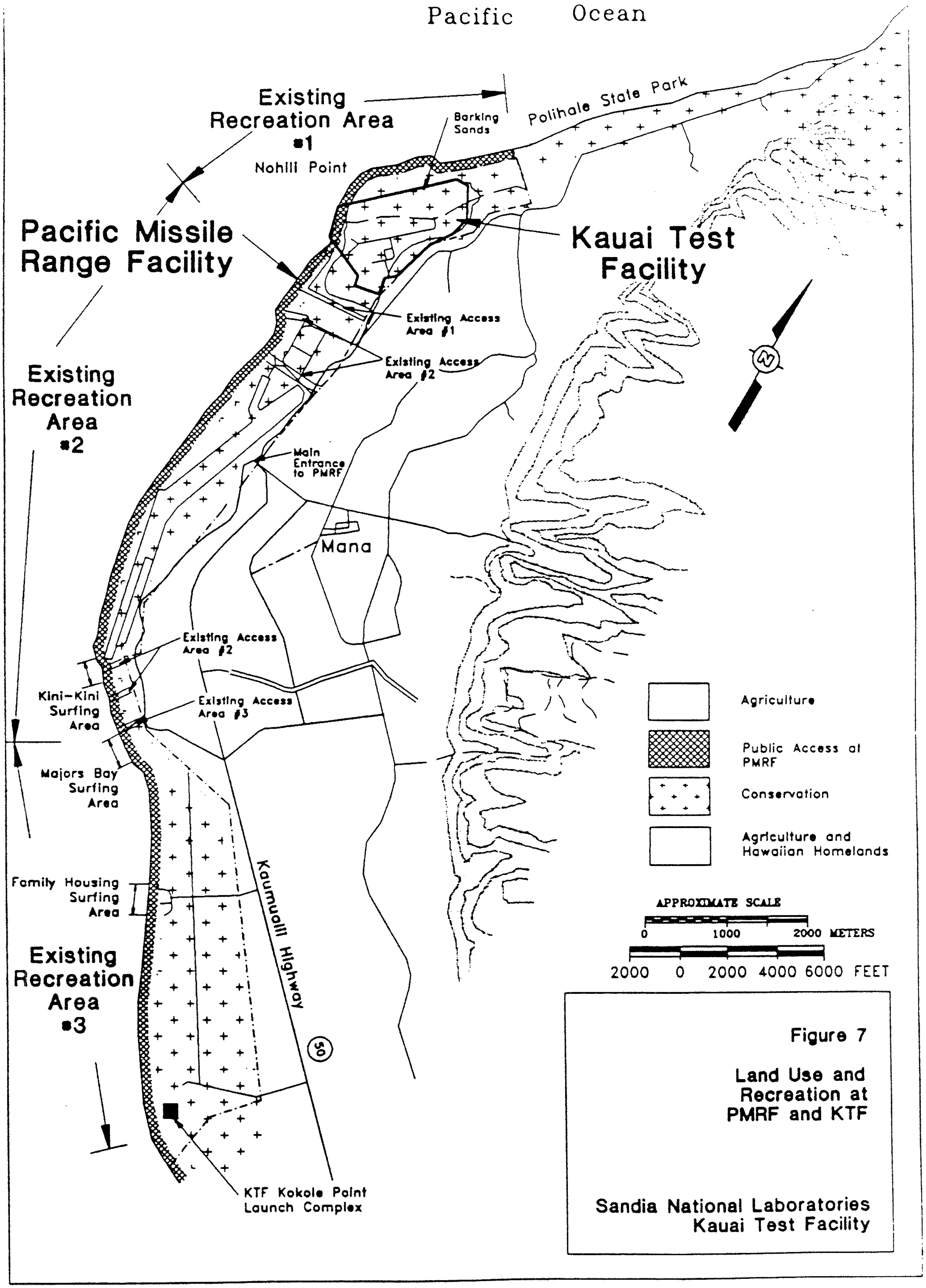

Figure 7

Land Use and Recreation at PMRF and KTF

Sandia National Laboratories Kauai Test Facility

4,476 were for Recreation Area No. 1 near the KTF (U.S. Department of Army, 1990b). Recreational uses at KTF include: fishing, surfing, diving, camping, and general beach recreation. Hawaii State Highway 50 (Kaumualii Highway) ends approximately 1.5 miles (2.4 km) south of the KTF. Access to Polihale State Park (Figure 7) is from approximately three miles (4.8 km) of unpaved road which winds through the adjacent sugar cane fields. The 140-acre (56-hectare) park supports day use recreational activities and overnight camping. According to the Division of State Parks, Polihale Park had approximately 400,000 day use and overnight visitors in 1989.

Land east of the PMRF is designated by the State as an "agricultural district." It is currently owned by the State of Hawaii and is leased to the Kekaha Sugar Company for the production of sugar cane (The Traverse Group, Inc., 1988). The cane fields occupy about 28,000 acres (11,200 hectares).

Lands within the 10,000-foot (3,030-meter) GHA which are not within the jurisdiction of the KTF or the PMRF are owned by the State of Hawaii. They include approximately 70 acres (28 hectares) of Polihale State Park and approximately 1,700 acres (680 hectares) of the lands leased by the Kekaha Sugar Company. A section of PMRF coastline approximately 100 feet (30 meters) wide and 17,300 feet (5,242 meters) long is also within the same GHA area.

Developed land on the KTF contains rocket launch complexes and support facilities (Figure 3 and EA Section 2.1.1). Navy facilities in the central portion of the PMRF include an aircraft maintenance hanger, a 6,000-foot (1,818-meter) long aircraft runway, storage facilities, administrative support, and technical facilities (U.S. Department of Navy, 1989b). The main entrance to the PMRF is located approximately 1.5 miles (2.4 km) south of the KTF complex.

3.7 SOCIOECONOMIC CONDITIONS

Kauai, with a land area of 627 square miles (1,630 square km), had a 1986 population of 44,000 (U.S. Bureau of the Census, 1988). While this computes to an average population density of 70 persons per square mile, it must be recognized that most of the central and western portions of the island are virtually unpopulated. Thus, in populated areas, the Kauai population density ranges from 11 to 149 persons per square mile. However, the Waimea District, where the KTF is located, is relatively unpopulated except for the villages of Kekaha and Waimea (Figure 1) which had a combined 1980 population of 4,900 (University of Hawaii, 1983). The largest towns in Kauai are both situated on the east coast: Kapaa and Lihue with 1980 populations of 4,500 and 4,000, respectively.

Kekaha, with a 1980 population of 3,300, is the closest population center to the KTF. The village is approximately two miles (3.2 km) south of the PMRF and nine miles (14.4 km) south of the KTF (Figure 2). Until mid-1989, the nearest community to the KTF was the village of Mana which was approximately two miles (3.2 km) southeast (Figure 2). The village has been closed by the Kekaha Sugar Company and the remaining population relocated. There are plans to relocate or demolish the remaining residences and other structures.

Sugar and tourism are the principal industries on Kauai. The cane fields contribute to the isolation of the PMRF, and the KTF, from population centers.

The KTF employs 14 permanent, on-site personnel during non-operational periods. "Non-operational" refers to those periods when rocket launches are not occurring at the facility. During operational periods (currently, about 60 days per year), an additional 50 to 75 persons from the U.S. mainland are employed at the KTF. Each of these "temporary" employees stays on the island three to five weeks and spends an average of $175 per day for lodging, meals, rental cars, and other expenses (Canute, 1990). In addition to the approximately $400,000 expended by temporary KTF employees, the SNL annual budget for operating the KTF ranges from $850,000 to $2.5 million per year.

3.8 NOISE

This section defines technical terms used in noise assessments. Existing (background) noise levels for the PMRF and the KTF are also described.

3.8.1 Noise Description Terms

It is commonly understood that noise is measured in decibels or dBs. However, while dBs are the basic measuring units, weightings, averages, equivalents, and other measurements are used to interpret noise levels and their effects. The principal noise descriptors are as follows:

- Decibel (dB) -- The range of acoustic energy density for the human ear between the threshold of hearing and the sensation of pain is as large as 10^{14} (one hundred million million). In order to handle this tremendous range, a logarithmic scale is used to compare different values of energy with a reference value (threshold of hearing). Use of the logarithmic scale reduces the average human hearing range to a manageable scale of 140 units, known as decibels (Saenz and Stephens, 1986).

- A-Weighted Sound Level (dBA) -- This weighting network, which is standardized both nationally and internationally, de-emphasizes the lower frequencies (those below 1,000 Hertz) and the higher frequencies (those above 6,000 Hertz) since they are generally inaudible to the human ear (Beranek, 1971). With A-weighting, a single number sound level description is obtained and recorded as dBA. Table 3 presents observed A-weighted sound levels for familiar noises.

- Equivalent Sound Level (Leq) -- The Leq is used to define noise levels over a specific time duration, for example, one hour. The Leq relates a series of fluctuating, time-varying sounds to an A-weighted energy equivalent of a nonfluctuating sound level.

- Equivalent Day/Night Sound Level (Ldn) -- The Ldn is a series of Leq measurements over a 24-hour period which has 10 dBA added to Ln (nighttime level). Ln lasts from 10 pm to 7 am while Ld (daytime level) lasts from 7 am to 10 pm.

- Sensitive Receptor -- Receptors are human or nonhuman organisms which are, or may be, sensitive to noise. They can be defined by type or location.

3.8.2 Background Noise Levels

The PMRF and KTF, located on the Mana Plain, have been designated as a "conservation district" in the Hawaii Land Use Plan (EA Subsection 3.6). Conservation districts are defined as, among other things, existing forest and water reserves, lands in national and state parks, and certain marine waters and offshore islands. In addition to the State land use designation, the County of Kauai has designated land surrounding the PMRF as

TABLE 3
TYPICAL NOISE LEVELS IN A-WEIGHTED DECIBELS FOR COMMON SOUNDS

Noise Levels for Typical and Critical Sounds (dBA)[1]	Description of Typical and Critical Sounds[2]
121	Concorde supersonic transport near take-off flight path
120	(Threshold of pain)
115	Pneumatic chipper at 5 ft. (1.5 m)
110	Boeing 707 near take-off flight path
105	Diesel locomotive at 50 ft. (15 m)
85	Diesel truck at 40 mph (64 kph) at 50 ft. (15 m)
65	Passenger car at 50 mph (80 kph) at 50 ft. (15 m)
65	(Speech interference)
60	Conversation at 3 feet (0.9 m)
50	(Sleep interference)
40	Quiet room
0	Threshold of hearing

Notes:

[1] The sound levels shown above are on a logarithmic scale. A six-decibel increase will be perceived as a doubling in noise level.

[2] Critical sounds are in parentheses.

(Sources: EPA, 1978; Noise Technical Assistance Center, Rutgers University, 1988; and Wilson, 1989)

"Agricultural," "Open," and "Scenic Ecological Area." A background noise level which is characteristic of the areas described above is 44 dBA (A-weighted decibels) (Harris, 1979). The land which the PMRF occupies is designated by Kauai County as "Public Facilities."

A review of the PMRF facilities and surrounding land uses indicated that all facilities on the PMRF are sited in acceptable noise level areas (U.S. Department of Navy, 1989b). A background noise level which is representative of a suburban residential area, such as the town of Kekaha approximately two miles (3.2 km) south of the PMRF (Figure 1), is 57 dBA (Harris, 1979).

An Air Installation Compatible Use Zone (AICUZ) program has been established at the PMRF for noise associated with air operations based on monitoring conducted during 1979. The results of this monitoring show that noise contours along the runway area ranged from 65 to 75 Ldn (day-night Leq). It should be noted that the Ldn contours do not extend as far north as the main KTF launch complex (U.S. Department of Navy, 1989b).

These background noise levels do not take into account the infrequent and short-term increases in noise levels which occur during rocket launches from either the main KTF launch complex or Kokole Point. Noise emissions from the 320 rocket boosters launched from the KTF from 1962 through 1990 were not monitored. The first noise monitoring, for the Strypi/LACE Two Experiment Rocket Campaign, was conducted in February 1991 (see Subsection 4.11.1.1).

4.0 ENVIRONMENTAL CONSEQUENCES

This section examines potential environmental consequences associated with the proposed action described in EA Subsection 2.1 and the alternatives identified in EA Subsection 2.2. Cumulative impacts are addressed under each subsection for each environmental parameter. Measures to mitigate possible adverse impacts, most of which have been addressed in other EA sections, are summarized in EA Section 5.0. Applicable regulatory requirements are summarized in EA Section 6.0. In general, the amount of detail presented with respect to the various environmental parameters in this section is proportional to the potential for adverse impacts.

4.1 OCCUPATIONAL HEALTH AND SAFETY

Routine and nonroutine KTF operations were examined to assess health and safety effects on KTF and PMRF occupants, with emphasis on the handling and use of the rocket motors and their potentially hazardous propellants. In addition, accidents associated with natural phenomena, commercial power and electrical system failures, mechanical failures and fires, explosives handling, and other potential operational accidents or failures were evaluated qualitatively and are summarized in EA Appendix D. It is important to note that the KTF has a rigorous occupational health and safety program in place as required by DOE orders and is voluntarily complying with OSHA regulations (see EA Subsection 2.1.1 and Appendix B).

4.1.1 Methodology

Quantitative assessments were used to estimate potential exposures to workers from the operations conducted at the KTF, primarily due to the firing of the test rockets. Total emissions for each of the first stage rocket motors launched at the KTF were used to estimate air concentrations for those emitted constituents. The estimated air concentrations were then compared to the Threshold Limit Values (TLVs), a nationally accepted set of standards for occupational exposure to chemicals (ACGIH, 1990). In addition, surface deposition (in soils) of metallic oxides in rocket motor exhaust was measured.

The TLV represents a time-weighted average air concentration to which workers can be exposed for a normal eight-hour day, forty-hour work week without adverse health effects (ACGIH, 1990). An estimated air concentration can be compared to the TLV to determine the relative impacts to humans from potential exposures. If the concentrations of chemical substances are at or below their TLVs, most workers will not experience adverse impacts (ACGIH, 1990).

4.1.2 Occupational Health and Safety Consequences of Routine Operations

The KTF, in operation since 1962, has been the site for the launching of approximately 320 rocket systems. Of particular concern to human health and safety are the following rocket exhaust constituents: aluminum oxide, nitrogen dioxide, hydrogen chloride, carbon monoxide, beryllium oxide, and lead oxide.

As part of a programmatic assessment of the U.S. Army's STARS program, the exhaust emissions of the STARS rocket system were modeled using a Gaussian dispersion model. Air concentrations of the exhaust constituents were estimated at 10,000 feet (3,030 meters), which corresponds to the maximum GHA for vertical-launches.

Table 4 provides the TLV and estimated concentration of each STARS exhaust constituent at the GHA boundary. The model predicts that concentrations will not exceed one ppm at the boundary. In each case, this is below the TLV and indicates that there should be no danger to the public or workers at the GHA perimeter.

Even though air concentrations close to the launch pad might temporarily exceed these occupational standards, neither non-essential workers nor the public is allowed into the area until the exhaust cloud has completely dissipated (Helgeson, 1990). Workers directly involved with a launch would be protected by being inside the LOB structure or would use PPE if required.

TABLE 4
CATASTROPHIC ROCKET FAILURE
ESTIMATED COMBUSTION PRODUCT CONCENTRATIONS
FOR THE STARS ROCKET MOTOR

Constituent	**TLV**[a]	**Calculated at GHA**	**Concentration Boundary**[b]
Al_2O_3[c]	10 mg/m^3	< 1 ppm	
NO_2	5 ppm	< 1 ppm	
HCl	5 ppm	< 1 ppm	
CO	50 ppm	< 1 ppm	

[a] Threshold Limit Value from American Conference of Governmental Industrial Hygienists (ACGIH), 1990-1991

[b] 10,000 feet from the launch pad

[c] Assumed to represent total suspended particulates in the exhaust

Although the STARS program modeling addressed only the exhaust constituents of the STARS rocket system, there is an appropriate GHA in effect for all launches at the KTF. This evacuation area is sized, in part, to prevent occupational or nonoccupational exposures to exhaust constituents of any rocket system used during the continued operation of the KTF (see EA Subsection 2.1.1 for a discussion of GHAs).

An additional source of potential occupational exposure from routine activites at the KTF is resuspension of deposited solids from previous KTF launches. Two metallic solids have been identified as present in the exhaust from first-stage rocket motors: aluminum oxide from the Nike, Castor, Terrier, Improved Honest John, Polaris A3, Recruit, and Black Brant; and lead oxide from the Talos and Terrier. Anticipated lead emissions from the Talos and Terrier boosters do not exceed the Hawaii standard, as discussed in EA Subsection 4.6 on the air quality impact analysis. A third metallic solid, beryllium oxide, was a constituent of exhaust from the Antares II. This is an upper-stage rocket motor that has never been fired from ground level at the KTF.

In October 1989, five grab samples of soils from the KTF were collected and analyzed for lead. The background samples showed no lead contamination, although samples collected near two of the launch sites ranged from 50 to 415 mg/kg. An extensive soil sampling program was undertaken in August 1990 to determine the extent and magnitude of soil contamination, if any, resulting from the use of the KTF as a rocket launching facility. Results of the soil sampling program are contained in EA Appendix J.1.

Results from the KTF soil sampling program show no elevated values of beryllium or aluminum oxides from rocket exhaust resulting from routine operations at the KTF. No beryllium was detected in KTF soils, and aluminum is not found at levels above background. There is slight elevation of lead values in the area of active launch sites. However, the quantities of lead in the soil do not represent increased risk to any workers at the site or to the public. Lead contamination action levels for soils are discussed in EA Appendix J.2.

Cumulative Impacts

Providing that SNL health and safety precautions are followed, no cumulative impacts to occupational health and safety are anticipated as a result of routine operations at the KTF.

4.1.3 Occupational Health and Safety Consequences of Nonroutine Operations

Qualitative assessments were used for the wide range of nonroutine operations (accidents) which could possibly occur at the KTF. The assessments followed the guidance for qualitative accident evaluations contained in DOE Order AL 5481.1B. This order provides standard hazard categories and accident probabilities ratings. For the KTF, this qualitative assessment was performed in "Safety Assessment for the Kauai Test Facility at Barking Sands, Kauai" (Helgeson, 1990). EA Appendix D presents summary tables of risks from postulated accidents.

The KTF has, in the past, been the site of damage-producing events. These events can be classified as either natural phenomena or operational accidents. The following discussion presents a brief description of non-routine events and the resulting consequences.

4.1.3.1 Natural Phenomena

On April 2, 1868, the largest recorded earthquake in the Hawaiian Islands occurred, estimated between 7.5 to 7.75 on the Richter scale. While this earthquake was felt at Kauai, no damage was reported. Although the Hawaiian Islands are volcanic in origin, there have been no volcanic eruptions on Kauai, the oldest of the main islands, in recent history. Even though Kauai lies within Seismic Zone 0, all buildings constructed at the KTF since 1987 have been designed to withstand seismic events of magnitudes expected to occur in Seismic Zone 2 (Helgeson, 1990).

On November 23, 1982, the island of Kauai suffered substantial damage from Hurricane Iwa. Winds in excess of 80 miles (128 km) per hour were recorded and several roofs on buildings located at the KTF were slightly damaged. However, no major structural damage was reported at the KTF. Since 1987, all newly constructed buildings have been designed to withstand a basic wind speed of 80 miles (128 km) per hour (Helgeson, 1990).

A wide range of possible accidents induced by natural phenomena and their effects on the KTF have been identified and assessed qualitatively following the guidance contained in DOE Order AL 5481.1B (DOE, 1988b). The annual probability of these accidents occurring at the KTF ranges from unlikely to extremely unlikely (Helgeson, 1990). Accidents due to natural phenomena have the potential to cause low impacts to operating personnel and low to high impacts on the facility. However, they are not expected to have any impact on members of the general public or the environment. A summary of the assessment is contained in EA Appendix D.

4.1.3.2 Operational Accidents

Since the KTF first started operations in 1962, SNL has launched approximately 320 rocket systems. During this period, there have been no ground or airborne failures that have caused injury or loss of life, nor have any facilities been damaged or destroyed. Early in KTF history (1964), one rocket system ignited prematurely on the launch pad and caused a ground fire that spread to the brush adjacent to the facility. As a result, system-specific SOPs were modified, and their use in conjunction with safety checklists has prevented a recurrence. Additional site clearing of the brush around the launchers and a regular site mowing schedule have reduced the danger of fires in the launcher field (Helgeson, 1990).

In April 1987, a failure of a positioning trailer occurred while loading a payload on launch pad No. 1. The failure resulted in the payload falling from the trailer to the concrete slab, causing minor injuries to some of the workers involved in the loading operation. Investigation of the trailer after the accident revealed faulty pressure relief valves as the probable cause of the failure. Since this incident occurred, the trailers have undergone extensive refurbishment. They are now maintained on a regular basis and tested before use in any operation (Helgeson, 1990).

4.1.3.3 Postulated Accidents

A wide range of possible accidents induced by operations and their effects on the KTF have been identified and assessed qualitatively following the guidance for such assessments contained in DOE Order AL 5481.1B (DOE, 1988b). A summary of the assessment is contained in EA Appendix D. The assessment indicates that post-launch rocket failure and accidental detonation during assembly are the accidents which have the highest risk assignment. These events have the highest potential for adverse impact on workers, members of the public, and the environment. These accidents, along with spills of the unsymmetrical (1,1)-dimethylhydrazine (UDMH) and nitrogen textroxide (N_2O_4) hypergolic fuels, are evaluated below.

Post-Launch Rocket Failure

Accidental detonation of the rocket propellants in the few seconds after launch, while the rocket is still in the KTF air space, could result in varying degrees of damage to the KTF buildings. The damage would depend on the rocket location relative to buildings when the detonation occurs and the probability associated with various fragments hitting those buildings from falling debris. The LOB and the metal roof over the buildings and trailers will protect nearby personnel during the launch, and all other personnel will be outside the effective GHA. The public will not be affected at any time during such an accident since the launch site, public beach, and highway has controlled access before and during launches (see EA Subsections 2.1.1 and 4.9). As indicated in EA Appendix D, there is an unlikely probability of occurrence of this type of accident (Helgeson, 1990).

Accidental or intentional detonation of a rocket over water would not result in any damage or danger to the public. The ocean area along the rocket flight path is monitored by PMRF security personnel for unauthorized vessels and aircraft. In the event unauthorized vessels stray into the area, the PMRF will not allow a launch until the area is cleared.

Accidental Detonation During Assembly

In the event of an accidental detonation of propellants in a MAB at the KTF, total destruction of the building would be expected. Fragment and blast overpressures resulting from a detonation could damage other facilities in the launcher field. Loss of human life in or near the MAB and substantial structural damage could be expected. The LOB would experience no damage because it has been designed to withstand blast overpressure and fragment impact. Most of the occupied facilities at the KTF are protected from the blast overpressure by the revetment barriers separating the launch field from those facilities. They are also protected from small fragments by a protective steel-plate roof covering the administrative and operations trailers.

Most of the rocket motors used at the KTF are explosives Class/Division 1.3. When combined with other elements of a rocket system, they can be rated as explosives Class/Division 1.1 (DoD, 1984). When such explosives are in the MAB, an ESQD with a 1,250-foot (379-meter) radius must be established to restrict nonessential personnel from the area (Figure 4) (DoD, 1984). As indicated in EA Appendix D, the history of explosives handling at the KTF demonstrates that the probability of a rocket booster exploding on the launch pad is unlikely (Helgeson, 1990). Accidental detonation during rocket assembly has not occurred during the 29-year history of KTF operations.

Spill of Hypergolic Fuel

The KTF has SOPs for the handling of hazardous fuels (see EA Appendix B). Great care is taken to ensure that only trained personnel, using proper PPE and vapor monitoring equipment, handle these substances. There have been no releases of hypergolic fuels at the KTF. Should a spill occur, workers in the immediate area would be protected by their PPE, which would include a full-face self-contained breathing apparatus (SCBA) and fuel resistant gloves and boots (Helgeson, 1990). As with other explosive material at the KTF, a 1,250-foot (379-meter) ESQD is maintained around the hypergolic fuel storage area (Figure 3). No nonessential personnel are allowed within the ESQD during fueling operations.

Assuming that the entire contents of a fueled rocket component were to spill, 76 liters of unsymmetrical (1,1)-dimethylhydrazine (UDMH) or 57 liters of N_2O_4 would be released (U.S. Department of Army, 1990b). This fuel would be entirely contained within the containment/catchment systems at the storage pads. Air concentrations of these highly volatile liquids were estimated at the 1,250-foot (379-meter) ESQD boundary, assuming a very stagnant atmospheric condition of 0.45 meters per second wind speed. For the UDMH, the concentration was 1.2 mg/m^3. For the N_2O_4, the concentration was 3.2 mg/m^3. Since the TLVs for these substances are 1.2 and 5.6 mg/m^3 respectively, no adverse health effects would be anticipated outside of the ESQD area from such a release. A further discussion on the method of determining these concentrations appears in EA Appendix E.1.

Effects of spills of hypergolic fuels on workers within the ESQD would be minimal to nonexistent since a high level of PPE is required at the KTF when handling such fuels. However, inadvertant exposure to UDMH would cause severe skin and eye irritations, temporary blindness, severe choking, chest pains, and nausea (NIOSH, 1985). Exposure to N_2O_4 would cause pulmonary edema, eye irritation, coughing, chest pains, mucoid frothy sputum, and tachycardia (NIOSH, 1985).

Cumulative Impacts

Providing that SNL health and safety protocols are followed, no cumulative impacts to occupational health and safety are anticipated as a result of nonroutine operations in the proposed action.

4.2 HEALTH AND SAFETY CONSEQUENCES OF HAZARDOUS CHEMICAL RELEASES TO THE GENERAL PUBLIC

There have been no known adverse health and safety consequences to the general public as a result of routine or non-routine activities at the KTF since it began operations in 1962. Because of the enforcement of safety procedures during launches and explosives handling, members of the public are not exposed to rocket exhausts, nor are they in danger from launch accidents or hazardous chemical spills. There is no elevation of metallic oxides in the soils adjacent to the KTF. The public beach area at Barking Sands was sampled during an extensive soils sampling program conducted in 1990. No lead, aluminum, or beryllium contamination was found.

4.3 ENVIRONMENTAL CONSEQUENCES OF HAZARDOUS CHEMICAL RELEASES

The environmental consequences of hazardous chemical releases are and will continue to be minimal at the KTF. Results of the soil sampling program show that, after 29 years of operation, the concentration of metallic oxides in the soil at the KTF has not been elevated to levels requiring remediation.

Spills of liquid fuels would be contained within containment/catchment systems at the storage pads. The spilled fuel would be quickly diluted to reduce its hazard, pumped into hazardous materials containers, and transported by an EPA-approved private waste contractor to the U.S. mainland for proper treatment. The liquid fuels are highly toxic and injurious to plant and animal life. However, using the safety procedures in place at the KTF, there will be no major impacts on the terrestrial environment.

The impacts of unspent rocket fuel on the marine environment were assessed for the February 1991 Strypi/LACE experiment (DOE, 1991). Based on a review of the solid rocket propellants utilized at the KTF by the Center for Global Environmental Technologies, it was determined that the environmental effects would be minor and limited in area (Nimitz, 1991). The Center assessed the environmental fate of four basic categories of components in sea water: aluminum metal, nitro-organics, ammonium perchlorate, and organic binders. The environmental effects were considered to be minor because (1) the quantities of chemicals involved are small, (2) most materials are quite nonreactive, and (3) all chemicals will degrade quickly to harmless materials (either by reaction with other chemicals in the environment or by biodegradation). Appendix E.2 contains the assessment of the Center for Global Environmental Technologies.

4.4 PHYSIOGRAPHY, GEOLOGY, AND SOILS

Measurable changes in the physiography of the KTF are not expected as a result of the proposed action. No change to the geology of the KTF will result from the proposed action. The soil is virtually unchanged except for its lead content which appears to be slightly elevated in the area of launcher sites at the KTF field. There is not expected to be any further change in soil composition at the KTF as a result of the proposed action. No cumulative impacts are anticipated.

4.5 SURFACE WATER AND GROUND WATER HYDROLOGY AND QUALITY

There will not be any major changes in the hydrology or water quality at the KTF as a result of the proposed action. Although site preparation for the EDX launch pad may slightly increase surface water runoff, it will have no effect of any consequence because of the rapid permeability and high infiltration of the KTF soils. No cumulative impacts are anticipated.

4.6 AIR QUALITY

The major air emission sources at the KTF are two diesel-powered generators and exhausts from rocket launches (see Table 4). The State of Hawaii approves and monitors all diesel generators for continued compliance with air emission standards. All air quality permit conditions are monitored at the KTF by the SNL. The diesel-powered generators operate in compliance with State permit P-767-1054. No change to this permit is required or expected.

Construction activities will have short-term impacts on air quality. Earth-moving activities and vehicular traffic during construction will slightly increase fugitive dust (total suspended particulates, TSP). This impact is expected to be of a short duration. The other impact will be the hydrocarbon air pollutants emitted in the exhaust from construction vehicles. This impact is also expected to be minor and short-term. Neither the TSP nor the hydrocarbon emissions are expected to exceed air quality standards.

The Hawaii Code of Rules and Regulations (HCRR) provides standards for various air pollutants to determine air quality. If pollutants do not exceed the standards, air quality is considered acceptable. Air quality standards are expressed in average concentrations of pollutants over a period of time. The specific numerical concentrations in the standards depend on the particular pollutant and the time period included in the calculation of the average. Concentrations are expressed in quantity of pollutant, measured in fractions of a gram [one one-thousandth or milligram (mg), one one-millionth or microgram (μg)] for a cubic meter of air. These concentrations are averaged over time periods ranging from one hour to one year, depending on the pollutant. Average concentrations over a period of time are used for standards because of the variability of pollutant concentrations over time and the inability of air sampling equipment to take instantaneous or nearly instantaneous samples. The average concentrations are representative of the air to which human or nonhuman receptors may be exposed.

Annual average emissions from KTF rocket launches are minimal because the launches are infrequent. However, individual launch activities will generate high levels of some pollutants for a short period in the immediate vicinity of the launch pad. As the launch vehicle ascends, the exhaust trail is quickly dispersed by wind and dissipated. Other than workers directly involved with launch operations, potential receptors can be assumed to be no closer than the perimeter of the 10,000-foot (3,030-meter) GHA. Potential emission concentrations at that point are discussed below.

The concentration of emissions at the GHA perimeter depends on the amount of emissions in the source. The maximum quantity of emissions would occur in a catastrophic failure of the rocket, which would allow all the propellants to burn at the launch pad. This unlikely event was used to estimate the maximum concentrations of emissions at the GHA perimeter from a normal launch. A theoretical catastrophic STARS rocket failure was assumed to create a cylindrical cloud of combustion products. This cloud was then assumed to be blown toward the GHA perimeter by winds exhibiting a range of velocities from 12 to 40 feet (3.7 to 12 meters) per second in a vertical profile typical of local winds from the ground to 100,000 feet (30,303 meters) altitude. The DIFOUT model was used to calculate the resultant concentration of the emitted constituents at the GHA perimeter. The results are listed in Table 4 (see EA Subsection 4.1.2).

Table 4 also lists the TLV for the pollutants as well as the calculated maximum concentration of pollutants at the perimeter of the GHA from a launch of the STARS booster. The TLV is discussed in Section 4.1. TLVs are presented in Table 4 only to provide an indication of possible risks from pollutant concentrations predicted for the STARS data.

The STARS data are considered to be representative of the maximum air emission levels expected from any rocket motor to be launched from the KTF. Therefore, they provide an estimate of the maximum level of each pollutant, except lead, expected to be emitted from any rocket launch. The STARS booster does not emit lead. The dispersion of aluminum trioxide from the STARS booster was used to approximate the dispersion of lead from other rockets. Anticipated lead emissions are compared to State standards in the discussion below.

The DIFOUT model is used by the DOE to calculate the distribution of particles and gases resulting from catastrophic events. The model uses a cylindrical source from the ground to a stipulated altitude and subdivides the source into discrete slices. Each slice is then moved by air currents represented by wind at the altitude of that slice and dissipates according to Gaussian theory. The results of the dispersal of each slice are then added together to determine the total effect.

It is not possible to directly compare the HCRR standards to the predicted concentrations at the GHA perimeter from intermittant rocket launches. The standards are average concentrations over a period of time while the predicted concentrations are maximum values reached. The standards presume a pollutant source that is frequent and repetitive. Rocket launches are infrequent and, in the discussion below, are assumed to occur four times a year. In order for an average concentration to be calculated, a time period during which the maximum concentration exists must be assumed. In the discussion below, the maximum concentration of each pollutant was assumed to exist at the GHA perimeter for ten minutes. At a wind speed of 12 feet (3.7 meters) per second, this ten-minute period represents the passage of a cloud 7,326 feet (2,220 meters) across. Calculations of the expected cloud formed by the explosion and total burning of a STARS result in a cloud estimated at less than 1,320 feet (400 meters) in diameter. Therefore, the comparison of the predicted STARS pollutant concentrations to the Hawaiian standards overstate the expected impact.

Carbon Monoxide

HCRR 11-59-4(c)(2) requires that the ambient air concentration of carbon monoxide (CO) not exceed an average of 10 mg of carbon monoxide per cubic meter of air (10 mg/m^3) during any one-hour period. The calculated maximum concentration of carbon monoxide at the perimeter of the GHA is less than one part per million (ppm) (Table 3). When this concentration is assumed to exist for ten minutes and is averaged over a one-hour period (the time period for which the standard is calculated), the maximum expected one hour average concentration is 0.2 mg/m^3. Thus, CO emissions will comply with the State standard.

Nitrogen Dioxide

HCRR 11-59-4(d) requires that the average concentration of nitrogen dioxide (NO_2) in ambient air during any 12-month period not exceed 70 µg of NO_2 per cubic meter of air (70 $\mu g/m^3$). Table 4 shows that the expected maximum concentration of NO_2 at the perimeter of the GHA is less than 1 ppm. If four launches occur during a 12-month period and the maximum concentration listed in Table 4 is assumed to exist for 10 minutes, the 12-month average emission concentration will be 0.09 $\mu g/m^3$. This is well within the NO_2 standard promulgated by the State.

Total Suspended Particulates

Under HCRR 11-59-4(e)(1), the total concentration of TSP matter cannot exceed a geometric mean of 60 µg/m³ during any 12-month period. The principal contributor of particulate matter in rocket exhaust is aluminum trioxide (Al_2O_3). As shown in Table 4, the expected maximum concentration of aluminum trioxide at the perimeter of the GHA is less than 1 ppm. If four launches of the STARS booster are assumed to occur during a 12-month period, and this concentration is assumed to exist for ten minutes for each launch, the average emission concentration will be 9 µg/m³. This is well within the State's TSP standard.

Lead

Lead is not an expected pollutant emission from the STARS rocket motor. However, lead will be emitted during the launch of the Talos and Terrier systems. Using the predicted $A1_20_3$ concentration as an indicator for lead, the maximum lead concentration at the GHA perimeter from a Talos booster will not exceed 0.085 mg/m³. If four launches are assumed each year, and the predicted concentration is assumed to exist for ten minutes, the average concentration of lead will not exceed 6×10^{-7} (0.0000006) µg/m³ per quarter. The standard for lead concentrations is 1.5 µg/m³, averaged over a quarter [HCRR 11-59-4(h)]. Therefore, the launch activity will not cause the standard for lead pollutants to be exceeded.

Launch of the STARS rocket motor will release less than 198 pounds (90 km) of Freon during second stage flight. At the present time, the STARS program office is evaluating alternatives which will reduce or eliminate this Freon emission. If a feasible alternative to Freon is found, it will be implemented.

Launch pad accidents in which the rocket motor detonates on the pad would have a momentary impact on air quality at the launch pad. The likelihood of such an accident is difficult to predict, however, because of the lack of recent operational rocket motor failures of this nature (Eno, 1990). If such an accident should occur, the rocket propellant is expected to fragment, resulting in less than total burning. The discussion above assumes total burning at the pad. The overall impact on average air quality from a catastrophic failure is not expected to be any greater than from a normal launch.

Cumulative Impacts

The principal cumulative impact on the area surrounding the KTF will be from deposition over time onto the soil around the launch pads of lead from some rocket motor exhausts. Numerous rocket motors launched since 1962 have released small quantities of lead and aluminum in the exhaust. Beryllium was present as a fuel constituent in second-stage rocket motors for a few rocket systems tested in early years at the KTF. A detailed soil sampling program was undertaken to determine whether contamination is present as a result of operations.

The results of the soil sampling program show that lead concentrations in the soil at KTF are mostly at background levels. Where they are somewhat elevated, they do not approach recommended cleanup levels (EA Appendix J.2). While aluminum values range widely, the metal is not present in concentrations that pose a threat to human health or the environment. Beryllium was not detected in any soil sample.

4.7 BIOLOGICAL RESOURCES

The proposed KTF construction project(s) will disturb approximately 15 acres (6 hectares) of topsoil, accompanying vegetation, and any wildlife species which utilize the topography or vegetation. The majority of construction activities will take place within the mowed open scrub vegetation zone (approximately 14 acres or 5.6 hectares). This nonnative open scrub or ruderal vegetation has been disturbed by previous projects within the KTF. Communications with the USFWS and the State of Hawaii DLNR are included in Appendix F.

The vegetation species which will most likely be sensitive to impacts from construction and operation is the *O. concinnum* observed at the western end of the KTF. Because the fern only emerges after a significant rainfall, it is difficult to plan avoidance strategies during dry periods when the plant is not visible. Trampling and unintentional excavation of individual plants during construction could occur. An apparently successful transplanting program involving approximately 70 plants was conducted as a mitigation measure for the EDX project (U.S. Department of Army, 1990c). A comparable measure could be implemented for any plants which cannot be avoided by KTF construction activities.

The Hawaiian duck, the American (Hawaiian) coot, the Hawaiian gallinule (moorhen), and the Hawaiian black-necked stilt (see EA Subsection 3.4.2) will suffer no known adverse impacts because KTF construction and operations will not disturb wetlands habitat utilized by these species.

The Newell's shearwater may be attracted to project floodlights during launch or construction activities. The birds are disoriented by the lights simulating the reflection of the moon on the water. They may collide with poles, power lines, trees, and buildings as they fly at low elevations toward the light. Mitigation measures are discussed in EA Subsection 5.3.

The Laysan albatross is a protected wildlife species which utilizes the open scrub vegetation for courtship and nesting activities. However, the amount of open scrub vegetation to be removed by KTF construction will not significantly impact the total area available to the albatross (U.S. Department of Army, 1990b). No mitigation measures are anticipated.

None of the threatened or endangered bird species that occur in the PMRF were observed using the KTF for nesting. The kiawe/koa-hoale vegetation may provide roosting habitat for the Hawaiian hoary bat. However, the construction of the access road (Figure 3) will transect only a small portion of the total kiawe/koa-haole vegetation. No mitigation measures are anticipated for restoring the lost habitat.

The monk seal and the humpback whale could be affected during launch periods should the launching misfire and cause debris or spilled fuel to enter the Pacific Ocean near the KTF. In addition, noise during the launch sequences may have a disruptive effect on these species. According to the National Marine Fisheries Service, no adverse effects on monk seals and humpback whales are expected from normal launch operations (splash downs) for the typical launch programs of STARS and EDX (see EA Appendix F).

Because construction activities planned for the KTF will take place well back from the shoreline, the probability of construction affecting green sea turtles is low. Regardless, the effect of construction on any nesting green sea turtles would be of a short duration. During rocket launches, there are several possible sources of impacts to turtles (Brock, 1990). It is possible that lights directed on the beach could be a deterrent to nocturnal nesting activities (Carr and Ogren, 1960; Mortimer, 1981). If the beach is open to vehicles and pedestrians, compaction of the sand due to the traffic could preclude successful emergence of turtle hatchlings (Mann, 1977). High noise levels during launches will probably have little impact to resident turtles near the KTF. During a survey of the turtle population in August 1990, a marine biologist was unable to detect any response by turtles surfacing for air despite Army artillary practice within 660 to 990 feet (200 to 300 meters) of the turtle resting area (Brock, 1990).

It is difficult to hypothesize on the impact of fuel spillage during an aborted launch without knowing the chemical components and amounts of fuel to be used during each launch. An unsuccessful launch which is aborted into offshore waters could have detrimental effects on any marine species in the vicinity. In general, it is expected that unspent rocket propellants from normal launches which splash down in the Pacific Ocean will have minor and short-term, limited areal impacts on the marine environment (see EA Subsection 4.3).

Sand dunes along the west and north of the KTF are recognized by the State and Kauai County as a sensitive area (EA Subsection 3.4.1). Although the KTF construction activities will not extend into the dunes, there could be secondary impacts to their scenic quality because of the increased number of people present during construction. In addition, the nesting activities of the green sea turtle could be affected if there is increased human use of the dunes during construction or operations. Mitigative measures include restricting access to the dunes by off-road vehicles (ORVs).

The wetlands areas along the coast to the west of the KTF will not be affected by construction activities. No removal of wetlands is anticipated. Construction activities will occur within the historic tsunami inundation zone (floodplain) of western Kauai. Mitigation measures for construction of facilities within the floodplain are discussed in EA Subsection 5.3.

Cumulative Impacts

There is potential cumulative impact to the Laysan albatross from both construction and operations. Albatross may be flushed off their nests by construction or launch noise. The duration of KTF construction will be several months. During construction and succeeding launches, there is potential for cumulative impact on nesting birds. Impacts would occur between November, when breeding begins, and September, when the birds leave the nesting islands.

The Newell's shearwater could be impacted by the outdoor floodlights during construction. Mitigation measures to prevent the birds from being attracted to the light can be implemented to reduce the cumulative impact to the species to a level of minor consequence if such mitigation is required (see EA Subsection 5.3)

Very little is known about the disruptive effect of launch noise on the marine species such as the humpback whale, the monk seal, and the green sea turtle which use the coastal waters of the KTF. Because the individual launch periods are of a short duration and low frequency (only 10 to 12 per year), the cumulative effects of the EDX, STARS, and other launches are not expected to be of major consequence.

4.8 CULTURAL RESOURCES

As was mentioned previously in EA Subsection 3.5, the 100 percent pedestrian survey of the KTF revealed no evidence of archeological surface features or artifacts. However, subsurface borehole testing along the KTF parking area southwest fenceline produced evidence of subsurface cultural materials. Communications with the Hawaii State Historic

Preservation Officer (SHPO) with respect to the survey and testing programs are included in Appendix G.

Because cultural resources have been recorded south of the KTF along Nohili Ditch (Kikuchi, 1979) and in the dune areas to the north and south, there is potential for buried cultural resources at the KTF. The U.S. Department of the Navy considers the entire PMRF/KTF a "major ancient burial ground" (U.S. Department of Navy, no date) (Figure 6), plus there have been burial sites confirmed within the PMRF by PMRF personnel (ASI, 1990). This compounds the potential for the presence of cultural resources, especially those of a sensitive human nature, in subsurface deposits at the KTF.

Although the extent and significance of the possible cultural deposits encountered during the borehole testing cannot be determined, the possibility that small archeological remains or human remains might be encountered during major construction excavations cannot be discounted (Welch, 1990). As mentioned previously in EA Subsection 3.5, there are no sites included in or eligible for inclusion in the National Register of Historic Places recorded at the KTF. In other words, no known archeological sites or human burials will be impacted by the KTF proposed action. However, evidence from the areas surrounding the KTF and from subsurface test holes within the KTF itself indicates that the potential for artifacts or human remains is substantial.

More extensive testing or, as an alternative option, a monitoring program during ground-disturbing activities have been advised to determine the presence and/or extent of any cultural remains (ASI, 1990; Welch, 1990). EA Subsection 5.4 more fully describes those mitigation measures.

Cumulative Impacts

There is potential for major cumulative impacts to cultural resources to occur during the construction phase of this and related projects. Specifically, human burial sites may exist in subsurface context at the KTF. Mitigation measures and a construction monitoring plan have been proposed to prevent cumulative effects on cultural resources or human remains present at the KTF (EA Subsection 5.4).

4.9 LAND USE AND RECREATION

Land use and recreational access to beach areas will be adversely affected when rocket boosters are on the launch pad and during launches. Under the most optimistic launch schedule, there will be a maximum of 10 to 12 rocket launches per year from the KTF complex as follows:

- Vertical launches -- 7
- Rail launches -- 4.

The average time that each category of rocket boosters will be on a launch pad is as follows:

- Vertical launches -- 14 to 30 days per launch or 98 to 210 days per year
- Rail launches -- 7 days per launch or 28 days per year.

Thus, rocket boosters will be in position for testing on a KTF launch pad a maximum total time of 238 days per year. It is possible that three boosters could be on three different launch pads simultaneously: one on Pad No. 1, one on Pad No. 42, and one on the EDX pad (Figure 3).

During the maximum 238-day period when rocket boosters are on launch pads, all nonessential personnel as well as the public will be cleared from and denied access to the 1,250-foot (379-meter) ESQD area (Figure 4). The maximum ESQD area which would be restricted (for STARS, EDX, and Pad No. 1) comprises three overlapping ESQD areas occupying an area approximately 3,000 feet (909 meters) in diameter. If the maximum ESQD restriction was in effect, the public would be denied access to approximately 3,215 feet (974 meters) of beach area in Recreation Area No. 1. If a STARS booster alone was on the launch pad, an area of coastline approximately 100 feet (30 meters) wide and 2,256 feet (684 meters) long or 5.0 acres (2.0 hectares) would be temporarily closed to the public.

However, access to Polihale State Park and nearby sugar cane fields will not be affected by the ESQD restrictions.

The second type of land use and recreation use restriction will occur during the actual launch of a rocket system when it will be necessary to establish a 300-foot (91-meter) to a 10,000-foot (3,030-meter) radius GHA (Figure 4). The size of the GHA will depend on the type of rocket system being launched -- 10,000 feet (3,030 meters) for STARS and EDX and 2,000 feet (606 meters) or less for much smaller size motors.

The GHA restriction during vertical rocket launches will be of much shorter time duration: from time-of-liftoff (TOL) minus ten minutes (T-10) to TOL plus ten minutes (T+10). During this 20-minute period, road blocks will be established to prohibit access to the GHA by unauthorized PMRF and KTF personnel and the general public. If any risk to the public exists, the 20-minute restriction period will be extended as required.

A closure of any portion of the beach area, while an ESQD or a GHA restriction is in effect, will prevent the public from using the beach or crossing the area from Recreation Area No. 1 to Polihale State Park north of the KTF. This represents a temporary change in land use which will adversely affect recreation access.

As discussed in EA Subsection 3.6, Recreation Area No. 1 is normally open Monday through Friday from 4:00 pm to 6:00 am and 24 hours per day on weekends. This schedule provides public recreational access 6,150 hours per year. If an ESQD area affecting 3,215 feet (974 meters) of the beach in Recreation Area No. 1 were closed to public access for a maximum of 238 days per year (assuming three rocket boosters are on a launch pad simultaneously, which is unlikely), 4,176 hours or 48 percent of the access time would be adversely affected. However, the beach area affected would represent only 7.4 percent of the 8 miles (13 km) of available beach along the PMRF and only 2 percent of the 22 miles (35 km) of available public beach along western Kauai. In summary, the maximum amount of beach area that could be affected by KTF ESQD arcs is 3,215 feet (974 meters) or 7.0 acres (2.8 hectares).

The fact that only 10 percent of the public access to the PMRF (4,476 of 43,678, see EA Subsection 3.6) is for Recreation Area No. 1 is an additional consideration in determining the magnitude of adverse impacts. Also, records indicate that the period of use by each visitor (mostly for fishing and general beach activities) is less than two hours per visit.

In summary, all of these considerations indicate that land use and recreation will be adversely affected for temporary periods but not to an appreciable degree.

Cumulative Impacts

As calculated above, the public will be denied access to approximately 3,215 feet (974 meters) of beach in Recreation Area No. 1 and 48 percent of the access time if three rocket boosters were on launch pads simultaneously. If only one booster was on a launch pad -- a more likely event -- the amount of beach to which the public would be denied access would be reduced to 2,256 feet (684 meters).

Although boosters could be on launch pads a maximum of 238 days per year, all of the days would not be in sequence. The total time would be interspersed with days when no booster was on a launch pad. The adverse effects of denial of public access to a small beach area would not occur continuously. Thus, the overall cumulative impacts would be minor.

4.10 SOCIOECONOMIC CONDITIONS

Existing socioeconomic conditions are briefly summarized in EA Subsection 3.7. Other than the continued employment of 14 permanent staff personnel and the addition of 50 to 75 temporary staff professionals two months of the year, the proposed action will not result in measurable socioeconomic affects. Most visiting staff will reside in motels and hotels on the southeastern coast of Kauai.

For the most part, construction activities will utilize existing KTF personnel. There will be no net increase in construction workers.

Small increases in automobile traffic (30 to 50 cars per day) will be of a temporary nature. The relative isolation of the KTF from population centers will prevent social or economic disruption. The KTF $850,000 to $2.5 million annual operating budget can be viewed as a beneficial factor in Kauai's economy.

Cumulative Impacts

There will be no incremental or additive socioeconomic effects from the proposed continuation of KTF activities with the addition of the STARS and EDX programs. Beneficial economic effects will remain relatively constant. There will be no appreciable change in automobile traffic patterns over time.

4.11 NOISE

The PMRF and the KTF have two major operational noise sources which will increase noise above background levels: aircraft operations and rocket launches. Due to safety restrictions, these two operations do not occur simultaneously. Potential impacts have been evaluated for rocket launch operations only as there is no expected increase in aircraft volume as a result of the addition of vertical-launch programs.

4.11.1 Methodology

A methodology generally accepted by the scientific community was used to assess the potential for noise impacts from rocket launches at several receptor locations surrounding the KTF. This methodology involves utilizing a computer model developed by the National Aeronautics and Space Administration (NASA) which predicts the acoustic pressures and power levels for rocket systems. Acoustic power levels associated with different propulsion systems during launch operations are based on various motor parameters. The motor parameters used for this impact analysis are consistent with the rockets planned to be launched from the KTF. This model is presently used to estimate noise levels at sensitive receptors during space shuttle launches at locations such as Cape Canaveral, Florida (Swanson, 1990). A description of the NASA model and input data used for this assessment are presented in Appendix I.

Once a characteristic noise level is estimated for a particular rocket system sound levels can be predicted at various distances away from the launch pad which corresponds to sensitive receptor locations. Table 5 lists each receptor location and its distance from the main KTF launch complex and Kokole Point. The 10,000-foot (3,030-meter) distances are based on the GHA established for the largest (and loudest) rocket systems (see EA Subsection 2.1.1 and Figure 4). Factors for choosing sensitive noise receptors include human susceptibility to hearing damage and physical stress and noise source proximity to wildlife habitat, marine feeding and breeding areas, and recreational facilities. Sensitive

TABLE 5
DISTANCES FROM NOISE SOURCES TO RECEPTORS

Receptors (Location/Type)	Main KTF Launch Complex (feet/meters)	Kokole Point Launch Complex (feet/meters)
Launch Operations Building Workers	1,240[1] (376)	200 (61)
Other KTF and PMRF Employees	10,000 (3,030)	2,000 (606)
Sugar Cane Field Workers	10,000 (3,030)	3,300[2] (1,000)
Residents of Kekaha	37,000[2] (11,212)	11,000[2] (3,333)
Public Spectators	10,000 (3,030) min. distance	1,250 min. distance (379)
Polihale State Park Visitors	10,000 (3,030)	35,500[2] (10,758)
Birds/Mammals at KTF and Kokole Point	600[3 and 4] (182)	600[3] (182)
Offshore Birds, Whales, Turtles, etc.	1,200[3] (364)	1,200 (364)

Notes:

1. Refer to Figure 4
2. Refer to Figures 8 and 9
3. Refer to Figures 5, 8 and 9
4. Refer to EA Subsections 3.4 and 4.7 and Figures 5, 8 and 9

TABLE 7
PREDICTED MAXIMUM SOUND LEVELS AT VARIOUS RECEPTOR DISTANCES FOR ROCKET SYSTEMS LAUNCHED FROM THE MAIN KTF LAUNCH COMPLEX

Sensitive Receptor Distance (feet/meters)	MAXIMUM SOUND LEVELS (dBA)			
	STARS	EDX	TALOS	STRYPI
600/182	122	122	129	131
1,200/364	116	116	122	124
1,240/376	115	116	122	124
2,000/606	111	111	117	119
3,000/909	107	107	113	114
6,500/1,970	98	98	103	105
10,000/3,030	92	92	97	99
37,000/11,212	72	71	75	76

TABLE 8
PREDICTED MAXIMUM SOUND LEVELS AT VARIOUS RECEPTOR DISTANCES FOR ROCKET SYSTEMS LAUNCHED FROM KOKOLE POINT

Sensitive Receptor Distance (feet/meters)	Maximum Sound Levels (dBA)	
	TERRIER	NIKE
200/61	138	135
600/182	128	125
1,250/379	121	118
2,000/606	117	113
3,300/1,000	111	107
11,000/3,333	95	91
28,800/8,727	79	75
35,500/10,758	74	71

(Results obtained from NASA Sound Level Simulation Model)

Similarly, the Nike rocket system maximum noise levels obtained during the monitoring program ranged from 2 dBA to 5 dBA lower than the modeling results. The Nike monitoring results correspond well with the modeling predictions.

Although the noise modeling results seem to overestimate the noise levels produced during launch operations, the modeled (predicted) noise levels provide the most conservative noise estimates.

4.11.2 Noise Impact Assessment

Noise level standards, guidelines, and classifications established by governmental agencies are presented in this subsection. The noise impact assessment compares noise levels predicted to be produced by KTF launch operations to the noise level standards or guidelines.

4.11.2.1 Noise Level Guidelines/Goals

Noise level goals have been established by the U.S. Department of Housing and Urban Development (HUD) to guide government agencies in dealing with noise issues. HUD, along with the Department of Transportation (DOT) and the Environmental Protection Agency (EPA), recognizes 55 dBA (expressed as an Ldn or day-night average) as a goal for outdoor noise levels. This goal is established for residential areas to protect the public health and welfare with an adequate margin of safety (Federal Interagency Committee on Urban Noise, June 1980). Noise zone classifications established by HUD, which define noise level goal ranges for several categories are listed in Table 9. The categories are "acceptable," "normally unacceptable," and "unacceptable" with noise level ranges of 55-65 dBA, 65-75 dBA, and above 75 dBA, respectively.

Occupational noise exposure limits have been established by OSHA to prevent damage to human hearing in the workplace (29 CFR §1910.95). The OSHA limit for an eight-hour day is a time-weighted average (TWA) of 90 dBA (Table 10). The OSHA limit for noise exposure of 15 minutes or less is 115 dBA. Comparable short-time limits have not been established by HUD, DOT, or EPA.

TABLE 9
NOISE ZONE CLASSIFICATIONS

Noise Zone	Noise Exposure Class	Ldn[1] Day-Night Average Sound Level (dBA)	Leq(hour)[2] Equivalent Sound Level	HUD Noise Standards
A	Minimal Exposure	Not Exceeding 55	Not Exceeding 55	"Acceptable"
B	Moderate Exposure	Above 55 But Not Exceeding 65	Above 55 But Not Exceeding 65	"Acceptable"
C-1	Significant Exposure	Above 65 Not Exceeding 70	Above 65 Not Exceeding 70	"Normally Unacceptable"
C-2	Significant Exposure	Above 70 But Not Exceeding 75	Above 70 But Not Exceeding 75	"Normally Unacceptable"
D-1	Severe Exposure	Above 75 But Not Exceeding 80	Above 40 But Not Exceeding 80	"Unacceptable"
D-2	Severe Exposure	Above 80 But Not Exceeding 85	Above 80 But Not Exceeding 85	"Unacceptable"
D-3	Severe Exposure	Above 85	Above 85	"Unacceptable"

1 HUD, DOT, and EPA recognize Ldn = 55 dB as a goal for outdoors in residential areas in protecting the public health and welfare with an adequate margin of safety (Reference: EPA "Levels" Document). However, it is not a regulatory goal. It is a level defined by a negotiated scientific consensus without concern for economic and technological feasibility or the needs and desires of any particular community.

2 The Federal Highway Administration (FHWA) noise policy uses this description as an alternative to L_{10} (noise level exceeded 10 percent of the time) in connection with its policy for highway noise mitigation. The Leq (design hour) is equivalent to Ldn for planning purposes under the following conditions: (1) heavy trucks equal 10 percent of total traffic flow in vehicles per 24 hours; (2) traffic between 10 p.m. and 7 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours. Under these conditions Ldn equals L_{10}^{-3} decibels.

3 The HUD Noise Regulation allows a certain amount of flexibility for nonacoustic benefits in zone C-1. Attenuation requirements can be waived for projects meeting special requirements.

Source: "Guidelines for Considering Noise in Land Use Planning and Control," Federal Interagency Committee on Urban Noise, June 1980.

The DOE occupational noise exposure and hearing conservation program standard is based on both the OSHA limits and the more stringent TLVs established by the American Conference of Governmental Industrial Hygienists (ACGIH) (DOE, 1988a). The TLVs refer to sound pressure levels and durations of exposure that are representative of conditions under which workers who are not unusually sensitive to noise can be exposed repeatedly without risk of adverse effects on their ability to hear or understand normal speech. The ACGIH eight-hour TLV is 85 dBA while the 15-minute TLV is 110 dBA. Thus, the TLVs are more stringent than the OSHA standards.

TABLE 10
NOISE LEVEL STANDARDS AND GUIDELINES APPLICABLE TO EMPLOYEE/EMPLOYER RELATIONSHIPS

Duration per day (hours)	OSHA Limits (dBA)	ACGIH (DOE) TLV (dBA)
16	NE*	80
8	90	85
6	92	NE*
4	95	90
3	97	NE*
2	100	95
1.5	102	NE*
1	105	100
0.5	110	105
0.25	115	110
0.125	115	115

* None established for this time duration.

4.11.2.2 Noise Impact Assessment for Rocket Launch Operations

A-weighted noise levels experienced during rocket launches are a function of rocket system thrust (pounds), engine exhaust configuration, and orientation of the rocket launch. In general, increased thrust will also increase noise levels since these are directly related. Also, because the rocket's velocity increases rapidly as it moves away from the launch pad, the increased noise levels are experienced by sensitive receptors (humans or wildlife) for less than 30 seconds. However, the duration of the increased noise generation interval varies, depending on the type of rocket system and launch trajectory.

As explained in EA Subsection 4.11.1, maximum noise levels produced during rocket launch operations were predicted using a NASA computer model; results are presented in Tables 7 and 8. Rockets with the loudest predicted noise levels were selected for each launch pad in order to obtain the most conservative assessment: Strypi for the main KTF complex and Terrier for Kokole Point. The overall maximum noise level predicted for each receptor type (regardless of the source) is listed in Table 11 for the rockets launched from the KTF. To make a comparison between these predicted noise levels and HUD guidelines, it was necessary to convert the maximum noise levels to Leq (one hour) values. The one-hour Leq values are also presented in Table 11.

4.11.2.3 Receptor Impacts for Launch Operations

The receptors listed in Table 11 can be categorized into the following groups: KTF employees at the LOB; KTF/PMRF employees outside the GHA; other human receptors outside the GHA; onshore birds and other wildlife; and offshore birds and marine life. Human receptors outside the GHA include public spectators, nonessential KTF/PMRF employees, sugar cane field workers, visitors to Polihale State Park, and residents of Kekaha. These receptors are listed in Table 11 along with the maximum noise levels to which they would be exposed during rocket launches. The GHAs are different for the two launch pads, as it depends on the size of the rocket being fired. Since this assessment assumed launching of the largest rocket systems, a GHA of 10,000 feet (3,030 meters) was assumed for the main KTF Complex and a GHA of 1,200 feet (364 meters) for Kokole Point.

Receptor numbers 1 (LOB) and 2 (KTF/PMRF employees) will be exposed to the highest noise levels during rocket launches, at Kokole Point, which are predicted to peak at 138 and 121 dBA, respectively. The one-hour Leqs are expected to be 105 and 88 dBA, respectively. While these receptors are not subject to HUD guidelines, they must comply with OSHA regulations. As already stated, the OSHA permissible exposure limit is 115 dBA for noise exposure durations of 15 minutes or less. The eight-hour time-weighted average of 85 dBA, derived from the ACGIH TLVs, is applicable to DOE contractors.

TABLE 11
MAXIMUM NOISE LEVEL ESTIMATES FOR SENSITIVE RECEPTORS[1]

Sensitive Receptor	Max. Noise Levels Produced During Rocket Launches at Main KTF Complex (dBA)[3]		Max. Noise Levels Produced During Rocket Launches at Kokole Point (dBA)[4]		Overall Max. Noise Levels Produced During KTF Rocket Launches (dBA)	
	Max.	Leq (1hr)[2]	Max.	Leq (1hr)	Max.	Leq (1hr)
(1) Launch Operations Building Workers	(124)	99	(138)	105	(138)	105
(2) Other KTF & PMRF Employees	(99)	74	(121)	88	(121)	88
(3) Sugar Cane Field Workers	(114)	89	(111)	78	(114)	89
(4) Residents of Kekaha	(76)	51	(95)	62	(95)	62
(5) Public Spectators[2]	(99)	74	(121)	88	(121)	85
(6) Polihale State Park Visitors	(105)	80	(74)	44	(105)	80
(7) Birds/Mammals at KTF & Kokole Point	(131)	103	(128)	95	(131)	103
(8) Off-shore Birds, Whales, Turtles, etc.	(124)	99	(121)	88	(124)	99

NOTES:

[1] The minimum distance for public spectators is 10,000 feet (3,030 meters) for the larger rockets at KTF and 1,200 feet (364 meters) for rockets at Kokole Point. See Table 4.

[2] An Leq (1 hour) value provides a conservative estimate of the day-night Leq (Ldn) value.

[3] Based on Strypi motor configuration shown in Table 5.

[4] Based on Terrier motor shown in Table 5.

Noise exposure limits for launch operations personnel within the LOB and other KTF/PMRF pesonnel will comply with these two regulatory limits by utilizing personal protective equipment (PPE) including earplugs and headphones. The LOB itself will also reduce noise levels by as much as 25 dBA (Harris, 1979). By mitigating the noise exposure to within permissible limits for these employees, the anticipated impact on this group will be reduced to acceptable levels.

Maximum noise levels for public spectators will occur during launches at Kokole Point (121 dBA). The estimated one-hour Leq for this area is 88 dBA. According to HUD guidelines presented in Table 9, Ldns greater than 75 dBA represent a severe exposure and are classified "unacceptable". Although public spectators will be subjected to high noise levels, they will be able to minimize their exposure by using PPE. Earplugs and earmuffs combined can provide protection by reducing noise levels by approximately 30 decibels (Harris, 1979). This would lower the predicted maximum noise level for public spectators to 58 dBA for peak levels. As shown in Table 9, the HUD guidelines would describe this noise level as "moderate" or "acceptable." Also, the noise levels will be of short duration (a few seconds) and the people involved will be aware of the planned launch.

The maximum noise levels to which sugar cane field workers, visitors to Polihale State Park, and residents of Kekaha will be exposed are 114, 105, and 95 dBA, respectively. The maximum one-hour Leq to which these same receptors will be exposed are 88, 80, and 62 dBA, respectively. People located at the receptor locations established for sugar cane fields workers and Polihale State Park will be subjected to one-hour Leq noise levels which HUD describes as severe exposure and "unacceptable." The fact that individuals in the sugar cane fields and at Polihale State Park will be exposed to such high noise levels is compounded by the fact that they are the least likely to be informed of a planned rocket launch. The prewarned public can take precautionary measures such as using PPE or increasing their distance from the noise source. The closest residence of Kekaha to the KTF will have a maximum one-hour Leq of 62 dBA, which is considered an acceptable noise level according to HUD.

For people who are unaware of the launch operations, sudden and unexpected noise can produce marked changes in the body. These changes include increased blood pressure, increased heart rate, and muscular contractions. Moreover, digestion, stomach contractions, and the flow of saliva and gastric juices cease when a person is subjected to a sudden, unexpected noise. Even a person who is accustomed to a noisy environment may experience physiological changes (Alexandre et al., 1976). Specific noise levels will illicit varying responses in different people, depending on their sensitivity to noise and their physical and mental health. Psychological effects caused by exposure to increased noise levels from rocket launches include irritation or annoyance.

Exposures of wildlife and marine life to elevated noise levels will vary due to the many scattered habitats surrounding the main KTF and Kolole Point launch facilities. The closest wildlife and marine life habitats which can be exposed to the maximum noise levels are shown on Figures 8 and 9. The predicted overall maximum noise levels for wildlife (birds and mammals) and marine life (offshore birds, whales, turtles, etc.) are 131 and 124 dBA, respectively. The respective one-hour Leqs are 103 and 99.

Experiments with certain animals have been conducted to determine if a correlation exists between animal and human noise exposure. Much of this research has been conducted on mice and rats using multiple stimuli such as light and vibration which complicates the research results. Other research has been conducted on certain rodents which may have a genetically determined susceptibility to sound-evoked seizures (Harris, 1979). Overall, these types of experiments which use noise stimuli that is often intense and prolonged increase the animal's blood pressure, heart size, and adrenal gland activities (Harris, 1979).

Some information exists showing that birds adapt to noise levels created by military aircraft (Alexandre et al., 1976). The proposed schedule of 10 to 12 launches per year will subject small mammals and birds to high noise levels of short duration. However, studies indicate that while seabirds and songbirds may "flush" when loud noises occur, they return to normal behavior a short time later (Manci et al., 1988). Similar information is not available for small mammals.

Marine life, as well as green sea turtle resting and foraging areas (Figures 5, 8, and 9) will also be subjected to increased noise levels. No specific data are available on acoustic disturbances of humpback whales, the Hawaiian monk seal, or green sea turtles. However, the overpressure caused by a "sonic boom" is less than that generated by ocean surface waves, leading to the conclusion that KTF-related noise effects on marine life will not be of major consequence (Alexandre et al., 1976).

4.11.3 Conclusions

Maximum and Leq one-hour noise levels have been predicted using a computer model for the proposed rocket launches. This model takes into account the rocket thrust, configuration of the booster system and orientation for the rocket launch. Tables 7 and 8 present the model results for the loudest rocket systems launched from the main KTF launch complex and Kokole Point. Table 11 presents maximum noise level estimates for various receptors. The Leq maximum noise levels are presented in Figures 8 and 9 for the KTF and Kolole Point launch pads, respectively. Several receptor categories are located at the same distance and the same noise level contour, due to the minimum GHA boundary which must be maintained for the largest rockets during all launches. These conservative numbers were used to assess whether or not an adverse impact will occur during a rocket launch.

Noise impacts to most employees of the KTF/PMRF will be minimal because of their awareness of the launch operations, the use of PPE, and the short duration of exposure. Most public spectators can also be made aware of planned rocket launch operations. By taking precautions, such as using PPE for a short duration or removing themselves to a greater distance, noise exposure from rocket launches to public spectators should be minimal. Sugar cane field workers and visitors to Polihale State Park could experience adverse effects if they are unaware of a launch prior to its occurance or are unable to take appropriate precautions. Residents of Kekaha, if they are not informed of each rocket launch, may be startled or annoyed as a result of a sharp increase in noise levels. However, the maximum noise levels (dBA), expressed as an Leq at the nearest Kekaha residence, fall within acceptable noise guidelines established by HUD. Thus, minimal noise impacts on Kekaha residents are expected during rocket launch operations.

As for wildlife and marine life, available data do not indicate that rocket launch noise levels will have an unacceptable impact on species present near the KTF.

4.12 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

Three alternatives to the proposed action (continued operation of the KTF with limited new construction and addition of the STARS and EDX programs) are identified in EA Subsection 2.2: "no action"; construction of a new facility at an alternative location; and KTF decommissioning. Insofar as they are known, potential environmental consequences of these alternatives are addressed in this section.

No Action

The "no action" alternative would preserve the status quo. It would assure the continued capability of the KTF to launch rocket systems similar to those that have been launched previously. There would be minor cumulative effects over a prolonged period on soils, vegetation, wildlife, and cultural resources. Occupational and public health and safety hazards would be the same as currently exist (see EA Subsection 4.1). Environmental impacts would not change appreciably.

However, unless there is a change of national defense policy goals or a discontinuation of the SDI program, the no action alternative would merely postpone the potential environmental consequences of new construction and future launches associated with the STARS and EDX programs. Vertically launched rocket systems of the type being developed for STARS and EDX will be required to be launched from a currently unknown location.

New Facility at an Alternative Location

Because no other site under United States jurisdiction displays the unique attributes listed in EA Subsection 2.2.2, an alternative location for a new facility is not feasible. Thus, an analysis of potential environmental consequences at alternative locations has not been conducted. However, it cannot be assumed that the environmental consequences would be either more or less adverse than at the KTF if an alternative location were to be identified.

KTF Decommissioning

This alternative would become reasonable only on the discovery and development of a new facility at another location with scientific, technical, logistical, and strategic attributes equivalent to those of the KTF. On decommissioning, some buildings and other areas would be decontaminated. If the facility was not utilized by the PMRF which has jurisdiction over the land, existing structures would be removed and disturbed areas would be reclaimed. However, there is a possibility that the Navy would use at least some components of the facility.

5.0 MITIGATION MEASURES

"Mitigation" is defined in §1508.20 of the Council on Environmental Quality (CEQ) regulations on NEPA implementation to include one or more of the following:

- Avoiding the impact altogether by not taking certain actions
- Minimizing impacts by limiting the degree of magnitude of an action
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time
- Compensating for the impact by replacing or providing substitute resources.

This section summarizes the mitigation measures to be employed at the KTF. Compliance with applicable environmental regulations, which also qualifies as mitigation measures, are addressed in EA Section 6.0.

5.1 OCCUPATIONAL HEALTH AND SAFETY

The KTF has a rigorous health and safety program which complies with DOE, DoD, and Navy requirements (see EA Subsection 2.1.1 and Appendix B). In addition, the facility complies with OSHA standards contained in 29 CFR Parts 1910 and 1960. These requirements include the use of PPE that is appropriate to any particular hazard presented by rocket exhaust emissions, accidental spills of hypergolic fuels, or noise levels. The ESQDs and GHAs establish safe separation distance for both workers and the general public (EA Subsection 2.1.1).

5.2 AIR QUALITY

Although no adverse air quality impacts are anticipated, an air quality monitoring program will be established to verify emission concentrations. The program will include collecting pre-launch baseline data as well as launch and post-launch data. Air quality and meteorological data will be collected as part of the KTF Environmental Monitoring Plan.

5.3 BIOLOGICAL RESOURCES

The only plant species that will require mitigation measures during construction is the Category 1 species *O. concinnum*. The Biological Assessment for the EDX termed the adverse impacts to *O. concinnum* significant but mitigable (U.S. Department of Army, 1990c). The practice of avoidance of the plant locations is the preferred option.

A second option is to remove and transplant individual plants as they emerge in areas not amenable to avoidance. As previously mentioned in EA Subsection 4.7, a program of transplanting 70 plants to an unaffected area of the PMRF was implemented for the EDX mitigation. Monitoring of areas of the KTF to be disturbed by construction can be performed by an individual trained to recognize *O. concinnum*. The monitoring can be conducted within several days after a heavy rainfall.

As stated in Subsection 3.4.3, the Newell's shearwater, a federally listed threatened species, may use the KTF as a night flight corridor during October and November as they fly between nesting area in the mountains and ocean feeding areas. Disoriented by lights used during launch operations or construction, the birds could potentially collide with various structures.

As discussed in Subsection 3.4.3, Newell's shearwater nestlings, a federally listed threatened species, may become injured or die when colliding with buildings, trees, and other objects as a result of being disoriented by bright lights. There is no present evidence that the birds regularly use the KTF or the PMRF as a night flight corridor (DLNR, no date). Lights will be used at the KTF during launches and for some construction activities. However, if mitigation of the shearwater light attraction problem is required, lights will not be used for launches or construction during the most critical part of the migration period: one week before to one week after the new moon in October and November. Where activities dictate, USFWS-approved light hoods and shields will be installed temporarily on launch pad lights, to the extent that human safety is not compromised by poor lighting.

Although lights directed on the beach near the KTF could disrupt nesting activities of the green sea turtle, it is not anticipated that lighting during construction or launch operations will be directed onto the beach areas. Care will be taken to report any nests that are exposed by pedestrian or vehicular traffic (or natural forces) to the USFWS.

The potential adverse impacts to the other seven threatened and endangered species listed for the KTF are not considered of major consequence; therefore, no mitigative measures are necessary at this time.

Because the KTF is located within the historic inundation zone for tsunamis and two 100-year flood zones, the facility will continue to be designed to minimize impacts to the floodplain. In addition, new construction will be in compliance with the Federal Emergency Management Administration (FEMA) standards. Since no adverse impacts are expected to occur to the coastal wetlands adjacent to the KTF, no mitigation measures are required for wetlands areas.

5.4 CULTURAL RESOURCES

To date, no significant cultural resources have been recorded on the KTF property. There are indications, however, that there is potential for the existence of subsurface archeological or human remains. Accordingly, an Archaeological Monitoring Plan to be implemented during earthwork construction and fence post-hole excavation has been submitted to and approved by the SHPO. The plan advises avoidance as the primary form of mitigation. If materials are recovered during fence post-hole excavation, the proposed fence boundaries will be adjusted to accommodate the subsurface site. The Archeological Monitoring Plan is included in Appendix G.

Additional subsurface testing has been recommended by the Hawaii SHPO for the areas slated for construction of the fuel holding pads prior to construction activities.

Should human remains be uncovered during construction, they will be treated in a manner consistent with the PMRF's Draft Burial Treatment Plan as approved by the SHPO and the

State of Hawaii, Office of Hawaiian Affairs (OHA). As a tenant of the PMRF, the KTF will honor the plan which assures dignified and culturally appropriate treatment of Native Hawaiian human remains. Options for disposition of any remains discovered or exhumed include avoidance of the burial site, repatriation (reburial) of the remains to another site and museum curation of the remains. Appendix G includes a copy of the Draft Burial Treatment Plan.

An additional mitigation measure was proposed in the STARS EA (U.S. Department of Army, 1990b). The measure is intended to protect the Nohili Dune from erosion and possible subsequent exposure of Native American burials. A portable blast defector shield would be erected between the STARS launch platform and the adjacent dune during initial launches to determine if such shields reduce the potential for ignition of the surrounding kiawe/koa-haole vegetation. If significant reduction in fire potential is demonstrated during the initial STARS launches, shields will be employed for future activities. Should the vegetation ignite, fire suppression crews would use an open spray rather than a direct stream to extinguish the flames. In this manner, cutting and erosion of the dune face would be minimized.

5.5 LAND USE AND RECREATION

As stated in EA Subsection 4.9, there are 9 miles (14 kilometers) of available beach along the PMRF and 22 miles (35 kilometers) along western Kauai. The availability of recreational beach area that serves as a reasonable alternative to the maximum seven percent that could be restricted 48 percent of the time serves to mitigate adverse impacts. Relaxing the public access restrictions during launch periods would not be an acceptable mitigation measure because it would compromise public safety.

5.6 NOISE

Although no adverse noise effects of KTF operations have been identified that cannot be mitigated, a monitoring program will be established by November 1991 as part of the KTF Environmental Monitoring Program to characterize the sound levels of each rocket system. Background noise levels will be determined prior to and/or after selected launches. The monitoring program will verify noise levels at sensitive receptors and locations where launch personnel and site workers are situated during launches. If noise levels are found to be unacceptable, additional mitigation measures will be implemented including the use of more effective PPE for workers and additional warnings to the public.

The physical surroundings, rocket launch orientation, booster thrust, and knowledge of the rocket's noise field created during launch will dictate the positioning of noise monitoring equipment at each KTF launch pad site including Kokole Point. Sound level meters will collect and record sound level data in either an A-weighted scale or specific octave bands during the launch. The program will be designed to take into account the potential for reverberation or echoes from the cliffs to the east.

If employees are at any time subjected to sound levels exceeding the ACGIH TLV of 85 dBA for eight hours or 110 dBA for 15 minutes, administrative or engineering controls will be utilized as protection against the effects of noise exposure. Controls include limiting the amount of time each employee will work in areas with increased sound levels, redesign of equipment, and barrier construction to block sound wave energy. Members of the public who may be exposed to high sound levels during launches will be informed in advance of planned launch activities and encouraged to wear PPE. With the implementation of these mitigation measures, the effects of noise are not expected to be of major consequence during operations.

6.0 APPLICABLE ENVIRONMENTAL REGULATIONS

Compliance by the KTF with applicable environmental laws and regulations at the federal, state, and local level: (1) helps fulfill the national environmental policy objectives enumerated in §101(b) of NEPA, (2) indicates the nature and magnitude of environmental consequences addressed in the Environmental Assessment, and (3) serves to mitigate what might otherwise be unacceptable environmental consequences. This section is devoted to a discussion of environmental laws and regulations that pertain to the following environmental parameters:

- Air Emissions
- Waste Management and Spill Control
- Reporting of Releases of Hazardous Substances
- Wastewater Discharges
- Threatened and Endangered Species
- Cultural Resources
- Coastal Zone Management
- Noise.

Regulatory requirements not applicable to the KTF are not discussed in this section.

<u>Air Emissions</u>

The launch activity associated with the KTF programs will comply with federal and State of Hawaii ambient air quality regulations and standards. The National Primary and Secondary Ambient Air Quality Standards promulgated under the Clean Air Act are contained in 40 CFR Part 50. The Hawaii Air Pollution Control Rules, Title 11, Hawaii Administrative Rules, Chapter 60, 11-6-1 definition of a "person" does not include the federal government or its agencies. However, it is the policy of the DOE that DOE facilities comply with state regulations. Therefore, the standards promulgated by Hawaii in Title 11, Hawaii Code of Rules and Regulations (HCRR), Chapter 59 will be met by the KTF. These standards are implemented by the Hawaii State Department of Health.

Ambient air quality standards have been promulgated by Hawaii in 11 HCRR 59, 11-59-4 for carbon monoxide, nitrogen dioxide, total suspended particulates, and lead, as well as other parameters not applicable to the KTF. These standards are established for stationary sources of pollution emitting a constant stream of pollutants, and are expressed in terms of average concentrations for some unit of time. The launch activities occur intermittently, are not truly stationary sources, and emit pollutants over very short time periods. EA Subsection 4.6 demonstrates that the State ambient air quality standards will not be violated.

EPA has promulgated National Emission Standards for Hazardous Air Pollutants (NESHAPs) defining conditions and standards for the test firing of rocket motors containing beryllium (40 CFR 61, Subpart D). The definition of "rocket motor test site" in 40 CFR 61.41(a) specifies that the test site is a fixed facility where static firing of rocket motors occurs. The standard, therefore, applies only at static test facilities. Some of the boosters launched from the KTF (e.g., Antares II) contain beryllium as one of the propellant ingredients. However, the test firing at the KTF is flight testing rather than static testing. Flight testing occurs over an extended space and the exhaust is emitted over this extended space. Because the test conditions are different, the standard for static testing is not applicable to flight testing of rocket motors containing beryllium.

Waste Management and Spill Control

The Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.) and the Hazardous and Solid Waste Amendments of 1984 (HSWA) set standards and requirements for the management of solid and hazardous wastes. These "cradle to grave" regulations control the management of hazardous wastes from the point of generation to the point of treatment or disposal. The KTF will comply with all provisions of RCRA and the regulations promulgated under the Act at 40 CFR Parts 260 to 272. However, KTF operations generate few wastes which are regulated under RCRA.

Hazardous wastes as defined by RCRA include characteristic (ignitable, corrosive, reactive, or toxic) and listed wastes (40 CFR Part 261). The hazardous wastes potentially generated by KTF include: solvents used for cleaning and routine maintenance of the facility and equipment; solid rocket propellant fragments which are ignitable and toxic for lead; liquid hydrazine fuel which is listed, toxic, and ignitable; and liquid nitrogen tetroxide oxidizer which is listed and corrosive (see EA Subsection 4.1.3). Solvent wastes are generated only in small quantities during nonlaunch activities. Propellant wastes are generated only if an accident involving rocket motors or propellants should occur.

Any hazardous wastes generated are collected by the KTF or the PMRF, labelled, and transferred to the PMRF for storage. The PMRF periodically transports regulated wastes to the Defense Reutilization and Marketing Office (DRMO), Pearl Harbor, Hawaii for disposal in accordance with DoD policy and RCRA and HSWA standards.

Under RCRA and HSWA, the entire PMRF is considered a single facility. As a tenant at the PMRF, the KTF must comply with the standards applicable to the PMRF. Since the PMRF must store hazardous wastes for more than 90 days because of the remoteness of the facility from the DRMO at Pearl Harbor, it is subject to RCRA permitting requirements. As a storage facility under "interim status," the PMRF has formulated plans for waste analysis, training, facility closure, and emergency response.

Under RCRA regulations contained in 40 CFR §265.52(b), the facility is required to prepare either a Contingency Plan or a Spill Prevention, Control, and Countermeasures (SPCC) Plan that has been amended to meet the requirements of the Contingency Plan. A modified SPCC Plan is to be prepared in accordance with the regulations implementing the Clean Water Act in 40 CFR Part 112. The purpose of a SPCC Plan is to prevent the discharge of oil from nontransportation-related onshore and offshore facilities into or upon the navigable waters of the U.S. or adjoining shorelines. The KTF complies with the SPCC requirement by virtue of its coverage under the PMRF SPCC Plan prepared by the U.S. Navy.

Under HSWA, any facility which is subject to RCRA permitting requirements must also identify, investigate and, if necessary, clean up all past sites where regulated hazardous wastes were disposed of at any time. This could apply to the KTF if the toxic metals (e.g., lead) in the rocket motor exhausts have, over time, accumulated to such a degree that the soil has become contaminated with these materials. Although the regulations do not specifically address this circumstance, the KTF will sample the soils around the launch pad to determine the degree of contamination by toxic metals.

The Hawaii Hazardous Waste Management Act requires the PMRF to obtain a permit to operate a hazardous waste storage facility. This requirement is independent of the RCRA permit requirement. The RCRA permit application presently under consideration will meet the present Hawaii requirements. The single permit, when issued, should suffice for both federal and State requirements.

Nonhazardous solid wastes are also generated by the KTF (see EA Subsection 2.1.1). These wastes consist of administrative wastes and other refuse from maintenance activities. As mentioned in EA Subsection 2.1.1, municipal-type solid waste is managed by a PMRF contractor or, occasionally, by KTF personnel. These wastes are subject to RCRA Subtitle D and the regulations in 40 CFR Part 241. The Hawaii Solid Waste Management Control Regulations (11 HCRR Chapter 58) also apply. The KTF will comply with these requirements.

Reporting of Releases of Hazardous Substances

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601 et seq.) requires reporting of releases of hazardous substances to air, surface water, ground water, and land. Section 103 of CERCLA requires that any person in charge of a facility immediately notify the National Response Center (NRC) of the release of a hazardous substance above reportable quantities. The regulations on releases of Reportable Quantities (RQs), as mandated by Section 102 of CERCLA, are provided in 40 CFR Part 302. If any part of the release leaves the facility boundaries, state and local agencies must be contacted. A reportable release is defined in 40 CFR §302.6 as "any release. . .of a hazardous substance from such. . .facility in a quantity equal to or exceeding the reportable quantity. . .in any 24-hour period. . . ."

Launches of the Terrier, Talos, and Nike rocket systems have released RQs of lead to the air. While the RQ for lead listed in 40 CFR §302.4 is one pound, these rocket systems have released between 3.7 and 20.4 pounds (1.7 to 9.2 kg) per launch. The KTF has notified the NRC as required by the regulations whenever total lead releases have exceeded one pound. Under the Superfund Amendments and Reauthorization Act (SARA) and regulations in 40 CFR §355.40, the KTF must also notify the Local Emergency Planning Committee (LEPC) and State Emergency Response Commission (SERC). KTF personnel have complied with all of the notification requirements and will continue to comply with respect to RQ releases from future launches.

Wastewater Discharges

Title 19, Chapter 342D of the Hawaii Revised Statutes (HRS) provides authority to the State Department of Health to prevent, control, and abate water pollution. The Hawaii Water Pollution Control Regulations in HCRR Title 11, Chapter 62 establishes requirements pertaining to wastewater systems. All new noncesspool systems must be designed by an engineer and plans and specifications must be reviewed by Department of Health personnel. Department of Health personnel must be notified at completion of wastewater system installations to perform a final inspection. Changes to existing wastewater systems are reviewed on a case-by-case basis by Department of Health personnel and, at a minimum, a courtesy notification is recommended.

The KTF has three existing septic systems: two leach fields and one septic tank (Figure 3). The three systems have been registered with the Hawaii Department of Health, Wastewater Branch. The systems are inspected periodically by the State. The Hawaii Water Pollution Control Regulations do not require that septic tank and leach field systems be permitted under the NPDES.

Threatened and Endangered Species

The Endangered Species Act (16 U.S.C. 1531 et seq.) states that it is "the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species."

The Endangered Species Act provides protection for threatened and endangered species of flora and fauna or of habitat critical to the survival of threatened and endangered species. Under 50 CFR Parts 17 and 402, it requires a federal agency to:

- Obtain a scientific permit for the capture, killing, monitoring, or scientific studies involving threatened or endangered wildlife and plant species
- Confer with the USFWS on proposed species or proposed critical habitat
- Consult with the USFWS on potential impacts to listed species or habitat
- Prepare a biological assessment for the proposed action, if necessary.

The key provision of the Act for federal activities is the Section 7 Consultation. Under Section 7 of the Act, federal agencies are to consult with the USFWS to ensure that any agency action (authorization, funding, or carrying out) is "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species." Therefore, the USFWS is required to provide a list of threatened or endangered species that may be present in the project area. Should adverse impacts be anticipated, the federal lead agency is required to conduct a biological assessment to determine what impacts the project actions may have on these species.

Under State of Hawaii statute "Conservation of Aquatic Life, Wildlife, and Land Plants," HRS 12, Chapters 91, 195D, the DLNR may designate additional species indigenous to Hawaii that are not listed under the Endangered Species Act to be threatened or endangered. The DLNR has regulations which parallel or are more strict than the federal regulations. DLNR Rule No. 4, "State Conservation District Use Law," prohibits the taking of any endangered species. Because the KTF/PMRF is in a "conservation district," any proposed actions within the KTF must be reviewed by the DLNR.

In the Fish and Wildlife Conservation Act (16 U.S.C. §670), Congress encourages "all federal departments and agencies. . .to conserve and to promote conservation of nongame fish and wildlife and their habitats." Further, the Act encourages each state to develop a conservation plan.

The Migratory Bird Treaty Act (16 U.S.C. 703 et seq.) protects many species of migratory birds. Specifically, the Act prohibits the pursuit, hunting, taking, capture, possession, or killing of such species or their nests and eggs. The Act further requires that any affected federal agency or department must consult with the USFWS to evaluate ways to avoid or minimize adverse effects on migratory birds.

In order to comply with the laws and regulations listed above, several measures will be taken at the KTF. The *O. concinnum*, as a proposed species, will be avoided or adverse effects will be mitigated. The KTF must provide for the protection of the nesting and eggs of the Laysan albatross, should these be encountered during construction. The nesting areas of the green sea turtle will be protected in the same manner. Outdoor lighting will be modified during construction to protect the Newell's shearwater. The USFWS and State of Hawaii DLNR Division of Forestry and Wildlife will be informally consulted prior to initiating any projects which will have known adverse impacts to species or critical habitat (see EA Subsection 4.7 and Appendix F).

Cultural Resources

The National Historic Preservation Act (NHPA) (16 U.S.C. 470 et seq.) was enacted to protect the nation's cultural resources. The Act established the Advistory Council on Historic Preservation (ACHP), the State Historic Preservation Officers (SHPOs), and the National Register of Historic Places (NRHP). Section 106 directs federal agencies to take into account the effects of their actions on properties included in or eligible for the NRHP. Section 110(f) requires specific planning and actions to minimize harm to any National Historic Landmarks that may be directly and adversely affected by a Federal agency's actions.

The Section 106 process as implemented in 36 CFR Part 800 involves five steps:

1. Identification of the historic properties within the area of a proposed action's potential affects. (NOTE: this step may include a literature/records search and a pedestrian cultural resources survey.)

2. Determination of the effects of the undertaking on those properties

3. Early consultation among the federal agency, the SHPO, and others to seek ways to avoid or reduce the effects on historic properties

4. Affording the ACHP a reasonable opportunity to comment on the undertaking

5. Proceeding with the agency's decision-making process.

The purpose of Archeological Resources Protection Act (ARPA) (16 U.S.C. 470 et seq.) is "to secure for the present and future benefit of the American people the protection of archeological resources and sites which are on public lands and Indian lands." The ARPA provides for the excavation and removal of archeological resources prior to surface-disturbing activities and requires a permit from the Department of the Interior for any excavation or removal.

The American Indian Religious Freedom Act (AIRFA) (42 U.S.C. 1996) states that it is the policy of the United States to protect and preserve the right of Native Americans (American Indians, Eskimos, Aleuts, and Native Hawaiians) to believe, express, and exercise their traditional religions and ceremonial rites. Consultation with potentially affected Native Americans is necessary if infringement on religious rites or ceremonial sites by a proposed action is likely to occur.

By Executive Order 11593, federal agencies are directed to locate, inventory, administer, and protect the cultural properties under their control in a "spirit of stewardship and trusteeship for future generations."

The Hawaii SHPO's "Rules Governing Minimal Standards for Archaeological Surveys and Reports" (HCRR Title 13, Subtitle 6, Chapter 147) and "Rules Governing Minimal Standards for Archaeological Monitoring Studies and Reports" (HCRR Title 13, Subtitle 6, Chapter 150) govern the cultural resources processes in the State and closely parallel the federal guidelines and requirements. Concurrence from the Hawaii SHPO will be obtained for any projects affecting cultural resources at the KTF.

Because the KTF is located in an area of potential archeological significance, the regulations and guidelines will be followed closely. Should any cultural or human remains be disturbed during construction, the construction activity in the area will be halted. A qualified archeologist or physical anthropologist will be called in to assess the remains. The SHPO and the U.S. Navy archeologist will be notified. Should human remains be inadvertently disturbed, the PMRF Environmental Engineer, the U.S. Navy archeologist, the Hawaii SHPO, the Kauai Burial Council, and the Office of Hawaiian Affairs will be notified. The remains will be treated in a manner consistent with the PMRF Draft Burial Treatment Plan.

Coastal Zone Management

The Coastal Zone Management Act (CZMA) of 1972 (16 U.S.C. 1451 et seq.) was established to, among other things, "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations." Under the Act, the Department of Commerce through the National Oceanic and Atmospheric Administration (NOAA) is authorized to assist states in developing land and water use programs for their coastal zones including policies, criteria, standards, methods, and processes for dealing with land and water use decisions of more than local significance.

The objectives of the CZMA include protection of coastal resources, fostering of state management of coastal development through approved state management programs, and providing for improved intergovernmental coordination in coastal zone decision making. Section 3.7 on "Coordination and Cooperation" has the most significance to the KTF. It provides as follows:

> Each Federal agency conducting or supporting activities affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs. [§3.7(c)(1), emphasis added.]

Section 3.7(c)(2) also applies to KTF activities as follows:

> Any Federal agency which shall undertake any development project in the coastal zone of the state shall insure that the project is, to the maximum extent practicable, consistent with approved state management programs. (Emphasis added.)

In actual practice, this means that DOE-supported activities must be consistent with the NOAA federal consistency regulations in 15 CFR Part 930. Federal activities include any development projects governed by 15 CFR Part 930, Subpart C. The Subpart C regulations require that all DOE activities and development projects be consistent (to the maximum extent practicable) with federally approved state coastal zone management (CZM) programs. A written "consistency determination" is required to be provided to the authorized state CZM agency for all activities directly affecting the state's coastal zone.

The Hawaii Coastal Zone Management Program (HCZMP) is an expression of the State's policy to guide the use, protection, and development of land and ocean resources within Hawaii's coastal zone. The program is authorized by the Hawaii Coastal Zone Management Law enacted in 1975 and contained in Chapter 205A of the Hawaii Revised Statutes. The law's objectives and policies address recreation, historic, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, and management or development. In addition to the Hawaii CZM law, there are many other State statutes which authorize regulations, plans, and review processes for activities affecting Hawaii's land and ocean environment. Those which relate directly to the CZM objectives and policies have been incorporated in the HCZMP as supporting policies and mandates. The Hawaii CZM program was formally approved by NOAA in 1978. As a result, the national CZM Act now requires all federal activities affecting Hawaii's coastal zone to be consistent with the State's federally approved CZM program.

The DOE has made a determination under §307(c)(1) of the Coastal Zone Management Act and 15 CFR Part 930 that continued operation in a manner which is, to the maximum extent practicable, consistent with the Hawaii Coastal Zone Management Law and the Hawaii Coastal Zone Management Program. After completing the Hawaii CZM Program

Assessment form, the DOE requested a review of the consistency determination by the Hawaii Office of State Planning (Appendix H).

In its letter of February 11, 1991 to the DOE, the Office of State Planning stated that it had "no objections" to the DOE's consistency determination as it applied to the February 1991 KTF Two Experiment Rocket Campaign. A copy of this letter is also included in Appendix H.

Noise

The federal Noise Control Act (42 U.S.C. 4901 et seq.) directs all federal agencies "to the fullest extent within their authority" to carry out programs within their control in a manner that furthers the promotion of "an environment for all Americans free from noise that jeopardizes their health or welfare." The Act requires a federal department or agency engaged in any activity resulting in the emission of noise to comply with "Federal, State, interstate and local requirements respecting control and abatement of environmental noise."

A noise rating developed by the EPA for specification of community noise from all sources is the day-night sound level, Ldn (see EA Subsection 3.8.1). An Ldn of 55 dBA is the maximum desirable outdoor noise level for residential areas. In addition, OSHA has established a damage risk criterion to reduce hearing loss. This standard specifies that 90 dBA (TWA) is acceptable for an eight-hour day and 115 dBA (TWA) is acceptable for 15 minutes per day [29 CFR §1910.95(a)]. The DOE has adopted both the OSHA hearing conservation limits and the ACGIH's TLVs as standards to protect contractor employees from excessive noise exposure. The TLVs are set up as TWAs and are more restrictive than the OSHA limits (see EA Subsection 4.11.2.1).

Under HRS 19, Chapter 342 and Chapter 342, Part IV of the Hawaii Noise Pollution Regulations, noise regulations are promulgated on an island-by-island basis. At this time, there are no noise regulations in effect for the Island of Kauai. Excessive short-term noise levels produced during launches of the larger rocket systems will be mitigated as described in EA Subsection 5.6 in order to fulfill noise control objectives. Mitigation measures will be designed to protect both KTF/PMRF workers and the general public.

7.0 LIST OF AGENCIES AND PERSONS CONTACTED

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505/845-9228

Mr. Dan Talbert
Sandia National Laboratories, Albuquerque
Division 7523

APPENDIX A
DOE/PMRF INTERAGENCY AGREEMENT

SUPPORT AGREEMENT	1. DOCUMENT IDENTIFIER ("X" one) ☒ NEW ☐ REVIEW NO ☐ REVISION NO ___ ☐ TERMINATION

2. SUPPLIER (Name, Office Symbol & complete address)	2a. MAJOR COMMAND CODE	2b. SUBORDINATE COMMAND CODE
Commanding Officer Pacific Missile Range FAcility Hawaiian Area, Barking Sands Kekaha, Kauai, Hawaii 96752 GEOGRAPHICAL AREA OR COUNTRY CODE:	N00019	N00019
	3. PRESENT AGREEMENT NUMBER: N0534A-87274-028 3a. SUPERSEDED AGREEMENT NUMBER: N0534A-81274-002	4. TERMINATION DATE (Month and Year): 0993

5. RECEIVER (Name, Office Symbol & complete address)	5a. DODAAC/FEDSTRIP NUMBER	
U.S. Department of Energy Pacific Area Support Office P.O. Box 29939 Honolulu, Hawaii 96820 GEOGRAPHICAL AREA OR COUNTRY CODE:	HD 3014	
	5b. MAJOR COMMAND CODE: HD 1102	5c. SUBORDINATE COMMAND CODE: HD 3004

6. SUPPORT AGREEMENT RESOURCE SUMMARY

SUPPLIER

a. CATEGORY CODES	b. MAN YEARS: MILITARY	b. MAN YEARS: CIVILIAN	c. GROSS ADDITIONAL COSTS: TOTAL	NON-REIMBURSEABLE	REIMBURSEABLE
AI	Mail Service		(Common Service)		
AH,AI	Police & Fire		(Common Service)		
AL	Emergency Medical		*See Remarks, Block 10		
AO	Shipping/Receiving		*See Remarks, Block 10		
AP	Utilities		$ 800		$ 800
AS	Calibration		*See Remarks, Block 10		
AX	Refuse Collection		*See Remarks, Block 10		
BB,BD	Safety & MWR		(Common Service)		
BC	Communication		1,700		1,700
BI	Operations		*See Attachment I, Para F.8.		
BO	Environmental Control		*See Remarks, Block 10		
BU	General Supply		2,000		2,000
BW,SZ	Disaster Preparedness & Property Disposal (Common Service)				
MG	Vehicle Maintenance		*See Remarks, Block 10		
MI	Construction Equip. Maint.		11,500		11,500
SD	Ordnance Handling		2,000		2,000
SI	Equipment Loan		*See Remarks, Block 10		
ST	POL		*See Remarks, Block 10		
TOTAL					$18,000

6d. RECEIVER DATA (When applicable, provide similar data required in blocks 6a, b and c)

7. SAVINGS ACCRUED/COSTS INCURRED/MAN YEARS SAVED/EXPENDED TO FEDERAL GOVERNMENT

7a. SAVINGS	7b. COSTS	7c. MAN YEARS SAVED	7d. MAN YEARS EXPENDED
FY:	FY:	FY:	FY:

8. FUNDING AND REIMBURSEMENT ARRANGEMENT (Include all details concerning billing/reimbursement procedures, funding limitations, and the appropriate "billing/submit thru" addresses. Also list those references which specifically apply to the type of organization being supported.)

The DOE will, on or before the beginning of each fiscal year, furnish PMTC a funded order or orders for the reimbursable support to be provided by COPMRF for DOE operations within the forthcoming fiscal year. The funded order(s) shall be based upon a predetermined mutually established estimate of reimbursable support to DOE. Funded order shall be mailed to the Commander (Code 0210), Pacific Missile Test Center, Point Mugu, California 93042.

Once each month, PMTC will bill DOE for costs incurred during the preceding month in furnishing reimbursable support to DOE at PACMISRANFAC.

DD FORM 1144, 1 APR 78 — PREVIOUS EDITIONS ARE OBSOLETE

ROUTINE REPLY, ENDORSEMENT, TRANSMITTAL OR INFORMATION SHEET

OPNAV 5216/158 (Rev. 7-78)
SN 0107-LF-052-1691

A WINDOW ENVELOPE MAY BE USED
Formerly NAVEXOS 3789

CLASSIFICATION (*UNCLASSIFIED when detached from enclosures, unless otherwise indicated*) UNCLASSIFIED

FROM (*Show telephone number in addition to address*)
Commanding Officer, Pacific Missile Range Facility
Hawaiian Area, Barking Sands, Kekaha, Kauai, HI 96752-0128

DATE 13 OCT 1987

SUBJECT
PMRF/DOE AGREEMENT NO. N0534A-87274-028

SERIAL OR FILE NO.
7050
Ser 7041/ 1380

TO:
U.S. Department of Energy
Pacific Area Support Office
P.O. Box 29939
Honolulu, HI 96820

REFERENCE

ENCLOSURE
(1) Subject Agreement

VIA:

ENDORSEMENT ON

[X] FORWARDED [ ] RETURNED [ ] FOLLOW-UP, OR TRACER [ ] REQUEST [ ] SUBMIT [ ] CERTIFY [ ] MAIL [ ] FILE

	GENERAL ADMINISTRATION
	FOR APPROPRIATE ACTION
	UNDER YOUR COGNIZANCE
	INFORMATION
	APPROVAL RECOMMENDED [ ] YES [ ] NO
	[ ] APPROVED [ ] DISAPPROVED
	COMMENT AND/OR CONCURRENCE
	CONCUR
	LOANED, RETURN BY:
	SIGN RECEIPT & RETURN
	REPLY TO THE ABOVE BY:
	REFERENCE NOT RECEIVED
	SUBJECT DOCUMENT FORWARDED TO
X	SUBJECT DOCUMENT RETURNED FOR RETENTION
	SUBJECT DOCUMENT HAS BEEN REQUESTED, AND WILL BE FORWARDED WHEN RECEIVED
	COPY OF THIS CORRESPONDENCE WITH YOUR REPLY
	ENCLOSURE NOT RECEIVED
	ENCLOSURE FORWARDED AS REQUESTED
	ENCLOSURE RETURNED FOR CORRECTION AS INDICATED
	CORRECTED ENCLOSURE AS REQUESTED
	REMOVE FROM DISTRIBUTION LIST
	REDUCE DISTRIBUTION AMOUNT TO

	CONTRACT ADMINISTRATION
	NAME & LOCATION OF SUPPLIER OF SUBJECT ITEMS
	SUBCONTRACT NO. OF SUBJECT ITEM
	APPROPRIATION SYMBOL, SUBHEAD, AND CHARGEABLE ACTIVITY
	SHIPPING AT GOVERNMENT EXPENSE [ ] YES [ ] NO
	A CERTIFICATE, VICE BILL OF LADING
	COPIES OF CHANGE ORDERS, AMENDMENT OR MODIFICATION
	CHANGE NOTICE TO SUPPLIER
	STATUS OF MATERIAL ON PURCHASE DOCUMENT

	PERSONNEL
	REPORTED TO THIS COMMAND:
	DETACHED FROM THIS COMMAND
	OTHER

REMARKS (*Continue on reverse*)

SIGNATURE & TITLE
Ricky Dennis
RICKY DENNIS, LT, SC, USN, SUPPLY OFFICER, By direction

COPY TO Jack Canute, SANDIA, PMTC Code 0220 (Karen Stenifer), COMNAVBASE, NAVAIR Code AIR-920, DLSC Cameron Sta., VA
7030, 7600

CLASSIFICATION (*UNCLASSIFIED when detached from enclosures, unless otherwise indicated*)
UNCLASSIFIED

ATTACHMENT 1

Specific Provisions

A. Purpose. This agreement delineates operational and support relationships between the parties and sets forth agreements and understandings for the support of the DOE Test Readiness Facility (DOE-TRF), sometimes unofficially referred to as the Kauai Test Facility (KTF), located at the Pacific Missile Facility (PACMISRANFAC), Barking Sands, Kauai, Hawaii.

B. Background. The DOE Test Readiness Facility was established prior to the assignment of the basic responsibility to the PMRF of the entire Barking Sands Complex. However, upon establishment of the PACMISRANFAC, the Test Readiness Facility remained a part of the national readiness program to be supported as a Tenant by the PACMISRANFAC with utilization including rocket flight testing to support the development of current and exploratory nuclear weapon systems.

C. Reference and Authority. This agreement is made in accordance with the applicable provisions of the following references and authority.

1. Safeguard C to the Limited Test Ban Treaty of 1963 (Safeguard C).

2. Memorandum of Understanding Between the Department of Energy and the Department of Defense for Planning and Support for Safeguard C and Conducting Nuclear Weapons Tests Outside North American Continental Limits, September 24, 1984.

3. Contract Number DE-AC04-76DP00789 between the United States Department of Energy and Western Electric Company, Inc., Modification M086, dated October 24, 1983.

4. DOE-Navy Quality Assurance Test Program and New Material Flight Test Program, AT(29-2)-1775, Mod. 2, March 10, 1972.

5. DRIS Manual DOD 4000.19M

6. SECNAVINST 7020.4C

7. NAVCOMPT Manual Vol 7

D. General

1. Construction

a. The DOE may construct, utilizing its resources and contractors, such facilities it deems necessary for the development, testing and monitoring of nuclear weapons systems and subsystems.

(1) Facility site plans and specifications shall be coordinated with host prior to construction to meet DOD/DOE criteria.

(2) By specific agreement with the DOE/PASO, the PMRF may construct for the DOE, facilities to the design, cost, and time limitations established by the DOE. Construction criteria shall generally meet or exceed DOE/Navy minimal standards.

(3) The DOE shall have exclusive use and control of any and all buildings funded by and constructed for the DOE.

b. The parties shall coordinate siting plans and construction work which may affect the other's operations.

c. Any new or additional construction projects will be coordinated and funded separate of this agreement.

2. Area and Facility Coordination

a. PACMISRANFAC owns all land areas contained in the PACMISRANFAC and hereby assigns to the DOE-TRF as depicted in Attachment III and IV. The DOE will control the TRF including all facilities financed by and/or constructed for the DOE, and agreed upon adjoining areas. Test facilities and/or assigned areas may be made available for use by others upon the mutual agreement of the parties. However, no activity shall be approved within the assigned areas which may result in any degradation of capabilities required for support of Safeguard C and development, testing, and monitoring of nuclear weapon systems and subsystems.

b. Ownership of DOE Facilities will be retained by the DOE. As-built drawings and approved siting plans will be provided to the PACMISRANFAC.

c. At such a time as DOE facilities are no longer required by the DOE, disposition will be accomplished within current DOE/DOD policies and practices existing at that time. The DOE retains the right to remove any or all DOE-owned property. DOE notice of removal will be given as far in advance as feasible. The DOE will restore all vacated premises in a condition acceptable to PACMISRANFAC on a mutually agreed basis.

E. Delegations

1. The DOE may authorize its technical contractor, within the limitations cited below, to represent the DOE in the implementation of this agreement.

2. The DOE may further delegate its contractor(s) authority to represent the DOE within the limitations of the agreement, such authority to include arrangements for support and coordination of administrative and logistical matters with designated local representative of PACMISRANFAC.

3. Delegated authority is to be exercised in conformance with the provisions of this agreement and does not extend to the development of modification of general policies, procurement, or finance.

4. In the event of national command authorization to prepare for the resumption of atmospheric testing, the Director, Defense Nuclear Agency, and (subsequently) the commander of an activated DOE-DoD Joint Task Force would assume operational control of DOE and DoD readiness resources, including the DOE Test Readiness Facility at PACMISRANFAC, and take such action as necessary to execute approved nuclear test programs.

F. Operational Coordination and Mutual Support

1. Facility construction, operations, frequency use, safety regulations, changes to established procedures or establishment of new procedures will be coordinated for mutual agreement.

2. The DOE, or its contractor, will prepare the necessary documentation to define and coordinate its flight test operations in accordance with COPMRF guidance.

3. The parties to this agreement shall coordinate and cooperate by exchange of planning information and shall provide mutual support when such support does not interefere with the primary missions of the DOD and/or the DOE. In this connection, long range planning requirements and operational requirements shall be exchanged as far as possible in advance of needs of the parties.

4. It is further understood and agreed that the COPMRF will exercise range safety control over all flights from the PACMISRANFAC and that operating DOE contractors will provide COPMRF with the data and information necessary for the implementation of this responsibility.

5. PMRF will perform Frequency Interference Control (FIC) functions at PACMISRANFAC in accordance with current policy. DOE will effect coordination with the PMRF by most feasible means of communication, in advance of DOE operation-frequency changes and/or other related frequency interference to preclude harmful electromagnetic interferences and to avoid frequency conflicts.

6. The COPMRF shall provide, within the mission of the National Missile Range policy and within resources available, those additional operational services requested by the DOE to support DOE programs.

7. Within the DOE-TRF, the DOE shall be respoinsible for operational, construction, and industrial safety. Where PMRF provides

base support, construction, or operational support within the DOE-TRF, work performance shall be commensurate with the DOE requirements. Within the DOE-TRF, the DOE shall perform necessary inspections or surveys of operations, maintenance, construction, security classification, operational, industrial safety, and OSHA compliance.

8. Operational requirements concerning procedures, support, and funding responsibilities will be defined by means separate of this agreement, i.e. Operating Directives and other appropriate range operating and funding policies, and upon mutual understanding between the parties hereto.

G. Base Support

1. At mutually agreed times, within each fiscal year, the Director, DOE Pacific Area Support office (PASO) shall advise the Commanding Officer, Pacific Missile Range Facility (COPMRF) of the requirements for services and support of DOE-TRF located at PACMISRANFAC which the DOE (PASO) intends to request from COPMRF for that fiscal year and, to the extent that program knowledge is available for the subsequent fiscal year.

2. The COPMRF shall advise the Director, DOE (PASO) of PMRF's support resource capability and the estimated cost to be charged DOE therefore.

3. Work requests shall be used as instruments to document the services requirements described herein.

4. Within available resources, COPMRF shall provide normal base support services, as mutually agreed, to include but not limited to the services delineated in attachment II.

ATTACHMENT II

FUNCTIONAL RESPONSIBILITIES

CATEGORY	SUPPORT FUNCTION	HOST WILL	TENANT WILL
1. (AE)	Mail Service. (Non-reimbursable)	Provide onboard distribution of official intra-activity mail.	Be responsible for pick-up and security of mail. Arrange for own post office box and pickup delivery service.
2. (AH)	Structural fire protection and fire fighting services. (Non-Reimbursable)	Provide this support.	Offer Host access to DOE facilities during normal working hours for fire inspection purpose.
3. (AI)	Security and Classification. (Non-Reimbursable)	a. Provide normal base security protection to Tenant. Special Security requirements will be provided on reimbursable basis.	a. Advise Host of special requirements and reimburse accordingly. Be responsible for classification and protection of classified matters.
		b. Establish and sustain current procedures and regulations for recognition of Tenant personnel; issue required identification cards, badges, vehicle decals, etc., by which these personnel shall have ingress/egress to PMRF Barking Sands to conduct authorize functions.	b. Insure proper controls over Tenant personnel, to include identification and processing of transiting official visitors and vehicle requiring access to PMRF and Tenant assigned facilities.
4. (AL)	Emergency Medical. (Reimbursable)	Provide this service within existing capabilities.	Reimburse the Host as applicable.

ATTACHMENT II

FUNCTIONAL RESPONSIBILITIES

CATEGORY	SUPPORT FUNCTION	HOST WILL	TENANT WILL
5. (AO)	Shipping and Receiving. (Reimbursable)	a. Provide as required shipping and receiving services, including movement/delivery of materials, supplies and equipment. Receiving services include off-load aircraft and other cargo carrying equipment. All support shall be on a reimbursable basis.	a. Submit advance notice of requirements and/or appropriate shipping data to Host in accordance with Host procedures and fund for services as requested.
6. (AP)	Utilities. (Reimbursable)	Provide maintenance services of Tenant electrical and water distribution systems on requested and reimbursable basis.	Submit requirements to Host and fund for services.
7. (AS)	Calibration. (Reimbursable)	Provide inspection, maintenance, repair, and calibration and certification of precision instruments, precision measurement equipment and Test Measurement and Diagnostic Equipment to ensure performance at established standards, on reimbursable and requested basis.	Submit Test Equipment inventory list and comply with base calibration procedures. Fund for services and materials on actual cost basis as requested.
8. (AW)	Facility Maintenance. (Reimbursable)	a. Provide maintenence and repair services of Tenant owned buildings and structures on requested and reimbursable basis.	a. Submit requirements and fund for services.
		b. Provide maintenance and repair of Tenant's exclusive use areas on requested and reimbursable basis.	b. Submit requirements and fund for services.

ATTACHMENT II

FUNCTIONAL RESPONSIBILITIES

CATEGORY	SUPPORT FUNCTION	HOST WILL	TENANT WILL
9. (AX)	Refuse Collection. (Reimbursable)	Provide this service on requested and reimbursable basis.	Submit requirements and fund for services.
10. (BB)	Ground Safety. (Industrial, Vehicle, and General) (Non-Reimbursable)	Promulgate and enforce base safety regulations and programs.	Coordinate and implement Tenant activities with Host safety programs. Upon accident or exposure, summaries of Tenant will not be consolidated with those of Host but reported separately.
11. (BC)	Communication Services. (Reimbursable)	Provide administrative telephone services on reimbursable basis.	Submit requirements and fund for services and charges.
		Provide over-the-counter autodin message services, including guard and relay of high-precedence traffic. (Non-reimb.)	Comply with Host procedures, and be responsible for message pickup and delivery.
12. (BD)	Community Service. (Non-Reimbursable)	Make available normal personnel services activities facilities such as Navy Exchange retail store, barber shop, clubs, special services, etc., to Tenant personnel on comparable privileged basis as provided to Host and other Tenant personnel in accordance with applicable base regulations.	Sustain liaison and provide required information for Host reporting. Insure compliance of policy and procedure by Tenant personnel in utilization of available personnel services.

ATTACHMENT II

FUNCTIONAL RESPONSIBILITIES

CATEGORY	SUPPORT FUNCTION	HOST-WILL	TENANT WILL
13. (BI)	Operations. (Reimbursable)	Support Tenant operations at the Host range on scheduled and mutually coordinated basis in accordance with applicable DOD directive for a DOD Major Range and Test Facility base.	Coordinate documentation, scheduling of Tenant range operations and funding with Host to satisfy requirements on mutually agreed basis as defined in paragraph F.8. of Attachment I.
14. (BO)	Environmental Control. (Reimbursable)	a. Provide the administration of programs for the control of air, water, noise, hazardous materials, and other forms of pollution.	a. Coordinate and comply with environmental control programs.
		b. Provide disposal services of hazardous materials under EPA and other applicable hazardous waste disposal procedures on required and reimbursable basis.	b. Submit requirements in accordance with Host procedures and fund for services on required basis.
15. (BU)	General Supply. (Reimbursable)	Provide over-the-counter issue of consummable general supplies on requested and reimbursable basis.	Comply with Host supply procedure and fund for consummable supplies used.
16. (BW)	Disaster. Preparedness (Non-Reimbursable)	Promulgate station disaster preparedness bill to include support of Tenant mission during natural disaster conditions.	Coordinate and comply with Host disaster preparedness instructions and procedures.

ATTACHMENT II

FUNCTIONAL RESPONSIBILITIES

CATEGORY	SUPPORT FUNCTION	HOST-WILL	TENANT WILL
17. (MG)	Vehicle Maintenance. (Reimbursable)	Provide maintenance and repair services for Tenant vehicles within Host capabilities on reimbursable and requested basis.	Advise of requirements in compliance with Host schedules and fund for services and materials.
18. (MI)	Construction Equipment Maintenance. (Reimbursable)	Provide maintenance and repair for Tenant construction equipment within Host capabilities on as required and reimbursable basis.	Advise of requirements in compliance with Host schedules and fund for services and materials..
19. (SD)	Ordnance Handling. (Reimbursable)	Provide ordnance handling and storage support as requested on reimbursable basis.	Reimburse Host of items support.
20. (SI)	Equipment Loan. (Reimbursable)	Assist Tenant as occasion may arise with loan of construction/vehicular equipment within availability of Host resources. Service, repair, and maintain loaned equipment.	Submit requirements in accordance with Host procedures and reimburse for usage in accordance with Host rental rates. Fund for damage repairs to Host equipment as the result of Tenant use.
21. (ST)	POL Support. (Reimbursable)	Provide POL products support on requested and reimbursable basis.	Advise Host of requirements. Comply with Host reporting requirements and reimburse for POL products received.

ATTACHMENT II

FUNCTIONAL RESPONSIBILITIES

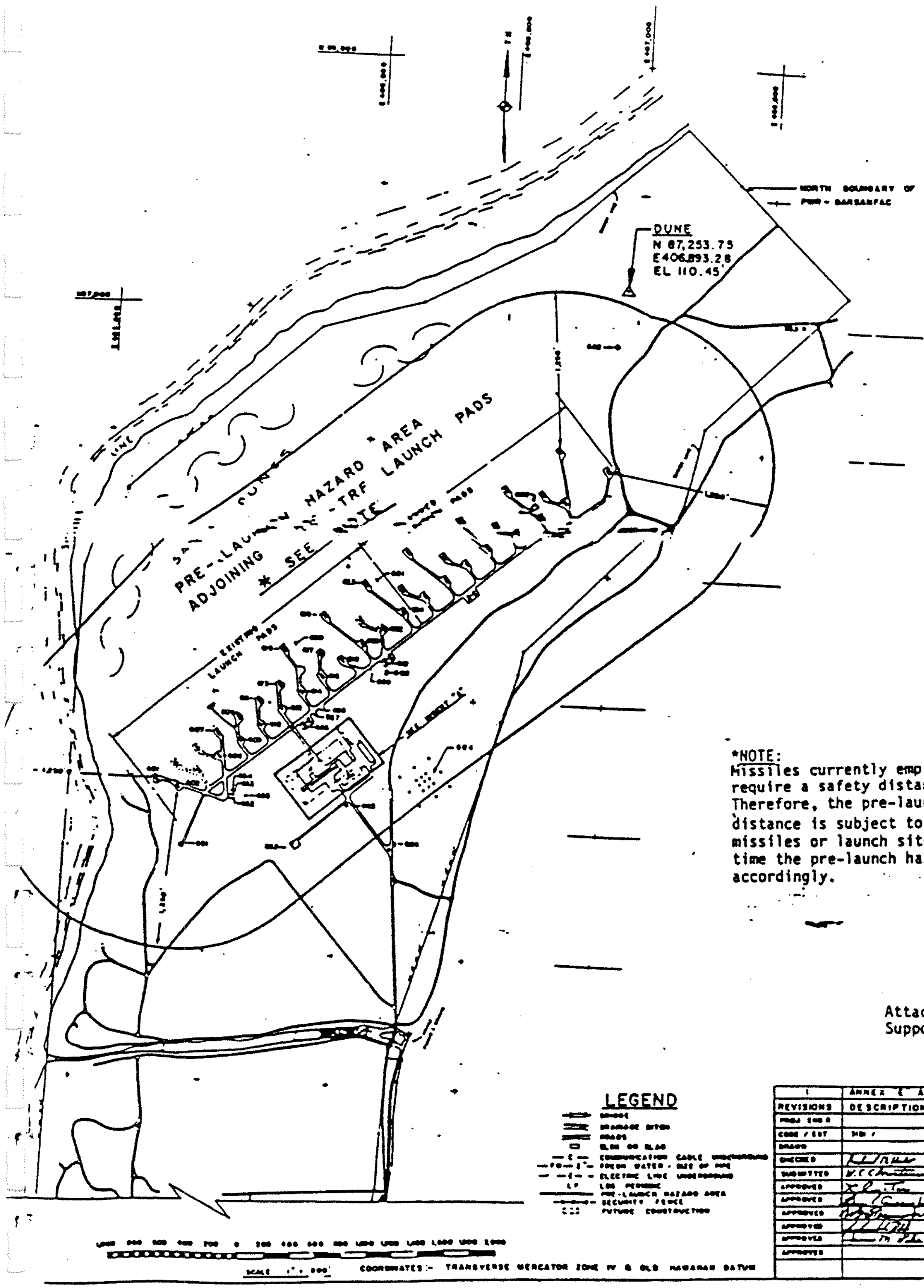
CATEGORY	SUPPORT FUNTION	HOST-WILL	TENANT WILL
22. (SZ)	Plant Property. (Non-Reimbursable)	1. N/A	1. Retain title of all Tenant owned property items.
		2. Provide disposal service of surplus scrap and salvage property generated by Tenant in accordance with DRMO directives and procedures.	2. Comply with Host procedures and turn-in schedules.

SAND88-1161
Unlimited Distribution
Printed September 1988

This publication supersedes SAND81-1807, dated August 1984

ENVIRONMENT, SAFETY AND HEALTH MANUAL

Environment, Safety and Health Department 3310
Sandia National Laboratories
Albuquerque, NM 87185



*NOTE:
Missiles currently employed in the program require a safety distance radius of 1250 feet. Therefore, the pre-launch hazard area safety distance is subject to change when different type missiles or launch sites are employed, at which time the pre-launch hazard area will be modified accordingly.

Attachment III to PMRF/DOE
Support Agreement

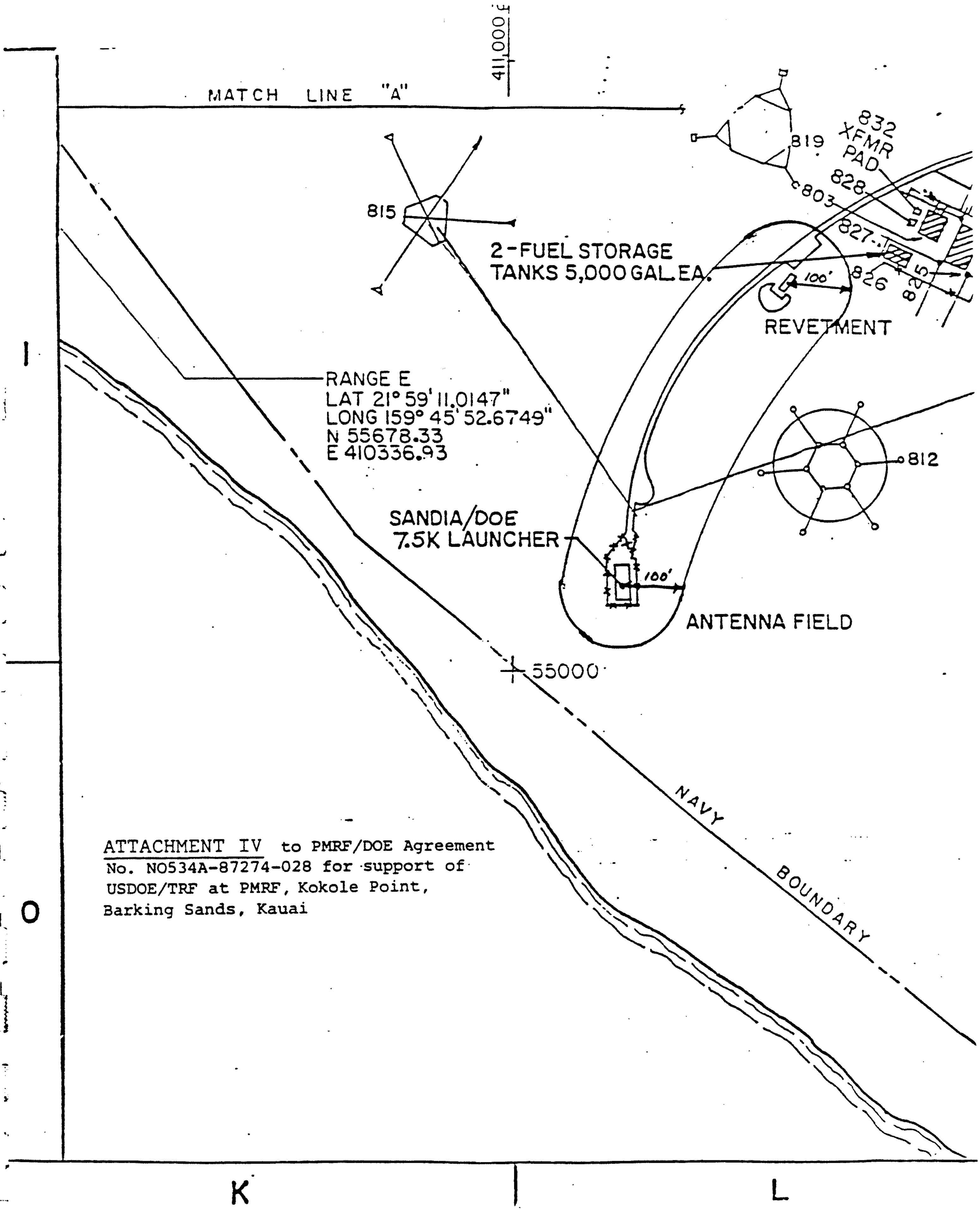
1	ANNEX "E" ADDED	9/22/67
REVISIONS	DESCRIPTION	DATE

DOE TEST READINESS FACILITY INCLUDING PRE-LAUNCH HAZARD AREA *

PACIFIC MISSILE RANGE FACILITY
BARKING SANDS, KAUAI, HAWAII, 96752

DATE 28 NOV. 66 — SK-H-660906

SCALE AS SHOWN — SHEET 1 OF 1



ATTACHMENT IV to PMRF/DOE Agreement No. N0534A-87274-028 for support of USDOE/TRF at PMRF, Kokole Point, Barking Sands, Kauai

APPENDIX B
KTF, SANDIA NATIONAL LABORATORIES (SNL), AND DOE OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS

B.1 GENERAL SAFE OPERATING PROCEDURE FOR OPERATIONS AT KAUAI TEST FACILITY

B.2 SANDIA NATIONAL LABORATORIES ENVIRONMENT, SAFETY AND HEALTH MANUAL

B.3 SUMMARY OF DOE ORDERS RELATED TO OCCUPATIONAL HEALTH AND SAFETY

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SOP Number 70212 9007
SUPERSEDES SOP No. 17700 8707
RESPONSIBLE ORG. 7523
DATE OF ISSUE 7/27/90

GENERAL

SAFE OPERATING PROCEDURE

FOR

OPERATIONS

AT

KAUAI TEST FACILITY

ABSTRACT

This document defines the general safe operating requirements and the responsibilities for all personnel participating in operations at the Kauai Test Facility.

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SOP NO. 70212 9007
SUPERSEDES SOP NO. 17700 8707

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SANDIA'S POLICY FOR ENVIRONMENT, SAFETY AND HEALTH PROTECTION

POLICY

Sandia National Laboratories deems the protection of human life and health and the environment to be among its primary responsibilities. Accordingly, Sandia National Laboratories will design products and conduct operations with the highest regard for the safety and health of its personnel, contractors, and the public, and for the protection and preservation of the environment.

GUIDELINES

* Assure ES&H commitment and accountability by all.
* Comply with applicable laws and regulations related to the protection of the environment and the health and safety of our people.
* Evaluate on a continuing basis, Sandia compliance with applicable laws and regulations.
* Contribute to the development of reasonable, cost-effective ES&H laws and regulations.
* Advise our people of and protect them from recognized workplace hazards.
* Minimize waste and conserve resources.
* Develop an awareness for sound ES&H practices in our employees.
* Integrate ES&H considerations into research, design, manufacturing, installation, operations, and maintenance activities.
* Include ES&H considerations as an important criteria by which projects, products, processes, purchases and employees are evaluated.

APPROVED BY: [signature] 9/22/89

D. Roth, Vice President — Date
Administration, 3000

APPENDIX B.3
SUMMARY OF DOE ORDERS RELATED TO OCCUPATIONAL HEALTH AND SAFETY

- DOE 5483.1A -- Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities. This order establishes procedures to assure that occupational safety and health standards established by the DOE provide protection for employees in government-owned, contractor-operated (GOCO) facilities which is consistent with health and safety protection available to private industry employees under the Occupational Safety and Health Standards applicable to federal facilities contained in 29 CFR Part 1910.

- DOE 5480.4 -- Environmental Protection, Safety, and Health Protection Standards. This order specifies requirements for the application of mandatory environmental protection, safety, and health (ES&H) standards that apply to all DOE and DOE contractor operations. It references the OSHA standards and DOE Order 5483.1A.

- DOE 5480.1B -- Environment, Safety, and Health Program for Department of Energy Operations. The order, applicable to all DOE and DOE contractor operations, references 16 other DOE orders pertaining to protection of health, safety, and the environment. It also encompasses the 29 CFR Part 1960 OSHA standards for federal employees.

- DOE 5482.1B -- Environment, Safety, and Health Appraisal Program. The order establishes an ES&H appraisal program (audits, appraisals, surveys, etc.) for all DOE and DOE contractor operations.

APPENDIX C
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APPENDIX C.1

LIST OF PLANT SPECIES OBSERVED AT KTF

The plant families in the following species listed have been alphabetically arranged within two groups, Monocotyledons, and Dicotyledons. The genera and species are arranged alphabetically within families. The taxonomy and nomenclature follow that of Wagner et al. (1990) and St. John (1973). For each taxon the following information is provided:

- An asterisk before the plant name indicates a plant introduced to the Hawaiian Islands since Captain Cook or by the aborigines
- The scientific name
- The Hawaiian name and/or the most widely used common name
- Abundance ratings are for this site only and they have the following meanings:
  - Uncommon -- a plant that was found less than five times
  - Occasional -- a plant that was found between five and ten times
  - Frequent -- a plant that was found in widely scattered parts of the site in low numbers
  - Common -- a plant considered an important part of the vegetation
  - Locally abundant -- plants found in large numbers over a limited area (e.g., the plants found in grassy patches).

This species list is the result of an extensive survey of this site during the dry season (July 1990) and it reflects the vegetative composition of the flora during a single season. Changes in the vegetation will occur due to introductions and losses and a slightly different species list would result from a survey conducted during a different growing season.

APPENDIX C.1
LIST OF PLANTS FOUND ON THE KAUAI TEST FACILITY

MONOCOTYLEDONS		
POACEAE -- GRASS FAMILY		
SPECIES	COMMON NAME	ABUNDANCE
**Cencherus ciliaris* L.	Buffelgrass	Common
**Chloris barbata* (L.) Sw	Swollen finger grass	Common
**Cynodon dactylon* (L.) Pers	Bermuda grass	Common
**Eragrostis cilianensis* (All.) Link	Stinkgrass	Common
**Eragrostis tenella* (L.) P. Beauv. ex Roem. & Schult		Occasional
**Panicum maximum* Jacq.	Guinea grass	Common
**Rhynchelytrum repens* (Willd) Hubb.	Natal redtop	Common
**Setaria verticillata* (L.) P. Beauv.	Bristly foxtail	Common
Sporobolus virginicus (L.) Kunth	Seashore rush	Locally abundant
DICOTYLEDONS		
AIZOACEAE -- FIG-MARIGOLD FAMILY		
Sesuvium portulacastrum (L.) L	'Akulikuli	Locally abundant
AMARANTHACEAE -- AMERANTH FAMILY		
**Ameranthus spinosus* L.	Spiny ameranthus	Common
**Ameranthus viridis* L.	Slender amaranth	Occasional
BORAGINACEAE -- BORAGE FAMILY		
Heliotropium anomalum Hook. & Arnott	Hinahina	Locally abundant
Heliotropium curassavicum L.	Seaside heliotrope	Locally abundant
CASURINACEAE -- IRONWOOD FAMILY		
**Casuarina equisetifolia* L.	Ironwood tree	Locally abundant
CHENOPODIACEAE -- GOOSEFOOT FAMILY		
**Atriplex semibaccata* R. Br.	Australian salt bush	Occasional
**Chenopodium murale* L.	'Aheahea	Occasional
COMPOSITAE -- SUNFLOWER FAMILY		
**Conyza canadensis* (L.) Cronq.	Hairy horseweed	Occasional
**Pluchea indica* (L.) Lees	Indian fleabane	Locally abundant
**Pluchea symphytifolia* (Mill.) Gillia	Sourbush	Occasional

APPENDIX C.1 (CONT.)
LIST OF PLANTS FOUND ON THE KAUAI TEST FACILITY

**Sonchus oleraceus* L.	Pualele	Occasional
**Verbesina encelioides* (Cav.) Benth. & Hook.	Golden crown beard	Common
CONVOLVULACEAE -- MORNING GLORY FAMILY		
**Ipomoea imperati* (Vahl) Griseb.	Hunakai	Locally abundant
**Ipomoea obscura* (L.) Ker-Gawl.		Occasional
Ipomoea pes-carprae (L.) R. Br. subsp. *brasilienis* (L.) Ooststr.	Beach Morning Glory	Locally abundant
Jacquemontia ovalifolia (Choisy) H. Hallier subsp. *sandwicensis* (A. Gray) Robertson	Pau-O-Hi'iaka	Locally abundant
**Merremia aegyptia* (L.) Urb.	Hairy merremia	Occasional
CUCURBITACEAE -- CUCUMBER FAMILY		
**Momordica charantia* L.	Bitter melon	Locally abundant
Sicyos sp.	Kupala	Occasional
EUPHORBIACEAE -- SPURGE FAMILY		
Chamaesyce celastroides (Boiss.) Croizat & Degener var. *celastroides*		Locally abundant
**Chamaesyce hirta* (L.) Millsp.	Hairy spurge	Common
**Chamaesyce hypercifolia* (L.) Millsp.	Graceful spurge	Occasional
**Chamaesyce prostrata* (Aiton) Small	Prostrate spurge	Occasional
**Ricinus cumminus* L.	Castor bean	Common
GOODENIACEAE -- NAUPAKA FAMILY		
Scaevola sericea Vahl.	Naupaka kahakai	Locally abundant
HYDROPHYLLACEAE -- WATERLEAF FAMILY		
Nama sandwicensis A. Gray	Hinahina kahakai	Locally abundant
LAURACEAE -- LAURAL FAMILY		
Cassytha filiformis L.	Kauna'oa pehu	Locally abundant
LEGUMINOSAE -- BEAN FAMILY		
**Desmanthus virgatus* (L.) Willd	Virgate mimosa	Occasional
**Crotolaria incana* L.	Fuzzy rattlebox	Occasional
**Indigo suffruticoas* Mill	Indigo	Occasional
**Leucana leucocephala* (Lam.) deWit	Haole koa	Common

APPENDIX C.1 (CONT.)
LIST OF PLANTS FOUND ON THE KAUAI TEST FACILITY

**Macroptilium lathyroides* (L.) Urb.	Wild pea	Locally abundant
**Prosopis pallida* (Humb. & Bonpl. ex Willd) Kunth	Kiawe	Common
MALVACEAE -- HIBISCUS FAMILY		
**Abutilon grandifolium* L. (Willd.) Sweet	Hairy abutilon	Common
**Malva parviflorus* L.	Cheese weed	Common
**Malvastrum coromandelianum* (L.) Garcke	False mallow	Common
Sida fallax Walp	'Ilima	Common
**Sida rhombifolia* L.		Common
**Sida spinosa* L.		Common
NYCTAGINACEAE -- FOUR O'CLOCK FAMILY		
**Boerhavia coccinea* Mill.		Occasional
Boerhavia repens L.	Alena	Common
PASSIFLORACEAE -- PASSION FLOWER FAMILY		
**Passiflora foetida* L.	Love-in-a-mist	Occasional
PLUMBAGINACEAE -- PLUMBAGE FAMILY		
Plumbago zeylanica L.	'Ilie'e	Locally abundant
PORTULACAEAE -- PURSLANE FAMILY		
**Portulaca oleracea* L.	Pigweed	Common
**Portulaca pilosa* L.	'Akulikuli	Common
PRIMULACEAE -- PRIMROSE FAMILY		
**Anagallis arvensis* L.	Scarlet pimpernel	Occasional
SAPINDACEAE -- SOAPBERRY FAMILY		
Dodonaea viscosa Jacq.	'A'ali'i	Common
SOLANACEAE -- TOMATO FAMILY		
**Lycopersicon esculentaum* Mill.	Tomato	Occasional
Solanum americanum Mill.	Popolo berry	Occasional
STERCULIACEAE -- STINK TREE FAMILY		
**Waltheria indica* L.	'Uhaloa	Common
VERBENACEAE -- VERBENA FAMILY		
**Lantana camara* L.	Lantana	Common

**Vitex rotundifolia* L. fil	Beach vitex	Common

APPENDIX C.2
LIST OF BIRD/WILDLIFE SPECIES OBSERVED AT KTF

Common Name	Hawaiian Name	Scientific Name	Status
Black-crowned Night-Heron	Auku'u	*Nycticorax nycticorax hoactli*	Native, Resident
Red Junglefowl		*Gallus gallus*	Introduced, Resident
Ring-necked Pheasant		*Phasianus colchicus*	Introduced, Resident
Spotted Dove		*Streptopelia chinensis*	Introduced, Resident
Zebra Dove		*Geopelia striata*	Introduced, Resident
Japanese White-Eye		*Zosterops japonicus*	Introduced, Resident
Cattle Egret		*Bulbulcus ibis*	Introduced, Resident
Northern Cardinal		*Cardinalis cardinalis*	Introduced, Resident
Red-crested Cardinal		*Paroaria coronata*	Introduced, Resident
Nutmeg Mannikin		*Lonchura punctulata*	Introduced, Resident
Chestnut Mannikin		*Lonchura malacca*	Introduced, Resident
Warbling Silverbill		*Lonchura malabarica*	
Northern Mockingbird		*Mimus polyglottos*	Introduced, Resident
House Finch		*Carpodacus mexicanus*	Introduced, Resident
House Sparrow		*Passer domesticus*	Introduced, Resident
Common Myna		*Acridotheres tristis*	Introduced, Resident
Short-eared Owl		*Asio flammeus*	
Gray Francolin		*Francolinus pondicerianus*	Introduced
Japanese Quail		*Coturnix coturnix*	Introduced
Ruddy Turnstone		*Arenaria interpres*	
Brown Noddy		*Anous stolidus*	
Great Frigate Bird		*Fregata minor*	
House Mouse		*Mus musculus domesticus*	
Feral Dog		*Canis familiaris*	
Feral Cat		*Felis catus*	

Source: Botanical Consultants, 1990

APPENDIX C.3
ENDANGERED AND THREATENED ANIMALS AND PLANTS OF KAUAI

Source: State of Hawaii, Department of Land and Natural Resources
Division of Forestry and Wildlife

Island Key: H = Hawaii   L = Lanai   Mo = Molokai   O = Oahu
K = Kauai   M = Maui   N = Niihau

Note: Unless otherwise noted, all species herein are considered to be endangered by both the federal and State governments.

Common Name [Hawaiian Name]	Scientific Name	Known Breeding Range	Area of Distribution Where Endangered or Threatened
BIRDS			
* Newell's Shearwater ['A'o]	*Puffinus auricularis newelli*	H, K, Mo	Entire
** Band-rumped Storm-Petrel ['Oe'oe]	*Oceanodroma castro cryptoleucura*	K	Entire
Hawaiian Duck [Koloa-maoli]	*Anas wyvilliana*	H, K, N, O	Entire
Hawaiian Gallinule ['Alae-'ula]	*Gallinula chloropus sandvicensis*	K, O	Entire
Hawaiian Coot ['Alae-ke'oke'o]	*Fulica americana alai*	H, K, M, Mo, N, O	Entire
Hawaiian Stilt ['Āe'o]	*Himantopus mexicanus knudseni*	H, K, M, Mo, N, O	Entire
** Hawaiian Owl [Pueo]	*Asio flammeus sandwichensis*	H, K, L, M, Mo, O, N	O
** White Tern [Manu-o-Ku]	*Gygis alba rothschildi*	O, Leeward Isls.	O
Pualohi	*Myadestes palmeri*	K	Entire
Kāma'o	*Myadestes myadestinus*	K	Entire
Kauai 'Ō'ō ['Ō'ō 'ā'ā]	*Moho braccatus*	K	Entire
Kauai 'Akialoa	*Hemignathus procerus*	K	Entire
Kauai Nuku-pu'u	*Hemignathus lucidus hanapepe*	K	Entire
'Ō'ū	*Psittirostra psittacea*	H, K	Entire
** 'I'iwi	*Vestiaria coccinea*	K, M, Mo, O	O, L, Mo

TABLE C.3 (continued)
ENDANGERED AND THREATENED ANIMALS AND PLANTS OF KAUAI

Common Name [Hawaiian Name]	Scientific Name	Known Breeding Range	Area of Distribution Where Endangered or Threatened
MAMMALS			
Hawaiian hoary bat ['Ōpe'ape'a]	*Lasiurus cinereus semotus*	H, K, M	Entire
Hawaiian monk seal ['Īlio-holo'i-kauaua]	*Monachus schauinslandi*	Leeward Isls.	Entire
Humpback whale	*Megaptera novaeangliae*	Oceanic	Entire
Fin or Finback whale	*Balaenoptera physalus*	Oceanic	Entire
Sperm whale	*Physeter catodon*	Oceanic	Entire
REPTILES			
Pacific green sea turtle [Honu]	*Chelonia mydas agassizi*	Oceanic	Entire
Pacific hawksbill turtle [Ea]	*Eretmochelys imbricata bissa*	Oceanic	Entire
Pacific leatherback sea turtle	*Dermochelys coriacea schlegelii*	Oceanic	Entire
Olive (Pacific) Ridley sea turtle	*Lepidochlys Olivacea*	Oceanic	Entire
PLANTS			
Kauai hau kuahiwi	*Hibiscadelphus distans* Bishop & Herbst	K	Entire
Dwarf naupaka	*Scaevola coriacea* Nutt.	H, K, L, M, Mo, N, O	Entire
Uhiuhi, kea, kalamona	*Mezoneuron kavaiense* (Mann) Hbd.	H, K, M, O	Entire

* = Listed as Threatened
** = Listed as Endangered by State of Hawaii only

APPENDIX C.4
U.S. NAVY
PROTECTED SPECIES LIST FOR
PACIFIC MISSILE RANGE FACILITY, KAUAI

BIRDS

Hawaiian Short-Eared Owl, *Asio flammeus sandwichensis*

Hawaiian Stilt, *Himantopus mexicanus knudseni*

Hawaiian Coot, *Fulica americana alai*

Hawaiian Moorhen, *Gallinula chloropus sandvicensis*

Hawaiian Duck, *Anas wyvilliana*

Laysan Albatross, *Diomedea immutabilis*

Wedge-Tailed Shearwater, *Puffinus pacificus chlororhynchus*

Newell's Shearwater, *Puffinus puffinus newelli*

Lesser Golden Plover, *Pluvialis dominica*

Wandering Tattler, *Heteroscelus incanus*

Ruddy Turnstone, *Arenaria interpres*

Sanderling, *Calidris alba*

Bristle-Thighed Curlew, *Numenius tahitiensis*

MAMMALS

Hawaiian Monk Seal, *Monachus schauinslandi*

Hawaiian Hoary Bat, *Lasiurus cinereus semotus*

Green sea turtle, *Chelonia mydas agassizi*

APPENDIX D
SUMMARY TABLES OF RISKS FROM POSTULATED ACCIDENTS

APPENDIX D

SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

This appendix summarizes the accident assessment for the Kauai Test Facility (KTF) as presented in SAND89-254, "Safety Assessment for the Kauai Test Facility at Barking Sands, Kauai" (Helgesson, 1990) and attaches qualitative descriptors to each accident scenario.

The qualitative descriptors that are used in the Risk Assessment From Postulated Accidents in this appendix are found in Tables D.1, D.2, and D.3. The various accident scenarios at the KTF have been developed from credible operational and nonoperational hazards.

The KTF has periods of relative inactivity when compared to the periods when launch operations are being conducted. During nonoperational periods, the explosives handling facilities are not in use and no explosives are on site. Hazards are then limited to those associated with construction and maintenance activities including operating equipment, power tools, and other occupational hazards. Every effort is made to assure a safe work environment through the use of SOPs, training, maintenance, safety meetings, and inspections. The hazards that exist at all times (for operations and nonoperations personnel) are included in the Miscellaneous Failures/Faults section at the end of the Summary of Risk From Postulated Accidents, Table D.4.

TABLE D.1
ACCIDENT HAZARD SEVERITY

HAZARD CATEGORIES	CONSEQUENCES TO THE PUBLIC, WORKERS, OR ENVIRONMENT
I - CATASTROPHIC	May cause deaths, or loss of the facility/operation, or severe impact on the environment.
II - CRITICAL	May cause severe injury, or severe occupational illness, or major damage to a facility/operation, or major impact on the environment.
III - MARGINAL	May cause minor injury, or minor occupational illness, or minor impact on the environment.
IV - NEGLIGIBLE	Will not result in a significant injury, or occupational illness, or provide a significant impact on the environment.

TABLE D.2
ACCIDENT PROBABILITIES

DESCRIPTIVE WORD	SYMBOL	NOMINAL RANGE OF FREQUENCY PER YEAR
Likely	A	$Pe > 10^{-2}$
Unlikely	B	$Pe=10^{-2}$ to 10^{-4}
Extremely Unlikely	C	$Pe=10^{-4}$ to 10^{-6}
Incredible	D	$Pe < 10^{-6}$

NOTE: Pe=Probability of event occurring per year

TABLE D.2
ACCIDENT PROBABILITIES

TABLE D.3
HAZARDS SEVERITY, CONSEQUENCE, OR IMPACT CATEGORIES

CATEGORY	PEOPLE	FACILITY	OPERATIONS	REGULATORY	PUBLIC SENTIMENT
1 - HIGH	FATALITIES 1 or more deaths	EXTENSIVE DAMAGE Loss of facility > $1M	DELAYED > 3 YEARS Major disruption to DP mission	COMPLIANCE ORDERED Audit, TSA, etc.	SERIOUS CONCERN -International -National
2 - MODERATE	SERIOUS INJURIES Severe occupational illness	MAJOR DAMAGE > $500K	DELAYED > 1 YEAR Significant disruption	NEED TO COMPLY	LOCAL CONCERN -State -City
3 - LOW	MINOR INJURIES OR ILLNESS	MINOR DAMAGE > $50K	DELAYED > 6 MOS Minor disruption	POTENTIAL NEW REGULATIONS COMING	MAY ATTRACT ADVERSE SENTIMENT

TABLE D.3
HAZARDS SEVERITY, CONSEQUENCE, OR IMPACT CATEGORIES

4 - NONE	NO SIGNIFICANT INJURIES	DAMAGES < $50K	NO SIGNIFICANT DELAY	NO SIGNIFICANT REGULATION IMPACT	NO ADVERSE SENTIMENT LIKELY

TABLE D.4
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
Accidents Associated with Natural Phenomena								
Floods	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Earthquakes	Extremely Unlikely	None	Low	Low to High	Low	>$500K	II-C	3
High Winds/ Hurricanes	Unlikely	None	Low	Low to High	Low to High	>$500K	II-A	1
Volcanic Eruptions	Extremely Unlikely	None	Low	Low to High	Low to High	>$1M	I-C	2
Tidal Wave	Unlikely	None	Low	High	High	>$1M	I-B	1
Lightning	Unlikely	None	Low to High	Low to High	Low to High	>$1M	I-B	1
Commercial Power Failures/Faults								
Loss of power due to lightning strike	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Pole or line failure	Likely	None	Low	Low	Low	<$50K	IV-A	2
Fire, auto or high wind accident	Likely	None	Low	Low	Low	<$50K	IV-A	2
Electrical System Failures/Faults								
Cable faults	Unlikely	None	Low	Low to High	Low to High	>$50K	III-B	2
Cable fires	Unlikely	None	Low	Low to High	Low to High	>$50K	III-B	2

TABLE D.4 (continued)
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
Bus fires	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-C	4
Hot Spots	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Phase to phase faults	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Phase to ground faults	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Breaker failures	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Ground faults	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Insulation failures	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Electrical Equipment Failures/Faults								
Main Switchgear Failure	Unlikely	None	Low	Low to High	Low to High	>$500K	II-B	2
Transfer switch failure	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-C	4
Transfer switch/Internal fault	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-C	4
Transfer switch/Coil failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Transfer switch/ Undervoltage relay failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3

TABLE D.4 (continued)
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
Transfer switch/Control voltage failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Transfer switch/Contact failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Generator failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Generator/ Winding failure	Extremely Unlikely	None	Low	Low to High	Low to High	>$500K	II-C	3
Generator faults	Unlikely	None	Low	Low to High	Low to High	>$500K	II-B	2
Generator trip	Unlikely	None	Low	Low to High	Low to High	<$50K	IV-B	3
Generator main switchgear failure	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-C	4
UPS failure	Extremely Unlikely	None	Low	Low to High	Low to High	>$500K	II-C	3
UPS/Battery discharge	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-C	4
UPS/Battery internal faults	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
UPS/Invertor failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
UPS/Converter failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Mechanical Equipment Failures/Faults								

TABLE D.4 (continued)
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
LOB comp unit HVAC failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
LOB roof top HVAC failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Assembly Buildings 2 & 3 HVAC unit failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Assembly Building 6 HVAC failure - one unit	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Assembly Building 6 HVAC failure - both units	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Payload Assembly Building HVAC failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Balance Building HVAC failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Igniter Checkout Building HVAC failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
VAT HVAC failure	Unlikely	None	Low	Low	Low	<$50K	IV-B	3

TABLE D.4 (continued)
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
Sprinkler system failures	Extremely Unlikely	None	Low	Low	Low	<$50K	IV-B	3
Fires								
LOB	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Assembly Buildings 2 & 3	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Assembly Building 6	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Rocket Motor Staging Area	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Payload Assembly Building	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Balance Building	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Igniter Checkout Building	Unlikely	None	Low	Low	Low	<$50K	IV-B	3
VAT	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Cable Termination Shelter	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Trailers	Unlikely	None	Low	Low to High	Low to High	>$1M	II-B	2
Explosives Handling Equipment Failures/Faults								
Crane failures	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2

TABLE D.4 (continued)
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
Crane overloading	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Crane overtravel	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Crane hoist impact loading	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Crane hoist brake failure	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Crane hoist cable failure	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Crane rigging failures	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
VAT hoist failure	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Assembly Building 2 & 3 hoist failures	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Assembly Building 6 crane failures	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Payload Assembly Building hoist failure	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Rocket Motor Staging Area crane failures	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2

TABLE D.4 (continued)
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
Rocket work dolly failures	Extremely Unlikely	None	Low to High	Low to High	Low to High	>$500K	II-C	3
Positioning trailer failures	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Launcher failures	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-C	3
Operational Accidents								
Accidental detonation during assembly	Unlikely	Low to High	Low to High	Low to High	Low to High	>$1M	I-B	1
Accidental detonation during transport	Extremely Unlikely	Low	Low to High	Low to High	Low to High	>$1M	I-C	2
Post-launch rocket failure	Unlikely	Low to High	Low to High	Low to High	Low to High	>$1M	II-B	2
Hazards from other Facilities/Sources								
PMRF	Unlikely	None	Low	Low	Low	>$50K	III-B	2
Aircraft	Unlikely	None	Low to High	Low to High	Low to High	>$1M	II-B	2
Explosives storage	Extremely Unlikely	Low	Low	Low	Low to High	>$1M	II-C	3
Hazards to Other Facilities								
Factories, airports	Extremely Unlikely	Low	None	None	Low to High	>$1M	II-C	3

APPENDIX E.1

ESTIMATION OF DOWNWIND AIR CONCENTRATIONS FROM SPILL OF HYPERGOLIC FUELS

In order to estimate air concentrations of 1,1-dimethylhydrazine and nitrogen tetroxide from spills of the hypergolic fuels, certain assumptions were made:

- Very low wind speed (1.5 feet or 0.45 meters per second)
- Spill volumes of 76 liters of 1,1-dimethylhydrazine and 57 liters of nitrogen tetroxide which corresponds to total volume of propellant for any given rocket system (U.S. Department of Army, 1990b)
- No interaction between the two constituents since simultaneous fueling is not conducted and the two constituents are stored with a minimum distance of 26 feet (8 meters) from any booster (U.S. Department of Army, 1990b)
- The spilled volume spreads to a depth of one inch (2.5 centimeters) determining the spill area (Clewell, 1980)
- The temperature of the spilled constitutents is 30° C.

Clewell, 1980, outlines methods to estimate volatilization rates of various hypergolic fuels, including 1,1-dimethylhydrazine and nitrogen tetroxide. The general equation is as follows:

$$Q = 0.08 * U^{3/4} * A * (1 + 4.3 \times 10^{-3} * T_p) * Z$$

where Q = evaporation rate (kg/hr)

U = wind speed (m/sec)

A = area of spill (m^2)

T_p= temperature of spilled fuel (°C)

Z = hydrazine normalized vapor pressure - molecular weight factor (20.7 for 1,1-dimethylhydrazine and 100 for nitrogen tetroxide)

When the Q has been determined for each spilled constituent, a gaussian dispersion equation was used to detemine air concentrations at 1,250 feet (379 meters) downwind, the

TABLE D.4 (continued)
SUMMARY OF RISKS FROM POSTULATED ACCIDENTS

Event or Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Impact on Facility	Programmatic Impact	Dollar Loss	Risk Assignment	Hazards Severity, Consequence or Impact Category
PMRF	Extremely Unlikely	Low	Low	Low	Low to High	>$1M	II-C	3
Public	Extremely Unlikely	Low	None	None	Low to High	>$1M	II-C	3
Miscellaneous Failures/Faults								
Diesel fuel spills	Likely	Low	Low	Low	None	<$50K	IV-A	2
Diesel tank rupture	Unlikely	Low to High	Low	Low	Low to High	>$500K	II-B	2
Diesel pump damage	Unlikely	Low	Low	Low	None	<$50K	III-B	2
Gas fuel spills	Likely	Low to High	Low to High	Low to High	None	>$500K	III-A	1
Gas pump damage	Unlikely	Low	Low	Low	None	<$50K	IV-A	3

APPENDIX E

E.1 ESTIMATION OF DOWNWIND AIR CONCENTRATIONS FROM SPILL OF HYPERGOLIC FUELS

E.2 ENVIRONMENTAL FATE OF ROCKET PROPELLANTS IN SEA WATER

limit of the hazard area assigned to these hypergolic fuels (U.S. Department of Army, 1990b). An equation from Hanna et al. (1982) was used as follows:

$$C=\sqrt{(2/\pi)}*(8*f_t*Q)/(\pi*\sigma(x)*U*X) \qquad (1)$$

where C = air concentration at distance X (mg/m^3)

f_t= fraction of time wind in sector (1)

Q = evaporation rate (mg/sec)

sigma(x)= $[0.14*X*(1+0.0003*X)^{-1/2}]$

U = wind speed (0.45 m/sec)

X = downwind distance (381 m).

CENTER FOR GLOBAL ENVIRONMENTAL TECHNOLOGIES

THE UNIVERSITY OF NEW MEXICO | ALBUQUERQUE, NEW MEXICO 87131

NEW MEXICO ENGINEERING RESEARCH INSTITUTE
TELEPHONE (505) 846-4644

MEMORANDUM

DATE: March 11, 1991

TO: Richard Hay, 7523

FROM: Jonathan S. Nimitz, Ph.D., Senior Research Scientist, Center for Global Environmental Technologies, New Mexico Engineering Research Institute, The University of New Mexico, Albuquerque, New Mexico 87131-1376

SUBJECT: Environmental Fate of Rocket Propellants in Sea Water

---

The solid rocket propellants utilized in systems flown from the Kauai Test Facility contain four basic categories of components: aluminum metal, nitro-organics, ammonium perchlorate, and binders. The fate of each of these components is considered in the following:

1. Aluminum Metal
   Aluminum metal is readily oxidized by O_2 or other metal ions to form alumina (Al_2O_3).

   $$Al + [O] \rightarrow Al_2O_3$$

   Alumina is a highly stable, inert material that occurs naturally. Oxidizing and reducing agents are in correct stoichometric proportion in the propellant and will likely react largely with each other and not with other materials.

2. Nitro-organics

   Nitro-organics (e.g. nitroglycerin, nitrocellulose) are biodegraded to CO_2 and ammonia (NH_3).

3. Ammonium perchlorate

   Ammonium perchlorate is not highly soluble in water; sea water has high natural ionic content, bottom sea water is cold, and the rocket fuel has a binder. Thus ammonium perchlorate dissolves slowly in water to form ammonium ions (NH_4^+) and perchlorate ions (ClO_4^-). Ammonium ions are naturally-occurring, are used as nutrients by many organisms, and pose no environmental hazard. Perchlorate organic materials (e.g. wood, dead biomass) oxidizing the organic materials and becoming a progressively weaker oxidizing agent.

ClO_4	$\rightarrow$	ClO_3^-	$\rightarrow$	ClO_2^-	$\rightarrow$	ClO^-	$\rightarrow$	Cl^-
perchlorate ion		chlorate ion		chlorite ion		hypochlorite ion		chloride ion

The ultimate product is chloride ion, which is abundant naturally and a component of sea salt ($NaCl$). Hypochlorite ion (ClO^-) is bleach.

If a stage containing NH_4ClO_4 falls into deep, cold water the NH_4ClO_4 will dissolve slowly. The NH_4^+ ions will dissolve into the water and cause no trouble. The ClO_4^- will dissolve gradually and oxidize nearby materials (such as Al metal in fuel, structural metals such as steel, metal ions or organics in seawater. If there are organisms in the immediate vicinity and they do not leave, they could be damaged (similarly to the situation where bleach is dumped in water). However, mobile organisms (e.g. fish) are expected to sense the chemicals and leave the vicinity until the chemicals have dispersed.

Because of the presence of organic binder, the fuel will not dissolve rapidly (i.e., near the surface).

At great depths reducing (anaerobic, O_2-deficient, or H_2S-rich) conditions are often present, as shown by the presence of bacteria and other organisms that produce hydrogen sulfide (H_2S). Under reducing conditions, an oxidizing agent such as ClO_4^- would be consumed and rendered harmless rapidly. There is some evidence for biodegradation or oxychloride ions (ClO_4^-, ClO_3^-, ClO_2^-, ClO^-). Bacteria that produce H_2S degrade these oxidized species to chloride ion (Cl^-).

4. Organic Binders

Binders such as polysulfide or hydroxy-terminated polybutadiene are very inert and will gradually break down into harmless materials.

Conclusions

The quantities of chemicals involved are small, most materials are quite nonreactive, and all will be degraded quickly to harmless materials in the environmental (either by reaction with other chemicals in environment or by biodegradation). Environmental effects would be very minor and limited in area.

APPENDIX F
CONCURRENCE LETTERS FROM FEDERAL AGENCIES -- THREATENED AND ENDANGERED SPECIES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

10 JAN 1991

rec.
JAN 14 1991
LO 11am

Mr. Albert Chernoff
Director, Management Support Division
U.S. Department of Energy, Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Chernoff:

International Technology Corporation (IT) is in the process of preparing an environmental assessment for the development and use of the Sandia National Laboratories' Kauai Test Facility (Facility) at Barking Sands, Hawaii. Ms. Lucille Bambrey of IT has provided us copies of botanical, ornithological, and sea turtle survey reports. In addition, we have reviewed biological assessments prepared by the Army for both the Strategic Target Systems Project (STARS) and the Exoatmospheric Discrimination Experiment (EDX)

After review of the documents and other information in our files, it is our belief that listed species of plants and animals which may be found in the vicinity of the Facility will not be adversely affected by the activities proposed at Barking Sands. This is with the understanding that floodlights will only be used on the beach for short periods and for specific purposes. Limiting the use of lights on the beach will help greatly in reducing any chance that nesting or hatchling sea turtles will be disoriented due to the illumination.

Unless significant changes are made in the Facility plans or operations which may affect listed species in ways not addressed in the STARS and EDX documentation and in the three survey reports referenced above, no further consultation with this Service is required.

Thank you for allowing us to review the reports and plans. If we can be of further assistance, please contact us again.

Sincerely yours,

Ernest Kosaka

Ernest Kosaka
Field Office Supervisor
Fish and Wildlife Enhancement

cc: R. Hansen, IT, Englewood, CO

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

TAKE PRIDE IN AMERICA

July 20, 1990

Colonel Arnold H. Gaylor
Deputy for Operations
U. S. Army Strategic Defense Command - Huntsville
P. O. Box 1500
Huntsville, Alabama 35807-3801

Attention: Environmental Office

Dear Colonel Gaylor:

This replies to your July 9, 1990 request for our review of the Biological Assessment for the **Exoatmospheric Discrimination Experiment** (EDX). It was delivered here on July 17, 1990 by Mr. Randy Gallien of your staff.

As noted in the Assessment, there are eight endangered and one threatened species (all animals) which can be found in the general area of the Pacific Missile Range Facility on Kauai. Eight of the species are under this Service's jurisdiction and are the subject of this response; the ninth species, the humpback whale, is under the jurisdiction of the National Marine Fisheries Service.

Two plants that are candidates for listing can also be found within the general project area.

We concur with your determination that the construction and operation of the EDX project will not affect seven of the eight species. These are the:

- Hawaiian coot
- Hawaiian common moorhen
- Hawaiian stilt
- Hawaiian duck
- Hawaiian hoary bat
- Hawaiian monk seal
- Green sea turtle

We also concur with your determination that although the eighth listed species, the threatened Newell's Townsend's shearwater, may fly over the site and may be affected by the lights as described in the Assessment, the mitigation offered of shading the lights and other measures to reduce upward light will greatly reduce the chances for birds being adversely affected to any appreciable degree. We recommend that the following mitigation be implemented to further reduce the chances for any adverse impact on shearwaters:

1. Unless absolutely necessary, flood lights and other non-essential lights should be extinguished during the few weeks each year when fledgling shearwaters fly from the upper interior portions of Kauai to the sea. This period is usually in the early Fall (October). The State's District Wildlife Biologist in Lihue can be consulted annually for more specific dates.

2. Although the security fence planned as part of the project will aid any shearwaters which may land within fenced areas by excluding such predators as dogs, the birds may fly into the fences if they are flying at low elevations. Security guards and other appropriate staff should be instructed to inspect fence lines during the fledging season and pick up any grounded shearwaters. Shearwaters can be turned over to "aid stations" established around the island during those weeks to collect, treat, and release "fallout" fledglings. A record of any such birds collected should be provided to the State's District Biologist and to this office.

The Assessment also identified that two species of plants which are Category 1 candidates for listing as endangered (Ophioglossum concinnum and Sesbania tomentosa) can be found within the Barking Sands facility. Of these, only Ophioglossum will be affected by the proposal. We were pleased that you adjusted your project design so that as few of these plants as possible will be adversely affected. The transplanting program helps to mitigate the loss of plants which will be destroyed during construction.

Both of the candidate plants are scheduled to be proposed for listing as endangered in 1992. Once a species is proposed for listing, you must consider the possible impacts of any further federal actions on them and may be required to formally confer with this Service.

Thank you for allowing us to review your proposal. Should you have any questions or comments, please contact us again.

Sincerely yours,

William R. Kramer
Acting Field Office Supervisor
Fish and Wildlife Enhancement

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

DENVER

TAKE PRIDE IN AMERICA

July 20, 1990

Colonel Arnold H. Gaylor
Deputy for Operations
U. S. Army Strategic Defense Command - Huntsville
P. O. Box 1500
Huntsville, Alabama 35807-3801

Attention: Environmental Office

Dear Colonel Gaylor:

This replies to your July 9, 1990 request for our review of the Biological Assessment for the **Strategic Target Systems** (STARS) project. It was delivered here on July 17, 1990 by Mr. Randy Gallien of your staff.

As noted in the Assessment, there are eight endangered and one threatened species (all animals) which can be found in the general area of the Pacific Missile Range Facility on Kauai. Eight of the species are under this Service's jurisdiction and are the subject of this response; the ninth species, the humpback whale, is under the jurisdiction of the National Marine Fisheries Service.

Two plants that are candidates for listing can also be found within the general project area.

We concur with your determination that the construction and operation of the STARS project will not affect seven of the eight species. These are the:

- Hawaiian coot
- Hawaiian common moorhen
- Hawaiian stilt
- Hawaiian duck
- Hawaiian hoary bat
- Hawaiian monk seal
- Green sea turtle

We also concur with your determination that although the eighth listed species, the threatened Newell's Townsend's shearwater, may fly over the site and may be affected by the lights as described in the Assessment, the mitigation offered of shading the lights and other measures to reduce upward light will greatly reduce the chances for birds being adversely affected to any appreciable degree. We recommend that the following mitigation be implemented to further reduce the chances for any adverse impact on shearwaters:

1. Unless absolutely necessary, flood lights and other non-essential lights should be extinguished during the few weeks each year when fledgling shearwaters fly from the upper interior portions of Kauai to the sea. This period is usually in the early Fall (October). The State's District Wildlife Biologist in Lihue can be consulted annually for more specific dates.

2. Although the security fence planned as part of the project will aid any shearwaters which may land within fenced areas by excluding such predators as dogs, the birds may fly into the fences if they are flying at low elevations. Security guards and other appropriate staff should be instructed to inspect fence lines during the fledging season and pick up any grounded shearwaters. Shearwaters can be turned over to "aid stations" established around the island during those weeks to collect, treat, and release "fallout" fledglings. A record of any such birds collected should be provided to the State's District Biologist and to this office.

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Both of the candidate plants are scheduled to be proposed for listing as endangered in 1992. Once a species is proposed for listing, you must consider the possible impacts of any further federal actions on them and may be required to formally confer with this Service.

Thank you for allowing us to review your proposal. Should you have any questions or comments, please contact us again.

Sincerely yours,

William R. Kramer

William R. Kramer
Acting Field Office Supervisor
Fish and Wildlife Enhancement

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
300 South Ferry Street
Terminal Island, CA 90731

July 24, 1990 F/SWR14:ETN

Colonel Arnold H. Gaylor
Deputy for Operations
U.S. Army Strategic Defense
Command - Huntsville
P.O. Box 1500
Huntsville, AB 35807-3801

Dear Colonel Gaylor:

This responds to your requests of July 9, 1990 to review the Biological Assessments (BA) for the Strategic Target System (STARS) and the Exoatmospheric Discrimination Experiment (EDX) under Section 7 of the Endangered Species Act of 1973, as amended, for potential impacts to listed species. The species list provided to you on April 20, 1990 for these projects and used in the Assessments remains valid for the purposes of this evaluation.

Humpback whales (Megaptera novaeangliae) are found around the main Hawaiian Islands during the winter breeding season from December through May, usually in waters less than 100 fathoms. Although humpback whales have been observed from Barking Sands, they can be found throughout the 100 fathom isobath around Kauai.

Hawaiian monk seals (Monachus schauinslandi) are occasionally reported from the main Hawaiian Islands. Consistent sightings of 1 to 3 monk seals have been reported from Kauai over the past four years. Solitary animals typically haul out at sites randomly around the Island.

Green turtles (Chelonia mydas) are distributed throughout the main Hawaiian Islands. While green turtles are commonly observed in waters around Kauai little is known about benthic resting habitat and intertidal and subtidal foraging areas there. Occasional nesting also occurs on Kauai, and one confirmed nesting was reported from the beach fronting base housing at the Pacific Missile Range Facility (PMRF), which is located at the opposite end of the base from the proposed projects.

The EDX program involves the use of the ARIES booster to launch optical sensing packages into the exoatmosphere to observe target vehicles during the mid-course of their trajectory. There would be a total of nine launches over a three year period from the Kauai Test Facility at the PMRF, Barking Sands, Kauai. A new launch pad, mission control center/payload assembly building and other associated infrastructure would be built within the Sandia Laboratory's Kauai Test Facility which houses similar launch facilities. This new construction is sufficiently removed from known terrestrial and aquatic habitats of Hawaiian monk seals and green turtles that it is not likely to affect either species. Launches of the booster and sensor packages would not likely affect these species for the same reason. The proposed impact area is sufficiently distant from known winter habitat of humpback whales around Kauai that booster impact and payload recovery activities would not likely affect humpback whales.

The STARS project consists of surplus Polaris A3 first and second stage motors, various payloads such as sensors, interceptors, or target simulators, and the necessary infrastructure at the Kauai Test Facility to support an average of four launches per year for ten years beginning in 1991. The project is part of a larger research program within the Strategic Defense Initiative to determine the feasibility of developing an effective ballistic missile defense system. New construction to support this project would be within the Kauai Test Facility at PMRF and would not affect any of the species listed above. Launches of the STARS systems will not likely affect these same species. As with the EDX system, the impact area for the first stage booster from the STARS vehicle is sufficiently removed from known winter habitat of humpback whales around Kauai so that first stage booster impact at approximately 74 miles from PMRF would not likely affect humpback whales.

Based on the best available information and that provided in the Biological Assessments we concur with your findings that the EDX and STARS projects as described will not likely adversely affect humpback whales, Hawaiian monk seals, or green turtles. The inclusion of impact area monitoring by PMRF and delaying the launch if humpback whales are observed in the zone will further ensure that humpback whales are not adversely affected by these projects. This concludes the Section 7 consultation process for these projects. Please contact Mr. Eugene T. Nitta, Protected Species Branch, Pacific Area Office, 2570 Dole St., Honolulu, HI 96822-2396 (Tel. 808/955-8831) should there be any further questions.

Sincerely,

[signature]

for E.C. Fullerton
Regional Director

cc: F/SWR14, Nitta

APPENDIX G
CONCURRENCE LETTERS FROM STATE HISTORIC PRESERVATION OFFICER (SHPO) -- CULTURAL RESOURCES

JOHN WAIHEE
GOVERNOR OF HAWAII

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
KEITH W. AHUE
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER RESOURCE MANAGEMENT

REF:HP-AAL

JAN 30 1991

rec. FEB 04 1991 LD Kaua

Albert Chernoff, Director
Management Support Division
Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Chernoff:

SUBJECT: National Historic Preservation Act Compliance -- Revisions to Archaeological Survey and Testing Report Department of Energy, Kauai Testing Facility (Advance Science, Inc. and International Archaeological Research Institute, Inc. August 1990) Sandia National Laboratories Mana, Waimea, Kauai

We received a fax on January 4, 1991, from Advance Science, Inc. which includes revised and amended pages from the above report per our letter (dated 10/5/90) to you. The original pages will be forthcoming. It is our understanding that our letter (dated 10/5/90) to you, also needs to be corrected. We added the acronym: EDX. Our apologies, this is incorrect.

We can now consider the report final. Archaeological testing has occurred in various areas, and some deposits were found near bore holes 3 and 4. In the future, it is our understanding that if any new areas will have land disturbing activities (outside of the previously studied areas), additional archaeological subsurface testing will occur. We are particularly concerned that this occur if any activities are to occur near bore holes 3 and 4. This testing would be done to determine if sites are present.

On February 15, 1991, a launch is scheduled for KTF. It is our understanding that these types of launches have taken place since ca. 1963. Therefore, we believe that this continued use of the launch areas will have "no adverse effect" on significant historic sites, since no new ground disturbance will take place.

If you have any questions regarding this matter, please contact Ms. Nancy McMahon our staff archaeologist for the County of Kauai at 587-0006.

Very truly yours,

WILLIAM W. PATY
Chairperson and State
Historic Preservation Officer

APPENDIX H
HAWAII STATE COASTAL ZONE MANAGEMENT COMPLIANCE LETTER

OFFICE OF STATE PLANNING
Office of the Governor
STATE CAPITOL, HONOLULU, HAWAII 96813 TELEPHONE (808) 548-5893
JOHN WAIHEE, Governor

Ref. No. P-1691

February 11, 1991

Mr. Albert Chernoff
Director
Management Support Division
Department of Energy
P.O. Box 5400
Albuquerque, New Mexico 87110

Attention: Mr. Richard Gonzales

Dear Mr. Chernoff:

Subject: Environmental Assessment for the Kauai Test Facility Two Experiment Rocket Campaign, Pacific Range Facility, Kauai, Hawaii

We have reviewed the subject environment assessment (EA) and have the following comments.

It is our understanding from the EA and the briefing meeting held on January 30, 1991, by Richard Gonzales of your staff, that these two launches are not part of either the STARS or EDX projects. Rather, the launches are part of the ongoing launch program at the Kauai Test Facility (KTF) and Pacific Missile Range Facility (PMRF) since 1962. The launch activities have been categorically excluded from individual EA review which expired in 1990. Because the categorical exclusion is not anticipated to be renewed until March 1991, and satellite opportunities are present in February 1991, an individual EA has been prepared for the two launches. None of the ground hazard area to be closed will extend beyond the boundaries of PMRF and that no State beaches or parks will be closed as a result of the launches. Also, solid fuel boosters and motors will be flown directly into PMRF by military aircraft. On this basis, we have no objections to the EA and proposed FONSI.

Section 4.7, page 13 of the EA contains a Coastal Zone Management (CZM) Federal consistency determination for the KTF and the PMRF. We have no objections to the CZM determination as it applies to the two rocket launches subject to the EA.

Mr. Albert Chernoff
Page 2
February 11, 1991

Thank you for your continued cooperation and compliance with Hawaii's CZM Program. If there are any questions, please call our CZM office at (808) 548-5973.

Sincerely,

Harold S. Masumoto
Director

cc: Dr. Bruce Anderson, Deputy Director of Health
Mr. Roger Evans, Department of Land and Natural Resources
County of Kauai Planning Department
Mr. John Naughton, National Marine Fisheries Service

Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P.O. Box 5400
Albuquerque New Mexico 87115

MAR 15 1991

Mr. Harold S. Masumoto, Director
Office of State Planning
Office of the Governor
State Capitol, Room 406
Honolulu, Hawaii 96813

Dear Mr. Masumoto:

Ref: Kauai Test Facility Hawaii Coastal Zone Management Program Federal Consistency Review

The U.S. Department of Energy (DOE), Kirtland Area Office, Albuquerque is seeking a review by the Office of State Planning of its determination under 307 (c)(1) of the Coastal Zone Management Act and 15 CFR Part 930, Subpart C that the continued operation of the Kauai Test Facility (KTF) on the island of Kauai will be conducted in a manner which is, to the maximum extent practicable, consistent with the Hawaii Coastal Zone Management Law and the Hawaii Coastal Zone Management Program (HCZMP).

In completing the enclosed Hawaii CZM Program Assessment Form, we have relied on our draft of the KTF Environmental Assessment (EA) which is in the process of being completed. EA subsections and figures referred to in the assessment form are also enclosed.

The KTF commenced operations in 1962 and became a permanent part of the nation's Test Readiness Program in 1963. From 1962 through 1990, 320 rockets were launched from the KTF. The current average launch activity consists of four to five rail launched per year.

The U.S. Army Strategic Defense Command is proposing to conduct experimental vertical rocket launch activities associated with the Strategic Target Systems (STARS) and the Exoatmospheric Discrimination Experiment (EDX) at the KTF. However, these activities are addressed in separate individual Stars and EDX EAs prepared by the Army. The Army has also completed a STARS and EDX CZM Program Assessment Form for review by your office (see Letter of July 23, 1990 to Mr. John Nakagawa from Colonel Arnold H. Gaylor). Thus, the consistency review we are seeking is for the KTF as a facility which accommodates a number of diverse experimental rocket launch programs.

As the Assessment Form and the enclosed material document, we feel that continued operation of the KTF will be conducted in a manner consistent with HCZMP objectives and policies on recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, and managing development.

We would appreciate your expediting this review if at all possible. If there is need for any further assistance please contact R. F. Gonzales of this office at (505) 845-6091.

Thomas Bolyde
for Albert R. Chernoff
Area Manager
Kirtland Area Office

Enclosure

cc w/enclosure:
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APPENDIX I
SOUND LEVEL MODELING METHODOLOGY
FOR KTF ROCKET LAUNCHES

APPENDIX I

SOUND LEVEL MODELING METHODOLOGY FOR KAUAI TEST FACILITY (KTF) ROCKET LAUNCHES

ACOUSTIC ENVIRONMENTS OF ROCKET EXHAUSTS

One possible harmful effect to a launch facility and its surrounding areas during a rocket launch operation is the acoustic noise field generated by the exhaust flow of the rocket motors during the first few seconds of flight. The acoustic field of a rocket exhaust is divided into three regions:

1. Near-field -- Highly frequency dependent. Occurs at distances within a wavelength.
2. Mid-field -- Part of the radiated field that appears to be originating from a spatially extended sources. Includes all distances on the order of approximately five wavelengths.
3. Far-field -- All distances over 50 nozzle diameters. All sources for the different frequencies appear to be located at a single point.

Since the distances of interest are well over 50 nozzle diameters, a far-field modeling technique was used to predict overall sound pressure levels in dBA.

Far-Field Sound Pressure Level Modeling

The techniques used for modeling the far-field acoustics assume ideal-homogeneous conditions and do not take into account effects due to focusing. Focusing is the convergence of sound waves which are in phase (synchronized) with one another and combine to create a wave of higher amplitude or increased noise level. It should be noted that sound levels listed in this study are not absolutes since the effects of focusing are highly dependent on rocket trajectory and line of sight of the rocket to the receiver.

Techniques for modeling far-field acoustics have been developed at the NASA George Marshall Space Flight Center in Huntsville, Alabama. NASA has developed a series of computer codes specifically for predicting acoustic pressures and power levels for rocket systems given various motor parameters. The agency has used these codes to predict the acoustic environments for different rocket systems including the space shuttle.

NASA has written a program that calculates Octave Band Power Levels (OBPWLs) for rocket systems given various motor parameters. This program has been employed for all the rocket systems listed in Table I.1. All rocket parameters were taken from data sheets found in the Rocket Motor Book. Using the outputs from NASA's program, a separate computer program was used to calculate the far-field pressure levels for each rocket at the given distances (Table I.1).

TABLE I.1

INPUT DATA

Pad	KTF Launch Pad	Kokole Point Launch Pad
Rocket Systems:	Stars Polaris (A3) EDX (Aires) Talos Strypi (Castor with two recruits)	Terrier (Mk 12 Mod 0) Nike
Distances (feet):	600 1200 1240 2000 3000 6500 10000 37000	200 600 1250 2000 3300 11000 28800 35500

A discussion of the equations that are used to predict noise levels at various distances follows below:

The far-field Octave Band Sound Pressure Level (OBSPL) can be calculated for a given rocket system as

$$OBSPL(f_c) = OBPWL(f_c) - 10\log_{10}A - EA(f_c) *x + Q$$

The first two expressions of the above relationship:

$OBPWL(f_c) - 10\log_{10}A$

convert the Octave Band Sound Power Level into Octave Band Sound Pressure Level assuming uniform spherical radiation in the absence of attenuation. The last three variables:

$- EA(f_c) * x + Q$

are corrections for non-uniform directivity and atmospheric attenuation.

Where:

A (Reference Area) = $4*pi*R^2$

where R is the distance in meters from the source to the observation point.

$EA(f_c)$ (Excess Attenuation) - Atmospheric Absorption Coefficient as a function of frequency per 1000 ft (see Figure I-1). The values listed are values for conditions at Vandenburg Airforce Base and are expected to be a good approximation for conditions at Kauai.

x - the distance in feet from the source to the observation point.

Q (Maximum Directivity = 7 dB) - An empirical value corresponding to radiation at the conical angle of maximum directivity. Although directivity is a function of frequency, 7 dB is a practical estimate of the maximum expected octave band level at all frequencies.

$OBPWL(f_c)$ (Octave Band Power Level (re: 10^{-12} Watts)) - Calculated from NASA computer program given various motor parameters.

where:

$OBPWL(f_c) = NSL(f_c) + OBPWL - 10\log_{10}(V_e/D_e) + 10\log_{10}(0.707*f_c)$

where:

$NSL(f_c)$ (Normalized Spectrum Level) - Determined from rocket motor experimental data that has been normalized given an engine type and Strouhal Number (SN).

OBPWL (Overall Acoustic Power) = $10\log_{10}(A_{oa}/(10^{-12}))$

A_{oa} (Acoustic Power) = $0.678*TT*V_e*Eff$

TT (Total Thrust) - Total Thrust of System in pounds.

SN (Strouhal Number) = $(f_c*D_e)/V_e$

V_e (Engine Exhaust Velocity) - Engine Exhaust Velocity in feet per second.

Eff (Acoustic Efficiency = 0.5%) - Acoustic Efficiency increases with mechanical power. However, the rate of increase diminishes with higher mechanical power levels and finally asymptotically approaches a constant value slightly higher than 0.5 percent. Given the mechanical power produced by the motors launched from KTF, 0.5 percent is considered to be a conservative value for this analysis.

D_e (Effective Diameter) - Effective engine diameter in square feet. If a system contains more than one engine, then D_e is equal to the square root of the number of engines multiplied by a single engine's area.

Once the OBSPL is calculated, the levels can be converted to dBA levels by arithmetically adding an "A-Scale weighting factor." These values are listed in Table I.2.

Table I.2

A-Scale Weighting Factors

Octave Band Center Frequency (Hz)	A-Scale Weighting Factors
63	-26
125	-16
250	-9
500	-3
1000	0
2000	1
4000	1
8000	-1

After the spectrum has been adjusted to the A-Scale, an overall maximum noise level at launch can be calculated through logarithmic decibel addition.

The results of this study for the various motors are listed in Tables I.3 and I.4. The OBPWL for each motor is plotted in Figure I.2 and I.3. Figures I.4 and I.5 show the power levels as a function of time for the two "loudest" rocket motors (the Terrier and Strypi) launched from Kokole Point and the main launch facility. The two rocket systems were assumed to be launched at a 90 degree QE. The altitudes are based on trajectory simulations for the Have-List-Terrier-Tomohawk and Bowshock-Strypi I vehicles.

Table I.3

Maximum Far-Field Overall Sound Levels (dBA) for the KTF Launch Pad

Distance	STARS	EDX	Talos	STRYPI
600	122.23	122.31	129.08	130.57
1200	115.76	115.84	122.47	123.97
1240	115.44	115.52	122.15	123.65
2000	110.74	110.82	117.28	118.78
3000	106.54	106.61	112.85	114.36
6500	97.72	97.76	103.34	104.86
10000	92.20	92.21	97.26	98.78
37000	71.65	71.39	74.92	76.09

Table I.4

Maximum Far-Field Overall Sound Levels (dBA) for the Kokole Point Launch Pad

Distance	Terrier	Nike
200	138.40	134.64
600	128.46	124.70
1250	121.45	117.68
2000	116.66	112.88
3300	111.15	107.36
11000	95.20	91.40
28800	78.67	75.15
35500	74.48	71.10

FIGURE I-1
Atmospheric Absorption Coefficients

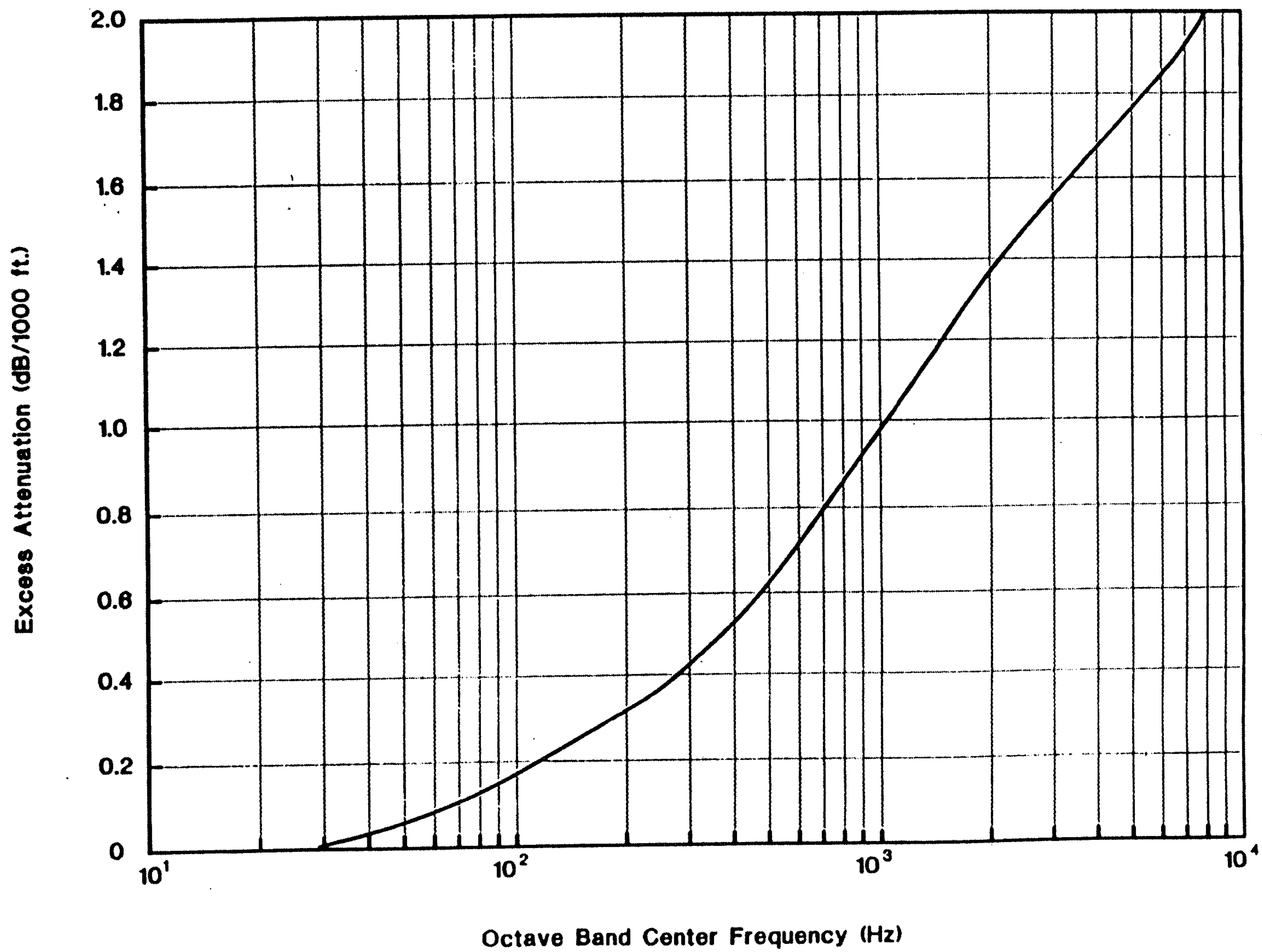


FIGURE I-2
Sound Power Levels for Kauai Test Facility Launch Pad

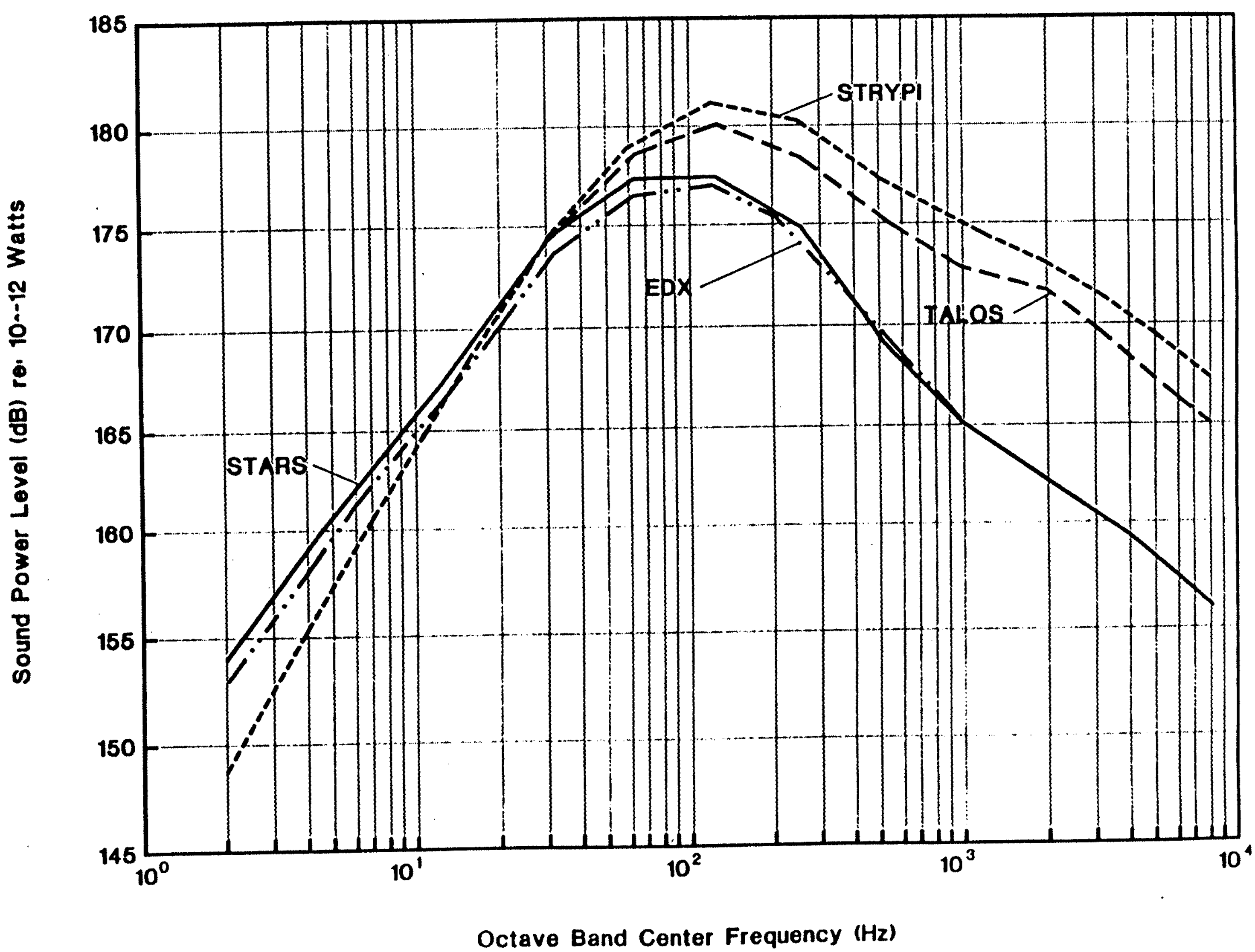


FIGURE I-3
Sound Power Levels for Kauai Test Facility Launch Pad

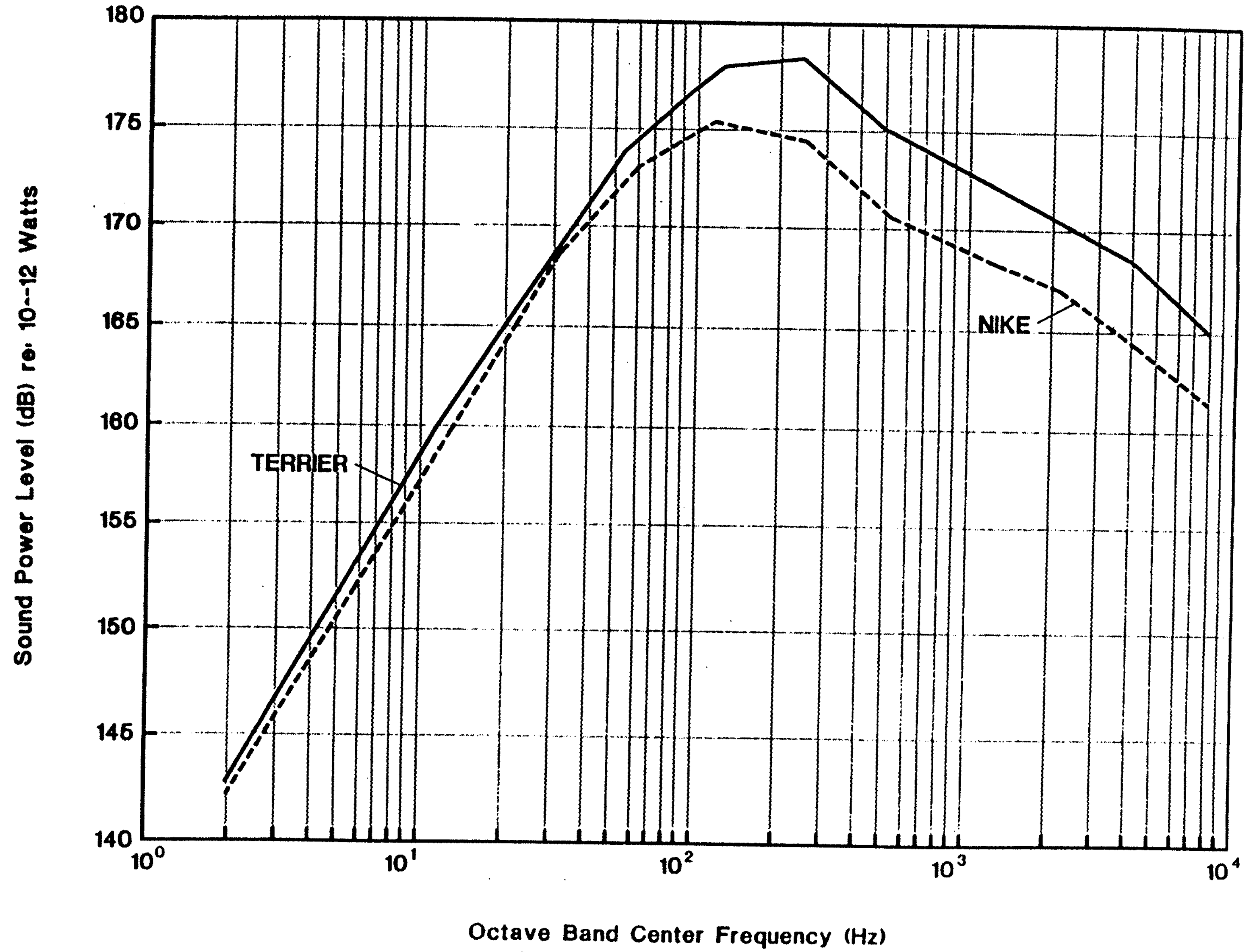


FIGURE I-4
Terrier Sound Levels 1,250 Feet From Launch Pad

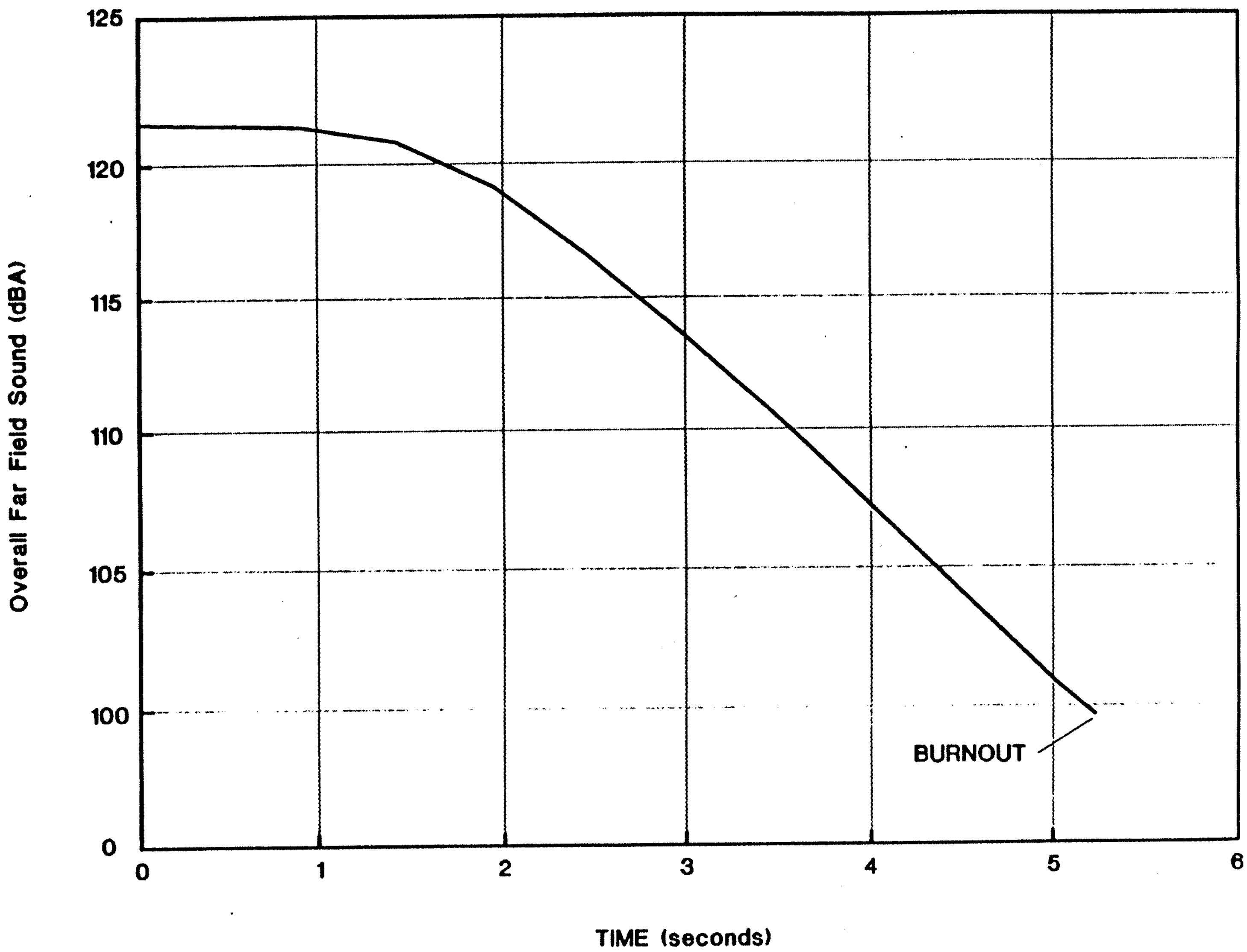
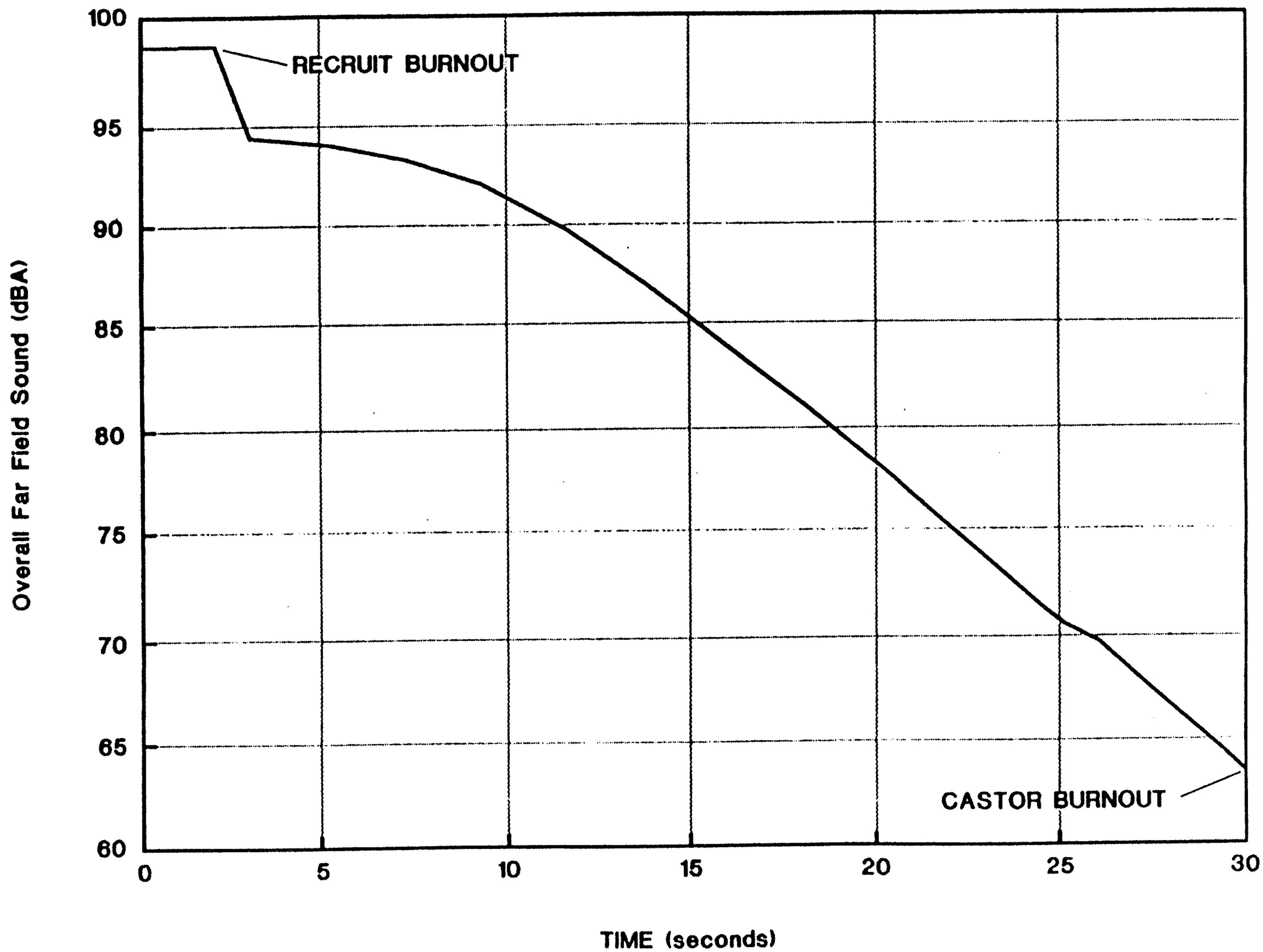


FIGURE I-5
STRYPI Sound Levels 10,000 feet from Launch Pad



APPENDIX J
SOIL SAMPLING DATA

J.1 SOIL SAMPLING PROGRAM FOR KTF

J.2 LEAD CONTAMINATION ACTION LEVELS FOR SOILS

APPENDIX J.1

SOIL SAMPLING PROGRAM FOR SANDIA NATIONAL LABORATORIES KAUAI TEST FACILITY, KAUAI, HAWAII AUGUST 1990

INTRODUCTION

Kauai, with a total area of 627 square miles, is the fourth largest of the eight main islands of the Hawaiian archipelago (University of Hawaii, 1983). The Pacific Missile Range Facility (PMRF) stretches eight miles along the western coast of Kauai on the Mana Plain from Kokole Point on the south to Nohili Point on the north. The PMRF comprises 1,925 acres, with the Kauai Test Facility (KTF) at its northern end near Nohili Point occupying approximately 133 acres directly south/southeast of the Barking Sands dunes. In addition, a small facility at Kokole Point is under the jurisdiction of KTF.

KTF has been operated by Sandia National Laboratories since 1962. It is used to test rocket systems with science and technology payloads, to advance development of maneuvering target vehicles, to study the atmosphere and the exoatmosphere, and to support other programs (Helgeson, 1990). Existing support facilities at the Nohili Point site include a wind radar site, missile launchers, maintenance operations facilities, a warehouse and shipping/receiving building, and three missile assembly buildings. The Kokole Point site has one launch site and a small support trailer.

Since 1962, approximately 320 rocket systems have been launched from the KTF (U.S. Department of Army, 1990a). Some of the rocket systems were propelled by fuels containing substances (lead, aluminum, and beryllium) which could, if present in the soil in sufficient concentrations, have deleterious impacts on the KTF environment or human health.

SOIL SAMPLING PROGRAM

The subject of this report is the soil sampling program that was undertaken at the KTF in August 1990. Its purpose was to delineate the extent and concentration of lead, aluminum, and beryllium in the soil at the KTF, and to determine whether such concentrations pose a threat to human health or the environment. The soil sampling analysis results were used to estimate the potential for future soil contamination or human exposure resulting from the routine use of the KTF as a launch facility.

Sampling

Soil samples were collected on a regular grid (primarily a 100-foot by 100-foot spacing) over the portion of the Nohili Point KTF field that has been used for launches during the past 26 years (Figure J-1). Most samples were taken from the ground surface (0 to 6 inches). A few samples were taken at depths of up to 24 inches. Approximately 5 percent (1 in 20) of the samples taken were duplicate samples, or field replicates. In addition, extra samples were taken near launch pads 12, 14, and 19, and from the field area south and east of the launch sites.

The Kokole Point KTF area soils were also sampled and analyzed for lead, aluminum, and beryllium (see inset, Figure J-1). A background sample (Table J.1, Sample SNLA-003281) was taken on the PMRF, but away from both launch areas and roads. Town site samples were taken from Kekaha (Table J.1, Sample SNLA-003216) and from Mana (Table J.1, Sample SNLA-003217). Mana and Kekaha are the two nearest off-base areas of human habitation.

Protocols

Strict environmental sampling protocols were observed, including collection and analysis of field replicates, chain-of-custody documentation, and decontamination of equipment between samples. A detailed sampling and analysis plan was prepared.

Chemical Analysis

The samples were analyzed at an EPA contract laboratory (ENCOTEC) for total lead, aluminum, and beryllium. The laboratory employed a quality control program to assess the precision and accuracy of analyses, and utilized EPA analysis method 6010 as listed in EPA SW-846 (EPA, 1986), with a modified sample dissolution technique appropriate to the samples. The soil samples are archived at Sandia National Laboratories in Albuquerque should additional information or analyses be required.

Modified SW-846 Sample Digestion Method

SW-846 sample digestion procedure 3050 was modified in order to increase the dissolution of metals, thereby effectively lowering the detection limits for the analytes. The modified method dissolved 10 grams (gm) of sample in acid to yield 200 milliliters (ml) final volume. The method was arrived at after tests with the actual KTF soil samples to ensure that this method would yield uniform dissolution for the KTF soil type.

Data Analysis Results

Chemical analysis results are reported in Table J.1. Beryllium was not detected in any sample. The detection limit for beryllium was 0.25 milligrams/kilograms (mg/kg).

Lead values in the background sample and town site samples ranged from less than the detection limit of 1.0 mg/kg to 11 mg/kg. Lead values for the Nohili Point KTF field range from less than 1.0 mg/kg (undetected) to 270 mg/kg. Of 266 samples, 215 had values within the range of the background and town site samples. Lead values for the 12 Kokole Point KTF samples ranged from less than 1.0 mg/kg (undetected) to 5.9 mg/kg.

Aluminum values for the background and town site samples ranged from 3,040 mg/kg (SNLA-003216, from Kekaha) to 14,350 mg/kg (SNLA-003217, from Mana). Analysis of the background sample from PMRF (SNLA-003281) showed 3,240 mg/kg. The detection limit for aluminum was 10 mg/kg. Nohili Point KTF soil aluminum values ranged from 1,100 mg/kg to 8,840 mg/kg. Kokole Point KTF samples had aluminum values ranging from 795 mg/kg to 1,910 mg/kg.

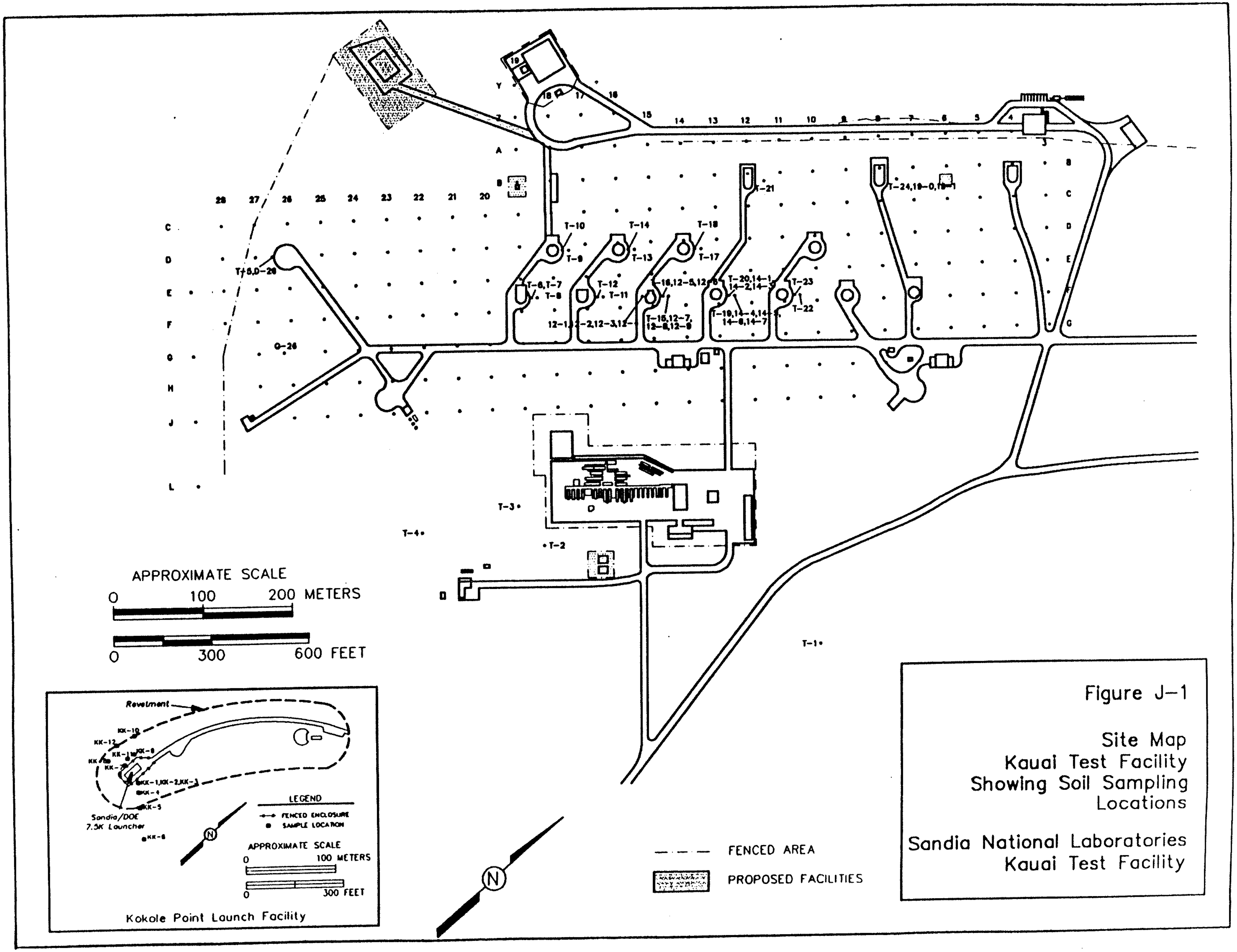


Figure J-1

Site Map
Kauai Test Facility
Showing Soil Sampling
Locations

Sandia National Laboratories
Kauai Test Facility

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003001	A-19	1.7	3970	U
SNLA-003002	A-17	5.5	3300	U
SNLA-003003	A-16	U	3150	U
SNLA-003004	A-14	2.1	3730	U
SNLA-003005	A-15	1.1	3740	U
SNLA-003006	A-13	1.1	3700	U
SNLA-003007	A-12	U	3790	U
SNLA-003008	A-11	1.6	3360	U
SNLA-003009	A-10	U	2910	U
SNLA-003010	A-9	1.2	3500	U
SNLA-003011	A-8	2.1	4050	U
SNLA-003012	A-7	1.9	3920	U
SNLA-003013	A-6	1.2	3830	U
SNLA-003014	A-5	1.3	2230	U
SNLA-003015	A-4	U	2720	U
SNLA-003016	B-3	1.2	3990	U
SNLA-003017	B-4	2.0	2400	U
SNLA-003018	B-5	U	2350	U
SNLA-003019	B-6	1.3	3120	U
SNLA-003020	B-7	82	3210	U
SNLA-003021	B-8	43	4120	U
SNLA-003022	B-9	1.9	3030	U
SNLA-003023	B-9	2.4	2880	U
SNLA-003024	B-10	1.8	2990	U
SNLA-003025	B-11	7.2	2980	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003026	B-12	5.8	4290	U
SNLA-003027	B-13	1.4	3110	U
SNLA-003028	B-14	1.1	3970	U
SNLA-003029	B-15	U	3790	U
SNLA-003030	B-16	1.8	3870	U
SNLA-003031	B-17	1.7	3890	U
SNLA-003032	B-18	1.7	4020	U
SNLA-003033	A-18	2.4	2660	U
SNLA-003034	B-19	1.8	2890	U
SNLA-003035	C-3	2.0	3550	U
SNLA-003036	C-4	1.1	2350	U
SNLA-003037	C-5	1.4	1690	U
SNLA-003038	C-6	U	3100	U
SNLA-003039	C-7	23	2550	U
SNLA-003040	C-8	131	2750	U
SNLA-003041	C-9	2.0	5230	U
SNLA-003042	C-9	3.2	5400	U
SNLA-003043	C-10	U	5170	U
SNLA-003044	C-11	U	3190	U
SNLA-003045	C-12	3.0	6940	U
SNLA-003046	C-13	6.1	5380	U
SNLA-003047	C-14	1.9	4140	U
SNLA-003048	C-15	1.1	3460	U
SNLA-003049	C-16	4.2	3820	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003050	C-17	1.0	3800	U
SNLA-003051	C-18	1.7	3470	U
SNLA-003052	C-19	1.0	3740	U
SNLA-003053	C-20	U	3370	U
SNLA-003054	C-21	2.9	3590	U
SNLA-003055	C-22	2.7	3100	U
SNLA-003056	C-23	1.4	3390	U
SNLA-003057	C-24	U	2290	U
SNLA-003058	C-25	1.4	2700	U
SNLA-003059	C-26	20	1740	U
SNLA-003060	D-26	44	2700	U
SNLA-003061	D-25	3.4	2200	U
SNLA-003062	D-25	4.0	1920	U
SNLA-003063	D-24	1.0	3040	U
SNLA-003064	D-23	1.0	4540	U
SNLA-003065	D-22	U	2880	U
SNLA-003066	D-21	4.2	4290	U
SNLA-003067	D-20	U	4190	U
SNLA-003068	D-19	1.3	4220	U
SNLA-003069	D-18	30	2800	U
SNLA-003070	D-17	U	4060	U
SNLA-003071	D-16	32	1100	U
SNLA-003072	D-15	1.3	3840	U
SNLA-003073	D-14	7.3	2260	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003074	D-13	3.8	3380	U
SNLA-003075	D-12	3.4	4750	U
SNLA-003076	D-11	U	2980	U
SNLA-003077	D-10	7.9	3210	U
SNLA-003078	D-9	1.7	6550	U
SNLA-003079	D-8	2.1	3320	U
SNLA-003080	D-7	1.9	3650	U
SNLA-003082	D-6	21	2840	U
SNLA-003083	D-6	16	3260	U
SNLA-003084	D-5	U	2790	U
SNLA-003085	D-4	U	2940	U
SNLA-003086	D-3	U	4040	U
SNLA-003087	E-3	1.2	3720	U
SNLA-003088	E-4	2.2	6520	U
SNLA-003089	E-5	U	2900	U
SNLA-003090	E-6	U	2550	U
SNLA-003091	E-7	1.0	2940	U
SNLA-003092	E-9	U	4810	U
SNLA-003093	E-8	39	2760	U
SNLA-003094	E-10	4.2	2720	U
SNLA-003095	E-11	6.3	4170	U
SNLA-003096	E-12	2.2	3530	U
SNLA-003097	E-13	12	6580	U
SNLA-003098	E-14	13	3500	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003099	E-15	8.4	5060	U
SNLA-003100	E-16	1.1	3340	U
SNLA-003101	E-16	2.4	3930	U
SNLA-003102	E-17	4.7	5070	U
SNLA-003103	E-18	5.4	3770	U
SNLA-003104	E-19	3.6	3930	U
SNLA-003105	E-20	3.3	4030	U
SNLA-003106	E-21	U	3060	U
SNLA-003107	E-22	U	3040	U
SNLA-003108	E-23	1.0	3860	U
SNLA-003109	E-24	U	2730	U
SNLA-003110	E-25	5.5	2790	U
SNLA-003111	E-26	2.2	2660	U
SNLA-003112	E-27	21	2980	U
SNLA-003113	F-27	U	2860	U
SNLA-003114	F-26	U	2710	U
SNLA-003115	F-25	2.5	3200	U
SNLA-003116	F-24	10	2460	U
SNLA-003117	F-23	U	3820	U
SNLA-003118	F-22	U	5700	U
SNLA-003119	F-21	1.3	3000	U
SNLA-003120	F-20	U	4740	U
SNLA-003121	F-19	48	3870	U
SNLA-003122	F-18	12	5110	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003123	F-17	59	8840	U
SNLA-003124	F-17	61	7830	U
SNLA-003125	F-16	8.7	4620	U
SNLA-003126	F-15	4.6	5060	U
SNLA-003127	F-14	14	4303	U
SNLA-003128	F-13	270	2620	U
SNLA-003129	F-12	107	4050	U
SNLA-003130	F-11	220	1470	U
SNLA-003131	F-10	21	4340	U
SNLA-003132	F-9	U	1140	U
SNLA-003133	F-8	U	3503	U
SNLA-003134	F-7	6.0	2110	U
SNLA-003135	F-6	1.5	3350	U
SNLA-003136	F-5	1.5	3500	U
SNLA-003137	F-4	U	5770	U
SNLA-003138	F-3	7.8	2710	U
SNLA-003139	G-3	2.1	5120	U
SNLA-003140	G-4	1.3	3950	U
SNLA-003141	G-5	U	3310	U
SNLA-003142	G-6	10.5	3820	U
SNLA-003143	G-7	13	7480	U
SNLA-003144	G-8	1.7	4780	U
SNLA-003145	G-9	2.2	2930	U
SNLA-003146	G-10	4.2	4230	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003147	G-11	9.6	3440	U
SNLA-003148	G-12	5.0	4790	U
SNLA-003149	G-13	5.8	3940	U
SNLA-003150	G-14	8.1	3180	U
SNLA-003151	G-15	22	4380	U
SNLA-003152	G-15	33	6490	U
SNLA-003153	G-16	7.8	3450	U
SNLA-003154	G-17	1.8	4330	U
SNLA-003155	G-18	6.4	3270	U
SNLA-003156	G-19	1.1	3390	U
SNLA-003157	G-20	2.6	3990	U
SNLA-003158	G-21	1.7	1580	U
SNLA-003159	G-22	4.0	4210	U
SNLA-003160	G-23	3.1	4160	U
SNLA-003161	G-24	1.0	2330	U
SNLA-003162	G-25	1.7	2870	U
SNLA-003163	G-26	U	2540	U
SNLA-003164	G-27	U	3660	U
SNLA-003165	H-27	2.2	2860	U
SNLA-003166	H-26	U	1940	U
SNLA-003167	H-25	U	3490	U
SNLA-003168	H-24	3.9	3880	U
SNLA-003169	H-23	4.3	2460	U
SNLA-003170	H-22	2.0	3015	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003171	H-21	2.3	3450	U
SNLA-003172	H-20	2.4	3072	U
SNLA-003173	H-19	1.9	2670	U
SNLA-003174	H-18	2.5	3260	U
SNLA-003175	H-18	1.7	3290	U
SNLA-003176	H-17	2.9	2790	U
SNLA-003177	H-16	4.6	4600	U
SNLA-003178	H-15	3.1	2490	U
SNLA-003179	H-13	4.2	4560	U
SNLA-003180	H-12	5.6	3400	U
SNLA-003181	H-11	22	3380	U
SNLA-003182	H-11	18	5160	U
SNLA-003183	H-10	2.2	3350	U
SNLA-003184	H-9	2.5	3600	U
SNLA-003185	H-8	19	4270	U
SNLA-003186	H-7	U	3950	U
SNLA-003187	J-8	3.5	3090	U
SNLA-003188	J-9	2.1	6230	U
SNLA-003189	J-10	3.0	3590	U
SNLA-003190	J-11	4.8	4460	U
SNLA-003191	J-12	4.6	4230	U
SNLA-003192	J-13	1.9	2910	U
SNLA-003193	J-14	U	3060	U
SNLA-003194	J-15	3.4	3350	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003195	J-16	U	3080	U
SNLA-003196	J-17	1.0	3040	U
SNLA-003197	J-18	U	2760	U
SNLA-003198	J-19	1.0	3200	U
SNLA-003199	J-20	U	3090	U
SNLA-003200	J-21	2.4	3320	U
SNLA-003201	J-22	4.6	3990	U
SNLA-003202	J-23	3.4	3170	U
SNLA-003203	J-24	U	3470	U
SNLA-003204	J-25	13	3550	U
SNLA-003205	J-25	U	3620	U
SNLA-003206	J-26	U	2370	U
SNLA-003207	J-27	4.7	2590	U
SNLA-003208	C-28	1.2	1580	U
SNLA-003209	D-28	U	2770	U
SNLA-003210	E-28	U	2740	U
SNLA-003211	F-28	U	1800	U
SNLA-003212	E-29	U	1480	U
SNLA-003213	G-29	U	1320	U
SNLA-003214	J-29	U	2420	U
SNLA-003215	L-29	U	2070	U
SNLA-003216	Q-1	9.1	3040	U
SNLA-003217	Q-2	11	14350	U
SNLA-003218	T-1	2.4	3410	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003219	T-2	U	3690	U
SNLA-003220	T-3	1.9	4280	U
SNLA-003221	T-4	U	5170	U
SNLA-003222	T-6	25	3730	U
SNLA-003223	T-5	4.7	2310	U
SNLA-003224	T-7	21	3190	U
SNLA-003225	T-8	1.1	4780	U
SNLA-003226	T-9	5.3	4520	U
SNLA-003227	T-10	29	3570	U
SNLA-003228	T-11	17	4620	U
SNLA-003229	T-12	59	4370	U
SNLA-003230	T-13	1.2	5960	U
SNLA-003231	T-14	28	7460	U
SNLA-003232	T-15	12	6180	U
SNLA-003233	T-16	25	4290	U
SNLA-003234	T-17	23	3730	U
SNLA-003235	T-18	17	1900	U
SNLA-003236	T-19	9.1	4220	U
SNLA-003237	T-20	15	4700	U
SNLA-003238	T-21	11	5880	U
SNLA-003239	T-22	4.9	2840	U
SNLA-003240	T-23	140	3390	U
SNLA-003241	T-24	19	6840	U
SNLA-003242	Z-19	U	4630	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003243	Z-18	1.0	2940	U
SNLA-003244	Z-17	1.0	2990	U
SNLA-003245	Z-17	1.1	4600	U
SNLA-003246	19-0	55	5020	U
SNLA-003247	19-1	12	5390	U
SNLA-003248	12-1	43	2980	U
SNLA-003249	12-2	U	3900	U
SNLA-003250	12-3	U	3140	U
SNLA-003251	12-4	U	3990	U
SNLA-003252	12-5	1.5	4380	U
SNLA-003253	12-6	U	4560	U
SNLA-003254	12-7	2.4	3310	U
SNLA-003255	12-8	10.3	4790	U
SNLA-003256	12-9	U	3470	U
SNLA-003257	14-1	1.8	3650	U
SNLA-003258	14-2	5.6	4260	U
SNLA-003259	14-3	U	2840	U
SNLA-003260	14-4	U	3150	U
SNLA-003261	14-5	U	3300	U
SNLA-003262	14-6	U	3770	U
SNLA-003263	14-7	U	5090	U
SNLA-003266	Z-16	U	3090	U
SNLA-003267	Y-165	U	3540	U
SNLA-003268	Y-19	U	3190	U

TABLE J.1

SOIL SAMPLING ANALYSIS RESULTS
(continued)

SAMPLE ID	LOCATION	Pb (mg/kg)	Al (mg/kg)	Be (mg/kg)
SNLA-003269	KK-1	U	870	U
SNLA-003270	KK-2	U	960	U
SNLA-003271	KK-3	U	810	U
SNLA-003272	KK-4	U	840	U
SNLA-003273	KK-5	U	920	U
SNLA-003274	KK-6	U	980	U
SNLA-003275	KK-7	5.9	1910	U
SNLA-003276	KK-8	1.6	819	U
SNLA-003277	KK-9	U	801	U
SNLA-003278	KK-10	U	830	U
SNLA-003279	KK-11	1.0	987	U
SNLA-003280	KK-12	1.0	795	U
SNLA-003281	Blank	U	3240	U

APPENDIX J.2

LEAD CONTAMINATION ACTION LEVELS FOR SOILS

There is currently no regulatory requirement to remediate soils contaminated with lead at concentration levels existing near some launch pads at the KTF. At a landfill site in Missouri with lead contamination, the Missouri Department of Health determined that capping areas with lead concentrations above 500 ppm would be protective of human health and the environment (Missouri Department of Natural Resources, 1990). In an endangerment assessment of the Smuggler Mountain site in Pitkin County, Colorado, the authors noted that "human health criteria for lead in soil have not been established in the United States" but that the United Kingdom Directorate of the Environment had developed a tentative guideline of 550 mg/kg for lead in soil in residential areas (LaGoy et al., 1989). The authors also cited authorities at the Centers for Disease Control as stating that lead levels in soil of 300 to 400 mg/kg were acceptable, based on studies of childhood lead poisoning (Mielke et al., 1984).

The highest lead value reported from the 1990 soil sampling program at the KTF was 270 mg/kg. This concentration does not approach the "action levels" suggested for other sites. Residential uses at the KTF are not anticipated. If the KTF is decommissioned in the future, sampling will be done again to determine whether lead is present in soils in sufficient quantities to require remediation.